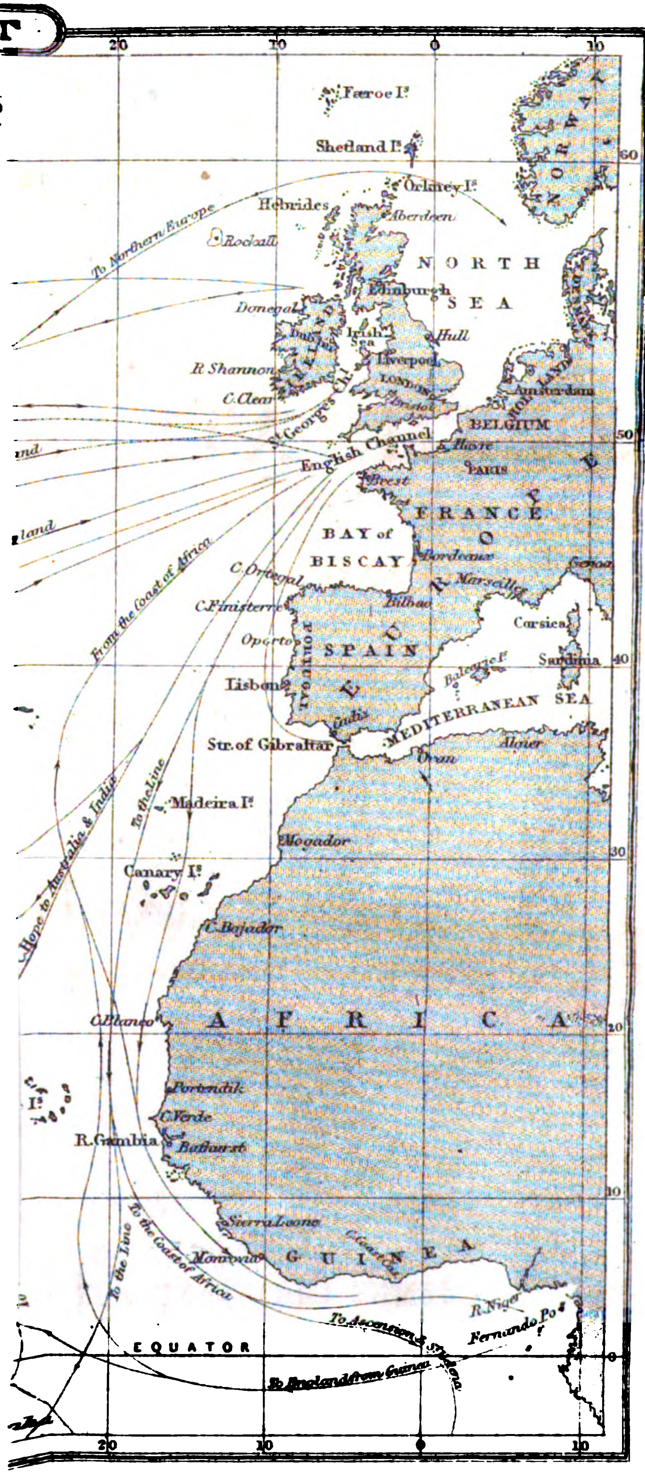

Færoe Is
Shetland Is
Orkney Is
Hebrides
Aberdeen
Rockall
To Northern Europe
NORTH SEA
NORWAY
Edinburgh
Donegal
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Irish Sea
Hull
IRELAND
R. Shannon
Liverpool
LONDON
C. Clear
St. George's Ch.
Amsterdam
HOLLAND
BELGIUM
English Channel
Havre
PARIS
Brest
FRANCE
EUROPE
BAY of BISCAY
Bordeaux
Genoa
Marseilles
C. Ortegal
Bilbao
C. Finisterre
Corsica
Oporto
SPAIN
PORTUGAL
Sardinia
Lisbon
Balearic Is
From the Coast of Africa
MEDITERRANEAN SEA
Cadiz
Str. of Gibraltar
Algiers
Oran
To Australia & India
To the Line
Madeira Is
Mogador
Canary Is
C. Bojador
C. Blanco
AFRICA
Portendik
C. Verde
R. Gambia
Bathurst
Sierra Leone
To the Coast of Africa
To the Line
Monrovia
GUINEA
Coast
R. Niger
To Ascension & St. Helena
Fernando Po
EQUATOR
To England from Guinea

NORTH ATLANTIC DIRECTORY.

THE

PHYSICAL GEOGRAPHY

AND

METEOROLOGY

OF THE

NORTH ATLANTIC;

TOGETHER WITH

SAILING DIRECTIONS

FOR THE

PRINCIPAL PORTS AND HARBOURS OF EUROPE, NORTH AMERICA, NORTH AFRICA, AND THE NORTH ATLANTIC ISLANDS; TO WHICH IS APPENDED A CATALOGUE OF ALL THE DOUBTFUL ISLANDS, ROCKS AND SHOALS; WITH NOTES ON MAKING PASSAGES, &c.

ILLUSTRATED WITH NUMEROUS CHART-DIAGRAMS AND PLANS,

By W. H. ROSSER & J. F. IMRAY, F.R.G.S.

NEW EDITION—THOROUGHLY REVISED.

LONDON:

JAMES IMRAY AND SON,

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1869.

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PREFACE.

This is a revised edition—newly arranged and remodelled throughout—of a work that has now been in circulation many years and which has been received by Navigators with considerable approbation: it embraces in as brief a compass as possible all that relates to the PHYSICAL GEOGRAPHY and METEOROLOGY of the NORTH ATLANTIC, together with SAILING DIRECTIONS for the principal PORTS and HARBOURS of that part of the Ocean.

More than ordinary care has been bestowed on this edition in obtaining the latest information, to the day of issuing from the press, on all subjects connected with the NAVIGATION OF THE NORTH ATLANTIC so as to render it as a DIRECTORY as complete as possible; and a copious Index will aid the Navigator in referring to any special subject respecting which he is desirous of acquiring a knowledge. To epitomize the contents it may be briefly stated that the work comprises full particulars as to the Wind and Weather, Currents and Tides of all parts of the North Atlantic; general Remarks on the Variation of the Compass, on Deep Sea Soundings, &c., and a List of all the Rocks and Shoals that have, at various times, been reported; ample Instructions are given respecting the Making of Passages from Port to Port, together with Directions for Approaching and Departing from Harbours and Roadsteads, and on the character of the Anchorages; valuable notes on Tropical and Extra-Tropical Hurricanes and Storms, and observations on the use of Meteorological Instruments at Sea, &c. &c. These subjects embrace a wide scope, but with all of them the Seaman should be more or less acquainted, in order profitably to exercise his professional duties.

This Work, together with its Companion on the South Atlantic, constitutes a COMPLETE ATLANTIC DIRECTORY.

N.B.—The Bearings and Courses are by Compass, *i.e. Magnetic*, unless expressed to the contrary.

The Distances are given in the Nautical (or Geographical) mile.

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PART I.

THE

PHYSICAL GEOGRAPHY & METEOROLOGY

OF THE

NORTH ATLANTIC.

CHAPTER I.

Brief Notes on the Physical Geography of the three Oceans:—Relative Extent of Land and Water—The Oceans—Subordinate Seas—The Shores of the Continents—Islands—Composition and Specific Gravity of Sea Water—Temperature of the Ocean—Artificial Boundaries of the Ocean—The Surface of the Atlantic—The North Atlantic.

1. **Relative Extent of Land and Water.**—The superficial area of our earth is estimated at 196¾ millions of square statute miles. Of this extent of surface, probably not more than 51 millions is land—making allowance for the unknown tracts within the limits of the Polar regions;—and the remaining portion of 145¾ millions may be assigned to the water. This preponderance of water over land can be readily seen, whether the globe is divided into two hemispheres by the equator, or longitudinally on the meridian of Teneriffe; but the large excess of the aquatic over the terrestrial element is in no instance so well displayed as when the globe is cut into two hemispheres by a plane perpendicular, not to the axis of rotation, but to the diameter passing from a point near the Land's End (Cornwall) to its antipodes; if charts of two hemispheres be projected on the horizon of these points—that in which England occupies the centre will contain the continental masses (Asia, Europe, Africa, North America, and nearly all South America), together with a considerable surface of water,—while the other will be nearly all water, with the exception of Australia, the narrow extremity of South America, the Eastern Archipelago, and scattered groups of islands; one

is the continental or land hemisphere, the other is the oceanic or water hemisphere.

According to a rough approximation, it is only between 30° N. lat. and the Pole that the land occupies a space about equal to that of the sea; between 30° S. lat. and the Antarctic circle it does not occupy one-sixteenth of that zone; while on the line of the equator, five-sixths of the circumference is water. It may also be remarked that there is a great excess of land in the northern hemisphere compared with the southern—in the ratio of 11 to 4—and to this may be attributed the fact that only one-twenty-seventh of the existing land has land diametrically opposite to it in the other hemisphere.

2. The Oceans.—Next to its immense expanse, the most remarkable feature connected with the water is its continuity; it is, in fact, one undivided Ocean, completely encircling the land, and penetrating into every large portion of it, defining by its outline the permanent elliptical figure of the earth, and furnishing a fixed mean level from which to measure the height of the land rising irregularly from out of its depths. The land, however, is grouped into two principal masses, each of which differs in contour and in direction: the New World stretches from north to south—the Old World from east to west, in its greatest extension; added to which, the latter is also terminated meridionally by land projected towards the south from the two extremes, viz., Africa on the western side, and the singular prolongation of eastern Asia, by a chain of large islands, to the Australian continent. Thus, the continents, by their horizontal form, determine the outlines of the great oceanic basins; the indentations of their coasts determine the figure of the border of the Oceans; and the islands, by their position, and by their less or greater frequency, give what else is wanting to complete the outline.

The two great oceanic basins—the Pacific and Atlantic—correspond to the two worlds they separate; and viewed in this light, the Indian may be regarded as an arm of the Pacific, from which it is only partially detached by the group of islands known as the Indian Archipelago; but nevertheless, it has many special characteristics. The frozen Oceans are alike in climate, but have this difference—that while the Northern or Arctic has some resemblance to an *inland* polar basin, the great Southern Sea is less an ocean by itself than a common reservoir, from which issue, so to speak, all the seas of the globe, to make their way amongst the lands.

The Pacific Ocean is in form a rude oval, wide open to the south, the sides of which go on approaching each other towards the north, so as to leave between America and Asia only the narrow passage of Behring's Straits, by which it communicates with the Arctic seas. The contour of the Atlantic is that of an elongated valley, the projections of the one side singularly corresponding with recesses on the other; it is of somewhat zigzag form, and widely open both to the north and to the south. The Indian Ocean has nearly the form of a triangle, the vertex of which is turned towards the north; but it is there broken by the peninsula of Hindostan, which has the effect of producing two deep and nearly symmetrical indentations; again, as compared with the Pacific and Atlantic, it is only half an ocean.

Thus, each of the three Oceans has a form peculiar to itself; and while as a general feature, their waters freely intermingle towards the south, nothing is more remarkable than their complete separation within intertropical regions, by the Isthmuses of Darien and Suez—two effectual barriers to all direct and continuous equatorial circulation. The movement of the warmer waters of the globe is thus necessarily toward the north and south, spreading their vivifying influence far and wide, and preventing too great an accumulation of ice within the polar basins.

3. Subordinate Seas.—Each of the three principal Oceans differs, also, to a certain extent, in the character of the subordinate seas which fringe their borders. On the western side of the Pacific there are no less than five considerable *land-locked* or *closed* seas formed by a singular system of peninsulas projected meridionally from the eastern coast of Asia, and prolonged by an equally singular system of volcanic islands, presenting a broken barrier between the enclosed area of water and the main Ocean; they are the Sea of Behring, formed by the peninsula of Ounalashka and the chain of the Aleutian Islands; the Sea of Okotsk, enclosed by the peninsula of Kamtchatka and the series of the Kurile Islands; the Sea of Japan, shut in by the island-chain of the same name; the Yellow Sea and its southern extension, locked by the Korea and the island-groups of Linschoten, Lu-Chu, and Meiaco-sima; and the China Sea, enclosed by Formosa, the Philippines, Borneo, and the peninsulas of Cambodia and Malaya. On the eastern side of the Pacific, the only considerable indentation of the coast is the Gulf of California.

The Indian Ocean has the Bay of Bengal and the Arabian Sea; besides which it pushes into the interior two inland seas, the Persian Gulf and the Red Sea, which partially detach the peninsula of Arabia from the Asiatic continent. These seas, without any northern outlet, impress on the Indian Ocean its distinguishing features.

The Atlantic Ocean is especially characterized by its *inland* seas, which advance far into the lands of both the Old World and the New. On the European side, there are the Baltic, and the Mediterranean with its three distinct basins—the Eastern, the Western, and the Black Sea; on the American side are the great bays of Hudson and Baffin—the latter communicating with the Polar Seas by a labyrinth of intricate and ice-encumbered passages. In addition to these, land-locked seas are not wanting; on the western side of this Ocean, there are the deep indentations of the Gulf of Mexico and the Caribbean Sea, enclosed by the peninsula of Florida and the chain of the West Indian Islands; and the Gulf of St. Lawrence, locked by the peninsula of Nova Scotia and the island of Newfoundland; and the basin of the North Sea on the eastern side. Nor must the widely open gulfs of Guinea and Biscay be omitted from the catalogue. It is this diversity of indentation—this blending, as it were, of the waters with the lands, which impresses on the Atlantic its individuality—making it the most *maritime* of the Oceans, as the Pacific may be regarded as the most truly *oceanic*.

4. **The Shores of the Continents.**—This sketch would be incomplete without a glance at the important differences which the Continents present with regard to the contour of their coasts, and the less or greater extent of the line of their shores—differences exercising a most significent bearing on the commerce and civilization of nations. The Ocean is the grand highway of the world; and Commerce, whose business is helping the peoples to reciprocate their wealth—mental as well as material—is developed in proportion to the greater or smaller number and size of the inflections of the coast—its peninsulas, gulfs, and inland seas—the convenience of harbours, and river-mouths, and their accessibility at all seasons. It should follow, then, that the region in which commercial enterprise is most active, must be that where there is the greatest extent of coast-line in comparison with its superficial area. Considered under this aspect, the three Continents of the Old World form a striking contrast.

Europe is the most varied in its contour; its principal mass is deeply cut in all parts by the ocean and by inland seas, and seems almost on the point of resolving itself into peninsulas, which repeat themselves to infinity, and are characteristic of the entire continent. With an area of 2,688,000 square geographical miles, the line of its shores is extended to 25,600 miles, being at the average rate of a mile of coast for every 105 square miles of surface—an enormous proportion compared with its small size—and of which only 3000 miles is difficult of access.

Of all the continents, Africa is the least diversified in its form; its mass is concentrated on itself; no important peninsula is projected from it, nor does it anywhere let into its bosom the waters of the ocean; it is singularly destitute of good harbours; and of its largest rivers, some are barred, and others pestiferous. The extension of the line of its coasts is only 16,000 miles for a surface of 8,720,000 miles (1 to 529.) Thus the coast-line of Africa is 9500 miles less, while its area is three times greater than that of Europe.

Asia, bathed on three sides by the ocean, is especially rich in peninsulas on its eastern and southern coasts, and whole countries are pushed into the waters; nevertheless, the extent of this continent is such that, in spite of the depth of the indentations, there remains at the centre a great mass of undivided land commanding the maritime regions. Asia, with 14,128,000 miles of surface, is indebted to its configuration for a line of coast of 40,500 miles (1 to 302), but nearly a fourth part of it is arctic and all but inaccessible.

Thus it appears that the ratio of the number of linear miles in the coast-line, to the number of square miles in the extent of surface, is 105 for Europe, 529 for Africa, and 302 for Asia,— a proportion greatly favourable to Europe. Africa is the most simple in its contour, and is closed to the ocean; it is a body without members—a tree without branches. Asia is a mighty trunk, the members of which make only a fifth of its mass, and it opens only its margins to the ocean. In Europe the members overrule the body, the branches cover the trunk, the peninsulas constitute almost a third of its entire surface; this continent deeply penetrated by the ocean, is thereby the richest in the variety of its districts, the most accessible for foreign connexions, at the same time that it is the most individualized. The child of the east has become the man of the west; he has learned to subdue nature by intelligence, and marches to the conquest of the world less by arms than by commerce and civilization.

The same contrasts are repeated, though less decidedly, in America—the northern portion of which is much more indented than the southern. North America has a coast line of 33,000 miles to an area of 5,472,000 miles (1 to 166): the western coast is the least broken; but on the Polar seas it consists of a labyrinth of bays and creeks, so that nearly a third of its coast-line is arctic and comparatively useless. The configuration of South America resembles that of Africa in the uniformity of its contours—it is only broken to the south and south-west, where the intricate fiords and sounds of Tierra del Fuego and Chile receive the full force of the antarctic current. On the east and north-east, however, it is remarkable for its vast river-systems, unexampled except in North America and Eastern Asia; these rivers fertilize the countries they traverse, and in the future, will become the highways of commerce into the interior. South America presents a coast-line of 19,400 miles to a surface of 5,136,000 miles (1 to 266).

Australia, in the length of the line of its shores, has 9,500 miles to an area of 2,208,000 miles (1 to 233); but a seventh part of its coast can only be approached through the narrow and dangerous channels (occurring but at rare intervals) of that enormous coral formation known as the Great Barrier Reef.*

5. Islands.—Finally, the islands constitute one of the most interesting characteristics of the oceans. They have been classified according to peculiarities which appear to be more or less connected with the causes of their formation. The *continental* islands—either elongated, round, or elliptical, and frequently found in series or line with each other—show by their proximity, their geological character, and their forming a line or being parallel with the mountain chains of the main land, that they are evidently connected with the continents. On the other hand, the *pelagic* or *oceanic* islands, very distinct in origin and in their elevation above the waters—dispersed singly or in groups, at a distance from the continents—generally of small dimensions and with a tendency to assume a circular form—are either volcanic or of coral formation.

The Pacific Ocean is richest in islands of both kinds—too many to enumerate in this place: as a contrast, the Indian Ocean is scanty in both—Madagascar and

* The ratios given above differ considerably from those heretofore published; they have been obtained by combining actual surveys with measurements of the rude outline of maps where no survey has been made. They are therefore more accurate than the ratios h[illegible]

Ceylon representing the continental islands—while Mauritius and Réunion, together with a few volcanic and coral islands, represent the pelagic.

The Atlantic Ocean possesses, in the Antilles, Newfoundland, the Falklands, the British Isles, and the islands of the Mediterranean, continental islands and archipelagos of great importance; but the pelagic islands are poorly represented there by the groups of the Azores, the Canaries, and the Cape Verdes, together with Madeira, St. Helena, Ascension, and a few others widely scattered in its southern portion.*

6. Composition and Specific Gravity of Sea Water.—Pure water is composed of two volumes of *hydrogen* united with one volume of *oxygen*—two gases which play an important part in the economy of nature, entering into combination with everything we see, feel, and taste. Sea water,† in addition to these, contains salt in the ratio of 3½ per cent of its weight, together with bromine, iodine, copper, silver, and, in very minute quantities, portions of whatever is soluble—for water being a universal solvent, dissolves, more or less, all earths, salts, acids, and metals. On the exceedingly small percentage (less than two-tenths) of sulphate and carbonate of lime, and of silica, depends the existence of the immense variety and numbers of mollusca, corals, and infusoria with which the ocean abounds—those substances composing either their external shell or internal structure. Slight differences in the constituents of the ocean depend on local circumstances. Deep seas are generally more saline than those that are shallow. The saltness of inland seas varies according to the quantity of fresh water they receive and the amount of evaporation. The amount of salt in the surface waters frequently differs in the different seasons—and in the Polar regions it varies from the melting of the ice and snow. At the mouths of great rivers, especially during freshets, the lighter fresh water flows on the surface to a very considerable distance before becoming thoroughly mixed with the waters of the ocean.

The mean Specific Gravity of sea water, taken up at a few feet below the surface is about 1·0275, at a temperature of 62° Fahrenheit. "Of the three oceans (the Atlantic, the Pacific, and the Indian) south of the equator, the

* These general views of the relative distribution and characteristics of the land and water are based on the observations of Forster, Steffens, Ritter, Hoffman, Guyot, and Humboldt.

† Regnault gives the following as the analysis of sea water:—

Water		96·476
Salts 3·505 =	Chloride of Sodium	2·700
	,, Magnesium	0·360
	,, Potassium	0·070
	Sulphate of Lime	0·140
	,, Magnesia	0·230
	Carbonate of Lime	0·003
	Bromide of Magnesium	0·002
Loss (including Iodides, Silica, &c.)		0·025
		100·000

Atlantic is the heaviest and the coldest; while the Indian is the lightest and the warmest; and the Pacific is between the two; as below :—

South Atlantic . . .	Specific gravity . . .	1·02676
„ . . .	Temperature	66·°66
South Pacific . . .	Specific gravity . . .	1·02658
„ . . .	Temperature	67·°70
South Indian . . .	Specific gravity . . .	1·02630
„ . . .	Temperature	69·°28

The North Atlantic *appears* to be both heavier and warmer than the North Pacific, but observations are wanting in the middle of the Pacific where the density is probably greater than in other parts of that ocean. The result of observations as far as they go is as follows :—

North Atlantic . . .	Specific gravity . . .	1·02664
„ . . .	Temperature	71·°56
North Pacific . . .	Specific gravity . . .	1·02548
„ . . .	Temperature	69·°94

The Indian Ocean north of the equator cannot, owing to local peculiarities, be compared with either the Atlantic or Pacific."*

7. **Temperature of the Ocean.**—"The ocean is the great moderator and equalizer of terrestrial climates," and when a sufficient number of observations, extending over a great many years, have been made to determine, with tolerable accuracy, the mean temperature of the waters between every five or ten degrees of latitude, several physical problems of the highest importance will be solved. At present our *absolute* knowledge of this temperature, both for the surface and for the depths of the ocean, is of the most limited character.

The observations of Kotzebue, Lenz, Beechey, and Sir James C. Ross, tend to show that in the ocean there is a stratum or band of water which has an invariable and uniform temperature of about 39°·5 Fahrenheit (according to Kotzebue 36°). The depth at which this temperature is found at the equator is 1,200 fathoms, from thence it gradually rises towards the north and south, coming to the surface in latitude 56° 26'., where the water has the temperature of 39°·5 at all depths. Sir James C. Ross crossed this circle of uniform temperature of the ocean at the six following places, viz. :—

1840 .	Dec. 21st .	in latitude	57° 52' S.,	longitude	170° 30'	E.
1841 .	March 30th	in „	55 9	„	132 20	
„ .	Dec. 13th	in „	55 18	„	149 20	W.
1842 .	March 23rd	in „	58 36	„	104 40	
„ .	Sept. 16th	in „	54 41	„	55 12	
„ .	Dec. 20th	in „	55 48	„	54 40	
	Mean latitude.		56° 14' S.			

* Meteorological Papers (No. 12) issued by the Board of Trade.

Or, considering the two latter as one point, in latitude 56° 26′ S.; so likewise on the polar side of this circle he found that the band gradually descended till in latitude 70° S. he found it at the depth of 750 fathoms: beneath which again to the greatest depth the temperature of 39°·5 obtains, whilst that of the surface is 30°.

Thus the *surface of this stratum of uniform temperature is a curve* beginning at the depth of 750 fathoms in high southern latitudes, whence it comes to the surface near the parallel of 56° 26′ S.; it then sweeps down to 1,200 fathoms in the equatorial regions, then rises to the surface on a corresponding northern parallel, from whence it descends again as it approaches toward the North Pole. By this band the ocean is divided into three great basins—two polar and one equatorial; in the former the temperature of the surface is always below, in the latter always above the mean temperature of 39°·5. It is by no means improbable that the place of the outcrop of the curve shifts with the seasons, vibrating in a manner similar to the Calm Belts of the system of the Trade Winds.

The *temperature of the surface of the ocean* is greatest *near* the equator, decreasing towards the north and south. For several degrees on each side of the Equator the maximum is about 82°·5 Fahrenheit, and about 79° at each tropic. Between the tropics the surface of the sea is also 6° warmer than the air above it. Maury says that, "in January, February, and March, the waters of the southern ocean are decidedly warmer, as at the opposite six months they are decidedly cooler, parallel for parallel, than those of the northern oceans." It scarcely admits of question that the western sides of the three oceans are several degrees warmer than their eastern sides; and that the average temperature of the Indian Ocean, between 10° N. and 10° S., is higher than that of either the Pacific or Atlantic between the same parallels. It can be readily perceived from these facts the line of *greatest* surface temperature must be very irregular, and cannot be coincident with the line of the terrestrial equator.

8. Artificial Boundaries of the Ocean.—Obviously, for the purposes of description and delineation, it is necessary that artificial boundaries of the ocean must be recognised—such as would receive the universal consent of geographers: these boundaries of the different oceanic basins are partly formed by the land and partly by meridians and parallels, as the Committee of the Royal Geographical Society of London, in 1845, reported:—

1. That the Arctic Ocean should comprise all the sea within the Arctic Circle.
2. That the Antarctic Ocean should comprise all the sea within the Antarctic Circle.
3. That the Atlantic Ocean be bounded on the north by the Arctic Circle; on the south by the Antarctic Circle; on the west by the continent of America, as far as Cape Horn, and thence prolonged on the meridian of that Cape, until it meets the Antarctic Circle; on the east by the shores of Europe and Africa as far as Cape Agulhas, and thence prolonged on the meridian of that Cape till that meridian cuts the Antarctic Circle.

4. That the PACIFIC OCEAN extend from the Arctic Circle on the north, to the Antarctic Circle on the south; that its western limit be the east coast of Asia and of the island of Sumatra, the northern shores of Java and Timor, and the coast of Australia from Melville island round to the southern point of Tasmania—thence along its meridian to the Antarctic Circle; that its eastern limit be the west coast of America—and the meridian of Cape Horn as far as the Antarctic Circle.
5. That the INDIAN OCEAN extend from India and Persia on the north, to the Antarctic Circle on the south; Africa and the Atlantic Ocean on the west; Birmah, part of the Malayan peninsula, the west coast of Sumatra, and the Pacific Ocean on the east.

9. The Surface of the Atlantic:—The Atlantic Ocean has the form of an elongated valley, in which the projections on one side singularly correspond with recesses on the other; "it is," says Humboldt, "as if a flow of eddying waters had been directed first towards the north-east, and then towards the north-west, and back again to the north-east." Its length, physically, *i.e.*, where fairly enclosed by land on either side is about 6861 miles—from Lat. 71° 11′ N. to Lat. 34° 50′ S. Its greatest breadth (without intervening land) is 3655 miles—on the 30th parallel (north); measured on the line of the equator its breadth is 3517 miles; while from Lat. 5° 28′ S., Long. 35° 16′ W., to Lat. 12° 20′ N., Long. 16° 46′ W., the distance between the two opposite continents is only 1586 miles. On the north it is gradually contracted by the converging coasts of Norway and Greenland, which with Iceland, constitute a natural boundary in that direction; but on the south it is broadly open, being 3691 miles wide where its waters are merged in those of the Great Southern Ocean.

10. The NORTH ATLANTIC—to the physical characteristics of which the following pages are chiefly devoted—is remarkable for the extreme length of its deeply indented coast-line, in comparison with its small size when contrasted with the other Oceans; and for the number as well as the extent of its *inland and land-locked seas* which stretch far into the lands of both the Old and New Worlds. It is this diversity of indentation—this blending as it were of the water with the land—which gives to the Atlantic its individuality, and impresses on it the character of an *inland ocean*—especially in its northern portion,—in which respect its general outline greatly differs from the open expanse of water constituting the Pacific and Indian Oceans;—and hence we see one physical reason for the maritime enterprise, industry, commerce, and civilization of the people whose shores are washed by its seas. If the Pacific is *par excellence* the GREAT Ocean, the Atlantic is peculiarly the HISTORIC Ocean.

11. The *subsidiary* waters of the North Atlantic are—*on the eastern side*—the North Sea, the Baltic Sea, the English Channel, the Bay of Biscay, the Mediterranean Sea, and the Gulf of Guinea; *on the western side*—the Bays of

Baffin and Hudson, the Gulf of St. Lawrence, the Bay of Fundy, the Gulf of Mexico, and the Caribbean Sea :—all these belong to the northern area of the ocean.

12. The Mediterranean is, on a small scale, what the Pacific is on a larger one —a deep sunken basin surrounded on all sides by broken and elevated slopes falling rapidly towards the interior of the continents,—such at least is its general character. It is also divided, physically, into two distinct areas—an eastern and a western one—and it communicates with the Black Sea, by the Sea of Marmora and the Dardanelles; a narrow strip of land, 60 miles wide—the Isthmus of Suez—separates it from the Red Sea; while the channel (the Straits of Gibraltar) through which its waters unite with those of the parent ocean is not more than 7½ miles wide in the narrowest part. Beautifully diversified with islands, bounded by every variety of soil, and enjoying the advantages of a most genial climate, it is and always has been the seat of a vast commerce; on its borders for thousands of years were established the successive governments of the earth in times of old: its waves wash the shores of Palestine and Egypt,—and of Greece and Italy—once the great centres of civilization; there navigation made its earliest efforts, and Carthage, Tyre, Sidon and Venice played each in its day the part of "Mistress of the Seas."

The greatest depth of the Mediterranean is a little over 2000 fathoms, and the rise of tide is small—five feet at most, but generally very much less.

13. The Baltic Sea—with its two arms, the Gulfs of Bothnia and Finland—is bounded on the north and N.W. by the rocky and elevated coasts of Finland and Sweden, and on the south and east by the low plains of Prussia and Russia; it stands therefore in marked contrast with the Mediterranean, and is subjected to influences of a totally different character; the warm and moist winds of the Atlantic, in their passage to the eastward, meet the cold blasts from the Arctic plains,—as a consequence, there is a copious fall of rain in summer, and of snow in winter; this, with the large river drainage diminishes considerably the saltness and of its waters, and its greatest depth being under 150 fathoms—generally, however, not more than 50 fathoms—its shores and ports are completely frozen during four or five months in the year. It may be regarded as a tideless sea.

14. The Gulf of Mexico and the Caribbean Sea form together a basin more than double as large as the area of the Mediterranean and Baltic; historically, the region is associated with the re-discovery of America, and the voyages of the great navigator Columbus when he sailed forth to "unlock the gates of the ocean," as the voice said to him in a dream when he lay on a sick bed; physically, the Caribbean Sea is remarkable as showing the appearance of having been, in the early ages of our planet, an inland sea as truly as the Mediterranean,—the West Indian Islands—greater and less Antilles—being all that now remains of the great barrier that separated it from the ocean.

The water of the Gulf of Mexico and of the Caribbean Sea has always a temperature many degrees higher than that of the Atlantic in the same latitude; here too is the unfailing source of the great Gulf Stream to which we must look for much that favourably affects the climate of the coast of Europe; while at the same time, it is probable that nearly all the bad weather for which the North Atlantic has long been celebrated has its origin in this region.

CHAPTER II.

ON THE WINDS AND SEASONS.

The Atmosphere—Wind—Maury's Hypothesis of the Circulation of the Atmosphere—Dove's Law of Gyration—Land and Sea Breezes—Rain—Seasons of the Torrid Zone—Clouds—Beaufort's Notation of Wind and Weather—Glaisher's Notation—Table showing the Force and Velocity of the Wind—Sources of Information.

1. **The Atmosphere** which floats round the earth, and revolves with it through space, has a necessary connexion with the Physical Geography of the Sea. It is impalpable to the touch, and its regions are immeasurable by the eye,—while its parts, in the fulfilment of their various offices, are undergoing perpetual change. It is the seat and source of some of the most remarkable phenomena in the natural world; and both by its own agency and that of the great elements of light, heat, and electricity, which operate through it, produces effects essential to the maintenance and well-being of every part of creation. The air which envelopes our globe extends to the height of about 50 miles,—at the distance of 80 or 90 miles, the vacuum is inconceivably more perfect than any that can be produced by an air-pump; it is densest at the level of the sea, growing thinner and thinner as it recedes from that level, so that three-fourths of its whole weight lies within an altitude of 5 miles; at the top of the loftiest mountains there is scarcely sufficient air to sustain life or to propagate sound. Though bulk for bulk, it is 840 times lighter than water, it nevertheless exerts a pressure of 15 lbs.* on every square inch of our bodies; but its influence is wholly unfelt, since the pressure is counterbalanced by the elasticity. So long as it is at rest, or nearly so, a soap bubble may float through it with impunity, and the aspen leaf will scarcely quiver on its stalk; but when it begins to stir in its might, it lashes the slumbering ocean into fury, tosses about great ships like playthings, crushes the oak and the pine by its power, and sweeps the proudest monuments of human skill like snow-flakes to destruction before it. Its complex character, as an atmosphere of air and aqueous vapour, distinct yet closely related by mutual action, makes it the agent in that constant circulation of water between ocean and land which is so essential to the economy of nature; resting upon the stream, and lake, and sea, the porous air sucks up their waters in vapour, forms with it the fleecy or the watery cloud, and retains its precious charge till its service is

* 14¾ lbs. nearly.

demanded in rain or in dew, in hail or in snow. Upon its chemical constitution alone depend the health, growth, and vigour of all organic life: composed of nitrogen, oxygen, and a minute portion of carbonic acid gas, it is the food of whatever breathes, the fuel of whatever burns, the essence of whatever grows, the spirit of whatever dies—the soul, in short, of matter—its element when it exists, its residuum when it decays. Finally, it ministers largely to every sense, and by its action on the solar light traversing it produces those many phenomena of colour, polarization and refraction which give lustre and beauty to the surface of the earth.

For the purposes of Navigation the atmosphere is chiefly important in connexion with its mechanical properties, and in this respect it may not improperly be called an ocean of air. "Like the sea, this ocean has its currents—which are winds; its waves of vast extent and magnitude, not visible indeed to the eye, but capable of being made so to the intellect by means of the barometer; and its tides due to the action of the sun and moon." These, together with the variations of temperature, the formation of clouds and rain, and other closely allied phenomena, constitute the science of METEOROLOGY—a knowledge of which is no less valuable to the seaman than Seamanship and Nautical Astronomy, since on the practical application of such knowledge frequently depends all the difference between a long and a short voyage,—or, it may be, a higher consideration still—the safety of human life.

2. WIND is the consequence of a disturbance of the equilibrium of the layers of the atmosphere; and the tendency of the various aerial currents is to restore the equilibrium which had been destroyed. The cause of the disturbance is inequality of temperature—or in other words, difference of temperature between places more or less widely distant from each other.

The effect of heat upon the air is to expand its volume; its density is then diminished, it is specifically lighter than it was; as a result, the warmer body of air must rise when pressed upon by the cooler and heavier masses contiguous to it. Here we have an ascending current, with lateral currents flowing from all sides towards the place of highest temperature. Take, as an example, a tropical island with its regular LAND AND SEA BREEZES.

a. We must remember that the land is heated more readily than the sea. In proportion as the sun rises above the horizon, the island becomes warmer than the neighbouring sea. Their respective atmospheres participate in these unequal temperatures; and, sometime after sunrise, the *Sea Breeze* springs up, increasing in strength till about two or three o'clock in the afternoon, when it gradually falls off; towards sunset a perfect calm prevails, for the atmosphere over land and ocean is in equilibrium. During the night it is the reverse,—the land cools more quickly than the sea; its atmosphere having become heavier, flows seaward as a *Land Breeze*—increasing in strength till towards morning, when it lulls; and this interchange lasts until the temperature, and consequently the density of the two atmospheres, has again become the same.

These alternating air currents are prevalent on all coasts within the tropics, where they occur every day with perfect regularity, unless masked or turned from their true direction by other more powerful winds; in general, however, these land and sea breezes do not extend—either seaward or over the land—to any great distance from the shore; in higher latitudes they are felt only during the summer months.

4. What takes place on a small scale, as just indicated, passes on a large scale between an entire continent and the ocean,—between the tropical regions on the one hand, and the temperate and polar regions on the other. To difference of temperature—unequal in duration and amount—correspond as a consequence particular atmospheric currents; to the difference of temperature between day and night we owe the *diurnal* breezes; to the difference of temperature between the extreme seasons, we owe the Monsoons, which are truly what the term in the original signifies, *season* breezes; to the difference of temperature between the tropics and the poles we owe the Trade-winds, the great *annual* breeze—the constancy of which is only the expression of the permanent inequality of the distribution of solar heat.

5. In the hottest zone of our earth a constant current of warm air rises from over land and sea; this is replaced from below by the colder air which presses in from higher latitudes—from north and south—on both sides of the equator. Now the air that has mounted up—warmed and expanded—cannot go beyond certain limits; it therefore flows back, in the upper regions of the atmosphere, on both sides, towards the poles, and falling as it is gradually cooled in its progress, it reaches the earth again in the middle or higher latitudes. The immediate effect of this constant circulation of the atmosphere is the phenomenon of the Trade and Counter-Trade* winds.

6. The Trades are polar winds—blowing from the poles to the equator—north winds in the northern hemisphere, and south winds in the southern; the direction of both being modified by the rotation of the earth on its axis, a fact to which the astronomer Halley drew attention in the year 1686.

7. The rotatory velocity of any point on the earth's surface is greater or less according to the size of the circle of latitude in which it is situated; thus commencing at the poles, where there is none, it gradually increases in the direction of the equator, where it is greatest—amounting there to 1525 feet in a second.

During a calm the air has no other motion than that which it shares with the earth,—it is moving round with the speed of the place over which it lies. If, however, in consequence of a variation of temperature, or any other cause, the wind blows, it can keep its direction unchanged, in spite of the earth's rotation,

* *Counter-Trades* is Commander Maury's term; Sir John Herschel calls them the *Anti-Trades;* but both have the same signification—*blowing in an opposite direction to the Trades.* Maury's nomenclature is adopted here, since seamen are more familiar with it, as well as with their other synonym—N.W. and S.W. passage winds.

only in one case,—and that is when the wind is exactly due east or due west,—or in other words, when its course does not deviate from the parallel of latitude from which it sets out; because this is the only case in which any spot on the earth's surface, at which this aerial current arrives, has exactly the same rotatory velocity as the place which it has left.

8. But, on the other hand, when the wind blows from the pole towards the equator, it passes from places moving with less, to others moving with greater rapidity. For instance, the rotatory velocity of the east to west, on the thirtieth parallel, is 1321 feet in a second,—on the twenty-ninth parallel it amounts to 13 feet more,—and on the twenty-eighth parallel to 26 feet more, in a second. Air, therefore, in passing from the thirtieth to the twenty-ninth and thence to the twenty-eighth parallel—and so on towards the equator—has an acquired speed less than that of the regions towards which it is moving. In its progression it assumes a greater rapidity of rotation, but as in virtue of the law of *inertia*, a certain time is necessary for this to take place, it must seem to an observer, who feels this *lagging* behind of the wind as an actual resistance, to blow in the opposite direction,—from east to west. From this it may be readily understood why, in the northern hemisphere, a current of air coming from the north, must as it advances southward, pass gradually into a north-east, and then into one more nearly east: and why, in the southern hemisphere, a south wind, which in like manner sets out from the south, must become first south-easterly, and then more and more easterly in its progress towards the north. These two general currents constitute the N.E. and S.E. Trades,—the prevalent winds of the Tropics.

9. Near the equator, where the Trade winds of the northern and southern hemispheres approach towards each other, lies the Region of Equatorial Calms. In that belt, the polar currents arrested in their progressive horizontal motion by the excessive heat, become ascending or vertical currents, and the air is in such a state of unstable equilibrium that it is easily and often violently disturbed; hence, the region is not less remarkable for the frequency and intensity of its thunderstorms, generally accompanied by torrents of rain, and for its sudden squalls from every quarter of the compass, than for its calms and light *easterly* airs—and on which account it has not inappropriately been termed the *Variables*.

10. Out of the same causes which produce the Trade-wind originate the westerly winds of middle and higher latitudes. The air which has been warmed, expanded and raised in the equatorial zone overflows—part tending northward and part southward; and thus between the Tropics, in the upper regions of the atmosphere, equatorial currents prevail, their general direction being from the equator towards the poles, which however have an impulse *eastward*, for they arrive successively in the higher latitudes with a velocity of rotation greater than that which they find there, and are always a little in advance of the earth's motion in each place. Hence, in the *northern hemisphere*, a southerly wind always becomes in its northward progress, first, a S.W., and at last, a westerly current:

and similarly in the *southern hemisphere*, a northerly wind passed by degrees from a N.W. into a west wind.

11. The foregoing remarks explain why between the tropics an east wind is prevalent, and why in the middle and higher latitudes—especially where the *return* Trade-wind has descended to the surface—a westerly wind is most frequent, although the former sets out at first as a polar, and the latter as an equatorial current. But again, it must be borne in mind that what has been here indicated is only found in the open ocean, at a distance from the continents and from the larger tropical islands, which by their disposition modify the winds in many ways. The region where this modification—still, however, due to unequal heating—is most distinctly and regularly present, is the Indian Ocean, where the N.E. Trade wind which blows between October and April (when the sun is in the southern hemisphere) is called the N.E. Monsoon; while between April and October (when the sun is in the northern hemisphere) a complete reversion of the air-currents takes place and the S.W. Monsoon is prevalent, the whole of Southern Asia (which forms the northern boundary of the Indian Ocean) being then heated by the burning sun of the northern summer. The transition from one Monsoon to the other is always marked as a period of variable winds alternating with calms, storms, and a general disturbance of the atmosphere.

12. It is unnecessary here to enter more into detail on the phenomena of the Monsoons as exhibited in different parts of the Indian Ocean, in the Seas of Southern China, and among the Archipelago of Sunda and the Moluccas; but turning to the Atlantic it may be remarked, as a now generally recognized fact, that during the northern summer and autumn months, when the sun's influence is most effective on the great deserts of Africa, the progress of the of N.E. Trade wind is arrested, and a S.W. Monsoon is prevalent between the equator and Lat. 13° N. Winds of a monsoon-like character also prevail on the Brazilian coast.

13. Maury's Hypothesis on the Circulation of the Atmosphere:—Commander Maury's hypothesis of the circulation of the atmosphere, though not generally adopted by Meteorologists, is a modification of that proposed by HALLEY, in his discussion of the system of the Trade-winds; it is as follows in nearly his own words adapted from his "Sailing Directions," and "Physical Geography of the Sea:—"

Observations show that from the parallel of about 30° or 35° north and south, nearly to the equator, we have, around the earth, two zones of perpetual winds, viz., the zone of the N.E. and of the S.E. Trades; they blow perpetually, and are always moving in the same direction, except where they are turned aside to blow as Monsoons. As those two main currents of air are constantly flowing from the poles towards the equator, we are safe in assuming that the air which they keep in motion must return by *some* channel, to the place near the poles whence it came, in order to supply the Trades.

This return current, therefore, *must* be in the upper regions of the atmosphere, at least, until it passes over those parallels between which the Trade-winds are always blowing on the surface. The return current must always move in the direction opposite to that wind the place of which it is intended to supply. These direct and counter currents are also made to move in a sort of spiral curve, turning *to* the west as they go *from* the poles to the equator, and in the opposite direction as they move from the equator towards the poles. This turning is caused by the rotation of the earth on its axis.

The earth we know moves from west to east. Now if we imagine a particle of atmosphere at the north pole, where it is at rest, to be put in motion in a straight line towards the equator, we can easily see how this particle of air, coming from the pole, where it did not partake of the diurnal motion of the Earth, would, in consequence of its *vis inertia*, find, as it travels south, the earth slipping from under it, as it were, and thus it would appear to be coming from the north-east and going towards the south-west; in other words, it would be a N.E. wind. On the other hand, we can perceive how a like particle of atmosphere that starts from the equator, to take the place of the other at the pole, would as it travels north, in consequence of its *vis inertia*, be going towards the east faster than the earth. It would, therefore, appear to be blowing *from* the south-west, and going towards the north-east, and exactly in the opposite direction to the other. Writing south for north, the same takes place between the south pole and the equator.

Such is the process which is actually going on in nature; and if we take the motions of these two particles as the type of the motion of all, we shall have an illustration of the great currents in the air—an upper and an under current—between the equator and each pole.

Let us return now to our northern particle, and follow it in a round from the north pole across the equator to the south pole and back again. Setting off from the polar regions, this particle of air, for some reason, which does not appear to have been satisfactorily explained by philosophers, travels in the upper regions of the atmosphere, until it gets near the belt between 30° and 35°. Here it meets, also in the clouds, the hypothetical particle that is coming from the south, and going north to take its place.

About this belt of 30°—35° north, then, these two particles press against each other with the whole amount of their motive power, and produce a calm and an accumulation of atmosphere sufficient to balance the pressure of the two currents from the north and south. From under this bank of calms, which seamen call the "horse latitudes," two surface currents of wind are ejected or drawn out; one towards the equator, as the N.E. Trades—the other towards the pole, as the south-west "passage winds" or *counter*-Trades. These winds come out at the lower surface of the calm region, and consequently the place of the air borne away in this manner must be supplied, we may infer, by downward currents from the superincumbent air of the calm region. Like the case of a vessel of water which has two streams from opposite directions running in at the top, and two of equal capacity discharging in opposite directions at the bottom—the motion of the water in the vessel would be downward; so is the motion of the air in this calm zone.

Following our imaginary particle of air from the north, across this "calm belt of Cancer," we now perceive it moving on the surface of the earth as the N.E. Trade-wind, and as such it continues till it arrives near the equator, when it meets a like hypothetical particle, which starting from the south at the same time that the other started from the north pole, has blown as the S.E. Trade wind. Here, at this equatorial place of meeting, there is another conflict of winds, and another calm region—for a N.E. and S.E. wind cannot blow in the same place and at the same time. The two particles have been put in motion by the same power; they meet with equal force; and therefore, at their place of meeting, are arrested in their course. Here, therefore, there is also a calm belt—the "Equatorial calms" or "Doldrums." Warmed now by the heat of the sun, and pressed on each side by the whole force of the N.E. and S.E. Trades, these two hypothetical particles, taken as the type of the whole, cease to move onward, and ascend. This operation is the reverse of that which took place at the meeting near the belt between the parallels of 30°—35°.

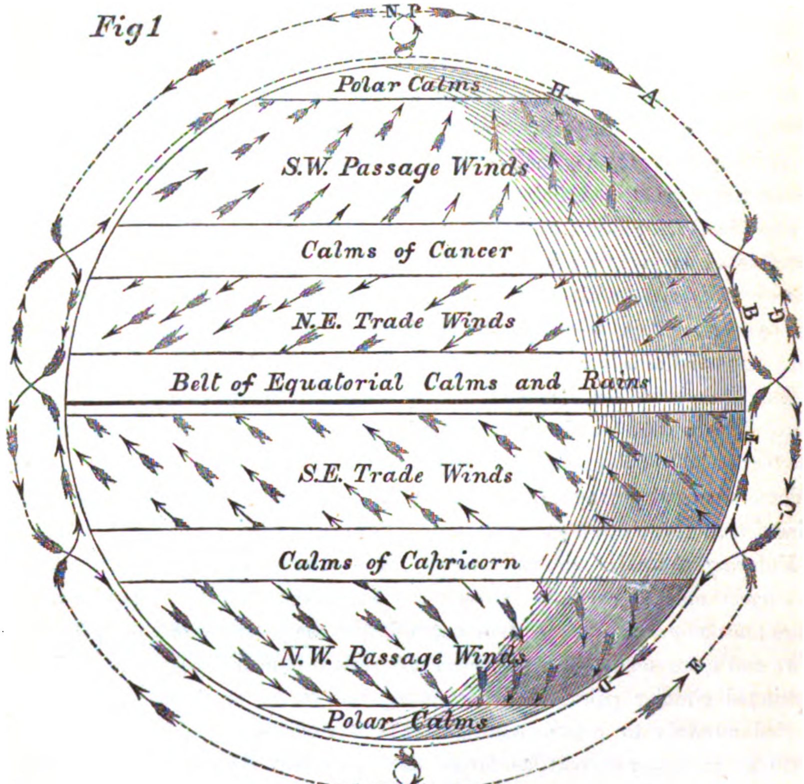
This imaginary particle then, having ascended to the upper regions of the atmosphere again, travels there counter to the S.E. Trade, until it meets, near the "calm belt of Capricorn," another particle from the south pole; here there is a descent as before; and it then flows on towards the south pole as a surface wind from north-west.

Entering the polar regions obliquely, it is pressed upon by similar particles flowing in oblique currents across every meridian; and here again is a calm place; for as our imaginary particle approaches the parallels near the polar calms more and more obliquely, it, with all the rest, is whirled about the pole in a continued circular gale; finally, reaching the vortex of the calm space, it is carried upwards to regions above, whence it commences again its flow to the north as an upper current, as far as the "calm belt of Capricorn"; here it encounters its fellows from the north; they stop, descend, and flow out as surface currents—the one with which the imagination is travelling, to the "Equatorial calm" as the S.E. Trade-wind; here it ascends, travelling thence to the "calm belt of Cancer" as an upper current, counter to the N.E. Trades. Here it ceases to be an upper current, but descending, travels on with the S.W. "passage winds" towards the pole.

14. The course a particle of air is supposed to take according to this hypothesis may be illustrated by a diagram (*Fig.* 1, p. 18) as follows:—an ascent in a place of calms about the north pole (N P): an efflux thence as an upper current (A) until it meets G (also an upper current) over the calms of Cancer. Here there is supposed to be a descent as shown by the arrows. The current (A) from the pole, now becomes the N.E. Trade-wind (B) on the surface, until it meets the south-east Trade-wind (F) in the equatorial calms where it arrow), and travels (as C) with the upper current to the calms of Capricorn, thence (as D) with the prevailing north-west surface current to the south pole, thence up with the arrow S P, and around *with the hands of a watch*, and back, as indicated by the arrows E, F, G, and H.

N.B.—The direction of the arrows in the Diagram shows the point towards which the different currents of air are moving.

Fig 1



Such is the system of atmospheric circulation as proposed by MAURY, in which it is seen that the air is continually moving from one pole to the other, and then back again to the place whence it originally started—sometimes as an upper current, and sometimes as an under current; but it is by no means clear that this is either possible or necessary for the elaboration of any physical phenomena with which we are acquainted.

15. DOVE'S THEORY.—THE LAW OF GYRATION:—The general tendency of the wind to "*veer with the sun*" is an old observation,* but now confirmed; in

* Lord BACON, in his "Historia Naturalis et Experimentalis de Ventis," speaking of the order of succession of the winds, says,—"When the wind shifts in the direction of the sun's course—that is, from morn till noon, and from noon till evening, &c., it seldom retrogrades;

fact, meteorological data, accumulated with assiduous care during the last 30 years show that the wind often makes a complete circuit in that direction—passing (in northern latitudes) from south through west, north and east, to south, in succession—or sometimes making more than one circuit in succession, occupying several days or weeks in such veering; and that it rarely veers in a contrary direction—"*against the sun*"—and rarer still makes a complete circuit in such a direction. The credit of having reduced these data into a system is due to Dove, of Berlin, one of the first meteorologists in Europe—who, by comparing observations gathered from all parts of the world, infers that the influence of the earth's rotation is not alone felt in the great system of circulation which affects the whole atmosphere, but that even *local* aërial movements are modified by it; this is the basis of what he terms the Law of Gyration* (or Rotation) of the Wind—a law not peculiar to any particular region, but, in fact, the general law (with few exceptions) throughout the world—and he has shown, that the Trade-winds, and the entangled relations of the winds of the temperate zone, are but the necessary and simple results of the same physical conditions.

Suppose an observer stationed at a spot, in the Northern Hemisphere, where the excitement of the wind begins—where, for instance, currents of warm air are mounting up from the heated soil, and if by this agency a current sets in from the North, he will see the wind-vane settle itself at first in a direction due North and South; if the cause of this motion of the air continues to act, the air of higher latitudes must share more and more in the effects, and coming to the place of observation from a continually higher and higher latitude, it arrives with continually less and less rotatory velocity; hence, in its passage over the station, it will take a direction more and more *towards the westward*, and thus the wind-vane must gradually pass from a North direction through N.E. to East.

If the North wind has passed by degrees into an East wind, the air will assume the rotatory velocity of the place over which it is situated, and it will thus remain suspended over it in a state of relative rest. If the tendency of the air to rush towards the equator still continues, precisely the same phenomena as before indicated will be repeated.

If, however, a South wind spring up and impinge on the polar current, which

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or when it does so, it is only for a short time. When, however, it shifts in the opposite direction—that is to say, from morning till midnight, from midnight till evening, &c.—it always returns to its initial point; at all events it does so before it has gone quite round the compass. When the south wind has blown for two or three days, the north will suddenly blow towards it; but when the north wind has blown just as many days in succession, it is not succeeded by the south wind until an easterly one has blown for some time." Still earlier observations to the same effect were made by Aristotle and Pliny. The latest observers are Mariotte, in France; Sturm, Romme, Kaemtz, and Dove, in Germany; and Toaldo, in Italy.

* Das Gesetz der Drehung,—This law is amply illustrated in the recent work of this meteorologist, "Das Gesetz der Sturme in seiner Beziehung zu den allgemeinen Bewegungen der Atmosphäre." (The Law of Storms considered in relation to the ordinary movements of the Atmosphere.)

has become more or less easterly, it will evidently be deflected towards the North, and the wind pass through S.E. to South. As the northward movement continues, the South wind will shift gradually round through S.W. to West, for the fresh arrivals of air (coming from the equator towards the poles) move from places which possess a *greater* rotatory velocity towards those which move *less* swiftly eastward.

A West wind will have a neutralizing effect on equatorial currents, and reduce them to rest. If the tendency *towards* the pole continues, the phenomena will always be repeated, until fresh polar currents change the West wind (through N.W.) into North, finally coming round again to N.E.

Similarly, in the Southern Hemisphere, winds which at their outset are South will gradually pass through S.E. towards East. An equatorial current (from the North) impinging on the polar current, which has become more or less easterly, will cause it to veer from East, through N.E. into North; and the movement continuing, the northerly wind in its progress will shift more and more through N.W. to West.

The West wind, as is the case in the Northern Hemisphere, will tend to check equatorial currents, and reduce them to relative rest; but if the polar-ward tendency continue, the phenomenon will always be repeated until fresh polar currents change the West wind (through S.W.) into South.

16. (A) If, therefore polar and equatorial currents are alternating with each other in the *northern hemisphere*, the regular shifting of the wind round the compass will be through

→ S., S.W., W., N.W., N., N.E., E., S.E., S. →

and the changes will take place oftener between South and West, and between North and East, than between West and North, or East and South;—for the first changes show a continuance of the exciting cause, while the latter point to a change of it—and being transition winds, they cannot blow for any length of time.

(B) By a like course of reasoning when, in the *southern hemisphere*, polar currents alternate with equatorial, the regular shifting of the wind round the compass will be successively through

→ S., S.E., E., N.E., N., N.W., W., S.W., S. →

and the changes ensue oftener between North and West, and between South and East than between West and South, or East and North.

17. This is the Law of Gyration,—or the *Law of the Rotation of the Wind*—and we see that the *veering* of the vane may merely indicate the existence of a steady current of air. It is a misapprehension of this fact that causes the existing confusion with reference to questions bearing on the theory of the winds. The essential difference between the veering of the vane as produced by a steady breeze and that resulting from a centripetal current, or a whirling motion with an advancing centre, is however, that in the first instance (*i.e.* with a steady breeze) the rotation is constantly in the same direction, but in the case of the second it veers on both sides of the track and in opposite directions. If, therefore, as regards the Northern Hemisphere, the partial rotation through S., W., N., E. be called "with the sun," or *direct*, and the partial rotation through S., E., N., W. be called "against the sun," or *retrograde*, as is customary: and similarly, in the Southern Hemisphere, the partial rotation through S., E., N., W., be called "with the sun,"* and the partial rotation through S., W., N., E. be called "against the sun,"* it follows that—

Steady winds turn the vane only in a *direct* sense, or *with the sun;*

Whirlwinds, or centripetal gales, when they advance, turn the vane either with or against the sun, according to the side on which the vortex passes by the place of observation.

When steady winds from different directions approach each other, rotations commence in either way;—direct when, on the west side of the compass, a wind is more northerly than that which preceded it, and retrograde when it is more southerly. On the east side, on the contrary, the gyration is direct when a wind is more southerly than its predecessor, and retrograde when it is more northerly. Winds blowing from directly opposite points may, by arresting each other's course, produce a calm, and therefore give rise to the same phenomenon which is visible in the vortex of a centripetal current (or in the centre of a whirlwind), that is to say, a calm intervening between opposite winds.

And we thus see that the same phenomena may occur under totally different conditions.

18. Such is a brief sketch of DOVE's *law of the rotation of the winds;* and a general summary of the result of his investigations may be given in (nearly) his own words, as follows:—†

(1.) All steady winds are modified by the rotation of the earth in such a manner that equatorial currents receive a westerly deflection, and polar currents an easterly deflection.

The N.E. and the S.E. Trade-winds are steady polar currents.

The Monsoons are alternations of a polar and an equatorial current twice during the year,—therefore, they are N.E. and S.W. in the northern hemisphere, and S.E. and N.W. in the southern hemisphere.

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* Neither of these expressions accords with the seaman's view: he is accustomed to regard a movement *from left to right* as being "with the sun," for the term originated in the *northern* hemisphere, beyond the tropic, where the sun culminates in the South, and hence, looking in that direction, the sun rises on the left and sets on the right hand—i.e. *left to right*, "with the sun;" this idea he carries over every part of the globe. But, in truth, left to right, "with the sun," is erroneous in the southern hemisphere, for, to an observer there, the sun culminates in the North, and when he looks in that direction he sees the sun rise on the right hand and set on the left, hence for the *southern* hemisphere *right to left* is "with the sun." The *northern* term—*left to right* "with the sun"—is therefore scientifically inaccurate when used in the southern hemisphere; the expression in the text is consequently correct, but not in the seaman's sense.

† "Das Gesetz der Stürme," p. 187—192.

(2.) Bodies of air set in motion from a state of rest turn the wind-vane in the direction of the meridian, as follows:—

(*a.*) The polar current in the northern hemisphere, from N. to E.

(*b.*) The polar current in the southern hemisphere, from S. to E.

(*c.*) The equatorial current in the northern hemisphere, from S. to W.

(*d.*) The equatorial current in the southern hemisphere, from N. to W.

Hence, of the winds in the northern hemisphere—

(*a.*) Those from N. to E. are the polar current.

(*b.*) Those from E. to S. mark the transition of a polar to an equatorial current.

(*c.*) Those from S. to W. are the equatorial current.

(*d.*) Those from W. to N. mark the transition of an equatorial to a polar current.

Similarly, in the southern hemisphere, the winds—

(*a.*) From S. to E. are the polar current.

(*b.*) From E. to N. mark the transition of a polar to an equatorial current.

(*c.*) From N. to W. are the equatorial current.

(*d.*) From W. to S. mark the transition of the equatorial to the polar current.

A complete rotation in the *northern* hemisphere is therefore—

→ S., W., N., E., S. → with the sun.

And in the *southern* hemisphere—

→ S., E., N., W., S. → also with the sun.

(3.) The course of a steady wind may be obstructed by the deflection originating in the rotation of the earth:—

(*a.*) By a wind blowing constantly in a direction perpendicular to its primitive one: such are the West India hurricanes, which, for this reason, go first from S.E. to N.W.; and those of the southern hemisphere, from N.E. to S.W.

(*b.*) By an aërial current with less deflection; such are the typhoons during the S.W. monsoon, which is circumscribed farther to the eastward by the South monsoon. Of the typhoons, however, many probably have a progressive motion from W. to E., caused by the heavy air of the Trade-wind region—situated to the eastward—rushing directly towards the rarefied air of the region of the S.W. monsoon, and thereby producing a whirlwind.

(*c*) By a mechanical impediment; as in the instance of a storm (described by Piddington) which occurred in the Bay of Bengal, June, 1839.

In these cases, when the storm is an equatorial one, whirlwinds are produced in the *northern* hemisphere in a *direction contrary to that in which the hands of a watch move*: and in the *southern* hemisphere in the *same direction as the hands of* *a watch move.* Hence, in the *northern* hemisphere the following shiftings of the wind-vane occur:—

(*a*) If the vortex (or centre) of the storm passes to the westward of the place of observation—

The rotation will be →→ S., W., N., E., S. →→ with the sun;

(*b*) If the vortex of the storm passes to the eastward—

The rotation will be →→ S., E., N., W., S. →→ against the sun.

But, in the *southern* hemisphere, when the storm is also an equatorial one:—

(*a*) If the vortex of the storm passes to the west of the place of observation—

The rotation will be →→ S., E., N., W., S. →→ with the sun;

(*b*) If it passes to the eastward—

The rotation will be →→ S., W., N., E., S. →→ against the sun.

Thus in both hemispheres, the passage of an Equatorial whirlwind storm on the west side of the place of observation produces *normal* revolutions, *i.e.* revolutions in accordance with the law of gyration; but its passage on the east side produces *anomalous* revolutions, *i.e.* contrary to the law of gyration. Polar whirlwind-storms move precisely in an opposite direction:—the revolution is normal when the vortex passes to the eastward, and anomalous (or abnormal) when it passes to the westward of the place of observation.

The old rule that "anomalous shiftings of the vane occur in stormy weather" is in this manner justified. It cannot, however, be ascertained from those shiftings whether an equatorial whirlwind passes on one side, or a polar one on the other;—this depends on the initial point of the shifting, and, as a consequence of the whirlwind, can never amount to more than half a circle.

(4.) The vane may shift from one direction to that immediately opposite to it—

(*a*) When steady winds oppose each other, or fight with each other, as the seaman says;

(*b*) When the vortex of a whirlwind-storm passes over the place of observation.

(5.) A whirlwind-storm may be passing even when the wind-vane does not shift at the place of observation. This happens when the place is but touched by the whirlwind. On one side the storm then appears to retrograde,—and on the other to advance:—for instance, a whirlwind (revolving in a direction contrary to that in which the hands of a watch move) is advancing from S.W. to N.E.; on the north-west side of such a storm, a N.E. wind appears in the south-westerly regions *earlier* than in the north-easterly, whilst on the south-east side of the storm a S.W. wind actually appears to advance, *i.e.* it enters the north-easterly regions at a later period. The first is the well-known case observed by Franklin during an eclipse of the moon. Those who, founding their theory on this and analogous instances, divide the winds into positive and negative,—

into winds *par inspiration*, and *par impulsion*,—call one side of such a storm positive and the other negative.

(6.) In the temperate zones storms are caused, also, by two currents of air in juxtaposition,—one pressing laterally on the other,—and during the transition, the shifting of the vane may be either with or against the sun, but ever according to the direction of the currents impinging on each other.

(7.) Local phenomena (as land and sea breezes, winds blowing through valleys, deflections of the Trade-winds along the coast, trombs, &c.) affect the wind vane according to local conditions, and they may be such as either to produce a veering of the vane in accordance with that consequent on general air-currents, or one in an opposite direction. In open regions they are more prominent during the day, when the general air-currents are less prevalent;—so also in the region of the "variables" between the Trades, at the time the monsoons change, and particularly in summer, when the ascending current *(courant ascendant)* weakens the power of of the horizontal currents. Indeed, it is not impossible that, setting aside local influences, one cause of a periodical shifting of the vane is to be found in the daily course of the sun;—thus, if the spot where the daily maximum of temperature occurred formed *a point of attraction* for bodies of air lying near it, the direction of the wind during the *morning* would necessarily be *westerly*, and during the *afternoon easterly*,—and thus the vane would turn in a direction contrary to the movement of the magnetic needle.

10. As whirlwinds are not confined to a definite locality, the probability that any given place is situated on its east side is just as great as that it should be on the west side; the same remarks also apply where whirlwinds owe their origin to local causes—and thus display a great degree of similitude as regards their course. The predominance of the gyration of the wind in a certain direction (with the sun) is consequently a phenomenon which is not connected with the whirling motion of the storm-winds, but only with the influence of the earth's rotation on progressive steady winds.

Now three things are possible:—

1. Either all revolutions of the vane through great arcs are caused by whirlwinds; and in this case,—

   (*a*.) If these whirlwinds occur first at one spot and then at another, indifferently, then there is no predominating direction in the shifting of the vane;

   (*b*.) Or, if the origin of these whirlwinds is local, and if in their progress they advance more or less along the same path, then there are, at certain places in each hemisphere, predominant shiftings of the wind-vane in the direction S., E., N., W., and in others, in the direction S., W., N., E.

2. Or, all shiftings of the wind-vane commence with the alternation of steady meridional air-currents, in accordance with the principles of Hadley's theory of the Trade-winds, and in consequence of opposing currents pushing through each other: then the vane traverses in the direction S., E., N., W. in the northern hemisphere,—and S., W., N., E. in the southern: *i.e.* in *both* cases the *wind veers with the sun*. The backing of the wind cannot under these conditions exceed the quadrant of a circle.
3. Or, lastly, the shiftings of the wind-vane arise, in both ways, (1) from the alternation and displacement of meridional air-currents, and (2) from a progressive whirlwind; consequently, in each hemisphere, both descriptions of rotation must occur, but that "with the sun" will predominate. The first cause—alternations of meridional currents—produces (in both hemispheres) only gyrations with the sun; and the second—*i.e.* the whirlwind—just as many with the sun as against it. Hence, however frequent whirlwinds may be, there must always be more gyrations that are direct than retrograde.

20. It is well known that whirlwind-storms, hurricanes, or cyclones, originate at certain places, and spread in certain directions; for instance,—

(*a*) The West India hurricanes (*Aracan* or *Huiran-vucan* of the coast of Mexico, *Vuthan* of Patagonia) commence on the inner edge of the N.E. Trade, and even within the Trade itself, especially in the latter part of summer and in autumn, the whirling motion of which is caused originally by the wind blowing from the S.E. encountering the N.E. Trade, or by portions of the upper Trade descending from above. They progress from S.E. to N.W. in the torrid zone, then recurving at right angles at the outer edge of the Trade-winds, they move from S.W. to N.E.; during the progression the whirlwind, which revolves in a direction opposite to that in which the hands of a watch move, expands very considerably. In the region of the S.E. Trade-wind of the Atlantic, whirlwind-storms occur with less frequency.

(*b*) The typhoons in the northern Indian Ocean and China Sea occur most frequently in autumn, but are also violent at the commencement of the S.W. monsoon. The direction in which they advance is rather more from E. to W. than from N.E. to S.W., especially on the south coast of China. In the southern half of the Indian Ocean they are likewise very violent, going there from N.E. to S.W. and recurving at right angles at the outer edge of the Trade, whence they advance from N.W. to S.E.

The rotation of the air in the whirlwind-storms of the northern hemisphere is in the opposite direction to that in which the hands of a watch move; and in the direction with watch-hands in the southern. The causes which produce these effects lie in the lateral juxtaposition of the regions of the monsoons and Trade-winds, as well as in the displacement of one monsoon by the other.

21. Under certain local conditions, a whirlwind-storm may be so modified as to assume at particular spots the form of a steady wind; although, when its course is observed over a large circuit, it shows itself to be a real whirlwind. This is the case, for instance, according to REDFIELD, with the hurricanes (*northers*) of the northern part of the Gulf of Mexico, which, especially from September to March, at Vera Cruz, reach their greatest height four hours after they commence, and then rage for 48 hours with undiminished fury. The explanation given by REDFIELD of this long duration of the storm without changing its direction is, that the whirlwind advancing from the eastward comes in contact with and is arrested by the high land, by which means it becomes, as it were, flattened, and its circular form is partially changed to a rectilinear one. The N.E. and N.N.E. storms in the Pacific Ocean, on the coasts of Nicaragua and Guatemala, known by the names *Papagallo* and *Tehuantepec*, are according to REDFIELD, the fine weather-side of a whirlwind-storm,—while the S.W. gales in August and September, which are called *Tapayaguas*, represent the other side.

22. The indications of approaching weather will be most simple in the zone of the Trade-winds, because the rotation of the earth, owing to the simple circumstance of the initial and terminal points of the aërial current remaining nearly the same, does not produce a regular shifting of the vane, but its constant deflection, viz., a steady wind—that of the Trade; and the storms have only one form—a rotatory one. In the regions of the monsoons they will be somewhat more complicated, because *there* two aërial currents, alternating one with each other in the year, produce one annual shifting of the vane, being periodical winds; and the storms, the form of which is likewise rotatory, have consequently a less constant direction, and in fact it must differ in a certain degree from the prevalent one in order to produce a whirlwind. They must, lastly, be most complicated in the temperate zone, where the law of gyration is universally prevalent, but where storms also occur in all forms hitherto known. The temperate zone has, however, this advantage over the torrid zone, that whirlwinds produce but modified effects as compared with the fearful violence of storms of this description in the tropics, and where they are so destructive.

23. Land and Sea Breezes:—The alternation of the Land and Sea Breezes (*see* § 8, p. 12), so well developed between the tropics, is only persistent there during the *dry* (or fine) season; these winds are, however, common in middle latitudes during the summer, and traces of them have even been noticed in Greenland.

The direction of these two breezes is perpendicular to that of the coast, but modified in various ways by the prevalent wind of the region, for example—if an east wind blows near an island, the sea-breeze will be stronger on the east coast, and the land-breeze will be weak; on the west coast, on the contrary, the land-breeze will be stronger than the sea-breeze; so also, on the south coast the land-breeze will blow from S.E. at the time of its greatest strength, and the sea-breeze from the N.E.,—while in the course of the twenty-four hours, the wind will take all the intermediate directions.

On and near promontaries the land-wind is weak; in deep gulfs the sea-breeze is weak. Neither of these winds, however, extends far seaward, except in occasional instances, in which case they gradually diminish in force until they give place to the usual wind characteristic of the region and time of year—not at all times without an intervening calm, or perhaps a squall accompanied by rain.

A knowledge of these winds is absolutely essential in coast navigation, since they may be turned to good account in shortening a passage; they are often very useful in making and leaving an anchorage.

It not unfrequently occurs, that on some coasts the interval of calm which precedes the setting in of the land-breeze is of shorter duration than that preceding the return of the sea-breeze. This difference, as well as the irregularity of the two winds themselves, is not alone due to the alternate heating and cooling of the land. The secondary causes which produce these results are probably the sinuosities and relief of the coast—the height and distance of the mountains—and, as before observed, the direction of the prevailing winds of the region.

24. Rain:—The atmosphere always holds in suspension more or less of aqueous vapour in a visible or invisible form; in fact, we may consider the globe as surrounded by two atmospheres—one of air and the other of aqueous vapour—which are not chemically combined, but commingled or mechanically mixed—each being, as it were, diffused through the pores of the other; and the union of the two exists at all times and in all places, though the *amount* of aqueous vapour is extremely variable, depending on the temperature of the air; for a given quantity of air (as a cubic foot), at a given temperature, can receive only a certain quantity of vapour; the warmer the air, the more it expands, and the greater its capacity for moisture; but in every case there is a point beyond which it can sustain no more, and it is then said to be *saturated;* whatever lowers the temperature of the air—as contact with the colder earth, or contact with and commingling of colder air-currents—diminishes its capacity for vapour, and produces condensation under the form of dew, fog, rain, snow or hail, as the case may be.

The course of the winds being known, it is easy to understand the distribution of rain, for it is chiefly through their agency that the moisture of the atmosphere, whether invisible still or in the form of clouds, is borne to and spread over the continents, there to fall in copious and refreshing showers. Rain seldom falls at sea within the region of the steady Trade-winds; for those winds coming from higher latitudes are acquiring temperature and taking up moisture as they pass over the surface of the ocean; but beyond the tropics where the *return* or *counter*

Trade descends to the level of the earth's surface and comes in contact with the colder air of temperate regions, its vapour held so far in abeyance, becomes condensed and is precipitated in rain, as in the case of the warm and moist S.W. wind of the Atlantic.

When a wind charged with clouds arrives in a warmer and drier air, that warmer air having a much greater capacity for vapour, instantly dissolves the clouds. Where, however, the advance of such a wind is arrested by a mountain chain or plateau, it rises into the colder layers of the atmosphere, the vapours are condensed, and rain flows down the opposing slope; the wind, accompanied by cloud, then passes over to the other side of the chain, where it arrives dry and cold, and deprived of nearly all its moisture. But it is even possible, that without such an opposing obstacle, a rapidly ascending current may hurry the abundant vapours of the lower strata to the more elevated regions of the atmosphere, where they are speedily condensed and fall back in torrents of rain, as is the case between the tropics.

25. Seasons of the Torrid Zone.—In the temperate regions of the earth we are accustomed to recognize the astronomical seasons—spring, summer, autumn and winter; but seasons of temperature are unknown between the tropics; there the inhabitants regard the year as divided into a *rainy* and a *dry* season.

When the Trade-wind (N.E. or S.E.) blows with its wonted regularity, the sky preserves a constant serenity, and is of a deep azure blue,—the air is then dry, and the atmosphere cloudless: such is generally the case when the sun is in the opposite hemisphere. But in proportion as the sun approaches the zenith of the space, the Trade-wind (by degrees) blows irregularly, giving place to variable winds; the sky, assuming a whitish tint, becomes overcast and cloudy; and in the afternoon, when the heat has attained its maximum, a storm accompanied by heavy showers ensues. As the storm progresses the showers become more frequent, pouring down at times in a perfect flood of rain, and inundating the earth with torrents of water; at this time the earth is so moist that, in many places between the tropics, the inhabitants live as it were in a kind of vapour bath; the heat is oppressive and stifling; the body is completely enervated, and the mind grows dull and listless: this is the period when those fevers that destroy so many Europeans are prevalent, but it is also the season when vegetation puts on new freshness and vigour. Ere long the sun in its annual progression, advances to pour down his vertical rays upon other places; the rains diminish, the atmosphere becomes once more serene and clear, the Trade-wind resumes its regularity as the prevalent wind, and the rainy season is at an end.

In general terms, therefore, the rainy season in the northern half of the torrid zone may be said to commence in April and last till October; while the dry season extends from October to April. In the southern half of the torrid zone this order of the weather and seasons is reversed. Also, as the sun passes from one tropic to the other, it follows that places in the immediate vicinity of the equator must have *two rainy* and *two dry* seasons; the second rainy season being distinguished by intervals of fine weather, as the second dry season is characterized by intervals of squalls and rain.

26. The *rainfall* is greatest within the tropics, and decreases as we advance north and south into the higher latitudes, but the number of rainy days is fewest there, and in this respect offering a perfect contrast to the temperate zones; in the latter regions, the earth is more or less watered by rain throughout the whole year, but secondary causes so far interfere that its distribution is as variable as the seasons, the winds and the temperature—in fact, except between the tropics, rain is the most irregular of all meteorological phenomena, both in respect of the frequency of its occurrence and in the quantity that falls in a given time.

27. Clouds.—Kaemtz adopting the classification of Howard, has given the following simple, but not less accurate description of the varied appearances of the Clouds* :—

The *cirrus* (*cat's tail* of sailors) is composed of thin filaments, the association which resembles a brush—at other times woolly hair—and at times slender net work.

The *cumulus* or summer-cloud (*ball of cotton* of sailors) frequently presents itself in the form of a hemisphere resting on a horizontal base. Sometimes these hemispheres are built one upon the other, and form those great clouds which accumulate on the horizon, and resemble, at a distance, mountains covered with snow.

The *stratus* is a horizontal band which forms at sunset, and disappears at sunrise.

Under the name of *cirro-cumulus*, Howard designates those little rounded clouds which are often called woolly clouds: when the sky is covered with them it is said to be *fleecy*.

The *cirro-stratus* is composed of little bands of filaments more compact than those of the *cirrus*, for the sun has sometimes a difficulty to pierce them with its rays. These clouds form horizontal strata, which, at the zenith, seem composed of a great number of thin clouds,—whilst at the horizon, when we see the vertical projection, a long and narrow band is visible.

When the *cumulus* clouds are heaped together and become more dense, this species of cloud passes into the condition of *cumulo-stratus*, which often assumes at the horizon a black or a bluish tint, and passes into the state of *nimbus*, or rain-cloud. The latter is distinguished by its uniform grey tint and its fringed edges; the clouds of which it is composed are so compounded, that it is impossible to distinguish them.

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* For a fuller description of the Clouds and their various phases, see "The South Atlantic Directory."

28. Beaufort's Notation of Wind and Weather:—The following method first devised by the late Hydrographer to the Admiralty, Sir FRANCIS BEAUFORT, is generally used by seamen to indicate the State of Weather, and the Force of Wind at Sea:—also in lighthouses, and at many stations on land.

b	Blue Sky - - - *also*	1
c	Clouds (detached) - - - -	2
d	Drizzling rain.	
f	Foggy - - - - - - -	3
g	Gloomy.	
h	Hail - - - - - - - -	4
l	Lightning.	
m	Misty (hazy) - - - - -	5
o	Overcast (dull) (*also* g) - -	6
p	Passing showers.	
q	Squally.	
r	Rain - - - - - - -	7
s	Snow - - - - - - -	8
t	Thunder. Lightning - -	9
u	Ugly (threatening) appearance of weather.	
v	Visibility. Objects at a distance unusually visible..	
w	Wet dew.	

Note.—A letter repeated augments its signification:—thus f f very foggy, r r heavy rain, r r r heavy and continuing rain. Sometimes a bar (—) or dot (.) is used for this purpose, as $\underline{\text{r}}$ heavy rain.

0	Calm.
1	Steerage way.
2	Clean-full—from 1 to 2 knots.
3	Ditto 3 to 4 knots.
4	Ditto 5 to 6 knots.
5	With royals.
6	Top gallant sails over single reefs.
7	Two reefs in top sails.
8	Three reefs in top sails.
9	Close reefed main topsail and courses.
10	Close reefed top sails and reefed fore-sail.
11	Storm stay sails.
12	Hurricane.

From 2 to 10 being supposed "close hauled."

The above method is very general, and in practice, it answers well; not only for seamen, but even for popular use on land, by *estimating* the force of wind, proportionally, between the extremes of its slightest motion and its utmost violence.

29. MR. GLAISHER (of the Royal Observatory, Greenwich) considers the following notation (0 to 6) of the wind preferable to the above, at least for land purposes, where there can be no definite reference to the power of the sails,—

Scale of Wind:—

BEAUFORT - - - - 1 to 12

Corresponding to

GLAISHER - - - - 1 to 6

1—3	Light. - - - - -	1
3—5	Moderate. - - -	2
5—7	Fresh. - - - - -	3
7—8	Strong. - - - - -	4
8–10	Heavy. - - - - -	5
10–12	Violent. - - -	6

30. This chapter may be aptly concluded with a general TABLE *showing the Force and Velocity of the Wind from Light Airs to Heavy Gales and Tempests*:—

Pressure in lbs. on Square Foot.	Velocity. Feet per Second	Velocity. Miles per Hour.	Popular Descriptions.
0·002	1	0·68	Gentle airs (unappreciable by guage.)
0·004	1·47	1	
0·005	1·56	1·06	
0·019	3	2	Light airs (just appreciable by guage); would fill the lightest sails of a yacht.
0·028	3.67	2·5	
0·032	3·9	2·66	
0·043	4·5	3	
0·052	4·9	3·3	Light breezes; such as would fill the lightest sails of a large ship.
0·065	5·58	3·8	
0·071	5·87	4	
0 090	6·6	4·5	
0·100	6·98	4·75	
0·112	7.34	5	
0·130	7·89	5·38	
0·136	8·1	5·5	
0·162	8·8	6	
0·228	10·4	7	
0·260	11	7·6	
0·291	11·8	8	Moderate breezes, in which ships can carry all sail.
0·364	13·2	9	
0·390	13·6	9·27	
0·452	14·7	10	
0·521	15·8	10·77	
0·551	16·2	11	
0·650	17·66	12	
0·780	19·8	13	
0·830	20	13·6	Fresh breezes, — topgallant-sails and royals.
0·884	20·6	14	
0·910	20·9	14·25	
1·042	22	15	
1·170	23·6	16	
1·250	24·2	16·5	
1·302	25	17	Fresh winds; reefs.
1·430	26·2	17·8	
1·470	26·5	18	
1·563	27·39	18·67	Strong winds; treble-reefed topsails.
1·630	28	19	
1·790	29·35	20	
1·820	29·55	20·14	Gales; close-reefed topsails and reefed courses.
2·084	31·15	21·47	
2·600	35·32	24	
3·126	38·73	26·40	Strong gales; close reefed top-sails and staysails.
3·647	41·83	28·52	
4·168	44·83	30·56	
4·689	47·44	32·34	
5·200	50	34	
7·800	61·18	41	Heavy gales and storms.
10·400	70·72	48·2	
13·000	79·07	53·91	
15·600	86·61	59	
20·800	100	68·18	Very heavy gales; great storms; tempests.
26·000	111·74	76·18	
31·200	122·62	83·6	Tornadoes; cyclones; hur-ricanes.
36·400	132·18	90·12	
41·600	134·30	90·34	
52·000	157·98	107·7	
62·400	173·06	120	

31. Sources of Information.—In collating and arranging the various particulars contained in these pages respecting the Winds and Weather, Currents, Tides, &c. &c. of the North Atlantic, the following are the principal sources whence the information has been derived—

MAURY's Pilot, Wind, Track, Rain and Storm Charts.

The Wind Charts of the Meteorological Department of the Board of Trade, under the superintendence of Admiral FITZROY, in which the *data* of Maury's Charts have been converted into a Diagram for each ten degrees of latitude and longitude.

The Publications of the Royal Meteorological Institute of the Netherlands.

Abstract Log-books (250 in number), for the Trade Winds—in HORSBURGH's India Directory.

WISE's 100 Voyages to India and China.

Abstract Log-books (720 in number) of British Vessels—between 1840 and 1862—in the possession of the Author.

MAURY's Sailing Directions and Physical Geography of the Sea.

Smithsonian Contributions to Knowledge.

American Journal of Science and Arts.

Reports of the British Association.

MARTIN's History of the British Colonies.

Admiral FITZROY's Weather Book.

Sir HENRY JAMES' Abstracts of the Meteorological Observations by the Royal Engineers.

The Mercantile Marine Magazine.

The Nautical Magazine.

Reports of the United States Coast Survey.

The Spanish Directory for the West Indies—*Derrotero de las Antillas.*

KERHALLET's Atlantic Ocean—*Considérations générales sur l'Océan Atlantique.*

Journal of the Royal Geographical Society.

Proceedings of the British Meteorological Society.

Various publications (Nos. 1 to 16) of the Meteorological Department of the Board of Trade.

The works of KAEMTZ, ROMME, DOVE, QUETELET, GLAISHER, Sir JOHN HERSCHEL, &c. on Meteorology.

The Works of CAPPER, REDFIELD, THOM, REID, PIDDINGTON, ESPY, DOVE, MELDRUM, HOPKINS, BIRT, &c. on the Law of Storms.

Various Surveying Voyages (by the British and French Governments) on the African and American Coasts.

CHAPTER III.

THE WINDS OF THE NORTH ATLANTIC.

The distribution of the prevailing winds of the North Atlantic, and the various modifications of the aerial currents as they sweep along, or blow towards or from, the extensive coast-line bounding that portion of the ocean, may be discussed, according to their leading physical characteristics, under *three* distinct heads, as follows :—

I. The Trade-Wind Region ;—

II. The Region of the Counter Trades or S.W. Passage Winds, inclusive of all the winds of the Temperate Zone ;—and

III. The Winds of the Arctic Regions ;—

and in drawing the attention of the navigator to the Meteorology of these principal regions—or of any of the subdivisions of them that may appear necessary—it will be of the first importance so to analyse the distinctive phenomena peculiar to each, and so to collate the materials derived from the numerous sources already indicated (p. 32), that the information thus condensed may be rendered available on any particular route, and be especially serviceable in determining *where* the most favourable winds may be found at all seasons of the year, by which knowledge that most practical of all purposes in the present day can alone be attained—the saving of time and the shortening of a voyage.

Before entering, however, into detail, it may not be amiss to give a brief sketch of the prevailing winds of the first two regions, and to show their *general* course over the North Atlantic, the leading features of which will be more clearly understood by reference to Chart-Diagrams I to IV., where the *arrows* in the different *areas* show the *direction* whither the several atmospheric currents tend during the four quarters of the year.

In the summer (*see* Diagram III., July, Aug., Sept.,) between the parallels of 40° and 50° there is a general current of air from west to east: between the meridians of 60° and 20° W. this current is inclined towards the north, so as to produce winds from the southward of west; the prevailing wind between Long. 50° and 40° W. (*area* 33) is S.S.W.,—approaching the western shores of Europe it becomes more and more westerly, until, between Long. 20° and 10° W. (*area* 30) being deflected southwards towards the Spanish peninsula, the prevailing wind is W.N.W. There can be no question that this is a great westerly stream or current of air modified by the seasons, and that it has its origin in the descending current at the "Calms of Cancer," between the parallels of 30° and 40°, and westward of the meridian of 25° W. The general direction of the wind in *areas* 29, 28, 27, 26, and 25, is S.S.W.; during the summer the descending current at first takes a direction nearly north, *i.e.* the wind blows almost from the south; as it approaches the higher latitudes the direction becomes more easterly—the wind blowing more from the west, and in the neighbourhood of Spain, as already seen, it becomes W.N.W.

At this season of the year (the summer) the N.E. Trade-wind is very generally found on, or to the northward of the parallel of 30°, but especially so to the eastward of the meridian of 30° W. From off the south-western coast of Spain, and along the western shores of northern Africa it appears as a N.N.E. wind—a direction which is maintained, with but slight variation, in all that part of the Atlantic eastward of 30° W., and northward of 11° or 12° N.; it traverses the central part of the ocean as a N.E. and E.N.E. wind, and becomes more and more easterly as it tends towards the region of the "equator of greatest warmth" in the Gulf of Mexico, and is deflected by the South American continent; the sweep of the Trade-wind with its inflections, and the general tendency towards the west, is seen at a glance on Chart-Diagram III.

At this period of the year also, the S.E. Trade-wind will be frequently found from two to five degrees north of the Line; and the equatorial limits of the two Trades (N.E. and S.E.) are most widely separated—the intervening space being occupied partly by the "Doldrums," and partly by a S.W. Monsoon.

Passing now to the opposite season, winter (*see* Diagram I., Jan., Feb., March), the same *general* direction of the N.E. Trade prevails, but its *mean* polar limit does not reach a higher latitude than 25° N., while its equatorial limit is pushed down seven or eight degrees nearer the Line than during the summer. A great change has, however, taken place to the northward of the 30th parallel, where *areas* 25 and 26 *only* retain the southerly current which was so well marked in summer; and it is not a little interesting that this S.S.W. wind should be so persistent amidst the change that has clearly supervened,—for while to the north of the parallel of 40° the same current from west to east prevails as in summer, the wind is now more generally between W.S,W. and W.N.W.,—but over all that part of the ocean between the meridians of 75° and 50° W. the current sweeps from the north of west, resulting in a general W.N.W. wind; turning also to *areas* 24 and 23 the change is no less strongly marked,—in the former *area*, containing the Western Islands, the wind may be characterised as all round the compass,—while in the latter *area*, containing Madeira, the N.E. Trade that swept the coast of Africa has given place to winds blowing directly towards that continent.

From that broad belt on the ocean designated by Maury as the "Calms of Cancer," the motion of the Trade-wind towards the equator and the tendency of the southerly winds towards the pole would be strictly in accordance with what might be supposed to occur—and, in fact, such a distribution of the wind is well defined from April to September (*see* Diagrams II. and III.): it might also be expected that during the winter season, the direction of the current of air tending polarwise would undergo some modification and be deflected from its usual summer course; but the characteristic N.W. and W.N.W. winds that appear to prevail northward of 30° N. and westward of 50° W., from October to March (*see* Diagrams I. and IV.) require explanation, indeed it may be said that MAURY's hypothesis of a pair of descending currents at the "Calms of Cancer" entirely fails here as it is impossible to conceive how the current flowing *out* from the base of the calm, should flow *to* it—which the prevailing winds indicate. The fact may possibly be something of this character;—the outflowing of the descending S.W. current is confined to mid-ocean,—here it is of sufficient strength to overcome any tendency of the wind to draw to a heated part of the ocean; not so, nearer the American continent. The intense cold of an American winter is well known; the warm Gulf stream, however, is at no great distance from the coast, and during the winter months one phase of a monsoon is established,—certainly such appears to be the case from Lat. 30° to 45° N., and from Long. 50° to 80° W.; the land is cooled down very considerably in winter; the warm Gulf Stream necessarily causes an ascending current over its heated waters, and the cold W.N.W. wind draws towards this ascending current. In *area* 27 although this current gives rise to the prevailing wind, the wind is also frequent from all points of the compass except from the N.E. quadrant, and even from this quarter winds are occasionally met with; probably, therefore, the winds between Lat. 30° and 40° N., Long. 50° and 60° W., mark the ascending current over the Gulf Stream, and to the eastward the ordinary polar current resulting from the descending current at the Calms of Cancer is maintained.

Thus, there are *three* distinct currents of air sweeping over the North Atlantic in winter; the N.E. Trade, between the equator and Lat. 25° N., and extending longitudinally from Africa to America; the S.W. "passage" wind, deflected in its course by the African continent; and the W.N.W. current drawing to the region of the Gulf Stream.

It is a fact that must not be forgotten when navigating the region of the *Equatorial Calms* and *Variables* that the equatorial limits of the N.E. and S.E. Trade-winds converge on the more westerly meridians—each as a general rule blowing more easterly than in any other part of the ocean—and as a consequence the Calm Belt has a greater average breadth on the African side of the Atlantic than in mid-ocean and to the westward of 25° W.

We now close this brief sketch of the distribution of the prevailing winds of the North Atlantic with the following *tabular view* of the Winds and Calms for both the North and South Atlantic, extracted from "Nautical Monographs, No. 1," by Commander MAURY—it shows the total number of observations in each band; the mean direction of the wind from each quarter; the average annual duration of the winds in days; and the number of days of calm.

TABLE I.—*Winds and Calms in the Atlantic Ocean.*

Bands in Latitude.	Mean Direction of the Winds.				No. of days of Calm.	No. of Observations.
NORTH ATLANTIC.						
Lat. 60° to 55° N.	N. 35° E.	S. 40° E.	S. 47° W.	N. 49° W.		392
No. of days	49	51	164	95	6	
Lat. 55° to 50° N.	N. 49° E.	S. 41° E.	S. 48° W.	N. 52° W.		3,610
No. of days	52	85	128	86	14	
Lat. 50° to 45° N.	N. 45° E.	S. 41° E.	S. 48° W.	N. 51° W.		8,491
No. of days	52	57	136	107	12	
Lat. 45° to 40° N.	N. 43° E.	S. 39° E.	S. 46° W.	N. 50° W.		16,299
No. of days	58	68	123	100	16	
Lat. 40° to 35° N.	N. 42° E.	S. 39° E.	S. 45° W.	N. 48° W.		22,207
No. of days	74	65	126	86	14	
Lat. 35° to 30° N.	N. 44° E.	S. 42° E.	S. 42° W.	N. 46° W.		12,897
No. of days	86	88	101	73	17	
Lat. 30° to 25° N.	N. 49° E.	S. 52° E.	S. 39° W.	N. 43° W.		36,862
No. of days	127	99	67	51	21	
Lat. 25° to 20° N.	N. 50° E.	S. 55° E.	S. 39° W.	N. 38° W.		25,614
No. of days	203	96	25	25	16	
Lat. 20° to 15° N.	N. 55° E.	S. 70° E.	S. 38° W.	N. 33° W.		19,845
No. of days	244	89	10	13	9	
Lat. 15° to 10° N.	N. 54° E.	S. 65° E.	S. 43° W.	N. 42° W.		16,950
No. of days	244	60	24	19	18	
Lat. 10° to 5° N.	N. 53° E.	S. 42° E.	S. 30° W.	N. 45° W.		22,777
No. of days	136	91	86	18	34	
Lat. 5° N. to Equat.	N. 52° E.	S. 41° E.	S. 24° W.	N. 33° W.		21,667
No. of days	85	192	49	11	28	
SOUTH ATLANTIC.						
Lat. 0° to 5° S.	N. 60° E.	S. 53° E.	S. 33° W.	N. 44° W.		15,463
No. of days	26	314	17	4	4	
Lat. 5° S. to 10° S.	N. 69° E.	S. 47° E.	S. 31° W.	N. 43° W.		13,714
No. of days	24	329	10	2	0	
Lat. 10° S. to 15° S.	N. 63° E.	S. 50° E.	S. 26° W.	N. 33° W.		14,422
No. of days	58	295	8	2	2	
Lat. 15° S. to 20° S.	N. 55° E.	S. 52° E.	S. 29° W.	N. 28° W.		17,844
No. of days	89	244	14	12	6	
Lat. 20° S. to 25° S.	N. 45° E.	S. 47° E.	S. 37° W.	N. 33° W.		20,762
No. of days	123	157	37	39	9	
Lat. 25° S. to 30° S.	N. 44° E.	S. 41° E.	S. 38° W.	N. 36° W.		19,817
No. of days	109	124	62	62	8	
Lat. 30° S. to 35° S.	N. 39° E.	S. 41° E.	S. 42° W.	N. 43° W.		15,845
No. of days	67	108	91	89	10	
Lat. 35° S. to 40° S.	N. 38° E.	S. 42° E.	S. 47° W.	N. 47° W.		23,581
No. of days	52	55	114	135	9	
Lat. 40° S. to 45° S.	N. 35° E.	S. 38° E.	S. 48° W.	N. 45° W.		8,783
No. of days	53	35	125	142	10	
Lat. 45° S. to 50° S.	N. 27° E.	S. 45° E.	S. 54° W.	N. 44° W.		4,330
No. of days	54	24	123	155	9	
Lat. 50° S. to 55° S.	N. 30° E.	S. 39° E.	S. 57° W.	N. 45° W.		3,732
No. of days	65	19	129	146	6	
Lat. 55° S. to 60° S.	N. 36° E.	S. 36° E.	S. 59° W.	N. 50° W.		4,370
No. of days	48	18	121	167	11	

CHAPTER IV.

THE TRADE-WIND REGION.

1. Tabular View of the Trade-Wind Region in the Atlantic:—No fact is better known to the Navigator than the prevalence of the Trade-winds between, and generally a few degrees beyond, the Tropics,—and experience has also taught him, that both the polar and equatorial margins of those winds (N.E. and S.E.), as well as the breadth of the intervening calm space, no less than the so-called calm belt on each polar edge—are constantly varying in position. The subject has been brought under his notice at different times, in a variety of ways, of which, probably, the most familiar instances are the Wind Charts of Maury, and those of the Meteorological Department of the Board of Trade; but it has been attempted, here, to bring together, in a *series of tables*, all the definite information at present known relative to the distribution of the Trades, the Equatorial Calms, and the S.W. Monsoon in the Atlantic Ocean,—which, if it have no other value, may at least claim the merit of presenting the phenomena in such a concentrated form that, at a glance, it may be seen *where*, in passing to and fro this region, the limit of each may be reasonably expected; this information he will also find fully delineated on the Chart-Diagrams I., II., III., and IV.; and it is hoped, that from the combination of the two (Tables and Charts) he may obtain such a general knowledge of the region as will be serviceable to him on his voyage.*

2. Mean Breadth of the N.E. and S.E. Trade-Winds:—It is generally held that the region over which the Trade-winds are prevalent, extends *thirty* degrees on each side of the equator—thus giving it a breadth of *sixty* degrees; but this is certainly an over-estimate of its *mean* breadth by nearly seven degrees—so far at least as regards their distribution in the Atlantic; for, on carefully revising

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* *N.B.* Tables II., III., and V. (pp. 40—46) sufficiently explain themselves by reference to the side columns and headings; for example, Tab. I. (A.) shows that from January to March, between Long. 20° and 25° W., the mean polar limit of the N.E. Trade is in Lat. 22¾° N., and its equatorial limit in Lat. 3¾° N.; and that the equatorial limit of the S.E. Trade is the Equator. But as greater detail is required for the Equatorial Calms, Tab. III. (p. 42) gives their position for every month,—thus, in January, between the same meridians, the equatorial limit of the N.E. Trade is in Lat. 3¾° N., and that of the S.E. Trade in Lat. 1¼° N., the intervening *calm and variable zône* being 2½ degrees broad; in March it is 4¾ degrees broad, and the equatorial limit of the S.E. Trade is in Lat. 1° S. In August, it will be seen that the intervening space is 10¼ degrees, but it is marked C. and S.W., indicating that it is the season of the year when the S.W. Monsoon is prevalent; this Monsoon and its range are given in Tab. V., (p. 46).

the various tables relating to this subject, it appears that the mean position of the polar edge of each Trade, for each quarter of the year, is as follows:—

1st Quarter,	N.E. Trade, Lat.	25¼° N.	....	S.E. Trade, Lat.	26° S.
2nd „	„ „	27¾	....	„	25½
3rd „	„ „	22¼	....	„	26¼
4th „	„ „	26¼	....	„	26¼
	Mean position	27¼ N.	....	„	26 S.

and hence it may be assumed, that the Trade-wind region of the Atlantic has an average breadth of (27¼° + 26°) only 53¼ degrees—estimating it to extend from the *mean* polar limit of the N.E. Trade to the *mean* polar limit of the S.E. Trade.

3. **Polar Limits of the Trade-Winds**:—The *mean* polar limit of each Trade-wind has been given above, and from Table II., (A), (B), (C), (D), the Navigator may see where, at any period of the year, when between any given meridians, he may expect to gain or lose the polar margin of the N.E. Trade, according to whether he is sailing north or south. The polar edges of the Trade-winds oscillate, as do their equatorial borders; for example, the N.E. Trade advances more towards the North in the summer than in the winter—its *mean* limit being in Lat. 30° N. in August, from which it commences its excursion southward and is generally found no higher than Lat. 25° N. in January—giving its *polar* limit a *mean* oscillation of *five* degrees. Similarly, the S.E. Trade generally reaches Lat. 27° S. in January and February (the southern summer); but recedes to Lat. 25° S. in July and August (the southern winter); the *mean* oscillation for the southern hemisphere being only *two* degrees.

It will have been noticed, that *mean* limits and *mean* ranges only have been spoken of here, and indeed it would be quite superfluous to discuss the *extreme* limits of the Trade-winds, for from MAURY's Charts the extent of the oscillation of the N.E. Trade is upwards of *ten* degrees, and it would almost seem that there was as much chance of meeting this wind on one parallel as on another; but there does not appear much difficulty in explaining this apparent anomaly; the prevalence of the S.E. wind at certain periods off the Cape of Good Hope, and thence carried into the true Trade-wind region, is well known; so it is said that the N.E. Trade is felt off the coast of Portugal, for meteorological observations at Mafra show that during the summer half of the year, the mean direction of the wind is N. 3° E.; whether either wind is the legitimate Trade may be questioned—both, however, serve the purposes of Navigation, which is of most importance to the mariner; but, at the same time, it is beyond dispute, that the margins of these belts are more irregular than seasonal changes alone would indicate; nor is it possible, in many cases, to determine when a ship first enters on their actual boundaries; at the seasons, or on the occasion when the approach to them is made through a region of variable winds and calms, the entrance on them may be unmistakeable; but, for example in respect to the N.E. Trade, when the ship advances southward under northerly or north-easterly winds, she slips into them without finding any marked or sensible margin; the two indications which however, always serve the experienced Navigator in forming a judgment as to whether he has entered the legitimate Trade-wind region are—the prevalent falling of the barometer, and certain peculiarities in the form and insular detachment of the clouds.

4. **Equatorial Limits of the Trade-Winds**:—The *mean* equatorial limit of the N.E. Trade for the year, deduced from Tab. II., is in Lat. 6° N., that of the S.E. Trade in Lat. 2° N.,—whence the mean distance between their equatorial margins is 4 degrees of Latitude or 240 miles; but the margin of each Trade has a considerable oscillation, that of the N.E. being much greater than that of the S.E.;—thus, from Table III. the equatorial limit of the N.E. Trade during August, September, and October is generally found in Lat. 8° to 12° N., but during March and April in about Lat. 1° to 4° N.;—while its *extreme* equatorial limit has been reported, at extreme seasons, between Lat. 17° N. and 3° S.,—it is rarely, however, found to the southward of the Equator except in mid-ocean, and even there only occasionally.

5. The *mean* **Direction of the N.E. Trade** between Lat. 5° N. and 30° N. (derived from Tab. I.) is N. 52½° E.; and its *mean annual duration* extends over 191 days; to the south of Lat. 5° N. this Trade-wind, on the average, cannot be expected for more than 85 days.

6. The *mean* **Direction of the S.E. Trade** between Lat. 5° N. and 30° S. is S. 48° E.; and its *mean annual duration* extends over 236 days.

7. These general remarks apply solely to the open ocean, and have no reference whatever to the direction or persistence of the Trades in the vicinity of the continents; for it is a well known fact that the nearer an approach is made to large masses of land the greater is the disturbance of the *approximate* regularity prevailing in mid-ocean. Between Lat. 35° N. and 35° S. the shore winds and those for a hundred miles or so to seaward almost invariably partake of a Monsoon character,—their direction and force being greatly dependent on the hemisphere, the situation of the place, and the time of the year (*i.e.* the position of the sun); thus, where the Trade blows *towards* a coast there is the least deviation,—the diurnal variations of the wind being excluded: but where the general direction of the Trade-wind is *from* the coast, there the greatest deviation from the normal occurs, as on the west coast of Africa in the Atlantic, and on the west coast of America in the Pacific,—where the winds blow either along the coast or assume the Monsoon character.

TABLE II. (A)—*Mean Position of the Polar and Equatorial Limits of the N.E. Trade-Winds:*—JANUARY, FEBRUARY, AND MARCH.

Trade Winds.	80° W. to 75 W.	75° W. to 70 W.	70° W. to 65 W.	65° W. to 60 W.	60° W. to 55 W.	55° W. to 50 W.	50° W. to 45 W.	45° W. to 40 W.	40° W. to 35 W.	35° W. to 30 W.	30° W. to 25 W.	25° W. to 20 W.	20° W. to 15 W.	15° W. to 10 W.	Mean Position.
Polar Limit of N.E. Trade.	26¼° N.	27¾° N.	26° N.	24¾° N.	22° N.	21° N.	24° N.	27° N.	26° N.	25° N.	24½° N.	22¼° N.	27½° N.	29¾° N.	25¼° N.
Equatorial Limit of N.E. Trade.						3⅓ N.	2¾ N.	2⅓ N.	1 N.	1½ N.	2⅓ N.	3¾ N.	5 N.		2¾ N.
Equatorial Limit of S.E. Trade.								2¼ N.	0	0⅓ N.	0¼ N.	0	0	0	0½ N.

TABLE II. (B.)—*Mean Position of the Polar and Equatorial Limits of the N.E. Trade-Winds:*—APRIL, MAY, AND JUNE.

Trade Winds.	80° W. to 75 W.	75° W. to 70 W.	70° W. to 65 W.	65° W. to 60 W.	60° W. to 55 W.	55° W. to 50 W.	50° W. to 45 W.	45° W. to 40 W.	40° W. to 35 W.	35° W. to 30 W.	30° W. to 25 W.	25° W. to 20 W.	20° W. to 15 W.	15° W. to 10 W.	Mean Position.
Polar Limit of N.E. Trade.	26¼° N.	29° N.	29¼° N.	25¾° N.	23° N.	25¾° N.	27° N.	30¼° N.	28° N.	28¼° N.	25¾° N.	27¼° N.	31° N.	33° N.	27¾° N.
Equatorial Limit of N.E. Trade.						6 N.	4¼ N.	4 N.	2¾ N.	3¾ N.	4 N.	5⅓ N.	5 N.		4½ N.
Equatorial Limit of S.E. Trade.								3¼ N.	1 N.	1 N.	¼ N.	1¼ N.	0¾ N.	1 N.	1¼ N.

TABLE II. (C)—*Mean Position of the Polar and Equatorial Limits of the N.E. Trade-Winds:*—JULY, AUGUST, AND SEPTEMBER.

Trade Winds.	80° W. to 75 W.	75° W. to 70 W.	70° W. to 65 W.	65° W. to 60 W.	60° W. to 55 W.	55° W. to 50 W.	50° W. to 45 W.	45° W. to 40 W.	40° W. to 35 W.	35° W. to 30 W.	30° W. to 25 W.	25° W. to 20 W.	20° W. to 15 W.	15° W. to 10 W.	Mean Positon.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
Polar Limit of N.E. Trade.	27 N.	29⅓ N.	29 N.	28¾ N.	25¼ N.	27¾ N.	31 N.	30⅓ N.	29¼ N.	28¼ N.	31⅓ N.	29¼ N.	33¼ N.	34¼ N.	29⅓ N.
Equatorial Limit of N.E. Trade.						10⅓ N.	10¼ N.	10¼ N.	10¼ N.	10¾ N.	11¾ N.	11¼ N.			10¾ N.
Equatorial Limit of S.E. Trade.								5⅓ N.	4½ N.	5 N.	2 N.	2 N.	1 N.		3¾ N.

TABLE II. (D)—*Mean Position of the Polar and Equatorial Limits of the N.E. Trade-Winds:*—OCTOBER, NOVEMBER, AND DECEMBER.

Trade Winds.	80° W. to 75 W.	75° W. to 70 W.	70° W. to 65 W.	65° W. to 60 W.	60° W. to 55 W.	55° W. to 50 W.	50° W. to 45 W.	45° W. to 40 W.	40° W. to 35 W.	35° W. to 30 W.	30° W. to 25 W.	25° W. to 20 W.	20° W. to 15 W.	15° W. to 10 W.	Mean Position.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
Polar Limit of N.E. Trade.	27 N.	28¼ N.	27¾ N.	26¼ N.	25 N.	23 N.	26 N.	30 N.	26 N.	24¼ N.	22¼ N.	25 N.	28 N.	29½ N.	26¼ N.
Equatorial Limit of N.E. Trade.						6¼ N.	6 N.	6½ N.	6½ N.	6⅓ N.	6¾ N.	7 N.	5¾ N.		6½ N.
Equatorial Limit of S.E. Trade.								5¼ N.	4½ N.	3¾ N.	2⅓ N.	2¼ N.	1¼ N.	1 N.	3 N.

TABLE II. (A)—*Mean Position of the Polar and Equatorial Limits of the N.E. Trade-Winds:*—JANUARY, FEBRUARY, AND MARCH.

Trade Winds.	80° W. to 75 W.	75° W. to 70 W.	70° W. to 65 W.	65° W. to 60 W.	60° W. to 55 W.	55° W. to 50 W.	50° W. to 45 W.	45° W. to 40 W.	40° W. to 35 W.	35° W. to 30 W.	30° W. to 25 W.	25° W. to 20 W.	20° W. to 15 W.	15° W. to 10 W.	Mean Position.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
Polar Limit of N.E. Trade.	26¼ N.	27¾ N.	26 N.	24¾ N.	22 N.	21 N.	24 N.	27 N.	26 N.	25 N.	24⅓ N.	22¼ N.	27½ N.	29¾ N.	25¼ N.
Equatorial Limit of N.E. Trade.						3⅓ N.	2¾ N.	2⅓ N.	1 N.	1½ N.	2⅓ N.	3¾ N.	5 N.		2¾ N.
Equatorial Limit of S.E. Trade.								2¼ N.	0	0⅓ N.	0¼ N.	0	0	0	0½ N.

TABLE II. (B.)—*Mean Position of the Polar and Equatorial Limits of the N.E. Trade-Winds:*—APRIL, MAY, AND JUNE.

Trade Winds.	80° W. to 75 W.	75° W. to 70 W.	70° W. to 65 W.	65° W. to 60 W.	60° W. to 55 W.	55° W. to 50 W.	50° W. to 45 W.	45° W. to 40 W.	40° W. to 35 W.	35° W. to 30 W.	30° W. to 25 W.	25° W. to 20 W.	20° W. to 15 W.	15° W. to 10 W.	Mean Position.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
Polar Limit of N.E. Trade.	26¼ N.	29 N.	29¼ N.	25¾ N.	23 N.	25¾ N.	27 N.	30¼ N.	28 N.	28¼ N.	25¾ N.	27¼ N.	31 N.	33 N.	27¾ N.
Equatorial Limit of N.E. Trade.						6 N.	4¼ N.	4 N.	2¾ N.	3¾ N.	4 N.	5⅓ N.	5 N.		4¼ N.
Equatorial Limit of S.E. Trade.								3¼ N.	1 N.	1 N.	¼ N.	1¼ N.	0¾ N.	1 N.	1¼ N.

TABLE II. (C)—*Mean Position of the Polar and Equatorial Limits of the N.E. Trade-Winds:*—JULY, AUGUST, AND SEPTEMBER.

Trade Winds.	80° W. to 75 W.	75° W. to 70 W.	70° W. to 65 W.	65° W. to 60 W.	60° W. to 55 W.	55° W. to 50 W.	50° W. to 45 W.	45° W. to 40 W.	40° W. to 35 W.	35° W. to 30 W.	30° W. to 25 W.	25° W. to 20 W.	20° W. to 15 W.	15° W. to 10 W.	Mean Positon.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
Polar Limit of N.E. Trade.	27 N.	29½ N.	29 N.	28¾ N.	25¼ N.	27¾ N.	31 N.	30½ N.	29¼ N.	28¼ N.	31⅓ N.	29¼ N.	33¼ N.	34½ N.	29½ N.
Equatorial Limit of N.E. Trade.						10½ N.	10¼ N.	10¼ N.	10¼ N.	10¾ N.	11¾ N.	11¼ N.			10¾ N.
Equatorial Limit of S.E. Trade.								5½ N.	4½ N.	5 N.	2 N.	2 N.	1 N.		3¾ N.

TABLE II. (D)—*Mean Position of the Polar and Equatorial Limits of the N.E. Trade-Winds:*—OCTOBER, NOVEMBER, AND DECEMBER.

Trade Winds.	80° W. to 75 W.	75° W. to 70 W.	70° W. to 65 W.	65° W. to 60 W.	60° W. to 55 W.	55° W. to 50 W.	50° W. to 45 W.	45° W. to 40 W.	40° W. to 35 W.	35° W. to 30 W.	30° W. to 25 W.	25° W. to 20 W.	20° W. to 15 W.	15° W. to 10 W.	Mean Position.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
Polar Limit of N.E. Trade.	27 N.	28¼ N.	27¾ N.	26¼ N.	25 N.	23 N.	26 N.	30 N.	26 N.	24¼ N.	22¼ N.	25 N.	28 N.	29½ N.	26¼ N.
Equatorial Limit of N.E. Trade.						6¼ N.	6 N.	6½ N.	6½ N.	6½ N.	6¾ N.	7 N.	5¾ N.		6½ N.
Equatorial Limit of S.E. Trade.								5¼ N.	4½ N.	3¾ N.	2½ N.	2¼ N.	1¼ N.	1 N.	3 N.

TABLE III.—*Showing the Mean Position of the Equatorial Limit of the N.E. and the S.E. Trade Winds for every month—with the approximate Breadth of the intervening zone, or region of the Calm Belt.*

		Long. 50° to 45° W.	Long. 45° to 40° W.	Long. 40° to 35° W.	Long. 35° to 30° W.	Long. 30° to 25° W.	Long. 25° to 20° W.	Long. 20° to 15° W.
		Lat.	Lat.	Lat.	Lat.	Lat.	Lat.	Lat.
January	N.E.	2½°N.	2¼°N.	2° N.	2¼ N.	2¾°N.	3¾°N.	5° N.
	S.E.		1⅔	1	1⅓	1⅓	1⅓	0⅓
Breadth of zone	C.		0½	1	1	1½	2½	4⅔
February	N.E.	2½ N.	2½ N.	1 N.	1 N.	2¼ N.	3¾ N.	5 N.
	S.E.		2	0¼	0¼	0½ S.	0¾ S.	0½ S.
Breadth of zone	C.		0½	0¾	0¾	2¾	4½	5½
March	N.E.	3 N.	3 N.	0	1 N.	2 N.	3¾ N.	5 N.
	S.E.		3	1 S.	0⅔ S.	1½ S.	1 S.	0
Breadth of zone	C.		0	1	1⅔	3½	4¾	5
April	N.E.	2¾ N.	2½ N.	0	1 N.	2 N.	4 N.	5½ N.
	S.E.		2	1⅓ S.	1⅓ S.	1⅓ S.	1 S.	0½
Breadth of zone	C.		0½	1⅓	2⅓	3⅓	5	4½
May	N.E.	4 N.	4 N.	2 N.	2½ N.	3½ N.	5 N.	5 N.
	S.E.		3¼	0½	0⅓	1⅓	2	1 N.
Breadth of zone	C. & S.W.		0¾	1½	2	2	3	4
June	N.E.	6 N.	5¾ N.	6 N.	7½ N.	9¼ N.	7¾ N.	
	S.E.		4⅔	4	4	3½	3	2⅓ N.
Breadth of zone	C. & S.W.		1	2	3½	5¾	4¾	
July	N.E.	8 N.	8 N.	8 N.	9¾ N.	10½ N.	11 N.	
	S.E.		4½	3½	6	2½	2⅓	2¼ N.
Breadth of zone	C. & S.W.		3½	4½	3¾	8	8⅔	
August	N.E.	11 N.	11 N.	11¼ N.	12 N.	12½ N.	12¾ N.	
	S.E.	7	6	5	5	2	2½	1⅔ N.
Breadth of zone	C. & S.W.	4	5	6¼	7	10½	10¼	
September	N.E.	12 N.	12 N.	11½ N.	10¼ N.	12½ N.	9¾ N.	
	S.E.	7	6½	5½	4⅓	1½	1	1 N.
Breadth of zone	C. & S.W.	5	5⅔	6	6	11	8¾	
October	N.E.	10½ N.	10 N.	9 N.	9¾ N.	10¼ N.	8 N.	
	S.E.	6½	6⅓	5½	4⅓	2½	1¾	1¼ N.
Breadth of zone	C. & S.W.	4	3⅓	3½	5½	7¾	6¼	
November	N.E.	6¼ N.	6¼ N.	6¼ N.	5¾ N.	5¾ N.	7 N.	
	S.E.	5¼	5⅓	5	4¼	3	3	2¾ N.
Breadth of zone	C. & S.W.	1	1	1¼	1⅓	2¾	4	
December	N.E.	3½ N.	4 N.	4 N.	3¾ N.	4½ N.	6 N.	
	S.E.		4	3	2⅔	1⅔	2	0½ N.
Breadth of zone	C.		0	1	1	2	4	

8. Maury's Summary of the Trade-Wind Region:—Commander MAURY referring to the marked difference in the prevailing direction of the wind, according to the season of the year, in the different parts of the ocean, gives the following summary of the Trade-winds in the North Atlantic. As a general rule, it may be remarked—

1.—That the nearer to the coast of Africa and to the Equator, the more the so-called N.E. Trade-winds haul to the South.

2.—That to the *west* of Long. 45°, between Lat. 20° and 30° N., the N.E. Trades blow much more steadily in May, June, July, August, and September than they do the rest of the year; and that during the other months, but particularly in March, they blow, between these parallels, nearly alike from all points of the compass.

3.—That between Lat. 15° and 20° N. they are most variable, *west* of Long. 35°, in the months of September, October, and November; while between the same parallels, *east* of Long. 30°, they are most variable in February, March, April and October.

4.—That between Lat. 10° and 15° N., to the *west* of Long. 35°, they blow steadily between E.N.E. and S.E., except in July, August, September, October, and November, when they are more variable, but especially so in the three months first named. To the *east* of Long. 35°, between these parallels, they may be said to lose their character as Trades, during July, August, September, and October—particularly in August and September—when they blow nearly alike from the four quarters. Calms, too, are more frequent here in these months.

5.—That between the equator and 10° N., to the *east* of Long. 35°, the winds assume a new feature. It may be said, almost literally, that in this part of the ocean they uniformly blow (when they blow at all) during July, August, and September, from some point between S.E. and West; they blow most between South and W.S.W., and very rarely from any point between North and E.S.E. To the *west* of the meridian of 35°, during the same months, they blow most between S.E. and N.E., inclining more and more to the North as you go west; and these are the months in which the winds vary most in this part of the ocean.

The prevailing direction of the wind within the Trade-wind region of the North Atlantic is shown by the arrows on the Chart-Diagrams I., II., III., and IV.

9. The Equatorial Calm Belt:—The breadth of this Calm Belt in the Atlantic is shown, for each month, in Tab. III (p. 42). Interposed between the Trade-winds, which follow the course of the sun, the Belt of Equatorial Calms shifts its position according to the season, being found farthest North in August, and farthest South in April—its *mean range* being between 11½° N. and 1° S., while its *extreme range* extends from 16° N. to 5° S. Owing to the preponderance of land in the northern hemisphere, the line of the earth's greatest heat (*equator of heat*) is always found a few degrees north of the terrestrial equator; and it would almost follow as a consequence, that the axis of vibration of the Calm Belt should approximate to the equator of heat, and such indeed is the fact, for it runs more or less in the direction of the parallel of 5° N. in the Atlantic; also, it may be observed, that calms are most frequent to the north of that parallel from June to November, both inclusive;—while the calm season south of the same parallel extends from January to May, both inclusive; again, as might be expected, the greatest number of calms is found in the vicinity of the axis of vibration—on the parallel of 4° N. (see Tab. IV.), and it will be seen that they diminish, more or less regularly, to the north and south of that parallel.

In reference to this region MAURY makes the following observations:

"The great *sun-swing* of this Calm Belt is annual in its occurrence; it marks the seasons, and divides the year into wet and dry for all those places that are within the arc of its majestic sweep. But there are other subordinate and minor influences which are continually taking place in the atmosphere, and which are also calculated to alter the place of this Calm Belt, and to produce changes in the thermal state of the air which the Trade-winds move. These are unusually severe winters or hot summers; remarkable spells of weather, such as long continuous rains or droughts, over areas of considerable extent. Either within or near the Trade-wind belts it is tremblingly alive to all such influences, and they keep it in continual agitation; accordingly we find that such is its state, that within certain boundaries, it is continually changing place and limits. This fact is abundantly proved by the speed of ships, whose log-books show that it is by no means a rare occurrence for one vessel, after she has been dallying in the Doldrums for days, in the vain effort to cross that Calm Belt, to see another coming up to her 'hand over fist' with fair winds, and crossing the belt after a delay in it of only a few hours instead of days."

Table IV. is deduced from MAURY's "Trade-Wind Chart"; it shows how many ships reported the Equatorial Limits of the N.E. and S.E. Trades on the several parallels,—where the S.W. Monsoon was gained or lost,—and the number of calms experienced.

TABLE IV.—*Showing the Distribution of Trades, Calms, and Monsoons, between Lat. 17° N. and 6° S.; from Long. 10° to 50° W.*

Parallels	N. 17°	N. 16°	N. 15°	N. 14°	N. 13°	N. 12°	N. 11°	N. 10°	N. 9°	N. 8°	N. 7°	N. 6°	N. 5°	N. 4°	N. 3°	N. 2°	N. 1°	0	S. 1°	S. 2°	S. 3°	S. 4°	S. 5°	S. 6°	Totals.
N.E. Trade	4	7	15	35	44	64	59	70	79	50	64	76	66	97	103	81	73	36	28	9	7	1	..	..	1068
Calms	1	3	7	21	46	69	94	120	160	156	182	178	179	202	173	172	144	119	96	62	45	19	14	1	2263
N. Limit of S.W. Monsoon	..	..	..	1	19	31	36	49	52	51	36	27	44	6	7	2	..	..	..	..	..	..	..	..	351
S. Limit of S.W. Monsoon	..	..	..	..	..	..	..	..	..	2	6	9	23	35	66	82	69	30	17	6	..	..	..	..	345
S.E. Trade	..	..	..	..	..	..	..	2	9	14	16	48	76	107	157	176	143	90	81	41	35	21	11	5	1032

10. The Cloud Ring:—Immediately connected with the Equatorial Calm Belt is the "Cloud Ring" of MAURY. The currents of warm air which constitute the Trade-winds absorb more and more moisture as they approach towards the Equator. When they commence their ascensional motion they are well nigh saturated; "as the air, with its vapours, rises up in this Calm Belt and ascends, these vapours are condensed into clouds, and this condensation is followed by a turgid intumescence, which causes the clouds to overflow the Calm Belt, as it were, both to the north and the south. The air flowing off in the same direction, assumes the character of winds that form the upper currents that are counter to the Trade-winds. These currents carry the clouds still farther to the north and south, and thus make the Cloud Ring broader. At least, we infer such to be the case, for the rains are found to extend out into the Trade-winds, and often to a considerable distance both to the north and the south of the Calm Belt.

"Were this Cloud Ring luminous, and could it be seen by an observer from one of the planets, it would present to him an appearance not unlike that which the rings of Saturn do to us. Such an observer would remark, that this Cloud Ring of the earth has a motion contrary to that of the axis of our planet itself—that while the earth was revolving rapidly from west to east, he would observe the Cloud Ring to go slowly, but only relatively, from east to west. As the winds which bring the cloud-vapour to this region of calms rise up with it, the earth is. slipping from under them; and thus the Cloud Ring, though really moving from west to east with the earth, goes relatively slower than the earth, and would therefore appear to require a longer time to complete a revolution. But unlike the rings of Saturn—through the telescope—the outer surface, or the upper side to us, of this Cloud Ring would appear exceedingly jagged, rough, and uneven.

"The rays of the sun, playing upon this peak and then upon that of the upper cloud-surface, melt away one set of elevations and create another set of depressions. The whole stratum is, it may be imagined, in the most turgid state; it is in continual throes when viewed from above; the heat which is liberated from below in the process of condensation,—the currents of warm air ascending from the earth, and of cool air descending from the sky,—all, we may well conceive, tend to keep the upper cloud-surface in a perpetual state of agitation, upheaval, and depression. Imagine in such a cloud stratum an electrical discharge to take place; the report being caught up by the cloud-ridges above, is passed from peak to peak, and repeated from valley to valley, until the last echo dies away in the mutterings of the distant thunder. How often do we hear the voice of the loud thunder rumbling and rolling away above the cloud-surface, like the echo of artillery discharged among the hills!

"Hence we perceive or infer that the clouds intercept the progress of sound, as well as of light and heat, and that this upper surface is often like Alpine regions, which echo back and roll along with rumbling noise the mutterings of the distant thunder. It is by trains of reasoning like this that we are continually reminded of the interest which attaches to the observations the mariner is called on to make. There is no expression uttered by Nature which is unworthy of our most attentive consideration—for no physical fact is too bald for study—and mariners, by registering in their logs the kind of lightning, whether sheet, forked, or streaked,—and the kind of thunder, whether rolling, muttering, or sharp—may be furnishing facts which will throw much light on the features and character of the clouds in different latitudes and seasons. Physical facts are the language of Nature, and every expression uttered by her is worthy of our most attentive consideration, for it is the voice of WISDOM."

11. The S.W. Monsoon:—The existence of a S.W. Monsoon in the region between the Trade-winds, and impinging on the African coast, was recognized by Navigators before the commencement of the present century: numerous observations tend to show that it is the S.E. Trade bent or diverted by the African coast; and in fact, that, while in mid-ocean, this Trade pursues an undeviating course from the S.E., on the American side it is converted into a N.E-ly wind, but on the African side it becomes a S.W. wind.

This Monsoon—from South to S.W. and sometimes more westerly, not unfrequently blowing strong, and at intervals in squalls accompanied with rain, —prevails more or less from the middle of May to the middle of November; it attains its maximum development in August (*see* Tab. V. and Chart-Diagram III.), when it extends across the Atlantic from Long. 40° W. to the African coast, and its northern margin is then found between Lat. 10° and 11° N.,—hence, it may always be expected during the same months that the Calms and Trades occupy their most northern position. Winds from the S.W. quarter rarely occur from December to April; but calms are much more frequent near the coast during the season when the Monsoon has ceased to blow than when it is prevalent. The following Table (V) shows the parallels where it is most frequently encountered.

Between the Equator and Lat. 15° N., the *mean direction* of the S.W. Monsoon is S. 30° W. and its *mean annual duration* 53 days.

TABLE V.—*Showing the Mean Position of the Northern Limit of the Atlantic S.W. Monsoon*:—

MONTHS.	Long. 45° to 40° W.	Long. 40° to 35° W.	Long. 35° to 30° W.	Long. 30° to 25° W.	Long. 25° to 20° W.	Long. 20° to 15° W.	MEAN POSITION.
	Lat. N.	Lat. N.	Lat. N.	Lat. N.	Lat. N.	Lat. N.	Lat. N.
May			3°	3°	4°	6°	4°
June	6°	6°	6⅛	6¾	6⅛	5	6
July	7¼	8	7¼	8⅛	9¼	6½	7¾
August	10½	10½	10½	10¾	10	10	10¼
September	10	10	9	10⅛	10	6½	9¼
October	9	9	9	7	7	8	8
November			4	3½	5	6	4½

12. Strength of N.E. and S.E. Trades in the Atlantic:—Commander MAURY, treating ships as *anemometers* for the purpose of determining the comparative strength of the Trade-winds, makes allowance for the different angles with the wind on which they sail, and by reducing the average knots per hour to the average speed of a *mean* ship sailing through average Trades, with *the wind impinging upon her sails at the same angle*, for example, *just abaft the beam*, thinks, that the rate of such a ship would be—

Through the N.E. Trade of the N. Atlantic, 6¼ knots per hour.
„ S.E. „ S. 8 „

and hence, he says "it is clearly estabiished that the S.E. Trades are stronger than the N.E."

Lieut. J. C. BRITO DE CAPELLO, of the Portuguese Navy, discusses the subject in a similar manner, and taking 1548 tracks, he reduces all the courses to the most favourable point of sailing for all ships,—that is, with the wind free; but he arrives at a conclusion slightly different from Commander MAURY as to the relative strength of the two winds.

For the N.E. TRADE he has 803 tracks—424 Dutch, and 379 American: the region of this Trade he divides into four parts, viz.,—1. The *eastern*, or that frequented by ships going south and passing to the *eastward* of the Cape Verde islands;—2. the mean route of vessels going south and passing *westward* of those islands;—3. the *central* part, containing the routes to the southward of ships from Europe and America; and 4, the part containing the *westernmost homeward routes* of American vessels.

For *February* and *March*, he finds that—

1. *East* of the Cape Verdes, the mean rate of 20 vessels, from 30° N. to 5° N., is 6·1 miles.
2. *West* of the Cape Verdes, the mean rate of 71 vessels, from 30° N. to 5° N., is 6·3 miles.
3. For the *Central* part, the mean rate of 262 vessels, from 25° N. to 5° N., is 6·5 miles.
4. For the *Westernmost* route, 44 American ships sailing from the Equator to 25° N., between Long. 32° and 38° W. of Greenwich, give a mean rate of 6·7 miles.

Hence, for the whole region of the N.E. Trade, during *February* and *March*, the mean rate is 6·4 miles.

For *August* and *September* when the N.E. Trade is weakest, and in its most northern position—

1. *East* of the Cape Verdes, the mean rate of 18 vessels, from 30° N. to 15° N., is 6·3 miles.
2. *West* of the Cape Verdes, the mean rate of 155 vessels, from 30° N. to 15° N., is 6·5 miles.
3. For the *Central* part, the mean rate of 193 vessels, from 30° N. to 15° N., is 5·3 miles.

4. On the *Westernmost* route, 85 American homeward-bound vessels, from 10° N. to 30° N., give a mean rate of 4·8 miles.

And for the whole region of the N.E. Trade, during *August* and *September*, the mean rate is 5·7 miles.

For the strength of the S.E. TRADE, there are 655 tracks,—417 Dutch, and 238 American; and the regions are,—1. the *western*, in which the vessels go southwards; and 2. the *central*, in which the ships are coming from the East Indies.

During *August* and *September* it appears that—

1. For the *Western* route, 282 vessels give a mean rate of 7·5 miles.
2. For the *Central* route, 124 vessels give a mean rate of 7·4 miles.

During *February* and *March* the results are as follows—

1. For the *Western* route, 142 vessels give 7·0 miles.
2. For the *Central* route, 157 vessels give 7·1 miles.

The S.W. Monsoon region gives according to 90 Portuguese ships an average rate of 4·9 miles for *February* and *March*; and 5·8 miles for *August* and *September*.

18. The Calm Belt of Cancer:—The *tropical calm belts*—varying in position as well as in breadth with the seasons—bound the Trade-winds on their polar sides, and oscillate with those wind zones:* it is there that the upper or return currents (p. 5) from the equator, cooled and condensed, come down to the surface, whence the greater part passes polarwise as the "passage winds,"—while, by the antagonistic agency of the polar current, a part may possibly be borne back towards the equator to augment the Trades. The winds there are variable and light, frequently interrupted by sudden squalls; but calms are not so common nor is the rain so copious as in the equatorial calm belt.

The CALM BELT OF CANCER in the North Atlantic—known also as the "Horse Latitudes"†—is contained between the northern edge of the N.E. Trade and Lat. 35° to 37° N.; for the whole breadth of the Atlantic between Long. 10° and 80° W., during August, the mean position of its polar edge is in Lat. 33¾° N.,—during February, in Lat. 30½° N.—the variability of its position under the different meridians may, however, be seen by referring to the Chart-Diagrams.

Generally, the number of calms in the summer as compared with the winter season is in the ratio of 3 to 1—clearly indicating the effect of the *sun-swing*; and taking the whole year round, the chances (according to Log-books) are also 3 to 1 that a ship when passing the latitudes of this belt will encounter light airs, baffling winds, and calms before meeting the Trade. Calms are more prevalent between 30° and 33° N. than in either a higher or a lower latitude, and

* Or, perhaps it would be more in accordance with the reality to assume that the calms are intermingled with the Trades and counter-Trades in these latitudes, rather than that they bound either region.

† So called from the circumstance of the vessels, formerly employed in carrying horses to the West Indies, when passing through this baffling region, having to throw them overboard.

it is between these parallels, on the western side of the Atlantic, that cyclones most frequently recurve.

14. The following *remarks descriptive of the* REGION OF THE TRADES AND CALMS—from the "Journal of a Voyage for Magnetical Research," in the S.S. *Royal Charter*, by the late DR. SCORESBY, F.R.S. (the celebrated Arctic Voyager)—are of sufficient interest to find a place here.

"The singularly small advantage we have derived from the N.E. Trade-winds has been to me and others greatly disappointing. No doubt our coming southward within the Cape de Verde Islands has caused this; but it is doubtful whether a circuit westward would, if we take into account the greater distance, have been any very great gain. At all events, our command of steam power rendered the inward course probably the best, if not specially advantageous to our progress. How far we actually enjoyed an advantage from the N.E. Trades is not easily determined, having apparently slipped into them under brisk northerly breezes. Our first north-easterly breeze within the probable range of the Trades commenced about noon of February 24th, when in Lat. 30° 45′ N., Long. 17° 10′ W., it had certain characteristic signs of a real Trade in the falling of the barometer and in the peculiar formations of clouds.

"It was only during the four following days that we held the wind (N.N.E. to East) in the strength of a 6 to 10 knot breeze. At noon of the 29th, the wind began to fail us, and steam was got up. Light breezes continued from the N.E. and northward for a day or two, and then subsided either into unaiding light winds, or calms—the effective sailing breeze ceasing, as intimated, on the 29th, when we were yet in Lat. 16° N., and soon becoming too light even for the purpose of ventilation.

"I was much struck with the stillness and strange solitariness of the regions which we now traversed within the northern tropic. Often when I looked scrutinizingly around, not a symptom of organic life, beyond the little world comprised on board the *Royal Charter*, was anywhere to be seen. Not a gull was tempted to watch our progress to fish for the oft-dispersed slops of the Cooks and Stewards. Not a whale, a porpoise, or other inhabitant of the ocean, for long periods together appeared. Nothing could be traced moving in sea, or sky,—and during much of the day not even a cloud. Sea and wind, in the early day, seem to sympathise in the characteristic repose. In high northern latitudes I had been accustomed to a perpetual accompaniment of birds in the air, and of creatures of various kinds and magnitude in the water, from the great whale down to the animalcules which swim amid and near the Arctic ices. But here there seemed, for hours and days together, to be an absence of all; and it was not until towards evening that the solitariness was broken by a few flying-fish emerging occasionally from the surface of the water, and after their habitual limited progress again disappearing.

"On March 3rd our Latitude at noon was 6° 55′ N., Long. 21° 9′ W.—The sky now became frequently cloudy—presenting an undefined sheet of thin clouds an atmosphere filled with vapour; and in the evening a like state of sky—though it cleared up towards midnight—prevailed; and whilst it intercepted the otherwise profuse dews, seemed to shut us in within a close unventilated canopy. There was a feeling of closeness, oppressiveness, as of damp heat, which I do not remember to have before experienced, interfering with the enjoyment of otherwise very fine weather. Our cabin, small and crowded with the necessary appliances for dressing and changes, &c., was found to be now greatly incommodious. Though the small port was kept continually open, night and day—and the door, and in part the window, whenever practicable—it was oppressively close, the temperature all night being from 83° to 82°. The effect on the skin was that of perpetual moisture, and not very pleasant clamminess of the touch and sensation.

"March 4th.—Nearly calm, or perfectly so, from midnight to midnight; an oppressive night; and close, damp-feeling, oppressive day. Scarcely a breath of wind refreshed our cabins or the deck. Perpetual unquenchable thirst and constant clammy moisture of the skin. The sky was generally covered with an undefinable screen of cloud, intercepting all refreshing radiation, or alternating thermometric influences between the sea and the heavens. It screened the direct rays of the sun, but like the curved roof of an oven, seemed but to act as a cumulative screen in preventing the escape of the oppressive condition of the atmosphere. Not that the temperature was actually high, for it scarcely exceeded 81°, but the effect on the feelings was that of languid oppressiveness. In our cabin at night, notwithstanding an open port and apertures inward for the escape of heat, the thermometer stood at 85½°. The evening was like the day, closed in by some slight showers of rain; cloudy (a thin screen above) with the occasional breaking through of the stars, and a continual stagnant air. It was observed by the night watches that the cloudy sky of the evening had, for several nights in succession, cleared away before midnight, showing a moderately bright and starlit sky.

"March 5th.—In the morning we found a pleasant change in a steady breeze, recently sprung up from the S.E.; and what was encouraging both as to the prospect of progress and comfort, it bore all the characteristics of the "S.E. Trade-wind," though we were yet *two degrees northward* of "the line." Our quick transit across the first two belts of light winds and calms, by the aid of our auxilliary steam power, is a result, being one to be relied on, which must give special advantage and popularity in Australian voyages to ships possessing this appliance. Passengers on board the *Royal Charter*, in describing the progress on former voyages, cite a variety of cases within their personal experience in which a week or ten days of anxious protracted suffering during calms have been spent in passing one or other of the "belts of calms and variables," which we accomplished in a third part of the time or less. In a voyage made in 1834, in an old East India ship, by a gentleman in the saloon, he describes their detention about this parallel during 19 days of light winds and calms. Many emigrants of the working-classes were on board; fever of the typhoid kind, or ship fever apparently, broke out during that detention, and spread amongst the passengers and others subsequently, so that 22 bodies were committed to the deep.

"During the forenoon and early afternoon we had a steady, moderate, and refreshing breeze from the south-eastward or eastward. The highest temperature in the shade was 82°, and that of the sea the same. As on many preceding days, nothing, except occasional flying-fish, was to be seen. The sea, as to its visible surface, was like a barren desert. Within its waters, indeed, a variety of minute creatures might be seen, on taking up a portion in a glass; they were generally of the animalcule size; and from the degree of luminosity of the sea at night, and the frequency of the flashes of phosphorescent light, it was obvious that there was a good supply.

"The change in the character of the clouds on coming into the verge only of the south-eastern trade was striking and characteristic. Within the equatorial belt of calms (the "doldrums" of the sailors) we had a prevailing semi-leaden canopy of clouds, of varying density indeed, and perceptibly patchy, yet not reducible into any ordinary species. The effect of this, as I have remarked, is cumulative of heating oppressiveness and lassitude, not however indicated by the thermometer which, as well as the barometer, is usually lower here than in the tracks beyond—especially in the particular Trade-wind region being then traversed by the sun. The incongruity, indeed, between thermometric temperature and that of the human perception is similar, only converse, to what we find betwixt the thermometer and sensation under a damp atmosphere in England, in November, December, or January, when the chill affects us much more than an actual depression of temperature of very many degrees, with a clear elastic state of the air.

"The change in the character of the clouds, just referred to, is as conspicuous as the change in elasticity of feeling is marked and enjoyable. Whilst clouds of the *cirri* kind may be seen in the upper cloud region of the atmosphere, the *cumulus*, travelling deliberately in picturesque effects of shadow on the waters, in separate masses, till forming, especially at sunset, a dense irregular cloud-bank on the horizon, becomes the characteristic formation.

"March 6th.—Wind S.E. to S.S.E. variable; though we had entered, as generally believed, the S,E. Trade-wind, it was yet, as is usual at the commencement, somewhat variable in direction, and still more so in strength; at noon our Lat. was 1° 16′ S., Long. 22° 40′ W.

Table VI. and VII. (p. 52) are deduced from the log-books of 1000 vessels that have sailed from or returned to English ports during the last 20 years; it shows that only 5 out of every 1000 vessels can, on the average, expect to cross the Equator, in the Atlantic, without meeting calms.

TABLE VI.—*Showing the Position of the Equatorial Edge of the N.E. Trade, as reported by* 1000 *Vessels.*

Parallels between which Ships report the Equatorial edge of the N.E. Trade.	Long. 40° to 35° W.				Long. 35° to 30° W.				Long. 30° to 25° W.				Long. 25° to 20° W.				Long. 20° to 15° W.			
	Jan. Feb. Mar.	Ap. May June	July Aug. Sept.	Oct. Nov. Dec.	Jan. Feb. Mar.	Ap. May June	July Aug. Sept.	Oct. Nov. Dec.	Jan. Feb. Mar.	Ap. May June	July Aug. Sept.	Oct. Nov. Dec.	Jan. Feb. Mar.	Ap. May June	July Aug. Sept.	Oct. Nov. Dec.	Jan. Feb. Mar.	Ap. May June	July Aug. Sept.	Oct. Nov. Dec.
North of 10° N.	1	1	19	7		5	24	9		8	76	13		8	86	13	5	2	1	1
From 10° to 5° N.	2	10	8	21	5	9	12	6	5	31	16	44	31	44	9	32	15	9	2	3
From 5° N. to Equator.	30	21	2	8	43	32	1	8	52	28	2	18	49	34	1	15	12	4	1	
South of Equator.	14	9		1	5	9			1	1		1	3	2						
Total Ships	47	41	29	37	53	55	37	23	58	68	94	76	83	88	96	60	32	15	4	4

TABLE VII.—*Showing how many of the above* 1000 *Vessels reported Calms—and where.*

Parallels between which Calms have been reported.	Long. 35° to 30° W.				Long. 30° to 25° W.				Long. 25° to 20° W.				Long. 20° to 15° W.			
	Jan. Feb. Mar.	Ap. May June	July Aug. Sept.	Oct. Nov. Dec.	Jan. Feb. Mar.	Ap. May June	July Aug. Sept.	Oct. Nov. Dec.	Jan. Feb. Mar.	Ap. May June	July Aug. Sept.	Oct. Nov. Dec.	Jan. Feb. Mar.	Ap. May June	July Aug. Sept.	Oct. Nov. Dec.
North of 10° N.	1	3	20	8	1	2	33	2	1	3	59	6	2	1	15	2
From 10° N. to Equator.	52	56	37	37	62	68	36	49	86	89	46	79	20	12	4	2
South of Equator.	11	10		1	18	10		2	28	11		3	4	2		1
Total Calms.	64	69	57	46	81	80	69	53	115	103	105	88	26	15	19	5

15. The foregoing remarks (pp. 38-52), together with Tables I. to VII., and the Chart-Diagrams I. to IV., will probably be found amply sufficient to give a general practical knowledge of the Trade-wind Region of the Atlantic, without the necessity of entering into any lengthened detail on the prevalence and direction of the winds, such as might be derived from a complete analysis of each of the wind-roses of MAURY's Charts; but in concluding this chapter, it may not be amiss to draw attention to the prevailing and frequent winds which may be expected in that strip of ocean between the parallels of 20° and 30° N., where the polar edge of the N.E. Trade is situated.

16. WINDS BETWEEN THE PARALLELS OF 20° AND 30° N. during *January, February,* and *March* :—*

14. Sub-Area included between Lat. 30° and 25° N.,—Long. 15° and 20° W. Prevailing wind N.N.E.—Frequent wind E.N.E.—Occasional winds, from between W.S.W. and N.N.W.—Calms, rare. (*Canary Islands*). (74)

14. Sub-Area included between Lat. 25° and 20° N.,—Long. 15° and 20° W. Prevailing wind E.N.E.—Frequent winds N. and N.N.E.—Calms, few. (74)

15. Area included between Lat. 30° and 20° N.,—Long. 20° and 30° W. Prevailing winds E.N.E. and N.N.E.—Frequent winds E.S.E., E., N. and N.N.W.—Occasional winds S.S.E. and S.S.W.—Calms, few. (75)

16. Area included between Lat. 30° and 20° N.,—Long. 30° and 40° W. Prevailing winds E.N.E.—Frequent winds E.S.E., E., and N.N.E.—Occasional winds S.S.E., S.S.W., and N.N.W.—Calms, occasional. (76)

17. Area included between Lat. 30° and 20° N.,—Long. 40° and 50° W. Prevailing winds E.S.E., E.N.E. and E.—Frequent winds S.S.W., N.E., N.N.E., S.S.E., and W.N.W.—Calms, occasional. (77)

18. Area included between Lat. 30° and 20° N.,—Long. 50° and 60° W. Prevailing wind N.E.—Frequent winds S.E., E., E.N.E., and E.S.E.—Occasional winds N., S.W. and N.W.—Calms, occasional. (78)

19. Area included between Lat. 30° and 20° N.,—Long. 60° and 70° W. Prevailing wind N.E.,—Frequent winds S.E., E., S.W. and N.—Occasional winds S. and N.W.—Calms, occasional. (79)

20. Area included between Lat. 30° and 20° N.,—Long. 70° and 80° W. Prevailing winds E. and N.E.—Frequent winds S.W., N.W., S., S.E., N. and W.—Calms, occasional. (*Bahamas and N.E. Coast of Cuba*). (80)

21. Area included between Lat. 30° and 20° N.,—Long. 80° and 90° W. Prevailing winds E. and N.E.—Frequent winds S.E. and N.—Occasional winds N.W., S. and S.S.W.—Calms, occasional. (*Western half of Cuba and eastern half of Gulf of Mexico*). (81)

22. Sub-Area included between Lat. 30° and 25° N.,—Long. 90° and 95° W.

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* The figures prefixed to each Area (or Sub-Area) correspond with those in the squares of the Chart-Diagrams that accompany this work; the figures in parentheses (as 74) at the end of the paragraph refer to the squares on the Charts published by the Meteorlogical Department of the Board of Trade.

Prevailing wind S.E.,—Frequent wind E.N.E.—Calms, frequent. (*Gulf of Mexico*). (82)

22. Sub-Area included between Lat. 25° and 20° N.,—Long. 90° and 95° W. Prevailing winds E. and S.E.—Calms, frequent. (*Gulf of Mexico.*) (82)

17. Winds BETWEEN THE PARALLELS OF 20° AND 30° N. during *April*, *May* and *June*:—

14. Sub-Area included between Lat. 30° and 25° N.,—Long. 15° and 20° W. Prevailing wind N.N.E.—Frequent winds N.E. and N.N.W.—Occasional winds E.N.E. and S.S.W.—Calms, few. (*Canary Islands*). (74)

15. Area included between Lat. 30° and 20° N.,—Long. 20° and 30° W. Prevailing wind N.N.E.—Frequent winds E.N.E., N.E. and N.N.W.—Occasional winds W.N.W. and S.S.E.—Calms, few. (75)

16. Area included between Lat. 30° and 20° N.,—Long. 30° and 40° W. Prevailing wind E.N.E.—Frequent winds N.N.E., E.S.E., N.E. and E.—Occasional winds S.S.W., S.S.E. and N.N.W.—Calms, frequent. (76)

17. Area included between Lat. 30° and 20° N.,—Long. 40° and 50° W. Prevailing wind E.N.E.—Frequent winds E., E.S.E., N.N.E. and N.E.—Occasional winds S., S.S.W. and W.N.W.—Calms, very frequent. (77)

18. Area included between Lat. 30° and 20° N.,—Long. 50° and 60° W. Prevailing wind N.E.—Frequent winds E., S.E., E.N.E., and E.S.E.—Occasional winds S.W. and S.—Calms, few. (78)

19. Area included between Lat. 30° and 20° N.,—Long. 60° and 70° W. Prevailing wind N.E.—Frequent winds S.E. and E.—Occasional wind S.W. and S.—Calms, few. (79)

20. Area included between Lat. 30° and 20° N.,—Long. 70° and 80° W. Prevailing wind N.E.—Frequent winds E., S.E. and S.—Occasional winds S.W., W. and N.W.—Calms, frequent. (*Bahamas and N.E. Coast of Cuba*). (80)

21. Area included between Lat. 30° and 20° N.,—Long. 80° and 90° W. Prevailing wind E.—Frequent winds N.E., E.N.E., S.E., and E.S.E.—Occasional winds S., S.W. and N.W.—Calms, frequent. (*Western half of Cuba and eastern half of Gulf of Mexico*). (81)

22. Area included between Lat. 30° and 20° N.,—Long. 90° and 100° W. Prevailing wind S.E.—Frequent wind E.—Occasional winds N.E. and S. Calms, frequent. (*Western half of Gulf of Mexico*). (82)

18. Winds BETWEEN THE PARALLELS OF 20° AND 30° N. during *July*, *August* and *September*:—

14. Sub-Area included between Lat. 30° and 25° N.,—Long. 15° and 20° W. Prevailing wind N.N.E.—Frequent winds N.E. and E.N.E.—Occasional winds N.N.W. and S.S.E.—Calms, few. (*Canary Islands*). (74)

14. Sub-Area included between Lat. 25° and 20° N.,—Long. 15° and 20° W. Prevailing wind N.N.E.—Frequent wind S.S.E. and N. (74)

15. Area included between Lat. 30° and 20° N.,—Long. 20° and 30° W. Prevailing wind N.N.E.—Frequent winds N.E. and E.N.E.—Calms, few. (75)

16. Area included between Lat. 30° and 20° N.,—Long. 30° and 40° W. Prevailing wind E.N.E.—Frequent winds N.N.E., N.E., E. and E.S.E,—Occasional winds S.S.E., N.N.W. and S.S.W.—Calms, few. (76)

17. Area included between Lat. 30° and 20° N.,—Long. 40° and 50° W. Prevailing wind E.N.E.—Frequent winds E., E.S.E., N.E., S.E. and N.N.E.—Occasional wind S.S.W.—Calms, numerous. (77)

18. Area included between Lat. 30° and 20° N.,—Long. 50° and 60° W. Prevailing wind N.E.—Frequent winds E., E.N.E., S.E. and E.S.E.—Occasional wind S.S.W.—Calms, frequent. (78)

19. Area inclosed between Lat. 30° and 20° N.,—Long. 60° and 70° W. Prevailing winds S.E. and E.—Frequent winds N.E., E.N.E. and E.S.E. Occasional winds S., S.W. and W.—Calms, frequent. (79)

20. Area included between Lat. 30° and 20° N.,—Long. 70° and 80° W. Prevailing wind E.—Frequent winds S.W., S.E., N.E., E.N.E., E.S.E. and S.—Occasional winds N., W. and N.W.—Calms, very frequent. *(Bahamas and N.E. Coast of Cuba).* (80)

21. Area included between Lat. 30° and 20° N.,—Long. 80° and 90 W., Prevailing wind E.—Frequent winds S.E., N.E. and E.N.E.—Occasional winds S., S.W., W. and N.W.—Calms, very frequent. *(Western half of Cuba and eastern half of Gulf of Mexico).* (81)

22. Area included between Lat. 30° and 20° N.,—Long. 90° and 100° W. Prevailing wind S.E.—Frequent winds E., S., E.S.E., E.N.E. and N.E.—Calms, very frequent. *(Western half of Gulf of Mexico).* (82)

19. Winds BETWEEN THE PARALLELS OF 20° AND 30° N. during *October, November* and *December:*—

14. Sub-Area included between Lat. 30° and 25° N.,—Long. 15° and 20° W. Prevailing wind N.N.E.—Occasional winds E.S.E. and S.—Calms, few. *(Canary Islands).* (74)

14. Sub-Area included between Lat. 25° and 20° N.,—Long. 15° and 20° W. Prevailing wind E.N.E.—Frequent winds N., N.N.W., N.N.E. and E.S.E. (74)

15. Area included between Lat. 30° and 20° N.,—Long. 20° and 30° W. Prevailing wind N.N.E.—Frequent winds E.N.E., N.E. and E.S.E.—Occasional winds S.S.E., S.S.W., W.N.W. and N.N.W.—Calms, frequent. (75)

16, Area included between Lat. 30° and 20° N.,—Long. 30° and 40° W. Prevailing wind E.N.E.—Frequent winds E.S.E., E., N.E., N.N.E. and S.S.E.—Occasional winds S.S.W. and W.N.W.—Calms, few. (76)

17. Area included between Lat. 30° and 20° N.,—Long. 40° and 50° W.

Prevailing winds E.N.E. and E.—Frequent winds E.S.E., N.N.E., N.E. and S.E.—Occasional winds S.S.W. and W.N.W.—Calms, few. (77)

18. Area included between Lat. 30° and 20° N.,—Long. 50° and 60° W. Prevailing wind N.E.—Frequent winds E., S.E., E.N.E. and E.S.E.—Occasional winds S., S.W. and W.—Calms, few. (78)

19. Area included between Lat. 30° and 20° N., Long. 60° and 70° W. Prevailing wind N.E.—Frequent winds S.E., E., E.S.E., N.N.E. and E.N.E.—Occasional winds S.W. and N.W.—Calms, few. (79)

20. Area included between Lat. 30° and 20° N.,—Long. 70° and 80° W. Prevailing wind N.E.—Frequent winds E., E.N.E., N., N.N.E. and S.E. —Occasional winds S.W. and N.W.—Calms, few.—(*Bahamas and N.E. Coast of Cuba*). (80)

21. Area included between Lat. 30° and 20° N.,—Long. 80° and 90° W. Prevailing wind N.E.—Frequent winds E., N., N.N.E., and S.E.—Occasional winds N.W. and W.—Calms, few. (*Western half of Cuba and eastern half of Gulf of Mexico*). (81)

22. Area included between Lat. 30° and 20° N.,—Long. 90° and 100° W. Prevailing wind S.E.—Frequent winds N.N.W., N.E., N., S. and N.W.—Calms, very frequent. (*Western half of Gulf of Mexico*). (82)

CHAPTER V.

REGION OF THE COUNTER-TRADES OR S.W. PASSAGE WINDS IN THE NORTH ATLANTIC.

1. Beyond the Tropics and to the north of the Calm Belt of Cancer lies the Region of the S.W. Passage winds—the theatre of an incessant conflict between the polar and equatorial currents of air—in which, although westerly winds predominate, yet they have not the persistency of the easterly breezes of the tropical seas; being not only uncertain in occurrence and duration, but very variable in direction—often passing abruptly from one point of the horizon to another,—sometimes in heavy gales, and sometimes in baffling light airs.

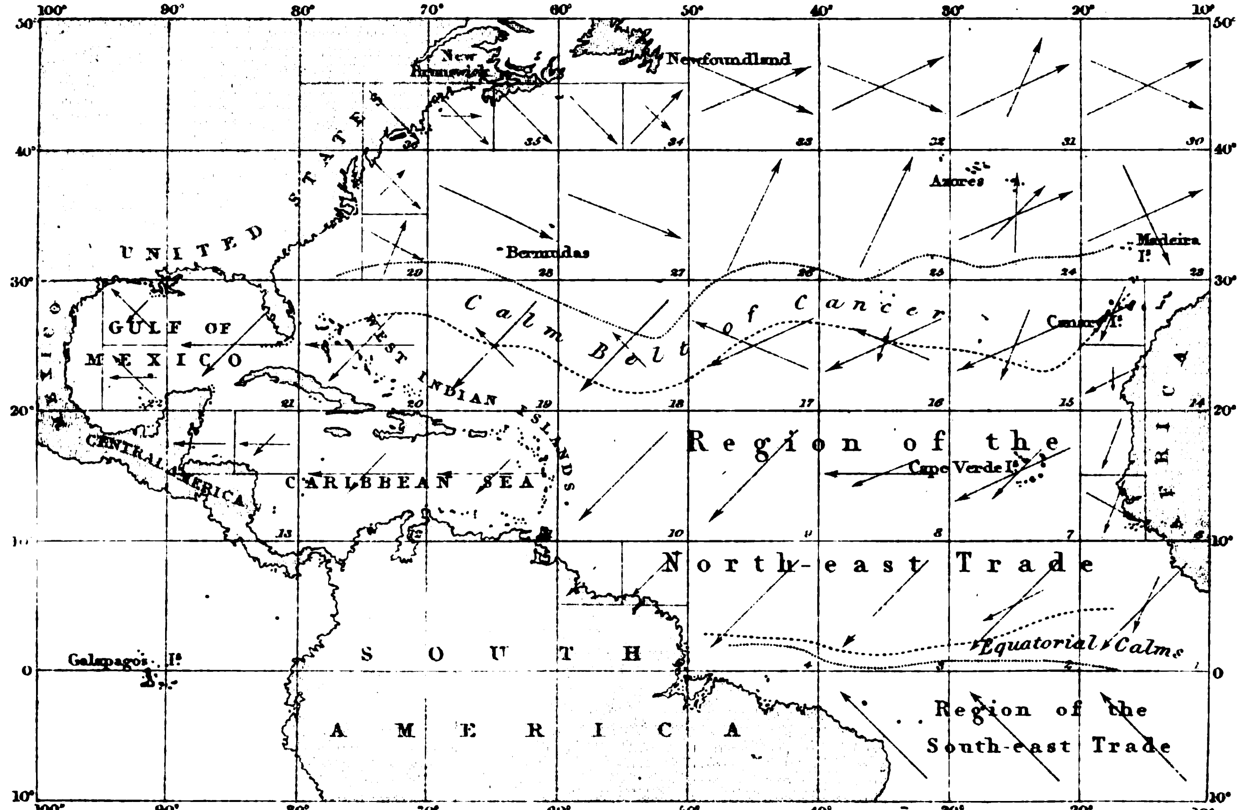
In the North Atlantic, westerly winds prevail in the ratio of 2 to 1 over easterly; and their mean direction is, on the average, from the southward of west—being generally from some point between W.S.W. and S.S.W.; except during that period when the sun has high southern declination, when W.N.W. and N.W. winds are not unfrequent, and which is especially the season for gales and bad weather.

2. The **Mean Direction and Duration** of the winds between Lat. 35° and 55° N., deduced from Tab. I. (p. 86) appear to be as follows:—S. 47° W. for 128

CHART DIAGRAM OF WINDS IN THE NORTH ATLANTIC

I

January, February, & March. [Winter]



To face p. 57

days; N. 51° W. for 65 days; S. 40° E. for 69 days, and N. 44° E. for 59 days; and the average number of CALMS, 14 days.

The distribution of the winds in each square of 10 degrees of latitude and longitude, from Lat. 30° to 50° N., is given in the succeeding pages, completing the general view of the North Atlantic respecting the winds *at sea*.

8. **Winds** BETWEEN THE PARALLELS OF 30° and 50° N. during *January*, *February* and *March*.—(Winter.)

23. Area included between Lat. 40° and 30° N.,—Long. 10° and 20° W. Prevailing winds between N.N.W. and W.S.W.—Frequent winds N.N.E., E.N,E., S.S.W., S.W., N.E. and N.—Occasional winds S.S.E. and E.S.E. —Calms, few. (*Madeira*). (110)

24. Area included between Lat. 40° and 30° N.,—Long. 20° and 30° W. Prevailing wind W.S.W.—Frequent winds S., S.W., S.S.E., E.N.E., N.N.E., N.N.W., S.S.W., and N.E.—Occasional winds from all the other points.—Calms, very frequent. (*Western Islands*). (111)

25. Area included between Lat. 40° and 30° N.,—Long. 30° and 40° W. Prevailing wind S.S.W.—Frequent winds S.S.E., S., E.S.E., S.E. and S.W.—Occasional winds W.N.W. and N.N.E.—Calms, few. (*Flores and Corvo*). (112)

26. Area included between Lat. 40° and 30° N.,—Long. 40° and 50° W. Prevailing wind S.S.W.—Frequent winds W.N.W., W.S.W., S., S.S.E. and S.W.,—Occasional winds N.N.E., E.N.E., and N.N.W.—Calms, few. (113)

27. Area included between Lat. 40° and 30° N.,—Long. 50° and 60° W. Prevailing wind W.N.W.—Frequent winds N.W., W.S.W., W., S.S.W., N.N.W. and S.W.—Occasional winds N.N.E. and E.N.E.—Calms, few. (114)

28. Area included between Lat. 40° and 30° N.,—Long. 60° and 70° W. Prevailing wind W.N.W.—Frequent winds W., N.W., W.S.W., S.W., S.S.W. and N.—Occasional winds N.E. and E.S.E.—Calms, few. (*Bermuda Islands*). (115)

29. Sub-Area included between Lat. 40° and 35° N.,—Long. 70° and 75° W. Prevailing wind N.W.—Frequent winds S.W., N.N.W., and W.—Occasional winds E., S. and N.E.—Calms, few. (*Coast of United States from New York to Cape Hatteras*). (116)

29. Sub-Area included between Lat. 35° and 30° N.,—Long. 70° and 75° W. Prevailing winds W.N.W., and S.S.W.—Frequent winds N.N.W. and W.S.W.—Occasional winds between N.N.E. and S.S.E.—Calms, few. (116)

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30. Area included between Lat. 50° and 40° N.,—Long. 10° and 20° W. Prevailing winds between W.S.W. and W.N.W.—Frequent winds S.W., N.W., S.S.W., N.E. S. and N.N.W.—Occasional winds S.E. and E.—Calms, few. (146)

31. Area included between Lat. 50° and 40° N.,—Long. 20° and 30° W. Prevailing winds between W.S.W. and S.S.W.—Frequent winds W.N.W., W., N.N.W. and S.—Occasional winds N.N.E., E.N.E. and S.E.—Calms, few. (147)

32. Area included between Lat. 50° and 40° N.,—Long. 30° and 40° W. Prevailing winds between W.S.W. and W.N.W.— Frequent winds S.S.W., S.W. and N.W.—Occasional winds S.S.E., N.N.E. and E.—Calms, few. (148)

33. Area included between Lat. 50° and 40° N.,—Long. 40° and 50° W. Prevailing winds between W.N.W. and W.S.W.—Frequent winds S.S.W., N.W. and N.N.W.—Occasional winds S.S.E., E.N.E., N.N.E. and E.S.E.—Calms, few. (149)

34. Sub-Area included between Lat. 45° and 40° N.,—Long. 50° and 55° W. Prevailing wind S.W.—Frequent winds N.W., S., and W.—Occasional winds N.E. and S.E.—Calms, few. (*S.E. Coast of Newfoundland*). (150)

34. Sub-Area included between Lat. 45° and 40° N.,—Long. 55° and 60° W. Prevailing winds between N.W. and W.—Frequent winds N.E., S.W., S.E., S. and N.,—Calms frequent. (*South Coast of Newfoundland*). (150)

35. Sub-Area included between Lat. 45° and 40° N.,—Long.60° and 65° W. Prevailing winds between N.W. and W.—Frequent winds S.W., N. and N.N.E.—Occasional winds E. and S. Calms, few. (*S.E. Coast of Nova Scotia*). (151).

35. Sub-Area included between Lat. 45° and 40° N.,—Long. 65° and 70° W. Prevailing winds between N.W. and W.—Frequent winds N., N.N.W. and S.W.—Occasional winds E., S., N.E. and S.E.—Calms, few. (*S. Coast of Nova Scotia and the Bay of Fundy*). (151)

36. Sub-Area included between Lat. 45° and 40° N.,—Long. 70° and 75° W. Prevailing wind N.W.—Frequent winds S.W., W., S. and W.N.W.—Occasional winds E. and S.—Calms, few. (*Coast of United States from Maine to New York*). (152)

4. Winds between the Parallels of 30° and 50° N. during *April*, *May* and *June* (Spring).

23. Sub-Area included between Lat. 45° and 40° N..—Long. 10° and 20° W. Prevailing wind N.N.E.—Frequent winds N.N.W., N., N.W., W.N.W., N.E., W.S.W. and W.—Occasional winds S.S.E. and E.S.E.—Calms, few. (*Madeira*). (110)

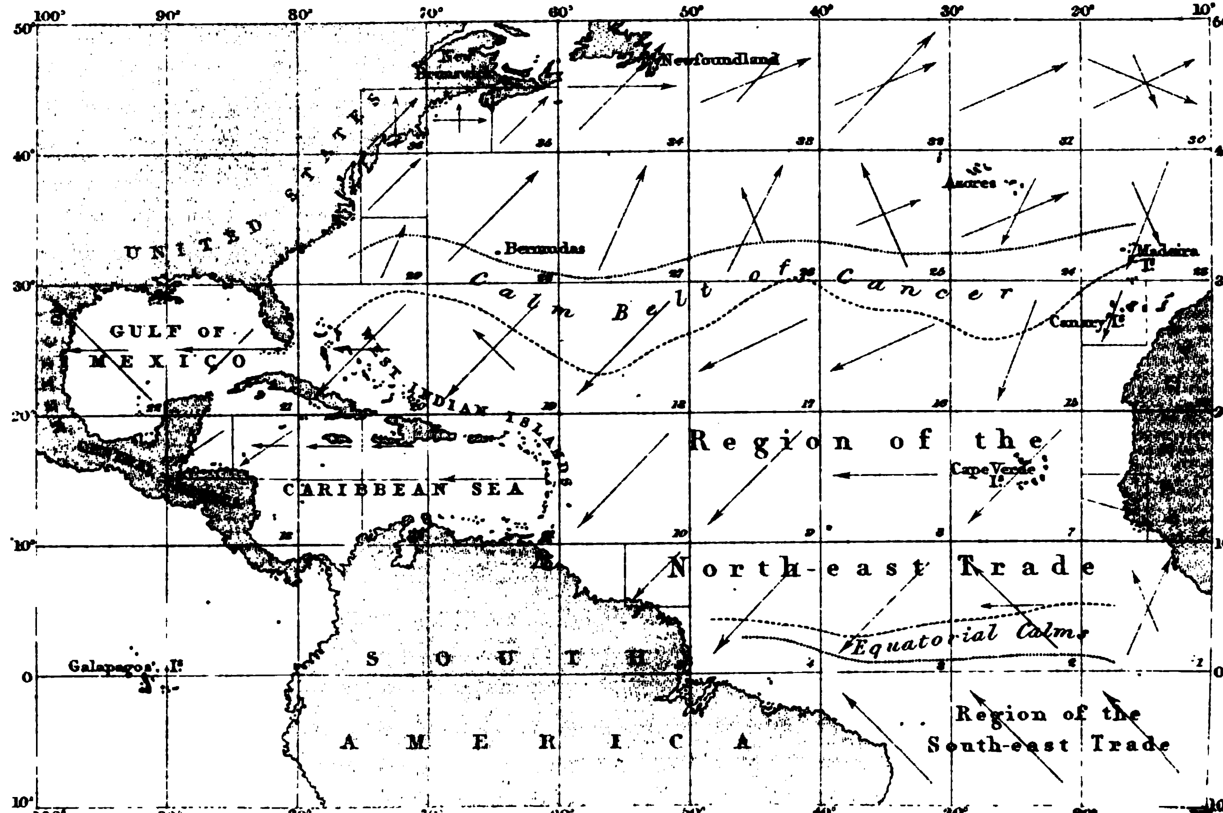
24. Area included between Lat. 40° and 30° N., Long. 20° and 30° W. Prevailing wind W.S.W.—Frequent winds N.N.E., S.S.W., N.N.W., W.N.W. and E.N.E.—Occasional winds from all the other points.—Calms, frequent. (*Western Islands*). (111)

25. Area included between Lat. 40° and 30° N.,—Long. 30° and 40° W. Prevailing wind S.S.E.—Frequent winds W.S.W., S.S.W., E.N.E., S.W.

CHART DIAGRAM OF WINDS IN THE NORTH ATLANTIC

II

April, May, & June. [Spring]



and S.—Occasional winds from all the other points.—Calms, frequent, *(Flores and Corvo).* (112)

26. Area included between Lat. 40° and 30° N.,—Long. 40° and 50° W. Prevailing wind S.S.W.—Frequent winds between S.S.E. and W.S.W.—Occasional winds E.N.E., N.N.W., N.N.E. and W.N.W.—Calms, frequent. (113)

27. Area included between Lat. 40° and 30° N.—Long. 50° and 60° W. Prevailing wind S.S.W.—Frequent winds S.W., W.S.W., S., W., W.N,W. and S.S.E.—Occasional winds between N. and E.—Calms, few. (114)

28. Area included between Lat. 40° and 30° N.,—Long. 60° and 70° W. Prevailing wind S.W.—Frequent winds between N.W. and S.S.E., as well as between E.S.E. and N.N.W.—Calms, few. *(Bermuda Islands).* (115)

29. Sub-Area included between Lat. 40° and 35° N.,—Long. 70° and 75° W. Prevailing wind S.W.—Frequent winds between W. and S., as well as between E. and N.—Occasional winds N.W. and S.E.—Calms, few. *(Coast of United States from New York to Cape Hatteras).* (116)

29. Sub-Area included between Lat. 35° and 30° N.,—Long. 70° and 75° W, Prevailing wind S.S.W.—Frequent winds S.S.E., N.N.E., W.S.W., S., W.N.W. and N.N.W.—Occasional winds between E.S.E. and E.N.E.—Calms, frequent. (116)

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30. Area included between Lat. 50° and 40° N.,—Long. 10° and 20° W. Prevailing winds W.S.W. and W.N.W.—Frequent winds N.N.W., S.S.W., N.W., W., S.W. and N.—Occasional winds N.N.E. and E.N.E.—Calms, frequent. (146)

31. Area included between Lat. 50° and 40° N.,—Long. 20° and 30° W. Prevailing wind W.S.W.—Frequent winds W., S.W., S.S.W., W.N.W., N.N.W., N.W., S., S.S.W., N. and N.N.E.—Occasional winds between E.S.E. and E.N.E.—Calms, frequent. (147)

32. Area included between Lat. 50° and 40° N.,—Long. 30° and 40° W. Prevailing winds S.W. and W.S.W.—Frequent winds between W.N.W. and S.—Occasional winds N.N.W., and between N.N.E. and E.N.E. —Calms, few. (148)

33. Area included between Lat. 50° and 40° N.,—Long. 40° and 50° W. Prevailing winds W.S.W. and S.W.—Frequent winds between W.N.W. and S.S.E.—Occasional winds between N.N.W. and E.N.E.—Calms, few. (149)

34. Area included between Lat. 50° and 40° N.,—Long. 50° and 60° W. Prevailing wind S.W.—Frequent winds W., S., W.S.W., W.N.W., and S.S.W.,—Occasional winds between N. and E.—Calms, few. *(S. Coast of Newfoundland.* (150)

35. Sub-Area included between Lat. 45° and 40° N.,—Long. 60° and 65° W.—Prevailing wind S.W.—Frequent winds W.S.W., W. and N.—Occasional winds S., N.E. and E.—Calms few. *(S.E. Coast of Nova Scotia).* (151)

85. Sub-Area included between Lat. 45° and 40° N.,—Long. 65° and 70° W.—Prevailing wind W.—Frequent winds W.S.W., S., E., S.W., S.S.W., S.E., and S.S.E.—Occasional winds N.N.W., N., and N.E.—Calms, few. (*S. Coast of Nova Scotia, and the Bay of Fundy*). (151)

86. Sub-Area included between Lat. 45° and 40° N.,—Long. 70° and 75° W. Prevailing winds S.W. and S.—Frequent winds N.E. to N.W.,—Occasional winds E. and S.E.—Calms, few. (*Coast of United States from Maine to New York.*) (152)

5. **Winds** BETWEEN THE PARALLELS OF 30° and 50° N. during *July*, *August* and *September* (Summer).

23. Area included between Lat. 40° and 30° N.,—Long. 10° and 20° W. Prevailing wind N.N.E.—Frequent winds N., N.E., E.N.E. and N.N.W. Occasional winds between W.N.W. and S.W.—Calms, few. (*Madeira*) (110)

24. Area included between Lat. 40° and 30° N.,—Long. 20° and 30° W. Prevailing winds N.N.E. and W.S.W.—Frequent winds S.S.W., S.W., N.N.W., E.N.E., S.S.E. and W.N.W.—Calms, very frequent. (*Western Islands*). (111)

25. Area included between Lat. 40° and 30° N.,—Long. 30° and 40° W. Prevailing wind S.S.W.—Frequent winds W.S.W., S.S.E., S., E.N.E. and N.N.E.—Calms, few. (*Flores and Corvo*). (112)

26. Area included between Lat. 40° and 30° N.,—Long. 40° and 50° W. Prevailing wind S.S.W.—Frequent winds W.S.W. and S.S.E.—Occasional winds E.S.E., E.N.E., W.N.W., N.N.W. and N.N.E.—Calms, few. (113)

27. Area included between Lat. 40° and 30° N.,—Long. 50° and 60° W. Prevailing winds S.S.W. and S.W.,—Frequent winds W.S.W., S., W. and E.S.E.—Occasional winds N.N.E., E.N.E., and N.W.—Calms, frequent. (114)

28. Area included between Lat. 40° and 30° N.,—Long. 60° and 70° W. Prevailing wind S.W.—Frequent winds W.S.W., S.S.W., W. and N.E.—Occasional winds from all the other points.—Calms, frequent. (*Bermuda Islands*). (115)

29. Sub-Area included between Lat. 40° and 35° N.,—Long. 70° and 75° W. Prevailing wind S.W.—Frequent winds N.E., S., N., W., S.E. and E. Occasional wind N.W.—Calms, frequent. (*Coast of United States from New York to Cape Hatteras*). (116)

29. Sub-Area included between Lat. 35° and 30° N.,—Long. 70° and 75° W. Prevailing wind S.S.W.—Frequent winds between E.S.E. and W.S.W.—Occasional winds between N.N.E. and N.N.W.—Calms, frequent. (116)

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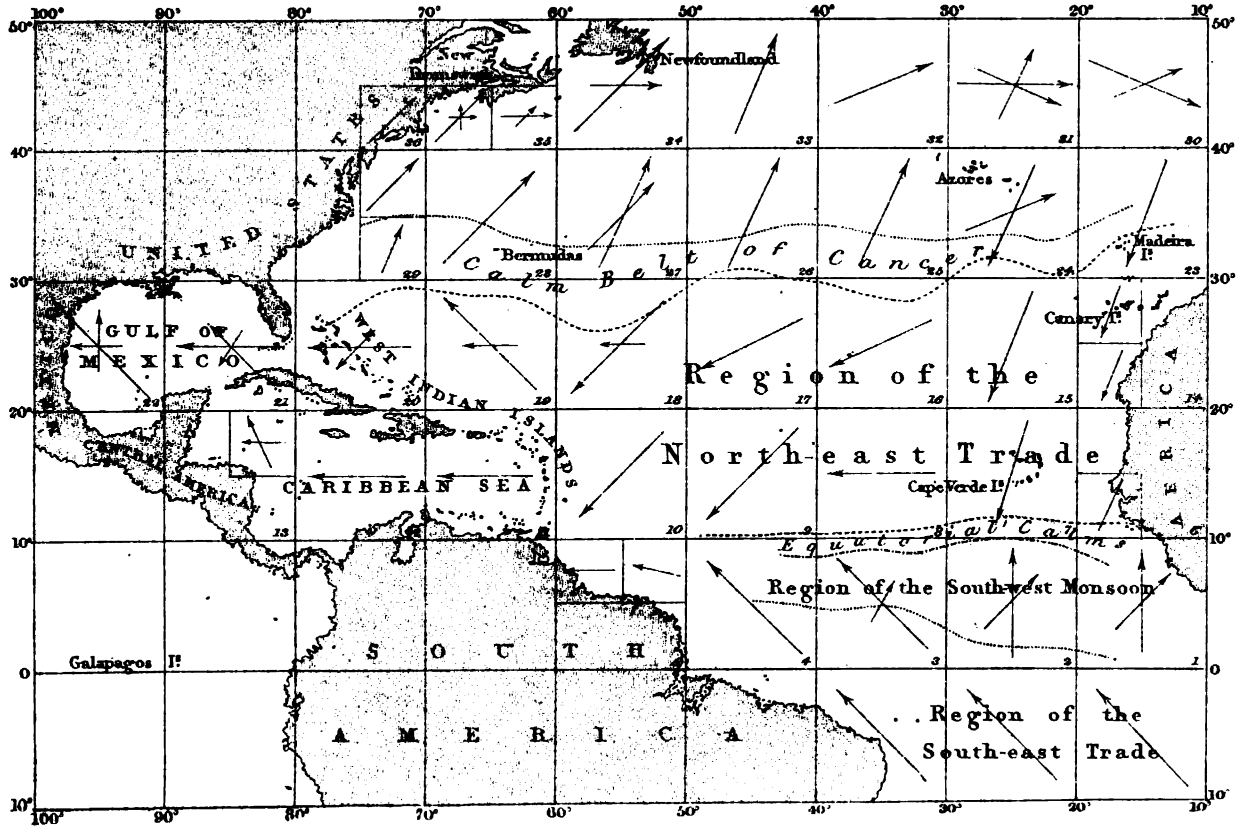
30. Area included between Lat. 50° and 40° N.,—Long. 10° and 20° W. Prevailing wind W.N.W.—Frequent winds W.S.W., W., N.N.W. and

CHART DIAGRAM OF WINDS IN THE NORTH ATLANTIC

III

July, August, & September. [Summer]



S.S.W.—Occasional winds E.N.E., N.N.E. and S.S.E.—Calms, few. (146)

31. Area included between Lat. 50° and 40° N.,—Long. 20° and 30° W. Prevailing wind W.—Frequent winds W.N.W., W.S.W., S.S.W. and S.S.E.—Occasional winds E.N.E., N.N.E. and E.—Calms very frequent. (147)

32. Area included between Lat. 50° and 40° N.,—Long. 30° and 40° W. Prevailing wind W.S.W.—Frequent winds S.S.W., S.S.E., S.W., W.N.W., W. and N.N.W.—Occasional winds between E.N.E. and E.S.E.—Calms, frequent. (148)

33. Area included between Lat. 50° and 40° N.,—Long. 40° and 50° W. Prevailing wind S.S.W.—Frequent winds W.S.W., S.S.E., S., E.S.E., W. and W.N.W.—Occasional winds between E.N.E. and N.N.E.—Calms, frequent. (149)

34. Area included betwean Lat. 50° and 40° N.,—Long. 50° and 60° W. Prevailing winds between S.W. and W.—Frequent winds, S., S.S.W. and N.W.—Occasional winds S.E., N., N.E. and E.—Calms, frequent. (*S. Coast of Newfoundland*). (150)

35. Sub-Area included between Lat. 45° and 40° N.,—Long. 60° and 65° W. Prevailing wind W.—Frequent winds S.W., W.S.W., S., S.S.W. and N.W.—Occasional winds between S.E. and N.E.—Calms, frequent. (*S.E. Coast of Nova Scotia*). (151)

35. Sub-Area included between Lat. 45° and 40° N.,—Long. 65° and 70° W. Prevailing wind S.W.—Frequent winds S., W., W.S.W. and S.S.W.—Occasional winds N.W., E., N. and N.E.—Calms, frequent. (*S. Coast of Nova Scotia and Bay of Fundy*). (151)

36. Sub-Area included between Lat. 45° and 40° N.,—Long. 70° and 75° W. Prevailing wind S.W.—Frequent winds between W. and S.—Occasional winds between E. and N.—Calms, few. (*Coast of United States from Maine to New York*). (152)

6. **Winds** BETWEEN THE PARALLELS OF 30° AND 50° N. during *October*, *November*, and *December* (Autumn).

23. Area included between Lat. 40° and 30° N.,—Long. 10° and 20° W. Prevailing wind W.N.W.—Frequent winds W.S.W., S.S.W., N.N.E., N.W., E.N.E.. S.S.E. and N.N.W.—Calms, very frequent. (*Madeira*). (110)

24. Area included between Lat. 40° and 30° N.,—Long. 20° and 30° W. Prevailing wind S.—Frequent winds N.N.E., E.N.E., N.N.W., S.W., and W.N.W.—Calms, very frequent. (*Western Islands*). (111)

25. Area included between Lat. 40° and 30° N.,—Long. 30° and 40° W. Prevailing wind S.S.E.—Frequent winds S., S.S.W., E.S.E., S.E., E.N.E. and W.S.W.—Occasional winds W.N.W., N.N.E. and N.N.W.—Calms, few. (*Flores and Corvo*). (112)

26. Area included between Lat. 40° and 30° N.,—Long. 40° and 50° W. Prevailing wind S.S.E.—Frequent winds E.S.E., W.S.W., S.S.W., S.E., S. and E.N.E.—Occasional winds W.N.W., N.N.W. and N.N.E.—Calms, few. (113)

27. Area included between Lat. 40° and 30° N.,—Long. 50° and 60° W. Prevailing winds between W.N.W. and S.S.E.—Frequent winds between N.N.W. and E.S.E.—Calms, few. (114)

28. Area included between Lat. 40° and 30° N.,—Long. 60° and 70° W. Prevailing winds N.W. and W.N.W.—Frequent winds W., W.S.W., N., S.W., S.S.W., and N.N.W.—Occasional winds between N.E. and S.S.E. Calms, few. (*Bermuda Islands*). (115)

29. Sub-Area included between Lat. 40° and 35° N.,—Long. 70° and 75° W. Prevailing wind N.W.—Frequent winds W., N.E., N., W.N.W. and S.W.—Occasional winds E. and S.—Calms, few. (*Coast of United States from New York to Cape Hatteras*). (116)

29. Sub-Area included between Lat. 35° and 30° N.,—Long. 70° and 75° W. Prevailing wind N.N.W.—Frequent winds N.N.E., N.W., W.N.W., W.S.W. and S.S.W.—Occasional winds E.N.E. and E.S.E.—Calms, few. (116)

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30. Area included between Lat. 50° and 40° N.,—Long. 10° and 20° W. Prevailing wind W.N.W.—Frequent winds W., N.W., W.S.W., N.N.W., S.W. and S.S.W.—Occasional winds S.E., N.N.E., E.S.E. and E.N.E. Calms, few. (146)

31. Area included between Lat. 50° and 40° N.,—Long. 20° and 30° W. Prevailing wind W.—Frequent winds W.S.W., W.N.W., S.S.W. and N.N.W.—Occasional winds E., N.N.E. and S.S.E.—Calms, few. (147)

32. Area included between Lat. 50° and 40° N.,—Long. 30° and 40° W. Prevailing wind W.N.W.—Frequent winds W., W.S.W., S.S.W., N.W., S., and N.N.W.—Occasional winds N.N.E., S.E. and E.—Calms, few. (148)

33. Area included between Lat. 50° and 40° N.,—Long. 40° and 50° W Prevailing wind W.N.W.—Frequent winds N.W., W.S.W., S.S.W., W., N.N.W., S.W., S. and N.—Occasional winds S.S.E., N.N.E. and E.—Calms, few. (149)

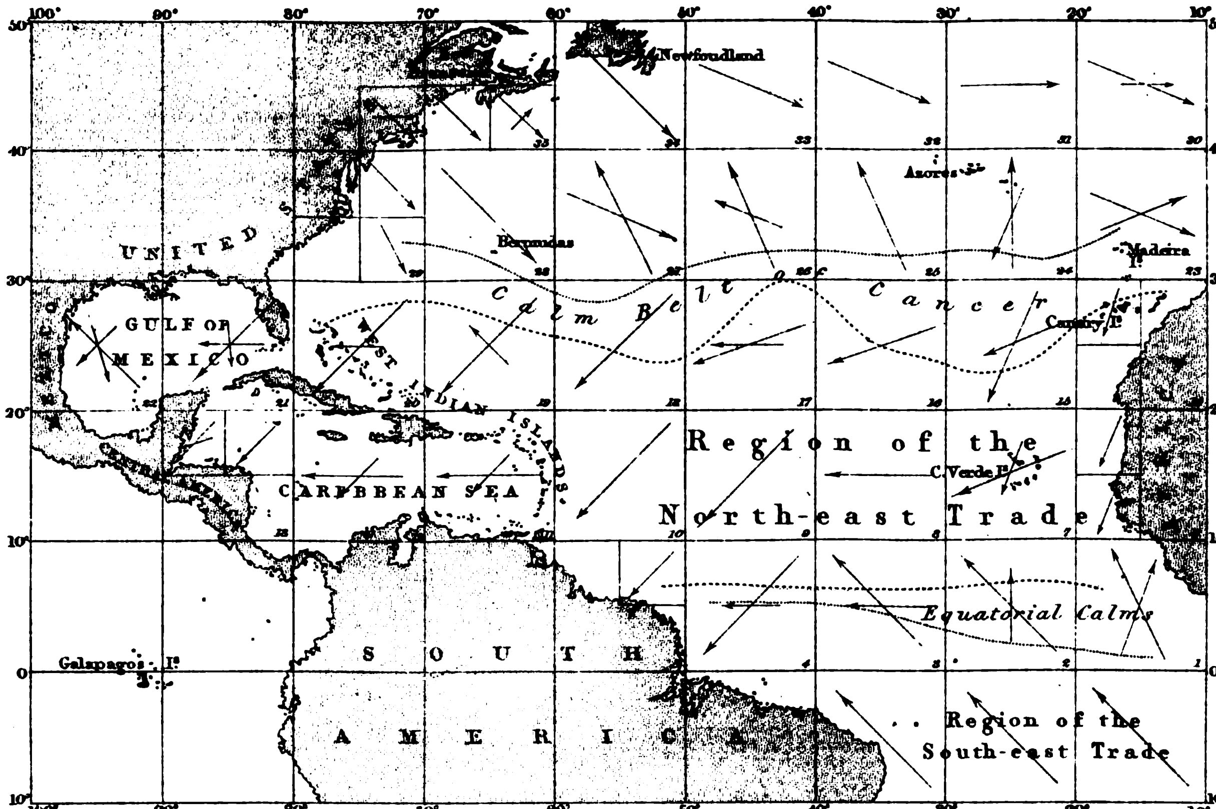
34. Area included between Lat. 50° and 40° N.,—Long 50° and 60° W. Prevailing wind N.W.—Frequent winds W., N.N.W., S.W., W.N.W., W.S.W., N. and S.—Occasional winds S.E., N.E. and E.—Calms, occasional. (*S. Coast of Newfoundland*). (150)

35. Sub-Area included between Lat. 45° and 40° N.,—Long. 60° and 67° W. Prevailing winds between N.W. and S.W.—Frequent winds N.N.W., N. and S.—Occasional winds between N.E. and S.E.—Calms, occasional. (*S.E. Coast of Nova Scotia*). (151)

CHART DIAGRAM OF WINDS IN THE NORTH ATLANTIC

IV

October, November, & December. [Autumn]



85. Sub-Area included between Lat. 45° and 40° N.,—Long. 65° and 70° W. Prevailing winds W.N.W., N.W., S. and W.—Frequent winds S.W., N.N.W. and N.—Occasional winds between S.E. and N.E.—Calms, occasional. (*S. Coast of Nova Scotia and the Bay of Fundy.* (151)

86. Sub-Area included between Lat. 45° and 40° N.,—Long. 70° and 75° W. Prevailing winds between W. and N.W.—Frequent winds W.S.W. and N. —Occasional winds E., S., N.E., and S.E.—Calms, few. (*Coast of United States from Maine to New York*). (152)

7. A glance at the Chart-Diagrams will at once show the general prevalence of south-westerly over north-westerly winds, *at sea*, in the temperate zone of the North Atlantic; but that the latter are very frequent during the autumn and winter months is a well known fact. KAEMTZ has also shown that this predominance of S.W. winds extends to the continents, for, from numerous observations, he infers that the mean direction of the wind in England is S. 66° W.; in France S. 88° W.; in Germany S. 76° W.; in Denmark S. 62° W.; in Sweden S. 50° W.; in Russia N. 87° W.; and in N. America S. 86° W. But the relation of north to south winds is by no means constant; it varies with the season and the locality. FRANKLIN long ago observed that on the eastern coast of America the winds during summer are from the south; and during winter from the north. Easterly winds probably attain a maximum in Europe during the spring.

CHAPTER VI.

NORTH ATLANTIC ISLANDS.

1. **Anno-Bon.—St. Thomas.—Princes Island, and Fernando Po**:—These islands, equally remarkable for their elevation and fertility, and for the similarity of their geological structure—being volcanic—are situated in a direct line with the Camaroon Mountains, with which they were probably at one time connected.

At ANNO-BON, which is the most distant from the African coast, there are two rainy seasons; the first occurs in April and May,—the other in October and November. The winds in the vicinity of the island are generally moderate, varying from South to S.E., and the climate is on the whole drier and more healthy than that of the other islands.

At ST. THOMAS and PRINCES islands, the climate approximates to that of the Gaboon and Corisco Bay, opposite to which they are situated; it is hot and moist, but the sea-breezes moderate the heat to a greater extent than along the coast of the continent. It can scarcely be said that there are more than two seasons;—that of the rains extends from November to March,—that of the tornadoes from

March to October; the former is the period of calms and light airs, though storms occur at times; the latter is the finest part of the year, but rainy days not unfrequently alternate with fine; July and August are generally the two driest months, and the winds are fresh from the S.W. The land and sea-breezes are tolerably regular though they do not extend far seaward, and they cease for a time during the rainy season.

At FERNANDO PO, which is close to the main land, the climate is very unhealthy, and much the same as that usually experienced at the head of the Bight of Biafra. Alternate land and sea-breezes are prevalent, more or less, throughout the year, for though they become irregular they do not wholly cease in the rainy season. The harmattan blowing irregularly and with no great force from December to February (both inclusive), comes after the rainy season, and dissipates the miasma engendered by an excessively moist atmosphere; this is the finest and healthiest part of the year, for when the harmattan ceases, the heat is tempered by breezes from S.S.W. to S.W.

2. The Cape Verde Islands:—The Cape Verde islands, though situated within the region of the N.E. Trades, cannot be said to enjoy those winds as a permanency; they may, however, be generally expected to prevail from November to May—varying between N.E. and N.N.W.; in June they blow more from the eastward, and are very light; the rains then commence—and continue from July to October, when tornadoes may be expected. During the rainy season (or winter) the winds blow from the South to S.W.—sometimes from S.E.—with variable strength, but often very strong, bringing squally bad weather and even fogs, so that vessels should not visit the bays of the islands exposed to those winds; westerly winds at this season do not last long; it is also at this season that calms are frequent in the channels between, as well as in the vicinity of the islands.

The climate is damp from December to July; but the unhealthy season comes with the rains. The islands suffer at times from drought, for though rain falls at the proper season—unlike the neighbouring coast of Senegal—it is deficient in quantity in some years.

At ST. VINCENT, used as a coaling station, the wind is generally from the N.E., except from July to October—the rainy season—when it frequently blows from S.E.

Porto Praya, though usually healthy, should be avoided in the rainy (and unhealthy) season, when the winds from S.E. to S.W. send a heavy sea into the bay.

3. The Canaries:—Among the Canaries, situated near the polar limit of the N.E. Trade, the prevailing wind throughout the year is from N.N.E.,—occasionally changing to North and N.N.W. From the middle of November to the middle of January, the regularity of the Trade is occasionally interrupted by very squally weather, with the wind from S.E. to S.W.—producing a high sea; this is also the season of rain and fog, and the only safe harbour during the two months is the bay of Palmas, in the Grand Canary, because a ship can get under weigh there with any wind.

In the vicinity of the islands the usual land and sea breezes, with the intervening calm, are felt,—the former seldom extending far seaward. The channels between the islands are safe, but caution is requisite in approaching the lofty and mountainous land—where the eddy winds are very strong at times; also, while it is blowing fresh on one side of an island, it may be perfectly calm for many leagues to leeward of the same island, or at most there may be no more than a gentle breeze—perhaps in the opposite direction.

The climate is fine and healthy; the temperature on the coast being rarely above 77°; the loftiest peaks are covered with snow during eight months of the year.

During the time (1856-7) that Professor C. Piazzi Smyth, F.R.S. was making a series of astronomical observations near the summit of the Peak of Teneriffe, M. Franz Kreitz undertook to carry on a series of meteorological observations at Orotava, on the N.W. side of the island—the station being 70 feet above the mean level of the sea; from these observations the following information is derived:—

Table—*Showing the No. of days on which each wind blew.*

Months.	N.	N.E.	E.	S.E.	S.	S.W	W.	N.W.	Land Breeze	Rain.
January	4	8	3	5	9	1		1	27	7
February	6	4	5	2	4	1		6	23	14
March	10	6	9	2	4				25	8
April	13	13	3	1					28	1
May	12	11	3		1			4	28	3
June	9	11	10						25	1
July	6	21	1		1			2	14	1
August	9	17	3	1	1				25	2
September	7	9	8	1	2	2	1		22	3
October	8	13	4	1	2	2	1		14	1
November	4	11	6	1	6		1	1	21	6
December	6	6	5	2	12				29	2

From which it appears that winds between North and East were experienced during 284 days; but the island runs N.N.E. and S.S.W., and the N.W. side is greatly sheltered by the central ridge of lofty mountains.

Foggy and hazy weather were most prevalent during November and December. Squalls with rain and a high sea occurred at the latter end of November, and again during January and February. Thunder and lightning were experienced in October and November,—at the end of the latter month, thunder storms with hail and heavy rain during three successive days.

4. **Madeira.**—The Trade-wind, from the N.N.E. is fully established at Madeira from the middle of April until the end of September, and during this

period a gale is of rare occurrence. The periodical rains, lasting fifteen days, fall in October; they commence with a strong S.E. breeze, which veers by the South to S.W., terminating at N.W., when the weather clears up. St. Martin's summer succeeds to these, and extends usually over the same period of time, accompanied by N.E. winds; but this summer is sometimes delayed to December.

During November and December the regular Trade has disappeared, and strong winds from S.E. to S.W. may be expected, but they generally attain their maximum strength in January and February, veering to West and N.W., the latter being the prevalent wind during March. North-easterly winds, however, are not uncommon from November till February.

During August and part of September, a kind of *harmattan*, known as the *Estes*, as it blows from the East, is not unfrequent, lasting sometimes for six or seven consecutive days; the weather is then hot and close, the air excessively dry, and the sky cloudless.

April, though not generally, is nevertheless occasionally a windy month. In May, June, and July, the nights are clear and fine, though the days are cloudy. Regular land and sea breezes prevail during these months with an interval of calm of about 4 to 5 hours duration.

During the winter season the indications of bad weather require attention. A swell from the S.W. in the roadstead of Funchal—with gloomy weather, drizzling rain, and an unsteady land-breeze—may generally be regarded as the precursor of a southerly gale, during which the squalls are very violent; the roadstead being then unsafe, ships should put to sea, for the best ground tackle is not always available against the force of these gales, which rarely, however, last long. Madeira, and Desertas, are not unfrequently enveloped in fog during these periods.

Vessels approaching too closely the high land on the western side of Madeira may expect to find a calm during the summer months.

On the whole, the climate of Madeira is esteemed as one of the finest in the world,—the mean temperature of the year being 67°·3 Fahr., from which there is not much deviation in any month. Snow falls on the mountains during March.

See also;—Winds in *area* 28 (p. 57—58; 60 and 61).

5. **The Azores, or Western Islands**:—These islands are situated in a part of the ocean where sudden and violent squalls as well as gales are common, and which, during the winter, are very heavy, and last for several days in succession. During the summer half-year the prevailing winds are from the N.E.-ward; and fine weather may be expected from May to September, when calms and light airs are of frequent occurrence. During the winter half-year the characteristic winds are from N.W. to S.W.—generally strong—and the latter accompanied by rain; heavy squalls from South to S.E. are also experienced at that period.

The results of ten years observations (1840-1849) made by Mr. Hunt, the

British Consul at St. Michael's, show that the mean duration in days of the winds from each quarter is as follows;—

Summer half-year:—North 7·29; N.E. 69·04; East 6·51; S.E. 20·98; South 2·72; S.W. 23·2; West 10·28; N.W. 39·52; Calms 3·51 days; Surf on the shore 6·65 days.

Winter half-year:—North 11·07; N.E. 46; East 5·19; S.E. 23·17; South 11·18; S.W. 38·46; West 8·17; N.W. 37·11; Calms 1·7 days; Surf on the shore 38·85 days.

"The regularity with which gales enter these seas in the N.W. quarter, and after crossing them, disappear at the S.E., is a circumstance the knowledge of which may be highly serviceable to commanders of ships sailing across them.

"The centre of a gale, in its approach, always effects a descent on the barometer, and a change in the fall of rain. In its actual passage over the instrument, the descent generally reaches 28·50, from which a rise of one-tenth appears to take place for every 10 miles' removal of the centre; so that the number of miles distance from the centre of an approaching gale might, perhaps, be indicated by the number of hundredths shown by the barometer over extreme of 28·50.

"The difference in the fall of rain has also its regularity; the approach of the centre bringing a temporary increase, and then a cessation of the rain, which is renewed, and, in a reversed order, diminished on the removal of the centre. According to the observations made at this office, there appears to be in every gale of wind a zone of rain about 120 miles in breadth, heaviest on the inner edge, which is about 60 miles distant from the centre; that the fall of rain decreases in proportion to the distance from this line; and that the fall on the inner edge being about twelve-hundredths of an inch per hour, the decrease is about one-hundredth for every 10 miles of removal."

During winter, besides gales and a heavy sea, the whole group of the Azores is subject to rain and fogs; the direction of the wind in the vicinity of the islands is, at all seasons, greatly influenced by the high land; and the progression of storms of a decidedly rotatory character is greatly determined by the peak of Pico. Storms however are not frequent or generally of long duration, but they are heavy while they last. S.W. gales, the most formidable in an open port of southern exposure, shift generally to the N.W., and moderate at that point, proving that they have a south-easterly course, their centres generally passing to the northward of St. Michael.

The mean height of the barometer in summer (April to September) is 30·212 in.; in winter 30·120 in. The thermometer ranges from 46° to 84°;—between 46° and 72° in February,—and between 64° and 84° in August.

Near Corvo and Flores the weather is changeable throughout the year, and the wind generally strong.

See also;—Winds in *areas* 24 & 25. (p. 57—58; 60 and 61).

CHAPTER VII.

WEST COAST OF AFRICA—N. OF THE EQUATOR.

1. The Harmattan—Tornadoes &c.—The HARMATTAN is an easterly wind peculiar to the west coast of Africa; it is prevalent during the *dry* season and is probably the Trade-wind blowing over the continent. It is felt, more or less, from the parallel of Madeira to that of the river Gaboon,—blowing with considerable strength (at times) on the coasts of Senegal and Senegambia, but being comparatively light on the coast of Guinea. It seldom lasts long—rarely more than from two to six days, and even during that period it is partially interrupted by the sea-breeze, which sets in about noon. It is an extremely dry wind, and has a disagreeable effect on the skin and lips, but it is not unhealthy since its tendency is to dissipate the noxious vapours resulting from the rainy season—the sickness incidental to which generally disappears on the return of the harmattan. It rarely extends far from the coast. A constant accompaniment of this wind is a dense haze which is often nothing more than extremely fine sand or dust; it obscures the coast to such an extent that great caution is requisite in approaching it, and strangers generally over-estimate their distance from the land at such a time.

The harmattan, though not prejudicial to the health of man, has a powerful effect on vegetation, which is much injured if not destroyed; it contributes, however, to the commercial wealth of the African coast, inasmuch as blowing immediately after the rainy season it suddenly arrests the rapid circulation of the sap and causes the trees to exude gum.

TORNADOES are sudden squalls of short duration, characteristic of the *rainy* as the harmattan belongs to the dry season; and they are more commonly felt on the west coast of Northern than of Southern Africa. Originating in the North or N.E. quarter, they advance against the prevailing winds, which for a time they supersede: their approach is unmistakeable, and they are always accompanied by thunder and lightning. Dark heavy clouds spread from the horizon upwards, taking the form of an arch, and the better this is defined the more violent will be the force of the gale. A brief interval of calm ensues, when the storm shifting from N.E. to East gradually gets to E.S.E. and S.E.; it is then at its height, blowing with great fury for twenty minutes or half an hour; the thunder is heard with louder crashings and torrents of rain immediately follow; it decreases in force as the wind passes to South and S.W. and then it lulls.

Navigating this region during the rainy season it is always necessary to be on the look out, and sail should be shortened in time, for though the tornado lasts but an hour or two, it blows with full hurricane force and the change of winds is very rapid.

The SEA BREEZE on the coast of Marocco blows generally from N.W.;—on the coast of Guinea from South to S.W. The prevailing winds along the coast of Africa, from Cape Bojador to the Isles de Los, are from N.E. to N.W., and rain seldom falls during eight months.

2. **The Gaboon**:—At the Gaboon it rains, more or less, throughout the whole year. The *dry* season, however, is usually supposed to last from the middle of June till the middle of September; the sky is then overcast and the sun rarely shows forth, yet the heat is intense.

The *rainy* season commences in September and terminates in January—raining heavily during November, December, and January; tornadoes are then common.

From February to May there are alternate periods of fine and rainy weather: the heaviest tornadoes take place in March and April, but during the other months storms are not unfrequent—they only differ from the tornado inasmuch as they do not blow with the same force.

During the rainy season the wind is fresh from the S.W.

The land and sea breezes are prevalent throughout the year; the former is generally light from S.E. to East; the latter varies between N.W. and S.S.W.

3. Along the **East Coast of the Bight of Biafra,** as far as Lat. 3° N., the season of tornadoes and general bad weather lasts from March to the middle of September. During July and August—comparatively the driest months in the year—the wind blows from S.S.W. to S.S.E.—generally fresh, but occasionally strong. The rainy season, beginning in September and lasting till March, brings with it the prevalent calms, and also light breezes varying between W.S.W. and South.

4. **The Old Calabar and Bonny Rivers.**—The fine season commencing in November lasts till the middle of May; it is then excessively hot; tornadoes occur, but principally in November,—also in March and April: the fine season is the period of the harmattan, which is especially prevalent in December, January, and February; the harmattan sometimes blows strong from the N.E. for several consecutive days.

At the end of May the rains commence, terminating in September; the downfall is incessant in July and August. The weather clears up in October, when fresh land breezes alternate with squalls of rain.

The fine season is that of the land and sea breezes,—the latter blowing from W.S.W.; during the rainy season the wind is generally from S.S.W. to S.W., and often strong and heavy.

The *smokes** prevail in September, October, and part of November; this is the unhealthy period of the year.

* The name given to the dense fog or haze prevalent on the West Coast of Africa at the termination of the rainy season.

5. **The Bight of Benin.**—The prevailing winds in the Bight of Benin are from S.W. and West.

In the fine or dry season—from October to February—the land and sea breezes are found near the coast, and especially at the mouths of the rivers; the temperature then ranges from 84° to 90°; this is the season of the *smokes*, which are very thick here, but they usually clear away towards 10 a.m.

Tornadoes, sometimes two a day (and very furious in this Bight), are prevalent from March to May,—also in June and July, once in twenty-four hours, but their force is not so great as in the former months; they always blow most violently in the season when the sea breeze attains its greatest strength. June is the coldest month of the year,—the prevalent wind is from S.W. fresh, and the thermometer is at 77°.

August and September are the months of the *great* rains.

The harmattan, from the East, is common in November, December and January, but it is weak, and only blows at intervals.

The seaman, navigating the Bight of Benin, must be cautious in respect to squalls having the characteristics of the tornado, and accompanied by electrical phenomena; they are very dangerous, and the puffs are very heavy from the S.E. quarter.

6. **The Ivory and Gold Coasts.**—The seasons here are four—two dry and two wet:—

The *fine* season, or *first dry* season commences in the middle of December, and ends in the middle of March.

The season of the *great rains* lasts from March to the middle of July.

The *second dry* season, from the end of July to the middle of October; and

The *second rainy* season, from the end of October to the middle of December.

At the end of December, the temperature of the air is high. Winds from the West and W.S.W. are now fresh and well established—they are the sea breezes, which alternate with the land breeze—the former, however, predominating and blowing with considerable strength, especially in January and February; the harmattan of this season may occasionally blow from the East for several days, but it is seldom as strong as the sea breeze. The temperature in the shade reaches 86° Fahr.

Towards the end of March the weather becomes stormy and the season of the *great* rain sets in; the heaviest downfall is in May and June; the air is then close and stifling: this is also the season of tornadoes—which blow with great force in April, May and June.

In July the rain gradually ceases; an overcast sky intercepts the sun's rays and the temperature falls to 68° Fahr.; the *smokes* are also prevalent; though tornadoes generally cease in June they occasionally last till August,—to which month the sea breeze blows fresh from S.W. and W.S.W.

In September the weather clears up and brightens, when calms alternate with light airs from South to S.S.W.; the temperature of the air increases, and light rain falls occasionally at the beginning of October.

The *smokes* are very dense, and obscure the land, in July, August, and September; they are also prevalent in December, January, and February; but in fact the horizon on this part of the coast is never perfectly clear.

7. **Liberia and the Grain Coast.**—The rainy season commences in April and ends about the middle of August; tornadoes then prevail; the wettest months are July and August—the period of the *great* rains.

Irregular winds from the S.W., with moderately fine weather, prevail from the middle of August till the end of September.

The second rainy season occurs in October and November, when tornadoes are again experienced,—but it only rains at intervals and with squalls.

The fine season commences in December—when the land and sea breezes blow with regularity.

The land breeze—from midnight to noon—varies between N.N.W. and N.N.E. The sea breeze varies between W.S.W. and W.N.W.; the interval of calm is short. At the beginning and end of the dry season the sea breeze has a S.W. tendency.

The harmattan blows in December, but neither with regularity nor force; nor is it so disagreeable as on the coast to the north; it is accompanied by fog which lasts from daylight till noon.

The *smokes* of the fine season are exceedingly thick, and though ordinarily prevalent during a few hours in the morning, sometimes last all day; but throughout the entire season the land is never wholly free from haze.

The tornadoes always blow from the eastward; storms, of short duration and less force, which occur in the interval between the tornadoes, blow from any point of the compass, but principally from the east.

During the rainy season the weather is always more variable 30 or 40 miles seaward than nearer the land; at that distance the wind is very irregular and uncertain, calms are frequent, storms are not uncommon, and rain is abundant, whereas at about 5 or 6 miles from the coast there is less calm, the rain is not so persistent, and the weather generally better.

8. **Sierra Leone and its Vicinity**:—During the fine (or dry) season—from November to April—the regular sea breeze is from N.W. to North, occasionally from W.N.W.; commencing at about 10 a.m. it lasts till near midnight, after which the land breeze from N.E. to E.N.E. takes its place; there is not always an intervening calm, but the sea breeze veers by the North into the land breeze,—the change occurring gradually, with light airs. These breezes, however, are not felt beyond 20 or 30 miles from the coast. Further seaward the wind is from N.N.W. to N.W. at this period of the year.

The harmattan (from E.S.E. to N.N.E.) blows in its strength during November and December,—sometimes in subsequent months, but it is then moderate or light.

The rainy season lasts from May to November; the winds are then from S.W. to W.S.W., sometimes blowing with considerable strength for a short time from W.N.W. and West. Tornadoes are in force during May; frequently also in October, and more rarely in November.

The rains are neither so heavy nor so copious as more to the southward.

In the Sierra Leone River, the wind and weather for the year appear to be as follow:—

January:—N.W.;—the harmattan in the morning; the sea breeze after mid-day.

February:—N.W.;—stormy, with rain.

March:—N.W. tornadoes prevalent.

April:—N.W. to S.W.; tornadoes prevalent.

May:—S.E. to S.W.; stormy at intervals.

June:—S.E. to S.W.;—the heat intense; rain with S.E. winds.

July:—S.E. to S.W.;—as in June.

August:—S.E. to S.W.;—as in June.

September:—E. to S.W.;—tornadoes prevalent.

October:—W.N.W. to S.W.;—sky overcast; heat oppressive.

November:—N.E. to W.N.W.;—as in October.

December:—N.E. to N.W.;—as in October; thunder and lightning towards evening.

9. Rio Nunez.—Bissagos Archipelago.—Casamanza and Gambia Rivers to Cape Verde:—Among the Bissagos Isles, and along the coast in their vicinity, as well as to the northward, Westerly winds—varying between W.N.W. and S.W.—prevail for eight or nine months: during the wet (or winter) season—from May to October—they blow incessantly, and frequently with considerable strength in July and August; it may also be remarked, that this season, which commences in May off the Bissagos, is more and more retarded in proceeding northward, so that off Goree, and the mouth of the Senegal river, it does not begin till June and July. The *great* rains fall from July to September.

During the fine season the usual land and sea breezes are experienced,—the former from N.N.E. and N.E. to E.S.E.,—and the latter from W.N.W. to W.S.W.

The harmattan blows strong at intervals from November to January—lasting from three to nine days in succession—but generally prevalent only in the morning.

Tornadoes may be expected during May, June, and July,—occasionally also in August and September.

Along the whole length of this coast, as well as to the northward and southward, the usual *smokes* and heavy fogs prevail, more or less, in the morning, during the fine season; and the mirage, due to the heated atmosphere, is so constant that astronomical observations are uncertain; the lead, therefore, is the only sure guide in navigating this part of Africa.

During November and December, at the mouths of the rivers, the dense, cold, and penetrating fogs, carrying with them an extremely fetid odour, are very unhealthy—being in many cases equally prejudicial to the natives and to Europeans.*

10. Coast of Senegal:—Between Cape Blanco and Cape Verde the winds are from N.E. or East to N.N.W. and N.W. during eight months of the year—from October to May: easterly winds prevail at night and towards the morning,—the more northerly winds and those from the westward towards the afternoon. The rainy season lasts from June or July to October or November; this is also the season for tornadoes which are succeeded by light winds from S.W. to W.S.W. At a short distance from the coast, during the fine season, N.W.-ly winds, blowing towards the land, are common, while further seaward the breeze is from the N.E.

11. The Coast of Sahara:—To the northward of Cape Blanco the seasons approximate to those of the coast of Marocco. July and August are the months when the heavy rains fall and when the tornadoes are most severe.

12. Coast of Marocco:—On the coast of Marocco, during the winter, the prevalent winds are from S.W. and W.S.W.—sometimes blowing with considerable strength, but especially so when the shifts have been rapid from S.E. through South to W.S.W.; the weather is then bad—with a high sea—and it does not clear up until the wind has passed to W.N.W. or N.W. During the fine season—in December especially—the prevailing winds blow between N.E. and N.W., generally fresh. From October to April, when thick fogs are common, the climate is unhealthy.

MOGADOR:—The climate of Mogador is mild and agreeable.

From March to December—nine months—the wind is regular and fresh from N.E.,—at which period the sky is clear and bright: but during the night it is generally calm; this wind produces a heavy swell along the coast, which at times reaches the anchorage of Mogador, subsiding however with the hours of calm.

East and S.E. winds, known as the *simoun*, are rare; coming from the land, they result in a total calm in Mogador harbour,—a very unusual event.

South and S.W. winds are of two characters—either light, in which case they

* The diseases to which Europeans (and, in a less degree, the natives) are subject, are, on their arrival, billious and gastric fevers; then dysentery, agues, and yellow fever. The universal antidotes in cases of fever are large doses of quinine, and emetics. Often, unfortunately, the patient has recourse to spirituous liquors, and it is hardly necessary to say, that their deadly effects are sooner felt in this unhealthy region, than in a more temperate climate.

are accompanied by a fog so dense that objects a few yards distant are scarcely visible,—or they are strong and tempestuous, generally preceded by a falling barometer. The horizon in the direction of the wind is greatly overcast; the clouds are dense and charged with rain, which, at first falls in slight showers, but afterwards heavily. At the commencement of the storm the wind is light, but subsequently increasing in intensity, blows in violent squalls; not unfrequently, towards the close of the gale, a perfect deluge of rain falls, accompanied by loud claps of thunder and much lightning. Three such gales have happened in November and December.

The N.W. wind is the most dangerous in Mogador harbour,—not so much from its strength, for the island shelters the anchorage in this respect, but from the exceedingly heavy sea which a wind from that direction raises,—wave after wave rolling in and breaking on every part of the beach, except in a sheltered nook quite under the lee of the island. The ground tackle must be exceedingly good to resist the combined force of wind and sea. These winds are most frequent in January and February;—but the harbour is generally insecure from December to March, which is the winter season, when westerly winds (—from N.W. to S.W.—) more or less prevail. S.W. winds which are accompanied with rain clear the atmosphere and lower the temperature.

The thermometer generally ranges from 64° to 70°; and it never falls lower than 58°.

General Remarks on the Winds and Climate of the West Coast of Africa.

18. Winds:—On certain parts of the West Coast of Africa *land and sea breezes* blow with great regularity, especially on those between the tropics and among the islands situated in the torrid zone, so much so, that they might be reckoned among the periodical winds. As a general rule, the sea-breeze blows during the day; the land-breeze, commencing towards evening, lasts part of the night, blows in nearly an opposite direction, and usually ceases shortly after sunrise, seldom lasting beyond 9 or 10 o'clock in the morning.

Along the coast of Marocco and Senegambia, the sea-breeze commonly blows from the N.W.; and on the coast of Guinea from South to S.W. They are generally found near the coast, but sometimes prevail far from it, gradually losing their force as the distance is increased, till they are opposed and overcome by the general winds.

On some parts of the coast of Africa, particularly on that of Senegambia, there are certain winds, termed *solar breezes*, because their changes appear to be regulated by the influence of the sun.

On the coast of Senegambia they vary from N.E. to N.W. The course of these winds, which blow strong, principally from November to April, is as follows:—The breeze at sea lasts through the day, strengthening in the afternoon, then weakening towards the evening; during the night it changes, and blows more along the land.

When in the vicinity of these coasts, ships should regulate their sailing so as to be near the land when the night-breeze springs up, and out at sea when that of the day begins.

In navigating the coast of Africa from the coast of Guinea northward, a haze varying in density will be found from the vicinity of the land to 40 or 50 leagues out to sea. It consists of the finer particles of sand, and is so thick as to cover the weather side of the rigging, giving it a slovenly appearance.

THE HARMATTAN* is a wind peculiar to the western coast of Africa. It blows from East, changing to E.N.E. on the north coast, from the parallel of 33° N. to the Equator, following what are called the latter rains. About the Gambia it sets in about a month later than in other parts. It commences at all times of the day or night, and continues from a day to a week, and even a fortnight. The period of the moon is no rule for its recurrence. It is generally a moderate breeze, not so violent as the sea-breeze, but still sufficiently strong to produce a change in the current which sets along the coast. On the coasts of Senegal and Senegambia it is sometimes very strong, but often light on the coast of Guinea. It may be described as a cold, dry wind, generally of 3, 6, or 9 days' duration, principally between the end of November and February or March, reaching, however, but a short distance from the coast, about 9 or 12 miles from which it is not found, though its effects on the temperature are experienced at 30 or 40 miles from it. Sometimes it commences at sunrise and ends in the afternoon.

The harmattan dries up almost every particle of moisture in the atmosphere, parching the skin, drying the planks of the sides and decks so as to render the seams leaky; and loosening casks by drying the staves so that the hoops fall off, unless they are attended to. By the effect of this wind the annual evaporation on this coast, which is stated at 64 inches, is raised to 134 inches. The hazy atmosphere peculiar to the African coast within the before-mentioned limits, is always increased during the harmattan, and assists in making the coast appear at a greater distance than it actually is. Although generally considered healthy, it is certainly very disagreeable and inconvenient; nevertheless, the great advantage derived from it is the production of gum.

TORNADOES.—These are violent squalls of about 3 hours' duration, which generally occur at the commencement and end of the rainy season, and are well

* "The Harmattan has been defined to be the Trade-wind blowing over the continent; during this season the *smokes* prevail, which are so dense that nothing can be seen more than a cable's length from the ship, and vessels approaching the coast have no resource but to anchor. In March, April, and May the weather is clearer, and occasionally, especially after a tornado, very clear, when the high lands of Fernando Po and Cameroons may be seen 100 miles; but even during these months a ship may get within 7 or 8 miles off the land without seeing it. The nights at this season are very fine."—*African Pilot.*

known on the West Coast of Northern Africa, while off the southern part they are either seldom experienced or are very slight. Their approach is heralded by clouds of a dull yellow colour, which by night are very black, originating in the North and N.E., and generally moving against the prevailing wind. They are not unfrequently distinguished by electrical phenomena, and gradually overcome the prevailing wind.

It is stated that when the wind precedes the rain, the storm is more violent. A calm often follows a tornado.

In order to meet these squalls vessels should shorten all sail, and furl if possible. Sometimes these tornadoes have the force of hurricanes of short duration, in which the wind changes so rapidly that a sail might be split and inevitably lost; at other times they are of longer continuance; indeed, it is never certain of what extent they may be.

The S.W. winds of the West Coast of Africa are often disturbed at certain periods, particularly in the winter, for in the Mediterranean, and on the coast of Portugal, intense polar currents are found, which, increasing the rapidity of the Trade-wind from North, forces it abruptly towards the Equator. The meeting of these winds and those from S.W. prevailing at this period, contributes, perhaps, to produce tornadoes, and in some way accounts for their frequency and violence in the northern hemisphere, for south of the Equator, as already observed, these disturbances of the atmosphere are very rare.

In the Bight of Biafra, north of Cape Lopez, tornadoes blowing from N.W. to West and S.W. sometimes though very seldom occur.

North of the Equator their visits are mostly at the commencement of the winter season, and, therefore, the time of their appearance varies according to the place. Thus, they occur at Cape Palmas a month earlier than at Sierra Leone, and at Sierra Leone a month or 6 weeks before they prevail at Goree and St. Louis.

Several localities are visited by them at the end of the winter season, but the principal are the coast of Guinea, and from Cape Palmas to the Bissagos Group. In the Gulf of Guinea* they occur mostly in the months of March, April, and May, and they again make their appearance in some places during November and December.

Climate.—The Western Coast of Africa, especially the intertropical portion, is considered extremely unhealthy to those natives of more temperate regions who

* Commander Wood of H.M.S. *Hound*, in his remarks on tornadoes in the Bight of Benin, in 1847, says, "They generally commence from the S.E., and draw round East and N.E.; but this is by no means certain, as we have had them blowing right on shore. One tornado, that occurred at night, began at East and drew round to South; and we have had them from the westward also. When the sea breeze is strongest, the tornadoes are found to be most violent. There are likewise hard squalls from the S.E., which have not the characters of the tornado, the black arch and vivid lightning gathering to leeward, but are not the less dangerous." At Quitta the tornado often blows so as to make it a lee-shore.

may be compelled to visit or reside there. This unhealthiness arises from the moisture and heat of the atmosphere, which is commonly impregnated with the miasma or malaria of the marshes, producing those indescribable feelings of heaviness, langour, nausea, and disgust, which require a considerable effort to shake off. But however prejudicial to the European, the natives seem to enjoy good health, and to live to a tolerably old age.

The seasons* may be divided into two—the wet and dry; the former of which is the most unhealthy for white residents and voyagers. The African climate derives its peculiar constitution from excessive atmospheric humidity, conjoined with a high temperature, and the constant exhalation of local miasmas, more or less influenced in their noxious prevalence and origin by various electrical laws, at present but very partially known.

The wet season, like the winter of Europe, produces inflammatory attacks of the lungs and pleura, with catarrh, or colds, &c. In the alluvial and swampy districts of Western Africa, and even in the more elevated table lands, the maladies from which Europeans suffer are those generated by *malaria*, an endemic or epidemic poison, resulting from a combination of different local influences. In many instances, when concentrated, they induce that morbid condition of the body which ends life; and as the diseases, therefore, proceeding from these causes are not unfrequently developed in an aggravated form, and a low, insidious type, an energetic mode of treatment at once becomes requisite.

The necessity for unacclimated persons adopting such measures as might enable them to withstand the attacks of the local affections, and modify their severity, is too obviously enforced to require comment. There can be little doubt that by a judicious code of sanitary regulations, a tolerable state of health may be maintained in several of these pestilential localities for a considerable period; but at the same time it must be distinctly understood, that though such regulations may prove unable to avert sickness, they will go far towards restricting its violence, and when the ordinary febrile and dysenteric diseases are somewhat divested of their more formidable symptoms, they will have lost much of that intractable character, so difficult of management, and consequently will be rendered more amenable to the remedial effects of medicine.

These climatorial influences do and must necessarily greatly interfere with and retard the development of commerce, and the civilization of the natives, notwithstanding the stimulus offered by regions unsurpassed in their fertility and productiveness. DR. WILLIAM F. DANIELL, a gentleman who served 17 years in most of the countries of Western Africa, has much assisted these agencies by giving the following rules for the preservation and maintenance of good health by those engaged therein:—

* Baron Roussin says, "the division of the two is connected with the periods when the sun crosses from one hemisphere to the other, and is modified as that luminary advances to, or recedes from the Equator."

He says, "The dress should be usually constituted of flannel, cotton, or such woollen fabrics as are best adapted for resisting the alternating vicissitudes of heat and cold. Flannel should be *invariably* worn next the skin. In the cold and rainy season, the shirts, trowsers,* and in fact the entire dress, if composed of flannel, would be found to be the best means for resisting the injurious action of a humid atmosphere or heavy showers, and their concomitant sequels, rheumatism and fever.

The head cannot be too carefully protected, and thick felt caps, or straw hats well lined will prove most serviceable; those of a black colour should be avoided. The feet must also be kept well dried, and woollen socks are preferable to cotton, if they do not produce inconvenience.

Ablutions of the body should, at least, occur daily, whenever the skin is not too much heated, and suitable opportunities offer. With reference to cold baths, some precautions are requisite, and as a general rule, they ought never to be used by debilitated persons, convalescents, or others subject to special visceral diseases, or whenever the body is bathed in a profuse sweat from labour or exercise. If any chill or sensation of coldness is experienced after their employment, they must be abandoned and tepid water substituted. Alluvial and muddy water from creeks, rivers, lagoons, and the embouchures of streams, or in the immediate vicinity of the coast, should never be resorted to for abluent purposes, if a purer or better quality can be obtained elsewhere. Filtration would remove, to a certain extent, the impurities that abound in fresh water. The surface of the skin immediately after every bath should be thoroughly dried by friction from a coarse towell, if no prickly heat or other cutaneous irritation exists. When, therefore, the body or clothes have been thoroughly saturated, either from immersions or continued exposure to heavy rains, the garments should first be removed without delay, and the skin well rubbed with strong spirits (rum, schiedam, or aquadente, would answer) until a sensation of warmth and dryness be induced. Dry clothes may then be put on.

Undue exposure to the sun should always be avoided; and great care is equally necessary not to create excessive fatigue, if so exposed. The solar temperature attains its maximum between 12h. and 8h.; all physical exertions should, therefore, be considerably restricted within these hours. Rest from all kinds of labour during mid-day will be attended by invigorating results. Whensoever

* It is important to health, that all those who must keep the deck during a tornado, should be in the blanket dress of frock and trowsers: for, notwithstanding the high state of the temperature, the beating of the rain numbs the limbs at the time, and a chill follows. It is likewise desirable that, on throwing off those wet clothes, an allowance of hot coffee should be issued: and if several stoves could be lighted below for a couple of hours after each tornado, and still better on every day during the rainy season, it would conduce much to the general health of the crew. It is horrible to be on short allowance of water in this climate, but much of the thirst which it induces may be counteracted, and the health improved, by the frequent use of the shower-bath of sea-water.

imperative duties demand noon-day visits from ship to shore, or from house to house, a cotton or silk umbrella must be employed to shield the head and eyes from the oppressive glare and heat. From 5h. 30m. to 6h. A.M. are the hours best adapted for rising. Previous, however, to the commencement of the toils of the day, a cup of coffee, tea, or chocolate, should be swallowed, in conjunction with a small piece of bread or biscuit. The intervals least unfavourable for excursions, or recreations, are from 6h. to 9h. A.M. and from 4h. to 7h. P.M. Moderate horse exercise is preferable to walking, whenever attainable.

Regulations for the prohibition of all persons sleeping without proper shelter, and thereby being exposed to the heavy night dews, and cold, baneful, land winds, however pleasant and refreshing they may be, cannot be too forcibly inculcated. Reclining on the damp ground after protracted exercise, or sleeping in apartments on shore with open windows, permeated by irregular currents of air, either from inland or evening sea-breezes, or in houses in close proximity to swampy localities on the banks of rivers, must, whenever practicable, be avoided. The more elevated the quarters are from the ground the greater will be the salubrity.

Use that kind of food best calculated to afford due support to the body, without inducing subsequent exhaustion or debility, by impairing the functions or increasing the activity of the digestive organs. The habits of the native tribes will frequently be found, in these respects, a tolerably safe guide; proper allowance being made for the moral and physical distinctions of race, previous mode of living, &c. In hot countries comparatively less food is required than in cold ones, and the stomach, after irregular intervals, looses much of its assimilative powers. Edibles most nutritious and wholesome, the indigenous products of the place, ascertained to be commonly in vogue, and prepared by the simple processes of native cookery, should, more or less, enter into the composition of the chief daily meals, the number of which must be regulated in accordance with the necessities of climate and constitution. Animal substances should invariably be well cooked; boiled meat, in the form of soups and stews, is therefore preferable to the same when roasted. More of vegetable, and less of the animal constituents, should be the fundamental principle in the disposition of meals. In tropical Africa, rice, yams, sweet potatoes, kouskous, cocos, and young cassada roots, constitute excellent substitutes for European vegetables. The oleaginous and other dishes of the natives, composed mostly of mutton, fowls, game, fresh and dried fish, with palm oil, ochros, peppers, yams, melochias, plantains, and other esculents, are very palatable and nourishing, and appear well adapted for European use, if visitors could only be induced to tolerate their somewhat nauseating aspect. Poultry is usually cheap and plentiful, and no better article of food could be purchased. Fish of various kinds, both dried and cured, with shrimps, crawfish, mangrove oysters, &c., can sometimes be obtained in large quantities; when fresh, they are in general of good flavour, and of easy digestion. Oranges, pineapples, guavas, melons, limes, bananas, mangoes, papaws, soursoups, custard ap les, and other fruits, if immoderately eaten, tend to promote indigestion and diarrhœa, with other irritation of the bowels, and occasionally lead to more serious disease. When desirable, a limited allowance should be taken early in the morning, previous to breakfast. Punctuality in meals, with a certain amount of rest after each, ought to be adopted.

The judicious use of wine and spirits may be advocated. Good sherry, madeira, and bucellas may be administered with advantage to invalids and others, and a few glasses at meal times are productive of an appropriate stimulus to the stomach. Port wine is commonly too much adulterated to be of benefit. Weak brandy and water may be drunk in moderation throughout the day, by those more habituated to the use of ardent spirits, and will in some degree mitigate the continual state of thirst. Claret (Bordeaux wine) and water is also a pleasant and cooling beverage to persons inclined for weaker potations, and not predisposed to visceral relaxations, dysenteric, and other gastro-enteritic maladies. Abstinence from *aquadente* and other sorts of inferior rum and spirits cannot be too strictly enjoined. Malt liquors should likewise be drunk with caution. Allsopp's or Bass's pale ale are, on the whole, more preferable to bottled porter, stout, or the stronger ales. The moderate indulgence of the passions is not prejudicial to health; but great care is requisite that their gratification becomes not habitual, so as to degenerate into excess.

Among the predisposing causes of sickness, one of the most frequent is the dread and prostration of spirits that pervades almost every class of people, on their first visit to this unhealthy coast. Notwithstanding the array of fearful drawbacks, individuals may reside in the majority of these regions, unimpaired in health or constitution, for a considerable number of years, by proper care and attention to gygienic considerations, by cheerfulness and confidence relative to future results, regularity and a tropical adaptation of diet, by a determination to resist hypochondriacal forebodings, or despondent impressions, by the appropriate employment of time in judicious mental and physical labour or recreations, and by tranquility of mind, and an implicit reliance upon the ever constant protection of an all-wise Providence."

CHAPTER VIII.

WEST COAST OF EUROPE FROM THE STRAIT OF GIBRALTAR TO THE ENGLISH CHANNEL.

1. **The Strait of Gibraltar—Tangier—Gibraltar**:—In the strait of Gibraltar the prevailing winds are either from the westward, or from the eastward;—the former varying between N.W. and S.W.;—the latter, between N.E. and S.E. It would appear, however, from observations made at Gibraltar, that a slight

change has taken place in the distribution of the winds at that place, inasmuch as prior to 1816 there had been an excess of easterly over westerly, while since that date there has been a preponderance of westerly winds.

The few observations made at Tangier seem to show that the westerly winds are slightly in excess of those from the eastward, and that the latter are especially prevalent in January, March, July, August and September; calms are not frequent; and the wind is often strong.

During the time (1850 to 1855) that the French government was making a survey of the Strait, a meteorological register was kept at Cadiz and at Gibraltar for comparison with that made on board the *Phare*, by Capt. C. P. de Kerhallet, and many of the following remarks are based on the observations of that officer—

Table.—*Showing the relative prevalence and direction of the wind at* Gibraltar *and* Cadiz *;—and the number of days of rain:—being the average of six years*:—

1850 to 1855	Gibraltar.				Cadiz.			
	No. of Days of				No. of Days of			
Months.	Wind from East.	Wind from West.	Variable Winds.	Rain.	Wind from East. — N.E. to S.E.	Wind from West. — N.W. to S.W.	Variable Winds.	Rain.
Jan.	8·2	20·6	2·2	9·1	6·7	12·3	12·0	2·5
Feb.	11·2	16·1	0·7	7·1	8·8	10·6	8·6	1·6
Mar.	16·0	13·6	1·4	6·2	7·7	16·1	7·2	2·0
April	12·2	17·3	0·5	10·1	10·2	13·8	6·0	1·7
May	7·3	23·3	0·4	6·1	4·4	20·2	6·4	1·6
June	11·8	16·6	1·6	1·8	7·7	18·5	3·8	0·2
July	18·5	12·2	0·3	0·4	6·9	19·9	4·2	0·0
Aug.	19·5	11·0	1·5	0·9	11·8	15·5	3·7	0·2
Sept.	17·3	12·6	0·1	2·9	11·0	15·7	3.3	0·7
Oct.	12·7	17·3	1·0	5·7	9·8	14·2	7·0	2·0
Nov.	10·5	17·8	1·7	9·5	8·5	11·4	10·1	3·8
Dec.	15·0	13·5	2·5	8·8	13·4	7·0	10·6	2·0

From this Table it is evident that the Meteorology of the two places, though no great distance apart, differs considerably. At Gibraltar, easterly winds are in excess during the months of March, July, August, September, and December; at Cadiz, during December alone; and further that, while at Gibraltar an average of 69 days of rain may be expected during a year, at Cadiz the average is only 18 days; it will also be seen that the most rainy month (April) at the former place does not coincide with that at the latter.

2. The two prevalent winds in the Strait of Gibraltar—the East and the West—are locally known by the name of *Levante* and *Poniente*. The Easterly wind is irregular, and comes in squalls near the land; indeed, along the coast,

and in the bays, a calm, or merely a light land-breeze may prevail, morning and evening, while in the middle of the Strait it blows hard: it is at all times a very moist wind in the eastern parts of the Strait, overspreading the land with mist and fog, which is thick in proportion to the strength with which it blows. In the fine season, but especially in June, if, after strong easterly winds, masses of white clouds collect over the land, and light S.W. or westerly airs set in, a thick fog-bank settles over the western portion of the Strait, equally as wet and dense as the fogs on the banks of Newfoundland during August, but it does not last long—disappearing almost as rapidly as it is formed. In the winter, the *Levanter*, blowing from the south of east, generally brings rain.

3. On the western side of the Strait,—and from CAPE TRAFALGAR TO CADIZ— the *Levanter* puts on another aspect; it blows in squalls, but while the horizon is thick, the sky is clear overhead; and during the summer it is a dry, suffocating wind; it will also spring up very suddenly and freshen to a gale in a few hours, but in that case it does not last long; when, however, it commences and gathers strength gradually, it may continue to blow hard from three or four days to ten days or a fortnight at a time.

4. It is a well recognised fact, that both the easterly and westerly winds have a tendency to follow the direction of the coast, and that they always blow hardest in the narrowest part of the Strait, where their course becomes so modified as to blow through; thus, a West wind in the Strait is a N.W. wind on the coast of Spain, and a S.W. wind on the coast of Africa; and an East wind in the Strait may be N.E. on the Spanish coast, but a S.E. wind on the African side. Another peculiarity of the winter season is, that it may so happen that, while a strong S.W. wind prevails in the Atlantic, a *Levanter* may be blowing in the Mediterranean, and the navigation of the Strait at such a time is very dangerous from the varying (always strong) eddy winds and cross sea which must of necessity occur.

The Atmospheric pressure and temperature at Gibraltar, appears to be as follows:—Barometer, *max.* 30·90 inches, *min.* 28·62; Thermometer, (Fahr.) *max.* 85°, *min.* 46·8: the annual fall of Rain is about 31 inches.

5. The following additional information is derived from Admiral W. H. SMYTH's work on the "Mediterranean:"—

"Between the capes ST. VINCENT AND SPARTEL, the S.W. winds are the most disagreeable, and when violent are sure to be denoted by a depression of the barometer. These gales are always indicated by a long hollow swell, and generally commence with a breeze between South and S.S.W., from which point it continues to blow for five or six hours, although the sea sets from the westward.

The outer harbour of CADIZ is greatly exposed to the waves thrown in by the westerly winds. But the hardest gale of the neighbourhood is the *Solano*, or *Levanter* of the Gibraltar pilots; it is preceded by a peculiar haziness and clammy humidity, the mercury gradually sinks, clouds cap the hills of Medina Sidonia, and the atmosphere becomes raw and bleak to the feelings. The *Solano* sets in from E.S.E. to S.S.E., for it is not the true *Levanter* of Mediterranean seamen; the one so named, inside the Strait, blows directly from East, freshens as the sun rises, and lulls as it declines—being generally at a maximum about noon.

That the winds in the Strait of Gibraltar blow either from the East or West points of the horizon (technically *down* or *up*) in general, has been immemorially remarked, and the conformation of its coasts, on both sides, renders the reason palpable. Of these winds the East is the worst and most violent, being often the cause of much inconvenience in the bay of Gibraltar from its gusty flaws and eddies, besides being always raw and disagreeable.

Within the Strait, the predominant breezes are from the North and West, except in the spring, when S.E. and S.W. winds prevail; but their duration and strength are extremely uncertain about the period of the equinoxes, at which time the wind seldom changes suddenly without an accompanying fall of rain, or, at all events, the formation of rain-clouds; for it rarely happens that the new wind is of the same temperature as the one it has superseded; no perilous weather, however, is likely to assail the navigator without giving sufficient warning; yet as the barometer does not vary more than a few lines, even to pretty sharp gales, careful attention is required to mark its indications; it may be laid down as a general rule that, whenever the mercury descends to 29·40 inches, severe weather may be looked for; especially if accompanied by dark globular clouds in masses, or when a gloomy haze encumbers the sky after serenity.

Proceeding up the Mediterranean by the Coast of Spain, the climate in summer is usually fine and dry. In winter, the flaws and gusts of wind from the mountain ranges are often furious, The South wind seldom blows on these shores except in the winter season; at which time the S.W. gales send in a great sea along the shores of Andalusia and Granada, where it blows dead on the shore. But a singular change is known to occur here,—for frequently, on arriving at the coast abutment, called cape San Martino, a ship running free before a Westerly wind, *there* encounters another from the North or N.E., often blowing fresh. Along these shores, and especially that of Catalonia, the "sea-fret" or dense mist generated on the ocean is the forerunner of Easterly winds which drive it in; when this first appears, ships at anchor should look to their ground tackle, and those under sail should gain an offing.

The Coast of Marocco experiences the alternations of land and sea breezes; the seasons are divided into the wet and the dry, the latter being from November to March. From Algiers to the strait of Gibraltar the winds follow, in a great measure, the direction of the coast,—being generally from W.S.W. round by North to the East—the former being most prevalent in winter, and the latter in summer. Excepting as a land breeze near the shore, the South wind seldom blows steadily, though it is occasionally both hot and violent. Between Melila and Ceuta, vessels must not be caught (in the bad seasons) by a North-easter, which is apt to rise suddenly and bring a high sea. Breezes from the East often draw round to South, and are sometimes—especially in the autumnal months—

immediately followed by a West wind: the Westerly winds, if light, are accompanied by fine clear weather,—but when strong, they are cloudy, with a high sea, and, if in winter they veer to the North, accompanied by a swell from that quarter, a brisk gale may be expected. The weather is treacherous in the winter season and should therefore be watched."

6. Cadiz.—Within the Gulf of Cadiz and thence to the Strait of Gibraltar, easterly and westerly winds are the most prevalent, while on the coast of Portugal, northerly and southerly winds are most common. By the term "*Levanter*" we mean those which blow from E.N.E. to E.S.E.; and by that of "*Poniente*," those blowing from the opposite points, or from W.N.W. to W.S.W.

The Levanter, or Easterly Winds.—Within the Mediterranean, Easterly winds are generally moist and attended with foul weather, heaping dense clouds on the mountains on the eastern side of the Strait of Gibraltar; but they are very dry and clear on the coast of Cadiz, Huelva, and Algarve, for, in traversing the heights of Algeciras, they dissipate their moisture and mist on the cordilleras which separate the high from the low land. The strength with which the easterly wind blows, increases until it passes the meridian of Tarifa; but it looses its strength as it approaches Cape Trafalgar, and frequently does not even reach Cadiz. It must be observed, however, that the strong *Levanter* which scarcely reaches Cadiz is experienced on the parallel of the Strait to a considerable distance from its western entrance. It is also to be noted that while the fresh *Levanter* prevails within the Strait, land and sea-breezes may be blowing at Cadiz, and in the Gulf of Huelva,—Cape Trafalgar being generally the dividing limit of the contending winds. Thus it is common, particularly in summer time, for a vessel to run through the Strait with a strong *Levanter* and then into Cadiz with a fresh sea-breeze. In such cases the *Levanter* carries the vessel to the meridian of Tarifa, and sometimes to that of Trafalgar, its strength abating, and hauling gradually to S.E. and South until it arrives at S.W. or W.S.W. If the navigator, bound to Cadiz, foresees this change, he does not keep along the coast, but runs on a parallel to the southward of Tarifa, so as to well clear of Cape Trafalgar, and in a good position when he catches the sea-breeze to make Cadiz with it. Sometimes the Easterly wind is two or even three days in reaching Cadiz, although it may be strong in the Strait. Sometimes also may reach Chiclana and Carraca without touching the mouth of the Cadiz bay where only the sea-breeze prevails; but soon becomes general, extending gradually over the whole coast as far as Cape St. Mary or even west of this cape. Occasionally it does not pass the Broa de Sanlúcar. Yet when the *Levanter* is spreading as just observed it is also intermittent,—coming in gusts of brief duration; in these cases vessels from the Strait making for Cape St. Vincent have it either partially or in gusts until it becomes general. Sometimes it does not pass the meridian of Cape St. Mary where it generally meets the westerly wind. On the coast of Cadiz—between Cape Trafalgar and the mouth of the Guadalquivir—the *Levanter* also comes in gusts; but when once established, above all in summer, it lasts sometimes as long as fifteen days together. Perhaps the only intermission is about sunset, and slackening throughout the night, but it regains its strength as the sun gets to its height; thus it sets in with gusts soon after sunrise, and blows hardest about noon.

The greatest scourge of the bay of Cadiz is undoubtedly the *Levanter*. When this wind has lasted a week, or a fortnight, especially in those places well exposed to it, all mercantile transactions are suspended, and the most powerful boats scarcely venture out except in the night or early morning when it is slack,—and at which time the *Levanter* occasionally becomes so light that it even assumes the characteristics of the land-wind and will draw to the north-east; but as soon as the sun is up it again makes itself felt in strong gusts, and at nine or ten o'clock no boat can cross the bay. This happens in the hot season, and at times when it is scarcely felt in the eastern entrance of the Strait of Gibraltar. Westward of the meridian of Tarifa the *Levanters* are very dry and clear, especially in summer. When, in this season, they blow with the intensity above-mentioned, they are attended with a suffocating heat, which obliges the people of Cadiz and its vicinity, as a protection from it, to close their houses to prevent the dust which it brings from entering their dwellings. It also destroys the crops, and affects the health. Within the bay it blows from E.S.E. and S.E., excepting about daylight when it is E., or even E.N.E. While the *Levanter* lasts, the sky keeps clear; but the horizon is somewhat hazy. Dryness is its distinctive character on the western coast of the province of Cadiz, one totally different to that which it presents on its eastern shore, where it is remarkable for its humidity. The most lasting *Levanters* set in gradually, in which case they do not reach Cadiz until they have prevailed for two or three days in the Strait: those which come suddenly (and perhaps with much strength) are the soonest over. In winter the *Levanters* do not last long, and at their commencement are clear, but lose this quality as they draw to S.E.; then they also bring heavy clouds and showers—sure signs that they will haul to the southward, and change to the *Vendaval*.

The indications of the *Levanter*, are the entire absence of dew, and the peculiar dryness of every thing about the decks. In calm weather, or when the wind is very light from the westward, this dryness is very evident, and at the same time light threads of gossamer will be seen clinging to the rigging; the same phenomenon is found at Vera Cruz with *Northers*, and at the Rio Plata with *Pamperos*, as well as in the interior of continents when dry winds prevail.

The experienced mariner who may be at Cadiz knows very well when the *Levanter* prevails in the Strait. If he sees on the heights of Ubrique and the more elevated mountains of Algeciras little white clouds like bunches of raw cotton adhering to their summits, he knows they are proofs of the easterly wind blowing in the eastern entrance of the Strait. And if, with these proofs, he experiences the suffocating heat which accompanies this wind, and also its dryness.

he concludes that the *Levanter* will soon be with him, although at the time the westerly wind may be blowing in the bay. Seamen in the Gulf of Huelva, or off the Broa de Sanlúcar, know that the *Levanter* is blowing at Cadiz and in the Strait, when the sun at rising presents a white appearance, and the land has a haze hanging over it.

Light land and sea-breezes (*viruzon*) are also a precursor of the *Levanter.* When it is found that the daily sea-breeze begins to decrease in strength, and when at night (hauling to the land) it inclines more to N.E. than N.W., accompanied by some light broken clouds, it may be expected shortly. It may also be expected when the heights of the distant mountains are distinctly visible. These same heights will remain clear while the wind continues N.E. or East; but as soon as their summits become clouded the wind may be expected to draw to S.E., and this is the wind that soonest overcasts the sky. The winds which preserve the clearest atmosphere are those from N.E. to East.

The barometer also announces the *Levanter;* a small depression in this instrument, and a simultaneous rise of the thermometer are indications of the quick approach of that wind; but as soon as it has set in, the mercury again rises.

After the *Levanter* has been blowing for some days, especially in summer, if the barometer is found to rise, this wind may be expected soon to cease, even if it be blowing in heavy squalls; and, in fact, it will be gone the next day, and be succeeded by a wind from the opposite quarter.

The Poniente or Westerly Winds.—These winds alternate with the *Levanter,* and consequently blow in all seasons. They are distinguished by their healthy influence on the animal system,—their freshness mitigating that heat and dryness which are the effects of the *Levanter.* The *Poniente* in contra-distinction to the *Levanter* is moist and generally accompanied by clouds. It never blows so hard as the *Levanter,* nor is it so persistent; and it generally lulls or goes down with the sun. In winter when these winds draw to S.W. they bring heavy clouds,—and showers which expend themselves in wind as well as in rain, in such a manner as to obscure the whole coast; still, between the showers, there are in general sufficiently clear intervals to enable the navigator to make his easting along the coast. If they draw to the N.W. they are clearer and generally last for intervals of eight or ten days.

The approach of the *Poniente* is marked by the dew which is deposited in the interval of the easterly wind, at night or early in the morning.

Veering of the Easterly Wind by the South to West.—In general before the West wind is set in, the Easterly wind will gradually lessen in force and veer by S.E. and South to S.W., accompanied at the same time by a fall in the barometer. Should this happen in winter the sky begins to become overcast as soon as the wind gets to S.E.; it blows from this point for a day or two, the barometer continuing to fall, and the wind then becomes South. As soon as it reaches this quarter the sky is entirely overcast, and the wind freshens up and changes to S.W., accompanied by heavy clouds and constant rain. In this state of the weather the barometer is at the lowest, and the wind may be soon expected to veer to West if the barometer has a tendency to rise and the rain becomes less frequent.

On the coasts of Huelva and Cadiz the East and West winds divide the year between them. It should not be supposed, however, that the easterly are more persistent than the westerly winds. The latter are more frequent than the former; but as the east wind is the scourge of Cadiz Bay and its vicinity, while the westerly wind mitigates and cools the atmosphere, a single day of easterly wind is more notable, than a week of westerly.

The annexed table will show the general prevalence of each wind, and corroborate what has been stated with regard to the excess of Easterly and Westerly winds.

Wind.	Number of Days of each Wind.					Total Days of each Wind.	Annual Average Days.
	1856	1857	1858	1859	1860		
Calms	0	1	2	1	1	5	1
Light Variable ...	19	16	4	28	20	87	17
North	2	6	13	5	8	34	7
N.N.E.	14	11	11	13	12	61	12
N.E.	14	16	15	22	12	79	16
E.N.E.	4	9	10	9	2	34	7
E.	76	72	50	46	53	297	59
E.S.E.	6	11	17	3	5	42	8
S.E.	12	13	9	16	16	66	13
S.S.E.	3	3	5	2	...	13	3
S.	14	16	18	6	9	63	13
S.S.W.	12	14	6	6	6	44	9
S.W.	28	27	35	27	30	147	29
W.S.W.	35	29	38	46	40	188	38
W....	27	31	22	27	26	133	27
W.N.W.	26	27	18	23	40	134	27
N.W.	70	55	84	79	81	369	74
N.N.W.	4	8	8	6	5	31	6

Results;—annual average—

Number of Days	N.	7	...	Number of Days of	1st quarter	94
,,	S.	13	...	,,	2nd ,,	87
,,	E.	59	...	,,	3nd ,,	102
,,	W.	27	...	,,	4th ,,	113

Days of Levanters, during the five years (total) 378; annual aver. 75.

Days of Poniente ,, ... 455; ,, 91.

This table has been formed from the daily official journal kept in the tower of Tavira; and the wind has been taken at noon of every day, when it is considered definitively established.

It will be seen from the above table that westerly winds (or those between W.N.W. and W.S.W.) much exceed those from the eastward (between E.N.E. and E.S.E.) although the number of days of East wind is considerably in excess of those from West. This must be attributed to the fact that the winds from the third quarter (or S.W.) are always more lasting than those of the second (S.E.), as those of the fourth (N.W.) are more so than those of the first (N.E.); consequently the Westerly which participate with S.W. and N.W., have a great predominance over the Easterly winds which participate with opposite points N.E. and S.E.

N.W. Winds.—The most prevalent winds at Cadiz and its vicinity are those of the fourth quarter, and of these, the N.W. predominate, which circumstance arises, in our opinion, from that bay being situated at the eastern limit of the Gulf of Huelva.

S.W. Winds.—Next to winds of the fourth quarter, those of the third may be considered to predominate; they bring the storms and rains of winter, and are what in summer constitute the *Virazon* (sea-breeze).

Northers.—Northerly winds are rare, coming generally in the winter. They must be considered as land winds, and always incline to the N.E.—if in the Mediterranean the *Levanter* prevails; but to the N.W. if, in the ocean, a westerly wind is prevalent. The winds of the first quarter (between N. and E.) are the least violent and mostly bring clear weather.

Southerly Winds.—Southerly winds are not frequent, for in winter they soon haul to S.W., and in summer they form part of the *Virazon* (sea-breeze) and are transitory.

N.E. Winds.—N.E. winds are most frequent from March to September, but blow hardest in April and May.

Although *Levanters* may blow at any time of the year, they are most frequent in the months of March and April, and in the hot months. In July, 1856, there was a whole fortnight of continuous East winds,—and also in August of that year.

From November to March (the winter months) S.W.-ly winds are most prevalent; and they are certainly the winds most to be feared in the Gulf of Cadiz, for, besides blowing strong, they bring heavy and constant showers which obscure the land, and also send such a sea that all the bars become impassable. These winds, called *Vendavales*, vary between W.S.W. and S.S.W. Fortunately they give good notice of their approach, and the navigator who may either be cruising off Cadiz or to the westward, can get clear of the shore to the parallel of the Strait, and if necessary he can always be sure of the Strait.

Signs of the Vendaval.—If the easterly wind veer to S.E. the sky becomes obscured and the coast hidden, especially the Broa of Sanlúcar; the wind may then be expected from the southward with rain, and soon the *Vendaval* will follow. This change is always preceded by a considerable fall of the barometer.

A calm with a dense fog is always a sign of the *Vendaval*. In winter after the *Levanter* has been blowing, if it draws from S.E. to South, and continues so, with light misty airs, a gale may be expected from the offing. Should a vessel be overtaken by a *Vendaval*, the whole coast between point San Sebastian and

Cape Trafalgar must be avoided as it is dangerous;—being beset with reefs, the sea breaks at a great distance from the shore, and it often happens that breakers are seen before the coast is visible. In the Gulf of Huelva a vessel runs great risks, for in addition to the breaking sea which is raised by the gale there is a set towards the shore; and if the navigator should not have sufficiently foreseen this, so as to provide for getting away from it, and becomes hampered with it, he may reckon himself fortunate if he be not wrecked on the Arenas Gordas. On that portion of coast between Cape St. Mary and Cape San Vicente the risks are not so great, for with the wind at S.W. a vessel can escape by standing off S.E. unless the wind be so strong that with it and the sea together she cannot weather Cape St. Mary.

In respect of the coast of Africa, included between Cape Mazigan and the Strait, there is not so much risk there with the *Vendaval*, because the land trends much in its direction and it has no great sinuosity. The worst winds on it are from W. to N.W., and with these a vessel should take care not to risk her safety in Jeremias Bay. What is most to be apprehended in this part is the sea which gets always up, which, in a gale on shore, will very soon lose a ship and her crew, should she unfortunately in the thick weather of the *Vendaval* mistake this Bay for the entrance of the Strait, a mistake indeed which has been fatal to many vessels.

Veering of the Vendaval.—Although usually the *Vendaval* does not last above three days, sometimes it is stubborn and will continue for nine or even twelve days with but slight interruptions. If after blowing strong it veers to west, fine weather may be looked for, because it does not remain long at this point, but hauls to N.W., which is generally the concluding quarter of the gales in our hemisphere, and is that which clears up the atmosphere. But if from west it returns again to S.W., bad weather will begin afresh, and the wind will blow harder than before although it may not last so long. But when it becomes steady at N.W., it very seldom backs to S.W.

The wind once established at N.W., it may blow hard for some days, after which it will become more moderate and is almost always attended with clear weather, although blowing harder by day than by night. If it change to north afterwards, it seldom remains so long, for it will pass to N.N.E. and then to N.E., where it will remain for some days more. This wind is always the precursor of the *Levanter*.

In winter time in the Gulf of Huelva N.E. winds are the almost certain sign of the *Levanter* blowing at Cadiz and in the Strait of Gibraltar, as the N.W. winds are of there being a westerly wind on the south coast of Portugal. In this Gulf of Huelva, far enough from the Strait, the *Levanters* are not so fresh nor yet so lasting: they sometimes take two or three days to reach Huelva, and die away here before they cease at Cadiz.

Baffling Winds.—When the *Levanters* enter the Gulf they do so by fits and starts, and are preceded by light baffling winds (from all parts of the horizon) that are called *Macareos* by Spanish sailors. If these baffling winds are attended by a suffocating heat in summer time, indicating the approach of the *Levanter*, they generally lasts some days when once set in, blowing hard from S.E. while the sun is high, and drawing to N.E. at night with fine weather. But in summer in the Sevilla river their heat is intolerable.

In winter time in the Gulf of Huelva the continuance of the north-easterly wind is generally considered a sign of the *Vendaval*, and as soon as it passes to the eastward this terrible wind may be expected, for then it soon becomes S.E. and shifts to south and S.W. As soon as the wind begins to veer thus, and the barometer falls, a vessel should get out of the Gulf as soon as possible into deep water, and avoid compromising her safety by getting hampered with the Arenas Gordas.

It frequently happens that while these winds are prevalent in the Gulf, the *Levanter* is blowing at Cadiz and in the Strait, and the *Poniente* prevails at Cape San Vicente,—with the Portuguese land clear, or only slight clouds at the mouth of the Guardiana.

Old sailors who know the Bay of Cadiz and its neighbourhood, have an idea that the climate of those parts has undergone a change of late, an alteration which they consider extends even to winds and storms. They consider that of late, storms are scarce in comparison with those of former times, when bad weather commenced in September and lasted until the spring; storms following each other with scarcely any intermission.

It seems that the general tendency of storms now almost as soon as they are established is to slacken, and not to last any time. But at any rate both in summer and winter the wind is more variable, and it is seldom observed the same wind will last for fifteen days together as in their opinion it used to do formerly.

Storms scarcely ever get up on the coast of Cadiz, but come from other parts more or less distant. A storm at Cadiz, even when remarkable for the force of the wind, is soon over; and in general bad weather comes from the S.E., a quarter from which the wind is much stronger than from the east.

Land and Sea-Breezes.—These partial winds proceeding from the same causes as those which give rise to the Trade-winds, are common during summer in the Bay of Cadiz. The sea-breeze, as in tropical countries, is found on the coast at Cadiz in summer when the East wind does not prevail, and are strong and lasting in the Gulf of Huelva.

Sea-breeze on the Coast of Cadiz.—From 9 to 10 o'clock in the morning the sea-breeze sets in gradually and veers to S.S.W. and S.W., as the sun gains height, attaining its greatest strength when the sun has passed the meridian, or at the hottest time of the day, and gradually subsides as the sun loses height, veering westerly until 8 or 9 o'clock in the evening when it falls calm. After two or three hours of calm the land-wind gets up, acquiring more strength in proportion as the coolness of the night increases. At daylight it has attained its utmost strength, and fails gradually as soon as the sun appears and begins to warm up the ground again to receive in its turn the cool sea-breeze.

In the Gulf of Huelva this land-breeze is from N.E. and E.N.E in the Bay of Cadiz; while on the African Coast it becomes E.S.E. When the land-breeze blows from the east in Cadiz Bay it shows that the *Levanter* is blowing in the Strait of Gibraltar.

Sea-breezes in the Gulf of Huelva.—These sea-breezes in the Gulf of Huelva begin at S.E. and leave off at N.W. In summer time they are almost constant, and while they last a vessel will be safe off the coast, even to anchoring to obtain water, or to rest from a cruize. Off the Cadiz coast the sea-breeze is not so strong, for it is subject to interruptions from the easterly wind, which is not so frequent in the Gulf, inasmuch as that noxious wind does not reach so far.

Although the sea and land-breezes belong to summer, they also come in winter attended with long intervals of fine weather.

7. **Winds on the Western Coast of the Peninsula.**—The prevalence of polar and tropical winds on the western shore of the Iberian Peninsula may be considered as constant; those from N.W. and S.W. are but inflections from them, and those from N.E. and S.E. may be considered as land-winds or from the opposite quarter.

On the south coast of Portugal, which forms a portion of the Gulf of Cadiz, winds from the S.E. and S.W. quarters are most prevalent, and the dividing limit between the winds from these two quarters may be considered as Cape San Vicente; so that a vessel doubling this Cape from one side or the other finds shelter from S.W. or S.E. winds, as the case may be.

In like manner, for a third-part of the year, northerly winds are found to prevail, the wind varying between N.E. and N.W., fresh, with clear weather during the summer, and cloudy or showery during the winter.

From April to October northerly winds mostly prevail; southerly winds blow during the other months, that is, S.W. winds prevail from November to March, and they generally leave off at N.W. When in the fine season the *Vendaval* prevails it is moderate and seldom lasting.

Southerly and S.S.E. winds, from December to March, scarcely blow for twenty-four hours, for they will be light with rain about a day, and then jump to S.W. where they remain longer, and leave off at West or W.N.W.

Winds of Winter.—Bad weather begins on this coast in November and ends in February. During these winter months heavy rains take place, and they come with S.W. and N.W. gales. The *Vendaval*, which is the term among the seamen of these shores given to the severe weather from S.S.W. to W.S.W., brings up heavy clouds from the southward, preceded by a light mist which scuds with more or less velocity according to the strength of the wind which may be expected.

Signs of the Vendaval.—When the sky is clear, and small, high, and scattered clouds appear embellishing the firmament (cirro-cumulus) and to which navigators give the name of *ciero aborrigado* (mackerel back), the *Vendaval* may be expected, especially in winter, the sky then becomes completely overcast, and the wind settled at south. If the *Vendaval* is strong it will bring abundance of rain in the first twenty-four hours and will next change to the S.W. where it will continue for two or three days, afterwards veering to West, and perhaps to N.W., always blowing hard, but perhaps with less rain.

The appearance in the rigging of those threads to which allusion is made on p. 85, is also a sign of the *Vendaval.* These, however, are mostly limited to very fine clear weather when all is calm and quiet. When this sign appears in winter a southerly wind may be expected, which will soon freshen to a gale, with rain. In summer this sign is preceded by cloudy weather and winds from the S.W. and N.W. quarters, which are those that bring rain.

There are some years when, during the whole of the winter, the S.W. and N.W. winds set in more or less strong, but always accompanied by showers,—the interval of clear weather between them being brief, and in these intervals the wind will shift from N.W. to North and N.E., at which points it will remain, and bring fine weather, until it returns to S.W.

Backing of the Vendaval.—When the *Vendaval* drops to a calm, and showers cease—there having been no N.E. wind—the S.W. wind may again be expected, with a return of bad weather, far worse than before. But in order to have any confidence in the weather, the *Vendaval* must take its normal course; having terminated at N.W., should the wind change to N.N.E. or N.E., it will be settled for several days.

The north-easters in winter are also attended with an overcast sky and occasionally showers accompanied with snow or hail, but in general they bring clear weather. In summer when they blow hard they are accompanied by a mist so that the coast cannot be seen from 12 or 15 miles off.

When about the end of winter the ground is saturated with wet, the *Vendaval* will not reach the coast, and vessels which may be running from bad weather at sea to some inlet, will find the wind change to the South or S.E. on nearing the coast. S.E. winds however are rare, and when they blow in winter they are attended by heavy snow showers and are very strong. The Easterly wind is always the coldest.

The Northerly winds, properly so called, vary between N.N.E. and N.N.W., and are mostly found on the west shore of the peninsula; they prevail from May to September, interrupted with light *Vendavals*, and are almost always attended with a clear sky.

The *Vendavals* of this season, which are almost always of brief duration, bring cloudy weather, which does not clear away until the wind veers to N.W. on its way to North. In proportion to the density of the clouds which the *Vendaval* brings, the shorter most probably will be the duration of the wind. Notwithstanding the general prevalence of northerly winds in summer on this coast it is also very liable, and especially on the coast of Galicia, to waterspouts, with violent gusts of wind and rain, the effects of opposing winds.

Waterspouts:—These phenomena will form with an easterly wind or perhaps some off-shore wind, at the time when the wind at sea is from S.W., and as the clouds which this wind accumulates over the coast are driven back by the off-shore wind a whirlwind and waterspout are the result. Sometimes the waterspout is formed instantaneously, accompanied by heavy thunder and rain, for which it is necessary to be prepared by shortening all sail, for it is usually attended with much wind. These opposing winds occur in August and September, and in summer when there is much heat.

As there are years with hot seasons on the coast of Cadiz and the Strait of Gibraltar from the prevalence of *Levanters*, so also are there years of cold seasons on the coast of Portugal, arising from Northers.

Thus, on the coast of Portugal—from cape San Vicente to cape Finisterre—Northerly winds, variable between N.E. and N.N.W., are prevalent during nine or ten months of the year; they are fresh, with fine weather during the summer. The winter gales generally come from South and S.W.,—sometimes from W.S.W.,—and blow very hard.

The following table formed from meteorological observations made at Lisbon will give a good idea of the winds which have prevailed there for two consecutive years, from the first of October, 1863, to the end of September, 1865.

Winds.	No. of Days it lasted.	Observations and Remarks.
Calm	10	They are generally clear and fresh during all the year, especially from May to September.
North	128	
N.N.E. ...	96	
N.E.	110	
E.N.E. ...	28	
East	88	They are fresh and attended with rain or snow from October to April, especially with winds from S.S.E. to W.S.W. Fogs are frequent from October to February and generally with S.E. to S.W. winds.
E.S.E. ...	18	
S.E.	9	
S.S.E. ...	2	
South	28	
S.S.W. ...	45	
S.W.	50	
W.S.W. ...	25	
West	26	
W.N.W. ...	18	They are fresh with snow showers and often rain in summer. In winter fresh and showery.
N.W.	49	
N.N.W. ...	56	

In detail, the foregoing table may be resolved into the following one, showing the prevalence of the wind from each quarter—

Months of Observation.	Winds of N.E. Quarter.	Winds of S.E. Quarter.	Winds of S.W. Quarter.	Winds of N.W. Quarter.
	Days.	Days.	Days.	Days.
1863, October	12	5	8	5
November	24	5	0	1
December	25	0	2	2
1864, January	19	7	2	3
February	12	0	11	5
March	13	3	11	2
April	12	3	6	6
May	14	5	8	6
June	15	4	3	8
July	14	5	8	9
August	18	2	5	6
September...	19	6	2	3
October	8	3	17	3
November	13	3	6	8
December	15	2	4	10
1865, January	6	2	15	8
February	15	2	3	8
March	20	0	4	7
April	9	4	10	7
May	15	2	9	5
June	14	4	5	6
July	20	0	1	10
August	14	0	6	11
September...	17	0	7	5
In the Two Years	363	67	148	144

From the above it appears that winds from the Northward, or those from between N.W. and N.E., both inclusive, have prevailed for ... 439 days

From South or between S.E. and S.W. ... ... 184 „

From East or between E.N.E. and E.S.E. ... ... 84 „

From West or between W.N.W. and W.S.W. . ... 64 „

So that the prevailing winds for the period of two years were from the North,—the preponderance of which over the rest, is remarkable; and they were most persistent from May to September.

It must be noted that the observations were made at 9 A.M., a time when perhaps the wind for the day is not established according to that outside, especially in winter; and that the place of observation was the observatory, which besides being well up the river Tagus (or rather the Lisbon estuary) is subject to the prevalence of the land wind which commences at the lower part of the Tagus. Observations carefully made at the lighthouse on the Berlings will give us hereafter etter idea of the winds which prevail on the western coast of the Peninsula. Nevertheless we may be satisfied from the above results that the prevailing winds on the coast of Portugal are Northerly; those from the opposite quarter prevail from October to April, and they alternate with winds from West to N.W.

8. Bay of Biscay and West Coast of France.—In the bay of Biscay the winds are very variable. In winter they generally blow from S.W. to N.W., more frequently perhaps from the latter quarter. From May to September Easterly winds—between E.N.E. and E.S.E.—are not uncommon; occasionally, they also blow fresh and with considerable persistence in December and January; when they come from the N.E., they are squally and strong, bringing rain; and a gale from the Eastern horizon will most probably blow from East to S.E., in which case it may be expected to be severe.

Winds due North or South are not common in the Bay of Biscay; at intervals, when they do occur, they may freshen and become squally, the South wind changing to S.E. or S.W., and the North wind passing into the N.E. or N.W. quarter. A breeze springing up from a point opposite to the sun never lasts, but merely indicates a temporary derangement of the course of the prevalent wind.

On the West coast of France, the prevalent winds are those from S.W. to N.W., which blow across the Bay of Biscay; they frequently last for seven or eight months, and in winter freshen into heavy gales. Winds from W.S.W. and S.W. generally bring rain or fog, while those from N.W. are squally with intervals of fine weather and clear sky; the N.W. winds, when moderate generally bring fine weather, which, in winter, is occasionally interrupted by heavy squalls accompanied by hail and thunder; they are known on the coast as the *orages de mer*. In summer the prevalent S.W. winds are alternately moderate and fresh, with occasional foul weather; but they are generally accompanied by a bright clear atmosphere at that season.

On the Coast of Brittany, gentle S.W. winds are characteristic of the summer season; but in the winter they blow strong from that quarter, veering to the West and N.W., bringing a gale with heavy squally weather.

9. The English Channel and Bay of Biscay.—At the entrance to the English Channel the wind is very variable, but those from the Westward greatly predominate—with more or less of northing or southing; they are probably most persistent from September to November (both months inclusive): Easterly winds may be expected at any time between December and March—sometimes appearing early, sometimes late in the season—not unfrequently lasting for a fortnight or even a month—causing great detention to homeward-bound vessels. It has also been remarked that, from whatever direction the wind is blowing in the open ocean, it has a general tendency to draw up or down both the English and St.

George's Channels, and it is from this tendency that the detention occurs with those vessels whose course may be in the opposite direction to the prevalent wind.

In the English Channel, as well as in the Bay of Biscay, when the wind is from S.W.—in winter or summer—if it blows in gusts with rain and the squalls increase in force—the wind at the same time being unsteady—a change is approaching; this change is generally from S.W. to W. or N.W. in a heavy squall, and it may continue to blow hard from the new direction for some considerable time. Should the shift of wind from S.W. to N.W. be preceded by a short calm, it may be regarded as a cautionary signal to make all snug for heavy weather.

10. **In the Eastern Part of the English Channel,** S.W. gales are the most dangerous; blowing in violent gusts, and accompanied by rain, the wind sometimes veers to N.W., North, and even to N.E. without abating its strength; should it back to S.W. the bad weather continues, but if it has moderated towards the northern points fine weather may be expected. Gales often follow strong S.E. and South winds which are accompanied by rain; on such occasions the squalls fly round to N.E. and North, where if it remains, fine moderate weather follows; but should it return to S.E. or South bad weather continues. Gales from North and N.E. though strong at times, do not last long, nor does the wind shift about as it does with those from the westward. Moderate N.W. and N.E. winds bring fine weather. During summer, a light S.E. breeze in the morning changes to a fresh N.E. breeze at noon, decreasing towards evening and is followed by a calm.

In all parts of the English Channel dead calms are rare, and in winter generally indicate bad weather.

Fog and haze are common at all seasons. Winds from the western horizon almost invariably bring thick clouds and a moist haze, which, hanging over the land, obscure it from view. The haze of the Easterly winds, also, is often very dense in the eastern part of the channel.

11. **The Channel Islands**:—In this part of the English Channel from April to September the winds are variable and uncertain.

During winter the prevailing winds vary from S.S.E. to South, West and W.N.W.,—those from the latter points are often very violent and disastrous in their [results on the shipping. The South and S.W. winds of this season bring stormy weather, which rarely clears up until it has changed to N.W., which it generally does. The Easterly winds of winter have more persistence in this vicinity than in any other part of the Channel; and all gales between North and South, by the Eastward, blow in squalls and strong irregular gusts.

CHAPTER IX.

THE CARIBBEAN SEA; THE GULF OF MEXICO; AND THE WEST INDIES.

1. **Guayana**:—On the coast of Guayana winds between N.N.E. and E.N.E. are experienced from November to May; in April, May and June, however, they are frequently variable with calms, after which winds between E.S.E. and S.E. set in—the latter generally prevailing from June to December. The wet season lasts from December to June; but during the dry season showers are not unfrequent, accompanied by storms.

2. At French Guayana, N.N.E. and N.E. winds prevail from November to March; during March and April they are variable between East and South; from May to July (both inclusive) they return to N.E., when calms are rare and the land-breeze ceases. The rainy season lasts from the middle of November or beginning of December to the end of July; the dry season from July to November; the heavy rains fall from December to February, and sometimes to March; during March and April there is an interval of three weeks or a month during which no rain falls, called *l'été de Mars* (the March summer),—this is the separation of the two rainy seasons; the rains re-commence in the middle of April, and terminate in July. Winds from the N.E. are characteristic of the rainy season, as those from E.S.E. mark the dry season,—and generally winds between East and South bring fine weather.

3. Demerara.—Observations made at Demerara give the following results:—

January,—wind Easterly; generally fresh and cool.
February,—wind N.E.; weather overcast and cloudy; showery.
March,—wind E.N.E.; heavy clouds, with frequent showers.
April,—wind Easterly; warm; no rain.
May,—wind N.E.; cloudy, lowering weather with lightning; rainy.
June,—wind Southerly and variable; hot, with rain at intervals.
July,—wind from East to South; hot; overcast.
August,—wind Southerly; hot, with rain at intervals.
September,—wind from South to East; hot, with thunder and lightning.
October,—wind variable but fresh, accompanied by gentle showers.
November,—wind from North and East, fresh, with light rain.
December,—wind N.N.E.; very fresh, and cool; heavy rain.

4. In the **Gulf of Paria**, during the dry season—from November to June—the sea-breeze commences about 9 A.M. blowing from East to E.N.E.,—in

January and February more northerly; it continues fresh until 6 P.M. when it lulls, being succeeded by calms and light airs which last throughout the night. During the wet season—from July to October—violent squalls from S.E. to South and West are not uncommon.

5. Cumana, Caracas and Gulf of Venezuela.—The Trades are constant here and follow their regular course, from E.S.E. and E.N.E.; between Point San Blas and Cape la Vela the direction is generally more northerly; during March, April, May and June the E.N.E. wind is frequently very strong and may rise to a gale, its force, however, being greater at sea than near the shore, and under any circumstances greatly abating at night. From July to December or January, the general Trade is interrupted at short intervals by a westerly wind accompanied by storm and rain (the *Vendavales* or head winds). In the Gulf of Venezuela, and thence northward, the Trade from E.N.E. at dawn will generally be at East, and E. by S. at noon, when the weather is fine, offering an advantage in a windward beat and enabling vessels to stem the current for some hours.

6. St. Marta, Cartagena, Darien.—At CARTAGENA the fine season begins in December and lasts till April; at PORTOBELLO it begins a month earlier; during that period the N.E. Trade is regular. The wet season, which also brings storms, is from May to November, when the winds are from S.W. to W.S.W. (the *Vendavales*) frequently very strong. In November and December it occasionally rains very heavily and the breeze is strong; during the wet season a species of tornado is not unfrequent. On the ISTHMUS OF DARIEN the Trade-wind from N.N.W. to N.N.E., blowing very strong, prevails during the dry season—from January to April; in the rainy season, the land wind blows from the mountains, with occasional squalls and rain, from the S.W.; S.E. or East winds seldom blow with any force. The strong Trade-wind causes a heavy sea along the coast.

7. Costa Rica, &c.—The Trade is regular (N.E. to E.N.E.) during the fine season from January to June; during the wet season from July to January the general S.W. and W.S.W. winds (*Vendavales*) are prevalent but not constant.

8. West Coast of the Caribbean Sea from Grey-Town to Cape Catoche:—This region embraces the MOSQUITO shores, the BAY of HONDURAS and the east coast of YUCATAN; the N.E. Trades are prevalent during February, March, April and May; they are occasionally interrupted during February and March by winds from the North and West. In June, July and August winds between S.E. and S.W. are common; they alternate with heavy squalls and calms. The rainy and stormy season is from September to February; the wind then blows from the S.W. and N.W., with heavy gales from W.S.W. to W.N.W. and North. In the bay of Honduras and thence to the northward, land and sea breezes are regular during the dry season; the sea breeze commences at 6 A.M. and lasts till evening;

during the rainy season this breeze is usually light or perhaps altogether fails. It is generally thought that the Northers do not extend as far as the bay of Honduras, but that when they are prevalent in the Gulf, a strong S.W. wind is felt in the bay, accompanied by a falling barometer and the usual appearances of a Norther; a sure sign of this wind is the Trepong mountains being free from clouds. Among the islands near this coast the wind in the morning is frequently from E.S.E. to S.E. changing to E.N.E. and N.E. in the afternoon.

9. Belize:—There are two descriptions of North wind generally prevalent at Belize in January,—one with wind from the N.E., unaccompanied with rain and dampness, very pleasant and agreeable, and called the "dry North;" the other with wind from the N.W., attended with thick mists and a constant dripping, mizzling rain, very damp and disagreeable, is called the "wet North." The latter always produces a host of complaints—none of them very serious, however, as the malaria seldom continues long.

Sometimes, during the "Northers," it is quite calm and still in Belize; but the noise of the breakers dashing against the reef and islands in the gulf is distinctly heard, and indicates the state of the weather outside.

The Pilots here say, when the water is clear and transparent outside, foul weather is sure to set in from the North.

At certain seasons of the year, when the swamps are either quite full or thoroughly dry, no sickness occurs to speak of; but when they are only partially dry (in a marshy state), with the land-wind prevailing, then the deleterious emanations from decomposing vegetable matter affect the sanitary state of the place in a very sensible degree. But it is principally the lower orders, and those living in dirty and filthy localities, that are seriously attacked.

Belize is built on a dead level along the shore in front of the sea facing the east; and dark mangroves, and festering swamps, and decomposing vegetable matter surround the town on the other sides; so that were it not for the prevalence of the East wind, which blows all the deleterious emanations into the back woods, the town would be very unhealthy indeed; but fortunately this easterly wind generally prevails and brings health and freshness to the place. But even then the breeze does not seem to circulate freely; for the different rooms differ materially in temperature as they receive more or less of the breeze *direct;* and in those facing the east, one hardly feels the cooling influence, unless he stands in front of a door or window; the moment he steps aside against the intervening wall, he feels as if there was no wind at all.

Upon the whole, however, the inhabitants seem to enjoy tolerable health, as is shown by the bills of mortality, and testified by many living to the age of 60 and 70. The yellow fever is *not* endemic; but it was *imported* here in 1859, when a great many persons, *natives* as well as Europeans, died. Even the *negro* lost his assigned immunity, and did not escape. It had not been known here for some twenty or thirty years before. Intermittents and Rheumatism are the prevalent complaints.

10. Yucatan from CAPE CATOCHE TO CAMPECHE AND LUGANA DE TERMINOS:—The regular Trade-wind prevalent from October to March (both inclusive) is occasionally interrupted by strong North winds. Squally weather from N.E. to S.E. sometimes sets in during April, but in general it is fine and moderate till June, after which a season of gales and squalls alternating with calms, continues till September; this is the rainy season and the sea-breeze is then from N.N.W. to N.E.—and the strength of the squalls is augmented in proportion to the freshness of this breeze. The land-breeze is from S.E. to E.S.E.. At LAGUNA DE TERMINOS the rainy season is from May to August and lasts longer than at Campeché; the rain is heavy and continuous during July and August.

11. Vera Cruz.—At Vera Cruz the rainy season commences about the middle of May and terminates in July; the Trade-wind is then interrupted by stormy and uncertain weather, accompanied by fog: from July to October gales and squalls are very frequent,—the heaviest are from the Eastward, but they do not last long.

Winds from the North prevail from October to March; they blow strongest from 9 A.M. till 8 P.M. and generally fall light at sunset. If, however, this wind does not commence till the afternoon, it blows with increasing force during the night, shifting to N.W.; and then should it veer to S.W. as morning dawns, the regular sea-breeze will set in at 9 or 10 A.M. A North wind shifting to East is a guarantee for fine weather—which may last five or six days. When the wind backs from N.E. to North the weather is always uncertain.

12. West and North Coast of the Gulf of Mexico:—From Vera Cruz to Matagorda Bay, East and S.E. winds prevail from April to July or August, passing to S. and S.W. during the night. The season for Northers is from September to March—the dry season—and they are frequently preceded by strong winds from East or E.S.E., which last two or three days.

Along the COAST OF TEXAS and LOUISIANA, winds from E.S.E. to S.E. prevail during the morning from April to July; they change to S.W. in the afternoon, and the land-breeze is regular during the night. During July, August, and September, sudden and heavy squalls with rain are frequent,—the wind varying from S.W. to S.E. round by the South; a gale at this time often lasts several days. From October to March, North winds may be expected. During February, March, and April, thick fog is prevalent at the mouths of the Mississippi, and thence along the coast to the Bay of Appalacha.

At CAT ISLAND HARBOUR, Mississippi, the prevailing winds are Easterly. During December, January, and February, N.E., East and S.E. winds prevail; with an excess of S.E. in March and April; and of N.E. (trade) in September, October, and November. During May, June, and July, S.E., South and S.W. winds prevail, with an excess of S.W. (sea-breezes). In August, N.E., East, S.E. and S.W. winds predominate.

Winds from N.E. round by East, and South to S.W. tend to raise the water in Cat Island Harbour; and those from S.W. round by West and North to N.W. tend to depress it.

At Pensacola and along the Coast from the Mississippi to Tampa Bay, winds from the Eastward—sometimes northerly, sometimes southerly—prevail in the morning from April to July,—they change to S.W. in the afternoon. Strong winds from S.W. and South (called *Virazones*) blow in heavy squalls during August, September, and October—which is the season for gales, and also hurricanes when they occur. Northerly winds may be expected from November to March; they set in with S.E. and southerly breezes—sometimes bringing heavy rain—then veering to S.W. and West (blowing very hard), they draw round to N.W. and North where they remain, and the weather is then fine.

From Tampa Bay to the Florida Cays the weather is squally and uncertain from May to August,—the wind blowing from S.W. to S.S.W. The easterly Trade-wind generally blows till noon, after which the sea-breeze from W.S.W. and W.N.W. sets in; winds from the southward and westward frequently raise a heavy sea along the coast.

18. In the Gulf of Mexico the winds called *Northers* are prevalent during the *dry season*—from October to March—and their influence is not unfrequently extended as far as the Bahama Channel; they blow with terrific force and are sometimes accompanied by rain, but the unmistakeable signs which always indicate their approach give ample warning to prepare and to put the ship under snug canvas.

Before the Norther sets in there is much moisture in the atmosphere, so that the distant mountain peaks and the high lands become distinctly visible; when in their vicinity, the ranges and slopes of San Martin are covered with a white haze; a peculiar phosphorescent glitter on the surface of the sea and gossamer filaments floating in the air; flashes of lightning shoot along the horizon in the N.W. and N.E. quarters; an increasing sultriness of the weather; a low thick fog coming from the southward; at times a dark cloud hanging in the N.W., morning and evening, at an altitude of 9 or 10 degrees above the horizon; and added to these, the barometer invariably predicts the coming storm by its steady descent, although some moments before the Norther approaches, the column of mercury has begun to rise.

In September and October the Northers, when they occur, do not blow with much force: in November they are well established and thence throughout December, January and February, they are constant and strong. The wind often commencing gently from the South, passes by the West until it arrives at N.N.W. increasing in strength for several hours; having attained its full force, it continues to blow for 48 hours, after which it moderates for a few days, drawing to the N.E. The Northers always bring dark cloudy weather and raise a high sea; and the interval from one to another, during the season, is rarely more than 4 or 5 days—but this interval is generally fine and pleasant when the Trade-wind resumes its place by day, and the land-breeze by night. In March and April they neither occur so frequently nor do they last so long, although during the first 24 hours they blow more violently than in the other months; the weather is also clearer.

In cases when the Norther has commenced in the morning, increasing towards the afternoon, but moderating towards sunset or even by midnight, should the wind change to S.W., the Norther may die out, and the sea-breeze come in at the usual hour: this does not often happen however, for at sunrise, or perhaps not till the beginning of flood, the North wind blows with the same force as on the previous day:—this is called the Norte de Marea, or *Tide-Norther*. Also, in cases when the Norther has passed to N.E., which is generally reckoned to be the precursor of fine weather, should the wind back to N.N.E. or North, it will begin to blow again.

During the season of the Northers the *mean* height of the barometer in the neighbourhood of Vera Cruz is 30·1 in., and its *range* is about eight-tenths of an inch; *maximum* 30-6 in.; *minimum* 29·8 inches.

The rainy season, which is that of the prevalence of the Trade-wind on the east coast of Mexico, begins in March and ends in September. At the beginning of the season, the Trade-wind (interrupted occasionally by North winds) blows from E.S.E. with variable weather, sometimes clear, sometimes overcast; when it draws to S.E., it lasts all night without giving place to the land-breeze, which is strongest when the rains set in.

From the middle of May to the middle of July (while the sun is to the northward of Vera Cruz) calms with thick weather are not uncommon; occasionally severe squalls occur. Towards the close of the rainy season and previous to the commencement of the regular North winds, heavy squalls (especially from the East) with thunder and lightning are frequent, and the rain is very abundant. During this season the *range* of the barometer does not exceed four-tenths of an inch: *maximum* 30·35 in.; *minimum* 29·96 inches.

Temperature:—in June, *maximum* 87°, *minimum* 83¼°; in December, *maximum* 80½°, *minimum* 66¼°.

On rare occasions violent North winds, known by the name of *Nortes del Hueso Colorado*, are experienced in May, June, July and August; the more moderate winds of this class during the same season are called *Chocolateros*.

14. The *hurricane season* in the Gulf of Mexico is principally from August to October. Generally, none of the coast winds reach far seaward, either in the Caribbean Sea or the Gulf of Mexico.

15. The prevailing wind in the Caribbean Sea is the Trade, variable between East and E.N.E.; and whatever wind may be blowing within 10 or 20 leagues of the shore, the Trade-wind is predominant at sea.

In the Gulf of Mexico the prevailing wind is the Trade blowing from East to E.N.E.; the rainy season lasts from March to September; the dry season from September to March, often brings *Northers;* and in the northern part of the gulf, squally weather may generally be expected from November to February, with winds from N.N.W. to N.W.

16. Along the shores of the Caribbean Sea and Gulf of Mexico the land and sea breezes are regular, but their direction varies with that of the land.

17. Northern Shores of the Gulf of Mexico:—The following results are deduced from the observations* of the officers of the United States Coast Survey made at GALVESTON (Lat. 29° 18′ N., Long. 94° 46′ W.), at MOBILE (Lat 30° 13′ N., Long. 88° 0′ W.) and at CAY WEST (Lat. 24° 33′ N., Long. 81° 48′ W.); they give a tolerably accurate idea of the prevailing winds and their changes along the northern shores of the Gulf of Mexico.

Winds from some northern quarter prevail from September to February (both inclusive); southerly winds from March to August (both inclusive). Winds from the eastward prevail throughout the year,—except at Mobile where, during May, June, July and August, the sea-breeze comes from the S.W. Taking the whole year, winds from the north and the south balance each other nearly, while those from the eastward greatly predominate over those from the westward.

The distribution of the prevailing winds affords the following classification of the months:—winter consists of December and January;—spring, of March and April;—summer, of May, June and July;—and autumn, of September, October and November;—February is the preparation for spring, as August is for autumn.

The winter and summer types are extremely distinct.

Winter type:—At Cay West, during December and January, N.E. and North winds prevail; at Mobile, North, E.S.E., and East; at Galveston, North and N.W.,—then E.N.E. and S.E. The general course of the N.E. Trade-wind is probably disturbed by local action at Mobile and Galveston,—the local position of greatest warmth being the Gulf.

The *summer* type (May, June and July) give S.E. as the prevailing wind at Cay West; S.E., South, and S.W. (sea-breeze) at Mobile; South, S.E., and East at Galveston,—blowing towards the land.

August resembles July, but the autumnal winds also appear.

Autumn:—During September, October and November, an E.N.E. wind prevails at Cay West; North, N.E., and East winds at Mobile; and North, N.E., East and N.W. winds at Galveston.

Spring:—During March and April, S.E., S.S.E., and East winds prevail at Cay West; North, S.S.E., and E.S.E. at Mobile; and North, S.E., and South at Galveston.

February resembles January, with a preparation for the spring period, and like August, it is characterized at Mobile and Galveston by a general diminution in the quantity of wind.

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* Observations made at Galveston, Texas from July 1851 to July 1852; at Mobile, Alabama, from June 1847 to June 1849; at Cay West, Florida, from June 1851 to June 1852; and collated by Professor A. D. BACHE:—*See* "Report of United States Coast Survey" 1856.

January presents the full winter type of the winds on the Gulf; June and July the full summer type: the changes are quite gradual and tolerably regular from one extreme to the other.

The following additional particulars are instructive and useful, giving the least and greatest quantities of wind in the principal directions, in different portions of the year.

The North wind is a minimum at the three places in July; and a maximum in January, during which month it is a very remarkable feature at all three places. The N.W. wind almost dies out from May to September; it first gains strength at Galveston in October, and attains its maximum in all the places during December; its quantity at Cay West and Mobile is always small.

The Northers and North-westers appear in force in April at Galveston. There is very little West wind, but more at Mobile than at either of the others, and chiefly during June and July.

The S.W. wind is rare, except at Mobile, where it constitutes the sea-breeze of summer, reaching its maximum in June and July, and suddenly diminishing in September.

There is but little South wind at Cay West: at Mobile it increases in amount in spring, attaining its maximum in June: at Galveston it is a marked feature as one of the prevailing spring winds, reaching its maximum in May and becoming feeble in August;—it re-appears in winter and rapidly increases in March.

The N.E. wind is a minimum at the three places in July and August; it is largest in quantity during September, October, November and December, at Cay West; during September and October, at Mobile; and during September, December and January, at Galveston; the sudden increase of this wind in September is remarkable at all three places.

The S.E. wind is a minimum during December and January, at Cay West; during January and February, at Mobile; and during December and January, at Galveston. It attains a maximum at Cay West during July; at Mobile, where the S.W. sea-breeze prevails during summer, the maximum of the S.E. wind is during November; at Galveston it occurs in May, doubtless from the disturbing effect of the land,—it is large also in July. This wind constitutes the sea-breeze off Cay West; at Galveston, the South and the S.E. winds are the sea-breeze.

The disturbing influence of the land is least at Cay West, hence the movement of the prevailing wind is very instructive. The S.E. wind is in force during April, May, June, and July; hauling to the eastward in August, and becoming E.S.E. During September and October it has passed into E.N.E.; becoming N.E. in November and December, and reaching North in January; it returns southward in February, being N.N.E.,—in March, East, and rapidly passing to S.E. in April. The *local* action is thus seen to prevail for the greater part of the year over the *general* action; for the whole year the S.E. wind exceeds any other from an easterly point.

The easterly wind at Mobile reaches no further south than E.S.E. during the spring and summer; in September the prevailing wind is N.E. passing to E.N.E. in October, and returning to E.S.E. in winter and spring. The changes at Galveston approximate to those at Cay West.

Of the winds in the three localities—the S.E. is the characteristic between Cay West and the others; the S.W. between Mobile and the others; and the N.W. between Galveston and the others. Another peculiar feature at Galveston is the South wind, shared in a corresponding degree during one month only by Mobile.

Both these places are also alike in the prevalence of Trade-winds during certain months.

Between May and September (inclusive) there appears to be little danger of *Northers*, although June has a considerable amount of northerly wind.

18. West India Islands:—The Trade-wind, variable between N.E. and E.S.E., is the prevalent wind of the region; it blows fresh, with a clear sky, during the dry season, from October to June. The rainy season is from June to October, when the weather is hot and close, calms alternate with squalls, and the wind is frequently from West to S.W.

Among the larger islands of the West Indies (Cuba, Jamaica, San Domingo and Puerto Rico) the land and sea breezes are very regular; the land-breezes being generally fresh and extending to a considerable distance seaward. Such, however, is not the case among the smaller islands, where the land-breeze is either so feeble or is found so close to the shore as to be useless for navigation.

At a short distance from the shore—to leeward of the high land of the larger islands—calms are frequent, alternating with dangerous squalls coming from the mountain gorges; the approach of these squalls is announced by a shrill howling of the wind, and occasionally by the agitated surface of the sea; they have force enough to dismast vessels at sea, and have even capsized them in harbour.

The *hurricane season* extends from the end of June to the middle of November; during that period the wind is generally light, calms are frequent and squalls come on without much notice; the records of hurricanes show that they generally occur in August, September, or October.

Rainy and Dry Seasons:—The two regular seasons—the rainy and the dry—obtain in the West Indies as in all places between the Tropics,—the rains commencing shortly after the sun has passed the zenith of the island in its progress northward; the weather does not again become settled, dry, and fine until the sun has passed into the southern tropic; about the time when the sun has its greatest southern declination (November to February) the wind is frequently from N.W. to North, blowing strong, and maintaining a sort of alternation with the regular Trade; the rainy season is the period when sickness is most prevalent.

19. At the Less Antilles the rainy season generally extends from the middle of June to the middle of October when very squally weather—if not gales

—may be expected, they being generally from West to S.W.; calms are also prevalent at that period. During the rest of the year the Trade-wind from E.N.E. to East predominates.

20. TRINIDAD.—The following observations made at the island of Trinidad, give a general idea of the winds and climate:—

January,—winds from E.N.E. to E.S.E.; cloudy with rain.
February,—winds from East to E.N.E.; cloudy, with heavy dew.
March,—winds from East to E.N.E.; weather fine and dry.
April,—wind E.N.E. generally fresh.
May,—winds between S.E. and E.N.E., often strong; thunder and lightning.
June,—winds between E.N.E. and E.S.E., unsteady; rainy.
July,—wind E.N.E.; stormy; rain.
August,—wind E.S.E.; sudden and heavy squalls, with rain.
September,—wind E.S.E., stormy; heavy rain.
October,—wind E.S.E. strong.
November,—winds from East to E.N.E.; fine, and occasionally very hot.
December,—winds from East to E.N.E.; at times cool.

21. At BARBADOS the weather is fine and dry from January to the middle of May, after which the rains set in. July is very oppressive; the Trade-wind is interrupted by breezes from S.W. and West; and rain falls in torrents. August and September are characterized by calms and light airs from the Southward, with heavy rain. The wind is variable—not unfrequently from S.W.—during October and November,—and it is still showery. Thunder storms are constant during the rainy season. In December, the Trade-wind becomes steady, but light showers fall daily.

22. At DOMINICA the wind and weather are as follows:—

January,—winds E.N.E. and North; cloudy.
February,—winds E.N.E. and S.E.; cool.
March,—winds N.E. to S.E.; fine, sometimes cloudy.
April,—winds E.N.E.,—S.E. and S.; fine.
May,—winds N.E. to S.E. and East; calm at times.
June,—winds S.E. to N.E.; calms and fogs; rainy.
July,—winds S.E. to N.E.; calms; nights cool.
August,—winds S.E. and N.E.; squalls followed by calms.
September,—winds S. to S.E.; rain at intervals; but generally fine.
October,—winds N.E. to S.E.; uncertain,—sometimes fine, sometimes cloudy.
November and December,—winds N.E. to S.E.; usually fine and dry, occasionally cool.

The winds &c. at Trinidad, Barbados and Dominica give a general idea of the weather in the small islands constituting the group of the Less Antilles: each of the larger West Indian Islands requires a separate description.

23. Puerto Rico:—The prevalent wind is N.E.; the sea-breeze commences at 8 A.M. and lasts till 4 P.M., but the land-breeze is generally very feeble; heavy rain falls from June to August; from June to November long calms alternate with light S.E. airs and terrific squalls,—the weather is then excessively hot; strong North and N.W. winds occur at intervals from November to March.

24. Haiti or San Domingo:—On the west coast, and at Port au Prince, the sea-breeze from the westward sets in at about 11 A.M. and lasts till 7 P.M., during the fine weather; the land-breeze from the S.E. frequently blows with great violence during the rainy season (from June to September). On the north coast of the island strong winds from North to N.W. are not uncommon from November to March. On the south coast strong southerly winds and heavy squalls are prevalent in June, July and August.

The land and sea breezes vary with the direction of the coast: at PUERTO DE PLATA the sea-breeze sets in strong from E.N.E. at 9 A.M., lulling towards sunset, after which a moderate land-breeze comes from the S.E.; at Aux Cayes the sea-breeze from the S.E. sets in shortly after mid-day, veering to South towards evening; the land-breeze from the N.W. generally veers gradually to the N.E.: at San Domingo the land and sea breezes are very regular during the winter and spring, but during the summer such is not the case,—and indeed generally when the N. or N.E. wind blows with any force across the island the sea-breeze is feeble on the south coast.

25. Jamaica:—The land and sea breezes are regular during the fine season. From December to March, Northerly winds (Northers) are occasionally experienced raising a high sea on the north side of the island: during the wet season from June to September calms alternate with heavy squalls from the S.E. and copious rain. At Port Royal from November to May the sea-breeze sets in at 9 A.M., lasting till 5 or 6 P.M. when the land-breeze will commence. In the channel between Jamaica and Cuba the winds are often very variable.

26. Cuba:—The land and sea breezes are regular during the fine season: the rainy season lasts from June to September: Northers may be expected from October to February. During the fine season the sea-breeze is very regular on the north coast commencing at 11 A.M. and lasting till evening, when its place is taken by the land-breeze. The Trade, on the north coast, generally commences in the morning at some point between South and East, veering to E.N.E. and N.E. towards evening.

The N.E. Trade may, however, be said to prevail over the whole island from March to November; when, during the other months, it veers to North and N.W. it frequently blows with great strength. At Havana the sea-breeze generally sets in at 10 A.M.

On the south coast of Cuba, land and sea breezes are prevalent, the former often very fresh and commencing soon after sunset. In fact when the Trade does not blow strong, the North wind of the morning veers to East and E.S.E. towards mid-day, inclining to South and S.W. in the evening, after which there is a short calm, when the land-breeze comes off again.

Calms and light airs are not uncommon from May to August.

27. In the OLD BAHAMA CHANNEL *Northers* blow at intervals from November to March,—the barometer giving scarcely any warning of their approach: a light Trade followed by a calm, the land unusually distinct, and dark clouds rising to the W.N.W. are sure signs of the approach of one of these gales; after blowing steadily at N.W. for a few days, the wind will draw round to North and N.E. in heavy squalls accompanied by rain. During the rest of the year the wind is generally from E.N.E. to S.E.

28. Bahama Islands:—The winds are very uncertain at all times among these islands: during the winter—from October to March—the Trade-wind is prevalent from E.N.E. to East; during the summer—from April to September—it is generally to the southward of East. At the former period, but especially in December and January, Northers are very frequent, sometimes lasting seven or eight days; they blow heavily, with the usual indications; the wind veers to South and S.W.; dark and heavy clouds rise in the westward; the breeze gains stength and freshens rapidly to a double or close-reef topsail gale; veering then to N.W. and North, the weather clears up, but it continues to blow from that quarter for two or three days; should it haul to N.E. it will blow with greater force, and in heavy squalls, after which it will wear itself out at East.

During the summer the Trade-wind is very variable—interrupted occasionally by very heavy squalls, accompanied with rain, thunder and lightning, alternating with calms and light airs—the atmosphere is also very oppressive. These islands lie in the track of the hurricanes, and even when none occurs, a heavy and dangerous S.E. gale may be expected in August or September. Southerly winds are very common in the Bahama Channel during March and April; also, during the summer, a light breeze from the Florida shore may be expected.

The northernmost of the Bahamas and the channels connected with them are situated near the northern limit of the N.E. Trade; it may be expected, therefore, that throughout the whole year, the wind and weather will be changeable and uncertain.

29. Along the UNITED STATES COAST from CAPE CANAVERAL TO SAVANNAH, heavy squalls are frequent from the beginning of November to the end of February; they generally blow from some point between N.N.E. and S.S.E. and give but slight warning of their approach.

For HURRICANES AND GALES *see* Chap. XIII.

CHAPTER X.

EAST COAST OF NORTH AMERICA.

1. **East Coast of the United States**:—The winds and weather of this part of the North American continent are very variable and uncertain. Arranging the winds according to their relative frequency, the following may be taken as an approximation,—those from the N.W. and S.W. nearly equal; then in succession South, N.E., S.E., West, North and East.

On the coast of South Carolina a N.E. wind, without rain, may last several days; the same wind when accompanied by rain will generally shift to East and S.E., after which, flying round to N.W. it will clear up, but continue to blow hard for a short time. During the summer, thunder-storms, with strong winds from the N.E. quarter, are frequent. Winds between S.S.W. and W.N.W., or those from North to E.N.E. are the most prevalent along the coast.

The vicinity of Cape Hatteras has always been notorious for general bad weather.

In general, along the Atlantic Coast of the United States, but especially towards the *northern* part, winds between S.W. and W.S.W. prevail when the sun is in the northern hemisphere; those from W.N.W. to N.W. when it is in the southern hemisphere. Rain usually accompanies winds blowing from East to S.E.

The late Professor James P. Espy, by collating a large number of Meteorological journals, and after examining 1800 different charts (printed and unprinted), eliminated the following generalizations respecting the Meteorology of the United States:*—

1. The rain and snow storms, and even the moderate rains and snows, travel from the West towards the East in the United States, during the months of November, December, January, February and March,—which are the only months to which these generalizations apply.

2. The storms are accompanied with a depression of the barometer near the central line of the storm, and a rise of the barometer in the front and rear.

3. This central line of minimum pressure is generally of great length from North to South, and moves side fore-most towards the East.

4. This line is sometimes nearly straight, but generally curved, and most frequently with its convex side towards the East.

5. The velocity of this line is such that it travels from the Mississippi to the Connecticut River in about 24 hours, and from the Connecticut to St. John's, Newfoundland, in nearly the same time,—or at the rate of about 36 miles an hour.

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* Fourth Meteorological Report of Professor James P. Espy, 1854.

6. When the barometer falls suddenly in the western part of New England, it rises at the same time in the valley of the Mississippi, and also at St. John's, Newfoundland.

7. In great storms the wind, for several hundred miles on both sides of the line of *minimum* pressure, blows towards that line, directly or obliquely.

8. The force of the wind is in proportion to the suddenness and greatness of the depression of the barometer.

9. In all great and sudden depressions of the barometer, there is much rain or snow; and in all sudden and great rains or snows, there is a great depression of the barometer near the centre of the storm, and a rise beyond its borders.

10. Many storms are of great and unknown length from North to South, reaching beyond our observers on the Gulf of Mexico and on the northern lakes; while their East and West diameter is comparatively small. The storms, therefore, move side-foremost.

11. Most storms commence in the "far west," beyond our most western observers; but some commence in the United States.

12. When a storm commences in the United States, the line of *minimum* pressure does not come from the "far west," but commences with the storm and travels with it towards the eastward.

13. There is generally a lull of wind at the line of *minimum* pressure, and sometimes a calm.

14. When this line of minimum pressure passes an observer towards the East, the wind generally soon changes to the West, and the barometer begins to rise.

15. There is generally but little wind near the line of *maximum* pressure; and on each side of that line the winds are irregular, but tend outwards from that line.

16. The fluctuations of the barometer are generally greater in the northern than in the southern parts of the United States.

17. The fluctuations of the barometer are generally greater in the eastern than in the western part of the United States.

18. In the northern part of the United States the wind, generally, in great storms, sets in from the North of East, and terminates from the North of West.

19. In the southern part of the United States the wind generally sets in from the South of East, and terminates from the South of West.

20. During the passage of storms the wind generally changes from the eastward to the westward by the South, especially in the southern parts of the United States.

21. The northern part of the storm generally travels more rapidly towards the East than the southern part.

22. During the high barometer on the day preceding the storm, it is generally clear and mild in temperature, especially if very cold weather preceded.

23. The temperature generally falls suddenly on the passage of the centre of great storms; so that sometimes when a storm is in the middle of the United States, the lowest temperature of the month will be in the West on the same day that the highest temperature is in the East.

2. The Bermuda Islands are situated in a region of variables, and directly in the track of the hurricanes which originate within the northern tropic; as a consequence the winds never blow with any great persistency, and during the autumn and winter months gales and storms are of very frequent occurrence.

According to observations made at H.M. dockyard during two successive years, it appears that:—

In 1853, at 9 A.M.	winds between	N.E. and S.E.	blew for	122 days.
,,	,,	S.W. and N.W.	,,	131 days.
,, at 4 P.M.	,,	N.E. and S.E.	,,	120 days.
,,	,,	S.W. and N.W.	,,	149 days.
In 1854, an 9 A.M.	,,	N.E. and S.E.	,,	100 days.
,,	,,	S.W. and N.W.	,,	174 days.
,, at 4 P.M.	,,	N.E. and S.E.	,,	114 days.
,,	,,	S.W. and N.W.	,,	176 days.

The remaining number of days in each year being made up of winds more northerly or southerly, with variables and calms.

The *mean* temperature was 73°; *max.* 87°; *min.* 55°.

The *mean* height of barometer 29·92 in.; *max.* 30·48 in.; *min.* 29·21 in.

The foregoing statement may be compared with that given by MONTGOMERY MARTIN in his "*History of the British Colonies*," compiled from observations made over several years:—

January,—wind N.W.; cold; frequent showers.

February,—wind N.E.; cold; frequent showers.

March,—wind N.W. by W.; mild; fresh breeze.

April,—wind S.E.; warm; light breezes.

May,—wind S.S.E.; very close; thunder.

June,—wind S.W.; warm; light breezes.

July,—wind East; warm; thunder; squally; gales.

August,—wind S.E.; very close.

September,—wind S.W. by W.; warm.

October,—wind N.E.; heavy rain; squally; gales.

November,—wind N.W.; cool; heavy rain.

December,—wind N.E.; cool; thunder and lightning.

In December, gales generally commence at South, and veering by the West, terminate at N.W. or N.N.W. The Squalls are very sudden and violent, especially during the winter months; the direction of the wind is very variable, and strong gusts follow each other every twenty minutes or half an hour, with brief intervals of calm ; the tendency of such a succession of squalls is to raise a high and irregular sea, especially dangerous to small vessels.

During summer, winds between S.E. and S.W. variable to N.W. are very prevalent. Cold and dry Northerly winds, in winter, sometimes blow hard for two or three days.

For hurricanes *see* Chap. XIII.

3. S.E. Coast of Nova Scotia.—In the spring and summer months all winds from the sea (*i.e.* from E.N.E., round by South, to W.S.W.) bring with them dense fogs or rain ; in winter the rain is generally replaced by snow ; during the autumn and winter months winds between North and South are frequent, which, blowing off the land, bring clear weather with them. Strong gales rarely occur in May, June and July ; but during the other months they blow with a force which requires the greatest vigilance, and strict attention to the barometer. Strong winds from seaward are accompanied by a falling glass ; and in winter, when a change of wind occurs from the opposite direction (*i.e.* off the land), with a rising barometer, severe frost sets in.

At HALIFAX, from *October* to *March* the relative frequency of the different winds during 1854, 1855, was as follows,—N.W. 37·5 days ; West 30·5 ; North 29·5 ; S.W. 28·5 ; S.E. 19 ; N.E. 18·5 ; South 12 ; and East 7 days. From *March* to *October*, West 40·5 days ; S.W. 30·5 ; South 29·5 ; North 29·5 ; N.W. 20 ; S.E. 16 ; N.E. 8·5 and East 4 days. From which it appears that, during the first period (*winter*), winds between North and West prevail for 97·5 days,—from the other quarters for 80 days ; during the second period (*summer*), winds between South and West are prevalent for 100·5 days,—from the other quarters for 79 days ; which with 8 days of calms and light airs make up the year. Barometer, *max.* 30·85 in. ; *min.* 28·85 in. Thermometer, *max.* 82°·5 ; *min.*—4°·5. Rain or snow on 57·5 days. Fog is generally prevalent from July to November. The southerly winds of summer, which in the BAY OF FUNDY are generally accompanied by fog, lose their moisture in passing over Nova Scotia, and appear on its northern shores, and among the islands in the southern part of the Gulf of St. Lawrence as warm dry winds.

4. Sable Island and Banquereau.—Southerly winds prevail during the summer months, occasionally replaced by those from the northward.

With winds from the Southward, the barometer rarely rises ; when it falls rapidly the wind is accompanied with rain ; after the middle of August, if the barometer falls very low, a heavy gale may be expected.

Winds between North and East are prevalent during spring and at the beginning of autumn ; when they come from the Northward, they bring fine weather and a high glass. During the winter and autumn, Easterly winds are accompanied with bad weather and a low barometer ; very heavy gales have been experienced in this neighbourhood, with the wind from East, which, when the barometer has attained its lowest point, has shifted to the N.W., still blowing strong, but followed by clear weather.

Winds between North and West may be expected in autumn and winter, when they generally bring fine weather, though they not unfrequently blow strong and are accompanied with hard frost.

The vicinity of the Gulf Stream exercises considerable influence on the climate and weather of this region; the easterly and southerly winds of summer bring with them a dense fog, often lasting for several days and nights, and rendering the proximity of Sable Island very dangerous, since the ship's position is somewhat uncertain; during the snow-storms of winter the weather is equally thick and foggy.

7. **Newfoundland.**—Most of the remarks just made in respect to the vicinity of Sable Island appertain with equal force to the South and S.W. Coasts of Newfoundland. Winds from between North and West prevail during the autumn and winter; coming off the land, they are always dry and cold, and bring clear weather. Winds between East and West round by South, which characterize the spring and summer (but especially July and August) invariably bring thick fog, or rain; when these southerly winds blow in winter they generally bring snow. Gales of wind are not frequent from May to the middle of August, but after that they are not uncommon; always attend to the barometer; strong breezes and sudden heavy squalls, the wind shifting rapidly to the opposite quarter frequently occur here.

According to observations made at St. John's the relative frequency of the wind is as follows,—N.N.W. to W.N.W. 200 days; S.S.W. to S.E. 102 days; West to W.S.W. 38 days; and N.E. 25 days; rain 110 days; snow 54 days; thunder and lightning 5 days.

Summer invariably brings fog to the South and S.W. coasts of the island; not so on the north and east sides; from the Bay of Fundy as far north as St. John's the fog is frequently seen like a great wall at sea, though in general it does not penetrate far inland,—as the people say "the shore eats up the fog."

8. **The Gulf of St. Lawrence.**—Easterly winds, frequently blowing for several weeks in succession, are prevalent in spring: to these succeed the West and S.W. winds of summer, occasionally interrupted by light southerly breezes,—during this period, northerly and N.W. winds are rare, but when they do occur, they generally follow easterly winds which have died out, and after blowing with some force, veer to the S.W.; these N.W. winds are usually dry, although at times they bring flying scud and occasional showers. In September strong steady north-westerly winds set in, and during the latter months of the year they frequently blow in heavy squalls, accompanied by hail and snow, or by a sharp frost. Thunder storms of short duration may be expected in July and August,—and near the mountainous part of the coast these storms are preceded by sudden

and violent gusts of wind. During summer the northern land-breeze may occasionally be carried nearly to the southern coast just before daylight, but the southern land-breeze rarely extends beyond five miles.

It may be remarked that strong winds and gales rarely veer suddenly from one quarter of the compass to another directly opposite without an intervening calm.

N.W. winds seldom veer by the North and East to S.E., although they often change, by degrees, to S.W. after moderating; so the S.W. winds rarely veer by the West and North to S.E. and East, but may occasionally change by the South to S.E. and East.

As regards the River and its Estuary, the prevailing winds, during the navigable season, blow either up or down,—changing their direction with the course of the chains of high land on either side of the great valley of the St. Lawrence; thus, a S.E. wind in the Gulf becomes E.S.E. between the island of Anticosti and the south coast, changing to E.N.E. above Point de Monts, and to N.E. above Green Island. Along the southern bank of the river the westerly winds are affected in the same manner,—the W.S.W. wind at Bic Island becoming W.N.W. and N.W. in proceeding towards Cape Gaspé, where it may be found blowing from the N.N.W. In almost all cases the easterly winds are cold, wet, and foggy; but the westerly are dry and accompanied by fine sunny weather. These winds may not unfrequently be found blowing strong for three or four days in succession.

On the whole, however, the weather of the Gulf and Estuary may be said to be uncertain. Although in common seasons, very heavy gales do not occur from May to October, close-reefed topsail breezes are frequent enough; and again, the same period in other years may be characterized as decidedly stormy—when strong gales, veering rapidly, follow in quick succession.

In the navigation of the Gulf and River St. Lawrence, fog which is most prevalent in the early part of summer, is far more dangerous than ice, and hence the constant use of the deep-sea lead is necessary. The fogs which rarely fail to accompany an easterly gale, extend high into the atmosphere but they are generally not so dense as those that occur during a calm, or even in very light winds; the calm weather fogs, however, do not always attain a great elevation, hence, objects which cannot be seen from the deck may then be visible from the mast-head. Winds between South and West may also frequently bring fog in the eastern part of the Gulf while the weather is clear above Anticosti. In October and November, the fog and rain of the easterly gales are replaced by thickly-falling snow.

9. **Canada.**—The prevalent winds are S.W. from May to September; and N.E. from October to May. From December to April the weather is generally fine but cold; and N.W. winds, when they occur, are very cold.

10. **Labrador and Hudson's Bay.**—On the coast of Labrador, East and S.E. winds are prevalent from June to October; North and N.W. from October to May.

CHAPTER XI.

WIND AND WEATHER IN THE ARCTIC REGIONS.

1. Northward of the parallel of 60° N. and thence within that portion of the Frigid Zone which has been traversed by whalemen and by our Arctic explorers, no regular succession of winds has been observed. The ice-bound and snow-clad masses of land, at no great distance apart, exert a varying but powerful influence on the currents of air according to the season. Northerly winds, however, are the most prevalent and regular; but as regards the winds with *easting* or *westing*—sometimes one will largely predominate, sometimes the other—while occasionally they may be pretty equally distributed throughout the year.

All the winds of this region are accompanied by snow, except during June, July and August, when it is less frequent than during the other portions of the year; but though the weather is generally fine and tolerably mild during those three months with southerly winds, yet snow not unfrequently falls—and rain occasionally,—while fog is their general attendant.

The coldest winds are those from the North and N.E.; and in June and July, winds between South and West are often accompanied with squally, bad weather.

During all seasons of the year, the electrical phenomena of thunder and lightning are rare, but always the precursors of bad weather; rotatory gales have been experienced in those regions; and continued gales from the southward and eastward, as well as from the northward and westward. The Aurora Borealis in all its grandeur is of frequent occurrence from October to March (both inclusive), but is seldom, if ever, vissible in a perfectly clear atmosphere. Lastly, while fogs are more or less frequent throughout the year, there are portions of the Arctic Regions where a dense and continued mist is much more common than in other parts of these cold and cheerless seas and lands.

2. At Nova Zembla, from September to May, the winds blow from the northward almost without interruption,—whilst from May to September they are generally more from the westward.

3. At Spitzbergen, during the early part of the year, the winds blow from the southward,—and during the remainder of the year from the northward. Winds from the N.E. and S.E. generally bring the greatest amount of snow.

4. On the coast of GREENLAND, from May to July, the weather is fine and the winds changeable, but not unfrequently strong from the S.S.W. The wind remains variable until September. Storms are rare and of short duration, but very violent squalls occasionally come from the southward. The coldest winds are from the N.E. Rain does not often fall.

5. In DAVIS STRAIT AND HUDSON'S BAY, from October to June, the prevailing winds are from North to N.W.;—and from June to October, from S.E. to East. Strong northerly winds, with squally, dirty weather, are not uncommon in spring and autumn.

6. The following abstracts derived from the observations of several of our celebrated Arctic explorers will give a tolerably accurate idea of the winds and climate of the ARCTIC REGIONS.

A series of observations made by PARRY* extends uninterruptedly from July 1819 to September 1820, principally between Lat. 74° and 75° N., on the S.E. side of Melville Island. The number of days (for a year) on which the winds blew from the different points is as follows:—North 110; N.N.W. 51½; N.W. 31; W.N.W. 4; West 33; W.S.W. 8½; S.W. 13; S.S.W. 3; South 17; S.S.E. 8½; S.E. 13; E.S.E. 9; East 19; N.E. 6; N.N.E. 8½; variable 24; calm 11 days.

An analysis of these observations shows that from April to September (both inclusive) there were—winds with *northing* for 89½ days; with *southing* 34:—with *westing* 65; with *easting* 38½.

From October to March (both inclusive) there were—winds with *northing* for 119 days; with *southing* 24:—with *westing* 71½; with *easting* 24.

The *mean* temperature of the year was + 1°·3 (Fahr.); *maximum* (in July) + 60°; *minimum* (in February)—50°.

The *mean* pressure was 29·87 in.; *maximum* (in July) 31·01 in.; *minimum* (in March) 29·00 in.

7. Another set of observations made by PARRY on his third voyage to discover the N.W. passage extends from June 1824 to September 1825: on this occasion the winter quarters were established at Port Bowen, in Prince Regent Inlet, Lat. 73° 13′ N., Long. 88° 54′ W., and the observations were made chiefly at that place. For a year, the winds blew as follows:—North 37 days; N.W. 54; West 29; S.W. 17½; South 17; S.E. 39; East 134; N.E. 23; variable 13; calm 1½.

A further analysis of the foregoing winds shows that from April to September (both inclusive) there were—winds with *northing* for 65 days; with *southing* 46;—with *easting* 79; with *westing* 63.

From October to March (both inclusive) there were—winds with *northing* for 49 days; with *southing* 27:—with *easting* 118; with *westing* 37.

* The late SIR EDWAED PARRY.

The large preponderance of East winds on that occasion is very remarkable;—from October 1824 to June 1825 (a period of nine months) it blew on the average, 15 days in each month from that point of the compass.

8. In 1827 PARRY started on another Arctic cruise—to reach the North Pole by means of boats and sledges from Spitzbergen: on that voyage, during the months of May, June, July and August, between Lat. 70° and 82° 40′ N., the winds appear to have been distributed as follows:—North 16 days; N.W. 13; West 14½; S.W. 10½; South 5½; S.E. 13; East 18; N.E. 15; variable 4½; calms 13.

9. From a meteorological register kept by Capt. (now Admiral) KELLET, from September 1852 to March 1853—the station being Dealy Island on the S.E. coast of Melville Island, near Lat. 75° N., Long. 109° W.—the wind observations show that it blew from the North 113 days; N.W. 25; West 12; S.W. 8; South 4; S.E. 15; East 20; N.E. 15; Calms 188 hours = 8 days nearly.

Thus it appears that on this occasion there were winds with *northing* on 159 days; with *southing* 33:—with *easting* 59; with *westing* 57.

The *mean* temperature of the six months (October to March) was—20° Fahr; *maximum* (in October) + 0°·3; *minimum* (in January)—35°·7.

In 1853,—in June it rained on 5 days,—July 11 days,—and in August 6 days: 15 hours heavy rain; 76 hours, moderate; and 6 hours, fine rain (drizzle).

10. Captain (now Sir Robert) MACLURE in 1851—1853 found the prevailing winds N.E. along the American shore of the Polar sea; and during his two winters detention in Mercy Bay, Baring Island (Lat. 74° N., Long. 118° W.), he found S.S.W. winds invariably bring the greatest cold.

11 Lastly, attention must be called to the Arctic Register* of Captain (now Sir Francis Leopold) M'CLINTOCK, who with his companions Commander HOBSON, and Captain ALLEN YOUNG (of the Merchant Service), in the little screw steamer *Fox*, spent two winters in the Polar Seas, and was fortunate enough to recover the only written documents relating to the expedition of Sir JOHN FRANKLIN, in the *Erebus* and *Terror*.

During the first winter (1857—1858) the *Fox* was hopelessly beset, and from August to April drifted with the ice in BAFFIN'S BAY and DAVIS STRAIT, from Lat. 75° N., Long. 62° W. to Lat. 64° N., Long. 59° W.—thus, more than 1200 miles were traversed in a varying irregular track, during eight months of absolute helplessness. During this season the winds† with *northing* blew for 164 days; with *southing*, for 74; with *easting*, for 77; with *westing*, for 161; with 2 days of calm.

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* Meteorological Papers published by the Board of Trade, No. IV.—see also "Voyage of the *Fox* in the Arctic Seas."

† Corrected for variation of the compass—their magnetic direction only is given in the Register.

It may be further noticed, that the mean direction of the wind for 124 days was N.W. ¾ N. (true), a fact to which Captain M'Clintock adverts, in his narrative communicated to the Royal Geographical Society, in the following terms:—

"From all that I was able to observe during our drift down the middle of Davis Strait, the movement of the ice was almost entirely due to the wind and not to current. We did not notice any indication of an under-current to the north: on the contrary, large icebergs which would have been influenced by it, drifted in our company, from Lat. 75½° N." And he continues—"Throughout the winter, long cracks or lanes of water were formed at spring tides, and oftentimes closed with sufficient force to crush up their edges into long ranges of hummocks several feet high. Fortunately our little vessel was never exposed to this ice action, although it sometimes took place within fifty yards of our position. During the autumn and early spring, about seventy seals were shot in the water spaces, affording a good supply of food for our dogs, and oil for our lamps. It was not until the 25th April, 1858, by which time we had drifted down to Lat. 63½° N. that we were able to escape out of the ice, under circumstances which will long be remembered by all on board. A heavy south-easterly gale rolled in such an ocean swell, that it broke up all the ice, and threw the masses into violent commotion, dashing them one against another, and against the ship in a terrific manner. We owed our escape, under Providence, to the peculiar wedge-formed bow and steam-power of our obedient little vessel."

As regards the weather during the 242 days of imprisonment in the drifting ice, it is recorded that it was misty on 88 days, foggy on 5, squally on 4; rain occurred on three days, snow on 40 and snow drift on 32.

The temperature of the eight months was, *maximum* + (August 27th) 37°: *minimum* (January 29th)—46°.

The pressure was—*maximum* (January 30th) 30·94 inches; *minimum* (March 11th) 28·72 inches.

Among the many remarkable meteorological phenomena noticed during this expedition the following* by Capt. Allen Young is particularly interesting:—

"Dec. 28th.—During Divine Service yesterday, the wind increased, and towards the afternoon we had a gale from the north-westward, attended with an unusual rise of temperature; to-day the gale continues, with a warm wind from the N.N.W.

The Danish settlers at Uppernavik, in North Greenland, are at times startled by a similar sudden rise of temperature. During the depth of winter, when all nature has been long frozen, and the sound of falling water almost forgotten, rain will fall in torrents; and as rain in such a climate is attended with every discomfort, this is looked upon as a most unwelcome phenomenon. It is called the *Warm South-east Wind.* Now, if the Greenlanders at Uppernavik are astonished at a warm S.E. wind, how much rather must the seaman, frozen up in the pack,

* "Cornhill Magazine No. 1,—January 1860,—p. 104.

be astonished at a warm N.W. wind. Various theories have been started to account for this phenomenon; but it appears most probable that a rotatory gale passes over the place, and that the rise in temperature is due to the direction from which the whole *mass of air* may come, viz. from the southward, and not to the direction of wind at the time."

The second season (1858—1859) the *Fox* was in winter quarters at Port Kennedy (Lat. 72° N., Long. 94° 10′ W.), when the winds were as follows:—North 2 days; N.N.W. 9; N.W. 102; W.N.W. 23; West 29; W.S.W. 6; S.W. 5; S.S.W. 2; South 1; S.S.E. 2; S.E. 1; E.S.E. 2; East 1; E.N.E. 33; N.E. 48; N.N.E. 8; variable 2; calms 40. From these observations, it seems that—

From October to March (both inclusive) there were—winds with *northing* for 136 days; with *southing* 6; with *westing* 106; with *easting* 49.

From April to July (both inclusive) there were—winds with *northing* for 89 days; with *southing* 11; with *westing* 69; with *easting* 46.

Or, by a further analysis, from October to March, winds between North and West prevailed for 103 days; between North and East for 46 days. From March to July winds between North and West were prevalent for 57 days; between North and East for 39 days.

The *mean* temperature for the ten months at Port Kennedy, was—1°·1; *maximum* (July 29th) + 55°; *minimum* (Jan. and Feb.)—48°.

The *mean* pressure was 30·18 in.; *maximum* (April 12th) 31·27 in.; *minimum* (July 10th) 28·97 in.

From the weather record at Port Kennedy, it appears that it was misty on 107 days, foggy on 2, and squally on 9; rain occurred on 2 days (in June), snow on 44, and snow drift on 62.

CHAPTER XII.

THE BRITISH ISLES AND NEIGHBOURING SEAS.

1. The preceding chapters (III. to XI.) give, in detail, full particulars respecting the *wind and weather* the Navigator may expect to encounter, at all seasons of the year, on any part of the North Atlantic; and it remains to draw his attention to the vast stores of accurate information which have been accumulated, within recent years, respecting the Meteorology of the British islands and the surrounding seas, and how far they may be applicable to the services of Navigation.

2. **The Greenwich Observations.**—Directions and Pressure of the Wind:—Observations relating to the *Direction and Pressure* of the Wind, extending over

20 years—from 1841 to 1860—have been ably discussed by J. Glaisher, Esq., F.R.S., in the *Proceedings of the British Meteorological Society*, of which the following is a summary:—

1. The *average* number of days of wind in a year with mean direction—

North	was	40·7	days.
N.E.	„	47·6	„
East	„	22·5	„
S.E.	„	19·9	„
South	„	34·2	„
S.W.	„	104·0	„
West	„	38·8	„
N.W.	„	24·1	„
Calm	„	38·7	„
		365	days.

Or, reducing the numbers to the four cardinal points, we find that for 20 years:—

The average number from North, as found from N. and its compounds, is 76·6 days.

The average number from South, as found from S. and its compounds, is 96·0 days.

The average number from East, as found from E. and its compounds, is 56·6 days.

The average number from West, as found from W. and its compounds, is 102·0.

And these, together with 38·7 calms, make up the entire year.

2. And if we take the difference between these numbers and those of each year, we shall determine the departure in every year from the average direction of each wind, and these values are shown to be as follows:—

The N. wind numbered {21 days in 1857; (— 20 days).*
59 days in 1849; (+ 18 days).}

The N.E. wind numbered {19 days in 1841; (— 29 days).
74 days in 1855; (+ 26 days).}

The E. wind numbered {11 days in 1845; (— 12 days).
38 days in 1858; (+ 15 days).}

The S.E. wind numbered { 4 days in 1847; (— 16 days).
36 days in 1848; (+ 16 days).}

* The figures in brackets give the number of days each wind was in defect (—) or in excess (+) of the average as shown in par. 1, above; thus, in 1857 the N. wind was in defect 20 days—the difference between 41 and 21 so in 1849 it was in excess 18 days—the difference between 59 and 41.

The S. wind numbered { 18 days in 1843 ; (— 16 days).
58 days in 1848 ; (+ 21 days).

The S.W. wind numbered { 80 days in 1856 ; (— 24 days).
128 days in 1858 ; (+ 24 days).

The W. wind numbered { 27 days in 1850 and 1852 ; (— 11 days).
64 days in 1860 ; (+ 26 days).

The N.W. wind numbered { 8 days in 1855 ; (— 16 days).
38 days in 1844 ; (+ 14 days).

Calm days numbered { 7 days in 1860 ; (— 27 days).
86 days in 1846 ; (+ 52 days).

8. As regards the distribution of the winds in the several months it appears that—

The N. wind is least prevalent in December.
„ most prevalent in May.
The N.E. wind is least prevalent in December.
„ most prevalent in May.
The E. wind is least prevalent in January.
„ most prevalent in April.
The S.E. wind is least prevalent in July.
„ most prevalent in March.
The S. wind is least prevalent in September and June.
„ most prevalent in January.
The S.W. wind is least prevalent in April.
„ most prevalent in July and August.
The W. wind is least prevalent in May and November.
„ most prevalent in October.
The N.W. wind is least prevalent in May.
„ most prevalent in March.
Calm days are least frequent in April.
„ most frequent in September.

The S.W. wind is the most prevalent wind in every month on the average of years : in January, June, July and August, it averages one-third of each of these months, and nearly one-third in October : in April its mean continuance is nearly one-fifth of the month : and in all the remaining months its duration is something more or less than one-fourth.

9. The following exhibits the extreme pressure of the wind in pounds on the square foot, for all the strong winds in every month during the twenty years in which the pressure has reached five pounds on the square foot :—

		Pressures varying from			Pressures varying from
1841.	January	5 to 10 lbs. S.W.	1842.	January	6 to 18 lbs. S.W.
	February	5 to 14 lbs. E.N.E.		February	5 to 9 lbs. S.W.
	March	5 to 9 lbs. S.S.W.		March	5 to 21 lbs. S.W.
	September ..	5 to 7 lbs. S.W.		September ..	10 to 12 lbs. S.W.
	October	5 to 7 lbs. W.S.W.			
	November .	5 to 24 lbs. S.S.W.			

		Pressures varying from
1843.	January	7 to 25 lbs. W.S.W.
	February	5 to 21 lbs. N.E.
	March	5 to 9 lbs. E.N.E.
	April	5 to 13 lbs. W.S.W.
	June	5 to 7 lbs. S.W.
	October	5 to 8 lbs. S.W.
	November ..	5 to 12 lbs. S.W.
	December ..	5 to 7 lbs. S.
1844.	January	5 to 12 lbs. N.W.
	February	5 to 12 lbs. S.W.
	March	5 to 17 lbs. W.
	May	5 to 9 lbs. N.
	June	6 to 8 lb. S.W.
	July	5 to 10 lbs. W.
	August......	5 to 10 lbs. S.W.
	October	5 to 8 lbs. S.W.
	November ..	5 to 7 lbs. E.
1845.	January	5 to 13 lbs. W.N.W.
	March	5 to 10 lbs. N.E.
		5 to 10 lbs. S.W.
	April	5 to 12 lbs. W.
	May	5 to 10 lbs. N.
	July	5 to 9 lbs. W.S.W.
	August......	5 to 7 lbs. W.S.W.
	September ..	5 to 8 lbs. S.S.W.
1846.	January	5 to 12 lbs. S.W.
	February	5 to 7 lbs. W.S.W.
	March	5 to 11 lbs. S.W.
	April	5 to 11 lbs. W.S.W.
	July	5 to 9 lbs. S.W.
	October	5 to 8 lbs. S.W.
	November ..	5 to 10 lbs S.S.W.
1847.	January	5 to 12 lbs. S.S.W.
	February	5 to 18 lbs. W.S.W.
	April	5 to 15 lbs. W.S.W.
	May	5 to 8 lbs. S.S.W.
	September ..	5 to 12 lbs. W.S.W.
	October	5 to 8 lbs. S.
	November ..	5 to 6 lbs. S.S.W.
	December ..	5 to 13 lbs. S.S.W.
1848.	January	5 to 6 lbs N.E.
	February	11 to 13 lbs. S.W.
	March	5 to 8 lbs. S.W.
	April	5 to 6 lbs. S.W.
	May	5 to 7 lbs. S.W.
	June........	11 to 13 lbs. S.W.
	July	6 to 9 lbs. S.W.
	August	5 to 8 lbs. S.S.W.
	October	8 to 10 lbs. S.
	November ..	7 to 9 lbs. S.W.
	December ..	5 to 12 lbs. S.W.
1849.	January	9 to 15 lbs. W.
	February	8 to 22 lbs. S.W.
	March	5 to 8 lbs. S.W.
	April	5 to 8 lbs. S.W.
	May	6 to 12 lbs. S.W.
	October	8 to 15 lbs. S.W.
	December ..	6 to 14 lbs. S.W.

		Pressures varying from
1850.	January	5 to 7 lbs. S.W.
	February ...	5 to 25 lbs. S.W.
	March	5 to 6 lbs. N.N.W.
	April	6 to 15 lbs. S.W.
	May	5 to 6 lbs. N.E.
	June	5 to 8 lbs. S.W.
	July	5 to 6 lbs. N.
	August	5 to 7 lbs. S.W.
	September .	5 to 6 lbs. S.W.
	October	7 to 16 lbs. W.
	November ..	5 to 19 lbs. S.W.
	December ..	6 to 10 lbs. S.W.
1851.	January	5 to 10 lbs. S.W.
	February ...	5 to 8 lbs. S.W.
	March	5 to 10 lbs. S.W.
	April	5 to 6 lbs. N.
	May	5 to 8 lbs. W.S.W.
	June	5 to 8 lbs. S.W.
	August......	5 to 11 lbs. S.W.
	November ..	5 to 6 lbs. N.
	December ..	5 to 9 lbs. S.S.W.
1852.	January	5 to 16 lbs. S.W.
	February	5 to 10 lbs. W.S.W.
	April	5 to 9 lbs. E.
	May	5 to 10 lbs. S.W.
	June........	5 to 7 lbs. S.S.E.
	August......	5 to 16 lbs. S.
	September ..	5 to 7 lbs. S.W.
	October	6 to 10 lbs. S.W.
	November ..	5 to 12 lbs. S.W.
	December ..	5 to 24 lbs. S.W.
1853.	January	5 to 12 lbs. S.W.
	February	5 to 15 lbs. N.
	March	5 to 6 lbs. N.W.
	April	5 to 8 lbs. W.
	May	5 to 6 lbs. N.
	June	5 to 12 lbs. S.W.
	July	5 to 6 lbs. S.W.
	August......	5 to 11 lbs. S.
	September ..	5 to 13 lbs. W.
	October	5 to 8 lbs. S.W.
	November ..	5 to 6 lbs. N.W.
1854.	January	5 to 6 lbs. N.E.
		5 to 6 lbs. S.W.
	February	5 to 17 lbs. W.
	April	5 to 7 lbs. N.
	May	6 to 9 lbs. S.W.
	September ..	5 to 7 lbs. S.W.
	October	5 to 10 lbs. W.N.W.
	November ..	5 to 12 lbs. S.W.
	December ..	6 to 10 lbs. W.
1855.	January	5 to 13 lbs. W.
	April	5 to 15 lbs. W.N.W.
	May	5 to 6 lbs. W.
	October	5 to 14 lbs. W.
	December ..	5 to 10 lbs. W.
1856.	January	5 to 15 lbs. S.S.W.

		Pressures varying from
1856.	February	5 to 10 lbs. S.W.
	March	5 to 6 lbs. E.N.E.
	April	5 to 10 lbs. N.E.
	May	5 to 16 lbs. S.W.
	June........	5 to 10 lbs. S.W.
	July	5 to 10 lbs. W.N.W.
	November ..	5 to 7 lbs. W.N.W.
	December ..	5 to 11 lbs. S.W.
1857.	January	5 to 12 lbs. S.W.
	March	5 to 13 lbs. S.W.
	April	5 to 6 lbs. W.
	July	5 to 6 lbs. S.W.
1858.	January	5 to 6 lbs. W.
	March	5 to 6 lbs. W.N.W.
	April	5 to 6 lbs. S.E.
	July	5 to 15 lbs. S.W.
	September ..	5 to 9 lbs. S.W.
	October	5 to 14 lbs. S.W.
	November ..	5 to 13 lbs. N.E.
	December ..	6 to 16 lbs. S.W.

		Pressures varying from
1859.	January	5 to 18 lbs. S.W.
	February	8 to 16 lbs. S.W.
	March	5 to 15 lbs. S.W.
	April	7 to 18 lbs. W.
	May	5 to 7 lbs. N.E.
	July	5 to 8 lbs. S.W.
	August......	5 to 7 lbs. W.S.W.
	September ..	5 to 8 lbs. S.W.
	October	5 to 13 lbs. S.W.
	November ..	5 to 20 lbs. S.W.
	December ..	6 to 12 lbs. S.W.
1860.	January	5 to 17 lbs. S.W.
	February	5 to 28 lbs. W.
	March	5 to 16 lbs. W.
	April	5 to 12 lbs. N.E.
		5 to 12 lbs. S.W.
	May	6 to 23 lbs. W.
	June	5 to 23 lbs. S.W.
	August......	5 to 9 lbs. S.W.
	October	5 to 10 lbs. S.W.
	December ..	6 to 13 lbs. S.W.

So that in 20 years the wind has blown—

Once from the	W.	with a pressure of	28 lbs.	(Feb. 1860.)
,,	S.W.	,,	25 lbs.	(Feb. 1850.)
,,	W.S.W.	,,	25 lbs.	(Jan. 1835.)
,,	S.S.W.	,,	24 lbs.	(Nov. 1841.)
,,	N.E.	,,	21 lbs.	(Feb. 1843.)
,,	S.	,,	16 lbs.	(Aug. 1852.)
,,	W.N.W.	,,	15 lbs.	(April 1855.)
,,	N.	,,	15 lbs.	(Feb. 1858.)
,,	E.N.E.	,,	14 lbs.	(Feb. 1841.)
,,	N.W.	,,	12 lbs.	(Jan. 1844.)
,,	E.	,,	9 lbs.	(April 1852.)
,,	S.S.E.	,,	7 lbs.	(June 1852.)
,,	N.N.W.	,,	6 lbs.	(March 1850.)
,,	S.E.	,,	6 lbs.	(April 1858.)

and there were no pressures to 5lbs. from either of the two remaining points, viz. N.N.E. and E.S.E.

The pressure of the wind never reached 5lbs. in—

January........	0 years out of 20	July	10 years out of 20
February	4 years out of 20	August	11 years out of 20
March	4 years out of 20	September......	10 years out of 20
April	3 years out of 20	October........	5 years out of 20
May	6 years out of 20	November......	6 years out of 20
June	11 years out of 20	December	7 years out of 20

January, therefore, is distinguished as the only month during those 20 years in which the pressure of the wind has always exceeded 5lbs.; the next in order of frequency of strong winds or gales have been February, March and April; then

May and the last three months of the year, which four months are of nearly equal frequency. The remaining months, viz. June, July, August and September, are distinguished by being the most free from strong winds, and to a very nearly equal degree.

From the preceding it would seem that the months free from strong winds have been, one February and March in 5 years; one April in 6¾ years; one May, October, November and December in 3 years; one June, July, August and September in 2 years.

Also in some years, as in 1841, 1842, 1843, 1846, 1849, 1855, 1856, 1857, no pressure has reached 5lbs. for several months together, whilst in other years, as in 1848, 1853, and 1859, this pressure has been exceeded in every month but one, and in 1850 in every month without exception. A marked difference seems to have taken place between the year 1848 and 1853 in the frequency of strong winds, both from the preceding and following years. The year 1860, the last of the series, is distinguished by the heaviest pressure in the 20 years, viz. 28lbs. in the month of February; and this year is no less remarkable for pressures of 23lbs. in both May and June, whilst in those months the extreme pressure is usually very much less.

The maximum pressure of each year, and month of occurrence, was as follows:—

In the year—

1841 was 24 lbs in November.
1842 was 21 lbs. in March.
1843 was 25 lbs. in January.

1844 was 17 lbs. in March.
1845 was 13 lbs. in January.
1846 was 12 lbs. in January.
1847 was 18 lbs. in February.
1848 was 13 lbs. in Feb. and June.

1849 was 22 lbs. in February.
1850 was 25 lbs. in February.

In the year—

1851 was 11 lbs. in August.
1852 was 24 lbs. in December.

1853 was 15 lbs. in February.
1854 was 17 lbs. in February.
1855 was 15 lbs. in April.
1856 was 16 lbs. in May.
1857 was 13 lbs. in March.
1858 was 16 lbs. in December.

1859 was 20 lbs. in November.
1860 was 28 lbs. in February.

It is also to be noted that the light pressures, with the exception of the year 1851, are in groups; as in the years 1844 to 1848 the maximum pressures are between 13lbs. and 18lbs.; and, again, in the years 1853 to 1858 the greatest pressures are between 13lbs. and 17lbs.; whilst in the years 1841 to 1843 they are from 21lbs. to 25lbs.; in 1849 to 1852 (with the remarkable exception of the year 1851) they are 22lbs. to 25lbs.; and in the last two years 20lbs. and 28lbs.

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4. **Dieppe.**—Observations have been taken during 15 years near Dieppe,*

* By M. Nell de Breauté.

from which the mean yearly continuance of the different winds appears to be as follows:

North, 86 days.	N.E., 41 days.
East, 28 ,,	S.E., 31 ,,
South, 37 ,,	S.W., 93 ,,
West, 48 ,,	N.W., 52 ,,

Calms 5 days.

From these observations it further results that winds between S. and W. prevail for 135 days; between N. and W. for 94; between N. and E. for 71; and between S. and E. for 61.

Again, arranging them according to their frequency in the different months:—

Winds between N. and E. are most prevalent in May and June.
,, ,, least prevalent in October and November.

Winds between S. and E. are most prevalent in December and January.
,, ,, least prevalent in June and July.

Winds between S. and W. are most prevalent in November and December.
,, ,, least prevalent in May and June.

Winds between N. and W. are most prevalent in July and August.
,, ,, least prevalent in October and December.

The N. wind numbered	21 days in 1821;	(— 15 days).*
	56 days in 1819;	(+ 20 days).
The N.E. wind numbered	22 days in 1828;	(—19 days).
	54 days in 1826;	(+ 13 days).
The E. wind numbered	12 days in 1821;	(— 11 days).
	41 days in 1820;	(+ 18 days).
The S.E. wind numbered	19 days in 1827;	(—12 days).
	46 days in 1818;	(+ 15 days).
The S. wind numbered	28 days in 1825;	(— 9 days).
	54 days in 1828;	(+ 17 days).
The S.W. wind numbered	67 days in 1831;	(— 25 days).
	121 days in 1825;	(+ 28 days).
The W. wind numbered	31 days in 1829;	(—17 days).
	72 days in 1830;	(+ 24 days).
The N.W. wind numbered	38 days in 1832;	(— 14 days).
	72 days in 1825;	(+ 20 days).

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5. **Exeter.**—From a series of observations, extending over many years, made at EXETER,† it appears that the average annual frequency of each wind is as follows,—North, 32·8 days; N.E. 42·8 days; East 29·7 days; S.E. 41·4 days;

* Showing the defect (—) or excess (+) of each wind in the several years as on p. 120.

† "The Climate of South Devon," by THOS. SHAPTER, M.D.

South 41·4 days; S.W. 44·8 days; West 78·7 days; N.W. 57·8 days. Thus the winds that more particularly prevail are the West and N.W.; the easterly wind, with its variations from the north and south, being the least frequent.

It has also been noticed that the East and S.E. winds prevail chiefly during May, July and October; the West and N.W. winds in June, November, February, December and May,—no winds blowing in any month so constantly as these do in the month of June; in September, South and S.W. winds prevail; and North and N.E. winds in January.

January, the mean temperature of which is 39°·8 is on the average, the coldest month of the year; from this month the temperature progressively increases until July, when the mean monthly maximum of 62°·6 is attained;—and the mean of the year is 50°·7. The temperature of the air is, however, much modified by the prevailing wind; taking the average of the whole year the South and S.W. winds are attended by the highest temperature (53°·5); and the North and N.E. winds by the lowest (48°·3); this is not, however, maintained during every portion of the year; in fact, the temperature, not only of these, but of all the winds, varies absolutely, as well as relatively during the several months; the East and S.E. winds, for instance, are accompanied by a temperature higher than any other wind in May, but in February by nearly the lowest; and the North and N.E. winds which have been referred to as being on the yearly average the coldest, are during the month of June warmer even than the South and S.W. winds;—in fact they are the coldest of all winds in winter, and the warmest in summer.

The tendency of the air is for the most part gentle and breezy from May to November; in December it moves with greater force and so continues through the several months to April. The storms of notable and peculiar violence in recent years have come from the westward, preceded to within one or two days by winds blowing from the northern points of the compass; usually these storms are accompanied by heavy rains, thunder and lightning, and a slight elevation of temperature.

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6. **Liverpool.**—Observations conducted at the Liverpool Observatory under the superintendence of Mr. Hartnup show, that not only are Westerly winds the most prevalent, but their velocity is also much greater than those from any other direction, while those from N.E.-ward have the slowest rate; for example—

North winds	have an	hourly rate of	7·8	miles.
N.N.E.	,,	,,	6·2	,,
N.E.	,,	,,	6·6	,,
E.N.E.	,,	,,	7·8	,,
East.	,,	,,	11·0	,,
E.S.E.	,,	,,	9·6	,,
S.E.	,,	,,	11·6	,,

S.S.E.	,,	,,	11·4 miles.
South	,,	,,	10·3 ,,
S.S.W.	,,	,,	11·8 ,,
S.W.	,,	,,	16·7 ,,
W.S.W.	,,	,,	15·5 ,,
West.	,,	,,	18·9 ,,
W.N.W.	,,	,,	19·0 ,,
N.W.	,,	,,	17·4 ,,
N.N.W.	,,	,,	12·7 ,,

The season also, as might be expected, has an influence on the velocity of the air currents ;—thus, in Winter the mean rate is 15·6 miles per hour ; in Spring 12·1 miles ; in Summer 11·8 miles ; and in Autumn 11·5 miles per hour. Again, the winds are generally stronger during the day than during the night ;—thus, at midnight, the rate has been found to be 11·2 miles per hour ; at 6 A.M. 11·8 miles ; at 9 A.M. 12·9 miles ; at noon 15·2 miles ; at 3 P.M. 14·6 miles ; at 6 P.M. 12·7 miles ; and at 9 P.M. 11·6 miles per hour.

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7. Orkneys.*—The direction of the wind has been noted every morning and evening for 33 years (1827-1859) from which it appears that the

N. wind, has a mean yearly continuance of			35·9 days.
N.E.	,,	,,	17·5 ,,
E.	,,	,,	33·3 ,,
S.E.	,,	,,	64·4 ,,
S.	,,	,,	48·3 ,,
S.W.	,,	,,	37·7 ,,
W.	,,	,,	67·6 ,,
N.W.	,,	,,	39·2 ,,
Variable, or Calm		,,	21·4 ,,

The West wind used to be considered the most prevalent wind in Orkney, but it appears not to have been so for the period noted. It blew, during the 33 years, from the West, S.W., South, and S.E. on 7194 days; while from the opposite points (East, N.E., North, and N.W.) it blew little more than half that time, or 4154 days. The West wind indeed prevails more than that from any other cardinal point; but the S.E. wind prevails above it, for to do it equal justice with, the West, there must be added to it 286 days of E.S.E. which were given to the East, and 250 days of S.S.E. which were given to the South,—thus, there were 2612 days of S.E. wind against 2230 days of West—or 382 days during the 33 years in favour of the S.E.

* Meteorological Papers published by the Board of Trade—No. V.:—"The Climate of Orkney," by the Rev. Charles Clouston, of Sandwich. The Manse of Sandwich is two miles from the sea shore and 100 feet above its level.

There seems, however, to be a group of years when the S.E. is in excess, and then a group when the West predominates—

1st ten years (1827-1836) S.E., 685 days; W. 649 days.
2nd ten years (1837-1846) S.E., 794 ,, ; W. 550 ,,
3rd ten years (1847-1856) S.E., 446 ,, ; W. 810 ,,

thus, in the first decade the S.E. wind exceeds the West very little ; in the second decade the excess is considerable; but in the third decade the West wind not only seems to prevail, but the restoration of the intermediate points to the S.E. still leaves it in the minority.

The distribution of the different winds according to their maxima and minima in the different years was as follows :—

The N. wind numbered	18 days in 1846 ; (— 18 days).* 54 days in 1856 ; (+ 18 days).
The N.E. wind numbered	3 days in 1850 ; (— 15 days). 28 days in 1845 and 1846 ; (+ 10 days).
The E. wind numbered	10 days in 1833 ; (— 23 days). 60 days in 1855 ; (+ 27 days).
The S.E. wind numbered	25 days in 1855 ; (— 39 days). 100 days in 1846; (+ 36 days).
The S. wind numbered	25 days in 1844 ; (— 23 days). 71 days in 1834 ; (+ 23 days).
The S.W. wind numbered	14 days in 1856 ; (— 24 days). 69 days in 1834 ; (+ 31 days).
The W. wind numbered	41 days in 1845 ; (— 27 days). 107 days in 1854; (+ 39 days).
The N.W. wind numbered	18 days in 1848 ; (— 21 days). 57 days in 1827 and 1829 ; (+ 18 days).
Variables or Calms numbered	9 days in 1835 ; (— 12 days). 41 days in 1852 ; (+ 20 days).

Temperature:—The thermometrical observations extend over 33 years (1827 to 1859). The mean temperature of the winter months (Jan., Feb., March) is 39°·02 ; of the spring months (April, May, June) 47°·99 ; of the summer months (July, Aug., Sept.) 54°·24 ; of the autumn months (Oct., Nov., Dec.) 43°·70 ; making the mean annual temperature 46°·24. The difference between the mean temperature of February, which is the coldest month (38°·25), and that of July, which is the warmest month (55°·14), is only about 17° ; during the 33 years the mean temperature of any month never fell so low as freezing point, except in February 1838 and February 1856, when it was respectively 31°·31 and 31°·64 ; and it never rose so high as 60°, except in July and August 1852, when it was 61°·36 and 60°·64. The thermometer was once observed as low as 14½° (March 16th, 1845), and once as high as 75° (June 5th, 1846).

* Showing the defect (—) or excess (+) of each wind in the several years, as on p. 120.

That the Atlantic moderates the extremes, and that it elevates the temperature of winter more than it depresses that of summer will be evident, when we consider that in 1857, when observations were first regularly noted, the Atlantic was about 6° warmer than the mean temperature of the air in January and February, and continued warmer for seven months, being nearly equal in April and August, and colder only in May, June and July, when the difference did not amount to 2° at an average. In 1858 these differences were still more strongly marked, the mean temperature of the Atlantic being 49°·66 or 3°·46 above that of the air, which it exceeded during ten months, and only fell below it during June and August. This explains also, how there is never frost and snow with West wind, and how, if the wind change to the West during frost, the thermometer speedily rises to 40° and upwards, because we have never yet found the Atlantic to be colder than 43°.

Another peculiarity of the Orkney climate is the way in which the temperature is distributed among the months; but this only becomes apparent from the result of a long series of observations.

In Britain generally, and particularly in the inland parts, the greatest heat occurs about the middle of July, and the greatest cold about the middle of January, and the months equidistant from these are most nearly of equal temperature, as February and December. In Orkney, however, February is the coldest month, though only 0·25 colder than January, and August is only a decimal of a degree colder than July, viz. 0°·6. Indeed, in the course of these 33 years January has been colder than February 16 years, and August has been hotter than July 14 years, so that January and February may be considered equally cold, and July and August equally warm, and the months equidistant from them on each side will be found to correspond most in temperature, as March and December, and again June and September. These facts are undoubted, and meteorologists agree in ascribing this retardation of the period of extreme heat and cold to the influence of the surrounding ocean, which is neither so quickly heated in summer, nor cooled in winter, as the surface of the land.

Calling attention to the mean temperature of the sea for the year (1857) which was 49°·6, or 2°·2 above that of the air and the soil, and nearly 3° above that of the best springs—and that it was even above the mean temperature of any year yet recorded, and a little above the mean temperature of the sea around the coast of Scotland—Mr. Clouston thinks, that on the whole, there is strong proof that the Gulf Stream reaches the shores of Orkney, or, at least, some stream from a warmer latitude, by whatever name it may be called, raises the temperature of the sea beyond what it could be raised by the power of the sun in Orkney, and higher than it raises that of the air, the soil, or the springs. Without such a stream, we are not aware that the mean temperature of the sea in other places exceeds that of all other things showing the mean temperature of the localities. As this stream carries to Orkney, along with its increased temperature, productions of the West Indies, the gulf weed, bottles thrown overboard on the passage between Britain and America, &c., we think its origin proved and know no other satisfactory explanation of all the phenomena.

Pressure;—Barometrical observations extend over 21 years (1839 to 1859). The mean pressure of the winter months is 29·688 in.; of the spring months 29·846 in.; of the summer months 29·810 in.; of the autumn months 29·698 in.; making the mean annual pressure for the year 29·761 in.; which corrected to 32° and reduced to the sea level becomes 29·836 in; this does not differ materially from the mean of 50 places published by the Scottish Meteorological Society. The barometer generally attains its greatest height in May (29·879 in.), and gradually descends on each side, the only exception being September, when it takes a rise upward, probably indicating the period known in Orkney as the "little summer". On the 24th January 1840, the mercury was as low as 27·69 in., and on the 1st February 1841 as high as 30·76 in.—giving a range during the 21 years of 3·07 in.

Rain:—From 19 years observation (1841-1859) the average annual quantity of rain is 36·95 inches. The month of May has the least rain as well as the highest barometer; and the previous months, embracing the previous December, have more rain the more they precede it: again, the quantity gradually increases in the succeeding months till October which is decidedly the wettest. The number of days on which rain falls is large; 212 in 1856; 198 in 1857; and 233 in 1859.

The Aurora Borealis is sometimes very brilliant in Orkney. Waterspouts are very rare.

3. Shetland Islands:*—During February and March winds from the Northward and Eastward prevail, when the weather, though cold, is more settled than when the winds come from between the South and West, which always in winter bring heavy rain. Fogs are common in April, May and June, with moderate weather. Towards the end of August rain sets in, the weather becomes broken and the end of summer is indicated, although that season at times continues throughout September. The autumnal period is always very uncertain, and heavy gales from N.W. and West frequently occur in September, especially towards the end of the month. October is often fine and the temperature low, after which during November, December and January, gales of wind from the most opposite points, accompanied by rain and snow, follow each other in rapid succession.

Gales from the S.W., with showers, often continue in winter for weeks together, backing to South or S.S.E., and then returning to S.W., with heavy rain. Hard gales from S.E. are not of frequent occurrence, but give ample warning. Nearly all the sudden gales are from N.W. to North, generally preceded by thick

* From the observations of the Rev. Z. M. Hamilton, of Bressay, combined with those of Dr. Edmondston.

weather and an unusual high temperature for the season; the thickness having cleared away, a calm morning exhibits a sky of a leaden coloured hue to the Northward, when a gale of extreme violence bursts out without any other warning, and lasts from 8 to 12 hours. Brilliant Auroras rising high towards the zenith for nights together are the sure precursors of gales and continued bad weather; while, on the other hand, if they only skirt the horizon, they as certainly indicate fine weather.

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9. Character of Storms affecting the British Islands:*—It is well known that no year passes in which the British Islands are not visited by storms, and that they vary in degree of force, from what is usually called a gale, to a hurricane almost irresistible in violence. Only of late years, however, has it been supposed, and but recently proved, that nearly all, if not indeed the whole of these remarkable tempests, by which such excessive injury has been done, have been so much alike in character, and have been preceded by such similar warnings, as to warrant our reasoning inductively from their well-ascertained facts, and thence deducing laws. Every one looks back to some extraordinary storms as exceeding all others in a lifetime; but a tempest that is severely felt in one part of a country is not always extensive, it is usually the reverse, more or less limited in area, varying in range, direction, and force. It would be inexpedient to refer to many of even the most devastating tempests; therefore, I propose to allude only to a few, and glance but summarily over their most marked features.

The first storm to which I would advert is that so well and so fully described by De Foe, 1703.† He calls it "the greatest, the longest in duration, the widest in extent of all the tempests and storms that history gives any account of since the beginning of time." "Our barometers," he continues, "informed us that the night would be very tempestuous; the mercury sank lower than ever I had observed it on any occasion;" it fell to 28·47.‡ This storm began at south and veered through the west towards the north, round to the south, and continued (chiefly between S.W. and N.W.) with more or less strength, for a whole week! Very remarkable it is that not only did De Foe suppose this storm began near the southern coast of North America, but that it traversed England, Denmark, and the Baltic, to lose itself in the Arctic regions. He recurs afterwards to its shifting from S.W. to N.W., and coming from the west *like other storms in the*

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* These remarks (p.p. 131—138) are from the Report of the Meteorological Department of the Board of Trade, 1862, by Admiral FitzRoy.

† The "Storm," 1704. A most striking collection of the then recorded tempests in England.

‡ In the Orkneys, Mr. Clouston has recorded 27·45. Perhaps De Foe's mercury could not fall more for want of space in the cistern,—a defect common in the earlier barometers, and not unknown now, occasionally.

south of England, but does not advert to any corresponding north-easterly wind, nor had he evidently any idea of a rotatory or circulating atmospheric current. Probably, accounts from the north of England were less inquired for then: it is noted, however, that the north of England escaped the violence of that storm, which seems to have been one of a succession of cyclones.

I will not take more from De Foe, but may venture to say that his graphic accounts of many storms, and the more comprehensive views of Dampier, are well worth the notice of all meteorologists. To them and to Franklin, Capper, Horsburgh, Redfield, Reid, Piddington, and Dove, besides other and more scientific authorities, seamen may well be grateful for their works on storms; the facts and inferences compiled by them having been demonstrated to be generally true—and invaluable.

Among other storms, two alone will probably suffice as types. The *Royal Charter* gale, so remarkable in its features, and so complete in its illustrations, I may say, from the fact of its having been noted at so many parts of our coast, and because the storm passed over the middle of the country, is one of the very best to examine which has occurred for some length of time. It occurred on the 25th and 26th of October 1859. The lowest barometer, and a corresponding or simultaneous central *lull*, prevailed over areas of from 10 to 20 miles across successively. But at the time that this comparative lull existed, there were violent winds around the central space, (by some called a vortex, but which can hardly be thus *appropriately* termed, because there was no central disturbance), while there were only variable winds or calms in the middle of the area. The wind attained a *maximum* velocity of from 60 to 100 miles an hour at a distance of 20 to 50 miles from the middle of this comparatively quiet space, and in successive spiral eddyings seemed to cross England towards the N.E., the wind blowing from all points of the compass consecutively around the lull; so that while at Anglesea the storm came from the N.N.E., in the Irish Channel it was northerly, and on the east coast of Ireland it was from the N.W.; in the Straits of Dover it was from the S.W.; and on the east coast it was easterly—*at the same minute.*

Thus there was an apparent circulation, or cyclonic commotion passing northwards from the 25th to the 27th, being two complete days from its first appearance in the channel; while outside of this circuit the wind became less and less violent; and it is very remarkable that, even so near as on the west coast of Ireland, there was fine weather, with light winds, while in the Bristol channel it blew a northerly and westerly gale. At Galway and at Limerick, on that occasion, there were light winds only, while over England the wind was passing in a tempest, blowing from all points of the compass in irregular succession around a central variable area. As it is the *north-west* half (from N.E. to S.W., true), which seems to be principally influenced by the cold, dry, heavy, and positively electrified polar current; and the south-east half of the cyclone that apparently shows effects of tropical air,—(*warm, moist, light, and negatively, or less sensibly* *electrified*), places over which one half of a cyclone passes, are affected differently from others over which the other part of the very same atmospheric eddy passes, the eddy itself being caused by the meeting of very extensive bodies of atmosphere moving in nearly, but not exactly opposite, directions, one of which gradually overpowers, or combines with the other.

On the polar side of a cyclone, continually supplied from that side, the sensible effects are chilling, drying up, and clearing the air—with a rising barometer and falling thermometer; while on the tropical or equatorial side, overpowering quantities of warm, moist air, rushing from comparatively inexhaustible supplies, push towards the north-east as long as their impetus lasts, and are successively chilled, dried, and intermingled with the conflicting polar currents.

Another storm that occurred a few days after was similar in its nature, though it came from a slightly different direction. This one was on the 1st and 2nd of November, and its character was in most respects like that just mentioned. Its centre came more from the westward, passed across the north of Ireland, the Isle of Man, and the north of England; then went over the North Sea towards Denmark.

The general effect of these storms was felt unequally on our islands, and less inland than on the coasts. Lord Wrottesley has shown, by the anemometer at his observatory in Staffordshire, that wind is diminished or checked by its passage over land. The mountain ranges of Wales and Scotland, rising from 2000 to 4000 feet above the ocean level, must have great power to alter the direction, and probably the velocity of wind independently of alterations caused by changes of temperature.

Very remarkable were the similarities of the storms of the 1st and 2nd of November,—the 25th and 26th of October,—the series of storms investigated by Dr. Lloyd during ten years,—and the observations of Mr. William Stevenson in Berwickshire. There is no discrepancy between the results of ten years' investigation published by Dr. Lloyd in "*Transactions of the Royal Irish Academy*," the three years' inquiries published by Mr. W. Stevenson, and other investigations which have been brought together during the last few years. They all tell the same story. Gales from the South and West are followed by dangerous storms from the North and East; and those from the North and East do most damage on our coasts. By tracing the facts it is shown that storms which come from the West and South come on gradually; but that those from the North and East begin suddenly, and often with extraordinary force. The barometer, with these north-eastern storms, does not give direct warning upon this coast, because it ranges higher than with the wind from the opposite quarter. But though the barometer does not give much indication of a north-east storm, the thermometer does; and the known average temperature of every morning in the year affords the means (from the temperature being much above or below the average of the time of the year) of knowing, by comparisons, whether the wind will be northerly or southerly (thanks to Mr. GLAISHER's deductions from more than eighty years' Greenwich observations).*

For a few days before the "*Royal Charter* Gale" came on, the thermometer was exceedingly low in most parts of the country: there were northerly winds in some places, with a good deal of snow, with low barometers. There had been a great deal of exceedingly dry and hot weather previously, which made the sudden change to unusually cold weather, with snow, more remarkable (for the season). In the north of Ireland, especially, at that time, thermometers were very low (on the 22nd and 23rd of October). Many days preceding the storm an extraordinary clearness in the atmosphere was noticed in the north of Ireland—the mountains of Scotland were never seen more prominently than they were in the few days preceding those on which it took place. The summer had been remarkable for its warmth; it was exceedingly dry and hot. All over the world, not only in the Arctic but in the Antartic regions, in Australia, South America, in the West Indies, Bermuda, and elsewhere, auroras and meteors had been usually prevalent, and they were more remarkable in their features and appearances than had been noticed for many years. There were also extraordinary disturbances of the currents along the telegraphic wires, (above ground and submarine) and these disturbances were followed within a few days by great commotions in the atmosphere, and by some remarkable change of weather.

Instances of singular exceptions to the force of these particular storms occurred. At some places there was little or no wind; the barometer fell much, but there was no storm; the wind apparently circulating around those districts did not affect them, while at other places, only a few miles off, the tempest was tremendous.

A very remarkable storm was carefully traced, and its description published, by MR. ROWELL, of Oxford. This blast occurred near Calne, in Wiltshire, cutting through fields and high trees. It actually lifted an empty waggon *from the road over a hedge, into the next field!* The violence of the wind was confined to a limited line. The downward and onward pressure of the wind was so great, in that place, that it acquired such elasticity as to lift opposing weights and carry them on. I have known wind lift a boat into the air and shake it to pieces; and we have all heard of houses being unroofed; of great trees being torn up or broken by the force of the wind; but this is the first well authenticated instance, it may be presumed, of a *heavy waggon* being lifted up and hurled over a hedge.

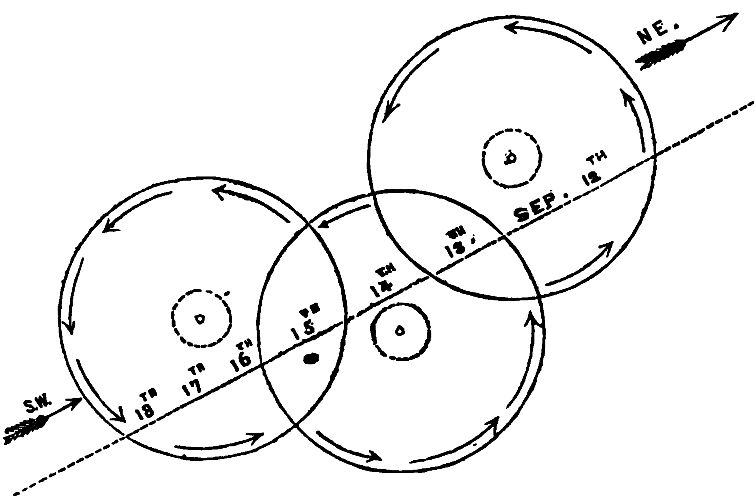
An extract from MR. STEVENSON's paper will probably be useful. His explanation of the interference of following or consecutive cyclones is frequently corroborated by practical observations, and deserves study:—

"I propose to state, as concisely as possible, some of the more important general conclusions regarding storms, to which I have been led by long-continued observations, made in the Merse of Berwickshire, compared with observations

* Besides electrical indications.

made in other localities; and then to offer a few practical suggestions which have occurred to me while reflecting upon the subject.

"The storms which pass over the British Isles are found generally to act in strict accordance with the cyclonic theory. In many cases, however, this accordance is not so obvious, and the phenomena become highly complicated. This is a result which often happens when two or more cyclones interfere—an event of very frequent occurrence. When interferences of this description take place we have squalls, calms (often accompanied by heavy rains), thunder storms, great variations in the direction and force of the wind, and much irregularity in the barometric oscillations. These complex results are, however, completely explicable by the cyclonic theory, as I have tested in several instances. A very beautiful and striking example of a compound cyclonic disturbance of the atmosphere, at this place, was investigated by me in September 1840, and found to be due to the interference of three storms, in the manner shown in the subjoined diagram:—



"The dotted line and the dates show the progress of the storms over this locality, and the curved arrows the vertical or cyclonic movement, from right to left, which is found to hold with regard to the storms of the northern hemisphere. A glance will suffice to indicate the nature of the meteorological changes which might be expected to occur at any point upon the dotted line, or on parallel lines, during the passage of the storms in question. The complicated veerings of the wind, the risings and fallings of the barometer, the calms, irregular gusts and occasional heavy showers, which prevailed for about a week, while this system of cyclones passed over this locality, appeared at first quite anomalous: and it was with no small pleasure that I found the varied phenomena explained in the most satisfactory manner, and agreeing beautifully with the received laws of storms, on the hypothesis of a combination similar to that shown in the diagram."

"Another striking instance of cyclonic interference was presented by a storm which passed over the North of Ireland on the 19th November 1850, and reached this place early on the following morning. On the 18th November, about noon, a storm commenced here from S.E., and continued till the afternoon of the 19th, at which time the wind had veered to S.W., showing that the centre of this storm had passed to northward. The completion of the veering of the wind was prevented by the arrival of the other storm above referred to, and the wind backed to S.E. A very great quantity of rain fell during the night and next day, the wind veering by N.E. and N. to N.N.W. The centre of this storm must therefore have passed to southward of this locality. The 21st was fine, wind light from S.W."

A third example of the interference referred to, was exhibited by a series of storms which passed over Britain in a direction nearly N.W. to S.E., between the 18th and 27th of February, 1853. The first commenced on the 18th, and had completed its course by mid-day of the 21st, the veering of the wind having been confined to points between W.N.W. and N.N.E., and the centre having passed to eastward. On the evening of the 21st, symptoms of a second storm began to appear. This one also moved in the same direction, its centre likewise passing to eastward. Its course was regular until the forenoon of the 24th, when it was interfered with by a third storm of quite the same character as the two preceding, but more nearly central here. The barometer fell until 9 P.M., when it attained its lowest point, the wind being from S.W. At twelve P.M. the wind had veered to N., and the barometer had risen ·05. The wind continued northerly, with a rising barometer, till about 3 P.M. of the next day, when the wind was backed to S.W. by a fourth storm coming over in the same direction. This one was nearly central here, and caused a great depression of the barometer. The 26th was very stormy, wind N.N.E. This, the last of the series, was permitted to complete its course with regularity, and by three P.M. of the 27th the atmosphere had become settled. During the passage of these storms, heavy snow and hail squalls, with high winds, occasionally interrupted by calms, were very prevalent."

"Numerous other instances of cyclonic interference might be cited, but those now given will, it is hoped, be sufficient to serve as examples of their general character. It not unfrequently happens that a series of cyclones follow hard upon each other for several weeks, the preceding members of the series being often overtaken and interfered with by those succeeding. It is, however, important to remark, that amidst all the complexity necessarily occasioned by such combinations—the greater and more violent storms, and particularly that portion of them which is most dangerous and destructive, exhibit almost invariably the simple cyclonic character. It is thus with the "Law of Storms" as with the "Law of Gravitation;" the grand results of both are exceedingly simple, but the minor details become more and more complicated in proportion to their minuteness."

"The direction of the *progressive motion* of the storms which pass over Britain is most frequently from about S.W. to N.E., but *occasionally* from other points, including it would appear all points from S.E. round by S. and W. to N. They seem very rarely to come over from any point between N. (round by E.) and S.E. About ten years ago, I was led to form the opinion, that *the direction of the progressive motion of any storm coincides with that of the upper current of the atmosphere prevailing at the time, at the ordinary altitude of cirri cloud.* Since then, I have met with no instance adverse to this view, but on the contrary, many highly confirmatory of it. The point cannot, however, be considered as determined until placed beyond doubt by the concurrent testimony of other observers, and I would beg to impress upon meteorologists the importance of giving the subject their close attention. It is obviously of very great consequence that this point should be ascertained, since if found to hold universally or even generally true, the movements of cirri clouds, at the time when a cyclone is approaching or passing over, would be of great utility in indicating the direction of its progressive motion, which being known, a little attention to the state of the barometer and the wind, will suffice to enable an observer to predicate, with confidence, general characters or elements of the storm, such as its probable violence, the manner in which the veering will take place, and the point from which the wind will blow with the greatest force. * * * * *

"Our heaviest storms generally have a progressive motion from S.W. to N.E. and the most frequent track of their centres, is a line passing in that direction across the North of Ireland, and the South of Scotland. A great number of these storms are central in the Merse of Berwickshire, hence the barometric range is greater in general here than at places situated to northward or southward. The damage done by such storms is much greater at places situated within the range of the Southern semicircle of the whirl, at a certain distance from the centre, than at places within the northern semicircle, or even in the course of the central line. A remarkable instance of this was afforded by the memorable storm of 7th January, 1839. The centre of this storm passed in a S.W. to N.E. direction, by Belfast, Dumfries, and the Merse. The barometer here fell rapidly with the wind at S.E., and rose with the wind from the N.W., the wind in passing through the westerly points having been comparatively light. In the southern semicircle of the storm, particularly at Dublin, Liverpool, &c., the violence of the wind was much greater than at this place, and was most furious from S.W. In the northern semicircle, embracing the central and northern districts of Scotland, the wind blew from the easterly and northerly points, and caused comparatively little damage. The greater force of the wind in the southern semicircle is readily explained by the consideration, that in it the maximum force of the wind is composed of the vortical force *plus* the progressive whereas in the northern it consists of the vortical *minus* the progressive. If we suppose the vortical or rotatory velocity of the wind, in a storm such as that referred to, to be 60 miles an hour, and the rate of the progressive motion of the storm to be hour, the greatest velocity of the wind across the central line, or axis, would be 60 miles, at certain points in the northern semicircle 45 miles (60—15), and at others in the southern semicircle 75 miles an hour."

"If the views stated above, relative to the motions of the upper currents of the atmosphere at the elevation of the cirri clouds, be found to be correct, they may prove to be of particular utility, in indicating at sea, or where there are no means of comparing observations, the directions of the progressive motion of any storm, and this is a point of essential importance to a thorough understanding of its other conditions."

CHAPTER XIII.

HURRICANES OR CYCLONES.

1. Those violent storms which partake of a double movement—one of rotation and the other of progression—and which, originating within the tropics, generally invade the extra-tropical and temperate regions of the globe, are variously known as "Revolving Storms," "Hurricanes," "Cyclones," and "Typhoons."

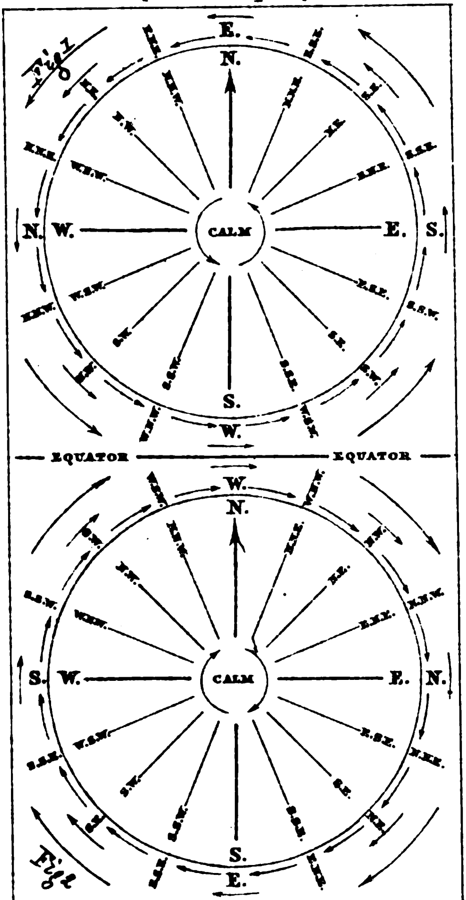
2. DOVE'S *Law of Gyration* has been briefly noticed in chapter II. (pp. 18—26); and it is unnecessary to repeat his observations here. The names most familiar to seamen in connection with Hurricanes are those of REDFIELD, REID and PIDDINGTON, but there are others who in their different works at different times have done good service in elucidating the "LAW OF STORMS;" these are CAPPER, THOM, SIR J. HERSCHEL, ESPY, MELDRUM, FITZROY, and BIRT: it is the result of their labours which it is here proposed to bring to the notice of the navigator in connection with the Hurricanes of the North Atlantic—first, collecting together the well-established laws of rotatory gales as developed in both hemispheres.

3. Bearing in mind the direction of the rotation of the wind in each hemisphere—viz., against watch hands in the Northern, but with watch hands in the Southern Hemisphere,—certain portions of the storm are characterized by certain hurricane winds;—and dividing the storm by diameters drawn from the northern to the southern margin, and again from the eastern to the western margin, we find that, in the Northern Hemisphere, on the northern margin the wind will be *easterly;* on the eastern margin, *southerly;* on the southern margin, *westerly;* and on the western margin, *northerly;*—each portion of the cyclone possessing its appropriate wind (*see* plate V. fig. 1).

The relation of the winds to the margins in the Southern Hemisphere will be exactly the reverse of their relations in the Northern;—thus, it is the southern margin of the storm, south of the equator, that exhibits an *easterly;* the western

HURRICANE WINDS

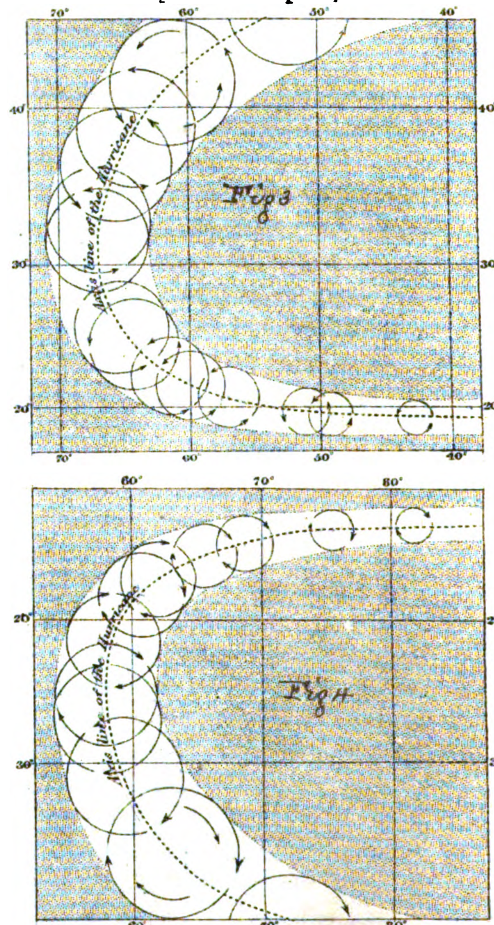
[Northern Hemisphere]



[Southern Hemisphere]

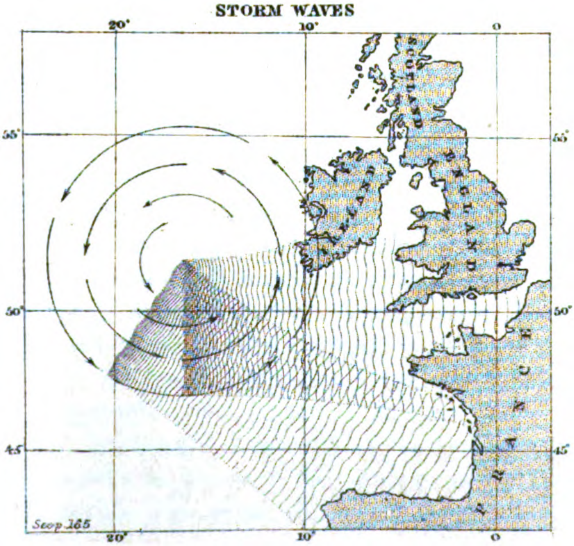
NORMAL COURSE OF HURRICANES

[Northern Hemisphere]

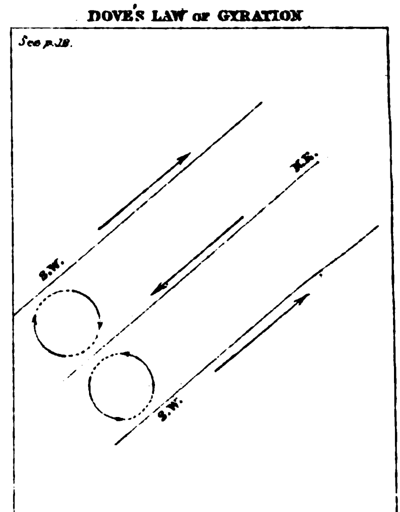


[Southern Hemisphere]

STORM WAVES



DOVE'S LAW OF GYRATION



To face p. 139

margin a *southerly;* the northern margin a *westerly;* and the eastern margin a *northerly* wind (*see* plate V. fig. 2).

4. Hence, each portion of the hurricane has its appropriate wind, and from this arrangement results a very simple *Rule for determining the bearing of the centre* of the storm from the ship, viz.—*Look to the wind's eye and set its bearing by compass,* the EIGHTH *point to the* RIGHT *thereof, when in the Northern Hemisphere,—but to the* LEFT *of the wind's direction when in the Southern Hemisphere—will be the bearing of the storm's centre.*

Thus, in the NORTHERN HEMISPHERE, from an *easterly* wind which characterizes the northern margin of the storm, its centre will bear *south;* from a *northerly* wind the centre will bear *east;* from a *westerly* wind it will bear *north;* and from a *southerly* wind, *west.*

But, in the SOUTHERN HEMISPHERE, from an *easterly* wind, the centre of the storm bears *north;* from a *southerly* wind the centre bears *east;* from a *westerly* wind, *south;* and from a *northerly* wind, *west.*

The above rule is perfectly clear and definite, but as it is especially important to avoid the centre of the storm the following Table shows at a glance its relative bearing in each hemisphere:—

IN THE N. HEMISPHERE.		IN THE S. HEMISPHERE.	
If the wind be	The centre of the Storm will bear from the Ship.	If the wind be	The centre of the Storm will bear from the Ship.
North	East	North	West
N. by E.	E. by S.	N. by E.	W. by N.
N.N.E.	E.S.E.	N.N.E.	W.N.W.
N.E. by N.	S.E. by E.	N.E. by N.	N.W. by W.
N.E.	S.E.	N.E.	N.W.
N.E. by E.	S.E. by S.	N.E. by E.	N.W. by N.
E.N.E.	S.S.E.	E.N.E.	N.N.W.
E. by N.	S. by E.	E. by N.	N. by W.
East	South	East	North
E. by S.	S. by W.	E. by S.	N. by E.
E.S.E.	S.S.W.	E.S.E.	N.N.E.
S.E. by E.	S.W. by S.	S.E. by E.	N.E. by N.
S.E.	S.W.	S.E.	N.E.
S.E. by S.	S.W. by W.	S.E. by S.	N.E. by E.
S.S.E.	W.S.W.	S.S.E.	E.N.E.
S. by E.	W. by S.	S. by E.	E. by N.
South	West	South	East
S. by W.	W. by N.	S. by W.	E. by S.
S.S.W.	W.N.W.	S.S.W.	E.S.E.
S.W. by S.	N.W. by W.	S.W. by S.	S.E. by E.
S.W.	N.W.	S.W.	S.E.
S.W. by W.	N.W. by N.	S.W. by W.	S.E. by S.
W.S.W.	N.N.W.	W.S.W.	S.S.E.
W. by S.	N. by W.	W. by S.	S. by E.
West	North	West	South
W. by N.	N. by E.	W. by N.	S. by W.
W.N.W.	N.N.E.	W.N.W.	S.S.W.
N.W. by W.	N.E. by N.	N.W. by W.	S.W. by S.
N.W.	N.E.	N.W.	S.W.
N.W. by N.	N.E. by E.	N.W. by N.	S.W. by W.
N.N.W.	E.N.E.	N.N.W.	W.S.W.
N. by W.	E. by N.	N. by W.	W. by S.

5. To those who prefer it, the rule just ennunciated may be put in another form, not however equally clear to all,—*the centre of a revolving storm bears eight points from the direction of the wind at the ship, reckoned with the apparent course of the sun;* and in this view, one rule holds good for both hemispheres, for though the bearings are precisely the reverse in the one hemisphere from those in the other, so is the apparent motion of the sun also reversed, since in the southern hemisphere that luminary rises in the east, *culminates in the north*, and sets in the west.

Thus, from the direction of the wind *only*, in a revolving storm, two very important points are made known,—the exact position of the ship in the cyclone, and the bearing of the storm's centre from the ship.

6. From the very nature of whirlwind storms the wind has a rotatory motion, as it were, on an axis. But the body of the storm has a progressive motion, generally from the Equator towards the Pole, at first with westing, but as the storm advances towards the Tropics it recurves, and then moves polarwise with easting.

The hurricane is impelled to the *west* in *low* latitudes because the tendency of the two currents of air (polar and equatorial) is in those regions to the westward *along the surface*; the equatorial current *is much less so*, and diminishing until actually altered to easterly, near the Tropic, after which its preserved equatorial rotatory force becomes more and more evident, while the *westwardly* tendency of the polar current *diminishes;* as a consequence, near the Tropic, the whirlwind ceases to move westward—it recurves—and then in its polarwise progression moves towards the eastward. Thus, in general terms, the progressive motion of the Hurricane in the Northern Hemisphere is from S.E.-ward to N.W.-ward; and after recurving, from S.W.-ward to N.E.-ward (Plate V., fig. 3). In the Southern Hemisphere from N.E.-ward to S.W.-ward; and after recurving, from N.W.-ward to S.E.-ward (Plate V., fig. 4). The place of recurvature is very dangerous, for the hurricane winds are deceptive, owing to the storm being comparatively stationary for a brief period.

7. The *area* over which these rotatory storms have been known to expand varies from 30 or 40 to 1000 miles; but while the diameter, so long as the storm is within the tropics, expands but very gradually, it suddenly increases in a remarkable manner after recurving.

Within the area of the cyclone the moving body of air frequently attains a rotatory velocity of from 70 to 100 miles an hour.

The *rate* at which they travel on their onward course also varies greatly, not only in different parts of the globe, but even in the same locality and at the same season. Generally, however, the rapidity with which the vortex of the hurricane progresses, is greater as the storm recurves on reaching the outer edge of the Trade-winds,—thus, the hurricane of August 1853 traversed 7276 English miles in about 12 days, with a mean velocity of progress of 26 miles per hour;

but after it had arrived at the Banks of Newfoundland, this velocity was increased to about 50 miles per hour.

8. Upon combining the rotatory with the progressive motion, some very valuable rules may be deduced. The path which the axis of rotation describes, is not inappropriately termed the *axis line*, and this divides the cyclone into *two semicircles*,—the right or *starboard* semicircle, and the left or *port* semicircle; there are consequently three divisions of a storm, each characterized by different phenomena. In the right hand semicircle, the hauling of the wind resulting from the passage of a cyclone in the Northern Hemisphere, is in the same direction as the apparent course of the sun; but in the left hand semicircle it is reversed, being against the apparent course of the sun. On the axis line there is no change of wind *until the centre has passed*, when, after a brief interval of calm, the wind springs up with great fury from the opposite quarter.

Thus, the direction of the wind at the ship gives her position in the storm as referred to the points of the compass, and what is of the greatest importance—the bearing of the centre from her; the hauling of the wind announces her position relatively to the axis line of the storm, which, combined with her track through the cyclone, will give the progressive direction of the storm itself; if the wind be found to increase in force *without hauling*, the ship is on the axis line; and if a calm occur, succeeded by a terrific and violent wind from the *opposite quarter*, the ship has passed through the centre.

From these remarks, it will appear evident, that in manœuvring a vessel when overtaken by a rotatory gale IN THE NORTHERN HEMISPHERE,—if she receive the wind on her *port* side, her head is directed (more or less) *towards the centre*; but if she receive it on her *starboard* side, her head is turned *from the centre*: and these facts indicate the means to be adopted to draw from the centre when lying-to;—if, with the ship's head from the centre, she receive the wind on the starboard side, then in lying-to (or drawing from the centre) she must be trimmed on the *starboard tack*.

IN THE SOUTHERN HEMISPHERE the reverse of this takes place;—a vessel sailing *out of* the gale, receives the wind on her *port* side, and she must therefore be trimmed on the *port tack*.

9. These rules deduced from the progressive motion of a storm, combined with its rotation, will be best elucidated by three examples, in which the vessels may be supposed to encounter a hurricane in that portion of the North Atlantic, where the ordinary storm-paths follow (more or less) the course of the Gulf Stream:—

1. A vessel on the usual course to the Gulf of Mexico or the West Indies, having attained Long. 50° to 55° W., observes the acknowledged meteorological signs of an approaching hurricane, the scud skirting the storm is already flying over her; the steady N.E. Trade is replaced, not by a wind from a different quarter, but by a N.E. wind of greater intensity, and characterized by strong and sudden squalls; the ship is soon just within the N.W. margin of the hurricane and the centre bears S.E. of

her; if she scud before the wind, she will approach the axis line of the storm: should she heave-to on the *starboard* tack, and allow the cyclone to pass over her, the wind will haul E.N.E., East, E.S.E., S.E. and S.S.E. successively—which is in accordance with the apparent course of the sun; and hence an extensive generalization indicates that, *in the northern hemisphere the wind always hauls with the sun in the right hand, or starboard semicircle of a rotatory storm.*

2. Another vessel pursuing the same course observes the usual significant signs of a cyclone, and experiences a slight change in the Trade-wind from N.E. to N.N.E., which, however, is continually increasing in force, until at last it comes on to blow furiously from that quarter (N.N.E.); the ship the while maintaining her course, at last finds it become suddenly calm; at the expiration of a few minutes (or perhaps half an hour) the wind suddenly springs up from the opposite quarter (S.S.W.); while this wind continues, its force abates until the storm has passed, and the N.E. Trade again resumes its sway. In this case, at the commencement of the storm, the centre of the cyclone bore E.S.E. of the ship, and it finally passed over her; so that the general rule may be deduced, that *on the axis line of a rotatory storm a vessel experiences only* TWO *winds, one the opposite of the other—with an intervening calm.*

3. Finally, with a third vessel a still greater change of wind occurs; the N.E. Trade, instead of being replaced (as in 1) by a violent wind from the same quarter, veers through N.N.E. to North. Should this vessel lie-to on the starboard tack, the winds will be in succession N.W. W., and S.W. The hauling in this case is exactly in the opposite direction to that in the first instance,—it is contrary to, or against the apparent course of the sun; *and hence the hauling of the wind, in the left hand or port semicircle of a revolving storm, in the Northern Hemisphere, will always be against the sun.*

RULES FOR TRIMMING THE SHIP IN A HURRICANE.—PIDDINGTON has justly said that all *positive* rules for monœuvring tend to mislead; every ship must have its own peculiar management depending on the four great elements of the problem, —1, the ship and her sea-room; 2, the track of the cyclone; 3, its rate of travelling; and 4, the ship's run and drift;—while on the part of the commander, caution and watchfulness are essentially requisite. Still, all the circumstances being favourable, *rules* may be given in a very brief compass *for trimming a vessel to the hurricane-winds;* these are embodied in the following Tables, where the directions of the wind-vane as set down in the first column, are tangents to the whirlwind in its course—these indicate the quarter from which the storm sets in; the points of the compass in the second column show the position of the storm's centre as regards the vessel; the fourth column gives the direction in which to steer when the wind shifts as indicated in the third column; but if it shifts, as indic ted in the fifth column, then bear away, as told in the sixth column.

1. For the Northern Hemisphere:—

Direction of Wind at commencement of Storm.	If the Centre (or Vortex) bears	And the Wind. shifts from	Steer	But if the Wind shifts from	
N.W.	N.E.	N.W. to W.	S.E.	N.W. to N.	Put the Ship on the Starboard Tack.
N.W. by N.	N.E. by E.	N.W. by N. to W.	S.E. by S.	N.W. by N. to N.	
N.N.W.	E.N.E.	N.N.W. to W.	S.S.E.	N.N.W. to N.	
N. by W.	E. by N.	N. by W. to W.	S. by E.	N. by W. to N.	
N.	E.	N. to W.	S.	N. to E.	
N. by E.	E. by S.	N. by E. to N.	S. by W.	N. by E. to E.	
N.N.E.	E.S.E.	N.N.E. to N.	S.S.W.	N.N.E. to E.	
N.E. by N.	S.E. by E.	N.E. by N. to N.	S.W. by S.	N.E. by N. to E.	
N.E.	S.E.	N.E. to N.	S.W.	N.E. to E.	
N.E. bv E.	S.E. by S.	N.E. by E. to N.	S.W. by W.	N.E. by E. to E.	
E.N.E.	S.S.E.	E.N.E. to N.	W.S.W.	E.N.E. to E.	
E. by N.	S. by E.	E. by N. to N.	W. by S.	E. by N. to E.	
E.	S.	E. to N.	W.	E. to S.	
E. by S.	S. by W.	E. by S. to E.	W. by N.	E. by S. to S.	
E.S.E.	S.S.W.	E.S.E. to E.	W.N.W.	E.S.E. to S.	
S.E. by E.	S.W. by S.	S.E. by E. to E.	N.W. by W.	S.E. by E. to S.	
S.E.	S.W.	S.E. to E.	N.W.	S.E. to S.	
S.E. by S.	S.W. by W.	S.E. by S. to E.	N.W. by N.	S.E. by S. to S.	
S.S.E.	W.S.W.	S.S.E. to E.	N.N.W.	S.S.E. to S.	
S. by E.	W. by S.	S. by E. to E.	N. by W.	S. by E. to S.	
S.	W.	S. to E.	N.	S. to W.	
S. by W.	W. by N.	S. by W. to S.	N. by E.	S. by W. to W.	
S.S.W.	W.N.W.	S.S.W. to S.	N.N.E.	S.S.W. to W.	
S.W. by S.	N.W. by W.	S. W. by S. to S.	N.E. by N.	S.W. by S. to W.	
S.W.	N.W.	S.W. to S.	N.E.	S.W. to W.	

2. For the Southern Hemisphere:—

Direction of Wind at Commencement of Storm.	If the Centre (or Vortex) bears	And the Wind shifts from	Steer.	But if the Wind shifts from	
S.	E.	S. to W.	N.	S. to E.	Put the Ship on the Port Tack.
S. by E.	E. by N.	S. by E. to S.	N. by W.	S. by E. to E.	
S.S.E.	E.N.E.	S.S.E. to S.	N.N.W.	S.S.E. to E.	
S.E. by S.	N.E. by E.	S.E. by S. to S.	N.W. by N.	S.E. by S. to E.	
S.E.	N.E.	S.E. to S.	N.W.	S.E. to E.	
S.E. by E.	N.E. by N.	S.E. by E. to S.	N.W. by W.	S.E. by E. to E	
E.S.E.	N.N.E.	E.S.E. to S.	W.N.W.	E.S.E. to E.	
E. by S.	N. by E.	E. by S. to S.	W. by N.	E. by S. to E.	
E.	N.	E. to S.	W.	E. to N.	
E. by N.	N. by W.	E. by N. to E.	W. by S.	E. by N. to N.	
E.N.E.	N.N.W.	E.N.E. to E.	W.S.W.	E.N.E. to N.	
N.E. by E.	N.W. by N.	N.E. by E. to E.	S.W. by W.	N.E. by E. to N.	
N.E.	N.W.	N.E. to E.	S.W.	N.E. to N.	
N.E. by N.	N.W. by W.	N.E. by N. to E.	S.W. by S.	N.E. by N. to N.	
N.N.E.	W.N.W.	N.N.E. to E.	S.S.W.	N.N.E. to N.	
N. by E.	W. by N.	N. by E. to E.	S. by W.	N. by E. to N.	
N.	W.	N. to E.	S.	N. to W.	
N. by W.	W. by S.	N. by W. to N.	S. by E.	N. by W. to W.	
N.N.W.	W.S.W.	N.N.W. to N.	S.S.E.	N.N.W. to W.	
N.W. by N.	S.W. by W.	N.W. by N. to N.	S.E. by S.	N.W. by N. to W.	
N.W.	S.W.	N.W. to N.	S.E.	N.W. to W.	

10. It was long ago remarked by PIDDINGTON, that "he who watches his Barometer, watches his ship." This invaluable instrument, if well understood, invariably announces the approach of a revolving storm,—shows whether the vessel is plunging into the vortex, or if she be receding from it;—and hence, by carefully noticing its indications, the disastrous consequences of a hurricane, may to a great extent be avoided, for the laws of its oscillations are very distinctly marked. The Barometer often stands unusually high before the commencement of a cyclone, and frequently (if not always) just *around* the storm; and conceiving the cyclone to be divided into two parts by a diameter at right angles to its path, it may be noted that—

(*a*) The Barometer always *falls* during the passage of the *advancing* semicircle of a revolving storm.

(*b*) The Barometer always *rises* during the passage of the *receding* semicircle of a revolving storm.

In cases of manœuvring to take advantage of the hurricane winds and to keep just within the verge of the storm, the barometer is of signal benefit,—it should be kept as high as possible without loosing the wind. In whatever position the ship may be, the rising of the mercury announces that the first (or dangerous) half of the storm has passed.

The barometer is a faithful guide; in the zone of the Trade-winds its ordinary variations are so small that any deviation from the normal height requires attention; its fluctuations are larger beyond the Tropics, but the indications are scarcely less certain if used in conjunction with the thermometer and hygrometer.

11. REDFIELD has traced one hurricane (August 30, 1858, *see* p. 162) from the west coast of Africa, across the Atlantic, to the seaboard of the States, and thence to Europe—thus crossing the Atlantic, in its route, twice,—and he was of opinion that all great rotatory gales follow the same course; but the evidence on this subject which has been accumulated within the last few years, not only in respect to the hurricanes of the North Atlantic, but also those of the southern Indian Ocean, tend to show that, though such storms may travel a considerable distance, for three or four days, a further extension of their progress cannot be proved; and, in fact, a succession of these gales, as they have occurred in different parts of the ocean, has been linked together to constitute one great hurricane; and this might happen without in the slightest degree invalidating the Law of Storms.

12. A few remarks* on manœuvring vessels in the hurricane regions of the North Atlantic may not be out of place.

When the gale sweeps along or among the West India Islands, the most dangerous quadrant (the advancing one) is characterized by north-easterly and

* These remarks are chiefly derived from an article by MR. BIRT, in the "Mercantile Marine Magazine." Vol. I.

easterly winds. A vessel in the Carribean Sea, or in the Gulf of Mexico, taking the storm at N.E., if she scud before the wind is approaching the axis line of the cyclone; she will in fact be rapidly approaching *the centre*, which in consequence of its curved path is likely under these circumstances, soon to overtake her. In no other part of a storm does a vessel so rapidly near the centre by scudding as in this, and the *quadrant of the starboard semicircle in advance of the centre and abutting on the axis line* is consequently regarded as by far the *most dangerous* portion of the hurricane.

13. Off the Bahamas, and the coast of Florida, vessels will experience important differences in the phenomena, according as they pass through the starboard, or port semicircles of the hurricane. In the immediate vicinity of the West India Islands, the path of the storm has been (more or less) towards the north-west. A vessel on a north-westerly course receives the northern margin of the gale with the wind from East; if she pursues her course, and the hurricane gain on her, she will soon experience a favourable wind for her voyage; the barometer falls until she is fairly under the influence of the S.E. wind, and by sailing parallel with the centre, she has a fair wind for the rest of her voyage, providing the cyclone does not alter its direction:—the fresh breeze from the S.E. with a steady barometer indicates that she preserves her parallelism with the centre. If, however, the barometer fall, and bad weather should come on rapidly, the course of the ship no longer continues parallel with that of the gale, but the centre is rapidly nearing the ship, and if means were not adopted to keep her near the margin, she would, under the circumstances here supposed, be so involved, that the centre would shortly overtake her. In this locality, a S.E. wind will invariably conduct the vessel to the centre, but if she lie-to as soon as the barometer falls, she will avoid getting nearer the centre,—the wind will continue to haul with the sun,—and the gale will finally leave her between S.W. and W. The most judicious as well as the most advantageous manœuvre in these localities, would be to lie-to, as soon as indications of the cyclone *recurving* are perceived; in fact *wait* until the S.E. wind is succeeded by a Southerly one with a rising barometer; the first half of the gale has then passed, after which cross the receding portion as far from the centre as may be consistent with safety, and pursue the original course N.W. From these remarks it is evident that if a vessel navigating these seas take the cyclone with any wind in the port semicircle, the recurving will so operate that the vessel will soon be removed from its influence; but a vessel in the starboard semicircle requires more than ordinary care in manœuvring, to avoid the centre bearing down upon her.

14. For vessels bound from Europe to the United States on any course between W.N.W. and W.S.W.—between Lat. 38° to 40° N., and Long. 60° to 65° W.—the hurricane moving to some point between N.N.E. and E.N.E. —the following results, derived from a comparison of the track with the Law of Storms, are apparent.

15. A ship falling in with easterly winds hauling against the sun (or to the N.E.) is in the left hand or port semicircle; she may pursue her course not only without inconvenience, but even with benefit from the cyclone winds. (*see* Plate VI., fig 1.)

16. A ship falling in with southerly winds hauling with the sun (or to the S.W.), is in the right hand semicircle, *directly advancing upon the centre.* As soon as the earliest indications of the proximity of the cyclone are perceived, the ship should be headed East or E.S.E., and she should wait until the hurricane makes northing. While waiting on the cyclone, if bad weather increase, with but little veering of the wind, the ship should stand a little to the eastward to avoid it. (*see* Plate VI., fig. 2.)

17. Upon the track, and in the region indicated, a vessel may take the hurricane by sailing into it at two points;—she may either sail into the posterior quadrant, getting a westerly wind, which if she wait will soon leave her;—or the hurricane may meet her with the wind at South, and in this case, upon her lying-to, she will experience the following winds,—S., S.S.W., S.W., W.S.W. and W. (hauling with the sun); the most prudent step appears to be "to wait on the cyclone" until the S.W. wind has passed, and the barometer begins to rise, when the earliest opportunity may be embraced for crossing its wake. She should be hove-to on the starboard tack. (*see* A. Plate VI., fig. 2.)

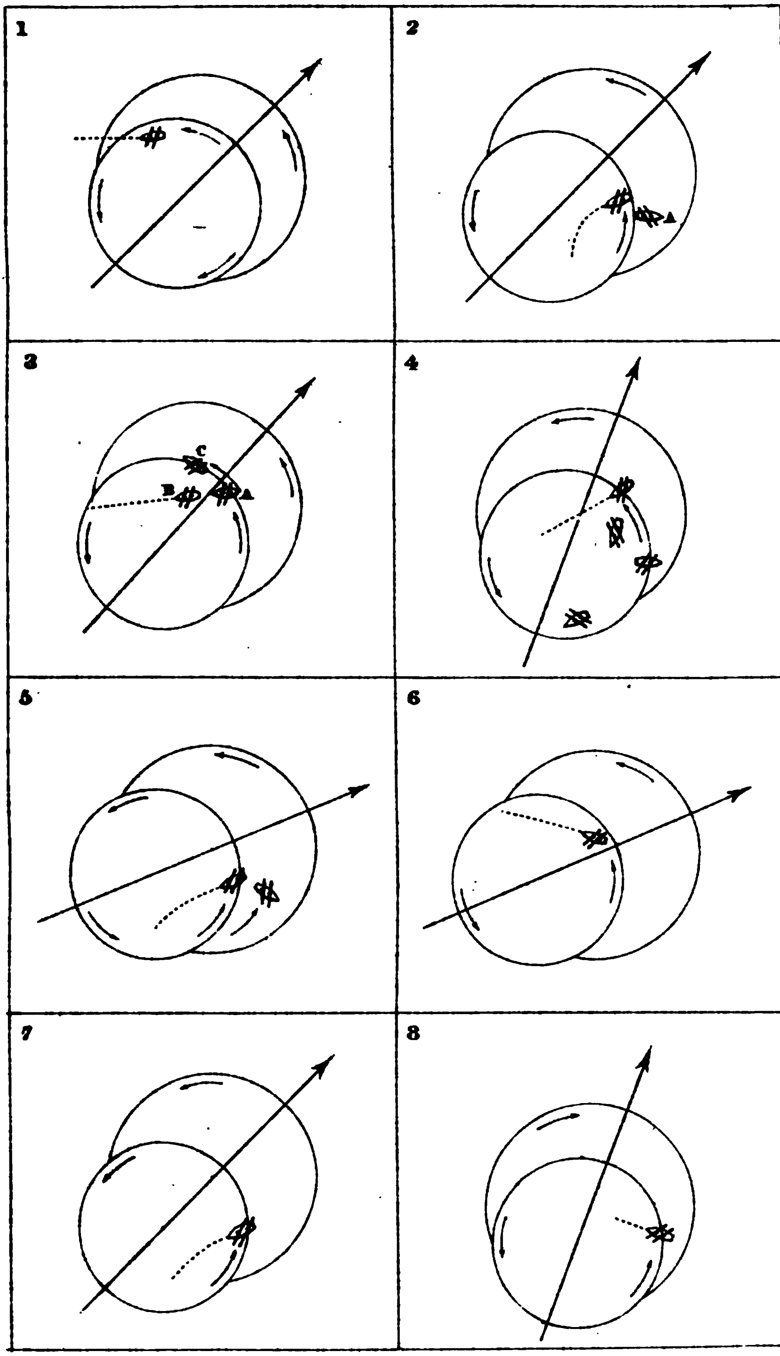
18. On a W.S.W. course in this part of the Atlantic a vessel is much more likely to fall in with S.E. than with East winds, and in such cases they will find it convenient to stand W. or even N.W.; "carrying on is likely to bring the ship *too near* the axis line, even if the hurricane be moving E.N.E. (This is shown in Plate VI., fig. 3, in which A represents the ship taking the S.E. wind, B the same ship standing on her course, and C one breaking off to the N.W.)

19. When the cyclone is moving N.N.E., and a ship upon a W.S.W. course meets it on the N.E. quadrant, with the wind from S.E., it is exceedingly probable she will—by "carrying on"—sail immediately upon the centre, the path of the hurricane being so inclined to the ship's course as to occasion the meeting of the ship and centre in the shortest time possible; in such a case, if the ship sails close hauled—heading to S.S.W. in the first instance, *i.e.* immediately on becoming aware of the proximity of the hurricane—and then wait (if hove-to it should be on the starboard tack) until she gets the wind hauling to the *west* of *south*, she may afterwards pursue a course parallel to her original one, behind the centre of the storm. (*see* Plate VI., fig. 4).

20. If a ship (on a W.S.W. course) meet a S.E. wind rapidly veering to East, with bad weather and a falling barometer, it is not only an indication that the cyclone is moving towards the N.E., but that the vessel is most assuredly approaching the centre. The best course that can be adopted under such circumstances is undoubtedly to edge away to the N.W. upon the earliest indications of bad weather, looking to the barometer—which, if the cyclone be advancing towards the N.E., will assuredly *rise;* but should the course of the

VI

STORM PATHS IN THE NORTH ATLANTIC



To face p.146

storm be more northerly, it will *fall*—and in that case edge away still more to the north, keeping up the barometer until the axis line has been *crossed*, unless there is reason to believe that it cannot be crossed without imminent risk, in which case adopt the course previously recommended (sec. 19). For an illustration of the position and manœuvres recommended in this section, the reader may consult Plate IV., fig. 8, in which A represents a ship meeting a cyclone on the N.E. quadrant; B, the ship standing on and plunging towards the centre; and C, a vessel breaking off to N.W. to sail round the northern edge.

21. A ship (upon a W.S.W. course) falling in with southerly hurricane winds, within or near the limits mentioned in section 14 will, upon the wind veering, find herself "headed off," should the cyclone be moving towards E.N.E.; nothing can be better in such a case than to adopt Sir W. Reid's rule, and put the ship on the starboard tack, her head E.S.E., away from the centre. While "standing on" in this direction, she will find the wind veering westwardly, and this will allow the course gradually to be changed, while the ship is creeping round the southern margin. Plate VI. fig. 5 illustrates this manœuvre, and it will be seen that this is the only safe course that can be adopted, *unless there is time to turn the ship's head northward, and sail round the advancing front.*

If upon due consideration the commander should come to the determination to turn his ship's head northward, he could not do better than adopt the directions given in Birt's "Hand-Book of the Law of Storms" p. 98, which are as follows:—

"*That vessels bound westwardly, when meeting with the starboard side of a revolving storm, should not 'carry on' by which they may sail or steam into the heart of the hurricane, but should sail round the advancing front, so as to make good northing and westing by the help of the south and south-east winds, and take up a good position in the left-hand semicircle, with a fair wind.*

"It is requisite in sailing round the advancing front, as directed in the above rule, to exercise great caution and to edge away to the N.E., that the vessel be not caught on the axis line *too near* the centre to extricate her from danger. Not only is a close attention to the barometer essential, by keeping it well up, &c., but the manœuvre should be executed upon the *earliest* symptoms of the southerly wind setting in, and the commander should not forget that he is here in the most dangerous quadrant, and by successfully crossing the storm's track, he gets a fair wind for his voyage; whereas, if he "carry on" through the heart of the gale, what he gains one way he loses the other, by meeting with contrary winds, damage, &c. If, however, the gale should be very extensive, and there should be indications of the commander being *unable* to cross the axis line successfully, a point that requires the deepest consideration, the best and most prudent course would be to heave-to and allow the centre to pass the meridian of the ship. This will be known by the wind veering to the *west*, and if he finds, while thus waiting, his barometer to fall considerably, and the wind to increase inconveniently in force, a standing to the east or southward of east will improve his condition until he gets clear of the cyclone."

If the gale should be moving N.E. it would be quite sufficient to bring the ship-to on the starboard tack, while the cyclone got northing, and as the wind veered aft she should stand to the southward to avoid the influence of the hurricane winds, till her original course or a parallel one could be resumed. (*see* Plate VI., fig. 7).

22. Of all the courses a ship may pursue in the hurricane region of the North Atlantic, a W.N.W. one is by far the most dangerous; it directly *crosses* the paths of the cyclones as they are coming up from the S.W., and as in the case of a W.S.W. course, in connexion with which each wind required a different manœuvre, so it is the same in the present case.

23. Ships falling in with Easterly or South-easterly winds,—the hurricane moving N.E. or E.N.E.,—they may pursue their course; they cannot have better winds, and the cyclone is rapidly leaving them.

24. If the hurricane be moving towards N.N.E. a ship may still lie her course it is true. With a S.E. wind she is in the *most dangerous quadrant*, but the courses of the ship and cyclone being at right angles to each other, and her distance from the axis line being comparatively short, she soon shoots across it, and is quickly out of further danger. A *word of caution* may probably not be out of place in reference to the *turning point* of the course, from W.N.W. to W.S.W.; should the hurricanes be coming up *from* W.S.W., by pursuing a W.S.W. course with a S.E. wind, the commander would be in precisely the same situation as indicated in sec. 18, in which a W. or even N.W. course is recommended. A little "carrying on" on the original course would be sufficient to remove the ship from danger.

25. S.S.E. winds are very likely to be met with by ships sailing on a W.N.W. course: with the cyclone moving E.N.E. it is well to "carry on." The ship and gale are every moment parting company, and she has fair winds. (*see* Plate VI. fig. 6).

26. This course (W.N.W.) is likely to bring commanders into very trying circumstances when the gale is moving in a more northerly direction. With a N.E. or N.N.E. cyclone track it would be worse than folly to "stand on" with the wind at S.S.E.,—the ship must be involved. To attempt to sail round the front of the hurricane when on the most northerly track would perhaps be attended with no little difficulty. Numerous circumstances must be taken into serious consideration ere the commander can determine on the course he should pursue. PIDDINGTON'S and REID'S remarks on these positions are so much to the purpose that they may be quoted entire.

PIDDINGTON says, "a vessel from Europe, bound, say to New York, meets with a strong S.S.E. gale and falling barometer, about the meridian of Bermuda. Here the seaman will observe, by the tracks and his storm card, that he is on the *eastern side* of the cyclone, which is travelling *towards* him on an E.N.E. or N.E. course, and that if he "stands on," he will inevitably meet it. To run off to the N.W. till he has brought the wind to at least E.N.E. or N.E., and his barometer is rising, would be the means of getting out of the way of the centre; but it is very uncertain what are the sizes of the cyclones hereabouts, and the distance he might have to run; most seamen will probably therefore prefer heaving-to and allowing the centre to pass them, when the wind will become a fair one."

He further remarks, "It has been noted before that these situations, when a ship is directly on the average track of a cyclone, are those of the greatest difficulty on two accounts. It is difficult to say beforehand, unless great attention has been paid to the run, and the veering of the wind, on which side of the track the vessel is; and the rate of travelling is here a serious question on which everything depends, and it is difficult therefore to judge if by running off for a few hours we shall really be getting farther out of the way. In the instance given above, the centre bears about W.S.W., and the track may be due E.N.E. or N.E. If it be only E.N.E., there might be time to cross in front and round the northern verge of the storm. But if it be travelling N.E., the wind and sea may become too heavy to allow of "standing on" and the run made would only have brought the vessel directly into the path of the focus, with the encumberance of her sail if she meets it unexpectedly."

Sir William Reid observes that, "most of the North Atlantic gales seem to have a north-easterly progression. When ships from Europe bound to America fall into the northern half of these gales, they will have the wind at east and fair for their voyage. If the weather should not be threatening, or the barometer fall rapidly, they should no doubt stand on their course.

"The appearance of the weather, and indications of the barometer, and also the swell of the sea, may be such as may make it very difficult for a commander to know what course is best to decide upon; thus on the 22nd of August, 1837, the barque *Barlow*, in her voyage from England to St. John's, New Brunswick, stood on in a gale at S.E. and obtained a fair wind by doing so; passing a ship hove-to, supposed to be the *Mediator*, bound for New York.

"In this instance, the *Mediator* might with advantage have run on like the *Barlow*.

"There may be danger in heaving-to in the North Atlantic with the wind at S.E., and a rapidly falling barometer, lest the gale should be moving N.E. In that case it would be waiting for the hardest part of the gale to pass over the ship.

"On the contrary, the fate of the barque *Carmelita*, in the North Atlantic, is an instance of the risk incurred by scudding in front of a progressive whirlwind, for the sake of profiting by the east wind of the front half of the storm; and it is of the greatest importance to discriminate between scudding in the front half, or hinder half of a progressive whirlwind.

"The *Carmelita* sailed from Fayal for Boston, on the 9th of September, 1848, and had light baffling winds, until the afternoon of the 18th. After that day the *Carmelita* began to feel the east wind of that same storm which caused some degree of alarm at Barbados on the 19th of September. By the 23rd, the wind had increased so as to have become a hurricane. The vessel was scudding towards Boston, and the first misfortune which befel her was carrying away the mainyard. From that time began the difficulties and perils incident to a ship in front of an advancing whirlwind tempest. Many of the crew and passengers were drowned, and the ship only kept afloat from the circumstance of her cargo being oil and wine."

27. From these two extracts, it appears that while PIDDINGTON considers most seamen will prefer heaving-to and allowing the centre to pass them, REID considers there may be danger in such a proceeding, and undoubtedly there is. With a S.S.E. wind, and the hurricane moving E.N.E. (a very common course), if the ship be hove-to she must meet all the brunt of the storm,—in fact, the centre will pass over her, and should she not have been brought-to on the *right* tack, the chances are she may founder. REID also shews that scudding in *front* of the gale is a dangerous expedient. But what is the seaman to do?—evidently to keep a good look out, and determine well his position in the gale; if he be on the axis line, his best course must surely be to get as quickly as he can into the left hand semicircle. We differ from PIDDINGTON, even in countenancing the idea that by heaving-to and allowing the centre to pass, the wind will become fair; it will certainly not be so on the course now under consideration;—a S.S.E. wind, the lull, and the shift to N.N.W.,—even supposing the ship bears the terrific wind and sea of the vortex,—will head her off her course; whereas, if she run on judiciously, *not scud*, edging away to the northward, if she finds the barometer falling and the wind increasing in force, she must better her position; and if, after all, the gale should be so extensive that she cannot readily escape from it, she will find, by the wind veering to East, that she can heave to in such a part of the semicircle that she may experience less of the violence of the wind. But to use the expressive words of PIDDINGTON, when a ship is right *before* the path of a tempest, "she *must* manage to get out of the way of the terrific centre at all events."

28. Returning to the consideration of cyclones moving N.E. or N.N.E., and ships meeting them on the N.E. quadrant, wind S.S.E., when the commanders find them to be so extensive that no alternative is left but to bring the ship to, it is exceedingly important to do so on the *right* tack. The general rule is to heave-to in a revolving gale in the northern hemisphere on the "starboard" tack, but the over anxiety to get to the westward has often kept the ship so long on the "port" tack, that she has not had sufficient canvass set to wear when the sea is getting the control over her. She consequently under such circumstances becomes disabled, and all the disastrous consequences follow that characterize either a too near approach to the centre of a revolving gale, or a continual falling off, until the ship lays in the trough of the sea.

29. As, in many instances, it is very likely ships, in order to make westing and *while it does not blow too hard*, will keep on the "*port*" tack, especially while sailing on a course parallel, but opposite to that of the cyclone (*see* Plate VI. fig. 5), a saving of time being thereby effected—still it is highly essential to know at what time and under what circumstances to "wear," so as to sail *out of the hurricane*, when the wind and sea become too heavy for further progress. The following remarks bear so closely on this head that we cannot do better than follow SIR W. REID's example in quoting them; with a S.S.E. wind, cyclone moving N.N.E., the wind veers S. and S.W. (*see* Plate VI. fig. 8), and may become so strong and the sea so heavy that the ship must be brought to. The remarks are as follows:—

"*Heaving-to.*—The recent disasters which have occurred to American ships, such as the *Dorchester*, *Medora*, *Ambassador*, and many others have caused some enquiry; and it has been suggested by experienced men, borne out by the facts, that the disasters may be traced to the 'heaving of ships to' on the wrong tack; that is, that vessels bound to the westward from Europe, instead of 'heaving-to' with their *port tacks on board* in a south-west gale, as is too often the case, should heave-to on the *starboard-tack*.

"It is well-known that our westerly gales in the winter season often begin at S. or S.W., and as they increase in intensity, haul round gradually, but sometimes suddenly in a squall to the N.W. Take then the case of a ship bound to the westward, the wind commencing at the S. or S.W., the ship on the larboard tack. The master anxious to get to the westward, carries his canvass as long as possible, and continues on that tack until he has his ship under close-reefed topsails, mizen stays sail or trysail, in fact, 'hove to' on the port tack, the sea making heavy from the S.W., the wind keeps hauling to the westward, and the ship falls off with it until she lays in the trough of the sea. The sea then, having the control over, and breaking with its full force on the broadside, there is no canvass at this time that she can wear under with safety. The ship is then disabled, and sometimes founders. The fact is, over-anxiety to get to the westward has kept the ship too long on this tack.

"Now what is the best course as a general rule to be adopted? We think that the rule should be laid down that when it is blowing so hard as to make it necessary to furl foresail or head-sails, previous to doing so the ship should be wore round, and hove-to on the starboard tack; and as the wind hauls, she comes up heading the sea more and more, until it is on the bow, and of course in the best position to avoid its shock.

"Again, often the wind changes so suddenly in a S.W. gale, that a ship is taken aback by being on the port tack, which is fearful at any time, and particularly at such a time. Those who have experienced it on a winter's passage from Europe, with a crew worked down by hard weather and on a dark night, can only imagine what a scene it is. This cannot occur on being 'hove-to' on the starboard tack."

80. Southerly winds, with the ship on a W.N.W. course, are always found in the most dangerous quadrant of a gale,—the nearer to the axis line the nearer the cyclone is moving towards the east. Under any circumstances it would be well to "carry on," as the ship would be rapidly nearing the centre. In the case of the hurricane moving E.N.E. it would be better, upon the earliest symptoms of the S. wind setting in, to run at first N., and as the wind veered E., make good westing so as to sail round the front of the gale; by this means the course could be resumed as soon as the ship had crossed the axis line. The case would be somewhat similar to that of the barque *Barlow* before quoted.

81. If the cyclone be moving N.N.E., it would be almost impracticable to sail round the front (*see* Plate VI. fig. 8); and in attempting it, much time would be lost. As in the case of a W.S.W. course with a southerly wind, we should be greatly disposed to recommend that the ship should be brought-to on the *port* tack. Although in the right hand semicircle and northern hemisphere, in which all storm writers recommend the starboard tack, yet with wind at S., hurricane moving N.N.E., the ship will, by heaving-to, feel so little of the influence of the cyclone, that her course can be readily resumed as soon as the wind has hauled to S.W. It is true that by resuming her course she will be headed off by westerly breezes, but by waiting a little the hurricane will make northing, which will enable her to stand rather to the north, so that by judiciously *following* the cyclone, as her barometer and wind will allow, she departs as little as possible from her course.

82. As it is exceedingly important to distinguish between a N.N.E. and E.N.E. course of the cyclones, the following changes in the hurricane winds may probably assist in this matter.

The cyclone moving N.N.E., the hurricane winds to a ship lying-to, will be as follows,—S., S.S.W., S.W.; and the intensity of these winds will not be very great.

The cyclone moving E.N.E., the ship while lying-to, will experience the following hurricane winds,—S., S.S.W., S.W., W.S.W., W., W.N.W., N.W.

Of these winds the first and last are of moderate force, but the others are very strong, especially that from W.S.W. If therefore the commander fall in with a S. wind, from which he concludes that he is on the eastern verge of a cyclone, and he pursues his course, and finds that long before the wind veers to S.S.E. his barometer falls very rapidly, and that he has to shorten sail, he may rest satisfied the hurricane is coming up from W.S.W., and he can adopt the necessary measures for *crossing in front as soon as he finds he must reduce his canvass*, but this manœuvre should not on any account be delayed. If on the other hand the barometer should fall but gradually, and he can carry sail for some time, the wind hauling slowly to S.S.E., he may consider the motion of the cyclone to be more northerly. To push on, however, is to involve himself in the centre or in the terrible sea behind. His best course is evidently to heave-to—if *early*, on the *port* tack—but he should have "carried on" so far as to be compelled to shorten sail, then the starboard is the tack, for reasons before assigned.

33. The following Catalogue* (pp. 154—168) arranged chronologically, includes every hurricane in the North Atlantic of which any record can be traced to the year 1855. The extent of surface over which they occur in that part of the ocean may be divided into areas, as follows:—I. The West African;—II. The West Indian, including the Gulf of Mexico;—III. The Eastern seaboard of the United States;—IV. The Central Atlantic;—and V. the Northern and Eastern Atlantic.

As regards the West African area, gales of a rotatory character are not very frequent there,—at least the records of them are few; and it cannot be said that the number of vessels navigating that portion of the Atlantic is not large.

The area including the West Indies and Gulf of Mexico is well known; but better and more accurate information relative to the *Northers* is required, for, although it appears probable that those dangerous and not unfrequent visitants of the Gulf, may result (as Redfield and Reid inferred) from the left hand semicircle of cyclones, which afterwards progress along the seaboard of the States, yet the actual instances in which the connection has been traced are few.

The storm paths of the Central Atlantic are not very well known.

The meteorology of the Northern and Eastern Atlantic—the locality of the great winter gales—though traversed by thousands of vessels every year, is not nearly so well known as it ought to be, and hurricanes of large extent but of varying—though too frequently of very dangerous—force sweep across that region, coming (at the end of autumn, during winter, and at the commencement of spring) from across the Atlantic towards the iron-bound shores of the western part of the British Isles, and the north-western shores of France.

From this Catalogue of 365 hurricanes, arranging them according to their monthly occurrence, it appears that there have been in

January 5;	May 5;	September 80;
February 7;	June 10;	October 69;
March 11;	July 42;	November 17;
April 6;	August 96;	December 7;

Hence, *from the middle of June to the end of November is the Hurricane season in the West Indies, and on the Western Atlantic*; but they may be more frequently expected in August, September and October than at any other time.

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34. The typhoon season of the China Seas is the same as that of the West Indian hurricanes. Out of 60 cyclones in the Bay of Bengal, 25 have occurred in October and November, and 22 in April and May. In the Arabian Gulf, cyclones occur during both monsoons; and in the southern Indian Ocean they

* This catalogue is based on that of Andres Poey, of Havana, and published in the Journal of the "Royal Geographical Society," Vol. XXV.

are most frequent during January, February, or March, but may be expected at any time between November and June.

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35. Catalogue of Hurricanes in the North Atlantic:—

1493. Feb. 12; North Atlantic.
1494. May 19—21; Cuba, between Cape de Cruz and Manzanillo. (Jacobo de la Pezuela, *Essayo Historico sobre la Isla de Cuba*).
1494. June 16; St. Domingo.
1495. St. Domingo.
1496. March (?); North Atlantic.
1498. Cuba. (Desiderio Herrera, *Memoria sobre los Hurricanes de la Isla de Cuba*).
1500. Aug.; Caribbean Islands.
1502. July 1, 2; St. Domingo.
1502. Dec. 5; Porto Bello, St. Domingo.
1504. Oct. 19; North Atlantic.
1508. Aug. 3; St. Domingo.
1509. Feb. (?), Mar. (?); Gulf of Mexico.
1509. July 29; St. Domingo.
1510. July ; St. Domingo.
1526. Oct.; St. Domingo.
1527. Cuba.
1530. Porto Rico, Cuba.
1548. St. Domingo.
1557. Cuba.
1563. Caribbean Islands.
1588. Cuba.
1591. Aug. 10; North Atlantic, Lat. 35° N.
1623. Sept. 19; St. Christopher.
1642, Windward Islands, Martinique.
— Martinique.
— St. Christopher, Martinique, Guadaloupe.
1650. St Christopher.
1651. Martinique.
1652. Martinique, Guadaloupe, St. Kitts.
1653. July 13; St. Vincent.
1653. Oct. 1; St. Vincent.
1656. Guadaloupe.
1656. Antilles. (Du Tertre, *Histoire Generale des Antilles*, 1667).
1657. Guadaloupe.
1658. Antilles.
1660. Antilles.
1664. Oct. 22, 23; Guadaloupe, Antigua.
1665. Oct.; Caribbean Islands.
1666. Oct. 4, 5; Guadaloupe, Martinique, St. Christopher.
1667. Aug. 19; Barbadoes, Nevis.
1667. Sept. 1; St. Christoval.
1670. Aug. 18; 90 leagues from Barbados
1670. Oct. 7; Jamaica, Barbadoes.
1674. Aug. 10; Barbados, Jamaica.
1675. Aug. 31; Barbados.
1680. Aug. 14; St. Domingo.
1681. Antigua.
1688. Mar. 1; East of Jamaica.
1691. Antilles.
1692. June 7; Jamaica.
1692. Oct. 24: Cuba.
1694. Aug. 13; Barbados.
1694. Oct. 13 (?), 17 (?); Barbados.
1695. Oct. 2; Martinique.
1700. Barbados.
1701. April 3; Antilles.
1702. Barbados.
1705. Feb. 7; Antilles.
1707. Nevis, Antigua.
1712. Aug. 28; Jamaica.
1712. Oct. ; Cuba.
1713. Guadaloupe, St. Thomas.
1714. Aug. 13, 14; Guadaloupe.
1714. Aug. 29; Jamaica.
1714. Cuba—perhaps the same as one of the two previously mentioned.
1718. Mar. 6, 7; St. Vincent.
1718. Sept. ; Nevis.
1720. Barbados.
1722. Aug. 20 (?), 28 (?); Jamaica and Carolina. U.S.
1722. Aug. 31; Antilles.
1725. Martinique.
1726. Oct. 22; Jamaica.
1728. Aug. 19; Antigua.
1728. Carolina. U.S.
1730. Cuba.
1731. Barbados.
1733. June; St. Kitts.
1733. July 16; Cuba,
1734. Sept. 1; Jamaica.
1737. Sept. 9; St. Kitts, Montserrat, St. Domingo.
1738. Guadaloupe, St. Thomas.
1739. Sept. 9; Antilles.
1740. Aug.; Antigua, Martinique, Dominica, &c. This hurricane, probably prevented Dr. Franklin observing an eclipse of the moon.
1740. Porto Rico.
1742. St. Thomas.
1744. Oct. 20; Jamaica.
1744. Nov.; Cuba.
1745. Caribbean Islands.
1746. Jan.; North Atlantic, Lat. 40° N.
1747. Sept. 21; St. Christopher, Leeward Islands.
1747. Oct. 24; St. Christopher, Leeward Islands.
1751. Mar. 7; Jamaica.
1751. Aug. 10; Jamaica.
1751. Sept. 2; Jamaica.

1751. Sept. 15; St. Domingo.
1751. Oct.; Jamaica, St. Domingo.
1752. Sept.; Charleston.
1753. Sept. 15; Charleston.
1754. Sept.; St. Domingo.
1756. Aug. 23; Barbados.
1756. Sept. 12; Martinique.
1757. From Florida to Boston.
1757. Aug. 29; Barbados.
1758. Aug. 23; Barbados and South Carolina.
1759. Sept.; Gulf of Mexico.
1761. May 4; Charleston.
1761. June 1; Charleston.
1762. Dec. 9; Cartagena.
1765. July 31; Martinique, St. Eustatius, Guadaloupe.
1765. Sept.; Martinique, Guadaloupe, St. Christopher.
1765. Nov. 13, 14; St. Domingo.
1766. Aug. 13; Martinique.
1766. Aug. 16; West of Jamaica.
1766. Sept. 11; Virginia.
1766. Sept. 13, 15; St. Christoval, Montserrat.
1766. Sept. 21; St. Eustatius, Tortuga.
1766. Oct. 6; Dominica, St. Eustatius, Guadaloupe.
1766. Oct. 22; Pensacola.
1768. Aug. 12; Grenada.
1768. Oct. 15; Cuba.
1768. Oct. 25; Cuba. (Havana.)
1769. Aug. 30; West of Florida.
1769. Oct. 29; East of Florida.
1770. June 6; Charleston.
1771. Aug.; St. Eustatius.
1772. Aug. 4; St. Domingo.
1772. Aug. 16; Cuba. ? (St. Jago.)
1772. Aug. 17; Antigua.
1772. Aug. 28; Porto Rico, Jamaica.
1772. Aug. 31; Leeward and Virgin Islands, Antigua.
1772. Sept. 1—4; Dominica, St. Domingo.
1772. Nov. 22; St. Christopher, St. Eustatius.
1773. July; St. Thomas, Cuba.
1773. Aug.; Boston; probably same as the previous one.
1774. Sept. 6. Guadaloupe.
1774. Oct. 2; Jamaica.
1775. July 30; St. Croix, Martinique.
1775. Aug. 25; Martinique.
1775. Aug. 27; St. Domingo.
1775. Sept. 14; Cuba, St. Domingo.
1775. Oct. 16; St. Christopher.
1776. Sept. 4; Antigua, Martinique, Guadaloupe.
1776. Sept. 5, 6; Martinique, Guadaloupe, St. Christopher.
1778. Oct. 28; Cuba.
1779. New Orleans.
1780. Aug. 25; St. Christopher, New Orleans.
1780. Aug. 3—12; Barbados, Martinique, Jamaica, Cuba; this hurricane destroyed the town of Savanna-la-Mar, in Jamaica, and was exceedingly violent in Lucea and Montego Bays; it crossed Cuba and the Bahamas, destroying and disabling several ships in SIR PETER PARKER's and SIR GEORGE RODNEY's squadrons—a portion of the latter having been stationed off the Delaware. It is also said to have been accompanied by an earthquake. (REID's *Attempt to Develop the Law of Storms*," 3rd edition, p. 289.)
1780. Oct. 10—18; called the Great Hurricane; it passed over the Windward an Leeward Islands, destroying many lives and much property; thence its course was over Porto Rico and St. Domingo; it recurved near the parallel of 22° N., and taking a direction towards the N.E. part of the Atlantic, passed south of Bermuda. It was very slightly felt at Jamaica. (REID's "*Attempt, &c.* p. 337.)
1780. Oct. 16—17; Solano's storm; it dispersed the Spanish fleet intended for the attack of Pensacola; it commenced near the west end of Cuba, and proceeded towards Texas. (REID's "*Attempt, &c.*" p. 394.)
1780. Oct. 31; Barbados.
1781. Mar. 15; West Indies.
1781. Aug. 1. Jamaica.
1781. Aug. 10; North Carolina.
1781. Sept. 5; St. Domingo.
1782. April 12; North Atlantic.
1782. July 25; N. Atlantic, Lat. 43½° N., Long. 42° W.
1782. July 31—Aug. 1; Jamaica.
1782. Sept. 16; North Atlantic.
1784. March 8; Cuba.
1784. July 10; Jamaica—accompanied by an earthquake.
1784. July 30; Jamaica, St. Domingo.
1785. July 6; West Indies.
1785. July 25; St. Croix.
1785. Aug. 24—27; Guadaloupe, St. Christopher, Jamaica.
1785. Aug. 31; Guadaloupe, Barbados, St. Domingo.
1785. Sept. 22—24; Carolina, Virginia.
1785. Sept. 27; St. Domingo.
1786. Aug. 11;. Barbados, St. Eustatius St. Domingo.
1786. Aug. 29; United States.
1786. Sept. 2; Barbados.
1786. Sept. 10; Guadaloupe.
1786. Oct. 5; Barbados, Grenada.
1786. Oct. 20; Jamaica.
1787. April; Bermudas, United States.
1787. July; Guadaloupe, and probably reached the United States on the 30th.

1787. Aug. 3; Dominica.
1787. Aug. 15; Florida.
1787. Aug. 23; Dominica.
1787. Aug. 29; Dominica.
1787. Sept. 2; Honduras.
1787. Sept. 19; United States.
1787. Sept. 23; Belize.
1787. Dec. 1; West Indies.
1788. Jan. 1; Honduras.
1788. March, April; St. Croix.
1788. July 22; United States.
1788. Aug. 14—19; Martinique, Porto Rico, St. Domingo, United States.
1788. Aug. 29; Dominica.
1788. Sept. 19, 20; United States.
1790. August; Nevis.
1790. July 31; Jamaica.
1791. June 21; Cuba.
1791. Sept. 27; Cuba.
1791. Oct. 20; Jamaica.
1792. July 15; West Indies.
1792. Aug, 1; Antigua.
1792. Aug. 6; Bermuda, and United States; possibly same as last.
1792. Sept. 10; Antigua.
1792. Oct. 29; Cuba.
1793. Aug. 12; St. Christoval, St. Eustatius, St. Thomas.
1794. Aug. 27, 28; Cuba.
1795. Aug. 10; Jamaica.
1795. Aug. 18; Antigua.
1796. Oct. 3; Bahamas.
1796. Oct. 24; Cuba.
1796. Nov. 2; Cuba.
1799. Cuba.
1800. Nov. 2; Cuba.
1801. July 22; Nassau, Bahamas.
1802. Feb. 21—23; Charleston to Nova Scotia.
1802. Sept. 16; Cumana, North coast of South America.
1803. July 10; Bahamas.
1804. Aug. 29; Jamaica.
1804. Sept. 3—9; Windward islands, passed over the Bahamas, recurved in about 31° N. and thence took a course to Nova Scotia.
1804. Sept. 3—6; Leeward Islands.
1804. Sept. 22; Jamaica, and Lat. 20½° N.
1804. Oct. 4; Savanna, Georgia.
1804. Oct. 9; United States.
1805. July 27; Jamaica.
1805. July 29; Northward of Barbados to Lat. 26° N., Long. 57¾° W.
1806. Aug. 30; Eleuthera, Bahamas.
1806. Sept. 9; Dominica.
1806. Sept. 24—27; Dominica and the West Indies.
1806. Oct. 5; Bahamas.
1806. Oct. 27; Bahamas.
1807. July 25—8; St. Christoval, Montserrat.
1809. Sept. 5; Cuba.
1809. July 27; Dominica, Guadaloupe.
1809. Aug. 1—3; Dominica, Guadaloupe.
1809. Sept. 2; Guadaloupe, Porto-Rico.
1809. Oct. 13; Martinique.
1809. Oct. 18; Trinidad.
1810. Aug. 12; Trinidad, Barbados.
1810. Aug. 28; Barbados.
1810. Sept. 28; Cuba.
1810. Oct. 25—26; Cuba.
1812. Aug. 14; Jamaica.
1812. Aug. 19; New Orleans; possibly the same as the preceding hurricane.
1812. Oct. 12; Jamaica;
1812. Oct. 14; Jamaica;
1812. Oct. 14; Trinidad and Cuba.
(possibly the same hurricane—but an error in the date.)
1813. July 20; Bermuda.
1813. July 22; Barbados.
1813. July 22—3; Dominica, Martinique, St. Christoval; Dominica suffered considerably from two hurricanes which succeeded each other within a short time.
1813. July 26; Bermuda, Bahamas.
1813. July 31; Jamaica.
1813. Aug. 1; Jamaica.
1813. Aug. 5—9; N. Atlantic, Lat. 41°; possibly the same as the preceding.
1813. Aug. 25; Dominica.
1813. Nov. 19; Nova Scotia.
1813. Belize.
1815. Aug. 9; Gulf Stream, Lat. 40°, Long. 60°.
1815. Aug. 31 to Sept. 1; St. Bartholomew where 30 sail were driven ashore, but the gale did not reach Barbados, N. Atlantic, Lat. 39°, Long. 56°.
1815. Sept. 18—23; St. Bartholomew.
1815. Sept. 20; Turk's Island.
1815. Sept. 29; Barbados.
1815. Oct. 18; Jamaica.
1816. Sept. 15; Barbados, Martinique, Dominica.
1816. Oct. 16; Dominica, Martinique.
1817. Sept. 15; Dominica.
1817. Oct. 21; Small Islands, St. Vincent.
1817. Oct. 23; Barbados, St. Lucia, Martinique.
1818. Aug. 28; Bermuda.
1818. Sept. 10—12; Cayman Isles, Campeche.
1818. Sept. 19; St. Domingo.
1818. Sept. 21; Barbados, Dominica.
1818. Sept. 22—25; Antigua; the same as the preceding.
1818. Sept. 27—30; Barbados.
1818. Oct. 7; Port Royal (Jamaica).
1818. Oct. 21; St. Lucia.
1818. Nov. 17—20; Jamaica (Cornwall County).
1819. Aug. 25; Dominica.
1819. Sept. 21—22; St. Lucia, Barbados, Virgin Islands, Porto Rico.
1819. Oct. 13—15; Barbados, St. Lucia.
1819. Cuba.

1821. Sept. 1; Guadaloupe, 300 lives lost.
1821. Sept. 1; Northward of the Bahamas; recurved in 32° N.; crossed New York and Boston on its passage towards Nova. Scotia. (REID's "*Attempt, &c.*," p. 13).
1821. Sept. 9; Antigua, St. Bartholomew.
1821. Sept. 23; New Haven, U.S.
1822. Mar. 11; Jamaica.
1822. July 11; Mobile, U.S.
1822. Dec. 18; Barbados.
1823. Oct. 30; Over the eastern part of the Atlantic, in the south of England, and at Geneva; the centre passing between these localities. LUKE HOWARD, author of the "*Climate of London*," says that "this northerly gale spent its fury on the ocean, west of Britain," (REID's "*Attempt, &c.*," p. 419.)
1824. July 26; West Indies.
1824. Sept. 7—8; Guadaloupe, and northward of Bermuda. (REID's "*Attempt, &c.*," p. 89).
1825. July 25—26; Dominica, Martinique, Guadaloupe.
1825. Oct. 1; Cuba.
1826. Aug. 18; Antilles.
1826. Nov. 6—9; Over the eastern part of the Atlantic, and at the island of Teneriffe. (W. C. REDFIELD, in the *American Journal of Science*, second series, Vol. XVIII., p. 179).
1826. Cuba.
1827. July 30; North Carolina.
1827. Aug. 17—28; Leeward Islands and the Bahamas; recurved in 30° N.; passed near Cape Hatteras, and to the southward of Nova Scotia and Newfoundland.
1827. Sept. 7; N. Atlantic.
1827. Oct. 11; Bahamas.
1827. Belize.
1828. Jan; between Bermuda and Halifax; it traversed the N. Atlantic and *reached* Plymouth on Jan. 13, where it was very destructive.
1828. Mar. 15; Gulf of Mexico.
1828. Sept. 19; CAPT. CORNING's hurricane, between Lat. 20° and 40° N., Long. 40° and 55° W., (W. C. REDFIELD and SIR W. REID).
1829. July 24; Boston, U.S.
1830. April 24; Vera Cruz.
1830. Aug. 7; Jamaica.
1830. Aug. 12; Northward of the Leeward Islands and the Bahamas; recurved in 31° N., just eastward of Florida; swept over the land in the neighbourhood of Cape Hatteras, and proceeded to the southward of Nova Scotia and Newfoundland. (REID's *Attempt*, and REDFIELD in *American Journal of Science*, first series, Vol. XX., pp. 34—38).
1830. Aug. 19—24; Martinique and United States.
1830. Aug.. 20; Northward of the Leeward Islands and the Bahamas; recurved in 31° N., making a direct course to St. George's Bank. (*American Journal of Science*, first series, Vol. XX. and XXI).
1830. Sept. 29; Northward of the Leeward Islands; recurved in 31° N., Long. 68° W., making direct for the Great Bank.
1830. Dec. 5—6; American Coast from Lat. 30° N.
1831. Jan. 13; Frst noticed about its point of recurvature 30° N.; 77° W., whence its path was traced as far as Nova Scotia.
1831. April 27; United States.
1831. Belize.
1831. June 10; Florida.
1831. June 23; Tobago and Trinidad (which are very rarely visited by hurricanes), across the Caribbean Sea, the Gulf of Mexico, and the Peninsula of Yucatan, thence towards Vera Cruz.
1831. Aug. 10—17; Barbados, St. Lucia, St. Domingo, Cuba, and thence to New Orleans. It recurved in 30° N., and was not traced further. (REID's *Attempt, &c.*)
1832. June 3—6; Cuba, Bahamas, Bermuda.
1832. Aug.; Between Havanna and Matanzas. (REID's *Attempt, &c.*, p. 81).
1833. Aug. 14; Guadaloupe, Antigua, Bermuda.
1833. Sept. 20; Dominica.
1833. Oct. 16—19; Cuba, Gulf of Mexico.
1834. Sept. 20; Dominica.
1834. Oct. 20; Martinique.
1835. April 28; United States Coast.
1835. July 26; Barbados, St. Vincent and St. Lucia.
1835. Aug. 12; Leeward Islands, Porto Rico, north of St. Domingo, Cuba, and across the Gulf of Mexico to Texas. Its course was almost identical with that of Solano's storm by which the Spanish fleet was dispersed on Oct. 17, 1780.
1835. Sept. 3; Barbados. (REID's *Attempt, &c.*)
1835. Sept. 18; Matamoras, Gulf of Mexico.
1835. Nov. 10; Across the great lakes to the southward of Toronto, and towards Nova Scotia.
1836. Nov. 23; From the St. Lawrence, across the Atlantic to the north of Germany; felt in the south of England.

1836. Nov. 30; New York. Barometer on the 28th, 30·27 in., depressed by cyclone 0·62 inch. (*American Journal of Science*, second series, Vol. XVIII., p. 186).

1836. Dec. 5; New York. Barometer on the 4th, 30·29 in., depressed by cyclone 0·35 in.

1836. Dec. 10; New York. Barometer on the 8th, 30·35 in., depressed by cyclone 0·44 inch.

1836. Dec. 14; New York. Barometer on 12th, 30·28 in., depressed by cyclone 0·86 inch.

1836. Dec. 17; New York. Barometer on 16th, 30·45 in., depressed by cyclone 0·90 inch.

1836. Dec. 21; New York. Barometer on 19th, 30·80 in., depressed by cyclone 1·05 inch. (*American Journal of Science*, second series, Vol. XVIII., p. 186, where W. C. Redfield has adduced the last six storms as illustrative of the rapid succession of revolving gales at New York in certain seasons. He says, "Each cyclone exhibited here the winds of its two right quadrants, gradually veering from a southern quarter, to the western board, as it went onward; thus showing the cyclonic centres to have passed far westward of New York, and over the Canadas, in their several routes to the northern regions of the Atlantic.") The storm which visited New York on Dec. 21, has been traced by Prof. Loomis across the lakes, and Canada to Labrador.

1837. July 9; Barbados, St. Lucia.

1837. July 26; Barbados, St. Lucia, St. Vincent, Martinique, Dominica, the Bahamas, and Florida. (Reid's *Attempt, &c.*, p. 47.)

1837, July 31; Eastward of the Leeward Islands, across them, and along the north-eastern part of St. Domingo, the Bahamas, and Florida. (Ried's *Attempt &c.*, p. 57.)

This is one of the most remarkable cyclones on record, inasmuch as it presents a very decided exception to the law of recurvature. The cyclone of July 26th, but a few days previous, clearly recurved, although it was not detected at the time, in about 31° N., while the present *instead of recurving, passed over the land in a direction towards the N.W. inclining to W.N.W.* It is rather difficult to explain this anomaly, especially as the *recurvature* of the cyclone of July 26, is the *earliest* of the season on record.

1837, Aug. 6; Less Antilles.

1837, Aug. 12; East and North of the Leeward Islands, the south-west margin crossed Turk's Island, the Bahamas, and grazed the eastern shores of Florida; the cyclone recurved in 32° N., and passed midway between Halifax and Bermuda; its path is delineated on Reid's chart, and he gives a large chart of it and all the details in his *Attempt, &c.*, p. 75.

1837, Aug. 24; east and north-east of the Bermudas, felt by the *Castries*, *Victoria*, and *Clydesdale*. (Ried's *Attempt, &c.*, p. 121).

1837, Aug. 30; from Appalacha and St. Mark, over Florida towards Cape Fear. (Reid's *Attempt, &c.*, p. 124).

1837, Sept. 27 to Oct. 10; from the Caribbean Sea across Yucatan and the Gulf of Mexico to Texas, recurved in 27° N., and passed over New Orleans and Charleston, on its way to the Atlantic,—XV. on Col. Reid's chart. Details and diagram in his *Attempt, &c.*, p. 133, and extracts from Mr. Redfield's paper on the Cuba Hurricane in the *Progress of Development*, p. 299.

This cyclone is interesting, as immediately connecting an Atlantic hurricane with the "Northers" of Mexico. It is also remarkable for recurving more westerly than any other *east of the mainland.*

1837, Oct. 13; Cuba.

1838, Feb. 13; Eastern Atlantic. Wind S.E. in Ireland, S.W. in Portugal. (Reid's *Attempt, &c.*, p. 412).

1838, Sept. 2; Lat. 29° 48′ N., Long. 68° 6′ W. (Reid's *Progress*, p. 41).

1838, Sept. 10; at New York. Cyclone traced from the Bahamas along the coast of America.

1838, Oct. 11; Eastern Atlantic. Centre not far north of Scotland, coming from northward of west, and moving to southward of east, chain bridge at Montrose damaged. (Reid's *Attempt, &c.*, p. 428).

1838, Oct. 28; Eastern Atlantic. Passed over England, severe in the southern counties. (Reid's *Attempt, &c.*, p 431).

1838, Nov. 1; Vera Cruz.

1838, Nov. 26; Vera Cruz.

1838, Nov. 26; Eastern Atlantic. Centre passed on a somewhat N.N.E. course over the Irish Channel. Stormy weather, probably arising from this cyclone, was observed at Gibraltar, on the coast of Portugal, and in the Bay of Biscay. (MILNE's paper in the *Transactions of the Royal Society of Edinburgh*).

1838, Nov. 28; Eastern Atlantic. Centre passed to the west of Ireland on a N.N.E. course. This cyclone has been traced by Mr. MILNE, and estimated to include in its eastern semicircle the whole of Great Britain and Ireland, France, Spain, Portugal, and a part of Germany, while its western semicircle embraced half the breadth of the Atlantic, on the parallel of 50° N. (*Transactions of the Royal Society of Edinburgh for* 1839. Chart in REID's *Progress of Development*, p. 323).

1839, Jan. 6; Eastern Atlantic. Centre moved on an E.N.E. course over Ireland, the Irish Channel, and Great Britain, towards Gotenburg in Sweden. (REID's *Progress of Development*, p. 329).

1839, June 9; Antigua.

1839, Sept. 8; The Bermuda hurricane; first experienced nearly 15° eastward of the Leeward Islands, cleared them about 5° to the N.E., and proceeded in a curved course to the Bermudas, passing them on the 11th and 12th; after these days it rapidly dilated in size, sweeping over Nova Scotia, the Gulf of St. Lawrence, and Newfoundland. SIR W. REID gives charts of this cyclone in both his works. He has devoted much attention to the *swells* raised by the hurricane in its progress. (*Attempt, &c.*, p. 439. *Progress of Development*, p. 36).

1839, Oct. 26; the Bermudas. Wind veering from S.E. by E. by the N. to N.W. Progression of cyclone towards N.E. Wind 7 of ADMIRAL BEAUFORT's Scale, from *Report of the Weather, Government House, Bermuda.* REID's *Progress of Development*, p. 248).

1839, Nov. 5; Galveston, Gulf of Mexico.

1839, Nov. 6; the Bermudas. Wind veering rapidly from S.W. to W.N.W., stormy weather north of the islands—thunder and lightning. (*Weekly report of weather at Government House.* REID's *Progress of Development*, p. 249).

1839, Nov. 13; the Bermudas. Wind veering from S.S.E. to W.N.W. Progression of cyclone nearly E.N.E.,—the centre passed north of the islands—sea breaking high and roaring loud. (REID's *Progress of Development*, p. 251).

The above cyclones, Oct. 26 to Nov. 13, as determined from *Meteorological Observations made at the Bermudas*, are inserted partly to corroborate MR. REDFIELD's view of the rapidity with which revolving gales succeed each other, and partly to indicate the value of constant observation. There can be no doubt that cyclones of every degree of force, from a light air to a violent hurricane, more or less, are perpetually present at one part or another of the ocean, and it is highly probable the Atlantic is *never* perfectly free.

1839, Dec. 5; the Azores; the sea rose at St. Michael's upwards of 30 feet, causing great loss of property, but only of one life. The centre appears to have passed near the western islands of the group. (REID's *Attempt*, p. 252).

1839, Dec. 13; From the interior of America, north of New Orleans, across Washington, Baltimore, Philadelphia, and New York, to the Great Bank. (Traced by W. C. REDFIELD). This cyclone has been made by REID the subject of comparison with MR. MILNE's gale of the 28th of Nov., 1838; they both appear to have been about the same size. SIR W. REID considers that sufficient evidence exists to shew that this hurricane crossed the Atlantic, and thus resembled those of Jan. 1828, and Nov. 23, 1836.

SIR W. REID's chart of the two gales (MR. REDFIELD's and MR. MILNE's), to be found in his *Progress of Development*, p. 323, is very instructive; it not only makes us acquainted with the vast extent of the "winter gales" of the high latitudes, but, when it is considered that these are the only two well worked-out instances, (and in the case of the north-eastern Atlantic, MR. MILNE's is the *only one*,—the Royal Charter gale, Oct. 1859, fully described by Admiral FITZROY, alone excepted), REID's chart indicates how much remains to be done in order to become as well acquainted with the European as we are with the American *destructive* cyclones.

1840, May 23; Madeira.

1840, Sept. 16; Porto Rico.

1840, Nov. 13; Eastern Atlantic. The British Islands, path N.N.E. (*Nautical Magazine*, 1841).

1840, Nov. 17; Eastern Atlantic. The British Islands, path E.N.E. (*Nautical Magazine*, 1841).

1840, Nov. 18; a Mexican Norther. Experienced by H.M. sloop *Victor* off the bar of Tampico. (REID'S *Progress of Development, &c.*, p. 314).

1840, Nov. 34; a Mexican Norther. Experienced by H.M. sloop *Victor* on her passage from Tampico to Vera Cruz, it was very severe, and lasted about forty hours. (REID'S *Progress of Development, &c.*, p. 315).

1840, Dec.; two Northers. Experienced by H.M. ship *Thunder*.

1841, Jan. 11; a Norther. Experienced by H.M. ship *Thunder*.

1841, Jan.; another Norther. Experienced by H.M. ship *Thunder*. (*Nautical Magazine*, 1841).

It is the opinion of both SIR WILLIAM REID and MR. REDFIELD, that these Mexican Northers result from the passage of the left-hand semicircles of cyclones as they sweep over the Gulf of Mexico, or *recurve* in the neighbourhood of Texas. Our information at present is but scanty relative to the connexion of the Northers with cyclones. A glance at COL. REID'S chart will shew that such a connexion must exist and the recurvature of the cyclone of Sept. 27, 1837, is a case in point. We want, however, well traced instances from Mexico onwards.

MR. PIDDINGTON, has this pertinent remark on the Mexican Northers. "As we have now one undoubted proof in the October cyclone of 1848, of the Bay of Bengal, that cyclones wherever and however they may originate, certainly *descend* and settle down on the ocean, after passing over high land, it may be worth while to consider whether these Northers, which often cannot be traced up from the eastward and south-eastward, may not be at times cyclones from the Pacific Ocean." (PIDDINGTON'S *Horn Book*, p. 317).

The following are considered as "precludes," generally announcing a Norther. First, a general humidity of the atmosphere. Second, the peak of the Orizaba Mountain visible and clear, the lower parts only being enveloped in dense hazy clouds. Third, the distant mountains, far inland to the S.E. exceedingly clear, together with excessive heat,—and depression in the animal kingdom.

1841, Oct. 3—6; Nantucket, U.S.

1841. Oct. 6; Barbados, St. Lucia.

1841, Oct. 21—28; Bermuda.

1841, Nov. 28; Cuba.

1842, July 12; Cape Hatteras, U.S.

1842, Aug. 30; North of the Leeward Islands. Crossed the Bahamas, passed between Florida and Cuba, and over the Gulf of Mexico, on its way towards Mexico. This is the only cyclone on record with a due westerly course. (*American Journal of Science* for 1846).

1842, Sept. 4; Cuba.

1842, Oct. 2; from the Gulf of Mexico, west of Yucatan, across Florida to the Atlantic, north of Bermuda. (*American Journal of Science*, 1846).

1842, Oct. 2—10; Bermuda.

1842, Oct. 24; a hurricane which probably originated on the western coast of Africa, recurved in the neighbourhood of (to the west of) the Canaries, passed over Madeira and thence towards Lisbon and Seville. (REID'S *Progress of Development, &c.*, p. 275.

1842, Nov. 3; Lat. 36° 40′ N., Long. 61° W.

1842, Nov. 19; a Mexican Norther; Ship *Electra*, Lat. 22° 50′ N., Long. 89° 21′ W.

1842, Dec. 8; a Mexican Norther; Ship *Electra*, at Sacrificios.

1843, Jan. 31; a Mexican Norther; Ship *Electra*, off Tampico, Lat. 23° 41′ N., Long. 94° 50′ W.

1843, Feb. 14; a Mexican Norther; Ship *Electra*, at Sacrificios. REID'S *Progress of Development, &c.*, p. 318, gives the Log of the *Electra* which experienced these Northers).

1843, Aug. 17; on a slightly curved track, a little to the west of Bermuda; and supposed by SIR W. REID to have passed over the Bay of Fundy. (REID'S *Progress of Development*, pp. 22 and 367).

1843, Oct. 13; Florida.

1844, Feb. 22; Martinique.

1844, May 12; Lat. 37° 47′ N., Long. 65° 22′ W.

1844, Oct. 2; from Fort Brady on Lake Superior, over the northern parts of the United States, Canada, and the Gulf of St. Lawrence to Newfoundland.

1844, Oct. 3; the great Cuba hurricane. First experienced near the Sea of Honduras, crossed the western part of Cuba and the Bahamas, and proceeded across the Atlantic to Newfoundland. (*American Journal of Science*, 1846; also copious extracts in COL. REID'S *Attempt, &c*, p. 295).

1844, Oct. 9; a Tornado cyclone in the English Channel, Lat. 49° 47′ N., Long. 4° 23′ W. Experienced by the Ship *Windsor*. Barometer down to 28·12 at 1 P.M. It appears the centre must have passed very near the ship. (PIDDINGTON'S *Horn Book*, p. 364, a quotation from REDFIELD.) On referring to the Greenwich Observations, it will be seen that the barometric depression occurring at 10 P.M. was 28·919; wind S.S.E., occasionally in gusts of 1½ lbs. to 2 lbs. pressure on the square foot. After the minimum, the wind veered to S. and S.S.W. These observations combined with the report from the ship, give for the path, across England, a nearly similar direction to that of the great winter gale of 1838.

1844, Dec. 11; from the north side of Cuba, along the coasts of the United States; path somewhat similar to that of the great Cuba hurricane, Oct. 3.

1845, April 22; Eastern Atlantic, mid-way between the Azores and the Lizard. Experienced by the ship *Monarch*, which passed through the centre. (PIDDINGTON'S *Horn Book*, p. 363.)

1845, Oct. 12; Florida Channel.

1845, Oct. 19; New York.

1845, Oct. 22; New York and Bermudas.

1845, Oct. 27; Bermudas. Centre passed S.E. of the Islands.

1845, Nov. 8; Experienced by H.M. ships *Vindictive, Rose, and Vesuvius*, between Bermuda and Halifax.

1846, Sept. 11—21; The Western Atlantic. This cyclone, in the opinion of SIR W. REID, was *formed* between the islands of Tobago, Trinidad, Margarita, and Grenada. He considers that in no instance has the commencement of a storm been better ascertained. From this locality it proceeded over Porto Rico and north-east of the Bahamas, to its point of recurvature in 29° N., from thence nearly midway between Nova Scotia and Bermuda, south of Newfoundland, crossing the Northern Atlantic, and finally passing between Iceland and Scotland. (*Progress of Development*, p. 370.) This cyclone is remarkable on account of the incurvature of its track by the influence of the Azores. MR. REDFIELD first noticed this remarkable feature when projecting its path; it has since been ascertained to belong to the cylones of *September*. (*American Journal of Science*, 2nd Series, Vol. XVIII).

1846, Oct. 6—18; from the Caribbean Sea, south of Jamaica, across the west end of Cuba, and Florida, the centre passed a short distance *inland* of the sea-board of the United States. The earlier branches of the paths of this and the previous hurricane are very similar, but separated by about 10° of longitude. (BIRT'S *Hand Book*, p. 48).

1847, Feb. 21; North Atlantic, Lat. 52° 18′ N., Long. 30° 33′ to 32° 8′ W. Experienced by CAPTAIN FREEMAN of the *Sea*.

1847, Oct. 10; from the Atlantic, eastward of the Windward islands, across Tobago to the mainland of America. This cyclone is, perhaps, the most remarkable on record in the lower latitudes of the Atlantic; it is the only instance of an equatorial progrssion, all the others moving from the equator to the poles; this, although having a westwardly progression, moved *obliquely towards the equator*. In the neighbourhood of the British Isles, instances have been met with of cyclones moving towards the equator on an eastwardly progression.

1848, Aug. 22 to Sept. 3; from the N.E. trades, eastward of the Leeward Islands across them and the Bahamas, skirted the shores of Florida and the Southern States, passed between Nova Scotia and Bermuda, and crossed the Atlantic towards the west of Ireland. (A well executed map of this cyclone will be found in LIEUT. MAURY'S *Physical Geography of the Sea*, and some remarks on it in COL. REID'S *Progress of Development*, p. 337.)

1848, Sept. 19; from Barbados to the Banks of Newfoundland.

1848, Sept.; fom the Gulf of Mexico to the Banks of Newfoundland.

1848, Sept. 29; in the neighbourhood of the Cape Verde Islands, the centre passed north of the Islands on a W.N.W. course. (PIDDINGTON'S *Horn Book*, p. 33).

1848, Dec. 16; the North Atlantic. Experienced by the *Marmion*, CAPT. FREEMAN, in Lat. 54° and 55° N., Long. 20° and 21° W.

1849, Jan. 9; the Atlantic, (locality not given, but not far from New York). Experienced by the *Christoval Colon*. (REID'S *Progress of Development*, p. 375). This cyclone appears to have been very severe.

1849, Feb. 28; Eastern Atlantic. Centre passed north-easterly up the Irish Channel and across the south of Scotland; very severe in the south of England. (REID'S *Progress of Development*, p. 327).

1849, Mar. 27; Eastern Atlantic, Lat 48° N., Long. 20 W. Experienced by the *Ashley*, which passed through the centre. REID is of opinion that the cyclone was moving southward of east. (*Progress of Development*, p. 334.)

1849, April 19; Eastern Atlantic, Lat. 48° N., Long. 6° W. Experienced by the *Iberia* mail steamer.

1850, Feb. 9; the Central Atlantic, in the neighbourhood of 27° N., 39° W. Experienced by the ship *Venice*. (MAURY's *Sailing Directions*, p. 417). This cyclone appears to have been moving westwardly.

1850, March 30; Nassau.

1850, Aug. 21; Cuba.

1850, Sept. 2; from the West Coast of Africa, over the Cape Verde Islands towards the West Indies. W. C. REDFIELD *corrects* the path as now referred to, and considers it probable the cyclone reached Bermuda on the 15th of Sept. (*American Journal of Science*, 2nd series, Vol. XVIII. p. 177).

1850, Oct. 14; the Central Atlantic, experienced bp the *Superior*, in Lat. 25° N., Long. 47° W., which capsized. (*American Journal of Science*, 2nd series, Vol. XVIII., p. 178).

1850, Oct. 18; the Central Atlantic, experienced by the *Damascus*, in Lat. 26° N., Long. 41 W. (*American Journal of Science*, 2nd series, Vol. XVIII., p. 178). MR. REDFIELD considers the paths of these cyclones to have been somewhat similar to that of CAPTAIN CORNING's hurricane in 1828,—(see p. 157).

1851, July 10; Barbados, St. Domingo, and St. Christopher.

1851, Aug. 16; first met with eastward of the Leeward Islands, which it swept, as well as Porto Rico, St. Domingo, and Cuba; it recurved in Lat 27½° N., sweeping the north of Florida and Charleston, and pursued its course on the Atlantic south of Nova Scotia, just touching the extremity of Newfoundland; its track is very similar to that of the cyclone of Sept., 1846, and like it, it passed northwards between the British Islands and Iceland; the earlier branches of the two cyclones were very dissimilar.

1851, Oct. 22; Off Cape San Lucas in the Pacific. (This cyclone is included in the catalogue on account of its apparent recurvature which connects it with the Atlantic cyclones; its path is to be found on MR. REDFIELD's latest map in the *Nautical Mag.*, Sept., 1854, entitled CAPTAIN BUDD's *Gale*, Oct. 1851, and *American Journal of Science*, 2nd series, Vol. XVIII., p. 183).

1852, Jan. 12; Vera Cruz.

1852, Sept. 22—26; St. Christopher to Porto Rico.

1852, Oct. 9; Florida.

1853, Aug. 30 to Sept. 11; the great Atlantic cyclone traced from the African continent to the northern parts of the Atlantic between the British Islands and Iceland. The path of the centre of this cyclone was entirely confined to the surface of the ocean. Commencing near the African coast, it swept northward of the Leeward and Bahama Islands, recurving about 31½° N. From this point, its onward course was considerably south of Nova Scotia and Newfoundland, with an inflected path between Iceland and Ireland. (It is marked XXIV. on MR. REDFIELD's last chart. Details, with chart, in *Nautical Mag.*, Sept., 1854, p. 466 and *American Journal of Science*, 2nd series, Vol. XVIII., p. 1). This is by far the most complete instance which we have on record of an Atlantic cyclone. No less than 142 logs or reports of vessels involved, have contributed to the determination of the most perfect storm track to be found in the annals of cyclonology. More than half this number of vessels (75) were dismasted or lost,—a great number (46) were crippled or otherwise damaged,—and only 21 escaped injury. In the opening remarks just previous to recording the reports of vessels involved, MR. REDFIELD has this passage. "For it seems to have been inferred by some that those gales which have previously been traced and their routes shewn on our storm charts, must have originated at or near the places where our first observations were obtained. It is obvious, however, that such inferences are quite erroneous." It would be premature at present to assume that all Atlantic gales follow the course indicated by *this* cyclone. SIR W. REID gives an instance (Sept. 11, 1846), of a cyclone forming near Trinidad; and MR. PIDDINGTON alludes to cyclones forming in the higher regions of the atmosphere, descending bodily and involving ships in some cases so completely that they have no possible chance of escape.

1853, Sept. 26; CAPT. MACLEAN's hurricane near the Bermudas. The ship *Gilbert Munroe* fell in with this cyclone in Lat. 33° 10′ N., Long. 59° 7′ W., not far from its point of recurvature; it appears to have described the usual storm path in this part of the Atlantic, the centre passing a little to the east of Bermuda. (*American Journal of Science*, 2nd series, Vol. XVIII., p. 180).

1853, Sept. 28; Eastern Atlantic, off the African coast. Experienced by the *John Wade*, in Lat. 15° N., Long. 34° 50′ W. (MAURY's *Sailing Directions*, 6th edit., and *American Journal of Science*, 2nd Series, Vol. XVIII., p. 178). MR. REDFIELD considers that the track of this cyclone coincides with that of the great Atlantic cyclone in Aug. and Sept. 1853.

1854 Jan. 2; Eastern Atlantic, Lat. 48° N., Long. 16° W. Experienced by the ship *Pyrenees*.—*Shipping and Mercantile Gazette*, Jan. 27, 1854. Letter from MR. W. W. PALMER, the chief officer. It is the opinion of MR. PALMER that the cyclone was travelling from the Azores to the Channel, and this opinion is borne out upon projecting the track of the vessel and the winds recorded. It would, however, appear that another cyclone not far distant, towards the S.E., also affected the ship, but the data will not allow us to decide positively on this point.

1854, Oct. 21; Bermuda.

1855, Jan. 20; Baltimore to Halifax.

1855, Feb. 10; Bermuda.

1855, May 24; Trelawny, Bermuda.

1855, Aug. 25, 26; Martinique and St. Domingo.

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86. Meteorological Signs preceding a Hurricane.—The meteorological signs indicating the approach of a hurricane or cyclone have been collected from various sources by MR. BIRT,* and are enumerated and classed according as the phenomena may be presented to the external sensations of feeling, sight, or hearing.

Meteorological signs recognised by the feelings—

1. A sultry oppressive state of the atmosphere.
2. A calm.

Meteorological signs recognised by the eye—

3. A remarkably clear state of the atmosphere, so that the stars may be seen to rise and set with nearly the same distinctness as the sun and moon.
4. A peculiar white appearance in the zenith, more or less of a circular form.
5. A remarkably red or fiery appearance of the sky. This is not unfrequently of such intensity as to tinge all the surrounding objects with a deep crimson; and when this is observed, there can be no question that the violent portion of the cyclone is not far from the vessel. When this red light is seen at night, the impression on the seaman's mind is, that "day has broken before its time."
6. A peculiar colouring of the clouds, more especially of an olive green. This is generally the precursor of a most violent and terrific hurricane.
7. A thick, hazy appearance in that quarter of the horizon in which the cyclone is raging.

* "Handbook of the Law of Storms; being a Digest of the Principal Facts of Revolving Storms." By W. R. BIRT. 1853.

8. A remarkable and peculiar appearance of the heavenly bodies. When shining through a haze, they are said to shine with a pale, sickly light, and are not unfrequently surrounded by rings of light, or halos. Some observers describe the stars as "looking big with burrs about them." Others speak of their dancing, and generally, they have been noticed as being remarkably bright and twinkling.
9. The sun on some occasions has exhibited a blue appearance, and white objects have been seen of a decided light-blue colour. The sun has also been observed of a pale and somewhat similar appearance to that of the full moon.
10. A dense, heavy bank of cloud in the direction of the hurricane.
11. A peculiar appalling appearance in this bank, more particularly as if it were a solid wall drawing down upon and closing around the ship.
12. A darting forward of portions of this bank, as if torn into rags and shreds by some violent force, and driven before, *not borne by*, the wind. When this indication is distinctly recognised, a run of about two hours *towards the centre* will involve the vessel in a destructive hurricane.
13. A peculiar motion exhibited by small bodies, as branches of trees, when agitated by the wind, consisting of a sort of whirling, *not a bending forward, as if bent by a stream of air.*
14. Lightning of a remarkably columnar character, shooting up in stalks from the horizon, with a dull glare; also like flashes from a gun, and sparks from a flint and steel.

Meteorological signs recognised by the ear—

15. A distant roar (probably of the hurricane itself), as of wind rushing through a hollow vault.
16. A peculiar *moaning* of the wind, indicative of the close proximity of the violent portion of the hurricane.

The meteorological phenomena accompanying a revolving storm may also be enumerated thus :—

1. A very rapid motion of the air, constituting the hurricane, and increasing in velocity as the centre is approached.
2. A fitful variation of intensity in the force of the wind, which sometimes blows with fearful violence, carrying away everything that opposes its progress, then sinking to a gentle breeze, or even lulling to a calm, but almost immediately afterwards springing up with greater violence than before. The hurricane winds are nearly, if not entirely, without exception puffy, violent, and blowing in gusts.
3. An immense condensation of aqueous vapour, forming large banks of cloud, which precipitate torrents of rain. The condensation appears to be so exceedingly rapid that large quantities of electricity are generally developed, giving rise to incessant flashes of lightning.

4. A general darkness and gloominess within the area of the cyclone, relieved only by the fitful glare of the lightning, or the appearance of the imperfect circle of light near the centre or axis of the storm.
5. A separation of the clouds in or near the centre of the hurricane, so as to produce in the immediate neighbourhood of the axis a clear sky, through which the sun and stars are often seen with great brilliancy.
6. A calm in the centre of the cyclone.

Indications of approaching or existing hurricanes manifested by the ocean, of special utility to vessels at anchor in roadsteads, &c.:—

1. A swell produced by the storm wave rolling in upon the shore, at first of a gentle character. The direction of this swell will pretty surely indicate the bearing of the storm, and its changes will point out, in some localities, the course the hurricane may be pursuing.
2. A swell rolling in, *without changing its direction*, may be regarded as indicative of a hurricane *approaching* the shore. The same phenomenon met with at sea (the ship's course being taken into account), will indicate the bearing down of the cyclone on the vessel.
3. A dirty green appearance of the ocean; on some occasions its assuming a muddy or brown colour, on others its being remarkably clear; its temperature increasing, and its smelling stronger than at other times, are all indications of the proximity of a cyclone.

87. The Storm-Wave.—The rotation of the wind in a hurricane violently agitates the surface of the ocean in the direction of the wind, producing a *swell* or STORM-WAVE, the undulations of which roll on to an extraordinary distance; the wave thus propagated advances as a tangent to the whirlwind. The wind, however, veers; and thence there results a series of undulations rolling from the margin of the storm, both in advance and regression of the storm itself, and the succession of undulations encountering each other produces, in the area of intersection, *cross seas* more or less dangerous according as they are met in advance of or behind the hurricane. It is easy to see that such a series of undulations must always *fringe* the storm's wake, and be found to the right and left of the path over which the cyclone has advanced; while the long rolling swell generally precedes it, and thus indicates the approach of the gale many hours—if not a day—before it is encountered by the ship. In the NORTHERN HEMISPHERE it is on the *left* side of the storm's wake, in the SOUTHERN HEMISPHERE on the *right* side of the storm's path, that the cross pyramidal sea is found; and when a ship meets with such a sea, it may be taken as a tolerably certain indication that a rotatory gale has passed over the locality. Generally the storm-waves undulate in a direction which, the further they are from the vortex, is more at right-angles with the direction of the wind: in a heavy gale they merely proceed in the direction of the gale itself.

Dove says, that the undulations of the waves, during a whirlwind storm, proceed from the centre in such directions that the farther they are from it the less is their radial difference; thus their course is from the centre of the storm to its circumference—in a direction somewhat inclined forward in relation to the gyration of the cyclone wind, and to which Reid's attention was particularly called; consequently, the three descriptions of storms more closely examined differ in the following manner, viz:—

1. In a whirlwind storm the waves undulate in a direction which is more at right angles with the direction of the wind the farther they are from the vortex.
2. In a heavy gale they proceed in the same direction as the gale itself.
3. In a gale which arrests the progress of a wind blowing from the opposite quarter, seamen say that the two winds are fighting.

We may well conclude these remarks by a brief description of an extraordinarily heavy cyclonic gale which visited the British Seas, known as the "Royal Charter Storm," the materials of which were compiled by the late Admiral FitzRoy.

"Royal Charter" Storm:—October 25th, 26th, 1859:—Few Londoners have yet forgotten the state of the Thames in 1859. Deficiency of water supply during 1858 and 1859, and great evaporation, caused a condition of its liquid excessively disagreeable to eye and nose, if not actually pestiferous.

Everywhere a want of water was felt, and this had been of considerable duration. In August the heat reached 92° (in places where usually summer heat is not above 80°), and the temperature of evaporation was 78°.

Hail and snow in the north, clouds and rain in the south, prevailed before the "Charter" gale; and this wintry weather, on the 21st of October, seems the more remarkable as so rapidly following very warm if not hot weather.

In the North of Ireland, near Garron Tower, on the 21st, it was exceedingly cold, the air remarkably transparent, and the Scotch mountains so distinct that everyone noticed their extraordinary visibiltiy. There was much vivid lightning to the southward.

Writing about these same days, Captain Boyd said,—"On the 19th I was at Belfast, oppressed with heat, in close weather, with small rain. It was like a muggy May day. The next three days I was travelling along the east coast, cut to the vitals by a piercing north wind, with snow and hail squalls."

The barometer continued to fall. Near London that night the temperature was only 22°, a degree of cold not often exceeded during a whole winter, and, on this occasion, the more remarkable, from its sudden succession to very mild, if not warm weather.

On the 22nd there were northerly, mixed with westerly winds; great variations of temperature within narrow geographical limits; and barometers still low.

On the 23rd a contest of air currents was evident, the temperature being even lower (only 18° that night near London), and the barometer remaining low, but unsteady.

The differences of temperature between the east and west coasts of England were very remarkable on these days.

On October 24th, with a low barometer and excessive differences of temperature (in very limited spaces), there was not much wind, or horizontal movement of air currents. On this day, it blew hard along the coast of Portugal, from the southward, but no evidence has been obtained of any storm, or cyclonic commotion at that time in the Atlantic to the southward or westward of the British Islands,—no proof of a cyclone having originated considerably to the south-westward, and having travelled across much of the ocean.

It was blowing strongly, from the northward, to the west of Ireland, on that same day (24th), but no ship reported a storm, on that or the previous two days.

As far as hitherto ascertained, the gale of October 25th and 26th appears to have had its commencement near the Bay of Biscay, and its conclusion about Norway or the Baltic.

During the night of the 24th, and on the morning of October 25th, there was no evidence of a storm moving towards England. During the previous days there was a preponderance of northerly wind (polar currents) over and near the British Islands. There was no cyclonic commotion of any kind to the westward or southward. It is very important to mark these facts,—because ideas have prevailed that all cyclones crossing our islands have travelled far, even across the Atlantic from the south-west. Plausible theories, and elaborate diagrams have been published, intended to show how cyclones had travelled—not only across the Atlantic Ocean from near the West Indies, but (having there altered their course, or recurved,) actually all the way from the coast of Africa.*

That such storms do travel, like eddies in water, a considerable distance, during two, three, or four days, has been demonstrated; but any further extension of their progress has not hitherto been satisfactorily proved.

At midnight of the 24th, and very early on the 25th, the *Alipore* was between Lat. 46° and 47° N., Long. 18° and 14° W., crossing the Bay of Biscay, and, therefore to the south-west of the English Channel. She had the barometer *then* at 28·98 with the wind at N.N.E. (true) blowing hard. Clearly there was no storm then to the westward of her. It was on the other side, but near. Its central part was at the entrance of the channel, not far from the Land's End. The *Alipore* had come from the south-west. No cyclone or strong wind had passed her from the southward. She *met* a north-east gale. The *Alipore* could not have overtaken a cyclone, supposing it moving only 15 miles an hour to the north-eastward, bodily. Had it travelled from far westward, or south-westward, it must have overtaken and passed that ship. Another ship, the *Neikar*, passed down channel to sea, on the days immediately preceding

* Redfield's track of the storm of September 1853, and other tracks shown by Sir William Reid, in his invaluable works.

the 25th. She met no storm. A ship belonging to MR. LAIRD met none.† More "crucial" instances could not be desired.

In the morning of the 25th, there was a strong gale from S.W. to S.E., over Portugal, Spain, France, and England. This was a warm, and very wet wind, which did not raise the then low barometer. Fog, dense clouds, or heavy rain prevailed. At this time a cold northerly wind was blowing in the Atlantic, and soon it contended against the warm, wet, southerly wind, from which its chilling influence caused the precipitation, or deposit of vapour, in fog, or rain. Both these winds were then blowing towards (afterwards around) that area, of the region near, in which the barometrical depression was greatest.

At this time, in Ireland, at Kingston, there was a very dense fog,—so dense that (said CAPTAIN BOYD) "although I fired full charges from guns on the seaward side, the packet (for whose guidance into port I intended them) though not more than a mile distant, only heard a few. The fog-bell was heard by her, only as the fog 'lifted' for a time, when she was about half-a-mile from the bell. In the afternoon it cleared to a fresh north-east wind. Not till near midnight had we the gale, fierce and startling, at the ship. The tide was unusually high. The weather had been singularly ominous and threatening for some days; so baffling also as to perplex the oldest and most weatherwise pilots."

The channel squadron under ADMIRAL ELLIOT, not far from the Eddystone, had a strong S.E. gale all the early part of the 25th, but about three in the afternoon the wind ceased, and the sun shone, though the sea continued "towering up and breaking." The barometer on board was then 28·50. Suddenly, in less than half an hour (the barometer *having* begun to rise), a blast swept furiously over the ships from north-west; and during the next three hours it blew with the force of a hurricane. *There* then, at three o'clock, was a lull or vortex of the storm, occasioned by an opposition of contrary currents of wind.

According to the most reliable accounts, the central area—where the barometer fell lowest, and *towards* which the winds blew—was over Cornwall at about three o'clock in the afternoon of the 25th, and over Lincolnshire at nine next morning, having thus advanced about 250 miles towards the north-east (true) in eighteen hours) *averaging* therefore, 14 miles an hour *over land*.

During the advance of the centrical area (a varying space, in which there was heavy rain but very little wind,) from Cornwall to Lincolnshire, all places south-eastward of the line between them, had a storm veering from south-eastward, through the South to S.W., West, and N.W.; while all those places north-westward of the axial line of progress found the same storm veer round from south-eastward, through East, N.E., North, and to the north-westward.

This is beautifully proved by facts, as to general limits and direction; excessive quantities of rain fell on the south-east side of, and within the area, as it

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† See page 99, sec. 844,—one of the African vessels.

progressed north-eastward; comparatively little or none on the north-west sides of that *centrical space.*

So limited was the actual gyration, that it only extended to Kingstown, hardly to Dublin, and did not affect France beyond a few miles inland. Thus its diameter scarcely reached 400 miles at the utmost, but often was nearer 300; and, therefore, while there was a storm from every point of the compass, around the progressive vortex above mentioned, the greater part of Ireland, especially its west coast, and the west of Scotland, had but little wind. The weather there was actually fine.

While there was an area of extreme barometrical depression about Cornwall, the Channel, and the "edge of soundings" towards the Bay of Biscay, there were two strong currents of wind advancing towards that place, one from the northward, and another, *then* strongest, along Portugal and across France from southward. Their encounter occurred near the channel entrance, and from that time, on the 25th, the two bodies of atmosphere that had been drawn towards the same place, to restore due equilibrium, mutually pressed on to maintain advance, while their place of gyration, an immense eddy, was forced north-eastward by the overpowering mass and momentum of the southerly (or tropical) current. But this eddy or cyclone, commenced on the 25th, and had almost expended its energy on the 27th, near the coast of Norway, having lasted between two and three days, as a definite and (mathematically proved) continuous circulation, or circuit. While the centrical area was moving north-eastward, from 10 to 20 miles an hour, the sensible velocity of wind, estimated (by comparisons with measured pressures and *practical experience*, not only then but at other times), could not have been less than 60 nor much more than 100 miles an hour. Probably at the strongest part, on the south-east side of the circuit, the velocity was about 80 miles, added to near 20 for the cyclone's advance, making 100; while on the other side about 60 was the utmost.

It has been observed that places in Scotland had no remarkable wind during the night of the 25th. When it blew hardest on the northern coast of Britain, from the eastward, on the 26th, there was but little wind in the English Channel or Ireland. This shows, in connexion with the facts immediately preceding the circular or gyratory movement which commenced near Cornwall, that the nearest quantities of air were pressed by ordinary dynamical laws towards the place of deficiency, and that the two great normal movements of atmosphere, from and towards the pole, were immediately affected by the local and temporary disturbance of Equilibrium.

Further Remarks on the "Royal Charter Storm":—It may be useful to reconsider the progress of this storm with reference to the condition and circumstances of surrounding regions.

It has been noted that the west coast of Ireland, and a large proportion of that island, were not affected at all. Scotland was not reached on the 25th, but was so subsequently. Neither the *Alipore*, nor the *Neikar* which were sailing *from* the Channel (on the 23rd), nor any other vessel, felt its influence *before* the 25th.

As the *Neikar* left Channel soundings on the 23rd, having been off Scilly on the 21st, she must have crossed any cyclone advancing from the south-westward, or from the Atlantic Ocean.

One of the African vessels sailed from Liverpool on the 24th. No storm was encountered. Only strong northerly winds were found, as she went to the westward, southward. But the barometer was generally low, over at least a thousand square miles of sea and land, and had become so gradually during many previous days,—about a week, indeed.

The *lowest* point then reached, however, was not nearly so low as has been *known*, nor was it even equal in depression to that caused by the subsequent storm of November 1st, which may have been caused by the rapid shift to the *northward*, and by so much polar current resisting the southerly mass.

On board the *Alipore* 28·98 inches was the lowest registered pressure. The Channel squadron noted 28·50. In London, at my house, the mercury was rather below 29 inches (reduced to sea level and 32°), rain being incessantly heavy, and wind violent from southward all the earlier part of the night.

At this time the *Royal Charter* was making way round Anglesea, close in shore, to her fatal anchorage on the north side of that island; where the full force of next day's tempest, from the northward, was felt, and that *doubly* powered ship of iron, which had circumnavigated the globe, was destroyed, with nearly all on board, in one short hour, about seven in the morning. With her power of steam, in addition to that of sails in perfect order, a few hours on the starboard tack, with but little way, would have saved her. So much, at such a time, depends on individual judgment. Another ship but a few miles off, a wooden sailing ship, —not a steamer, the *Cumming*, and several smaller vessels, acted thus—stood to the westward—and not one was wrecked, nor even injured materially.

While the storm was most violent against Anglesea its force was not excessive at Liverpool. The strongest part of the north-west side of the cyclonic circulation did not sweep over that town till shortly before noon of the 26th. Mr. Hartnup wrote to me, "The storm on the 25th and 26th of October did not reach Liverpool till about 12 hours subsequent to the wreck of the *Royal Charter*."

"We had at the Observatory, Liverpool, light winds until 9 A.M. on the 26th, when the gale first reached us. At 11·45 A.M. the extreme pressure was 28 lbs. on a square foot, and the greatest horizontal motion, measured hourly, was 57 miles between noon and 1 P.M. The direction of the wind being N.N.W. (true)."

A letter from Dublin said, "In England you have had this tremendous gale (October 25, 26). Here it was not felt. The barometer fell much, but nothing followed."

Captain McKillop, R.N., informed me that "during the gale which swept the coast of England and Wales, when the *Royal Charter* was lost, a dead calm, and a sharp frost of unusual severity for the country (Ireland), was experienced along the coast, from Westport to Galway, the wind going round from north-east to south-east;—when the frost ceased, and a most unusual quantity of rain fell, with light variable winds from south to west."

The *Wyman* returning from Iceland had heavy gales from N.N.E. (true) between October 23rd and 28th. This was in Lat. 64° to 61° N., and Long. 28° to 23° W. On the 24th, 25th, and 26th, the wind's force was stated at 10 to 11. During the *whole* of the time, when variable or southerly winds prevailed eastward of Ireland, as well as while the polar current alone was felt between Ireland and the Baltic, across France to Spain, and in the eastern Atlantic,—during the whole of this time, the expeditionary vessel *Wyman*, employed by Colonel SHAFFNER to explore a submarine track for his intended telegraphic communication, was in northerly (or polar) winds, on four days extremely strong, with a high barometer. On the 28th the barometer had risen considerably in general, but not to its normal height (29·94 to 30·00). Winds were variable, and temperatures extremely so. Much rain fell.

On the 29th there was a local cyclone, apparently at the meeting of northerly and southerly currents of wind, near the coast of Scotland, in the North Sea. This had not travelled. It grew, and then diminished, in one locality. There was much variation in the temperatures of even neighbouring places, showing great mixture of air currents. There was little wind, and that, very variable—in many places from the *land to the sea*—the land having been considerably chilled by previous northerly winds, by rain and evaporation, while the sea retained nearly uniform, and at that time of year, rather high comparative temperature (48°) October 30th. With barometers everywhere low, and falling, with ominous skies and increasing warmth, with south-easterly winds approaching towards the north-east, it was seen that another gale might be expected immediately; and next day, 31st, it commenced in Ireland, having been felt heavily in the Atlantic, at a considerable distance, previously.

On the 1st of November this storm's centre crossed Ireland, the north of England, and then on the 2nd of November, appeared to diminish rapidly in its strength as it overspread the North Sea, progressing towards Denmark. A more distinctly marked cyclone than this as it appears demonstrated on our charts, it is hard to imagine. That it existed three days is proved, and that its centrical area progressed eastwards about 15 miles an hour, on an average, cannot be far from the truth. The barometer fell before this storm, considerably lower than it did before its more generally remarked precursor, and the thermometer was much higher. These indications showed preponderance of the southerly (tropical) element over that from the polar direction; and that the meeting, place of gyration, or node, was therefore further toward the north.

That its direction of progress should have been nearer eastward, across the British Isles, instead of more northerly (in consequence of such southern predominance) may have been a consequence of the Scottish mountains, 3000 to 4000 feet high, impeding such a course as would have been taken across open sea.

At Kew, and at Brompton, the lowest barometrical reading in the night of the 31st October, or morning of November 1st, was 28·80, the thermometer in open air being 50°. It has been stated that *there* the lowest on the night of the 25th was 29·00 (sea level and 32°), and the temperature then 25°. Two aneroid barometers, considered to be good instruments, near Lake Windemere, fell to 28·09 and 27·70 (approximately reduced to sea level) the night of the 31st. The first of these showed 28·77, nearly, (reduced), the night of the 25th of October.

On the 29th, Colonel Rogers' barometer had fallen to 28·42, and at 11 P.M. on the 31st to 28·27; but nothing of consequence followed besides rain; no strong wind. At eight next morning his barometer showed 28·09, and at 3 P.M. the sky had cleared, the glass was rising; Windermere had felt no storm, and did not experience any strength of wind afterwards. This is by no means a singular case, but is quoted here as one of the well-marked exceptional anomalies that occurred during this storm of November 1st, as well as that of the 25th October, on which occasion, also, Lake Windermere escaped undisturbed. Colonel Rogers said of that time (Tuesday night 25th October);—"My aneroid fell to 28·60 at night. Rain fell, but no remarkable wind occurred. It was fresh and gusty, but at no time severe." Similar exceptions occurred in Ireland, Wales, and Scotland; in some degree resulting, probably, from the sheltering or deflecting effects of high land, but chiefly from the very diversified action of violent winds, expanding and expended, in some places, and so extremely compressed (as it were) and elastic at others, that heavy weights are lifted, large trees snapped asunder, or laid prostrate, and strong buildings unroofed.

CHAPTER XIV.

ON THE USE OF METEOROLOGICAL INSTRUMENTS.

1. Three instruments—the Barometer, the Thermometer, and the Hygrometer—used together, constitute a perfect Weather Glass. The barometer indicates the changes in the pressure of the atmosphere,—the mercury falling as the air becomes lighter, rising as it becomes heavier, and remaining stationary so long as there is no change in the air; the thermometer shows changes in the temperature of the air; and the hygrometer, the changes in the moisture of the air.

With the first two instruments the seaman is generally more familiar than with the last—the hygrometer; a few remarks on it will not therefore be out of place. A variety of instruments have been contrived to measure the amount of moisture in the atmosphere, but reference is here made to that which is by far the most simple,—the most easily managed, and the most efficient of them all—viz., the dry and wet bulb thermometers. Nothing more is requisite than to select two good thermometers; ascertain with the greatest care their index errors for every part of their respective scales; cover the bulb of one with a piece of thin book muslin, and to this muslin attach a piece of cotton lamp wick; provide a small reservoir for water into which the lamp wick may dip; place the two thermometers in a double case a few inches apart, and keep the muslin constantly wet with distilled water. The reservoir should *not* be immediately under the bulb.

The observation of this instrument is exceedingly simple;—first read the dry bulb thermometer, and then the wet, and record the two readings. In all researches, however, that have reference to the humidity or moisture of the atmosphere, these readings are highly important; it very seldom happens that they are alike; should they be so, it is a proof that the air is saturated with moisture, *i.e.*, there is so much water in the atmosphere that it can take up no more—no evaporation is taking place—and both wet and dry bulbs are of the same temperature. If there be less moisture in the atmosphere than will saturate it, it will take up water from all sources; evaporation in consequence will be induced from the muslin, which will be attended with a depression of temperature, so that the wet bulb will read *lower* than the dry, and this depression will be proportional to the *dryness* of the atmosphere. It would be well to read the barometer whenever observations of the wet and dry bulbs are made.

By means of certain calculations applied to the readings of the dry and wet bulbs, and the barometer, various circumstances connected with the moisture of the atmosphere may be ascertained. Many of these circumstances are of high interest in a meteorological point of view,—among them the *dew point*, or that precise temperature at which the condensation of the existing moisture in the atmosphere takes place, producing haze, mist, fog, cloud, rain, hail, or snow. This is not uninteresting to the seaman, inasmuch as it will show whether a fall of the mercury of the barometer will be attended with wind only, or with wind and rain.

The barometer being influenced by both dry air and aqueous vapour (or water in an invisible gaseous state), it may fall from the effects of a rotatory storm quite independently of the presence of vapour. In this instance the depression of the mercury will invariably be attended with wind, which will fearfully increase as the mercury falls; but if the atmosphere should be gradually getting more moist, as indicated by decreasing differences between the dry and wet bulbs, the pressure at the same time diminishing, rain may confidently be expected. Observations of the hygrometer in connection with those of the barometer are greatly calculated to indicate to the seaman the *kind of weather* he may expect.

Another interesting point connected with observations of the hygrometer is the quantity of vapour present in the atmosphere. This may be expressed either as the *degree of humidity*, a perfectly saturated atmosphere being represented by 1000, or by the number of grains of vapour in a cubit foot of air. Although this meteorological element may not be generally interesting to seamen, yet its careful determination in various oceanic localities is exceedingly important. It is to be presumed that nothing like the differences met with on land, especially in the interior of large continents, obtain on the ocean. Yet different zones of the oceanic surface must be marked by different degrees of humidity; the two regions of Trades are clearly much drier than either of the three belts of calms; and the zones of the "Passage winds," north and south of the equator, must vary very materially as regards moisture.

Another most important point immediately connected with the last is the determination of the *elasticity* of the aqueous vapour. The aggregate pressure of the atmosphere on the mercury in the cistern of the barometer is made up of two components, viz.:—the pressure of dry air, and the pressure of aqueous vapour; these pressures are subjected to distinct laws, and a very interesting object of inquiry is the distribution of the pressure of dry air over the surface of the ocean, especially within the tropics. This can be ascertained by observations of the wet and dry bulbs in connection with those of the barometer, when certain computations are applied to them.

There are one or two other points of interest, but those already mentioned are the most prominent; and in using the hygrometer it is necessary to obtain GLAISHER's *Hygrometric Tables*, which are the best for ascertaining the numerical values of the different elements by *inspection.*

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2. DOVE comes to the following conclusions as regards the movements of meteorological instruments in connection with the Law of Gyration:—Calculating the mean of all the readings of the barometer, thermometer, and hygrometer, observed during all the different changes of the wind, taken individually, after the elimination of the periodical changes,—if we define the mean distribution of pressure, temperature, and moisture round the compass, or if, in other words, we construct a *barometrical, thermal, and atmospherical wind-rose,*—it becomes evident that *this wind-rose has two poles of pressure and heat;*—in fact, that there are two points in it situated opposite to each other, at one of which the weather is coldest, and the reading of the barometer is highest;—and at the other the weather is hottest, and the reading of the barometer is lowest. From the maximum of pressure to its minimum, as well as from the maximum of heat to its minimum, the mean barometrical and thermal influence of the wind decreases in an uninterrupted ratio. The former point happens to be nearly at N.E., and the other nearly at S.W. But from S.W. through West to the N.E. the mean height of the thermometer decreases, whilst the mean readings of the barometer increase; from N.E. through East to S.W. the mean height of the thermometer increases, whilst the mean readings of the barometer decrease. What is perceptible in the mean thermal and barometrical influence (in the mean thermal and barometrical movements) of the winds must also occur at the time of their transition into each other,—and just as much on the suppositon of a

varying as on that of a uniform rotatory velocity. Now, however, as the elasticity of vapour, so far as regards its distribution around the compass, is in close connexion with the thermal wind-rose, but the pressure of the dry air is closely connected with the barometrical one, it follows that the fluctuations in the pressure of the dry air and of the barometer are precisely in an inverse ratio to the changes in the temperature of the air and in the elasticity of the vapour suspended in it. Assuming then that the N.W. point has the same part in the southern hemisphere as the S.W. point in the northern, the S.E. point in the former corresponds to the N.E. point in the latter; consequently we have as the

Mean Movements of Meteorological Instruments;

In the Northern Hemisphere.

1. The barometer sinks with east, south-east, and south winds, is arrested in its downward progress by a S.W. wind, rises with west, north-west, and north winds, and ceases to rise with one from N.E.

2. The thermometer rises with east, south-east, and south winds; it ceases to rise with a S.W. wind; it falls with west, north-west, and north winds, and ceases to fall with one from N.E.

3. The elasticity of vapour increases with east, south-east, and south winds; its increase changes to a decrease with one from S.W.; it decreases with west, north-west, and north winds, and its decrease changes to an increase with a N.E. wind.

4. The pressure of the dry air decreases with east, south-east, and south winds; its decrease changes to an increase with a S.W. wind; it increases with west, north-west, and north winds, and its increase changes to a decrease with one from N.E.

In the Southern Hemisphere.

1. The barometer sinks with east, north-east, and north winds, is arrested in its downward progress by a N.W. wind, rises with west, south-west, and south winds, and ceases to rise with one from S.E.

2. The thermometer rises with east. north-east, and north winds; it ceases to rise with a north-west wind; it falls with west, south-west, and south winds, and ceases to fall with one from S.E.

3. The elasticity of vapour increases with east, north-east, and north winds; its increase changes to a decrease with one from N.W.; it decreases with west, south-west, and south winds, and its increase changes to a decrease with a S.E. wind.

4. The pressure of the dry air decreases with east, north-east, and north winds; its decrease changes to an increase with a N.W. wind; it increases with west, south-west, and south winds, and its increase changes to a decrease with one from S.E.

Thus, the movements of meteorological instruments are the *same* with *east* winds in the Northern Hemisphere as they are with *east* winds in the Southern: The same is the case with the *west* winds. The *difference* between the two hemispheres is only quantitative with N.W., N.E., S.W., and S.E. winds; and on the other hand it is qualitative with North and South winds, *i.e.* the mean fluctuations of the meteorological instruments are greatest in the Northern Hemisphere with N.W. and S.E. winds, and of the least importance (owing to the compensation of the opposite movements) with N.E. and S.W. winds; in the Southern Hemisphere (owing to the compensation of opposite movements) they are of least importance with N.W. and S.E. winds, and, on the contrary, they are greatest with N.E. and S.W. winds. The changes with north winds in the Northern Hemisphere are, however, different from the changes which occur with north winds in the Southern Hemisphere: under like climatic conditions, however, they are the same in both, according to their amount,—if, for instance, there be a rise in an instrument with a north wind in the Northern Hemisphere, it sinks with a north wind in the Southern, and *vice versâ*. The same occurs with the south winds.

3. It is in reference to these observations, in so far as they appertain to the North Temperate Zone, that Dove shows that the weather indices (words) on the barometer are of very subordinate importance, because the difference in the temperature and, as a consequence of it, in the pressure of the two currents (polar and equatorial), is generally far greater in winter than in summer. As thus the fluctuations of the barometer are generally far more considerable in winter than in summer, the relative proportions, according to which the scale has been constructed, should be at least double in winter what they are in summer; as they are constructed at present, however, we are easily led astray by them. Properly speaking, the upper part of the index should represent the north-east wind or a tranquil polar current; the middle part, the east and west winds, or, more correctly, the transition of the two aerial currents; and the lower part, the south-west wind, or, better still, the equatorial current. Now as the air of the polar current flows from colder to warmer regions, its capacity for creating vapour increases, and the effect of this increase stands on the index thus: "very dry, or fine." If owing to the transition of the currents into each other from east and west, and their mingling together, precipitation follows, but clearer weather sets in afterwards, this is set down on the index as "changeable." If, as the current from the south moves onward into higher latitudes it gradually looses its vapour over the ground, which becomes colder as it advances, this effect is set down as "rainy." If, however, it rushes rapidly into higher latitudes, and its pressure, although diminished, is contrasted when it is strongest, owing to the rarefaction of its air by heat and the loss of its accompanying vapour, with its mean amount, it is set down under the head of "stormy."

4. It is on these and similar researches that the late Admiral FitzRoy recommended that the old and comparatively useless barometer-indices on which are marked "fair," "change," "rain," "stormy," be abolished, and that the following more appropriate readings be substituted:—

On Barometer scales the following contractions may be useful in North Latitude:—

RISE	FALL
FOR	FOR
N.E.-ly	S.W.-ly
N.W.—N.—E.	S.E.—S.—W.
Dry or less	Wet or More
Wind.	Wind.
Except Wet	Except Wet
from	from
N.E.-ward.	N.E.-ward.

In South Latitude substitute South or Southward for North, &c.

Thus, 1. The Barometer rises for Northerly Wind (including from N.W., by the North to the Eastward); for Dry or *less* Wet Weather; for *less* Wind; or for more than one of these changes:—

Except on a few occasions when Rain (or Snow) comes from the Northward with *strong* Wind.

A Thermometer falls for *change* of Wind towards *any* of the above directions.

Also, 2. The barometer falls for Southerly Wind (including from S.E. by the South to the Westward); for Wet Weather; for *stronger* Wind; or for more than one of these changes:—

Except on a few occasions when *moderate* wind with Rain (or Snow) comes from the Northward.

A Thermometer rises for *change* of Wind towards the Southerly directions *only*.

Moisture or Dampness in the air (shown by a Hygrometer) increases *before* or with Rain, Fog, or Dew.

And the following summary may be useful *generally* throughout the world:—

RISE FOR	FALL FOR
Cold, Dry, or Less Wind.	Warm, Wet, or More Wind.
Except Wet from Cold Side.	Except Wet from Cold Side.

Since therefore thermometrical readings in conjunction with those of the Barometer are of much consequence in determining the character of the weather, the following are given by the late Admiral FitzRoy, as the temperatures for the British Islands;—for about the middle of

January	37°	July	62°
February	39°	August	61°
March	41°	September	57°
April	46°	October	50°
May	53°	November	43°
June	59°	December	39°

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6. Commander Maury remarks, in reference to Admiral FitzRoy's observations on "the weather," that since the *westerly* (or land) winds are, along the Atlantic shores of America, the *dry* winds,—and the *easterly* winds (or those from the sea) the wet winds; the rules applicable to the eastern side of the Atlantic are not quite the same as those for the western side: and that, as the dry winds on the American side are moving with the general set of the atmosphere, which in extra-tropical latitudes is from the westward, while on the European side the dry

winds are counter to that set, so the average force and prevalence of westerly winds will be different on opposite sides of the Atlantic. He also states that, to the west of 45° W. between the parallels of 40° and 50° N., as a general rule, when the wind blows from the N.E. quarter it is as apt to haul to the N.W. as to the S.E.; when it is in the S.E. quarter, the chances are 3 to 1 that it will haul to the S.W.; when it is in the S.W. quarter, the chances are 4 to 1 that it will haul to N.W.; and that when it is in the N.W. quarter it is most apt to go back to S.W.

e. According to MAURY—Monograph 2, "*The Barometer at Sea*,"—from observations derived from American and Dutch vessels,—the following are the MEAN HEIGHTS OF THE BAROMETER IN THE NORTHERN AND SOUTHERN HEMISPHERES:—

Lat. 78° 37′ N.	29·759	inches.	Dr. KANE
59° 51′	29·88	,,	St. Petersburgh.
55° to 50°	29·95	,,	England.
50° to 45°	30·060	,,	from 8282 observations.
45° to 40°	30·077	,,	,, 5899 ,,
40° to 35°	30·124	,,	,, 5103 ,,
35° to 30°	30·210	,,	,, 4989 ,,
30° to 25°	30·149	,,	,, 4892 ,,
25° to 20°	30·081	,,	,, 3816 ,,
20° to 15°	30·018	,,	,, 3592 ,,
15° to 10°	29·964	,,	,, 4496 ,,
10° to 5°	29·922	,,	,, 5343 ,,
5° to Equator.	29·915	,,	,, 5114 ,,
Equator to 5° S.	29·940	,,	,, 3692 ,,
5° to 10°	29·981	,,	,, 3924 ,,
10° to 15°	30·028	,,	,, 4156 ,,
15° to 20°	30·060	,,	,, 4248 ,,
20° to 25°	30·102	,,	,, 4586 ,,
25° to 30°	30·095	,,	,, 4780 ,,
30° to 36°	30·052	,,	,, 6970 ,,
40° to 43°	29·88	,,	,, 1703 ,,
43° to 45°	29·78	,,	,, 1130 ,,
45° to 48°	29·63	,,	,, 1174 ,,
48° to 50°	29·62	,,	,, 672 ,,
50° to 53°	29·48	,,	,, 665 ,,
53° to 55°	29·36	,,	,, 475 ,,
56½° S.	29·29	,,	,, 1126 ,,

These results may be compared with the following more extended Table, published by the Meteorological Department of the Board of Trade, which is the result of Dutch and English observations, made with accurately verified instruments:—

TABLE A.—*Mean Monthly and Annual Pressure of the Barometer between the Tropics.*

Latitude.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly Mean.
° °	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
30 to 25 N.	30·169	30·232	30·124	30·166	30·225	30·227	30·189	30·163	30·097	30·138	30·025	30·178	30·161
25 to 20 N.	30·096	30·109	30·105	30·097	30·139	30·157	30·092	30·075	30·029	30·072	30·013	30·056	30·087
20 to 15 N.	30·011	30·064	30·042	30·003	30·056	30·034	29·999	30·000	29·995	29·995	29·985	30·009	30·016
15 to 10 N.	29·951	29·968	29·987	29·968	29·993	29·958	29·974	29·935	29·931	29.950	29·961	29·956	29·961
10 to 5 N.	29·904	29·937	29·908	29·921	29·937	29.937	29·976	29·968	29·949	29·934	29·941	29·910	29·935
5 N. to 0	29·883	29·914	29·887	29·905	29·916	29·926	29·978	29·967	29·985	29·950	29·924	29·906	29·937
0 to 5 S.	29·894	29·910	29·896	29·917	29·939	29·940	29·987	29·998	30·018	29·961	29·938	29·910	29·942
5 to 10 S.	29·946	29·938	29·917	29·938	29·989	30·009	30·017	29·981	30·033	30·025	29·993	29·961	29·979
10 to 15 S.	29·973	29·985	29·961	29·989	30·036	30·048	30·052	30·060	30·087	30·075	30·040	30·005	30·026
15 to 20 S.	30·017	30·013	30·018	30·029	30·087	30·087	30·095	30·127	30·114	30·103	30·048	30·052	30·065
20 to 25 S.	30·064	30·046	30·074	30·047	30·064	30·141	30·112	30·156	30·171	30·184	30·079	30·078	30·101
25 to 30 S.	30·075	30·052	30·060	30·027	30·139	30·093	30·131	30·178	30·135	30·162	30·079	30·083	30·101

These readings (Tab. A.) together with those given in Tab. B., p. 180 from the *Meteor. Papers* of the Board of Trade are especially valuable, inasmuch as they indicate the normal barometric pressures between the Tropics for each month any deviation from them will most probably announce the approach of a Hurricane or Tropical Storm,—for between the Tropics the ordinary barometric range is very small (a few tenths).

TABLE B.—NORTH ATLANTIC.—Lat. 0° to 10° N., Long. 10° to 45° W.
Mean Normal Pressure (and Range) for each month (reduced). At 9 A.M., 1855-6.

	January.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	October.	Nov.	Dec.
Lat. 10° N.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
Means	29·924	30·050	29·971	29·976	30·010	30·010	29·971	30·019	30·020	30·013	29·980	29·970
Range	0·21	0·09	0·15	0·15	0·24	0·06	0·10	0·17	0·08	0·19	0·21	0·04
No. of Observations	9	4	12	24	18	9	9	27	3	41	13	2
Lat. 5° N.												
Means	29·900	29·963	29·960	29·971	29·978	30·010	29·968	30·016	30·017	30·023	29·934	29·929
Range	—	0·21	0·20	0·18	0·21	0·06	0·14	0·17	0·02	0·17	0·20	0·11
No. of Observations	1	11	22	30	22	16	4	23	3	12	15	9
Equator.												

Mean height of barometer (from 174 obs.), Lat. 0° to 5° N., 29·972; mean range, 0·15.
" (from 171 obs.), " 5° to 10° N., 29·993; " 0·14.

7. **Signs of Weather.**—It cannot be doubted but that there are many signs, having a distinct physical basis, that indicate *change of weather* with more or less precision; a few of these—the more marked signs—have been very judiciously selected by the late Admiral FitzRoy, as useful to seamen, and are extracted from his "Manual," already referred to:—

Whether clear or cloudy, a rosy sky at sunset presages fine weather; a red sky in the morning, bad weather or much wind, perhaps rain: a gray sky in the morning, fine weather: a high dawn, wind; a low dawn, fair weather.*

Soft-looking or delicate clouds foretell fine weather, with moderate or light breezes; hard-edged, oily-looking clouds, wind. A dark, gloomy, blue sky is windy; but a light, bright blue sky indicates fine weather. Generally, the *softer* clouds look, the less wind (but perhaps more rain) may be expected; and the harder, more "greasy," rolled, tufted, or ragged, the stronger the coming wind will prove. Also, a bright yellow sky at sunset presages wind; a pale yellow, wet; and thus, by the prevalence of red, yellow, or gray tints, the coming weather may be foretold, very nearly;—indeed, if aided by instruments, almost exactly.

Small inky-looking clouds foretell rain: light scud clouds driving across heavy masses show wind and rain,—but, if alone, may indicate wind only.

Beyond tropical latitudes, high upper clouds crossing the sun, moon, or stars, in a direction different from that of the lower clouds, or from that of the wind then blowing, foretell a change of wind.†

After fine clear weather, the first signs (in the sky) of change are usually light streaks, curls, wisps, or mottled patches of white distant clouds, which increase, and are followed by an overcasting of murky vapour that grows into cloudiness. This appearance, more or less oily or watery, as wind or rain prevail, is an infallible sign.

Light, delicate, quiet tints or colours, with soft, undefined forms of clouds, indicate or accompany fine weather; but gaudy or unusual hues, with hard, definitely outlined clouds foretell rain, and probably strong wind.

Misty clouds forming, or hanging, on heights show wind and rain coming, if they remain, increase, or descend. If they rise or disperse, the weather will improve, or become fine.

When sea birds fly out early, and far to seaward, moderate wind and fair weather may be expected; when they hang about the land, or over it—sometimes

* A "high dawn" is when the first indications of daylight are seen above a bank of clouds. —A "low dawn" is when the day breaks on or near the horizon—the first streaks of light being very low down.

† In the tropics, or regions of Trade-winds, there is generally an upper and counter current of air, with very light clouds, which is not an indication of any approaching change. In middle latitudes, such upper currents are not so frequent (or evident?) except before a change of weather.

flying inland—expect a strong wind with stormy weather. As many creatures besides birds are affected by the approach of rain or wind, such indications should not be slighted by an observer who wishes to foresee weather.

There are other signs of a coming change in the weather, known less generally than may be desirable, and therefore worth notice—such as when birds of long flight, rooks, swallows, or others, hang about home, and fly up and down, or low, —rain or wind may be expected. Also, when animals seek sheltered places, instead of spreading over their usual range—when pigs carry straws to their sties —when smoke from chimneys does not ascend readily (or straight upwards during calm), an unfavourable change is probable.

Dew is an indication of fine weather; so is fog. Neither of these two formations occurs under an overcast sky, nor when there is much wind. One sees fog occasionally rolled away, as it were, by wind—but seldom or never formed while it is blowing.

Remarkable clearness of atmosphere near the horizon; distant objects, such as hills, unusually visible, or raised (by refraction);* and what is called "a good hearing day," may be mentioned among the signs of wet, if not wind, to be expected.

More than usual twinkling of the stars, indistinctness or apparent multiplication of the moon's horns, haloes, "wind dogs,"† and the rainbow, are more or less significant of increasing wind, if not approaching rain, with or without wind.

Near land, in sheltered harbours, in valleys, or over low ground, there is usually a marked diminution of wind, during part of the night, and a dispersion of clouds. At such times an eye on an overlooking height may see an extended body of vapour below (rendered visible by the cooling of night) which seems to check the wind.

Lastly, the dryness, or dampness of the air, and its temperature (for the season), should always be considered, with other indications of change or continuance of wind and weather.

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a. It may not be amiss briefly to refer to the explanation of some of these popular prognostics, as given by Sir Humphrey Davy, in his "Salmonia."

One of the speakers in the dialogue, inquiring why the clouds in the west, being red, with a tinge of purple, should portend fair weather, is answered, that the air, when dry, refracts more of the red and heat-making rays than when moist; and as dry air is not perfectly transparent, those rays are reflected in the horizon. It is added, that a halo round the moon is a sure indication of approaching wet weather, since it is produced by precipitated water; the larger the circle is, the

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* Much refraction is a sign of easterly wind.

† Fragments, or pieces (as it were) of rainbows (sometimes called "wind-galls") seen on detached clouds.

nearer are the clouds—consequently, the more ready to descend in rain. In explaining why a rainbow in the morning betokens rain, and one in the evening fair weather, it is stated that the bow can only be seen when the clouds depositing the rain are opposite to the sun; thus, in the morning the bow is in the west, and in the evening in the east; and as the rains in this country are usually brought by westerly winds, a bow in the west indicates that the rain is coming towards the spectator; whereas a bow in the east indicates that the rain is passing away from him. The indications of fine weather from swallows flying high, is explained by stating that the insects on which these birds feed frequent the warm strata of air,—that warm air being lighter than that which is moist, occupies a higher part of the atmosphere, and that therefore the birds then find their prey in the upper regions: on the other hand, when the warm air is near the surface of the earth, the insects and birds are there also.—and then, as the cold air from above descends into it, a deposition of water takes place. The popular belief that sea birds seek the land in order to avoid an approaching storm, is stated to be erroneous,—the probable cause being that the fish upon which the birds prey go deeper into the water during storms, and the birds come to the land merely on account of the greater certainty of finding food there than out at sea.

9. Forecasts of Weather.—British Isles and N.W. Coast of Europe :—The following maxims were among those employed by the *Meteorological Department of the Board of Trade, when under the late* Admiral FitzRoy, in determining the daily forecasts. They are here introduced as likely to be of interest and service to our seafaring readers. It is to be hoped that Meteorologists will both amend and add to this imperfect list, for while "some of these maxims rank among the long-established truths of Meteorological science, others are clearly open to considerable doubt."

I.—*Atmospheric or Air Currents.*

(*a.*) In the Latitudes of the British Isles, and of North-Western Europe generally, there are two, and only two, essentially different atmospheric currents—one S.W., running from the equator towards the pole, and the other N.E., running from the pole towards the equator.

(*b.*) The characteristics of the S.W. current lie not only in its general direction, but in its quality; for it is light, warm, and moist. In other words, its presence is shown by a low barometer, by a high thermometer, and by a small difference between the wet and dry bulb thermometers.

(*c.*) The characteristics of the N.E. current, in a similar way, lie not only in its general direction, but also in its quality, for it is heavy, cold, and dry. In other words, its presence is shown by a high barometer, by a low thermometer, and by a large difference between the wet and dry bulb thermometers.

(*d.*) The weather in this country depends almost wholly on the conflict, combination, alternate preponderance, or alternate succession, of portions of these opposite currents.

(*e.*) Not only is the actual presence of either current shown by its corresponding instrumental tests, but, an approaching change from one current to the other is foretold by the instruments beginning to change their indications. (Hence, as changes of weather must necessarily commence at some places earlier than at others, there is great advantage in receiving by telegraph information of the state of the weather, and of the instruments at many stations.)

(*f.*) When S.W. and N.E. currents alternately prevail, the wind blowing over any station has a strong tendency to "veer," and not to "back." That is to say, the general order of the changes is N.E.S.W.N., and not N.W.S.E.N.

II.—*Weather Changes.*

(*a.*) Gradual changes of weather are shown by a gradual rise or fall of the barometer; for instance, at the rate of one-hundredth of an inch in an hour.

(*b.*) Great differences of temperature at the same, or adjacent places, are followed by changes of weather.

(*c.*) Rapid changes of all kinds commonly presage violent atmospheric commotion.

(*d.*) The result of all rapid changes in the weather, or any of the instrumental indications, is brief in duration; while that of a gradual change is more durable.

III—*Direction and force of Wind.*

(*a.*) The wind usually blows from a region where the barometer is high to one where the barometer is low.

(*b.*) The force of the wind is usually proportionate to the differences of barometric pressure, at adjacent places. In other words, the greater the barometric tension, the stronger the wind.

(*c.*) Strong winds are far more steady in duration than light or moderate winds.

IV.—*Gales or Storms.*

(*a.*) Great storms are frequently preceded by excessive meteorological disturbance; as by heavy falls of rain or snow, by much lightning, by unusual cold, or by excessive heat.

(*b.*) Sea disturbance often precedes gales.

(*c.*) Great storms are usually shown by a fall of the barometer, exceeding one inch in 24 hours, or by a fall of nearly one-tenth of an inch in one hour.

(*d.*) The barometer frequently continues high during a N.E. storm, but there is a fall of the thermometer.

(*e.*) Most of our violent storms travel bodily, in a N.E. direction.

V.—*Calms.*

(*a.*) Calms may be due to either of three different states of weather:—

(1.) The appulse of winds coming together from opposite quarters.

(2.) The divergence of winds going towards opposite quarters.

(3.) The centre of cyclonic storms.

The barometer rises in (1), and sinks in (2).

It is extremely low in (3.)

(*b.*) When the S.W. and N.E. currents intermingle, water is precipitated in the form of cloud, rain, or snow.

10. The Moon's Influence on the Weather.—Sailing directions, as well as popular belief, very commonly attribute *changes of weather to the moon's influence*; any such influence is extremely questionable,—or its extent, at present at least, quite unknown. One thing however is certain,—the so-called "Herschel's Weather Table" is a fiction of the most absurd character, and requires no comment; it was never issued by the authority of either of the illustrious astronomers whose name it bears.

So with regard to all other "predictions" *months, and even a year or more in advance;* the periods of atmospheric disturbance are generally given—according to the phases of the moon and its position in apogee and perigee—for intervals of six or seven days, and are further stated to apply to all parts of the earth's surface; this is a very safe way of stating the case; for, as HUMBOLDT said of earthquakes, "if we could obtain information regarding the daily condition of all the earth's surface, we should probably discover that it was almost always undergoing shocks at some point or another;" so we may with tolerable certainty predict that a gale or considerable atmospheric disturbance is every day taking place at some part or another of so large a superficial area as 197 millions of square miles.

CHAPTER XV.

CURRENTS OF THE NORTH ATLANTIC.

1. Three causes mainly tend to set in motion the waters of the oceanic basins, viz.—1. difference of temperature,—2. evaporation,—and 3. the rotatory motion of the earth; and these causes combined with the influence of the winds, and the trend of the coast-line, produce those numerous currents which preserve a constant circulation—a flow and reflow—of the fluid mass.*

Taking into consideration these various modifying agencies, it is not difficult to understand that some currents must be *warm*, others *cold*;—some are *surface*, others *under* currents,—and of the latter it may be truly said that nothing is known with certainty;—some are *periodical* and *variable*, changing with the periodical winds, now flowing to augment the strength and breadth of the *constant* currents—now tending to oppose, though they cannot counteract them. Further, currents are classed according to their apparent origin, into *drift* and *stream*.† Every constant or very prevalent wind (such, for example, as the Trades) that sweeps the ocean, drives before it the surface water in the form of a *drift* current; impelled to leeward, it moves on until it meets some obstruction, all the while tending to produce an accumulation of *flowing* water which eventually gives rise to a *stream* current. The drift current is generally shallow, and its velocity will depend greatly on the force of the wind and its angle of incidence on the surface: the obstacle opposing its onward progress may be land or a stream current already formed. A *stream* current is the flowing off of the accumulated waters of a drift current in the effort to restore the equilibrium of the general

* A general description of the Currents of the Ocean is given in "The South Atlantic Directory," by W. H. ROSSER.

† A distinction to which attention was first called by Major RENNELL, in his "Investigation of the Currents of the Atlantic Ocean."

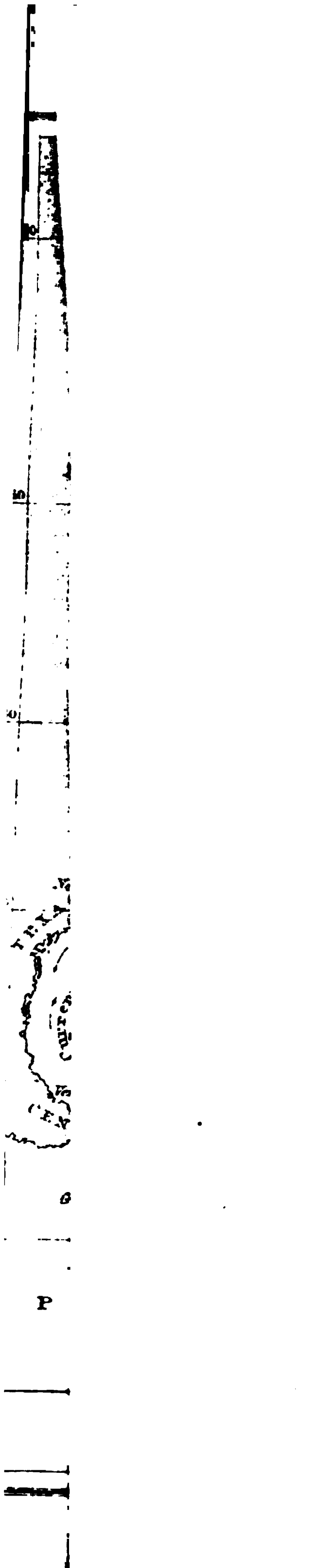
level surface of the ocean, and it may be of any bulk, depth, and velocity. A drift current when opposed by a stream already formed will either fall into and augment the latter, if the angle which its direction makes with that of the stream current be less than a right angle,—or, if it be greater, the drift itself becomes a stream current, and in this case takes a parallel but opposite course to that of the stream by which its progress has been interrupted.

In the North Atlantic the *three* principal currents are the Equatorial, flowing from *East to West*,—the Gulf Stream, the general direction of which is *from S.W. to N.E. and East*—and the Arctic current, the set of which is *from North to South*;—and out of these originate many subordinate as well as counter currents, the direction and rate of which have an important influence on navigation. But before entering into detail, the circulation of the waters of the North Atlantic may be briefly described as follows:—

The equatorial current sets out from near the equator, and close to the African coast; to the south of the islands of St. Thomas and Annabon, it has a speed of 20 or 24 miles in twenty-four hours, and a temperature of 73°. Increasing quickly in bulk, and spreading out more and more on both sides of the equator, it flows rapidly due west towards the coast of South America; in mid-ocean, between the continents of Africa and America, a branch striking off from it towards the north-west, is finally lost in the drift current of the N.E. Trade, about the twentieth degree of latitude.

The main stream continues to run farther west. At the eastern point of South America (Cape San Roque) it divides into two branches. One of these, the southern washes the coast of South America, and between the tropic of Capricorn and the mouth of the La Plata, beyond the limit of the S.E. Trade-wind, turns gradually to the south-east: it may be traced in that direction past the Cape of Good Hope, and far into the Indian Ocean. The northern arm of the Equatorial current follows the north-east coast of South America, gaining continually in temperature under the influence of the tropical sun: its speed has now slightly increased, but it soon falls off again when it gets into the Caribbean Sea; flowing slowly through the whole length of the sea, it reaches the Gulf of Mexico through the Straits of Yucatan, where a part of it, however, sweeps round Cuba; but the main stream nearly follows the coast-curve of the Gulf, and at last, pouring out between Florida and Cuba, takes the name of the Gulf Stream. Narrow at first, the Gulf Stream flows round the peninsula of Florida with a velocity of about 70 miles a day, following the coast in a due north and afterwards in a north-east direction. North of Cape Hatteras it leaves the American coast altogether, keeping its north-eastward course; and, to the south of the St. George's and Newfoundland Banks, it spreads its waters more and more over the Atlantic Ocean, as it stretches towards the Azores. Near these islands a part of it turns south-eastward towards the African coast.

The Gulf-Stream has, so long as its waters are kept together along the American coast, a temperature of 86° Fahr.: but even under north latitude 36°, they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have been found at 74° Fahr. in December, while the sea-water beyond the stream showed only 62° Fahr. Under north latitude 40°—41°, the water is, according to HUMBOLDT, at 72° Fahr. within, and 63° Fahr. without the stream.

A great part of this warm water is carried, partly by its own motion, but chiefly by the prevailing westerly winds, towards the N.W. coast of Europe,* and even beyond Spitzbergen and Nova-Zembla; and thus a part of the heat of the tropics reaches far into the Arctic Ocean;—hence, also, on the north coast of the old continent, the ocean remains free from ice during a great part of the year, even as far up as Lat. 80° N.; while on the opposite coast of Greenland the ice is not quite thawed even in summer. In the two seas that bound this latter peninsula, a current of cold water (the ARCTIC CURRENT) is found running from north to south; this forms the only outflow of water from the Arctic Ocean that can be perceived at the surface. The temperature of this stream at Newfoundland has been found to be 12° below that of the air in May: it brings down in the spring great masses of drift-ice and large icebergs, which are carried from the Polar Sea between Greenland and Spitzbergen, as well as from Baffin's Bay and the coast of Labrador, often nearly as far south as Lat. 40° N.; and which are not melted away till they get into the Gulf-Stream. These conditions are one chief cause of the great difference between the climates of the west coast of Europe and of the east coast of North America, under the same latitudes.

It has been mentioned that a part of the Gulf-Stream, on reaching the Azores takes a southern direction, and turns down towards the African coast: a similar southward movement of the ocean-water is remarked between the coast of Portugal and the Azores; it approaches more and more towards the coast of Africa and about the Cape Verde Islands increases in strength; farther south this current bends with the coast and flows into the Gulf of Guinea, with considerable velocity, from west to east, so that there are two strong currents running near each other in opposite directions. The temperature of the Guinea current is some degrees higher than that of the Equatorial stream, into which the former does not pass till it is turned again by the African coast near the equator.

As a consequence of the set of the waters of the North Atlantic, as seen in the Equatorial current and the Gulf Stream, with their many subordinate branches, there is found, nearly in mid-ocean, an extensive area in which the movement of the surface water, as a current, is reduced to a minimum, and in which there is always more or less sea-weed and drift;—this central area is known as the Sargasso Sea.

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* In the years 1682 and 1684, Esquimaux driven by storms from their own coasts were carried by those easterly currents, in their seal-skin boats, to the Orkney Islands. Tropical seeds and plants are constantly carried by the drift of the Gulf Stream to the north-west shores of Europe.

2. The Atlantic Equatorial Current:—This current commences in about 5½° E., and the island of Annabon (in Lat. 1° 37½′ S.) serves as a sea-mark to show the variability of its position; thus, to the northward and eastward of that island the currents generally flow between north and east, but to the southward of Annabon they fluctuate between N.E. and W.N.W., while to the westward and N.W. of the island the Equatorial current is always found running W.N.W., but with uncertain velocity—generally from 15 to 24 miles in April and June. Gradually extending north and south, ranging between 3½° N. and 5° S., it flows at an average rate of 25 or 30 miles per day, as far as Long. 12° or 14° W. by the side of the Guinea current running in an opposite direction—from west to east—and several degrees warmer than the Equatorial current. Advancing westward with increasing velocity and the while continuing to spread, the Equatorial stream sends off a branch towards the N.W. near the meridian of 20° W., which penetrates to 20° and 25° N. The main stream in its westerly progress becomes wider and wider, and long before it reaches the American side shows its tendency to bifurcate by varying in direction between W.S.W. and W.N.W. Its velocity now is from 45 to 60 miles a day. That body of the stream which has a West and W.N.W. direction, flows towards, and then along the northern shores of Brazil, becomes known as the Guayana current, and passes *slowly* into the Caribbean Sea and Gulf of Mexico. The W.S.W. branch gradually takes a more southerly divergence, and runs parallel with (but at a considerable distance from) the American shores as the Brazil current. From the place where the Equatorial current begins to spread out—with the tendency to bifurcation—the borders have a greater velocity than the central parts.

The average *rate* of this stream may be estimated at 45 miles a day; and taking the mean temperature of its waters, in the middle of the ocean, at 77° Fahr., it increases to the westward and diminishes to the eastward—4° or 6°.

The drift currents from the action of the Trade winds, which tend in the main to produce the Equatorial current, do not, on their outer limits, attain a greater velocity than from 9 to 12 miles in 24 hours.

3. The Guayana Current is a continuation of the Equatorial current running along the low shores of Guayana towards the island of Trinidad, and thence flowing into the Caribbean Sea by the many passages among the Less Antilles. Its *rate* varies, according to the locality, from 10 miles a day near the coast to 40 miles in the strength of the stream, and its *temperature* has been found as high as 80° Fahr.

4. Current of the Caribbean Sea and the Gulf of Mexico:—The Guayana current, together with the drift from the N.E. Trade, flowing through the channels between the Less Antilles, forms in its westerly progress the current of the Caribbean Sea; between Honduras and Yucatan on the S.W. and the islands of Jamaica and Cuba on the N.E., this current takes a W.N.W. and N.W. direction passing through the channel of Yucatan into the Gulf of Mexico, of which it makes the circuit, as follows,—flowing across the Campeche Bank in a westerly direction, it thence bends to the S.W. and takes its course according to the inflexion of the shores as far as Long. 95° W., there it turns sharply to the N.N.E. taking a more and more easterly direction as it advances to the parallel of 25° N., where it becomes E.N.E. and then East, with a tendency south of East as it approaches the channel between Cuba and the Tortugas where it joins that portion of the current from the Caribbean Sea which flows to the N.E. round the west extremity of Cuba, and thus commences the celebrated Gulf Stream.

The main current of the Caribbean Sea gives rise to two counter-currents of considerable importance to navigation;—both of which have an easterly tendency. One of these commencing northward of the parallel of St. Jean de Nicaragua, follows the coast and terminates in the vicinity of Carthagena: the other is in the Bay of Honduras, and flows towards Cape Gracias a Dios; in each case these currents have been found 25 to 35 miles off shore. During the season of the *northers*, southerly currents prevail at times on the Mosquito coast and on the west side of the Bay of Honduras.

On the west side of the Gulf of Mexico, between the river Goazacoalcos and the Bay of Galveston, the current depends on the winds; sometimes they run to the W.N.W. and N.W. with a velocity of 1 or 2 miles an hour; but with northerly winds they run to the South and S.S.E. at the rate of 1 or 1½ miles per hour.

Westward of the S.W. branch of the Mississippi, and thence towards Galveston, a strong westerly current is generally found to the distance of 40 or 50 miles off shore, running W.S.W. and S.W. Eastward of the Mississippi the current usually runs to the E.S.E. and S.E. Near the west coast of Florida the currents like the winds are variable, but their most frequent direction is towards the south.

5. **Currents in the West Indies**:—The Equatorial current makes itself felt (more or less) throughout the West Indies; and as a general rule, there is a north-westerly or westerly set of from half-a-mile to three-quarters of a mile an hour among the islands of the Bahama group: this set is occasionally stronger or weaker, according to the varying force of the Trade wind; in the neighbourhood of Conception Isle it is said generally to run strong to the N.W. Some observations tend to show that after Northers, or on the increase of the moon, the current sets to the north-east; and on the decrease of the moon as it approaches to change, there is a similar set to the south-west. There is, however, no certainty in the case, and consequently, more than ordinary attention is required when navigating among the West India Islands; the seaman, therefore, should not fail to take advantage of every opportunity of determining the ship's position at night by observations of stars, to the north and south for latitude, and to the east and west for time. This mode of observing would generally compensate for a dull or indistinct horizon, and with practice would give a result within about 8 miles of the truth.

Kerhallet gives the following Table (derived from numerous observations) as showing how variable are the set and direction of the currents among the Less Antilles:—

Place.	The Part of the Channel or Island.	Current. Direction.	Current. Rate in 24h.	Remarks.
Channel between Trinidad and Tobago	Middle	W.	48m.	Sometimes N.W. by W. 72m. with the flood tide.
	South	W.N.W.	48	
	North	W.S.W.	48	
Tobago	N.E.	N.W. and N.N.W.	40	
	S.E.	N.W. and W.N.W.	24	
	E. side offing	W. by S.	43	
	W. side offing	S.W. by W.	12	
	N.	W. by S.	..	
Channel between Trinidad and Grenada	Middle	W.	24	
	N.	W. by S. to W.	24	
	S.	W.N.W. and W. by S.	29	
Grenada	W.	W.S.W.	29	
	S.E.	W. by S.	24	
	N.	W.N.W.	28	Between Grenada and the Grenadines
The Grenadines	Long. 60¼°	N.N.W.	40	Sometimes N.N.W. 69m. Among the Grenadines the current is W.N.W. and N.W. by W. 10m. It is strongest (22m.) between Grenada and Cariacou.
	S.E. of the group	W. by S.	10	
	N.E.	N. and N.N.E.	33	
	W.	N.W.	16	
St. Vincent	S.	W.N.W.	12	To the westward of the island the current is W. 19m.
	N.E.	N.W.	33	
Channel between St Vincent and Barbados	Middle, S.	N.N.E.	33	
	Middle, N.	N.W.	18	
Barbados	E.	W.	..	
	S.E.	W.	..	
	W.	W.S.W.	..	
	N.	W. by S.	..	Sometimes S. by E.
Channel between St. Vincent & St. Lucia	Middle	W.	30	Sometimes 72m. in May.
St. Lucia	S.W.	N.W., W.S.W. & S.W.	33	Some distance to the westward of the Island the current is W. 19m.
	N.W.	S.W.	10	
	E.	N.W. and N.W. by W.	18	
Eastern entrance of the Channel between St. Lucia & Martinique.	Middle	N., N. by E., & N.N.W.	20	Sometimes to N.N.E. 48m. in May.
	S.	N.W. by W.	18	
	N.	N. and N. by E.	28	Running along the E. coast of Martinique.
Western entrance of the Channel between St. Lucia & Martinique.		N., N.W., and N.N.W.	19	Generally very variable.

Place.	The Part of the Channel or Island.	Current. Direction.	Current. Rate in 24h.	Remarks.
Martinique	W.	N.W.	30	
	S.E. (offing)	W.N.W.	35	
	E. (offing)	W.	10	
Channel between Martinique & Dominica	E. entrance	W.	10	
	W. entrance	N.W. and N.N.W.	9	In the offing W. by S.
Dominica	W.	N.N.W.	31	
	S.E.	W. by S.	..	
	N.E.	W. by N.	35	
Channel between Dominica and Marie-Galante	Middle	W.	35	
	S.	W.N.W. and W. by N.	35	
	N.	W. by S.	35	
Channel formed by Desirada and Guadaloupe on the N., and Petite Terre, Marie Galante and Les Saintes on the S.	Middle	W. by S. and W.S.W.	20	Sometimes W.N.W. and W. by N.
Channel between Dominica & Guadaloupe.	Middle	W. by S. and W.S.W.	14	
Guadaloupe	S.W.	N.W.	15	
	N.W.	N.E.	21	
	E.	W.	11	
Channel between Guadaloupe and Montserrat.	Middle	W.	18	
Channel between Montserrat and Antigua.	Middle	N. and W.N.W.	..	
Channel between Guadaloupe and Antigua.	Middle	W. and W.S.W.	18	
Channel between Antigua and Barbuda.	Middle	N.W.	..	
Channel between Barbuda on the E. and Nevis and St. Kits on the W.	Middle	N.W.	..	Towards St. Kits the current sometimes runs S.S.E. 15m.
Channel between Montserrat and Nevis	Middle	W. and W.S.W.	18	
Channel between St. Kits and St. Eustace	Middle	W.	..	
Channel between St. Eustace and Saba	Middle	N. by W.	21	
Saba Isle	To the Westward	W. by S.	..	
Channel betwen St. Eustace and St. Bartholomew	Middle	N.W. to N.E.	36	
St. Bartholomew	W.	N.N.W.	..	
Channel between St. Bartholomew and St. Martin	Middle	N.E.	36	This is the result of a single observation, and is most probably exceptional.
Channel between St. Bartholomew and Saba	E.	N.N.W.	24	

Place.	The Part of the Channel or Island.	Current.		Remarks.
		Direction.	Rate in 24h.	
Channel between Anguilla and Sombrero	Middle	W.	15	
Channel between Sombrero and Anegada	Middle S.	S.W. N.W. by W.	16	With N.E. winds the current at sea is generally westerly. With S.E. winds, near the Anegada the current is N.W.
Channel between Anguilla, St. Martin, and St. Eustace on the one hand, and the Virgin Islands on the other	Middle W. E.	N.W. W. W. by S.	24 22 17	But generally very variable in mid-channel.
Channel between St. Eustace and St. Cruz	Middle	W.	17	
Channel between St. Cruz and the Virgin Isles	Middle	S.W. by W. & W.S.W.	12	
To the northward of the Virgin Isles . .	Offing	W. and W.S.W.	8	

Between Barbados and Trinidad, on the meridian of the former island, the current runs N.W. and N.N.W. often at the rate of 58 miles in the 24 hours,—rarely it may attain the velocity of 65 or 70 miles. Between the parallels of Martinique and Dominica, and near those islands, a N.W. current is not uncommon.

To the *eastward* of the Less Antilles, and between the parallels of St. Lucia and Anguilla, the current runs W.S.W. and W. from 10 to 12 miles a day. Between the parallels of Anguilla and Anegada, it is W. about 11 miles. To the *westward* of the Less Antilles the current is West, variable between W.S.W. and W.N.W., at the rate of 13 or 14 miles.

Both north and south of Puerto Rico and Haïti the general tendency of the current is to the westward,—but stronger on the south than on the north side; between the two islands it often sets with great strength to the N.W. Between Haïti and Cuba the current is generally towards the S.W., the velocity being greatly accelerated during the season of the *Northers*.

The current is generally to the westward around Jamaica, but easterly currents have been reported after *Northers*.

6. **The Gulf Stream** has its origin in the heated water of the Gulf of Mexico, which flowing towards the strait separating Cuba from the Tortugas Bank and the Florida Reefs, is there joined by a portion of the current of the Caribbean Sea that turns abruptly to the N.E.-ward along the Colorado Reefs

(W. side of Cuba). Running, at first, to the eastward its direction becomes north when it encounters the Bahama Bank, after which it pursues its course along the coast of Florida, bending to the north-eastward in Lat. 31° N., and so continues to Cape Hatteras; here, from the recession of the coast-line, the direction of the stream becomes again more northerly, but spreading out wider and wider as it advances, until off the shoals of St. George and Nantucket, it flows to the eastward. As it passes over the southern extremity of the great Bank of Newfoundland, its course is still a little north of east, and it preserves this direction (between the parallels of 38° and 43° N.) as far as Long. 38° W.; there it sends off a branch towards Iceland, the Færoe Isles, and to the west shores of Northern Europe, while the larger part is diverted to the south, and south-eastward in the vicinity of the Azores.

The velocity of the Gulf Stream is not great between Cuba and the Florida Reefs, (from 24 to 60 miles a day); it acquires increased speed as it advances, being 60 to 100 miles a day on the parallel of Bemini Island (Lat. 35¾° N.), and as much as 120 miles off Cape Canaveral; thence, as it spreads out, its velocity diminishes until—on the meridian of 65° W. it is about 55 miles, on that of 42° W. about 33 miles, and to the westward of the Azores it is about 10 miles a day.

The mean temperature of the Gulf Stream is about 86° Fahr., or 9 degrees higher than that of the ocean on the same parallel; but though this diminishes rapidly in its north-easterly progress, it is still higher than that of the waters among which it makes its way. At the end of August, and beginning of September, the Gulf Stream acquires its greatest velocity, and has its highest temperature; its minimum of rate and temperature occurs in February.

7. **An Arctic Current** originates in the frozen regions near the North Pole and flows along the east coast of Greenland towards Cape Farewell; there a portion of it continues its progress southward towards Newfoundland, while a large part passes round the cape and proceeds northward along the west coast of Greenland, and unites with the current flowing from the polar seas through Davis Strait. The Davis Strait current runs southward, and being augmented in its course by the Hudson's Bay current, these cold polar waters coast the shores of Labrador, and pass into the strait of Belle Isle, and thence into the Gulf of St. Lawrence on the one hand, and on the other they flow along the N.E. coast of Newfoundland towards and over the Banks, finally uniting with the Arctic current which has descended from the east coast of Greenland; continuing their southerly course they meet the Gulf Stream, when a considerable branch of this arctic or polar current bends towards the west, along the southern shores of Newfoundland; then to the S.W. along the shores of Cape Breton Island, Nova Scotia, and towards Nantucket Island, and thence along the east coast of the United States, forming what is called the "cold wall" of the Gulf Stream; at the same time, a large portion of this current must pass to the southward as an

under current, beneath the waters of the Gulf Stream, as is shown by the temperature of the water at different depths in the Atlantic, from the observations made by the U.S. Coast Survey officers, when employed in defining the varying limits of the Gulf Stream.

8. **The Arctic Current and the Gulf Stream.**—It has been observed above that the Arctic current flows along the coast of the United States—between it and the Gulf Stream, to which it is a natural boundary—and as such is known to navigators as the "cold wall;" but this cold polar current also *underlies* the Gulf Stream, and as the sea-bottom is irregular and uneven (like the surface of the land above the oceanic level—here rising into hills and there descending into valleys), these undulations of the bed of the ocean, over which the cold current is moving, cause the waters of the two currents to become (to a certain extent) intermingled, and as a consequence, the Gulf Stream is composed of alternate bands of hot or warm and cool or cold water, the most distinct of which is that containing the *axis* of the Gulf Stream. As an instance of this it appears, from the United States Coast Survey reports, that off Sandy Hook the whole space from the shore to 240 miles seaward is occupied with comparatively cold water—here is the "cold wall"—next comes the hot water of the Gulf Stream rising to a maximum temperature of 82°, then falling to a minimum of 80°, rising to a second maximum of 81½°, falling to a second minimum of 78°, and rising from this to a third maximum. Navigators have noticed these changes of temperature, and have supposed themselves at each occurrence of warmer water to be in the hottest portion of the stream, and so have been greatly embarrassed, deeming the phenomena and limits of the Gulf Stream to be very irregular. The following Table shows the *distance of the "cold wall" from the shore, and the width of the several bands of cold and warm water of the Gulf Stream*:—

Names of Sections.	Distance of cold wall from shore, in miles.	Width of first max. or warm band.	Width of second min. or cold band.	Width of second max.	Width of Gulf Stream proper.	Width of third min. or cool band.	Width of third max. or warm band.	Width of fourth min. or cold band.
Sandy Hook	240	60	30	37	127	60	50	Indef.
Cape May	125	55	30	40	125	70	65	70
Cape Henry	95	45	32	47	124	80	60	50
Cape Hatteras . . .	30	47	25	45	117	37	75	70
Cape Fear	60	30	20	37	87	30	60	25
Charleston	62	25	15	30	67	26	35	...
St. Simon	87	25	13	20	58	25	25	...
St. Augustine . . .	70	20	13	12	47	22	20	...
Cape Canaveral . .	35	20	...	...	35	14	12	...
Cape Florida . . .	10	25	...	...	25	5	...	...

This Table shows that the cold wall is nearest to the coast at Cape Florida and Cape Hatteras: the distance of the axis of the stream from its coast will be found by adding half the numbers in the second column to those in the first column,—thus, 240 + 30 = 270 miles, is the distance of the axis of the Gulf Stream from Sandy Hook.

The Table also shows a width in the Gulf Stream proper, along the Atlantic coast, of from 25 miles off Cape Florida to 127 miles off Sandy Hook. The warm water at, say fifteen fathoms, varies from 30 to 150 miles in width: the stream widens each way from Cape Florida; but the several divisions of the Atlantic stream, as shown in the Table, lose a portion of their distinctness on passing northward and eastward, as the stream widens.

The form of the sea bottom as found by sounding off Charleston and Cape Florida is remarkable, and applies to the sections between them as far as explored;—first, there is a gentle slope; then a sudden descent; a second steep pitch to a considerable depth; a range of hills; a valley, and a second range. The correspondence of these features with the bands of temperature as shown by the table is plainly marked;—the cold water lies in the valleys, and passing along the bottom rises upon the tops of the hills. The discovery of this range of hills was made at nearly the same time, by Lieut. Maffitt on the Charleston section, and by Lieut. Craven on the St. Simon's section. The figure of the bottom of the Strait of Florida shows why there are no bands formed prior to passing Cape Florida; in other words, why the regimen of the stream is different in the straits from what it is in the Atlantic. In the strait, after leaving the United States shore and the comparatively flat surface extending to the reef, there is a rapid descent towards the Cuban side of the Strait, the axis of the Gulf Stream being found in the deep hollow of that side of the strait. It would seem from the configuration of the bottom that the cold stream at the bottom of the Strait of Florida divides, one portion passing to the north and west into the Gulf of Mexico, and the other passing around the western end of the Island of Cuba: that the polar stream still occupies the bottom of the strait is shown by the temperature of 35° Fahr. being reached at 600 fathoms from the surface off Havana.

It has also been found that, off the coast of the United States, the cold water between the Gulf Stream and the shore has bands of varying temperature, but less regular than those in the Gulf Stream itself; thus, off Sandy Hook there are two well-marked maxima and two minima, of which one seems to correspond in position to the sudden deepening of the water 100 miles from that place.

9. Numerous observations made by the regular traders and others in the Florida Strait show that there is a south-westerly current prevailing, more or less, between the easterly Gulf Stream and the Florida Reefs. Such a counter, or eddy current, is definitely indicated on Jeffrey's map of 1794, by a dotted line, above which is written, "*North of this line is a current setting south-westward) unless when the wind is at north, or east, which winds admit of no south-*

west;" and, "*South of this line the current of the Florida Stream sets always northwardly.*" Lieut. Hunt of the U.S. Coast Survey, says also that "there is enough westerly current in the Gulf of Florida to be of vast importance to navigation, if its movements can be defined,—and to constitute a great danger, if it is not known. I am also quite persuaded, not only from actual testimonies, but from the fact that a coral bank extends above Cape Catoche, that at least a large part of the Gulf Stream turns to the north-east around the west end of Cuba, instead of making the circuit of the Gulf of Mexico; the effect of the earth's rotation, and its own inertia, on the current coming north of the Caribbean Sea, would be to give it an eastward bend. It is also quite incompatible with the tendency of the westerly current to expand towards Tortugas, to suppose that the main Gulf Stream comes sweeping in from near the mouth of the Mississippi towards this point."

Captain Richardson, pilot of the Coast Survey surveying steamer, *Corwin*, says, in substance:—The westerly current appears irregularly chiefly in the winter, but sometimes during the prevalence of the regular trades. It extends from ten to fifteen miles off from Sand Cay, sometimes running as much as two miles an hour. It never prevails over the reef proper. It sets for two months or so, some winters. It spreads farther from the reef as it goes west. Has known it as far north as Carysfort, just outside the reef,—and at Cape Florida even, where the reef is narrow and deep, this current sometimes sets across it some two miles from shore, but is not very frequently found there. As it runs west it seems to increase in breadth. Off Indian Cay he has known it to extend seven miles from the edge of the reef; at Bahia Honda it is sometimes ten miles, and at Sand Cay, from ten to fifteen miles. In some winters there was very little of this current. In crossing from Cay West to Havana the Gulf Stream runs much stronger on the Cuban side. A few navigators know this westerly current, and use it with great advantage when bound west.

Captain Wilson, who for several years ran the vessel serving Fort Jefferson, on Tortugas, as a mail boat to and from Cay West, thinks that this westerly current sometimes extends half-way across to Cuba. But that it mainly disappears during the prevalence of the regular summer trades.

10. In reference to the Approaches to Cape Race, and the *currents* and *soundings* off that headland, the following information has been communicated by Captain J. Orlebar, R.N.:—Although the current between the Grand Bank and Newfoundland commonly sets to the W.S.W., sometimes at the rate of nearly one mile per hour, it is not always so; and near the shore, in moderate weather it even changes with the tide. At these times, during the flood it runs to the S.W., and during the ebb to the N.E., the former being the stronger. Westward of Cape Race it must also be remembered that, the current so frequently setting to the N.W. one mile per hour in the offing, is not invariable in strength or direction, but is affected greatly by the prevailing wind. It is observed generally to run in upon the eastern side of the great bays indenting the south coast of Newfoundland, and out on their western side. In the offing it is influenced by the winds, and near the shore it is also altered and influenced by the tides; so that during spring tides the stream of ebb runs weakly to the S.E., and the stream of flood to the N.W.; the latter sometimes two miles per hour round the headlands.

11. **The North African or Guinea Current**:—It is, well-known that the whole body of water between Cape Finisterre and the Azores is in motion to the south and south-east, the western part running more southerly, and the eastern, lying towards the continent of Europe, more easterly. As far as the parallel of Cape St. Vincent, it runs half-a-mile per hour, and then southward about three-fourths of a mile. To the south of Cape St. Vincent, the coasts of Europe and Africa form as it were the pipe of a funnel; and here it is observed that the whole body of water between the above-named cape and Cape Cantin on the African Coast, and as far westward as the 20th meridian, sets towards the Strait of Gibraltar, probably to supply the deficiency of the water caused in that close sea by the evaporation produced by its higher temperature, which is 5° or 6° above that of the ocean under the same Latitude. From Cape Cantin to Cape Bojador (26° 7′ N. Lat.), the motion of the sea, for a distance of more than 300 nautical miles from the land, points nearly towards the shore; and the same direction is observed to Cape Blanco, five degrees farther south, but in the latter space it extends only from 150 to 180 miles from the land. This current along the coast of the Sahara, united to the westerly wind which continually blows in this sea, renders it extremely dangerous to the unwary navigator, and has been the cause of numerous shipwrecks. From Cape Blanco to Cape Verde, the current along the coast sets somewhat to the west of south, and identifies itself with the drift-current of the trade-winds; but it does not mingle with it, as is indicated by the lower temperature of its water, which near the Cape Verde Islands is 8° lower than that of the ocean moved by the drift-current. At the Cape Verde Islands it turns slowly round towards the south, and afterwards towards the S.E. and E.S.E., influenced by the form of the coast of Africa. Between Cape Verde and Cape Mesurada, the distance of the current from the shore is about 150 nautical miles, and this space is occupied by periodical currents. Having passed Cape Mesurada, the current sets due east, and runs here with increased rapidity, sometimes at the rate of 2 miles per hour. It ranges along the coast of Guinea until it is partly dissipated in the sea opposite the mouth of the Quorra, between the Bights of Benin and of Biafra, and partly stopped ahead by the Equatorial current. The Guinea current extends along these coasts, at a mean, about 180 miles, or 3° degrees in breadth; and its greatest velocity is during the season of the S.W. winds (from June to September) in the sea lying west of Sierra Leone and south of the Cape Verde Islands. Its temperature is lower than that of the ocean by several degrees as far as the Cape

Verde Islands, where the difference sometimes, as we have already observed, amounts to 8°; but to the south of these islands it receives a large accession of water from the westward, by which its temperature is considerably raised.

12. A portion of the waters of the Gulf Stream mingling with the Arctic current, and drifted by the agency of westerly winds, flows towards Cape Finisterre and the Bay of Biscay: off that Cape it is divided into two branches, one of which is known as Rennel's Current, and the other as the Portugal Current, each of which has a considerable influence on the navigation of that part of the Atlantic.

13. Rennel's Current flows along the north coast of Spain, then proceeds north along the west coast of France, where it is felt at 30 or 40 miles off shore, and is from 15 to 20 miles across; and running at the rate of from one-half to two-thirds of a mile per hour. It varies according to the strength of the wind and its direction. It is sometimes found to flow at the rate of a mile an hour, and to this current is attributed the loss of many vessels in the English Channel. It becomes wider as it proceeds northward; in the Latitude of Brest it is 80 miles across, and its direction nearly N.W. It issues from the Bay of Biscay, passes west of Ouessant at 15 or 20 miles from that island, crosses the entrance of the English channel, and takes a westerly direction from the Scilly Isles. At the entrance of the Irish Sea it discharges a small branch into that sea,—the principal branch flowing W.N.W. and West, towards Cape Clear, and losing itself, near the meridian of 18° W. Long., in the polar current flowing towards Northern Africa.

14. The Portugal Current, from off Cape Finisterre, flows towards the S.S.E. and S.E., making at times a very near approach to the coast, and finally passing round Cape St. Vincent, it joins the waters of that part of the North African current which enters the Mediterranean by the Straits of Gibraltar. The *velocity* of the Portugal current has been found from 12 to 24 miles a day; but it is variable according to the prevalent winds—their strength and duration; and on this account, when near the coast it must be guarded against, especially in the winter or with strong N.W. winds. The same remarks apply to the current of the Bay of Biscay, and to Rennel's current. They are strong with a continuance of west winds (changing from N.W. to S.W.), especially when they have blown with force.

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15. Currents in the Vicinity of the Roccas Reef.

(*a*) It was given in evidence by Captain Selwyn at the inquiry into the loss of the *Duncan Dunbar* that—"in making the survey (of the Roccas) I examined the books usually found on board a man-of-war, describing the currents; I found them described as strong westerly currents: I tested the truth of this description myself and established the opposite fact. The currents, instead of setting to the westward during the month of November that I was there, set strongly to the southward in the immediate vicinity of the rock. I tested it 10 or 15 miles north and west of the island and found it took a *southerly direction, with a tendency towards the east.*" In a correspondence that subsequently ensued the southerly current is continually spoken of, but without reference to easting or westing.

Now, the question to be answered is—*What direction do the currents take in the vicinity of the Roccas?*—north, south, east, and west of that reef—but especially to the north of it?—and our task would have been comparatively short and easy had not Captain Trivett in a letter on the subject introduced the observations made on board the Hon. Hudson's Bay Co's ship *Princess Royal* on nine outward and homeward passages, which has necessitated the production of observations made on board *other* vessels of the Mercantile Marine. But here we cannot refrain from remarking that the log-book on board merchant vessels is *very rarely* kept with the precision due to a record supposed to have a scientific value; and consequently the currents, deduced from the difference between Obs. and D.R., must partake of the errors of the documents whence they are derived; indeed, it is probably not going too far to say that *no* vessels, except those especially equipped for surveying purposes, can correctly determine the currents in the region of variables, for, where calms, light airs, and strong puffs alternately prevail, the rate of a vessel's progress through the water, independently of her having at times no steerage way, can be but imperfectly recorded;* the ordinary log and reel, under such circumstances is not more valuable than guessing the distance run on each course; but the *patent log*—which is not often found on board our merchant sailing ships—would be of essential service; Lieutenant Lee in his survey of the Roccas has these remarks on the subject,—"the reckoning was carefully made up at noon from the run both by patent log and common log. The daily difference was sometimes as much as 11 miles, though the judgement of the officer of the deck (who always hove the log) was insensibly influenced by habitual comparison with the patent log. The average daily difference was 3 or 4 miles. The patent log sometimes showed least, but generally most run; agreed closest with the measurements by astronomical observations, and was always adopted. More attention should be paid to this important instrument;" and Captain Toynbee in one of his papers bears similar testimony to the value of this instrument.

We now proceed to give the records; and shall then close this part of our subject with a *general summary*—on the currents in the middle and on the

* The correctness of this assertion cannot be better illustrated than by the following record:—The vessels of the U.S. Exploring Expedition sailed from Porto Praya in October; all crossed the line near the same spot and all were bound for Rio, yet "the set by current of the squadron from Porto Praya to the Line, in 24° days, was N. 25° E. 132 miles; the *Peacock* experienced it N. 56° E. 144 miles in 23 days; and the *Relief* N. 48° E. 203 miles in 25 days." The N.E. Trade-wind was lost in 12¼° N. and 24° W.—after which the winds prevailed from S.S.W. to S.S.E., generally light inclining to calm.

western side of the Atlantic Ocean between Lat. 15° N. and 20° S.—*especially referring to the vicinity of the Roccas.*

In the first place we give the observations of Lieutenant LEE, because they are the most important—as being connected with the survey of the vicinity of the Roccas.

(*b*) In the progress of his surveying voyage he arrived, February 19th, in Lat. 1° 42′ S., Long. 24° 39′ W.; thence to Lat. 3° 36′ S., Long. 31° 45′ W. (his position February 23rd), the surface current, by ship's reckoning had set between N. 76° W. and N. 83° W. at the mean rate of 1·3 knots per hour, by observations from boat, between West and N.W. by W. at the mean rate of 1·2 knots,—the under current at the depth of 10 fathoms setting West to N.W. by W. 1·4 knots.

The winds recorded are,—S. once; S. by E. 6 times; S.S.E. 9 times; S.E. by S. once; and S.E. by E. twice.

From February 24th to 27th, the *Dolphin* was anchored at Fernando Noronha, and from 17 observations on the wind, S.E. is recorded 7 times, and E.S.E. 8 times; the remainder being *equally divided* between those from more southerly and more easterly. "Observed by heaving the log hourly that the greatest set of tide in the roadstead was $\frac{6}{10}$ of a knot westerly."

February 28th, in Lat. 4° 35′ S., Long. 32° 44′ W.; the surface current (from boat) was W. by N. 1·2 knots, the under current the same.

March 1st, in Lat. 8° S., Long. 34° 25′ W.; surface current (from boat) S.S.W. 0·6 knot, the under current S.S.E. 0·7 knot.

The winds in the 3 days had varied from S.E. to E. by S.

From March 2nd to 7th, at anchor in Pernambuco roads,—the wind during the stay being from S.E. to E.S.E.

March 8th.—Lat. 7° 14′ S., Long. 34° 17′ W.; surface current N. 55° W. 0·6 knot; wind S.E. to E.S.E.

March 9th.—Lat. 6° 15½′ S., Long. 33° 24′ W.; surface current N.W. by N. 0·3 knot; under current the same; wind S.E.

March 10th.—Lat. 4° 35′ S., Long. 32° 23′ W.; surface current West, 1·1 knots: under current S.W. by W. 1 knot; wind S.E. by S. to S.E. by E. at 8 P.M., in Lat. 4° 43½′ S., Long. 32° 48′ W., no bottom with 1250 fathoms of line.

March 11th.—Lat. 3° 56¾′ S., Long. 32° 19′ W.; surface current West, 1·3 knots; wind S.E. and S.E. by E.

March 12th.—At anchor at Fernando Noronha; wind S.S.E. and E.S.E.

March 13th.—Lat. 3° 51¾′ S., Long. 33° 2½′ W.; surface current N.W. 0·5 knot; under current W.N.W. 0·5 knot; wind S.E. by E.; bottom at 2150 fathoms.

March 14th.—Lat. 3° 35¾′ S., Long. 33° 26¾′ W. surface current N. 60° W. 1 knot; wind S.E.

March 15th.—At anchor off Las Roccas; wind S.E. by S. to E.S.E.

March 16th.—At anchor; wind S.S.E. to E.S.E.

March 17th.—Lat. 3° 53′ S., Long. 33° 52′ W.; winds S.E. to E. by S.

March 18th.—Lat. 3° 51° S., Long. 33° 56′ W.; surface current S. 85° W. 1·5 knots; wind E.S.E.

March 19th.—Lat. 3° 24½′ S., Long. 33° 49½′ W.; surface current S. 78° W. 1·5 knots; winds S.E. to E.S.E.

March 20th.—Lat. 2° 46½′ S., Long. 33° 22′ W.; surface current S. 78° W. 1·5 knots; winds S.E. by S. to E. by S.

March 21st.—Lat. 3° 28½′ S., Long. 33° 18′ W.; surface current N. 84° W. 1 knot; winds S.E. to E. by N.

March 22nd.—Lat. 3° 30¾′ S., Long. 33° 31′ W.; surface current W. by N. 1·4 knots; under current W. by N. 1·4 knots; no bottom at 1000 fathoms; wind S.E.

March 23rd.—Lat. 3° 30′ S., Long. 33° 48½′ W.; surface current N. 75° W. 1·3 knots.

March 24th.—Lat. 3° 46′ S., Long. 33° 42½′ W.; surface current N. 71° W. 0.9 knot.

March 25th.—Lat. 4° 0½′ S., Long. 33° 40¾′ W.; surface current W. by N. 1·1 knots; no bottom at 1000 fathoms.

March 26th.—Lat. 3° 59′ S., Long. 33° 58′ W.; surface current N. 75° W. 1·2 knots.

March 27th.—Lat. 3° 49′ S., Long. 33° 52½′ W.; surface current N.W. 0·9 knot; under current N.W. 1 knot; no bottom at 500 fathoms.

March 28th.—Lat. 4° 11½′ S., Long. 34° 38° W.; surface current N. 50° W. 1 knot; under current N.W. 1·4 knots.

March 29th.—Lat. 4° 30′ S., Long. 35° 3′ W.; surface current N. 61° W. 1·3 knots; thence the route was along the north coast of Brazil.

[Seven of these observations, viz., March 19th, 20th, 21st, 22nd, 23rd, 24th, and 27th were immediately to northward of Las Roccas, and give the mean direction of the surface current N. 80° W.; the subsequent observations to south and west of the reef give a surface current of N. 58° W.]

March 30th.—6h. A.M.; Lat. 4° 26′ S., Long. 25° 9′ W.; surface current (by boat) South, 2 knots; no bottom at 1000 fathoms; noon, Lat. 4° 21½′ S., Long. 35° 17′ W.; surface current N. 88° W. 1·7 knots.

March 31st.—Lat. 4° 17′ S., Long. 35° 19½′ W.; surface current N. 77° W. 0·9 knot; at 3 P.M., Lat. 4° 17½′ S., Long. 35° 20½′ W.; surface current (by boat) S.E. 1·4 knots; under currents S.E. 1·2 knots; no bottom at 1000 fathoms.

April 1st.—Lat. 3° 34½′ S., Long. 35° 38½′ W.; surface current N. 67° W. 0·8 knot; at 3 P.M., Lat. 3° 18′ S., Long. 35° 45′ W.; surface current (by boat) W. by S. 0·9 knot.

April 2nd.—6 A.M., Lat. 2° 33′ S., Long. 36° 36½. W.; surface current (by boat) W.N.W. 1 knot; under current N.W.;—noon, Lat. 2° 27′ S., Long. 36° 46′ W.; surface current S. 87° W. 1 knot.

The remarks for March 30th are:—" The difference between the observations (which were many and good) and reckoning, which was necessarily uncertain in such weather, showed a current of 1¾ knots per hour, setting West: if the observations made in the boat were correct, we were probably in an eddy, or influenced by tide; * the brig's position at this time was about 25 miles N.E. of bottom at 25 fathoms on the flats of San Roque."

The remarks for March 31st are:—" The surface current from five agreeing trials set S.E. ½ S.; when these observations were made the sea was glassy smooth, with a long swell from N.N.E.; the reckoning and observations to-day show a current of 1 knot per hour Westerly, whilst the drift of the brig from the sounding boat and current observations of the boat indicate a considerable current to southward.

" We were three days within from 20 to 30 miles north of the flats of San Roque, off cape Touro; the current between the Roccas and the main sets generally *from* the Southward and Eastward, from 1 to 1½ knots, *until near the flats*, where we experienced indications of a counter current of tide."

(*c*) From the log of the Honourable Hudson's Bay Co's ship *Princess Royal*;—

Sept. 28th, 1856.—Lat. 3° 43′ S., Long. 29° 21′ W.; current S. 55° W. 9 miles. (Captain Trivett).

May 31st, 1857.—Lat. 1° 56′ S., Long. 30° 59′ W.; current N. 70° W. 27 miles. (Captain Trivett).

October 21st, 1857.—Lat. 4° 18′ S., Long. 32° 58′ W.; current none (Captain Trivett).

July 3rd, 1858.—Lat. 3° 10′ S., Long. 26° 29′ W.; current S. 55° W. 22 miles. (Captain Trivett).

October 26th, 1858.—Lat. 3° 47′ S., Long. 32° 46′ W.; current S. 38° W. 34 miles, (Captain Sinclair).

June 19th, 1859.—Lat. 3° 46′ S., Long. 32° 28′ W.; current S. 54° W. 44 miles. (Captain Sinclair).

June 20th, 1859.—Lat. 1° 21′ S., Long. 33° 6′ W.; current S. 47° W. 23 miles. (Captain Sinclair).

Nov. 10th, 1859.—Lat. 3° 42′ S., Long. 33° 6′ W.; current N. 78° W. 18 miles. (Captain Trivett).

June 7th, 1860. —Lat. 1° 8′ S., Long. 29° 1′ W.; current S. 14° W. 12 miles. (Captain Trivett).

October 21st. 1860.—Lat. 3° 15′ S., Long. 29° 46′ W.; current S. 50° E. 8 miles. (Captain Trivett).

May 24th, 1861.—Lat. 4° 49′ S., Long. 33° 42′ W.; current N. 74° W. 11 miles. (Captain Trivett).

May 25th, 1861.—Lat. 1° 41′ S., Long. 34° 20′ W.; current S. 9 miles. (Captain Trivett.)

* The flood sets to the westward, the ebb to the eastward.

October 13th, 1861.—Lat. 4° 44′ S., Long. 30° 47′ W.; current S. 11° W. 4 miles. (Captain Kingcome).

May 26th, 1862.—Lat. 3° 9′ S., Long. 31° 14′ W.; current N. 37° W. 6 miles. (Captain Kingcome).

October 14th, 1862.—Lat. 3° 45′ S., Long. 33° 53′ W.; current S. 53° W. 24 miles. (Captain Kingcome).

May 13th, 1863.—Lat. 2° 47′ S., Long. 32° 9′ W.; current N. 79° W. 37 miles. (Captain Kingcome).

October 15th, 1863.—Lat. 2° 14′ S., Long. 30° 22′ W.; current S. 12° E. 19 miles. (Captain Kingcome).

October 16th, 1163.—Lat. 4° 45′ S., Long. 31° 13′ W.; current N. 16° E. 14 miles. (Captain Kingcome).

May 23rd, 1864.—Lat. 4° 6′ S., Long. 28° 45′ W.; current S. 74° W. 39 miles. (Captain Kingcome).

May 24th, 1864.—Lat. 1° 1′ S., Long. 28° 45′ W.; current N. 74° W. 37 miles. (Captain Kingcome).

October 27th, 1864.—Lat. 4° 0′ S., Long. 30° 54′ W.; current W. 6·6 miles. (Captain Marshall).

May 28th, 1865.—Lat. 4° 45′ S., Long. 27° 16′ W.; current N. 41° W. 20 miles. (Captain Marshall).

May 29th, 1865.—Lat. 1° 31′ S., Long. 27° 19′ W.; current W. 23 miles. (Captain Marshall).

(*d*) The U.S. Exploring Expedition, under Captain Wilkes, spent a fortnight in the vicinity of the Equator (October-November, 1838), searching for reported shoals, after which it sailed for Rio. "From the Equator to Lat. 3° S., the set by the Equatorial stream was S. 69° W., 75 miles; while from Lat. 3° S., Long. 20° W. to Lat. 13° S., Long. 30° W. its set was N. 80° W., 100 miles; thence to the latitude of cape Frio it was to the southward and westward. The greatest set we experienced between Lat. 10° N. and 13° S. was on the meridian of 26° 30′ W., 30 miles a day, nearly West.

(*e*) Extract from the log of the ship *True Briton*, Captain Edward A. Reynell.

"November 12th 1856.—At 11h. 30m. A.M., sighted the Roccas, bearing N.E. by E. At 1h. P.M., the island then bearing E. by S., distant about 7 miles, made out two ensigns flying from separate flagstaffs; feeling uncertain whether it was a fishing station or people in distress, close-hauled the ship that we might near it as much as possible. At 2h., tacked to the southward, intending to work the ship as close in as could be done with safety, and then send a boat on shore to ascertain the truth; but finding that instead of nearing the bank we were, in consequence of the strength of the current, constantly increasing our distance from it, I determined to send the boat away at once. At 2h. 15m., sent the cutter with five hands, provided with water, food, blue lights, &c., in charge of the chief officer, with directions to reach the shore, if practicable, and to bring off any distressed people that might be there. During the boat's absence I continued to work the ship to windward, but lost ground so fast that at 5h. 30m., the bank was not visible from the poop deck. At 5h. 45m., the boat returned without having accomplished a landing, the chief officer stating that they had been as far as within 2½ miles of the shore, but that finding night was coming on, that the ship in consequence of the current was nearly hull down, and being apprehensive that if they continued to pull towards the land they would be unable to reach the ship again, he had deemed it necessary to return. At 6h. P.M. the bank was barely visible from the mizen-top, and finding it impossible to contend against the strength of the current, the captain was reluctantly compelled to abandon all hopes of communicating with the shore.

"November 13th.—Find that the ship during the last twenty-four hours has been set to the westward 60 miles.

"November 14th.—Find that the ship has been set to the westward 36 miles during the last twenty-four hours."

(*f*) Captain H. Toynbee's observations in 1858 are as follows:—

October 18th.—Lat. 0° 52′ S., Long. 31° 24′ W.; current S. 44° W., 12 miles.
October 19th.—Lat. 3° 15′ S., Long. 31° 56′ W.; current S. 13° W., 8 miles.
October 20th.—Lat. 5° 37′ S., Long. 34° 38′ W.; current N. 57° W., 7½ miles.
October 21st.—Lat. 6° 36′ S., Long. 34° 41′ W.; current S. 64° W., 18 miles.
October 22nd.—Lat. 7° 28′ S., Long. 34° 11′ W.; current N. 16° W., 7½ miles.

(*g*) Captain L. Saabye, of the *Benjamin Howard*, 1856.

December 10th.—Lat. 1° 45′ N., Long. 24° 8′ W.; current W.N.W. 0·8 mile per hour.

December 11th.—Lat. 0° 59′ S., Long. 26° 37′ W.; current N.W. 0·8 mile per hour.

December 12th.—Lat. 3° 55′ S., Long. 29° 57′ W.; current W. ¾ S. 2·5 miles per hour.

December 13th.—Lat. 7° 2′ S., Long. 31° 10′ W.; current S.W. by W. 0·7 mile per hour.

December 14th.—Lat. 10° 24′ S., Long. 31° 22′ W.; current S.W. by W. 0·7 mile per hour.

(*h*) Captain Overton, of the *Nagpore*, December 10th, 1863, crossed the Equator in Long. 30° 30′ W., *intending to pass well to windward of Fernando Noronha.* The U.S. man-of-war *Vanderbilt*, had been hove-to for a week or more to the southward of the Equator on the lookout for Confederate cruisers; at 10 P.M. the second lieutenant boarded the *Nagpore*, and informed Captain Overton that the current for several days had been running strong to the N.W.-ward, and that he would scarcely weather the island.

December 11th.—Lat. 3° 15′ S., and at 8 P.M. made out Fernando Noronha. which he just weathered, having been carried more to the N.W. than he had anticipated,—but in accordance with the information obtained from the *Vanderbilt*.

(*i*) Captain Sir J. C. Ross, on his Voyage of Discovery in the Southern and Antartic Regions crossed the Equator, December 3rd, 1839, in Long. 30° W. and remarks that—in crossing the Equator, Long. 26° or 27° W. is preferred, for the strong westerly current is liable to carry ships too near the coast of Brazil; the current diminishes in strength to the southward, and in Lat 8° or 9° S. gives place to a feeble northerly set.

(*j*) Captain R. Liddle, of the *Bride*, passed the Roccas in 1857, and the following are extracts from his log:—

January 9th.—Lat. 0° 14′ N., Long. 32° 15′ W.; current in the last 24 hours S. 18° W. 9 miles.

January 10th.—Lat. 1° 28½′ S., Long. 33° 38′ W.; current N. 82° W. 22 miles.

January 11th.—Lat. 3° 49′ S., Long. 33° 47′ W.; current S. 84° W. 8 miles: at 1h. P.M. passed the Roccas, being by D.R. 5 or 6 miles to leeward of it.

January 12th.—Lat. 6° 9′ S., Long. 33° 59′ W.; current S. 15° W. 23 miles.

Thence to January 15th.—Lat. 13° 16′ S., Long. 34° 36′ W.; the current was south 55 miles during the three days; and the wind since crossing the Equator varying from S.E. to S.E. by E.

(*k*) Steamship *W. S. Lindsay*, Captain W. W. Palmer, 1857:—

February 1st.—Lat. 0° 5′ N., Long. 28° 45′ W.; no current.

February 2nd.—Lat. 2° 32′ S., Long. 29° 2′ W.; no current.

February 3rd.—Lat. 5° 30′ S., Long. 30° 22′ W.; current S. 48° W. 18 miles.

February 4th.—Lat. 8° 14′ S., Long. 32° 1′ W.; current S. 61° W. 13 miles.

February 5th.—Lat. 11° 4′ S., Long. 33° 20′ W.; current S. 43° W. 15 miles.

(*l*) Captain L. Saabye, of the Danish ship, *Benjamin Howard* in 1858, states:—

February 28th.—Lat. 1° 32′ N., Long. 28° 36′ W.; current W. by S. 1 mile per hour.

March 2nd.—Lat. 3° 10′ S., Long. 30° 7′ W.; current W.S.W. 1 mile per hour.

March 3rd.—Lat. 6° 32′ S., Long. 30° 54′ W.; current S.W. ¾ of a mile per hour.

March 4th.—Lat. 10° 4′ S., Long. 31° 36′ W.; current S.W. by W. near 1 mile per hour.

(*m*) The French transport *Bonite*, Captain Jouan, bound for New Caledonia in 1860, states that the current when approaching the Equator, as determined by the difference between D.R. and astronomical observations, was not perceptible, except from February 29th to March 1st, Lat. 8° 12′ N., Long. 24° W., when it set S. 69° W. 14 miles. To the south of the Equator the winds were E.S.E. and East, fresh; and by keeping clear full no nearer approach was made to the coast of Brazil than 70 leagues. The greatest strength of current was observed 80 leagues E.N.E. of Fernando Noronha when it set S.W. 33 miles in the 24 hours; thence to Trinidad it set S.W. and South, 13 to 14 miles.

(*n*) Captain F. Mitchell, of the *Queen of Nations*, writes,—February 20th, 1863, lost the S.E. trade winds in Lat. 1° 20′ S., Long. 22° W.; had light variable airs for three days, which carried us to Lat. 0° 29′ N., Long. 22° 10′ W.; no wind from that time until March 5th, in which interval the vessel drifted to Long. 28° 40′ W. on the Equator,—a distance of 391 miles, giving a current setting S. 86° W.; here we got the N.E. Trades.

(*o*) The French steam frigate *Sibylle*, Captain Pouget, in April, 1862, crossed the Equator in Long. 31° 10′ W., and thence to windward of Fernando Noronha; from Lat. 5° N. to the parallel of Parahiba, the set of the current was successively S.W.—S.S.W.,—W.S.W. (off Fernando Noronha), and then West; approaching 10° S. it became more southerly.

(*p*) H.M.S. *Sapphire*, on a cruise on and near the Equator, found the current setting W.S.W. to W.N.W., but much weaker in Long. 37° W. than in 43° W., and strongest when near the land. In April, 1815, H.M.S. *Leonidas* found the current setting in the same direction from 28 to 50 miles per day, near Long. 40° W., and south of the Equator. H.M.S. *Inconstant*, April, 1814, was set N. 73° W. 47 miles in 24 hours in Long. 38° W. near the Equator.

(*q*) Captain L. Saabye, of the *Benjamin Howard*, in July, 1856, states that from Lat. 7° S., Long. 27° W., to Lat. 2° S., Long. 24° W., the current was S.W. ½ a mile per hour; thence to Lat. 2° N. a drain of current to the S.E.-ward.

(*r*) The French ship *Saint Michel*, Captain Fradin, "crossed the Equator (July 31st, 1862), in Long. 29° 45′ W.,—the wind being from S. to S.S.E.

"August 2nd, with the same winds, squally weather, and a moderately high sea, we had Fernando Noronha in sight to the S.E.; our position at noon was Lat. 3° 29′ S., Long. 32° 10′ W., and at 3 h. P.M. about midway between that island and Las Roccas. From this position I began to fear I should not double cape San Roque, though well to windward of Las Roccas; I decided, however, to keep my course until I sighted the coast of Brazil, for the chopping sea, with the crests of the waves breaking against the wind, led me to conjecture that the current set to windward,—and thus contrary to what is stated in my directions. I was confirmed in this opinion when, being still on the same tack, at noon, August 3rd, our position was Lat. 5° 34′ S., Long. 33° 37′ W. and no land in sight; nor was it till the next day at noon, in Lat. 6° 58′ S., that we saw land, being then well to windward of cape San Roque."

We shall return to Captain Fradin's observations in connexion with the winds, &c., but it is to be regretted that he has not said something on the current between the Equator and Fernando Noronha.

(*s*) Major Rennell says:—Experience most fully proves, that although nature effects all her operations in such a manner as that, ultimately, the whole system is balanced and preserved, yet that, in detail, she often appears irregular, according to our limited comprehension. The trade winds and the currents of the ocean partake of these irregularities, although the general system is upheld. The trade winds in the Atlantic are often unsteady, even to 5° or 6° within their northern boundary; and instead of N.E. winds, there are found N.W., and even S.W. winds for many days consecutively; and this state of things prevents the *drift* current from being so regular there, as in the heart of the trades.

Anomalies also take place in the great Equatorial Current, and in that of the S.E. trade. The former has been known, at one time, to run to the eastward, or directly opposite to its general, and as is commonly understood, perpetual course,—and at about the same rate; and with it, the whole mass of water from 5° N. to 12° S. At another time, a like anomaly took place between the parallels of 2° N. and 7° S. This latter was *observed to take place* at 6° or 7° to the eastward of cape San Roque; but the other about midway between the two continents. In a third case, nearly in the middle, the current *ceased altogether*: or rather there was neither an easterly nor a westerly current. This happened in February; the other two in July and August."

Rennell generally gives instances, though none are adduced to corroborate the sweeping statement just made; but he says that in August, 1816, Sir James Yeo found *no current* between the Equator and Lat. 1½° S., from the meridian of Greenwich to Long. 15° W.; although four other ships experienced currents running from 22 to 63 miles per day in the same month, and also in February and April.

(*t*) Captain G. Chevely, in June, 1830, when on the Equator in Long. 40° W. found the current setting N.N.E. 1½ miles per hour.

The French corvette *Diane*, September, 1823, when near Long. 45° W. between Lat. 6° and 4½° N., was set to the eastward between 2 and 3 knots an hour during 2 days; on approaching *nearer* the mouth of the Amazon she had a westerly set of 1½ miles an hour.

(*u*) From the log of the French ship *Colosse*, Rear-Admiral Jurien:—June 8th to 11th, 1821, from Lat. 1° 35′ N., Long. 41° 23′ W. to Lat. 4° 21′ N., Long. 44° 38′ W. the currents were successively N. 7° W. 38°m., S. 45° E. 32m., S. 73° W. 38m.

(*v*) From the log of the French ship *Thetis*, Captain the Baron de Bougainville: —From May 3rd to 9th, 1824, Lat. 0° 35′ N., Long. 28° 17′ W. to Lat. 5° 8′ N., Long. 28° 49′ W. the currents were successively N. 64° E· 22m. in 2 days, S. 83° E. 23m., N. 28° E. 4m., West 4m., and N. 71° W. 6m.

(*w*) From the log of the French ship *Lyonnaise*, Lieut. Lartigue, October 11th to 25th, 1825, the currents in the area comprised between Lat. 6° 32′ and 3° 26′ N., Long. 38° 10′ and 35° 46′ W. were successively N. 48° E. 20m., N. 17° W. 12m., N. 57° W. 25m., N. 6° W. 81m. in 3 days, N. 12° W. 51m., N. 2° E. 40m., N. 6° W. 19m., N. 30° E. 26m., N. 72° E. 34m., N. 73° E. 29m., N. 38° E. 18m., and N. 32° W. 25m.

(*x*) From the log of the French brig *Aigle*, bound from the coast of Guinea to the Antilles, in 1847:—

November 9th.—Lat. 0° 3′ N., Long. 16° 50′ W.; current N.E. by E. 7 miles per day.

November 10th.—Lat. 0° 49′ N., Long. 19° 41′ W.; current N.N.W. 15 miles.

November 11th.—Lat. 1° N., Long. 25° 3′ W.; current N. ½ W. 17 miles.

November 12th.—Lat. 1° 57′ N., Long. 26° 30′ W.; current N. by W. 22 miles.

November 13th.—Lat. 3° 46′ N., Long. 28° 53′ W.; current N.N.E. ½ N. 4 miles.

November 14th.—Lat. 5° 8′ N., Long. 30° 28′ W.; current N.W. by N. 4 miles.

November 15th.—Lat. 6° 15′ N., Long. 31° 7′ W.; current E. by N. 4 miles.

November 16th.—Lat. 7° 1′ N., Long. 31° 2′ W.; current E. ½ N. 23 miles.

November 17th.—Lat. 8° 57′ N., Long. 33° 52′ W.; current S.E. by E. 13½ miles.

November 18th.—Lat. 10° 47′ N., Long. 35° 0′ W.; current East.

November 19th.—Lat. 11° 53′ N., Long. 37° 53′ W.; current S.E. 7 miles.

November 20th.—Lat. 12° 51′ N., Long. 41° 25′ W.; current N. ½ W. 10 miles.

November 21st.—Lat. 13° 46′ N., Long. 44° 36′ W.; current N.E. 1½ miles.

November 22nd.—Lat. 14° 23′ N., Long. 47° 45′ W.; current North 1 mile.

November 23rd.—Lat. 15° 4′ N., Long. 51° 15′ W.; current N.W. by N. 14 miles.

November 24th.—Lat. 15° 48′ N., Long. 54° 57′ W.; current North 10 miles.

November 25th.—Lat. 15° 57′ N., Long. 58° 10′ W.; current N.E. by E. 15 miles.

From November 5th, in Lat. 0° 2′ S., Long. 5° 5′ W., until Guadaloupe was made on the 27th the set by current was N. 30° E. 144 miles,—giving a mean rate of 6½ miles in 24 hours.

(*y*) The following is the substance of a paper read at the Royal Geographical Society, January, 1863:—

"In this paper is given an account of the voyage of the brigantine *Monte Christo*, from Cayenne, in French Guayana, to Parahiba, in Brazil, in July and August, 1862, from which the author considers that the current was at that time reversed in a most unmistakeable manner. The departure was taken from "Ile la Mer." one of the islands known as "Remire," off Cayenne, on the 26th; the wind blowing east, with which a direct northerly course was made until the 30th, when the position of the ship was 7° north, and in the same longitude as Cayenne. On this date the wind changed to the south and continued to blow from that quarter to the S.S.W. until the 7th of August, when the ship's position by dead reckoning was 42° 14′ W., and an Austrian ship that was spoken, gave the position as 27° W. It was not discovered until some days after, when a second ship was spoken, that the latter was the actual position. From this it appears that for eight consecutive days the *Monte Christo* was drifted at the rate of 4¾ knots an hour in an E.S.E. direction, diametrically opposite to the usual flow of the stream. Throughout the remainder of the voyage, extending over a further period of fourteen days, the same current was experienced. The Captain of another ship, the *Loyal*, which came into Parahiba some days after, having a chronometer on board, had abandoned his observations believing his chronometer to be out of order. Also while sailing on board the French man-of-war steamer *Alecton*, from Surinam to Cayenne, the author met with the same phenomenon, leaving little room for doubt that the current was reversed throughout, and for a considerable time."*

(*z*) "The East India Co's ship *Britannia* and *King George* transport were wrecked on the Roccas at 4 A.M., November 2nd, 1805, when the current set at the rate of 2¼ knots to the westward."

(*aa*) From the log of the French frigate *Circe*, Captain Duplessis Parscau, 1828:—

May 6th.—Lat. 11° 28′ S., Long. 31° 50′ W.; current N. 85° W. 32 miles; wind S.S.E. to E.S.E.

May 7th.—Lat. 8° 4′ S., Long. 31° 30′ W.; current S. 77° W. 32 miles; wind S.S.E. to E.S.E.

May 8th.—Lat. 6° 14′ S., Long. 33° 50′ W.; current W. 9 miles; wind S.S.E. to E.S.E.

May 9th.—Lat. 3° 46′ S., Long. 35° 57′ W.; current N. 72° W. 25 miles; wind S.E. to E.S.E.

May 10th.—Lat. 2° 10′ S., Long. 38° 55′ W.; current 7° 78′ W. 53 miles; wind E.S.E.

May 11th.—Lat. 0° 25′ S., Long. 42° 34° W.; current N. 77° W. 82 miles; wind E.N.E. to N.E.

May 12th.—Lat. 0° 51′ N., Long. 45° 24′ W.; current N. 70° W. 93 miles; wind E.N.E. to N.E.

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* This statement must be received *cum grano salis;* that the *Monte Christo* experienced an easterly current in the region and at the period of the year mentioned is very probable and there is nothing new in the fact; but we must decline to accept the rate;—there are but very few instances of such a velocity of current, and these are either where the Stream of tide unites with the general current near the coast, or where the water is jammed into a very narrow passage—none such in the open ocean. The *Monte Christo* evidently had no chronometer on board,—*query*, were any amplitudes or azimuths taken to verify the courses made good?—D.R. carried on from day to day without any rectification is a very unsafe basis on which to determine the rate of a current; one of the old E. I. Co's ships in running from a Brazilian port made the Roccas 2° 12′ east of Fernando Noronha, equivalent to a westerly current of 216 miles; another made an island on the west coast of Sumatra and supposed she was just south of the Maldivhs; we do not suppose D.R. is more carefully kept now than it formerly was. The author of this work has, however, in his possession, the log-books of several vessels that crossed the equator far west in July and August 1862, but can find no trace of such a current as indicated by the *Monte Christo*.

(*bb*) From the log of the French frigate *Amazone*. Admiral the Baron Roussin:—

October 20th.—Lat. 3° 53′ S., Long. 27° 51′ W.; current S. 85° W. 33 miles; wind E.S.E.

October 21st.—Lat. 1° 11′ S., Long. 27° 41′ W.; current W. 23 miles; wind S.S.E.

October 22nd.—Lat. 1° 4′ N., Long. 27° 41′ W.; current W. 31 miles; wind S.E.

October 23rd.—Lat. 2° 48′ N., Long. 27° 47′ W.; current S. 45° W. 10 miles; wind N.N.E. to S.E.

(*cc*) From the log of the French frigate *Clorinde*, Captain the Baron de Mackau, 1823:—

October 18th.—Lat. 9° 11′ S., Long. 27° 26′ W.; current N. 70° W. 21 miles; wind E. to E.S.E.

October 19th.—Lat. 6° 36′ S., Long. 27° 23′ W.; current N. 78° W. 14 miles; wind E. to E.S.E.

October 20th.—Lat. 3° 54′ S., Long. 27° 31′ W.; current N. 81° W. 29 miles; wind E.S.E.

October 21st.—Lat. 1° 8′ S., Long. 27° 10′ W.; current N. 82° W. 14 miles; wind E.S.E. to S.E.

October 22nd.—Lat. 1° 2′ N., Long. 27° 10′ W.; current N. 88° W. 26 miles; wind E.S.E. to S.E.

October 23rd.—Lat. 2° 46′ N., Long. 27° 26′ W.; current S. 63° W. 14 miles; wind E. to S.S.E.

(*dd*) From the log of the French surveying vessel *Lyonnaise*, Lieutenant Lartigue, 1825:—

November 5th.—Lat. 1° 23′ S., Long. 34° 42′ W.; current W. 12 miles; wind S.E. to E.

November 6th.—Lat. 2° 39′ S., Long. 34° 42′ W.; current S. 54° W. 21 miles; wind E. to E.S.E.

November 7th.—Lat. 2° 57′ S., Long. 34° 28′ W.; current S. 73° W. 22 miles; wind E.S.E. to E.N.E.

November 8th.—Lat. 1° 51′ S., Long. 33° 28′ W.; current S. 71° W. 10 miles; wind E.S.E. to S.E.

November 9th.—Lat. 1° 8′ S., Long. 32° 6′ W.; current N. 14° W. 16 miles; wind S.E. to S.S.E.

November 10th.—Lat. 1° 55′ S., Long. 32° 30′ W.; current N. 45° W. 17 miles; wind S.E. to E.S.E.

November 11th.—Lat. 2° 29′ S., Long. 32° 28′ W.; current N. 24 W. 18 miles; wind E.S.E. to S.E.

November 12th.—Lat. 3° 14′ S., Long. 32° 42′ W.; current N. 59° W. 21 miles; wind S.E. to E.S.E.

November 13th.—Lat. 3° 49′ S., Long. 32° 48′ W.; current W. 21 miles; wind S.S.E. to E.

November 14th.—Lat. 5° 11′ S., Long. 32° 46′ W.; current S. 79° W. 13 miles; wind E. to E.S.E.

November 15th.—Lat. 6° 38′ S., Long. 32° 59′ W.; current S. 76° W. 8 miles; wind E. to E.S.E.

November 16th.—Lat. 7° 44′ S., Long. 34° 28′ W.; current N. 50° W. 36 miles; wind E. to S.E.

December 4th.—Lat. 7° 19′ S., Long. 32° 11′ W.; current S. 75° W. 32 miles; wind E.S.E. to S.E.

December 5th.—Lat. 4° 49′ S., Long. 31° 27′ W.; current S. 68° W. 31 miles; wind S.E.

December 6th.—At Fernando Noronha, current N. 69° W. 20 miles; wind S.E. to E.S.E.

December 8th.—Lat. 3° 55′ S., Long. 33° 20′ W.; current N. 76° W.; wind S.E. to E.S.E.

December 9th.—Lat. 4° 19′ S., Long. 35° 46′ W.; current N. 86° W. 29 miles.

December 10th.—Lat. 3° 50′ S., Long. 38° 6′ W.; current N. 84° W. 32 miles.

(*ee*) From the log of the French frigate *Thetis*, Commander Baron de Bougainville. 1824:—

April 27th.—Lat. 7° 52′ S., Long. 31° 16′ W., current S. 60° W. 17 miles; wind E. to E.S.E.

April 28th.—Lat. 5° 57′ S., Long. 30° 43′ W.; current N. 80° W. 20 miles; wind E.S.E.

April 29th.—Lat. 4° 19′ S., Long. 30° 4′ W.; current N. 84° W. 25 miles; wind E.S.E. to S.E.

April 30th.—Lat. 2° 34′ S., Long. 29° 5′ W.; current N. 76° W. 21 miles; wind S.E.

May 1st.—Lat. 0° 48′ S., Long. 29° 3′ W.; current N. 71° W. 18 miles; wind E.S.E. to E.

May 2nd.—Lat. 0° 6′ N., Long. 28° 28′ W.; current N. 49° E. 20 miles; wind E.S.E. to N.E.

May 3rd.—Lat. 0° 35′ N., Long. 28° 17′ W.; current N. 8 miles; wind E.S.E. to S.S.E.

(*ff*) From the log of the *Unicorn*, 1841:—

November 19th.—Lat. 1° 2′ N., Long. 26° 26° W.; current W. by N. 61 miles.

November 20th.—Lat. 0° 24′ S., Long. 27° 3′ W.; current W. ¾ N. 32 miles.

November 21st.—Lat. 4° 5′ S., Long. 29° 35° W.; current W. 32 miles.

(*gg*) "1858, Commander J. H. Selwyn, in H.M.S. *Siren*, visited the Roccas, and states that the anchorage is fair and protected from the prevalent swell from N.E. to S.E. and, from its situation *in the heart of a westerly current, which varies in force from one to two miles*, and its comparative vicinity to the mainland, a lighthouse would be most valuable to the mariner, as a means of ascertaining his position with certainty."

(*hh*) From registers deposited with the Meteorological Department of the Board of Trade between 1856 and 1865, of 42 ships passing from the North to the South Atlantic Ocean, within a distance of 30 to 40 miles East or West of the Roccas at various seasons of the year, it appears that 14 do not record whether they have experienced any current or not. One experiences 'a strong westerly current,' and was 'driven back.' The remaining 27 found currents of the following direction and rate.

11 vessels were set West;—4 of these from 48 to 24 miles, and the remaining 7, from 20 to 10 miles a day.
8 ,, ,, W.N.W.;—4 of these from 51 to 30 miles, and 4 from 29 to 21 miles a day.
5 ,, ,, W.S.W.;—3 of these from 48 to 30 miles, and 2 from 20 to 10 miles a day.
1 ,, ,, S.W.;—40 miles a day.
2 ,, ,, North;—12 to 8 miles a day.

"The strongest of these 27 recorded currents were found in June, July, August and November."

(*ii*) These statistics (pp. 198—212) relating to the currents in the part of the Atlantic Ocean under discussion are more ample than have hitherto been collected together in any other work; and we think they are sufficient to dispel the illusion of any S.E.-ly current between the Roccas reef and the Equator.

Since the foregoing remarks were originally published in the *Mercantile Marine Magazine*, the following "Bottle Paper" has been published by the Hydrographic Office; it had been forwarded to the Admiralty by H.M. Consul at Pernambuco—

"This paper was thrown overboard by H.M.S. *Lee* on the 26th September 1865, in Lat. 9° 10′ S., Long. 12° 53′ W., on the passage from St. Helena to Ascension. It was found on the following 5th February, at a village on the coast of Brazil called Praias or Arcias, in the province of Ceará, which is in Lat. about 4° 20′ S., Long. 28° 50′ W." The bottle travelled therefore in a direct line W. by N. 1530 miles in 132 days, or at the rate of 12 miles a day, and must have been passing the vicinity of the Roccas about the time the *Duncan Dunbar* was lost, and is strongly confirmatory of the Westerly Equatorial current.

Again,—"A bottle paper was thrown overboard from H.M.S. *Lee*, August 6th, 1865, at 1 P.M., Lat. 6° 23′ S., Long. 12° 2′ W., proceeding from Lagos to Ascension. It was found on the 15th April 1866, at Bafall in the Bay of Guayaguayare, in the County of Mayaro, in the Island of Trinidad.

Other "Bottle Papers" thrown overboard in the vicinity of the Equator have drifted in the same direction; and an outward bound vessel abandoned close to the Equator after drifting for many months were cast ashore at Ceará,—all tending to confirm the existence of the westerly current.

(*jj*) **General Summary on the Currents in the Equatorial Region of the Atlantic**—(1.) THE EQUATORIAL CURRENT—due to the combined influence of the earth's rotation on its axis and the drift of the S.E. Trade wind—pursues its course steadily from east to west across the equatorial region of the Atlantic.—the great body of the stream in mid-ocean being, however, found south of the Equator. Advancing westward with increasing velocity—a velocity ever varying with the strength and persistence of the Trade wind—and widening as it advances, its tendency to bifurcate is sensible long before it reaches the South American shores.

(2.) That portion of the current which has a West and W.N.W. direction flows towards, and then along, the northern shores of Brazil, where it becomes known as the GUAYANA CURRENT; it passes on each side of Fernando Noronha and the Roccas, at an average rate of from 1½ to 2 miles per hour,—here also its least rate is about 12 miles and its greatest 60 miles in 24 hours; more to the westward a velocity of 2 and 3 miles an hour is not uncommon.

(3.) As a natural consequence of the bifurcation of the Equatorial current by the easterly projection of the South American continent, a portion of that stream —*but a small portion*—known as the BRAZIL CURRENT, runs to the southward at some distance from the coast, *spreading* as it gets southing—so as to take the direction of the coast line (S.S.W.) in the offing, but S.S.E. to seaward. The rate of this current varies from 10 to 15 miles a day, decreasing in velocity as it advances to the south.

(4.) CURRENTS NEAR THE BRAZILIAN COAST:—Inside this off-shoot from the Equatorial current—between it and the coast of Brazil—there are *counter currents* which, in the main, take their direction from the prevalent winds,—and as these are, at particular seasons, extremely variable, the currents are no less so. During the period of the strength of the N.E. monsoon—commencing in October—the current runs to the S.W., sometimes with a velocity of 25 to 30 miles a day; and this is especially the case off the salient projections of the coast, as at cape San Augustin, the Rio Doce, Cape San Thomé and Cape Frio—so that making Pernambuco or Bahia during this season due allowance must be made for the S.W.-ly set; but the velocity of this current varies as the cause which produces it, and hence in November, December, and January it is generally weak.

During the S.W. monsoon this counter current is Northerly, attaining its greatest velocity in June and July, but at other times comparatively weak; to the south of Cape Frio it is N.E.-ly, and takes a more northerly direction as it passes Bahia and Pernambuco—in fact following the lay of the coast.*

"Misconception has arisen relative to the *easterly current* which has occasionally been found in the parallels of 9° to 2° N.

"This *counter current* of the Equatorial stream has been traced to extend, at certain months of the year, from the meridian of 53° or 50° W. to that of about 25° W., and thus joining or forming a part of the well known Guinea current.

* Les Côtes du Brésil, Description et Instructions nautiques, par M. Ernest Mouchez, Capitaine de frégate, 1864.

It is seldom experienced to the southward of 2° N., and there are very few records of its being found on or to the southward of the equator; it must not, therefore, be confounded with the Equatorial Current, as before described, for on the meridian of the Roccas its southern edge may generally be expected to be found about 850 miles to the northward. The western limits of this occasional *easterly current* have been ascertained from numerous observations of French ships of war visiting Cayenne and the neighbouring ports, and discussed by the able French officers Lartigue and Montravel, and may be generally stated as existing between the meridians of 53° and 40° W. and the parallels of 9° and 5° N., where it has been found running at the rate of 60 miles a day in July, August, and September. Within these limits this counter current does not appear to be constant or certain in direction, a westerly current more generally prevailing.

"To the eastward of 40° W. part of this easterly current approaches nearer the equator, or to about 2° N., and decreases considerably in strength, until joining the Guinea current, where it increases again in velocity as it nears the African shores. Within these eastern limits it appears to run the strongest in the summer and autumn months; and East of 30° W. to be generally constant during the year. Between the meridians of 30° and 20° West and the parallels of 8° and 4° N. it has been found to run from 30 to 15 miles a day."

It is probable that this *occasional easterly current* is strongest and most prevalent during the strength of the S.W. monsoon in the North Atlantic—between June and October; although it has been reported in May and November. During the other months of the year, the drift of the N.E. Trade wind reaches the equator, and at the time when the drift from the S.E. Trade wind is least in volumn, tends to augment the Equatorial current.

At the same time we cannot refrain from remarking that the currents as stated to exist are so *opposite* in direction, and there are such whirls within two or three days, that we believe much of this must be attributed to errors arising, as we have already said, from the impossibility of keeping a good D.R., where the wind is often all round the compass, and when at times the vessel has but little steerage way; besides it will scarcely be questioned that in the region of variables the *stream of air tends more to the eastward than to the westward*, and in passing from North to South, or from South to North, the ship makes more easting than is generally supposed or reckoned for. It would be well if every vessel in H.M.'s service were strictly enjoined to make special trials for the current when crossing this region.

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16. Additional Remarks on the Guinea Current.

The following remarks are from an article by Lieut. De Brito Capello, "On the Winds and Currents of the Gulf of Guinea,"—and which may be found *in extenso* in Rosser's "South Atlantic Directory," together with a fuller description of the Equatorial current.

December, *January* and *February*:—During these months the Guinea current runs East and E.N.E. between the parallels of 5° and 3° N., from the meridian of 19° or 20° W. The axis of the current—where its velocity is greatest and its direction most regular—as far as Cape Palmas lies between 4° and 3° N. Its southern limit is on a line extending from 3° N. in 20° W. to 2° N. on the meridian of 6° E. At this season its rate is about 1 mile per hour,—rarely attaining to 1½ miles.

March and *April*:—Between the parallels of 6° or 5° N. and 2° N. eastward from the meridian of 18° W. the Guinea current is tolerably regular, but its velocity is scarcely so great as in the preceding months. Its southern boundary is now the parallel of 2° N., between 22° W. and 3° W.

May and *June*:—The Guinea current is now well established between the parallels of 8° or 7° N. and 4° or 3° N., running E.N.E. and East. Its southern boundary at this season extends from 24° W. on the parallel of 4° or 3° N., to the middle of the Bight of Biaffra on the parallel of 2° N.

July, *August* and *September*:—At this season from the meridian of 24° W. in 4° or 3° N. the Guinea current flows steadily in a N.E. to East direction towards the coast, when it bifurcates,—a part of the waters turning to the N.W.-ward, and a portion following the trend of the land to the E.S.E. Its southern limit is on a line drawn from 5° N. in 24° W. to 1½° N. on the meridian of Greenwich. Its velocity averages 1 mile per hour; but off Cape Palmas it reaches 1½ miles.

October and *November*:—The currents in the Gulf of Guinea are most irregular at this period of the year, but the Guinea current is well established southward of the parallel of 9° or 8° N. to the eastward of the meridian of 20° W.: a line drawn from 6° N. on the meridian of 24° W. to 1° N. on the meridian of Greenwich marks its southern limit:—it attains its greatest velocity (from 1 to 1½ miles per hour) to the eastward of 10° W.

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17. As a broad generalization of all atmospheric and oceanic movements, it may be observed that the Winds (or *aerial* currents) and the Currents of the Ocean, alike form parts of a great system of circulation, the special characteristics of which can be thus expressed:—

(1.) Between the Tropics, the winds and the oceanic currents have a prevailing direction towards the westward.

(2.) In Middle Latitudes, the prevailing currents of the air and the ocean alike tend towards the eastward.

(3.) In High Latitudes, the general direction of the winds and of the oceanic currents, is from the poles towards the equator, *i.e.*, from north to south in the Northern Hemisphere, but from south to north in the Southern Hemisphere.

CHAPTER XV.

THE TIDES OF THE NORTH ATLANTIC.

1. In "the South Atlantic Directory"* it is shown that the wave which enters the South Atlantic is a day old, and that it thence progresses northward. It is also stated that, from some cause as yet unknown, the tide is earlier along the coast from the Cape of Good Hope to Cape Palmas, than at the islands in the same latitudes.

From Sierra Leone to Cape Verde, the times accord with the main tide wave, and the rise is from 8 to 12 feet, while on the coast of Guinea it is not more than 7 feet.

There is, however, an anomaly in the tidal hour at the Canaries and Azores, as compared with the coast; and it is probable that the whole of this area of the ocean lies out of the main route of the tide wave, for while the ocean to the westward of the Cape Verdes is from 4 to 5 miles deep,—between that group and the Azores, the depth is not more than from 2 to 3 miles.

The main wave having passed northward of the Azores, falls obliquely on the coasts of Spain, Portugal, and France; but the range has increased considerably.

Turning to the coast of the United States, it appears that the difference of the time of tide at Nantucket Island and Cape Hatteras is 6½ hours, so that while it is high water at one it is low water at the other; but along the coast between those places it is high water nearly simultaneously. The rise near Nantucket is small (2½ feet); but from the contraction and shallowing of the Bay of Fundy it rises to 60 feet at the head of that bay.

The tide wave enters the Gulf of St. Lawrence by two passages—one north and the other south of Newfoundland; where the two waves meet, on the west of Newfoundland, the tide is very small; but that which passes on to Quebec ranges high.

South of Prince Edward's Island there is only a single day tide.

Among the West India Islands and in the Gulf of Mexico the tide is small, but it is at times much affected by local influences of wind; in many parts of the Gulf of Mexico, as well as in the Caribbean sea, there is only one tide a day.

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2. There is much in relation to the Tides which could not be included here—in fact, could only be noticed in specific "Sailing Directions" for any

* A general description of the Tides and of the Tidal Wave is given in "The South Atlantic Directory," by W. H. Rosser.

given place, and to those books the navigator is referred for detailed information; but he must bear in mind, that on a knowledge of the tidal currents of shallow seas not unfrequently depends the safety of a ship, as the following brief remarks on the Tides of the British Islands will sufficiently indicate:—

First, as a general principle, it may be observed that in a deep sea the movement of the wave is quick, that of the water is slow; but in a shallow sea the movement of the wave is slow, while that of the water is quick. If the tide-wave have to pass through a channel open at both ends, so that it goes in at one end and out at the other, the current of the water must go with it; but although the wave never returns, the water must return;—there must be an equal current in the opposite direction, otherwise the whole of the water would in course of time be carried from one end of the channel to the other. Thus, the passage of the tide-wave produces two currents; one in the same direction as itself,—the other a compensating current, in the opposite direction. These are generally called "flood and ebb" currents; but these terms, although sanctioned by usage, are not correct, because "flood" and "ebb" are applied to the rising and falling of the water, which is quite a different thing. The use of the flood current is to supply water for the wave, and the wave requires water after its summit has passed any particular point, so that at that point *flood current* continues, though *ebb tide* may have commenced. Although, therefore, at first sight, it might be imagined that the current will run one way while the tide is rising, and the other way while the tide is falling, yet, a little consideration of the connexion between the current and the tide-wave will show that in the case of a travelling wave the rule will be thus:—While the sea is *above* half tide level, the water runs *with the wave*, while it is *below* half tide level, the water runs *against the wave*.

This is the most ordinary relation of the tidal streams to the tidal wave, and it is technically called "tide and half tide."

A great portion of the tides on the British coast, however, is in a state exceptional to this ordinary law, and the principal to which they must be referred, may be explained as follows:—Suppose the tide-wave to enter a gulf, instead of a channel with an opening at the other end to allow it to pass out.

At the entrance of the gulf the wave will travel as in an open channel, and the current will change its direction at half tide. At and near the head of the gulf, however, it is clear that so long as the water is running up, there being no escape for it, the tide must rise, and directly the current turns the tide will begin to fall, owing to water being taken away from it. Proceeding up the gulf, then, the change of current occurs nearer and nearer to high water, till at the head of the gulf the change of current and the change of tide are simultaneous.

The same effect will be produced if, instead of a closed head to the gulf, the tide be met by a counter tide which is coming in the opposite direction. The current will be stopped, not by a solid obstacle, but by a stream of water running against it. While the streams are running towards one another the water must rise, and it will go on rising till the streams separate, when the water will begin to fall.

This meeting of two waves is found both in the Irish and English Channels; the tides in them, therefore, present the appearance of a stationary rather than a travelling wave, while the great rise of tide and the comparatively small depth of the seas make the currents a very important feature, on account of the force of momentum which they communicate to a vast body of water.

8. **The Irish Sea**:—The Atlantic tide-wave strikes the Scilly Islands and Cape Clear almost simultaneously; it then travels regularly along the north coast of Cornwall and the south coast of Ireland for an hour, till it arrives on the latter coast at Dunmore Head; about the same time it falls upon the S.W. point of Pembrokeshire. As far as Dunmore Head the tide-wave has been gradually increasing in height from 9 or 10 feet (at Cape Clear), up to 13 feet; at St. David's, in Pembrokeshire, it has attained 16 feet. From Dunmore Head it gradually diminishes, until at Courtown, near Arklow, it almost vanishes. From Courtown the wave again begins to increase, till at Dundalk Bay it has attained a range of 16 feet. From the point at which the tide northward of Courtown becomes regular, up to Dundalk Bay, the time of high water is almost simultaneous, and that time is the hour of low water at Dunmore Head, the point at which the tide-wave reached its greatest height on the south coast.

Turning to the north coast of Ireland,—the tide is nearly simultaneous here and on the south coast; the north-west shore of Donegal corresponding in time with Dunmore, and the range being nearly the same, about 12 feet. From thence it gradually diminishes, till off Rathlin Island it is again nearly extinguished, and only appears in very anomalous undulations, there being, within a few miles, differences of several hours in the time of high water. After entering the narrow channel between Scotland and Ireland, the wave again gradually increases; the time becomes nearly uniform all along the coast, and that time is the time of high water in Dundalk Bay. This northern branch, however, is less regular than the southern, owing to the great irregularities in the line of the Scottish coast. Here then, along the east coast of Ireland an almost simultaneous rise of tide from Rathlin Island on the north, to Courtown on the south; the wave forming an apex in the centre of Dundalk Bay.

On the opposite shore—along the Welsh coast—there is a regular progress of the tide-wave from St. David's Head round Carnarvon Bay, and also in the more direct line from St. David's head by the extreme point of Carnarvonshire to Holyhead, in 4 hours,—the time at Holyhead being nearly an hour earlier than that in Dundalk Bay. Thence, along the whole of the Welsh coast, along the coasts of Lancashire and Cumberland, and along the south coast of Scotland, as well as at the Isle of Man, the time of tide is very nearly uniform; and the range regularly increases according to the distance from Courtown on the south, or Rathlin Island on the north; thus, along the whole of the Welsh coast, between St. David's and Holyhead, the range varies from 16 to 18 feet; from Holyhead to Liverpool it increases from 18 to 26 feet; along the English coast, north of Liverpool, it is from 28 to 30 feet, and from the Solway Firth to the Mull of Galloway it again decreases till it is 15 feet at the latter point, and it farther diminishes in passing northwards through the straits. On the Scottish coast no regular progression of time can be traced as upon the corresponding portion of the Welsh coast, —arising probably from anomalies inseparable from the irregular and deeply indented coast-line.

The tide-wave of the Irish Sea, then, may be simply described as a great undulation between two points, Courtown and Rathlin Island, and the quantity of water thus passing in and out of this sea at every tide is enormous; greater in amount than that discharged by all the rivers of Great Britain and Ireland in a year; and the whole of this has to be supplied twice a day by the two channels, north and south. We find, then, streams running constantly in one direction or the other. That from the south flows up St. George's Channel at a rate, in some parts, equal to 4 miles an hour, impinges on the Isle of Man, and turns away at the eastward towards Liverpool. The northern one flows between Donaghadee and Portpatrick, attains about the same velocity in the narrow part of the channel, impinges upon the north coast of the Isle of Man, and turns to the eastward parallel to the southern stream. Between the Isle of Man and Dundalk the meeting of the two streams causes still water, and here the tide rises and falls some 18 feet, without any stream whatever. These streams, throughout the whole extent of the Irish Sea, change their direction at the time that it is high and low water at Liverpool, flowing in during the rising tide, and out during the falling tide.

The two systems of currents meet, and counteract each other, along a line joining St. John's Point, county of Down, with the Calf of Man; and again, to the eastward of the Isle of Man, they blend their streams together and flow in a united course to the eastward, from Maughold Head into Morecambe Bay, in Lancashire. To the west of the Isle of Man, where the flood currents from the north and south channels meet and destroy each other, there is still water at all times of tide over a large elliptical area; this space of no tidal current shows itself by the nature of its bottom, which is composed altogether of fine blue mud.

The line joining St. John's Point with the Calf of Man, and Maughold Head with the centre of Morecambe Bay, is called the "*Head*," or "*End of the Tide*," and is remarkable for many reasons.

1st. It separates the two systems of tidal currents from the north and south channels, which here meet and destroy each other's motion.

2nd. The greatest rise and fall of the tide takes place along this line in consequence of the meeting of the waters. The range of tide at St. John's Point is 15 feet, and in Morecambe Bay, 31 feet, which are the greatest ranges on the Irish and English coasts of the Irish Sea.

3rd. The hour of High Water (and of Low Water) along this line of the head of the tide rules the course of the currents of tide both in the north and south channels. The following may be laid down as the golden rule of tidal currents in the Irish Sea; and was first stated distinctly by the late REAR-ADMIRAL BEECHEY.

There is Slack Water throughout the whole Irish Sea and channels from 40m. before to 40m. after the Time of High and Low Water at the Head of the tide, from St. John's Point to Fleetwood; during the flow of tide the currents set simultaneously both in the north and south channels towards the line of the Head of the tide, and during the Ebb of the tide the currents run simultaneously both in the north and south channels from the line of the Head of the tide.

This remarkable law was first proved to be true for the southern half of the Irish Sea in CAPTAIN BEECHEY's paper, read before the Royal Society of London in 1848; in which he thus expresses himself:—

"The stream in the southern channel has been ascertained to move *simultaneously in one vast current throughout;* running six hours nearly each way, at an average rate of from two to three knots per hour at the height of the springs, increasing to four knots and upwards near the banks and at the pitch of the headlands; its *times of Slack Water* corresponding sufficiently near for all practical purposes, with the times of High and Low Water for the day at Morecambe Bay, or more correctly at *Fleetwood*, which is 12 minutes earlier than Liverpool."

The same rule prevails in the Northern Channel, where the stream also *sets in one vast current throughout* but runs at a much more rapid rate. In the narrow part of the Channel, between Fair Head and the Mull of Cantyre, the rate of the stream of tide in springs is fully 5 knots per hour.

A remarkable channel, much deeper than other parts of the Irish Sea, exists between Wigtonshire and the county of Down. It is 28 miles long, 1¼ miles wide, and 145 fathoms deep. It is thus described by CAPTAIN BEECHEY:—

"The North Channel Stream, pressing more heavily on the Wigtonshire coast, has scooped out along this coast a remarkable ditch, upwards of 20 miles long, by only a mile in breadth, in which the depth is from 400 to 600 feet greater than that of the general level of the bottom about it."

It has been explained how the northern and southern Tidal Streams, meeting to the westward of the Isle of Man, produce permanent slack water; this causes the deposit of a fine blue mud, which the current is too feeble to carry off. The eastern branches of the northern and southern Tidal Streams, on the contrary, meeting, not directly opposed, but under an angle, to the east of the Isle of Man, form by their union a current which sets rapidly, at the rate of 1 to 2 knots per hour, into Morecambe Bay, where they cause an excessive deposit of mud, ooze, and fine sand, with only one deep channel leading through the banks, viz., the Lune Deep.

"Morecambe Bay, the grand receptacle of the Streams from both Channels, is notorious for its huge banks of sand heaped up in terrible array against the mariner unacquainted with its locality, and also remarkable for a deep channel scoured out by the stream, and known as the Lune Deep, which to the wary navigator is the great hidden beacon of his safety, and serves him, alike in fog or in sunshine, as a guide to his position and to a harbour of safety in case of need."—Beechey, *Phil. Trans.*, 1848.

It should be borne in mind that the ebb Tidal Streams press more upon the Irish coasts than the flood Tidal Streams, and in some places near the Blackwater Bank actually flow across that bank almost in a westerly direction. This circumstance renders an ebb Tide always dangerous to vessels which have approached too near the Wexford coast.

4. **The Bristol Channel**:—The Irish Sea tide is only one branch of the great wave which comes in between Cape Clear and Scilly: a branch of almost equal importance is cut off from it by the projecting S.W. point of Wales, and flows up the Bristol Channel. The progress of this wave is regular; the time occupied in passing from St. Gowan's Head to the mouth of the Avon, being about an hour and a half.

At St. Gowan's Head the rise is 24 feet; at Padstow, in Cornwall, which lies nearly due south, it is 20 feet; at Lundy Island, it has increased to 27 feet; at Worm's Head it is 28 feet; in Swansea Bay, 30 feet; Nash Point, 33 feet; Minehead and Bridgewater Bay, 35 feet; Cardiff, 38 feet; and Portishead, 41 feet. These are ordinary spring tides; they often rise 3 or 4 feet higher. The great rise in the Bristol Channel is due no doubt to the gradually contracting shores of the gulf.

The currents at the lower part of the Bristol Channel are much influenced by those which enter the Irish Sea; but above the reach of this influence the streams run up and down channel with a considerable velocity, increasing in the higher parts, where the range of tide and consequent proportional quantity of water required to supply the tide increases. The velocity off Lundy Island, where the rise is about 27 feet, is 3 miles an hour at springs. At King Road, where the range is 44 feet, the stream runs 3½ to 4 miles an hour, and at the Aust Passage it rushes through a narrow part of the channel at the rate of 6 to 7 miles an hour. In all parts it changes its direction soon after high and low water, as it universally does near the head of a gulf; and in a gulf gradually narrowing, like the Bristol Channel, from a much greater distance from the head than if the sides were parallel.

5. **The English Channel**:—The English Channel approximates (roughly) in form to the Irish Channel, and there is a certain analogy in the tides of each. It was shown (p. 220) that the tide-wave, progressing in time and increasing in height from Cape Clear to Dunmore, became irregular beyond the last-named place, the node of the tide being found in Courtown; similarly, in the English Channel there is a regular progress in time to a point to the westward of Portland, and though the increase of range is not observable thus far, its diminution beyond is very marked, until in the vicinity of Swanage there is a node corresponding to that at Courtown in Ireland, and, as at the latter place, there are at times *four* tides a day. From near Portland to Dover (which is the

point corresponding to Donaghadee on the Irish Coast), there is the phenomenon of a nearly simultaneous tide all the way. On the French coast there is a great range of tide in the Bay of St. Malo, as in the Bristol Channel, and a close correspondence in the times. From Cape la Hougue to Havre, the progress approximates to that along the Welsh coast as far as Holyhead, but the increase in height is more regular in the former instance than in the latter, being from 17 feet at La Hougue to 28 feet at Havre. Beyond Havre the channel begins to contract to the Straits of Dover, whereas in the similar part of the Irish Sea there is an enlargement, and thence a marked difference in the characters of the tides occurs, to understand which it is necessary to follow the progress of the main wave which passes round the north of Scotland.

The GREAT ATLANTIC WAVE reaches the Orkneys and Shetlands about 2¼ hours after it has touched the Western islands. The great rapidity of the tidal streams among the Orkneys makes a correct knowledge of their periods and velocities of the utmost importance to the mariner.

In the terrific gales which usually occur four or five times in every year, all distinction between air and water is lost, the nearest objects are obscured by spray, and everything seems enveloped in a thick smoke; upon the open coast the sea rises at once, and striking upon the rocky shores, rise in foam for several hundred feet, and spreads over the whole country.

The sea, however, is not so heavy in the violent gales of short continuance as when an ordinary gale has been blowing for many days; the whole force of the Atlantic is then beating against the Orcadian shores, rocks of many tons in weight are lifted from their beds, and the roar of the surge may be heard for twenty miles; the breakers rise to the height of sixty feet, and on the North Shoal, which lies 8 miles N.W. of Costa Head, the broken sea is visible even at Skail and Birsa.

Similar effects may be witnessed in any stormy region, but here they are increased by the power of the tidal stream, and when the whole mass of water is in motion, a very slight inequality at the bottom of the sea is indicated by a ripple on the surface, so that by these means shoal spots have been detected (to the eastward of North Ronaldsha) at a depth of 47 fathoms, though the difference in depth was but 20 feet. On the rocky bank of the North Shoal, which is about 4 miles in length, the ripple readily (during the survey) distinguished any inequality of 10 and 15 feet, at a depth of 30 fathoms, even when the stream was moving but one mile per hour. It is only in calm or very fine weather that these ripplings can be observed, but when the wind increases upon a weather tide the sea will break over every inequality of the sea bottom. These broken seas are a most formidable danger, and, during the survey of these islands, the vessel was often in great peril from moving her before sufficient time had elapsed for the sea to become quiet.

The body of the tide-wave comes from the N.W., and makes high water on the whole west coast of the Orkneys at nearly the same time; the establishment for

Stromness being 9 o'clock, and that for Pierowall in Westra, is about 6 minutes later. At the north-east end of the Orkneys it is but a few minutes later than at the north-west, as the establishment for Otters Wick is 9h. 18m.; but the tide there is probably retarded by having to pass over the shoal water at the mouth of the bay.

The tide stream runs with greater velocity and turbulence through the Pentland Firth than in any other part of the Orkneys; so that with a strong gale and a weather spring-tide the sea is in many places impassable, and after the wind has gone down, the sea continues to break with great violence for some days, indeed in a sailing ship more danger is to be apprehended from a calm than from a gale of wind. The tide-wave from the Atlantic, opposed by the west coast of the Orkneys, is pressed against the shores of Caithness, where at Thurso the tide rises nearly 5 feet higher than at Stromness, though the latter is but 20 miles to the northward. This accumulated mass of water finds egress through the Pentland Firth, where the velocity of the stream near the Little Skerry was said by Captain Otter to have acquired the rate of 10 knots. At the Great and Lother Skerries, which resist a large body of the tidal stream, the water is sensibly higher by 1 or 2 feet upon the stream side, and a small rapid is formed, of little height indeed, but of great power. Vessels that have drifted upon this rock, when covered by the tide, have been rolled over it, and sunk in deep water on the other side.

The tide wave having passed round the Shetlands, travels regularly southwards. A little later it washes the coast of Norway at Tananger, and there divides; one branch proceeding northwards, and the other southwards. The northward branch reaches the Lofoten islands at 12h.; the southward branch may be traced along the S.W. coast of Norway into the Skagerrak; its height is very small—the greatest range being scarcely more than one foot. On the coast of Jutland it is scarcely perceptible. The other extremity of the wave, however, on the coast of Scotland, increases as it progresses. The tides near the Pentland Firth are influenced by the combination of the two branches, viz., the impeded one along the north coast of Scotland, and the freer one, which has passed round the Shetlands. The average rate of the stream in the offing is very moderate, not exceeding a knot and a half; but that part of the stream which enters by the Pentland Firth acquires a furious rapidity, amounting at spring tides even to 8 knots. From the Firth, however, it immediately abates in strength, as it diverges into open water; its eastern branch filling up the basin of the North Sea as it advances towards the coast of Jutland and Holland; whilst its western branch, more or less confined by the Dogger and other outlying banks, swells along the shores of Scotland and England, and makes high water in all the rivers and harbours successively till it arrives in the Thames, as follows:—

On the N.E. coast of Aberdeen there begins a regular progress, the time being about 12h. at new and full moon, *i.e.* 2 to 3 hours later than at the Shetlands, and the range being from 10 to 18 feet. At the entrance of the Firth of Forth the time is a little after 2h., and the range from 14 to 16 feet. North of the river Tyne it is about an hour later; at Scarborough the time of high water is 4h. 11m., and the range is 16 feet. This is 12 hours after the first approach of the wave to the south coast of Ireland.

At the entrance to the Humber the time is 5h. 26m., and the range has increased to 20 feet; here, and along the coast of Lincolnshire, is the apex of the tidal range, corresponding to that at Dunmore Point, on the south coast of Ireland; it is also very nearly twelve hours later, so that two consecutive waves are simultaneous at Dunmore Point and on the Lincolnshire shores. From this the progress continues to the north-east shore of Norfolk; but the range gradually diminishes, till at Happisburgh it is only 11 feet. The node is near Yarmouth, near which there are some movements of the tidal wave, analogous to those of Courtown and Swanage,—the range being small, about 7 feet. The node, however, does not lie on the shore as at Courtown, but the place at which there is little or no rise and all of tide is somewhere between Yarmouth and the opposite coast of Holland, where the range is also very small (not more than 2 feet), and the time of high water corresponds nearly with that of low water at Yarmouth.

Southward of Yarmouth, after some irregularity, the time of high water becomes stationary, and simultaneous with that at Dover and the upper part of the English Channel; the range also gradually increases from 6 feet at Yarmouth to 12 feet at the mouth of the Thames, 15 feet at the North Foreland, 19 feet at Dover, and 22 feet at Dungeness.

Thus, the North Sea tide approximates to the tides of the Irish Sea and English Channel; there is in all cases the progressive wave nearly up to the node, and thence, after a short interval of apparent irregularity, the stationary wave rising and falling nearly simultaneously on the greater part of the length between the two nodes.

But the seas in which these stationary waves are found are very different in their respective forms. The Irish Sea at the place of meeting is expanded to a width of 180 miles; the English Channel is contracted by the Straits of Dover to 20 miles, from which it suddenly expands into the North Sea. There is no analogy in the Irish Sea to the coasts of the Netherlands, lying north-east of the Straits of Dover, and consequently a movement of the tides exists here to which there is no parallel in the Irish Sea.

On the English coast to the north of the Straits of Dover there is the stationary undulation, but on the opposite coast from Dunkirk to Katwyk at the mouth of the Rhine, a regular progression of the wave is accompanied by a regular diminution of the range from 19 feet at the Straits, to not more than 5 feet at Katwyk; the time occupied from Dunkirk, where the progression seems to begin, to Katwyk is 2½h.; high water at the latter place being 2½h. at new and full moon, that of the stationary wave 12h.

Beyond Katwyk the progression is irregular, as though it were the neighbourhood of a node; this is nearly opposite to Yarmouth.

At the island of Ter Schelling, north of the Zuider Zee, the tide is six hours later, or alternating with that at Katwyk, and a new progress beginning, accompanied by a regularly increasing range, from 5 feet at Ter Schelling to 10 feet at Helgoland. Beyond Helgoland the progress continues along the coast of Denmark, but the range diminishes till at the northern part of the peninsula, Jutland, the tides are nearly extinct, although the same northerly movements of what little remains of the wave appear to continue. Hence, the tides on the coasts of Holland and Denmark are very complicated in their movements; the extinction of the tide on the coast of Jutland being inexplicable.

•. The *Course of the Currents* in the English Channel and North Sea may now be approximately described.

From the entrance of the English Channel, between the Land's End and Ouessant, up to a line drawn between Portland Island and Cape la Hougue, and in the North Sea as far south as a line between Lincolnshire and the north coast of Holland, the streams turn at half tide; that is, in the natural manner of an advancing wave. Between Portland and Lincolnshire, the streams approach more nearly in their character to those of the Irish Sea. They are running towards the Strait of Dover, while the water is rising at Dover; and in the opposite direction, while it is falling at that place. They are meeting, therefore, during high water, and separating during low water, near the Strait of Dover.

But now comes a remarkable distinction between the Channel tides and the Irish Sea tides. In the Irish Sea, to the west of the Isle of Man, there is constantly still water; a rise and fall without any current. In the case of the Strait of Dover, the place of the meeting of the currents is not fixed; but at one time of tide it is in one place, at another time in another place, while at the place where an hour after low water was still water, at three hours' flood is in a rapid stream.

Thus, at the beginning of flood the streams meet between Beachy Head and Dieppe. As the tide rises, the easterly current advances, and the westerly recedes, till at a little before high water the place of still water is between Dover and Cape Gris-nez. After high water, the stream between Beachy Head and Cape Gris-nez continues to run to the eastward, and the separation takes place at Beachy Head. Then gradually the current slackens off Beachy Head, and turns to the westward, so that the place of separation travels eastward as the place of meeting had done, till at low water there is still water a little eastward of the Strait of Dover. In mid-channel the line of separation is nearly where the line of meeting was at high water, but the streams near shore have already begun to run for the flood tide. The space over which the points of meeting and separation thus move, has been called by Admiral Beechey, who first described them, "the intermediate tide." This is important to notice, as it produces an apparent "tide and half tide," though the wave is in reality stationary.

The peculiar effect of the junction of the streams of the progressive and stationary waves, which occurs near the nodes deserves notice; in these places there is a meeting or separation of two streams, which do not coincide in the times of their changes; and if they vary a little in direction, they will produce what is called a revolving current. If a stream running north encounters one of equal force running west, the two will combine into one stream running north-west. But if the northerly stream becomes more strong, while the westerly one becomes more weak, the combined streams will tend more and more to the north, till when the westerly stream has entirely ceased there remains nothing but a due north stream. Now the water which formerly was running west turns and commences to run east. The combined resultant stream will, therefore, tend to the eastward a little, and as the northerly stream slackens and the easterly stream strengthens, the two will ultimately result in a due east stream. In this manner the direction of the resultant stream has made half a circle during the time that one stream has been running north. During the other half of the tide, while the water is returning, the resultant stream will make the other half of the circle, and thus the whole will be completed in the twelve hours of the tide.

There are such revolving currents in all the cases where the progressive ocean wave changes to the stationary channel wave. The revolving current for the Irish Sea is off the coast of Pembrokeshire; there is one to the westward of the Island of Alderney, in the English Channel; another abreast of the mouth of the Humber in the North Sea. In these places the current never slackens, but is continually changing its direction. These points are all rather nearer the open sea than the nodes of the wave, but they are all equally a distinguishing feature of the change from one kind of tide to the other.

There is one point connected with the meeting of the two tides near the Strait of Dover, which should be remarked upon, namely, that the two waves are not due to the same passage of the moon, but the one which has passed round Scotland is twelve hours later than the other. The effect of this is, that in that part where the actual rise and fall are compounded of two tides, there is no diurnal inequality, the higher tide being in all cases equalized by meeting the lower one. Thus, while the diurnal inequality makes at Liverpool a difference of two feet in the height of morning and evening tides, at London and Dover there is no diurnal inequality. It is curious that the Thames, which from its familarity to most navigators has been taken as the standard with which the tides in all parts of the world have been compared, is a remarkable exceptional case in this particular.

The phenomena presented by the tides near the nodes are very curious, and have not, so far as we are aware, been yet fully explained. The double tide at Courtown is probably due to the nodes of the solar and lunar wave being in rather different positions; but we are not aware how far this explanation will hold good for the regular double tides of Swanage Bay, and the occasional ones of Yarmouth.

There are two other ways in which a double tide may be produced. First, where the place is approached by two channels of different length and by each of which the wave can arrive. One wave comes in, reaches its height, and begins to fall before the other arrives. This is probably the cause of the double tide in Southampton Water, a wave being transmitted on either side the Isle of Wight.

Occasionally also there occur double tides in the Thames, which may perhaps be due to the same cause, when the Channel and North Sea tides are unequally affected by some local disturbance, so as to prevent their meeting in the ordinary place.

A second cause is this: it has been found that when a wave of the first order travels a certain distance over a shallow bottom, its summit becomes depressed, until at last it forms a hollow between two summits. This effect may often be witnessed in the case of breakers upon a flat shore, where one swell of the ocean will be divided into two or more waves before falling upon the beach. A wind wave upon approaching the shore assumes many of the features of the wave of the first order; this among others.

It remains to be noticed that the direction of strong winds, as well as the varying pressure of the atmosphere, considerably affect both the times and the heights of high water. Thus in the North Sea a strong N.N.W. gale and a low barometer raise the surface 2 or 3 feet higher, and cause the tide to flow all along the coast from the Pentland Firth to London half an hour longer than the times and heights predicted in the Tables. Easterly, S.E. and S.W. winds produce opposite effects, which will be felt as far down the Channel as Dungeness. On the contrary, at the entrance of the Channel, at Plymouth, and as far up as Portland, south-westerly winds, with a low barometer, raise the surface of the water; and north-easterly winds, and a high barometer, always lower it.

The winds affect also the locality of the meeting of the North Sea and Channel Tides; during moderate breezes this takes place somewhere between the North Foreland and the north end of the Goodwin Sands, to the southward; and between the Kentish Knock and the Galloper, to the northward; but both these places of meeting are liable to be removed further south or north by strong northerly or south-westerly winds.

On the Tidal Currents on the West Coast of Scotland*:—The tidal currents on that part of the west coast of Scotland which is comprised between the Mull of Cantyre and the island of Mull run in general with great velocity. Their velocity, direction, and the time of their change, or of slack water, are therefore matters of great importance to navigators. On the other hand, the rise and fall of the tide is so small, and the depth of water in the channels and the harbours so considerable, that the times of high and low water are of comparatively small importance.

While the laws of the currents are thus of more importance than the laws of the rise and fall of the tide, they are also much more simple. The times of high and low water are very different at different parts of the coast, while the times of slack water are nearly the same throughout the whole region in question. In a great part of this region the current, which sets for six hours in one direction, has no distinct title to be considered either a flood tide or an ebb tide. The

* Paper read before the Royal Society and published in the Proceedings.—By Archibald Smith, M.A., F.R.S.

consequence is, that to describe the laws of the currents by reference to the time of high and low water, introduces great and unnecessary complexity. The application to the currents of the method first applied by Admiral Beechey to the tidal stream of the English Channel and German Ocean (Phil. Trans. 1851, p. 703) introduces at once order and simplicity, and makes that intelligible which before was only a confused maze.

In the following paper an attempt is made, from the materials to be found in the charts of the Admiralty Survey of the West coast of Scotland, now nearly completed, to obtain a first approximation to a tidal chart of the west coast of Scotland. For this purpose I have, with the kind assistance of Commander Evans, F.R.S., the first Naval Assistant to the Hydrographer of the Navy, deduced from the charts all the information to be there found as to the direction and times of change of the tidal streams, as well as the times of high and low water.

In the seas now under discussion, the stream at any point generally flows for six hours in one direction and for six hours in the opposite direction.

The time of high and low water in the region which we are considering may be thus described. Near the two extremities, viz. the Giant's Causeway and the island of Eysdill, the time of high water at full and change is nearly V ½ Greenwich time, being very nearly that due to the great Atlantic tidal wave propagated from S.W. to N.E., and the same is very nearly the hour of high water on the chain of islands of which Isla, Jura and Scarba are the chief. But along the coast of the main land of Ireland and Scotland the case is very different. Between these two countries is the great opening into the Liverpool basin, in which it is high water about XI. The change in the time of high water takes place by the following gradations:—At Giant's Causeway it is high water about VI., at Ballycastle VII., Torpoint X., Mull of Cantyre XI., Gigha II., Loch Killispoint IV., Eysdill and Scarba V., Jura and Islay V ½. But while the hour of high water varies, the stream through nearly the whole of the region runs from X. to IV. in one direction, and from IV. to X. in the other.

Between the Mull of Cantyre and the N.E. coast of Ireland, the X. to IV. stream runs to the north.

The most westerly part turns to the west, and runs through the Sound of Rathlin along the north coast of Ireland; the central part flows to the N.W. past the Rhynns of Islay; the easterly part, which has flowed partly through the Sound of Sanda, turns sharply round the Mull of Cantyre, and flows to the northward, pouring with great velocity through the narrow openings in the chain of islands, viz., the Sound of Islay between Islay and Jura, the Gulf of Corryvreckan between Jura and Scarba, the little Corryvreckan between Scarba and Lunga, the Slate Isles and the Cuan Sound; of these the little Corryvreckan is quite impassable; and Corryvreckan and the Cuan Sound are seldom attempted except near slack water.

These channels open into the basin which lies between Jura and Iona—a comparatively tideless sea, owing apparently to the circumstance of the ocean tide from the outside of Islay rising to nearly the same height as that which pours through the openings, so that the tidal stream would be little altered by building a dam from Islay to the Ross of Mull.

The question may now be asked, Is the great X. to IV. stream which has just been described a flood or an ebb tide? So far as regards the Mull of Cantyre, Fairhead, and all that lies to the south or east, it is a true ebb tide. So far as regards Jura, Scarba, and the coast to the north and east, it is a true flood tide; but as regards a great part of the region in question, it cannot be called either a flood or an ebb tide, and much confusion is occasioned in the Charts by attempting so to distinguish it.

At the south end of Gigha in the Admiralty charts an arrow is laid down, indicating that the flood tide runs to the northward; and a few miles south of this, another arrow is laid down, indicating that the flood tide runs to the southward. From these arrows we might expect to find at this place a meeting of the tide and a sudden change in the direction of the flood stream. But the stream which is indicated by these arrows is nothing more than the great X. to IV. northerly current which we have described. The spot which is treated as a meeting of the tides, is merely that at which it is high water at I. North of this, for more than three hours of the X. to IV. stream, the tide is rising, and it is indicated as a flood tide. South of this for more than three hours the tide is falling, and it is indicated as an ebb tide.

On the south and west coast of Islay the confusion is greater. In some of the charts, the incoming stream is marked as the flood, in others, and perhaps with better reason, the outgoing tide. It is in truth neither the one nor the other.

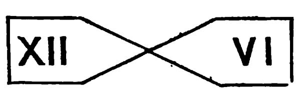
The extreme complication which arises from describing the time of change of the stream by reference to the time of high and low water will now appear; thus we should have to say that in the Sound of Sanda, the ebb stream begins two hours before high water; at the Mull of Cantyre, one hour before high water; a little north of this again two hours before high water. At the south of Gigha we might say indifferently, that the flood tide runs to the south and begins three hours before low water, or that it runs to the north and begins three hours after low water; in the Sounds of Islay and the Gulf of Corryvreckan that it begins an hour before low water; and in describing the streams along the north coast of Ireland, we have even greater complication.

The direction of the tidal streams on the rest of the west coast of Scotland is easily described. The X. to IV. stream, through the course which I have described, becomes an XI. to V. stream at the outside of Islay, an dthrough the Sound of Iona. The stream which sets to the northward up the Sound of Jura fills the Linnhe Loch, and causes high water at the south end of the Sound of Mull at half-past V., whilst the high water caused by the ocean tide at the north end of the Sound of Mull is an hour later; the consequence, as may easily be seen, is that nearly the whole flood tide through the Sound of Mull runs to the northward, and the nearly whole ebb tide runs to the southward.

The tides round the island of Skye are comparatively simple. The V. to Y tide from the outside of Mull is gradually retarded to a VI. to XII. stream outside of Skye, and then as it rounds the north end of Skye, it is met by the tidal stream which has rounded the north end of the island of Lewis, and bends round into the inner Sound of Skye, where it becomes a VII. to I. tide; the course of both streams being nearly the same as if there were an embankment from Loch Shell in the island of Lewis to Ru Rea on the coast of Ross-shire. At the same time, another branch of the tide which has rounded the point of Ardnamurchan flows through the Sound of Skye as a XII. to VI. tide, and being an hour earlier than the tide which has rounded the north end of Skye, it pours with great velocity through Kyle Rea, but only to fill Loch Alsh and Loch Duich; the retardation which it meets with in so doing, making the rise inside of the narrows at Kyle Akin so nearly contemporaneous with the rise outside, that there is little stream through that narrow opening; the flood stream, as I am informed, sometimes flowing in one direction and sometimes in the other, according to the prevailing winds.

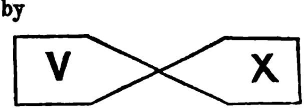
There are many more minute details in these streams which have features of great interest. I have not, however, ventured in the present imperfect state of the data which we possess to enter upon these. I venture, however, to express a hope that before the survey is completed, the data may be obtained for showing, and that the charts may show, the direction and rate of the stream at every place and at any time.

[The times here spoken of are those at F. and C., and they will consequently vary day by day in each locality, between the time of F. and C., but the *direction of the stream* will not vary, and hence Mr. A. Smith recommends the projection of a few symbols on the chart for the information of mariners navigating the seas indicated; thus,—



shows a stream flowing from XII. o'clock to VI.,—6 hours towards the east; and from VI. to XII.,—6 hours towards the west.

The same symbol is adapted to the case of a stream flowing longer in one direction than in the other. Thus in the Sound of Sanda the stream at full and change may be indicated by



showing that it flows seven hours towards the west and five hours to the east.]

The following Table gives the Time of High Water on Full and Change days at all principal Ports and Harbours of the North Atlantic, *with the Rise of the Tide at Springs and Neaps.*

Place.	High Water Full and Change.	Rise. Spg.	Rise. Nps.
	H. M.	ft.	ft.
Abaco, Bahamas . . .	8 0	3	
Abbey Head, England. .	11 10	23	17½
Aberdeen, Scotland . .	1 0	12	10
Aberdovey, Wales . . .	8 0	15	
Abervrach, France . . .	4 14	22	16
Aberystwyth, Wales . .	7 31	13½	10
Achillbeg, Ireland . . .	5 14	10¾	8
Agadir, or Santa Cruz Africa.	12 45	9	
Aggerminde, Jutland . .	4 9	2	
Agnes, St., Scilly Isles .	4 30	16	12
Aix, Ile d', Charente R., France.	3 20	17	12½
Aldborough, England . .	10 45	8?	6½?
Alderney, English Channel	6 46	17	12¾
Algeciras, Spain . . .	1 49	4	2½
Alloa, Firth of Forth, Scotland.	3 18	17½	15
Altona, Germany . . .	5 19	7	
Ameland Gat. Netherlands	9 0	7	
——— Hollum Rd., Netherlands.	11 30	7	
Amet Sound, Nova Scotia	10 30	8	5
Almwch, Wales	10 30	18?	13?
Anegada, Virgin Islands .	9 0	1½	
Angra, Azores	12 32	4½	
Annan Foot, England .	11 56	20	14
Annapolis, Nova Scotia .	11 0	30	
——— United States	17 4	1	1
Anne, St. B. Cape Breton	8 34	6	4¾
Anticosti Id., G. St. Lawrence, East Cape . .	1 0	5	3
,, Bear Bay . . .	1 10	5	3
,, West Point . .	2 0	6	4
Antigonish Harb., R. St. Lawrence.	9 0	4	2
Antigua Id., Caribbean Sea.		2	
Antonio, Cape St. Cuba .		1½	
Antrobus Id., G. St. Lawrence.	10 30	5	3
Antwerp, Belgium . , .	4 25	15	
Apalachicola B., Gulf of Mexico.		2	
Appeetetat Bay, Gulf St. Lawrence.	11 10		
Appledore, England . .	5 28	23	16½
Araish El, Africa, N. Cst.	1 30	9–12	
Arbroath, Scotland . .	1 35	14	11
Arcachon, France . . .	4 37	11¾	9¼
Arcas Rks. G. of Mexico	noon	1½	
Ardglass, Ireland . . .	11 0	16	12
Ardrishaig, Loch Fyne .	11 53	9	7½
Ardrossan, Scotland . .	11 45	10	8
Argyle, Bay of Fundy . .	9 36	13¾	10½
Arichat, Nova Scotia . .	8 10	5	4
Arkhangel, White Sea .	7 28	2½	
Arklow, Ireland	8 45	4	3
Arundel, England . . .	12 25		
——— (Bar)	11 35		
Askaig Port, Islay . . .	4 58	6¼	4
Athline, Loch Seaforth .	6 16	15	10
Augustine St., U.S. . .	8 32	5	4
Axim, Africa, W. Coast .	4 30	4	
Ayr, Scotland	11 50	8¾	7½
——— Point of, Isle of Man	11 7	20?	16?
Balbriggan, Ireland . .	10 40	11	
Bald Head, United States	7 26	5	4½
Ballinacourty, Dungarvan, Ireland.	5 12	12½	9½
Ballinskellig Bay, Ireland	3 40	12	7½
Ballycastle Bay, Ireland .	6 8	4	
Ballycotton, Ireland . .	4 54	12	9½
Ballycrovane, Kenmare R., Ireland.	3 42	10½	7¾
Ballynakill Bay, Ireland, W. Coast.	4 40	12½	9¼
Ballyness (Bar), Ireland .	5 22	11½	8¼
Ballysadare (Quay), Ireland.	6 0	8¾	5¾
Ballyshannon (Bar) . .	5 18	11¼	8½
Ballyweel, Ireland . . .	5 23	12½	8
Balta, Scotland	9 45	6	4½
Baltimore, Ireland . . .	4 23	10¼	8¼
——— United States	18 59	1½	1¼
Banana Ids., Africa, W.C.	8 15	9	
Banff, Scotland	0 28	10½	8
Bantry Harb., Ireland .	3 47	10	7½
Bardsey Id., Wales . .	7 40	15	
Barfleur, France . . .	8 51	17	13½
Barmouth, Wales . . .	7 41	17	13½
Barnstaple, United States	11 0	9	
Barnstaple Bar, England	5 30	19	14
——— Bridge ,,	6 28	10½	7½
Barquero (entrance) Spain N. Coast.	3 0	15	
Barrow Harbour, Newfoundland.	7 10?	5?	
Bas, Ile de, France . .	4 49	23	17
Bathurst, G. St. Lawrence	8 15	7	4
Bathy, Netherlands . .	3 15	15	
Batiscan, R. St. Lawrence	9 48	3½	2
Bayonne (Bar), France .	3 45	12	10
Beachy Head, England .	11 20	20	15
Bear Cape, Prince Edward Island.	9 0	6	3
Beaubère Id., Gulf St. Lawrence.	6 30	6	4
Beaufort, United States .	7 26	3¼	2¾
Beaumaris, Wales . . .	10 32	21½	16¼
Beaver Harb., Nova Scotia	7 40	6½	4½
Bedeque Harbour, Prince Edward Island . . .	10 15	7	5
Belfast, Ireland	10 43	9½	8
Bell Sound, Spitsbergen .	8 56	3¼	
Belles Amour B., Labrador	9 0	4½	2¼
Bembridge Pt., England .	11 0	14	10½
Benin R., Africa W. Coast	4 30	7	
Berbice, Guayana . . .	4 30	11?	
Bergen, Norway . . .	1 30	4	
Bermudas: Ireland Id. .	7 14	4	
Bernera, Loch Roag, Lewis I.	6 11	11	8

Place.	High Water Full and Change.	Rise. Spg.	Rise. Nps.
	H. M.	ft.	ft.
Berneray, I. of Harris. Scotland.	6 11	13	9½
Bersimis R., Gulf St. Lawrence.	2 0	12	7
Berwick, Scotland . . .	2 18	15	11½
Betcheween Harb., G. St. Lawrence.	11 32	5	3
Bic Id., G. St. Lawrence	2 15	14	8½
Bideford, England . .	6 7	16	
Bijouga Islands, Arcas Channel, Africa, W. Cst.	10 10	12	9
——Bissao, Africa, W. Coast.	11 0	8	
——Orango Channel, Africa, W. Cst.	10 0	11	
Bilbao (Bar), Spain . .	3 0	13	
——(Town), ,, . .	3 20	9	
Binnic, France	6 3	30	22½
Bird Island Light, United States.	7 59	5½	4½
Blaavand Point, Jutland .	1 44	5	
Black Ball Harb., Ireland	3 40	9½	7½
—— Rock Lt., Bay of Fundy.	11 36	37½	29
Blacksod Bay, Ireland .	5 38	10½	7½
Blakeney, England . .		9	
—— (Bar) ,, . .	6 30	15	
Blankenberg, Belgium .	12 48	13	11
Blanco Cape, Africa, W. Coast.	11 46	6	
Blewfields, Mosquito Cst.	1 50	2	
Block Id., United States .	7 36	3½	2½
Bluff Cay, Bahamas .	7 0	4½	
Blyth, England . . .	3 15	15	11
—— R., Southwold, England.	10 20	6½	4½
Bodkin Light, United States.	13 8	1½	1
Bojador Cape, Africa . .	12 0	8?	
Bolt Head, England . .	5 45	15?	11?
Bonacca Id., Bay of Honduras.	9 0	1½	
Bonanza, Spain. . . .	2 0	12½	8
Bonne Esperance Harb., Gulf of St. Lawrence.	9 15	5	2½
Bonny R. Africa, W. Cst.	5 0	9	
Bordeaux, France . . .	6 50	14	12¾
Borkum (Road), Germany	10 30	8–10	
Boscastle, England . .	5 15	25	17½
Boston (Sluice), England	7 0	12	
—— Deep (Clay Hole), England.		21½	
—— Hob Hole, England.		17	
—— (Charleston Yard) United States.	11 27	11½	10
——Light, United States	11 12	11	9½
Boucaut, France . . .	3 39	8¾	6
Boughton Harb., France Edward Island.	8 40	5	2¾
Boulogne, France . . .	11 25	25	19½

Place.	High Water Full and Change.	Rise. Spg.	Rise. Nps.
	H. M.	ft.	ft.
Bradore Bay, Labrador .	8 45	4	2
Braha Harbour, Newfoundland.	7 0?	2–3?	
Brandy Pots, River St. Lawrence.	3 0	17	10
Brass River, Africa . .	4 0	6	
Bray Head, Ireland . .	10 45	12	9½
Bréhat, France . . .	5 51	31	23½
Brest, France	3 47	19	13¾
Bridgeport, United States	11 11	8	6½
Bridgewater (Bar), England.	6 50	35	26½
Bridlington, England .	4 39	16	12
Bridport, England . .	6 5	11½	7¾
Brielle, Netherlands . .	3 0	5	
Brighton, England . .	11 15	19¾	16
Bristol (King Road), England.	6 56	44	33
Broadhaven Har., Ireland	5 0	10½	7½
Broom Loch (Ullapool) .	6 40	14½	10½
Broughty Ferry, Scotland	2 22	14½	11
Brouwershaven, Netherlands.	2 15	10	8
Brunsbuttel, Germany .	1 58	9	
Buctouche River, Gulf St. Lawrence.	3 30?	4?	2½?
Budehaven, England . .	5 34	23	17
Bulama Island (Arcas Channel), Africa, W. Cst.	10 10	14	11
Bull Id., Newfoundland .	7 22	3½	2
Bulls Island Bay, United States.	7 16	5¾	4½
Buncranna, Ireland . .	5 40	16	
Burntisland, Firth of Forth, Scotland.	2 24	16½	1 ¾
Burnt Isles, Kyles of Bute, Scotland.	11 50	10	8
Burrard Inlet, Gulf of Georgia.	6 0	16	
Burry, Port, Wales . .	6 1	25½	18½
Busuanga, Burias Island	12 30	6	
Button Islands, Hudson Strait.	6 50		
Cacheo River, Africa W. Coast.	7 45	8	
Cadiz, Spain	1 45	9½	
Caen, France	10 57		
Caermarthen (Bar), Wales	6 10	26	19½
Caernarvon, Wales . .	9 33	13¾	10½
Calais, France	11 49	19½	15½
Caldy Island, Bristol Channel.	6 0	24?	16?
Calebar R., Africa, W. Cst.	5 0	9	
Caledonia Harbour, New Granada.	11 40	1½	1
Calf Sound, Isle of Man .	11 17	16½	13
Calshot (Castle Pt.), England.	11 30	13	9½
Cameroon R., Africa, W. Cst	4 0?	6	
Campbell Town, Gulf St. Lawrence.	4 0	10	7

Place.	High Water Full and Change.	Rise. Spg.	Rise. Nps.
	H. M.	ft.	ft.
Campbellton, Scotland .	11 45	8½	6
Campeche, Yucatan . .	1 45	2½	2
Campobello, B. of Fundy	11 19	21	18½
Cancale, France . . .	6 20	37	27
Canso Gut, (Plaistow Cove), Nova Scotia	9 10	4½	3
——— Har., C. Breton Id.,	7 48	6½	4½
Cantin Cape, Africa . .	10 0	10	
Cape Coast Castle, Africa, W. Coast	4 30	6	
Cape May Landing, U.S.	8 19	6	5
Caraquette Harbour, Gulf of St. Lawrence . . .	2 40	6	3
Cardiff, Wales	6 59	38	29
Cardigan, Wales . . .	7 1	12	9
——— Bay, Prince Edward Island	8 40	5	3½
Caribou Harbour, Nova-Scotia	10 0	6	4
Carouge, River, R. St. Lawrence	7 15	16	11
Carleton Point, Gulf of St. Lawrence	8 0	6	4
Carlingford (Bar), Ireland	10 40	17	13
Carlisle Port, England .	12 10	20	14
Carrigaholt, Ireland . .	4 44	14	10½
Carsaig, Scotland . . .	5 28	10	7½
Cartagena, New Granada	11 0	1½	1
Carteret, France . . .	6 25	31	22½
Cascumpeque Har., Prince Edward Island . . .	5 40	3	2
Cashla Bay, Ireland . .	4 33	16	12
Casquets, English Channel	6 45	15½	
Castleton, Hudson, R., U.S.	4 29	3	2½
Castletown, Bearhaven, Ireland.	4 14	9¾	7½
——— Isle of Man .	11 10	20	16
Castletownsend, Ireland .	4 21	10¾	8
Castors Harbour, Newfoundland	10 50	5?	
Catalina Harbour, Newfoundland	7 0	6	4
Cattawade Bridge, Stour River, England . . .	1 8	4½	
Catoche Cape, Yucatan	9 30	1	
Cawee Islands, Gulf St. Lawrence	1 50	9	5
Cay West, United States.	9 22	1½	1
Cay N.W. Channel, U.S.	9 10	1½	1½
Cayenne, Guayana . .	3 45	6	
Cayeux, France. . . .	11 5	27½	21
Cedar Cays, United States	13 15	3½	1½
Cedeira, Spain, N. Coast	3 0	15	
Ceuta, Africa, N. Coast .	2 6	3¾	2½
Chacuarama B., Trinidad	4 20	4	2½
Chacachacara Id., Trinidad, Caribbean Sea . . .	3 30	4	
Champlain R., St. Lawrence.	9 45	3	2
Charles Cape, U.S. . .	7 45	5	
Charleston, United States	7 26	6	4
Charlottetown, Prince Edward Island	10 45	9½	7
Charlowka, R., Lapland .	8 8	12	
Chateau Bay, Labrador .	7 35	3½	1
Chatham, England . .	1 2	17½	14
Chatte Cape, United States	12 0	13	8
Chausey, Isles de, France	6 9	35	26
Chepstow, England . .	7 30	38	28½
Cherbourg, France . .	7 49	17	12¾
Chesilton, England . .	6 13	10½	7
Chester. England . . .	10 30	26	
Chester River (Rockhall Creek), United States .	5 23	2½	1
Chetican, C. Breton Id. .	8 15	3½	
Chichester, England . .	11 30		
Chignecto C., B., of Fundy	11 0	32	
Chipiona, Spain . . .	1 34	12½	8
Christchurch, England .	9 0 / 11 30	5	
Christianstæd, Santa Cruz	7 30	½	
Chutes Cove, Bay of Fundy	11 15	32	25
Clam Point, Bay of Fundy	8 0	7	5½
Clare Island, Ireland . .	4 38	12½	9½
Clarence Harbour, Long Island, Bahamas . .	8 30	4	3½
Clarke Har., B., of Fundy	8 40	9½	7
Clear Cape, Ireland . .	4 0	9	6½
Clearwater Point, Gulf St. Lawrence	11 30	5	3
Cley, England, N.E. Cst.		5½	
Clifden Bay, Ireland, W. Coast	4 30	13½	10
Clinch Fort, Fernandina, United States . . .	7 53	6¾	5½
Clonokilty Bay, Ireland .	4 30	11	8½
Coacoacho Bay, Gulf of St. Lawrence	10 30	5	3
Cocagne River, Gulf of St. Lawrence	7 30?	4?	2?
Cockenzie, Firth of Forth, Scotland	2 16	15¾	13
Cod Cape, United States	11 30	13	
Codroy Island, Newfoundland.	9 15	6	4
Cold Spring Inlet, United States	7 32	5½	3½
Coleraine, Ireland . . .	6 24	6½	4
Colne Point, Colne River, England	12 0	14	10
Colombilla Cay, Pearl Cays, Caribbean Sea .	2 0	2	
Componee R. Africa, W.C.	10 0	15	11½
Concarneau, France . .	3 12	13	9½
Conil, Spain	1 18	11¾	7½
Conquet Road, France .	3 46	21	15
Cook Har., Newfoundland	7 25		
Coquet Road, England .	3 0	14½	11
Cordouan Lt. house France	3 37	13¾	10½
Corentyn River, Guayana	5 10	8½	6
Corisco Bay (Elobey Isles), Africa, W. Cst. .	5 0	7	

Place.	High Water Full and Change. (H. M.)	Rise. Spg. (ft.)	Rise. Nps. (ft.)
Cork (Penrose Quay), Ireland	4 58	12¾	10
Corn Ids., B. of Honduras	1 45	2	
Cornwall Cape, England	4 35	18?	13
Corpach (Loch Aber), Scotland	5 59	11½	
Corran (Loch Aber), Scotland	5 43	12	8¼
——— Loch Linnhe, Scotland	6 37	14½	
Corunna, Spain	3 0	15	
Coudres Id. (Prairie Bay), R., St. Lawrence	4 25	17	10
Courseulles, France	9 7	20	15½
Courtmacsherry, Ireland	4 36	10¾	8½
Coverack, England	4 35	14½	11¼
Cow Head Harbour, Newfoundland	10 41	8¼	6½
Cowes (West), England	10 45 / 11 45	12½	9½
Cozumel, B. of Honduras	8 30	1½	
Crane Island, River St. Lawrence	5 24	17	13
Cranford Bay, Mulroy Bay Ireland	8 3	4	
Crapaud, Prince Edward Island	10 0	8	6
Crinan, Scotland	4 49	6–8	4–5
Croc Harbour, Newfoundland	6 30?	4?	
Cromarty Scotland	11 56	14	11
Cromer, England	7 0	14¾	11
Crow Harb., Nova Scotia	8 0	6½	4½
Crooked Island, Bahamas	7 0	2½	
Crookhaven, Ireland	4 9	9¾	8
Cuckolds Point, River Thames, England	1 45	19?	15?
Culdaff Bay, Ireland, W. Coast	5 53	8¾	6
Culebra or Passage Id., Caribbean Sea	9 0	1	
Cumberland Basin, Bay of Fundy	11 48	50	37
Cuttyhunk, United States	7 40	4¼	3
Cutwell Harbour, Newfoundland	7 0?	2–4?	
Cuxhaven, Germany	1 8	10	
Dahouet, France	6 5	32	23½
Dalhousie Harb., G. St. Lawrence	3 10	9	
Dalkey Island, Ireland	10 45	13	11
Danes Island, Spitzbergen	0 24	5½	
Dark Harbour, Bay of Fundy	11 3	18	15
Dartmouth, England	6 16	14	10
De Roompot, North Sea	12 30	12	8
Deal, England	11 15	16	12½
Deer Sound, Orkneys	10 30	10	7½
Deer Harb., Newfoundland	7 49	3½	2
Delaware (Breakwater) United States	8 0	4½	3
Delftzyl, Germany	11 15	8–10	
Demerara R., Guayana	4 45	9	6
Devonport Dockyard, England	5 43	15½	11½
Dielette, France	6 40	27	20¾
Dieppe, France	11 6	27	20½
Digby Gut., Bay of Fundy	11 2	28	22½
Dingle, Ireland	3 51	10¾	7¾
Dives, France	9 39	21	16
Doboy Lighthouse, U.S.	7 33	7¾	5½
Dodo River, Bight of Benin	4 17	5	
Donaghadee, Ireland	11 13	11¼	9½
Donegal Harbour, Ireland	5 18	11½	8½
Dornock Road, Scotland	12 0	11	
Douglas, Isle of Man	11 12	20¾	16
Douglas Road, Bahamas	8 30	4	2½
Dover, England	11 12	18¾	15
Downham Reach, Orwell, England	12 27	12	
Dragons Mouth, Caribbean Sea	3 0	4	
Drogheda (Bar), Ireland	11 0	11¾	9
Duart, Isle of Mull	5 0	12	10
Dublin (Bar), Ireland	11 12	13	9–11
Dumbarton, Scotland	0 40	9	
Dunbar, Scotland	2 8	14½	11
Dunbeacon, Ireland	3 51	10¼	7½
Duncansby Ness, Scotland	10 14	10	7
Dundalk, Ireland	10 56	13¼	11½
Dundee Scotland	2 32	14½	11¼
Dungeness, England	10 45	21¾	19
Dunkerque, France	12 8	16¼	13½
Dunkerron, Kenmare R., Ireland	3 45	10½	8
Dunmanus Harb., Ireland	3 57	9½	7¼
Dunmore, Island	5 27	12¼	9¾
Dvina (Bar), White Sea		3¼	
Easdale Sound, Scotland	5 25	1012	
East Point, Prince Edward Island	8 30	3½	2
Eclipse Harb., Labrador		5	
Ecrehous, France	6 32	31	22½
Edgartown, United States	12 16	2½	1½
Edmonstone Id., Sherbro River, Africa			8
Edina, Africa, W. Coast	5 50	4	
Egg Id. Lt. United States	9 4	7	5
——— Gulf St. Lawrence	2 0	11	6
Egmont Bay, Prince Ed. Island	3 0	4	2
Eides Fiord, Færoe Ids	11 0	9½	7½
Eigg Island, Scotland	6 15	14	10
Elbe, Entrance, Germany	12 0	11	
Ellen Port, Islay	5 0	5	4
Ellenwood Id, B. of Fundy	9 47	13	9½
Emden, Germany	12 0		
Ems River, (outer buoy), Germany	10 0	8–10	

Place.	High Water Full and Change.	Rise. Spg.	Rise. Nps.
	H. M.	ft.	ft.
English Harb., Antigua .		2	
Erebus Bay, Barrow Strait	12 6	8	
Erme River, Bigbury Bay, England	5 40	16½	11¼
Erqui, France	5 59	33¼	24½
Escumenac Point, Gulf of St. Lawrence . . .	4 10	4	2½
Exmouth England . .	6 21	12¼	8½
Exuma, Bahamas . . .	7 20	2½	
Eyemouth, Scotland . .	2 15	15?	11
Fair Isle, Shetlands . .	11 0	5	3½
Fall Harbour, Labrador .	6 40	3½	
Falmouth, England . .	4 57	16	12
Fanny Hole, Mulroy Bay, Ireland	6 17	9¾	8
Fareham (close to the Upper Quay), England	11 48	11¼	8½
—— Bridge, England .	11 51	7½	4¾
Fayal, Azores, Atlantic	11 45	4	
Fear Cape, United States	7 0	7	
Fécamp, France . . .	10 44	23½	18
Fenit, Tralee Bay, Ireland	4 3	12½	9¼
Feolin Ferry, Jura . . .	4 41	6½	4¼
Fernandina, Chinch Port United States . . .	7 53	6¾	5¼
Fernando Po, Bight of Biafra	4 0	7	
Ferole Cove, New, Newfoundland	10 50	5?	
—— Harb., Old Newfoundland	9 28	4½6½	
Ferribly Sluice, River Humber	6 41	20¼	
Ferrol, Spain	3 0	15	
Ferro, Canary Islands .	12 30?	9?	
Ferry Side, South Wales	5 49	23	16¾
Filey Bay, England . .	4 20	16	12½
Finisterre Cape, Spain .	3 0		
Fish Hd., G. Manan, Bay of Fundy	11 4	24	18½
Fishguard, Wales . . .	6 56	11½	8¼
Flamborough Hd., England	4 30	16	12
Flamand Bay, St. Domingo	irr.	2–3	
Flatholm, Ids., Bristol Channel	6 54	37?	28?
Fleetwood Port, England	11 12	26¼	19¾
—— Wyre Light . .	11 11	27	20½
Fleur de Lis Harbour, Newfoundland . . .	7 0?	2–4?	
Florida Cape, United States	8 34	1¾	1¼
Flushing, Belgium . .	1 20	15	
Fogo, Id., Newfoundland	7 20	4	
Folkstone, England . .	11 7	20	16½
Folly Point, Petitcoudiac River, Bay of Fundy .	11 49	45	38
Forcados River, Bight of Benin	4 22	5	
Forecarreah R., Africa, W. Coast	7 40	11	
Formby Point, England .	10 35	28	
Fort Dauphin, St. Domingo	7 0	5½	3½

Place.	High Water Full and Change.	Rise. Spg.	Rise. Nps.
	H. M.	ft.	ft.
Foulness, Crouch River, England	12 5	14½	10½
Fowey England . . .	5 14	15	11¾
Foyle Lough (Warrenpoint), Ireland . . .	6 20	6½	5
Foynes Island, Ireland .	5 35	15½	12
Fraserburgh, Scotland .	0 40	11	8½
Freehelle Point, River St. Lawrence	8 0	14	9
Friederichstadt, Denmark	2 37	9	
Frederickshaab, Greenland	6 3	12½	9¼
Fugloe Fiord, Faroe Ids .	11 15	6½	4½
Funchal Bay, Madeira .	12 48	7	
Funk Id, Newfoundland .	7 0?	2–3?	
Fury and Hecla Strait, Arctic Regions . . .	7 0	8	
Gaboon River, Africa W. Coast	5 30	3	
Gallinas R., Africa, West Coast	6 45	4	
Galloway (Mull of) . .	11 15	15?	12?
Galveston, Gulf of Mexico		4	
Galway, Ireland . . .	4 35	14¾	11
Gambia R., Africa, West Coast	8 10	6–9	
Garliestown, Scotland, W. Coast		17	12
Garroch Head	11 49	10	
Gaspé Basin, G., St. Lawrence	1 50	5	3
Gay Head, United States	7 37	7	
George Cape, Nova Scotia	10 15	4	2
George d'Elmina St., Africa, W. Coast	4 30	6	
—— Port, B., of Fundy	11 22	34	26½
——Shoals, United States	10 30	7	
—— St., Harb., Newfoundland	10 3	6¾	4½
Georges, St., Sound, Gulf of Mexico, middle entrance.	1 31	1¾	1¼
—— west entrance	irr.	2½–4	
Georgetown, United States	8 40	4½	3½
Germain St., France . .	6 20	34	25
Gibraltar (Old Mole), Spain.	2 20	3½	
Gigha Sound, Scotland .	2 22	4	2½
Gijon Bay, Spain, N. Cst.	3 15	15	
Gilbert Pt., Saint Mary B., Bay of Fundy . . .	10 39	22½	17
Gilmorris Island, Africa, W. Coast	6 0	11	
Glasgow, Scotland . . .	1 25	9	7½
—— Port, Scotland .	0 18	9	
Glenan Isles, France . .	3 12	13	10
Gloucester Harbour, U.S.	11 4	10¾	8¾
Gluckstadt, Germany . .	3 9	10	
Godbout River, Gulf St. Lawrence	1 52	11	6
Goeree (West Gat) . .	1 45	7	
Good Bay, Newfoundland	10 40	7½	5½
Goole, River Humber, Eng.	7 26	13	

Place.	High Water Full and Change.	Rise.	
		Spg.	Nps.
	H. M.	ft.	ft.
Gomera, Canary Islands	12 45?	9?	
Gometra, Loch Tuadh, Isle of Mull	5 29	11¾	8
Goose Cove, Newfoundland	7 0?	2–3?	
Gorda Sound, Virgin Is.	8 30	1¼	
Gorée, Africa, W. Coast	7 45	2½	
Goury, France	7 6	22	17½
GonaivesBay, St. Domingo	8 0	1	
Gracias, Cape, Harbour, Bay of Honduras	10 30	2	
Grand Cestos, Africa, W. Coast	5 20	4	
——— Harb., Gd. Manan, Bay of Fundy	11 4	17¾	14½
——— Lahou, Africa, W. Coast	4 20	4	
——— Rustice, Prince Edward Island	6 40	4	2
Grand Passage, B. of Fundy	10 43	20¾	17
Grande-digue, Madame, Id., Cape Breton Island	7 55	6½	4½
Grandine, R. St. Lawrence	9 0	9	6
Granton Pier, Scotland	2 20	16	12½
Granville, France	6 13	37	27½
Gravelines, France	12 0	19	15
Gravesend, England	1 10	17½	14
Great St. Lawrence Harb. Newfoundland	8 30	7	4
Greatman Bay, Ireland. W. Coast	4 39	15½	11½
Greencastle Point, Ireland	11 2	14	11¼
Green Island, River St., Lawrence	2 45	16	9½
Greenock, Scotland	12 8	9¾	8¼
Greenwich, England	1 43	19	15
Grenada (St. George Harb.) Caribbee Is.	2 40	1½	¾
Grenadines, Caribbee Is.	3 0	1¼	1
Greytown, Mosquito Coast	9 0	1¼	
Gribanika Pt., White Sea	4 50	3	
Griffith I., Barrow Strait.	12 15	3¾	2¾
Griguet Bays, Newfoundland	7 0?	2–3?	
Grimsby, England	5 36	19½	15
Grindstone Ireland, Bay of Fundy	10 39	44	33½
Grisnez Cape, France	11 27	21½	16¾
Grondine R., St. Lawrence	9 0	9	6
Gruinard Island, W.C. of Scotland	6 37	14½	
Guernsey (St. Peter's Port) English Channel	6 48	26½	18½
Guinchos Kay, Bahamas	7 40	3	
Gulliver Hole, B. of Fundy	10 51	26	19¾
Gun Cay, Bahamas	8 30	3	
Gunfleet Sand, England	11 40	12	8
Guysborough, Nova Scotia	8 20	6½	4½
Gweedore (Bunbeg,) Ireland	5 32	11	8
Haarlem, Netherlands	9 0		
Habitable Id., Lapland	7 9	9	
Hakluyt Hd., Nova Zembla	1 30	4	
Halifax, Nova Scotia	7 49	6	4
Hamburg, Germany	5 29	6½	
Hammerfest, Norway	1 10	9	
Hammond Knoll, England, E. Coast	7 40		
Hanniwell Pt., Maine, U.S.	11 15	9½	7
Hanover Sound, Bahamas	8 15	4	3
Harbour Grace, Newfoundland	7 30?	7?	
Harbour Id., Nova Scotia	7 40	6½	4½
Harrington, Port, England	11 5	26	19
Hartlepool, England	3 28	15	11¾
Harwich, England	12 6	11½	9½
Hastings, England	10 53	24	17½
Hatteras Cape, U.S.	9 0	5	
——— Inlet, U.S.	7 4	2½	1¾
Haute Isle, Bay of Fundy	11 27	35½	27½
Havana, Cuba		3	
Hâvre, France	9 51	22	18
Haytien C.. St. Domingo	6 0	3	
Hearts Content, Newfoundland	7 30	4	2½
Héaux, Lights, France	5 45	31	23½
Helena St. Sound, U.S.	7 8	7½	4½
Helford, England	4 43	15½	11½
Helgoland, German Ocean	11 33	9½	7
Helier St., Jersey, English Channel	6 25	30½	21¾
Hell Gate, Long Island, U.S. (Blackwells Dock).	9 59	6	5½
Hellevoetsluis, Netherlands	2 30	8	6
Henlopen Cape, U.S.	8 0	3–4	
Henry Cape, United States	7 40	4	
Heybridge, Blackwater River, England	12 20	12	8
Hierting, Jutland	2 45	5	
Higbees, Cape May, U.S.	8 33	6½	4
Hillsborough R., Charlottetown, Prince Edward Id.	10 45	9½	
——— (Head of R.)	11 0	10	7
Hillswick Firth, Shetland	9 45	6½	5
Hilton Head, United States	7 19	7½	6½
Hirtshals, Jutland	4 28	1	
Hollesley, England	11 30	8?	6?
Holmes Hole, U.S.	11 43	1¾	1½
Holsteinborg, Greenland	6 30	10	
Holy Island, England	2 30	15	11½
Holyhead, Wales	10 11	16	12½
Honfleur, France	9 29	23½	18
Hood Port, Gulf St. Lawrence	9 0	4½	2
Hope Harb., Falkland Ids.	8 10	7	
Horn or Blaavand Point, Jutland	1 44	5	
Horton Bluff, B. of Fundy	12 30	48	40
Hougue, La, France	8 42	18½	14½
Hourdel, France	11 26	27½	21
Howden, R. Tyne, Eng.			
Howth Harbour, Island	11 9	13	10
Hull, England	6 29	20¾	16½

Place.	High Water Full and Change.	Rise. Spg.	Rise. Nps.
	H. M.	ft.	ft.
Hull Bridge, Crouch R., England	12 25	16	11
Hurst (Camber), England	10 0 12 0	7½	6
Husum, Denmark . . .	2 36	9	
Hyannis, U.S.	12 22	4	1¾
Icacos Point, Trinidad .	4 14	7	4
Ilfracombe, England . .	5 42	27¼	21¼
Inagua, Bahamas . . .	8 0	3½	2½
Indian Cay, Florida . .	8 18	2½	1¼
Inkanskie, White Sea . .	9 15	14	
Inishbofin, Ireland . .	4 34	12¼	9½
Inishkeel, Ireland . . .	5 10	11	8
Inishturk, Ireland, W. Cst.	4 36	12¼	9½
Intsi Point, White Sea .	11 55	16	
Inverary, Scotland . . .	12 0	10	
Inverness, Scotland . .	12 18	12	9½
Iona Sound, Scotland .	5 11	11¾	8¾
Ipswich, England . . .	12 35	13½	
——— United States .	11 26	10¼	8½
Ireland Id., Bermudas .	7 4	4	
Island Harbour, Choiseul Sd., Falkland Islands .	5 20	6	
——— Country Harbour, Nova Scotia	7 40	6½	5½
Isle-aux-Coudres, R. St. Lawrence	4 25	17	10
Isles de Los, Africa, W. C.	6 35	13	
Ives St., England . . .	4 44	21	15
Jacmel, St. Domingo . .	irr.	2–3?	
James R. (City Point), U.S.	2 37	8	2½
Jebogue, Bay of Fundy .	9 47	16½	11½
Jedore, Nova Scotia . .	7 45	6½	4¾
Jekatarina Is., Lapland.	6 23	10	
Jersey (St. Helier), English Channel	6 25	30¼	21¾
——— (Rosel)	6 15	30	21½
Jijginsk Id., White Sea .	5 15	4	
John St., Bay of Fundy .	11 24	26½	19½
——— New Brunswick	11 23	23	20
——— Newfoundland .	7 30	7	
——— (North Coast) .	10 40	7½	5½
——— River, U.S. . .	7 28	5½	3¾
Joombas R., Africa, W.C.	8 10	6	
Jones Harb., Newfoundland.	7 49	3½	2
Jourimain Island, New Brunswick	9 30	6	3
Juan San, Porto Rico . .	8 2	1½	
Juby Cape, Africa . . .		8	
Judith Point, U.S. . .	7 32	8¾	2¾
Jukan Ids., Lapland . .	9 0	13	
Julian San, Port, Patagonia, E. Coast . . .	10 45	30	
Julianshaab, Greenland .	5 6	7	5
Julien, St., Harbour, Newfoundland	7 21 A.M. 6 30 P.M.	4½	3
Junk River, Africa W.C. .	5 45	5	
Jura Feolin Ferry (E. Side)	4 41	6½	4¼
—— Island, (Small Isles) Scotland	5 3	3½	2¼
Kalgalakska, White Sea .	6 50	7	
Kandalaksha, White Sea .	3 25	7	
Kanushin Cape, White Sea	11 54	15	
Katwyk, Netherlands . .	2 30	5	7
Kegashka B., G. St. Lawrence	10 45	5	3
Kenmare R. (W. Cove), Ireland	3 52	10	7½
Kennebec River (Hanniwells Point), U.S. . .	11 15	9¼	7
Kentish Knock, England	11 47		
Keret, White Sea . . .	8 8	6	
——— Point, White Sea	4 30	5½	
Kettle Cove, U.S. . . .	7 48	5	3¾
Kilbaha, Ireland . . .	4 16	13	9½
Kilda, St., Hebrides . .	5 30		
Kildin Id., Lapland . .	6 45	12	
Kilkieran Cove, Ireland .	4 34	15½	11
Killala Bay, Ireland . .	5 22	10¼	8
Killeany Bay, Arran Ids., Ireland	4 28	13½	10
Killibegs, Ireland . . .	5 16	11½	8½
Killingholme (Humber R.) England	6 2	19¾	15½
Kilmichael Point, Ireland	8 30	4½	3
Killyleagh, Ireland . .	12 40	11	9¼
Kilrush, Ireland . . .	4 14	14	10½
Kincardine, Firth of Forth Scotland	2 53	17¾	15
King Port, Falkland Ids.	7 30	5	
Kingsbridge, England .	5 46	10	
Kingstown, Ireland . .	11 10	11	8¾
Kinsale, Ireland . . .	4 43	11½	9
Kircubbin, Ireland . .	12 42	11½	9½
Kirkcudbright, Scotland .	11 10	23	
Kirkwall, Orkneys . . .	10 9	10	7½
Kouloi River	1 15	20	
Kou Zomen, White Sea .	3 30	6	
Kovda Bay, White Sea .	3 35	6	
Kyem River, White Sea .	5 23	4	
Kykduin, Netherlands .	7 0	12	
Kyle Akin, Loch Alsh, Scotland	6 16	15½	11
Kyle Rhea, Scotland . .	6 0	15	11
La Poile Bay, Newfoundland	9 0	6	4
Lacul Harb., St. Domingo	6 0?	3?	
Lagos, Portugal . . .	2 7	13	
——— River, (Bar), Bight of Benin	6 0	3	
Lagos River (Consulate Wharf.)		2	
——— (Palaver Ids.)		1	
Laguna de Terminos, G. of Mexico	noon	1½	
Lamalin, Newfoundland .	9 0	8½	
Lamlash, Scotland . .	11 49	10	7
Lancaster, England . .	11 16	8½	
Landshipping, Cleddau River, Wales	6 27	20	14½
Lanzarote, Canary Ids. .	1 0?	9?	

Place.	High Water Full and Change.	Rise. Spg.	Rise. Nps.
	H. M.	ft.	ft.
Largs, Scotland . . .	11 50	10	
Latitude Bay, Tierra del Fuego.	2 5	4	
Laun, Great and Little, Newfoundland . . .	8 15	7	4
Laura Harb., Tierra del Fuego.	1 0	6	
Lawrence, Great St., Harb. Newfoundland . . .	8 30	7	4
Le Have Cape, Nova Scotia . . .	7 48	7	5¾
——— Nova Scotia, Crooked Channel.	7 51	7¼	6
——— Mothers Island	7 51	7	5¾
——— Getsons Cove .	7 55	7¼	6
——— Bridgewater (McKean's Wharf.)	8 6	8	6½
——— Lunenberg (Spidlers Cove.)	7 54	7¼	6
Le Maire Strait, Tierra del Fuego.	4 0	7	
Leervig Fiord, Farœ Ids.	0 30	6½	4½
Leith, Scotland	2 17	16½	12¾
Leman Shoal, England E. Coast.	6 0		
Lennox Cove, Tierra del Fuega.	4 40	8	
Leopold Port, Barrow Strait.	12 6	6	4½
Lepreau, Bay of Fundy .	11 18	24½	21
Lerwick, Shetland . . .	10 30	6	4
L'Etang Harb., Bay of Fundy.	11 9	23½	20
Levrier Bay, Africa, W.C.	12 0	6	7
Lewis Cape, St., Labrador	6 30		
Limerick, Ireland . . .	6 16	18¾	13¾
Lisbon Bar, Portugal . .	2 30	16	
Liscanor Bay, Ireland .	4 23	13¾	10
Liscomb Harbour, Nova Scotia.	8 0	6½	4½
Lissa, Adriatic	4 10	2½	
List, Denmark	2 21	6	
Litke Ridge, White Sea .	11 45	15	
Little Egg Harbour, U.S.	7 10	4½	3½
Little Gull Island, U.S. .	9 38	3	2¾
Littlehampton, England .	11 36	16	11½
Little Metis, G. St. Lawrence.	2 10	13	8
Little Milford Quay, River Cleddau, Wales . . .	6 31	19	13½
Little Natashquan, G. St. Lawrence.	11 0	5	3
Little Port, Newfoundland	10 42	5½	
Little Tancock Island, Nova Scotia.	7 43	7¼	6
Liverpool Bay, Nova Scotia	7 50	8	5
Liverpool, England . .	11 23	26	20¼
Liza Bay, Lapland . .	5 58	9	
Lizard Point, (Perran Vose Cove), England .	5 0	14¼	10½
Llanelly (Bar), Wales .	6 16	28	21

Place.	High Water Full and Change.	Rise. Spg.	Rise. Nps.
	H. M.	ft.	ft.
Loch Aline, Scotland .	5 33	13¾	10½
—— Alsh ,, .	6 16	15½	11
—— Boisdale ,, .	5 47	12¾	9½
—— Broom ,, .	6 40	14½	10½
—— Carron ,, .	6 29	16½	11½
—— Cuan ,, .	5 36	13	9½
—— Duich ,, .	6 0	15½	11
—— Dunvegan ,, .	6 7	15¼	11
—— Eil (Head of Loch)	6 27		
—— Eport ,, .	6 6	12½	9¼
—— Eriboll ,, .	7 43	14¾	11
—— Erisort ,, .	6 43	15¼	11½
—— Etive, Stonefield ,,	7 3		
——— Bunawe ,,	7 54	5¾	
—— Ewe ,, .	6 39	14½	10½
—— Fleet ,, .	0 22	10¾	
—— Goil ,, .	12 6	10	6
—— Harport ,, .	5 54	13¾	10
—— Hourn ,, .	5 45	13¾	10¼
—— Inver ,, .	6 40	14	11
—— Laxford ,, .	6 44	15	11¼
—— Laven (Head of Loch)	6 28		
—— Linnhe ,, .	5 26	12¼	8½
—— Long ,, .	12 6	12	
—— Maddy ,, .	6 6	12½	9¼
—— Moidart ,, .	5 44	13½	9¼
—— Nevis ,, .	5 47	14½	10
—— Roag ,, .	6 11	11	8
—— Ryan (Head of Loch)	11 12	11	
—— Skiport ,, .	5 52	12½	9
—— Strivan ,, .	11 55	6	
—— Sunart ,, .	5 40	13½	
—— Tarbert, West, Harris Island, Scotland.	6 4	11¾	8½
——— East ,,	6 10	13½	10
——— West, Argyleshire, Scotland.	2 30	1–4	
——— East ,,	11 53	9	
—— Tongue ,, .	7 53	15	12
—— Torridon ,, .	6 20	15	11
—— Tuadh ,, .	5 23	11¾	8
Lobos Cay, Bahamas .	7 40	3	
Lofoten Ids., Norway .	12 0	9	7½
Loire R. (St. Nazaire), France	3 40	15¼	11
London Bridge, England	2 7	19¼	16¾
——— Docks, England .	1 57	19½	17
Londonderry, Ireland .	8 1	7¾	5½
Looe (East), England .	5 26	16	13
Lookout Point, U.S. . .	12 58	2	1
Lopez Cape. Africa . .	4 30	4–6?	
L'Orient (Port Louis), France	3 11	13	9½
Lough Larne, Ireland .	10 48	6¾	6¼
——— Rossmore, Ireland	5 29	11	8
Louis Port, France . .	3 11	13	9½
Louis, St., Bay, St. Domingo.	irr.	2–3?	
Louisburg Harbour, Cape Breton Island . . .	8 0	5	4
Low Bay, Falkland Ids. .	5 0	5½	

PLACE.	High Water Full and Change.	RISE. Spg.	RISE. Nps.
	H. M.	ft.	ft.
Lowestoft, England . .	9 57	6½	5¼
Luis St., Texas, Gulf of Mexico.		3½	
Lunaire Bay, Newfoundland.	7 0?	2-3?	
Lundy Island, England .	5 15	27	20
Lyme Regis, England .	6 21	11½	8¼
Lymington, England .	10 25 12 15	8	6
Lynn Deep, England . .	6 0	23	
—— Harbour ,, . .		18	
—— Road ,, . .		20	
Mabou River, C. Breton Id.	9 0	4	
Machias, Seal Ids., Bay of Fundy.	11 5	18	14¾
Macquereau Point, G. St. Lawrence.	2 0	5	3
Madoc, Port, Wales . .	7 30	17	
Magdalen Islands, G. St. Lawrence.	8 20	3	2
Magdalen River, R. St. Lawrence.	11 0		
Magdalena Sta., Island, Magellan Strait.	12 10	10	
Mahneah R., Africa, W.C.	7 40	11	
Mahone Bay, Nova Scotia	8 0	7	
———— Heckmans Anchorage.	7 45	7¼	6
———— Princes Inlet	7 42	7¼	6
———— Ham Island	7 47	7¼	6
———— Martins R. .	7 43	7½	6½
———— Chester .	7 44	7	5¾
Mahons River, U.S. . .	9 52	7	5
Maiden Rocks, Ireland, N.E. Coast.	10 43	6¾	6¼
Malaga, Spain	12 0	3	
Malahide Inlet, Ireland .	11 15	10	8
Maldon, Chelmer River, England.	12 32	10	6
Malo, St., France . . .	6 5	35	26
Mancenilla Bay, St. Domingo.	7 0	4–5	
Man-of-War Cay, Bahamas	8 10	4	
Manicouagon River, R. St. Lawrence.	2 15	12	7
Manybranch Harb., Falkland Ids.	7 40	7½	
Maplin Light (Thames), England.	12 5	14½	10½
Maquereau Point, G. of St. Lawrence . . .	2 0	5	3
Maranhao, Brazil . . .	7 0	16½	10¾
Marble Head, U.S. . .	11 30	12	
March Harb., Tierra del Fuego.	3 10	6	
Marcouf, St., France . .	9 55	20	
Mare Harb., Falklands Ids.	6 0	6	
Margate, England . . .	11 40	15½	13
Margarets, St., B., (Shut-in Island) Nova Scotia .	7 47	7¼	6
———— Newfoundland .	9 28	4½–6½	
Maristow, River Tavy, England.	5 47	8½	4½
Mark, St., Bay of, St. Domingo.	8 0?	1?	
Marks, St., United States	1 38	3	1½
Maroni River, Guayana .	5 30	8	6
Martin, St., de la Arena, Spain, N. Coast.	3 30	15	
Martin, St., Cove, Tierra del Fuego.	3 30		
———— C. Horn Ids., Tierra del Fnego.	3 50	8	
Martin Vas Rocks, South Atlantic.	3 45		
Martinique, Robert Harb. Caribbean Sea.		4–5	
Mary C. St., Newfoundland	8 30	7	5
—— Port St., I. of Man .	11 10	20	16
—— St., Scilly Is. . .	4 27	16	12
—— St. Har., Newfndlnd.	7 40	7½	5
Maryport, England . .	11 3	18	13
Matacumbe Bay, Lower United States.	8 23	2½	1¾
Matan River, G. of St. Lawrence.	2 15	11	7
May Cape, United States	8 19	6	5
Mellacoree, R., Africa W.C.	7 40	11	
Mellon, Ireland	6 1	18¼	13¾
Memory Rock, Bahamas .	7 50	3	
Menadou Bay, C. Breton Island.	8 15	5½	
Menemsha Bight, U.S. .	7 45	4	1¾
Mercy Bay, Banks Land .		2	
Merigomish, Nova Scotia	10 6	5¼	3¼
Merville, France . . .	9 36	21	17¼
Metway Port, Nova Scotia	7 59	8	5
Mevagizey, England . .	5 4	15½	12
Mezen, White Sea . . .	1 48	15	
Miaveness, Færoe Islands	3 12	6½	4½
Michael, St., Azores . .	12 30	6	
Middle Cove, Tierra del Fuego.	3 30		
Middlesborough, R. Tees, England.	3 55	13	
Middleton R., Bight of Benin.	4 15	5	
Milford Haven (St. Ann Lighthouse), Wales .	5 56	24	16
Millport, Cumbrae Island, Scotland.	11 50	10	6
Minehead, England . .	6 30	35	26½
Mingan Harbour, Gulf St. Lawrence.	1 16	6	4
——— Id., Gulf St. Lawrence.	1 30	6	4
Minimegash, Prince Edward Island.	3 30	5	3
Minquiers Rocks, France	6 6	35	26
Miramichi (Bar), Gulf St. Lawrence.	5 0	5	3

Place.	High Water Full and Change.	Rise Spg.	Rise Nps.
	h. m.	ft.	ft.
Mira-por-vos, Bahamas .	9 30	3	2½
Miscou, G. of St.Lawrence	2 30	5	3
Mississippi, S.W. Pass., G. of Mexico.		1½	
Mistanoque, Labrador .	10 30	6	3
Mistley Quay, Stour R., England.	0 48	11¾	
Mobile, Gulf of Mexico .	irr.	2	
Mogador, Africa, W. Cst.	1 18	11	
Monach Ids., Scotland, W.C.	5 44	12½	8½
Monckton (Railway), Bay of Fundy.	0 15	47	37½
Mondego (Bar), Portugal	2 30	7	
Monomoy, United States	11 30	5½	4
Monrovia, Africa, W.C. .	6 0	6	
Montauk Point, U.S. . .	8 20	2½	2
Montrose, Scotland . .	1 25	13	10
Monts, Point de, Gulf St. Lawrence.	12 0	12	6
Morewellham, R. Tamar, England.	6 12	10½	6½
Morjovets Id., White Sea	11 20	17	
Morlaix Road, France .	4 53	24	18
Moudiuga Id., White Sea	5 50	3½	
Mount Desert Island, United States.	11 10	13	
——— Louis Bay, R. St. Lawrence.	11 0	6–8	4
Mouton Port, Nova Scotia	7 54	7½	5¾
Moville, Ireland . . .	7 6	7½	5½
Mucaras Reef, Bahamas .	7 40	3	
Mugeres Harb., Bay of Honduras.	9 30	1½	
Mull of Cantyre, Scotland	10 35	4	
Mulroy Bay (Bar), Ireland	5 40	11¾	8
Mumbles Lt.house, Wales	6 1	27½	20½
Mutton Island, Ireland, W. Coast.	4 20	13¾	9½
Myggenæs Fiord, Færoe Islands.	9 0	9½	7½
Naalsoe Fiord, Færoe Ids.	4 0	6½	4½
Nantucket, United States	12 24	3½	3
Narrows (First), Magellan Strait.	9 0	36 42	
——— (Second), Magellan Strait.	10 0	23	
Nash Point, Bristol Channel	6 25	33	25
Nassua Bay, Tierra del Fuego.	4 0	6	
Nassau, New Providence, Bahamas.	7 40	4	3
Navallo Port, France . .	3 42	13	9¾
Nazaire, St,, France . .	3 40	15½	11
Naze, The, England . .	12 6	12½	10
Needles Point, England .	9 46	7½	5
Negro Har., Nova Scotia	8 12	7	5¾
Negro River, Patagonia .	11 0	14	
Neuf Port, Gulf St. Lawrence.	2 10	13	8
———, River St. Lawrence.	8 30	14	9
New Bedford (entrance) United States.	7 57	4½	4
New Bedford, Perlican Harb., Newfoundland .	7 30	4	2½
Newcastle, United States	11 53	7	6¾
—— Haven, United States	11 16	6½	5½
—— London, U.S. . .	9 28	3	2½
—— Providence, S.W. Bay, Bahamas . .	7 30	4	
—— Rochelle, U.S. . .	11 22	8½	7½
—— Ross, Ireland . .	6 4	12½	10
—— York, U.S. . . .	8 13	5½	4½
Newburyport, U.S. . .	11 22	9	7½
Newcastle, England . .	4 23	10½	
——— Ireland . .	10 30	16	12
Newhaven, England . .	11 51	20	15
Newport, United States .	7 45	4½	4
——— Wales, S. Cst.	7 10	38	29
——— W. Cst.	7 0	12	9
Newton Stewart, Scotland, W. Coast.*	12 0	12	6
New Quay, Wales . . .	7 30	15	
New Year Sound, Tierra del Feugo.	3 30		
Nicholas, St., Harb., G. of St. Lawrence.	1 55	12	7
Nicolas, St., Bay, Magellan Strait.	2 6		
Nieuport, Belgium . .	12 18	16	13
Nieuwediep, Netherlands	7 27	4	3½
Niger River (Nun entrance) Africa, W. Coast . .	4 8	6	
Nikolskoi Chan., White Sea.	5 25	3	
——— Twr. White Sea	6 0	2	
Noamh Island, Scotland	5 2	11½	7
Noel Bay, Bay of Fundy	12 41	50½	43½
Noirmoutier, France . .	3 2	16	11½
Noir Island, Tierra del Fuego.	2 30	5	
Norderney, Germany . .	10 30	8	
Nore, England	12 30	15½	13
North Cape, C. Breton Id.	8 0	12	9½
North Cape, Edisto River, United States.	7 10	7	5¾
North Harbour, Newfoundland.	8 0	7½	5
Nova Zembla Harbour, Lapland.	6 36	10	
Nuevo Gulf, Patagonia, E. Coast.	7 0	10	
——— Port, Central America.	3 10	12	
Nunez River, Africa, W. Coast.	10 0	15	11½

* At Carty Quarry.

Place.	High Water Full and Change.	Rise. Spg.	Rise. Nps.
	H. M.	ft.	ft.
Nyminde Gab, Jutland	2 41	2	
Oban, Scotland	5 22	12	9½
Obb of Harris, Isle of Harris, Scotland	6 16	11½	8½
Ocracocke, United States	7 4	2½	2
Olaveaga, Bilbao River, Spain.	3 15	12	
Old Pt., Comfort U.S.	8 17	3	2½
Old Providence, Bay of Honduras	irr.	1	
Olenji Islands, Lapland	7 30	12	
Oleron, Ile d', France	3 50	19	
Omonville, France	7 29	15½	12½
Onega River, White Sea	9 17	6–7	
Oporto, Portugal	2 30	10	
Orford Haven (Bar), England.	11 30	7½	
——— Quay, England	12 30	7½	
Orfordness, England	11 15	8	6½
Orinoco River (entrance), Guayana.	6 0	3	
Orleans Id., R. St. Lawrence.	5 40	17	13
Ormond, Kenmare River, Ireland.	3 43	10	7½
Ornsay, I. of Skye, Sctlnd.	5 50	14¾	10½
Orlov Letni C., White Sea	5 18	4	
Ostend, Belgium	12 25	19	15
Otterswick, Orkneys	9 13	11	8
Ouro R., Africa, W. Coast	12 0	8–9	
Ouse R. (Goole), England	7 44	14	
Ower Shoal, England, E. Coast.	6 30		
Oxbaasheia, Svee Fiord, Norway.	12 0	8	
Oyster Bay, United States	11 7	9½	8
Oystreham, France	9 38	21	16
Padstow, England	5 13	20½	16½
Pagham (entrance), England.	11 30	16½	12½
Paimpol, France	6 0	31	23½
Palais, Port le, Belle Ile, France.	3 18	14½	10½
Palma, Canary Ids.	12 30?	9?	
Palmas Cape, Africa, W. Coast.	4 30	4	
Pansand Hole, England	12 0	15½	13
Para, Brazil, N. Coast	12 0	11	
Parsboro, Bay of Fundy	12 17	43	37½
Pasages, Port, Spain	3 0	12	9
Passage or Culebra Point, Caribbean Sea	9 0	1	
Passamaquoddy, Bay of Fundy.	11 30	25	
Patapsco R. (Bodkin Pt.) United States.	5 42	1½	1
Patrick, Port, Scotland	11 10	15	12
Patuxent R., U. States	1 16	2	1½
Paul St., G. St. Lawrence	8 0	5	3
Peel, Isle of Man	11 8	16½	13
Pembroke Dockyard, Wales	6 12	21	15½

Place.	High Water Full and Change.	Rise. Spg.	Rise. Nps.
	H. M.	ft.	ft.
Peniche, Portugal	1 54		
Penmark Rocks, France	3 16		
Pennington R., Bight of Benin	4 15	5	
Pensacola, G. of Mexico		1½	
Pentillie, R. Tamar, England.	5 55	13½	9½
Pentland Firth, Stroma, S. side	9 47	7½	6
——— Swona, E. side	10 24		
——— W. side	9 35		
——— Great Skerry, E. side.	11 4	7¾	6½
——— W. side	10 53		
Penzance, England	4 30	16½	12½
Perth, Scotland	3 35		
Peter, St., Bay, C. Breton Island.	7 30	6	4
Peter St., Harb. Prince Edward Island.	8 30	4	2½
Peterhead, Scotland	0 34	10¾	8½
Petit Port, B. of Islands, Newfoundland	10 42	5½	
Petit Passage, B. of Fundy	10 41	22	18
Philadelphia, U.S.	1 18	6¾	5½
Piankatank R. (Cherry Point), United States	10 5	2	¾
Pictou Har., Nova Scotia	10 0	6	4
Piel Harbour, England	11 5	28	21
Pierre, St., Newfoundland	8 33	6½	4½
Pillars, River St. Lawrence.	5 0	17	10
Pinmill, Orwell River, England.	12 20	12	
Placentia, Newfoundland	9 15	8	
Playa de Incia, Cuba	7 31	2½	
Ploughrescan, France	5 17	25½	18¾
Ploumanach, France	5 15	24½	18½
Plymouth Breakwater, England.	5 37	15½	11½
Plymouth (Sutton Pool)	5 32	15½	11½
Plymouth, United States	11 19	11½	10½
Pomquet, Nova Scotia	9 15	4	2½
Ponga River, Africa, W.C.	7 30	12	9½
Poolbeg Lighthouse, Ireland.	11 12	13	9–11
Poole, England	{ 9 10 / 12 45	} 6½	4½
Poolewe, Loch Ewe, Scotland.	6 39	14½	10¾
Port of Spain, Trinidad	4 30	4	2½
Portaferry, Ireland	12 0	{ 18 / 21	12 / 16
Port-au-Choix, Newfoundland.	10 47	5	
Port au Prince, Saint Domingo.	8 0?	1?	
Port Beaufort, U.S.	7 26	3½	2½
Portchester, England	11 46	13½	10½
Port-en-Bessin, France	8 57	20	15½
Portendik, Africa, W. Cst.	10 0	6	

Place.	High Water Full and Change.	Rise. Spg.	Rise. Nps.
	H. M.	ft.	ft.
Port Royal, Jamaica	11 0	1	
——— Sound, Ent. U.S.	7 16	7¼	6¼
Portsbridge (Portsmouth) England.	11 48	6½	4
Porthcawl, Wales	6 8	28½	21¼
Porth-dyn-lleyn, Wales	8 30	16	
Portishead, England	7 16	41¼	31
Portland, United States	11 25	10	7½
——— Breakwater, England.	7 1	6¾	4½
Porto Praya, C. Verde Ids.	6 0?	5	
Portree, Isle of Skye	6 32	15	10¾
Portrieux, France	6 0	31	23½
Portsmouth Dockyard, England.	11 41	12½	10
——— United States	11 23	10	8½
Poulamente B., Madame Id., C. Breton Id.	7 50	6	4
Poulton-le-Sands, Englsnd	11 26	27¼	21½
Preston, England	11 49	10	4½
Princes Id., B. of Biafra	3 45	4½	
Prospect River, Nova Scotia	7 43	7	6
Provincetown, U.S.	11 22	10¾	8½
Pubnico (Beach Point), Bay of Fundy.	9 25	12	10
Puerto de la Luz, Gran Canaria, Africa, W.C.	12 52	10	
Puerto de Baitiqueri, Cuba	9 7	2¼	
——— Maravi, Cuba	7 56	2½	
——— Mata, Cuba	6 49	2¾	
——— la Plata, St. Domingo.	7 30	3?	
——— Taco, Cuba	8 49	2¾	
Pugwash Har., Nova Scotia	10 30	7	4
Pulaski Fort, U.S.	7 20	8	7
Pwlheli, Wales	7 46	13½	9¾
Quaco, Bay of Fundy	11 35	30	25
Quebec, R. St. Lawrence	6 38	18	13
Queensferry, Firth of Forth, Scotland	2 37	18	14
Queenstown, Ireland	5 1	11¾	9
Quicks Hole (S. side) U.S.	7 36	3¾	3½
——— (N. side) ,,	7 31	4¼	3
Quillebœuf, France	10 6	9½	7½
Quoile Quay, Strangford, Ireland.	12 45	11	9¼
Rabat, Africa, W. Coast	1 46	9–12	
Race Cape, Newfoundland	7 0	6½	5
Ramos R., Bight of Benin	4 20	5	
Ramsay Sound, Wales	6 0	17	
Ramsey, Isle of Man	11 12	19¼	16
Ramsgate, England	11 44	15	12
Ramso Fiord, Norway	10 45	7	
Rappahannock (Saunders Wharf) United States	3 2	2¾	2
Rathmullan, Ireland	5 42	12½	9
Red Bay, Labrador	7 45	3½	1½
Red Bay (Pier), Ireland	10 31	4	4
Redbridge, England	10 42 / 12 57	8½	6
Régneville, France	6 20	35	26

Place.	High Water Full and Change.	Rise. Spg.	Rise. Nps.
	H. M.	ft.	ft.
Reikiavik, Iceland	5 0	17½	13¼
Rendsborg, Denmark	7 42	4	
Renfrew, R. Clyde, Scotland.	1 15	9	
Ribble Lighthouse, England	10 51	24	17
Richibucto R, Gulf St. Lawrence.	3 30	4	2½
Richmond, U.S.	4 28	3½	2¾
——— Harb., Prince Edward Island	6 0	3	2
Richmond Island, U.S.	11 30	10½	9
Rio Nunez, Africa, W.C.	10 0	15	11½
Ristegouche R., Campbelltown, G. St. Lawrence	4 0	10	7
Rivadeo, Spain, N., Coast	3 0	15	
Roche Cape, R. St. Lawrence.	9 30	6	4
Rochefort, France	4 6	17	13
Rochelle, France	3 31	17	13
Rockall, N. Atlantic	3 30	12	
Rockport, United States	10 57	10½	8
Romdals Ids., Norway	10 45	6	
Rona (South) Light, Scotland.	6 20	14½	10½
Roscoff, France	4 46	23	17½
Rosel, Jersey, English Channel.	6 15	30	21½
Rota, Spain	1 24	12½	8
Rotterdam, Netherlands	3 45	7	
Rouen, France	2 28		
Rouge Harbour, Newfoundland.	7 0?	2–4?	
Roundstone, Ireland	4 28	13¾	10½
Royal Island, Bahamas	7 45	3½	
Royal Harbour, Ruatan, Bay of Honduras.	7 45	3½	
——— Port, Jamaica	11 0	1	
Royan, France	3 38	13½	10½
Rugged Id., Bahamas	8 0	3	
Rugged Id., Nova Scotia	7 59	7½	6
Rush Port, Ireland	6 8	5¼	3¼
Rutland Id., Ireland, W.C.	5 22	11	8
Ryde, England	11 20	13½	
Rye Bay, England	11 20	22	17¼
Sabine Pass, G. of Mexico		1¾	
Sable Cape (Clam Point), B. of Fundy.	8 27	8½	6½
——— (Clarkes Harb.),	8 58	11	9
Sable Island, N. side, Nova Scotia.	7 30	4	
——— Island, S. side, Nova Scotia	6 30	4	
Sables d'Olonne, Les, France	3 26	14	10
Sacred Bay, Newfoundland.	7 23	2½	
Saguenay, Chicoutimi, G. St. Lawrence.	4 11	12	8
——— Tadousac, G. St. Lawrence.	2 45	17	10
Saintes, Caribbean Sea	6 45		

Place.	High Water Full and Change.	Rise. Spg.	Rise. Nps.
	H. M.	ft.	ft.
Sal, C. Verde Ids., Africa, W. Coast.	7 45	5	
Salcombe, England . .	5 41	15	11½
Salem, United States . .	11 13	10½	8
Salm River, Africa, West Coast	8 10	6	
Salmedina Rocks, Spain .	1 27	12½	8
Saltash, R. Tamar, England.	5 45	15	11
Salt Cay Anchorage, Bahamas.	8 15	4	3
Saltees, St. George's Channel.	5 40		
San Juan, Puerto Rico .	8 2	1½	
San Lucar, Spain . . .	1 53	12½	8
San Fernando, Trinidad .	4 38	5	3
Sand Cay, United States	8 40	2	1
Sands Point, U.S. . .	11 13	9	7½
Sandy Cove, E., Bay of Fundy.	10 33	21½	17¾
Sandy Cove, W., Bay of Fundy.	10 47	23	19
——— Hook, U.S. . .	7 29	5½	5
Sangwin R., Africa, W.C.	5 15	4	
Santa Cruz or Agadir, Africa.	12 45	9	
——— Teneriffe, Canary Ids.	1 30	8	
Santander, Spain . . .	3 30	15	12
Santiago de Cuba, Cuba .	8 33	2½	
Santona, Spain . . .	3 30	12½	10½
Sarn Badrig or the Causeway, Wales.	7 30	13	
Sarn-y-bwch Reef, Wales	7 40	14	
Savannah (city), U.S. .	8 13	7½	6½
——— (entrance), U.S.	7 20	8	7
Scales Point, Blackwater River, England . . .	12 0	14¾	10
Scalloway, Shetland . .	9 30	5¾	4½
Scapa, Orkneys . . .	9 5	10	7½
Scarborough, England .	4 11	15¾	12½
Scarcies R., Africa, W.C.	7 10	10	
Scarnish, Tiree Id., Scotland.	5 31	12	9
Scilly, Trescow	4 22	16½	12½
Scilly (St. Agnes Id.) . .	4 30	16	12
——— (St. Mary Id.) England.	4 18	15¾	11½
Seaforth Loch, Athline, Scotland.	6 16	15	10
Seaham, England . . .	3 24	14½	10½
Seal Id., C. Sable, Bay of Fundy.	9 49	12¾	10
Seal Cove, Grand Manan, B. of Fundy	10 54	20	15
Seamount Bay, Mulroy B., Ireland.	6 44	7½	
Sebastian, Spain, N. Coast	3 0	12	9
Sein, Isle de, France . .	3 21	17½	12
Seleney Bay, Lapland .	7 9	9	
Selsea Bill, England . .	11 45	10½	12½

Place.	High Water Full and Change.	Rise. Sp g.	Rise. Nps.
	H. M.	ft.	ft.
Senegal, (Bar), Africa, W.C.	8 42	6	
Senegal (Guet N'Dar) .	8 42	6	
——— (St. Louis), Africa W. Coast.	10 0	6	
Serrana Bank, Mosquito C.		2	
Serranilla Bank, Mosquito Coast.	irr.	2	
Setubal, Portugal . . .	2 30	8	
Seudre River, (entrance), France.	3 31	15	11½
Seven Islands, Lapland .	8 20	12	
——— Bay, Gulf of St. Lawrence.	1 40	9	5
Shediac Harbour, New Brunswick.	1 0 8 0	4	2
Sheffield Island, U.S. .	10 58	8½	7½
Sheephaven, Ireland . .	5 32	11¾	8½
Sheerness, England . .	0 37	16	13½
Sheet Harb., Nova Scotia	8 6	6½	4½
Shelburne, Nova Scotia .	8 4	7	5½
Sheldrake Island, Gulf St. Lawrence.	6 0	5	3
Sherbro R., Africa, W.C.	6 0	11	
Shields, North, England .	3 23	13½	10
Ship Harb., Nova Scotia .	7 54	6½	4½
Shippigan, G. St. Lawrence	3 42	5½	3
Shoreham, England . .	11 34	18	13½
Sierra Leone, Africa, W.C.	7 55	8	
Simons St., Island, U.S.	7 43	8½	6¾
Sinou, Africa, W. Coast .	5 0	4	
Sisal, Gulf of Mexico .		2	
Skaapen Fiord, Faroe Islands :—			
Between Stormoe and Sandoe.	5 0	9½	7½
Between Hestoe and Sandoe.	5 30	9½	7½
Skagen or the Skaw, Jutland.	5 56	1	
Skerry, Great, E. side, Pentland Firth.	11 4	7¾	6½
Skerry, Great, W. side, Pentland Firth.	10 53		
Skerries, Ireland, N. Cst.	6 15	5	3
Skerries, E. Coast . . .	11 0	13	10
Skip Ness, Scotland . .	11 50	9	
Skull, Ireland	4 2	9¾	7½
Slaughden, Orford, England.	1 0	7½	
Slievebane Bay, Ireland, W. Coast.	5 49	10½	7½
Sligo Bay, Mullaghmore Ireland.	5 18	11½	8½
——— Harbour, Ireland .	5 23	11½	8½
Sylne Head, Ireland, W.C.	4 30	13½	10
Smalls Lighthouse, St. George's Channel.	6 0	21	
Smerwick, Ireland . . .	3 50	11½	8
Smithville, United States	7 19	5½	
Snape Bridge, Orford, England.	3 0	6	

Place.	High Water Full and Change.	Rise. Spg.	Rise. Nps.
	H. M.	ft.	ft.
Socoa, France	3 19	12¼	8¾
Solovet Road, White Sea	5 0	4	
Solway (Tarn Point), Scotland.	11 22	23	18
Sosnovaia Bay, White Sea	2 40	6	
Sosnovets, White Sea .	11 44	18	
Souma, White Sea . .	6 30	5½	
South Rock, Ireland . .	10 58	13	10¾
Southampton, England .	10 30 12 45	} 13	9½
South West Bay, New Providence.	7 30	4	
o utherness, England .	{ 11 20	28	
o uthwold, England . .	{ 10 20	6¼	4½
Spain, Port, Trinidad .	4 30	4	2½
Spensers Anchorage, Bay of Fundy.	11 42	39	33
Sphax Roads, Mediterranean.	4 30	5	3
Spicers Cove, Bay of Fundy	11 35	37	30½
Spitzbergen (Bell Sound)	8 56	3¼	
Spitzbergen, Danes Sound	0 24	5½	
Spurn Point (Humber R.), England.	5 26	18¾	15
Stirling. Firth of Forth, Scotland.	10 53	14	11½
Stirrup Cays, Bahamas .			
Stockton (Tees), England	3 52	7½	4½
Stonefield (Loch Et ive,	7 0	4	
Scotland.	4 40	11	
Stonehaven, Scotland . .			
Stonington, United States	7 3		
Stornoway, Lewis Island,	1 10	14	11
Scotland.	9 7	3½	3
——— Quay			
——— Head of Lough	6 46	13	9½
Strangford (Killard Point),	12 31	10½	8¾
Ireland.	12 44	11½	9½
Stroma, S. side, Pentland Firth	9 47	9	6½
Stromness, Orkneys . .	9 0	10	7½
Suderoe Fiord, Færoe Ids.	6 0	9½	7½
Sumburgh Head, Shetland	9 45		
Sunderland, England . .	3 22	14½	11
———N., England.	2 30	14	11½
Surin St., Fayce . .	4 11	14¼	11
Surinam, GuLana . . .	6 0	5½	
Sutton Pool, England .	5 32	15½	11½
Sviatoi Nos, Lapland . .	9 15	14	
Svinoe Fiord, Færoe Ids.	12 0	6½	4½
Swansea (Mumbles Lighthouse,) Wales . . .	6 1	27½	20½
Swona, E. side, Pentland Firth.	10 24	10	7½
——— W. side, Pentland Firth.	9 35	10	7
Sydney Harb., Cape Breton	9 0	5	4
Tabou R., Africa, W. Cst.	4 45	3–4	
Tampa Bay, United States	11 21	1¾	1½
Tanera, Summer Islands, Scotland.	6 37	14	10½

Place.	High Water Full and Change.	Rise. Spg.	Rise. Nps.
	H. M.	ft.	ft.
Tangier, Africa, N. Coast	1 42	8	
Tappahannock, U.S. . .	0 42	2	1½
Tarbert, Ireland . . .	4 57	14½	10½
Tarifa, Spain	1 46	6	3½
Tarn Point, Solway, Scotland.	11 22	23	18
Tarpaulin Cove, U.S. .	8 4	2¾	2¼
Tarrytown, U.S. . . .	9 57	4	3½
Tatamagouche, Nova Scotia	10 0	8	5
Tay River (Bar), Scotland	2 6	16	14
Teelin Harb., Ireland .	5 16	11¼	8½
Tees R. (Bar), England .	3 45	15	
Teignmouth, England .	6 0	13	9½
Tenby, Wa'es	6 0	27	20
Tenerife Cape Verde, Ids. (Santa Cruz).		8½	6
Terceira, Azores . . .	12 32	4½	
Teriberka R., Lapland .	7 20	12	
Terschelling (West), Netherlands.	8 40	6	5
Tetrina, White Sea . .	3 17	7	
Tetuan, Africa, N. Coast	2 23	2½	1½
Texel (outside Shoals), Netherlands.	6 30	4	3½
Thomas St., Island, Africa	3 25	4½	
Thorsminde, Jutland . .	3 34	2	
Three Points Cape, Africa, W. Coast.	4 0	4	
Three Rivers, River St. Lawrence.	11 30	1	
Throgs Point, U.S. . .	11 20	9¼	7½
Thurso, Scotland . . .	8 28	13½	9½
Timballier Bay, G. of Mexico.	•	2	
Tobago, Caribbean Sea .	3 0	4	2
Tobermory, Isle of Mull .	5 36	13	9½
Tonning, Germany . .	2 1	9	
Torbay, England . . .	6 0	13	10
Tortola, Virgin Islands .	8 30	1½	
Tortugas, Florida, U.S. .	9 56	1½	1
Tracadie, Prince Edward Island.	7 3	3½	2
Træ Islands, Norway . .	11 45	7	
Trawbreaga Lough, Ireland	6 10	11½	8½
Tréguier, France . . .	5 32	25	18½
Trek Island, White Sea .	10 48	20	
Trepassey, Newfoundland	7 0	6½	5
Tréport, France . . .	11 9	27	21
Triangles, Gulf of Mexico		1½	
Trieste, Adriatic . . .	9 35	3½	
Trinidad (Port Spain), Caribbee Islands.	4 30	4	3
Trinity Bay (Bull Island), Newfoundland.	7 22	3½	2
Trinity Harbour, Newfoundland.	7 10	3½	2
Tripoli (Syria), Mediterranean.	10 20	2	
Triton Harb., Newfoundland.	7 0?	2–4?	
Tromsö, Norway . . .	1 45	8	

Place.	High Water Full and Change.	Rise. Spg.	Rise. Nps.
	H. M.	ft.	ft.
Troon, Scotland . . .	11 50	10	7½
Truro, England (Town Quay).	5 5	10	6
Tudwall, St., Road, Wales	7 45	14	
Tunis, Mediterranean .		3	
Turks, Islands, Bahamas		3	
Turna Bay, White Sea .	9 54	11	
Turner C., Prince Edward Island.	6 10	4	2
Tynemouth (Bar), England	3 20	14¾	11
Uist, S. (Loch Boisdale), Scotland, W.C.	5 47	12¾	2½
Uist North (Kallin), Scotland, W. Coast.	5 59	13¼	9½
——— (Vallay), Scotland, W. Coast.	6 10	11¼	8½
Ullapool, Loch Broom, Scotland.	6 40	14¼	10½
Upernvik, Greenland . .	11 0	8	
Urie Firth, Shetlands . .	9 45	6¼	5
Ushant, France . . .	3 32	19¼	13¾
Værö, Norway	12 0	9	7½
Valentia Harb., Ireland .	3 42	11	8
Valery St., en-Caux, France.	10 46	27	21½
——— sur-Somme, France	11 46	27	21½
Vallay, N. Uist, Scotland	6 10	11¼	8½
Veere, Netherlands . .	1 20	15	
Ventry, Ireland . . .	3 44	10½	7¾
Vera Cruz, Gulf of Mexico		2	
Verde Cape, Africa, W.C.	7 45	5	
Verte Bay, Nova Scotia .	10 0	9	5
Vermilion Bay, Gulf of Mexico.	irr.	2¼	1½
Vigo, Spain	3 0	12	
Vin Harb., G. St. Lawrence	5 45	5	3
Vincent, St., Caribbean Sea	3 0	1½	1
Vivero, Spain, N. Coast	3 0	15	
Voronov C., White Sea .	11 20	17	
Waagoe Fiord, Færoe Ids.	6 0	9½	7½
Walker, R. Tyne, England		10½	
Wallace Har., Nova Scotia	10 30	8	5
Wapitagun Harb., G. St. Lawrence	10 30	5	3
Warleigh Quay, R. Tavy, England.	5 47	14½	10½
Warrenpoint, Carlingford, Ireland.	11 10	14½	12
——— Lough Foyle Ireland.	6 20	6½	5
Watch Hill, United States	9 0	3	2¾
Waterford (Bridge), Ireland	6 6	13½	10¾
——— (Duncannon Ft.)	5 20	12½	10
Weir Head, R. Tamar, Eng.	6 17	5½	1¼
Wellfleet, United States .	11 5	13¼	12
Wells, England . . .	7 0	12	
——— Bar, England . .	6 20	18	
Weser (outer light vessel), Germany.	11 30		
West Cove, Kenmare R., Ireland.	3 52	10	7½
West Gat, Netherlands .	1 45	7	
West Quoddy, B. of Fundy	11 12	21	17
Westmanshaven, Færoe Islands.	8 0	9½	7½
Westness, Orkneys . .	9 11	19	7½
Weston-super-Mare, Eng.	6 54	37	28½
Westport, Ireland . . .	4 57	12½	9½
Wexford, Ireland . . .	7 21	5	3½
Whitby, England . . .	3 45	15	11½
Whitehaven, England .	11 14	23¼	8¼
———, Nova Scotia	8 0	6½	4½
Wick, Scotland	11 22	10	7½
Wicklow, Ireland . . .	10 29	9	6½
Widewall, Orkneys . .	9 3	10	7½
Wigton, Scotland . . .	11 30		
WilliamPrt., Scotland, W.C.	11 10	18	10
Wilmington, U.S. . . .	9 6	3	2¾
Winter Harbour, Melville Island.	1 30	3¾	
Winterton Ness, England	8 25	7¾	6¼
Wisbeach, England . .	7 30	15	
——— Eye, England		20	
Wivenhoe, Colne River England.	12 10	15	10
Wostenholm Sound, Arctic Regions.	11 8	7½	
Woodbridge, KingstonQuay	0 35	10	
———, Wilford Bdg.	0 55	7	
Woodbridge or Bawdsey Haven (Bar), England	11 45	12	9
Woods Hole (entrance from Vineyard Sound), United States.	8 34	2	1½
——— (entrance from Buzzard Bay), United States.	7 59	4¾	4
Woolwich, England . .	1 37	18	15½
Workington, England .	11 4	20	15
Wrabness, Stour River England.	12 29	12	
Wranger Oog, Germany .	12 0	9?	
Wrath Cape, Scotland .	7 30	15½	
Yafa Mediterranean . .	10 0	1½	
Yarmouth Haven (Brush), England.		5¾	4¼
———, Bay of Fundy	10 9	16	13
——— Bridge, England		5	4
——— (Rd.) England	9 15	6	4
———, Isle of Wight, England.	10 0 / 12 0	7	6½
Yealm River, Bigbury Bay, England.	5 37	16¼	11½
Yellaboi, Africa, W. Coast	7 10	10	
Yeu, Ile d', France . .	3 6	14¼	10
York Factory, Hudson Bay	11 15	12	
——— River, (Moody's Wharf), United States.	9 35	3½	
——— Harb., Newfoundland	10 37	5½?	
Youghal, Ireland . . .	5 14	12¾	10
Young Cove, B. of Fundy	11 14	32	25
Zieriksee, Netherlands .	2 0	11	9

The foregoing Table,—p. 231—245, which is very complete for the North Atlantic—will enable the mariner, with the aid of his "Epitome of Navigation," to find the approximate time of High Water at the port to which he is bound on any day of the year.

In conclusion,—to the remarks on the Tides (p. 216-230) we are enabled to append another valuable paper originally contributed to the *Mercantile Marine Magazine*, and which seamen will find of great service when navigating the coasts of England, Scotland and Ireland.

TIDE-TABLES FOR THE COAST OF GREAT BRITAIN.

BY E. BURSTAL, Commander R.N.

It has frequently occurred to me that the seaman, when navigating our shores, is much perplexed to know how the stream is running, and when it will be slack, and that he has to refer to a "tide-table" of the nearest port, and deduce from the time of high water at that port the time when the stream will end where he is;—otherwise he observes that it is high water, full and change, at a certain time, and from that calculates, according to the age of the moon, what the time of high water is on the day required, and then applies the necessary correction for the time of slack water. The value of being tolerably well informed as to the tides, the set and velocity of the stream, and when it turns, must be apparent to every person having the care of navigating a vessel along the coast.

With these views of the subject, after many years service on nautical surveys on our coasts, I have been led to consider that *one uniform port of reference* will be best suited to give the seaman that information on the subject of tides. I have, therefore, made *London* that port of reference, and as every almanac has a London time-table in it, it will be only necessary to add to or subtract from the time of high water at London, the constant shown in the following tables, when the time of high water *slack* will be found at any point along the coasts of Great Britain and Ireland.

The time used is the local time at each position, it not being necessary to make any correction for difference of longitude with London.

I am aware that the semimensual inequalities in time with London and the various ports will, in some instances, cause a variation of 15 minutes from the truth, but as the tides are so much influenced by atmospheric changes, the result arrived at from these tables will, I venture to hope, be sufficiently correct for all the purposes of navigation.

In the following Tables—a, signifies *after;* b, *before.*

PLACE.	Time of Slack Water, or the ending of the Flood stream to the S.E. before or after High Water at certain places of reference.		REMARKS.
		LONDON.	
	H. M.	H. M.	
North Ronaldsha Firth	.. ..	3 20 b.	High Water F. & C. on the shore 9h. 0m.; stream 4 knots.
Stronsa Firth	.. ..	2 40 b.	Springs 6 knots; neaps 3.
Pentland Firth, middle	.. ..	2 20 b.	Stream close inshore makes to the westward soon after H.W., and slacks at L.W., or 2h. 40m. sooner than in the middle; springs run 7 knots; neaps 3½.
Clyth-ness	3 40 b. Leith.	3 10 b.	Springs 3 knots; neaps 1½.
Cromarty, entrance of the Moray Firth	2 40 b. Leith.	2 15 b.	Off Cromarty and Fort George, 3 to 4 knots.
Cullen	.. ..	1 0 b.	Streams easy.
Kinnairds Head, 6 miles off	1 20 b. Leith.	At H.W., London.	Springs 2½ knots.
Do. 12 miles off	.. ..	1 10 a.	
Buchan-ness, inshore	.. ..	At H.W., London.	Springs 4 knots.
Do. 15 miles off	0 40 a. Leith.	1 0 a.	
Girdle-ness	0 10 a. Leith.	1 10 a.	Springs 2¾ knots; neaps 1½.
Montrose and Arbroath	.. ..	0 40 a.	Flood stream sets to W.S.W., towards Tay Bar.
Bell Rock, 2 miles outside	2 50 a. Leith.	3 20 a.	
Between Bell Rock and Fife-ness ..	0 50 a. Leith.	1 20 a.	
St. Abb's Head, inshore	2 55 a. Leith.	3 20 a.	Stream 2½ knots.
Do. 18 miles off ..	3 15 a. Leith.	3 40 a.	
Berwick, 5 miles off	4 10 a. Leith.	4 15 a.	Close inshore by Berwick and Holy Island the stream turns at 2h. 0m. after H.W., London, being 1½h. earlier than in the offing.
Farn Islands, 5 miles off	.. ..	3 55 a.	
Do. close in	.. ..	3 20 a.	
Coquet Island, 5 miles off	.. ..	4 0 a.	Stream 2½ springs; 1¼ neaps—on both tides.
Blyth, inshore	3 40 a. Leith.	4 0 a.	Close inshore 20m. earlier.
Do. 6 miles off	.. ..	4 10 a.	
Tyne, 6 miles off	3 40 a. Leith.	4 15 a.	
Sunderland, miles 5 off	.. ..	4 20 a.	
Hartlepool, 4 miles off	.. ..	4 40 a.	
Whitby, 4 miles off	.. ..	4 50 a.	
Scarboro', 4 miles off..	.. ..	5 0 a.	A good slack in Filey Bay 2m. off shore on the ebb.

PLACE.	Time of Slack Water, or the ending of the Flood stream to the S.E. before or after High Water at certain places of reference.	LONDON.	REMARKS.
	H. M.	H. M.	
Flambro' Head, 5 miles off	.. ..	5 10 a.	A good slack in Bridlington bay on the flood.
Spurn Point, 7 miles off	.. ..	5 30 a.	
Leman and Ower	.. ..	3 30 b.	Flood to S. by W. from 2h. after H.W., London to 8h. after; Ebb to N. ½ E. from 3h. before H.W. London to 2h. after.
Dudgeon Light	.. ..	7 0 a.	Flood from 1 to 3h. after H.W. London sets from W. round to S.S.W.; from 3 to 7h. after H.W. London, main flood stream S. to S.S.E. 2½ knots; Ebb begins about 4h. before H.W. London N.N.E. to N.N.W. 2½ knots, and ends ½h. after H.W. London.
Cromer, 4 miles off	.. ..	3 50 b.	
Would, fairway	.. ..	3 40 b.	
Hasboro' Gat	.. ..	3 30 b.	Flood S. to S.S.W.; Ebb N. to N.N.W.
Cockle Gat	.. ..	3 10 b.	Flood S.; Ebb N.N.E.; Springs 2½ knots.
Yarmouth Roads	.. ..	3 5 b.	Stream sets S.S.W., 1½h. after H.W. at Yarmouth; Ebb sets N. by E. ½ E. 1½h. after L.W. at Yarmouth.
Lowestoft, 4 miles off	.. ..	3 0 b.	Streams turn at 1½h. after High and Low Water by the shore; the same in Lowestoft and Corton roads.
Orford-ness	.. ..	2 30 b.	
Swin, East	0 20 a. Harwich.	1 45 b.	The last quarter flood sets to the N.W. over the Gunfleet.
Swin, West	0 10 b. Sheerness.	1 25 b.	
Kentish Knock	0 30 a. Dover.	2 30 b.	General set on flood S.W. ½ S.; springs 2 knots.
Margate Road	1 0 a. Dover.	2 0 b.	
Queen & Prince Channel	1 20 a. Dover.	1 40 b.	Young flood S.S.W.; half flood W.N.W.; last flood N.W.

BETWEEN THE NORTH FORELAND AND DOVER.

N. Foreland, Elbow buoy	4 10 a. Dover.	2 10 a.	General set N.E. at buoy; N.N.E. inshore.
Gull Stream	4 30 a. Dover.	1 30 a.	,, N.E. by N.; springs 2¾; neaps 1¼ knots.
Dover Strait	4 0 a. Dover.	1 0 a.	,, E.NE. 3 knots springs: neaps 1¾ knots.

ENGLISH CHANNEL.

PLACE.	Time of Slack Water, or the ending of the Flood stream to the N.E., before or after High Water at certain places of reference.	LONDON.	REMARKS.
	Ending of Flood Stream to the Eastward.		
	H. M.	H. M.	
Dungeness, 7 miles W. by S. of ..	3 45 a. Dover.	0 45 a.	Springs 2 knots; neaps 1¼; Set E. by N.
Off Fairlight and Rye Bay..	3 0 a. Dover.	H.W. London.	The tides from the Channel and North Sea meet off Fairlight; if a ship works up to Fairlight by the time it is High Water at Dover, she will keep an eastern stream for 4h. afterwards.
Hastings, 7 miles off	1 0 a. Hastings.	2 30 b.	Stream easy, seldom more than 1½ knots.
Royal Sovereign shoals	At H.W. Eastbourne.	3 0 b.	Stream strong on both tides; 3 knots.
Eastbourne, 1½ miles off	0 30 b. Eastbourne.	3 30 b.	Stream easy.
Beachy Head, 6 miles off	At H.W. Eastbourne.	3 0 b.	Stream 2½ to 3 knots.
Beachy Head, inshore by Seven cliffs and Seaford Bay	1 20 b. Newhaven.	4 5 b.	All alongshore, within 3 miles of the land, the eastern stream ceases about 1h. before High Water; and after half ebb, there is an eddy tide to the eastward, inshore.
Newhaven, inshore	1 0 b. Newhaven.	4 30 b.	
Do. 10 miles off	At H.W. Newhaven.	2 45 b.	
Do. 14 miles off	0 10 b. Newhaven.	3 0 b.	
Brighton and Rottingdean	0 40 b. Newhaven.	3 25 b.	Flood easy, S.E. by E.; Ebb 1½ knots, N.W. by W.
Brighton, 5 miles off	0 30 b. Brighton.	.. ..	To the westward of Brighton the eastern or flood stream is very slack.
Park	1 30 b. Portsmouth.	4 0 b.	
Looe Stream	1 40 b. Portsmouth.	4 0 b.	
Owers, 4 miles outside	At H.W. Portsmouth.	2 30 b.	Flood E. by S. ½ S.: Ebb W. by N.; 1½ knots.
Spithead	2 30 a. H.W. ,,	Slack at H.W. London Bridge.	To S.E. by S. from H.W. at London Bridge to 6½ h. after it; to N.W. by N. from 5h. before H.W. London until H.W. there.
Solent	1 35 b. H.W. ,,		
Needles	1 40 b. ,,	4 0 b.	Stream runs out at the Needles from 4h. before H.W. London Bridge until 2h. 20m. after it.
Culver Cliff, 2 miles	1 40 b. ,,	4 0 b.	
Dunnose. 5 miles off	0 25 b. ,,	3 20 b.	The Stream off the S. side of the Isle of Wight runs 4½ knots close inshore; between Dunnose and St. Catherine are several races or overfalls on both sides.

PLACE.	Time of Slack Water, or the ending of the Flood stream to the N.E., before or after High Water at certain places of reference.	LONDON.	REMARKS.
	Ending of Flood Stream to the Eastward.		
	H. M.	H. M.	
St. Catherine's, 5 miles off	0 30 b. Portsmouth.	3 0 b.	
Needles, 4 miles off	1 0 b. ,,	3 20 b.	
St. Alban's Head, 2 miles off	1 50 b. ,,	4 10 b.	Race S.S.E. distant 1¼ miles from the head.
Portland Bill	2 20 b. ,,	4 40 b.	Race from ¼ mile to 1½ miles from the Bill; stream close inshore begins to set to the Eastward at Low Water at Weymouth, and to the Westward at H.W.
Do. 1 mile off	2 35 a. H.W. Weymouth.		
Beer Head	.. ..	3 30 b.	Very slack on both tides.
Lyme, 13 miles S. of..	.. ..	4 0 b.	Streams N.W. and S.E.
Plymouth, 6 miles off	2 40 a. Devonport.	6 10 a.	Long slack.
Eddystone, 4 miles off	3 0 a. Devonport.	6 30 a.	E. by S. from ¾ flood to ¼ ebb by the Dock Yard, 2 miles an hour; West to N.W. from ¾ ebb to ¼ flood.
Do. 22 miles off	3 5 a. Devonport.	6 40 a.	
Lizard, 7 miles S.W. of	2 0 a. Plymouth.	5 30 a.	

WEST COAST OF CORNWALL.

PLACE.	Slack Water or Ending of Flood Stream to the Northward.	LONDON.	REMARKS.
Seven Stones, along the North Coast of Cornwall to Hartland Point ..	.. ..	3 0 a.	Flood N.E. by E.; Ebb S.W. by W.
Hartland Point	.. ..	3 30 a.	

BRISTOL CHANNEL.

PLACE.	Slack Water	LONDON.	REMARKS.
Off Lundy Island	.. ..	3 30 a.	Springs 3 knots; neaps 2 knots.
Ilfracombe	0 30 a. H.W. by shore	4 0 a.	
Off Nash Point, in mid-channel ..	.. ..	4 20 a.	Inshore, and in Swansea Bay, slack water is 1h. earlier.

IRISH SEA (South Channel).

PLACE.	Time of Slack Water, or the ending of the Flood stream to the Northward before or after High Water at certain places of reference.	LONDON.	REMARKS.
	H. M.	H. M.	
Smalls Light	0 20 b. Liverpool.	3 0 b.	Flood N.N.E.; Ebb S.S.W.
Between the Smalls and Milford Haven	0 10 b. "	3 20 b.	The Stream off Milford towards the Bristol Channel runs nearly 4 knots an hour at springs; general set is S.E.; and slacks at 3h. 20m. after H.W. at London.
Between Tuskar and Bishop rocks, mid-channel	0 20 b. "	3 0 b.	Flood N.E.; Ebb S.W. by W.; velocity 2¼ knots, springs.
Off Waterford, Saltees Light-vessel	0 40 b. "	3 20 b.	
Irish Channel between the Tuskar and 30 miles N. of Holyhead	0 15 b. "	3 0 b.	General set N.E. in the southern portions; N.E. by N. off Arklow; and N.N.E. off Holyhead; velocity about 3 knots. Inshore streams from Milford round the Bishop's run 5 knots, and take an E.N.E. direction up Cardigan Bay, running 2 knots.
Between the Isle of Man and Anglesea	0 15 b. "	3 0 b.	Midway, East, 2 knots; inshore from the Skerries towards Liverpool E. by S. to E.S.E. 2 knots.
Between the Isle of Man and Dundrum Bay	.. ..	.. ..	Stream scarcely perceptible.

IRISH SEA (North Channel).

PLACE.	Ending of Flood Stream to the S.E.	LONDON.	REMARKS.
Between Copeland Islands and Mull of Galloway	0 15 b. Liverpool.	3 0 b.	Mid-Channel S.S.E. towards the N.W. point of Isle of Man, velocity 2 knots; and E.S.E. 3 knots to the north of Point of Ayr, thence Southerly towards Morecambe Bay, 2 knots.
Donaghadee, inshore	2 0 b. "	4 45 b.	Eddy on the flood, south of the Copelands; stream strong outside, 2¼ knots.
Maidens	0 30 b. "	3 15 b.	Flood, South, 1½ knots.

SCOTLAND (West Coast).

PLACE.	Ending of Flood Stream to the S.E.	LONDON.	REMARKS.
	H. M.	H. M.	
Mull of Cantyre..	0 35 b. Liverpool.	3 20 b.	Flood S.S.E. 3 to 4 knots, springs; to E.S.E. and N.N.E. up to Kilbrannan Sound 1½ knots, and off to East to Frith of Clyde.
	Ending of Flood Stream to the Northward.		
Perch of Clyde or Ailsa craig	0 20 b. ,,	3 5 b.	Streams easy on both sides in the Frith of Clyde.
Islay, Mull of Kinho	At H.W. by shore.	3 0 a.	Flood N.N.W. 5 knots, springs; 3 knots, neaps; Ebb inshore sets towards the Otter rock, and passes 2 miles South of Texa Island, when the stream from Jura Sound meets it, and thence out towards the Coast of Ireland.
Islay, Rhynns of Oversay Lighthouse	At H.W. by shore.	3 0 a.	The ebb sets to S.W. 1¾h. before H.W., or 1½h. earlier than outside; very strong race off Oversay Light extends 2 miles off; 7 knots springs; an eddy on the flood near the shore to the N.E. of Ru Andrew or S.W. point of Islay.
Islay, N.W. side, near Noamb Island	1 20 a. H.W. by shore.	4 30 a.	H.W.F. and C. by shore 4h. 45m.; stream 2 knots, setting East.
Off Rudha Mhail Point, N. entrance of Islay Sound	.. ..	5 0 a.	Gradually turning into Islay sound, and joining the ebb stream to S.S.W. for 2h. after the time of H.W. by the shore.
Islay Sound	Flood to N.N.E. until 1 0 b. H.W. at Feolin Ferry.	2 0 a.	Flood to N.N.E. slacks 1h. before H.W. on shore; stream to S.S.W. commences 1h. before H.W. and ends 5h. after it; velocity 4 to 6 knots off Feolin ferry; but near the North and South entrances of the Sound about 2½ to 3 knots.
	Ending of Flood Stream to N.E.		
Between South of Oronsay and Islay.	2 45 a. H.W. Oronsay.	5 30 a.	H.W.F. and C. Oronsay 5h. 0m.
Between Colonsay and Jura	.. ..	.. ..	Stream scarcely perceptible; mid-channel seldom more than ½ knot.
Jura Sound, East of Sgeir Maoile Lighthouse	0 30 b. H.W. on the shore.	2 20 a.	Near Sgeir Maoile Lighthouse, velocity 2½ knots, springs; streams slacken ½h. before High and Low Water.

IRELAND (South Coast).

PLACE.	Ending of Flood Stream to the Eastward.	LONDON.	REMARKS.
Cork Harbour, 6 miles off	.. ..	4 0 a.	The ebb or Western stream close inshore commences at 5h. 10m. on days of F. and C.; in the offing at 6h. 0m.; velocity 1¼ knots.
Old Head of Kinsale, 6 miles off ..	.. ..	4 20 a.	Close to the Head is a race on the Flood to S.E. 2¾ knots, and on the ebb is a race to the S.W.

IRELAND (SOUTH COAST)—*continued.*

PLACE.	Ending of Flood Stream to the Eastward.		REMARKS.
		LONDON.	
		H. M.	
Galley Head, 6 miles off	.. ..	4 30 a.	Close inshore it slacks 1h. earlier.
Cape Clear, 6 miles off	.. ..	4 50 a.	Flood sets S.E. by E. 1½ knots; a race close to the Cape; on the ebb or Western stream, there is a slack inside the line of Cape Clear and Mizen Head.
Off Mizen Head	.. ..	4 50 a.	Close to Mizen Head is a strong race of nearly 4 knots, S.S.E. and N.W. by N., and the stream turns 1½ to 2h. earlier.
Off the Bull, Cow and Calf	.. ..	4 40 a.	Flood S.S.E. 1½ knots; Ebb, North; between these rocks and Dursey Island there are overfalls and strong currents.

IRELAND (WEST COAST).

PLACE.	Ending of the Flood Stream setting to the Northward.		REMARKS.
Off the Blaskets	.. ..	4 30 a.	Flood N. by E. 1½ knots; the flood wave divides about 3 miles South of the Skelligs, going Northward towards the Lemon Rock and Puffin Island, and Southward towards the Bull, Cow and Calf; stream varying from ½ to 1½ knots, it being strongest after a prevalence of Westerly winds, and very weak after Easterly winds.
Blasket Sound	.. ..	2 20 a.	
Shannon River entrance	.. ..	2 50 a.	Close inshore the stream makes out very shortly after H.W., or 2h. after H.W. London.
Seven miles off Kilkee	.. ..	5 0 a.	Flood sets N.E. 1½ knots.
Six miles off Arran Islands	.. ..	5 30 a.	Flood N. by E. 2 knots; Ebb S.W. by S. 1½ knots.
Six miles off Slyne Head	.. ..	5 30 a.	Inshore near Slyne Head is a race of 3 knots.
Off Inishbofin	.. ..	5 20 a.	Flood N.N.E. ½ E. 2 knots.
Off Achill Head	.. ..	6 0 a.	Flood N.E. by N. 1 knot.
Eagle Island	.. ..	6 0 a.	
Sligo Bay	.. ..	6 30 a.	Close inshore the Western tide makes soon after H.W., or 3½h. after H.W. at London; but in the offing it sets E. by S. towards Donegal Bay until 6½h. after H.W. at London.
Tory Island and Inishtrahul, in the offing.	.. ..	6 30 a.	Flood sets East 1 knot; Ebb, West; inshore the H.W. slack is 2h. earlier.

As a general rule, the stream in the offing on the N.W. Coast of Ireland runs to N.E., until 3 hours after High Water by the shore, and the inshore stream ceases very shortly after High Water.

Prevailing S.W. winds cause the flood stream to run longer and stronger, and they have the contrary effect on the ebb stream.

CHAPTER XVI.

DEPTH OF THE NORTH ATLANTIC.

1. **Deep-Sea Soundings.**—Our absolute knowledge of the depth of the ocean is very limited. It is true that a large number of deep-sea soundings have been made here and there, but even if they could be received as *perfectly accurate*, they would no more furnish data for establishing the *mean* depth than determining the height (above the sea-level) of a few scattered points in Great Britain would give an approximate knowledge of the general surface of the country. Many of the earlier observations are known to be erroneous, inasmuch as in some instances the line was running out to supposed enormous depths at the same rate as at starting, which it certainly could not do *if the lead were descending*; in fact, only a small part of the velocity in such instances could have been produced by the downward movement of the sinker, and the inference is that no bottom was reached with from 1000 to 2000 (or perhaps 3000) fathoms, beyond which limit the higher numbers represent the influence of undercurrents—together with the drift of the vessel on the surface.

In making deep-sea soundings it is now the practice to *time the descent* of each hundred fathoms as the marked line goes out. The United States set the example in improved methods of taking these soundings, and they have been well followed up by Commander Dayman, R.N. The mean of experimemts for the sinker and twine is now estimated as follows:—

2m. 21s.	as the average time of descent	from	400 to 500	fathoms.
3m. 26s.	,,	,,	1000 to 1100	,,
4m. 29s.	,,	,,	1800 to 1900	,,

Nevertheless, when a great length of line has run out, anomalies still show,—and it will require all the resources of modern science, and all the ingenuity that can be brought to bear on the subject, before the lowest depths are satisfactorily determined.

The pressure increases with the depth,—to the amount of 15 pounds upon every square inch for every 34 feet in depth; but the density is not thereby sensibly increased, owing to the incompressibility of the water; so that neither the buoyant force, nor the resistance to the motion of any body, is sensibly increased from the surface to the bottom. At the depth of 3000 fathoms, for instance, the pressure upon a square inch is nearly 8000 pounds, but the column of 18,000 feet of water is only shortened about 60 feet; the density is thus but slightly increased; but the effect of this enormous pressure upon compressible bodies, as air, wood, &c., is to condense them into a smaller bulk, by which they may be rendered *heavier than water*, and will sink of their own weight.

Now, how is it with the sounding lead and line? The lead, if allowed to descend *alone*, will fall with a uniform and rapid velocity to the bottom. This velocity will be attained within a few feet of the surface, and will be due to the opposing forces of gravity and the resistance of the water, which will be balanced when the uniform velocity is reached. But if a line be attached to the lead, a few hundred feet of the line will offer a resistance to the motion nearly equal to the whole weight of the lead, and as successive lengths of line are drawn into the water, the resistance is constantly increased; so that at 2000 or 3000 fathoms depth, the weight will be almost entirely suspended in the sea by the resistance of the water along the side of the line.

Some idea of the resistance which opposes the motion of a sounding line may be formed from the fact that, upon 1000 fathoms of a line one-tenth of an inch in diameter, moving with a velocity of 3 feet per second, the resistance is between 25 and 30 pounds. And if the velocity be increased to 6 feet per second, the resistance upon the line becomes 100 pounds nearly. Or, if the length of the line be doubled, with the same velocity, the resistance is doubled; and it is also directly proportional to the diameter of the line.*

These are some of the reasons why an improvement in the mode of measuring the depths of the sea is not only desirable, but necessary, before an accurate knowledge of those depths can be obtained; and the end to be attained is far from unimportant, regarded physically, since it would be valuable to know how far the general features of the land, as seen in the bounding continents, extend and influence the space between them, and whether the ocean descends to its lowest depths with all the irregularities that the continents present in attaining to their greatest altitudes.

In regard to navigation these deep-sea soundings tend to disprove the existence of many shoals incautiously reported; but they certainly cannot do so in *all* cases.

The following table includes all the important soundings that have been made in the NORTH ATLANTIC between Lat. 50° N. and the Equator; the capital letters in the fourth column refer to the several authorities by whom they were taken;—thus, B., for LIEUT. BERRYMAN, U.S. Navy; D., for COMMANDER DAYMAN, R.N.; P., for CAPT. PULLEN, R.N.; L., for LIEUT. LEE, U.S. Navy; and *A., J., J.A., L., P. and S.*, are respectively attached to the observations made by officers of the U.S. Coast Survey in the *Albany, Jamestown, John Adams, St. Louis, Plymouth, Portsmouth, Saranac*, and *Susquehanna*.

The Asterisk (*) in the third column indicates that *no bottom* was found at the depth stated.

* Professor W. P. Trowbridge.

Position.		Depth in Fthms.	By whom made.	Position.		Depth in Fthms.	By whom made.
Lat.	Long.			Lat.	Long.		
49° 59′ N.	17° 35′ W.	2700	B.	39° 17′ N.	27° 46′ W.	805	D.
49 57	13 16	1580	B.	39 14	19 1	2820	B.
49 53	31 34	1900	B.	39 12	32 22	1075	D.
48 16	35 22	2100	B.	38 54	31 2	925	D.
47 48	11 12	2275	D.	38 54	33 30	1500	B.
47 38	9 1	1800	B.	38 51	28 27	766	D.
47 12	10 0	2525	D.	38 50	43 49	1600	*J.*
47 6	12 57	2350	D.	38 38	66 31	1625*	*A.*
46 53	37 46	2000	B.	38 33	29 33	960	D.
46 48	21 42	2465	B.	38 23	28 50	409	D.
46 42	13 5	1500*	P.	38 15	45 33	2000	*J.*
46 33	14 39	2450	D.	38 13	62 32	3700	*J.*
46 32	12 42	2190	B.	38 3	67 14	4920*	B.
46 26	26 55	1400	B.	37 50	32 7	2000	*J.*
46 15	30 4	1760	B.	37 28	56 22	5000	*P.*
46 12	13 3	1800	P.	37 26	65 48	1175*	L.
45 58	29 35	1900	B.	37 24	68 52	2920	B.
45 53	16 7	2300	D.	37 6	68 2	2000	*J.*
45 13	27 38	1320	B.	36 59	19 59	2500	B.
45 11	17 26	2100	D.	36 49	19 54	2750	B.
45 7	26 8	1500	B.	36 43	74 0	1500*	*J.*
44 52	30 38	1560	B.	36 33	73 0	1900*	*J.*
44 43	24 35	1370	B.	36 16	46 52	5070*	*L.*
44 42	24 35	1500	B.	36 4	73 59	1460*	L.
44 41	40 16	1800	B.	36 0	27 20	4000*	*J.*
44 34	18 47	2375	D.	35 52	65 56	1000*	L.
44 5	20 0	2100	D.	35 7	25 43	1040	*J. A.*
44 5	13 29	2560	B.	35 6	26 50	4000*	*J.*
43 47	24 24	1850	B.	34 23	20 57	2150	B.
43 40	42 55	2700	B.	34 18	16 45	2298	B.
43 17	21 20	1800	D.	34 11	43 21	2800	*P.*
43 10	46 56	2760	D.	34 2	73 6	700*	L.
42 44	28 20	1210	B.	33 50	52 34	2600	*J. A.*
42 40	31 11	1680	B.	33 35	38 32	1800	*S.*
42 24	43 19	2725	D.	33 34	61 38	1950*	*A.*
42 22	50 0	1650	B.	33 8	16 10	2950*	B.
42 16	22 32	1900	D.	33 3	48 36	3550	B.
42 10	42 4	1850	B.	33 3	72 14	345*	L.
42 7	15 29	2500	B.	32 55	47 58	6600*	B.
42 7	41 28	3000*	*J.*	32 47	50 0	3250	B.
41 50	23 40	1830	D.	32 46	59 56	800*	L.
41 43	51 31	3130	B.	32 29	47 2	1950*	B.
41 40	56 1	2595	B.	32 10	59 9	300*	L.
41 40	59 23	2600	B.	32 6	44 47	5500	*J. A.*
41 12	62 38	2200	B.	32 1	44 21	2250	B.
41 9	43 40	1975	B.	31 46	22 3	2850	B.
41 7	49 23	4580	B.	31 17	23 8	2400	B.
41 7	54 37	2710	B.	31 17	53 22	500*	L.
41 4	24 31	2050	D.	31 16	43 28	2080	B.
40 50	64 44	2200	B.	31 1	44 31	2300	*J. A.*
40 49	29 0	1080	B.	30 49	27 25	1100*	B.
40 48	30 2	830	B.	30 49	27 25	2200*	B.
40 36	54 18	3450	B.	30 38	70 10	600*	L.
40 35	31 56	1230	B.	30 5	58 52	1000*	*A.*
40 34	58 30	2750	B.	29 26	56 42	1480	B.
40 24	25 25	1200	D.	29 14	35 49	2270	B.
40 20	17 48	2650	B.	29 12	22 50	2800	B.
40 10	35 2	2775	D.	28 56	69 4	1000*	L.
39 41	26 37	1425	D.	28 55	41 12	1880*	B.
39 40	33 34	1925	D.	28 23	64 47	2518	B.
39 39	70 30	1000*	B.	28 20	59 24	2900	B.
39 36	41 6	2675	B.	28 14	69 44	2950	B.

Position.		Depth in Fthms.	By whom made.	Position.		Depth in Fthms.	By whom made.
Lat.	Long.			Lat.	Long.		
28° 4' N.	61° 4' W.	3080	B.	17° 2' N.	28° 8' W.	2460	B.
27 21	68 6	1000*	L.	16 59	21 38	1580	L.
27 19	77 18	690	*A.*	16 43	58 6	345*	L.
27 10	75 6	1806	*A.*	16 43	58 55	3200*	L.
27 10	76 59	1180	*A.*	16 42	59 6	1000*	L.
27 5	21 21	1700	B.	16 34	20 47	1875	L.
27 2	30 48	2580	B.	16 30	20 58	1941	L.
26 49	66 54	2710	B.	15 56	49 34	500*	L.
26 43	38 39	800*	L.	15 56	49 39	500*	L.
26 33	67 33	1000*	L.	15 54	56 45	1000*	L.
26 32	60 7	3825	L.	15 52	49 34	540*	L.
26 31	74 10	1590	*A.*	15 52	49 40	560*	L.
26 28	73 50	1778	*A.*	15 25	55 1	3020	L.
25 45	60 7	556*	L.	15 24	21 47	1220	L.
25 30	37 44	1560*	L.	15 9	22 29	1380	L.
25 30	37 42	1720	L.	15 8	22 57	1120	L.
25 30	72 7	4100	P.	15 6	50 34	500*	L.
25 14	66 57	2350	L.	15 3	23 13	790	L.
25 11	60 0	520*	L.	15 0	48 58	250*	L.
25 4	36 13	1000*	L.	14 48	23 50	900*	L.
24 48	69 39	3600	*A.*	14 21	51 24	564*	L.
24 48	70 22	1893	*A.*	13 28	52 26	1960*	L.
24 37	59 49	534*	L.	13 1	22 59	680*	L.
24 37	65 12	3560*	L.	12 47	52 58	2780	L.
24 34	65 32	1000*	L.	12 20	54 49	2570*	L.
24 28	63 30	1000*	L.	12 9	55 17	2435	*S.*
24 27	62 55	450*	L.	11 47	53 49	1000*	L.
24 11	61 44	3450	L.	11 12	47 37	1855*	L.
23 58	24 20	2700	B.	11 7	21 57	1120	L.
23 43	32 39	2180*	L.	11 7	21 57	1160	L.
23 42	67 37	2940	B.	10 38	47 40	500*	L.
23 41	32 39	2200*	L.	10 0	27 30	2000	P.
23 36	59 25	600*	L.	8 43	20 52	2270	L.
23 15	32 24	2200*	L.	7 58	47 51	1970	L.
26 6	44 0	1760	B.	7 17	20 7	1940	L.
23 1	59 26	358*	L.	7 17	20 7	2050	L.
22 40	69 0	2762	*A.*	5 37	19 35	2019*	L.
22 39	59 26	800	L.	4 27	19 21	2540	L.
22 27	53 15	2390*	B.	4 16	21 42	2700	P.
21 48	32 36	7020	B.	4 14	19 20	2670	L.
21 45	55 46	2800	B.	4 5	19 15	2125	L.
21 26	51 31	2300	B.	3 51	19 6	2760	L.
21 19	38 10	4700	*P.*	3 42	19 6	2760	L.
21 19	66 27	2960	B.	3 1	18 36	2725	L.
21 18	46 14	1875	B.	2 36	19 22	2780	L.
21 6	24 38	2625	B.	2 20	28 44	1080	P.
21 6	42 9	2370	B.	2 17	15 45	900*	L.
20 51	58 26	2830	B.	2 10	19 57	2690	L.
20 29	34 18	2850	B.	2 10	19 57	2750	L.
20 12	59 39	1200*	L.	1 10	44 11	500*	L.
20 2	61 2	2810	B.	1 7	42 58	1000*	L.
20 2	31 6	2560	B.	1 7	48 44	2000*	L.
19 23	40 23	2580	B.	0 57	41 6	2980	L.
19 2	59 33	3300	L.	0 54	43 36	500*	L.
18 49	36 16	2820	B.	0 54	44 52	1000*	L.
18 44	29 18	2520	B.	0 45	18 29	2680	L.
18 39	25 24	1970	L.	0 43	45 1	1000*	L.
18 32	49 48	2370	B.	0 42	44 21	640	L.
18 19	25 5	1670	L.	0 18	18 41	2000*	L.
18 11	23 48	1612	L.	0 16	18 51	1900*	L.
18 10	24 51	2080	B.	0 10	38 44	1000*	L.
17 35	22 50	1370	L.				

CHAPTER XVII.

ON THE SPECIFIC GRAVITY AND TEMPERATURE OF THE WATER OF THE ATLANTIC OCEAN.

A few remarks on this subject have already been incidentally introduced at p. 6 to 8; the following observations are chiefly from the "Twelfth No. of the Meteorological Papers" issued by the Board of Trade.

1. **The N. and S. Atlantic**:—The mean specific gravity of the whole of the North Atlantic from the equator to latitude 50° is 1·02664, while that of the South Atlantic between the corresponding parallels is 1·02676, showing an excess on the side of the waters south of the Equator, but only of ·00012.

The accession of the river Plate has considerable influence in diminishing the density of the sea in its vicinity; and by omitting all observations above 30° north and 30° south, the mean densities become respectively 1·0267 and 1·0271; that is to say, between the Equator and 30°, the southern waters are heavier than the northern by ·0004.

This difference is less than has hitherto been generally supposed, and even *this* exists only between the Equator and 20°, and is chiefly occasioned by the greatly diminished density of the water between the Equator and 10° N. in the belt of Equatorial calms and rains.

Though but little *heavier* the South Atlantic is decidedly *colder* than the North, nearly five degrees, their mean temperatures being 71°·6 and 66°·7 respectively, and this difference is found to be tolerably uniform, parallel for parallel, on projecting the thermal curves.

Changes of temperature in sea water are frequently abrupt, and in studying the temperatures accompanying these observations (p. 260-263), it should be borne in mind that it is the fact of those temperatures being the means of all observations within squares of ten degrees that causes the transitions to appear gradual.

When H.M.S. *Nile* was going from Halifax to Bermuda, in May 1861, Admiral Milne found the temperature 70° at the bow, while only 40° at the stern, as he entered the gulf stream.

In the neighbourhood of the Cape of Good Hope the changes of temperature are, as is well known, both sudden and frequent.

The register of H.M.S. *Encounter* states, that when in 39° 30′ S., 15° E. in February 1860,—"At 6 A.M. upon drawing "water from alongside it appeared quite warm to the hand," and the temperature was found to be 72°, which was 17° higher than it had been the previous day at noon, when the ship was in the same latitude, but 1° 58′ further to the westward. The specific gravity (*uncorrected* for temperature) continued unchanged at 1.0285, and a northernly current of 19 miles had been experienced.

The *Sebastian Cabot*, Capt. Quirk, in very nearly the same position and in the same month found the surface temperature at 6 A.M. to be 57°, at noon 73°, and at 6 P.M. (the same day) 76°. This was in Lat. 39° 25′ S., Long. 16° 30′ E. to 18° 30′ E., current E.N.E. about 12 miles per 24 hours.

Farther to the southward, the *Pomona*, Capt. Bergen, Lat. 41° to 43° S., Long. 15° to 25° E. found the temperature of the water varying from 48° to 64°, changing frequently; though no great difference was observed in the specific gravity (uncorrected).

In illustration of the effect of heavy rains, in at least temporarily diminishing the specific gravity of the surface, a most remarkable instance was observed by Dr. C. K. Ord of H.M.S. *Hermes*, when that ship was lying in Simon's Bay in August, 1859. On the 4th of that month at 9 A.M. the specific gravity was 1·0266, and in one hour it was reduced by the heavy rain that fell to 1·0193, the water becoming brown in colour, merely brackish in taste, and its current setting distinctly outwards. By noon the density had increased to 1·0253, and at 3 P.M. the surface had recovered its former density of 1·0266. The next day the specific gravity was again reduced by heavy rain and again rose.

The *temperature* of the surface was also temporarily lowered from 58° to 55°, the temperature of the rain being 50°.

2. Mediterranean.—The mean specific gravity of the whole of the Mediterranean, derived from about 600 observations, is 1·0289.

The mean density increases gradually from west to east; the observations to the west of Long. 10° E. giving a mean density of 1·0286, while between 10° E. and 30° E. the mean is 1·0291, showing an excess of ·0005 on the side of the eastern half of the sea.

The maximum and minimum *reliable* observations (omitting those made very near the mouths of rivers) are respectively 1·0320 (near the Archipelago), and 1·0258 (not far from Marseilles).

The average temperature at the surface is 67°·3 (the mean of all observations). The highest temperature recorded is 79°, and the lowest recorded is 58°.

3. Dardanelles and Black Sea.—The only observations in the Dardanelles are those of one ship, the Peninsular and Oriental Company's steamer *Colombo*. This steamer while passing through the straits to the Black Sea found the specific gravity decrease from 1·0278 to 1.0162.

The mean of all the observations in the Black Sea (nearly 200) show an average density of only 1·0148, the maximum recorded is 1·0209, the minimum* 1·0114.

* Except off the mouths of the rivers.

The large influx of fresh water from the great rivers which discharge themselves into the Black Sea is no doubt the cause of its diminished density, as compared with the Mediterranean. Its mean temperature is 56°·8 or 10°·5 lower than that of the Mediterranean.

4. **North Sea and Baltic.**—There is a very marked difference between the mean densities of the North Sea and the Baltic; for while the density of the former differs but little from that of the Atlantic Ocean generally, the specific gravity of the Baltic, as derived from about 100 observations, is even less than that of the Black Sea.

North Sea -	Mean specific gravity -	1·0261
	Maximum ,, -	1·0280
	Minimum ,, -	1·0199
Baltic - -	Mean specific gravity -	1·0086
	Maximum ,, -	1·0232
	Minimum ,, -	1·0003

The mean of the observations in the western half of the sea (Long. 10° to 20° E.) is 1·0112, while the observations to the east of Long. 20° show a mean density of only 1·0042.

No observations in the Gulf of Bothnia have been received.

The temperature of the water appears to decrease eastward, but the observations are not sufficiently numerous to be of much value.

5. Specific Gravity and Temperature of each square of Ten Degrees in the North Atlantic Ocean and adjacent Seas.

Between the parallels of 70° and 60° N. :—*

Long.	0° to 10° W.	... ...	temp.	52°·0;	sp. gr.	1·0267
,,	10 to 20 W.	... ...	,,	49·4	,,	1·0265
,,	20 to 30 W.	... ...	,,	49·1	,,	1·0272
,,	30 to 40 W.	... ...	,,	49·0	,,	1·0266
,,	40 to 50 W.	... ...	,,	36·7	,,	1·0244
,,	50 to 60 W.	... ...	,,	38·2	,,	1·0255

Between the parallels of 60° and 50° N. :—

Long.	30° to 20° E.	... ...	temp.	45°·5;	sp. gr.	1·0042
,,	20 to 10 E.	... ...	,,	51·9	,,	1·0112
,,	10 to 0 E.	... ...	,,	50·9	,,	1·0261
,,	0 to 10 W.	... ...	,,	55·8	,,	1·0265
,,	10 to 20 W.	... ...	,,	56·8	,,	1·0268
,,	20 to 30 W.	... ...	,,	55·8	,,	1·0268
,,	30 to 40 W.	... ...	,,	52·7	,,	1·0268
,,	40 to 50 W.	... ...	,,	44·1	,,	1·0260
,,	50 to 60 W.	... ...	,,	45·6	,,	1·0247

* The numbers *before* the "Long." are those of the ten degree squares on the wind charts of the North Atlantic Ocean, which accompany this work.

Between the parallels of 50° and 40° N.:—

	Long. 0° to 10° W.	... ...	temp. 57°·8;	sp. gr. 1·0268
(30)	„ 10 to 20 W.	... ...	„ 59·7	„ 1·0265
(31)	„ 20 to 30 W.	... ...	„ 60·1	„ 1·0269
(32)	„ 30 to 40 W.	... ...	„ 61·5	„ 1·0272
(33)	„ 40 to 50 W.	... ...	„ 56·3	„ 1·0266
(34)	„ 50 to 60 W.	... ...	„ 54·7	„ 1·0256
(35)	„ 60 to 70 W.	... ...	„ 51·6	„ 1·0238
(36)	„ 70 to 80 W.	... ...	„ 56·4	„ 1·0247

Between the parallels of 40° and 30° N.:—

	Long. 30° to 20° E.	... ...	temp. 71°·2;	sp. gr. 1·0296
	„ 20 to 10 E.	... ...	„ 68·2	„ 1·0288
	„ 10 to 0	... ...	„ 65·2	„ 1·0286
	„ 0 to 10 W.	... ...	„ 65·3	„ 1·0282
(23)	„ 10 to 20 W.	... ...	„ 66·7	„ 1·0277
(24)	„ 20 to 30 W.	... ...	„ 67·2	„ 1·0275
(25)	„ 30 to 40 W.	... ...	„ 68·4	„ 1·0271
(26)	„ 40 to 50 W.	... ...	„ 70·6	„ 1·0277
(27)	„ 50 to 60 W.	... ...	„ 68·2	„ 1·0270
(28)	„ 60 to 70 W.	... ...	„ 64·6	„ 1·0268
(29)	„ 70 to 80 W.	... ...	„ 64·1	„ 1·0260

Between the parallels of 30° and 20° N.:—

(14)	Long. 10° to 20° W.	... ...	temp. 71°·0;	sp. gr. 1·0279
(15)	„ 20 to 30 W.	... ...	„ 72·5	„ 1·0278
(16)	„ 30 to 40 W.	... ...	„ 74·8	„ 1·0279
(17)	„ 40 to 50 W.	... ...	„ 78·3	„ 1·0276
(18)	„ 50 to 60 W.	... ...	„ 77·8	„ 1·0272
(19)	„ 60 to 70 W.	... ...	„ 77·5	„ 1·0272
(20)	„ 70 to 80 W.	... ...	„ 77·7	„ 1·0269
(21)	„ 80 to 90 W.	... ...	„ 76·0	„ 1·0271

Between the parallels of 20° and 10° N.:—

(6)	Long. 10° to 20° W.	... ...	temp. 74°·4;	sp. gr. 1·0265
(7)	„ 20 to 30 W.	... ...	„ 74·4	„ 1·0272
(8)	„ 30 to 40 W.	... ...	„ 76·4	„ 1·0271
(9)	„ 40 to 50 W.	... ...	„ 76·4	„ 1·0273
(10)	„ 50 to 60 W.	... ...	„ 79·4	„ 1·0271
(11)	„ 60 to 70 W.	... ...	„ 79·4	„ 1·0266
(12)	„ 70 to 80 W.	... ...	„ 80·5	„ 1·0272
(13)	„ 80 to 90 W.	... ...	„ 83·5	„ 1·0258

Between the parallels of 10° N. and the Equator:—

	Long. 10° E. to 0°	... ...	temp. 81°·3;	sp. gr. 1·0258
	„ 0 to 10 W.	... ...	„ 78·9	„ 1·0242
(1)	„ 10 W. to 20 W.	... ...	„ 79·7	„ 1·0267
(2)	„ 20 W. to 30 W.	... ...	„ 80·3	„ 1·0267
(3)	„ 30 W. to 40 W.	... ...	„ 80·4	„ 1·0268
(4)	„ 40 W. to 50 W.	... ...	„ 80·6	„ 1·0262
(5)	„ 50 W. to 60 W.	... ...	„ 81·7	„ 1·0235

SUMMARY.—North Atlantic Ocean.

From Lat. 50° North to the Equator.

Zones.	Means.		Maxima.				Minima.				Extreme Range.		Approximate Number of Observations.
	Specific Gravity at 62° F.	Temperature.	Specific Gravity.	No. of Square on Chart	Temperature.	No. of Square on Chart	Specific Gravity.	No. of Square on Chart.	Temperature.	No. of Square on Chart	Specific Gravity.	Temperature.	
North.		°			°				°			°	
50° to 40°	1·0260	57·5	1·0304	82	79	82	1·0099*	St. Lawrence.	32	34	0205	47	4,000
40° ,, 30°	1·0271	67·0	1·0323	24	81	26	1·0239	25 & 28	49†	28	0084	32	2,300
30° ,, 20°	1·0274	75·1	1·0312	17	85	20	1·0235	16	58	15	0077	27	2,100
20° ,, 10°	1·0270	77·8	1·0318	7	83	7	1·0198‡	7	64	6	0115	19	2,000
10° ,, 0°	1·0257	80·4	1·0318	2	84	2	1·0206§	5	74	2	0112	10	3,000

* Near the entrance to the St. Lawrence, and affected by the fresh water.

† 33° is *said* to have been met with near the American coast (square 29) in January.

‡ After much rain. H.M.S. *Boscawen.*

§ The ship *Victory*, while trading on the African coast, found the specific gravity lower on several occasions—1·0164, 1·0130, 1·0129, 1·0167.

In a log kept by Admiral Sir Frederick Grey himself, on the coast of Africa, there is the following passage:—"At the surface of the water, after we anchored, the stream of brown congo water prevailed generally, while at a little depth below, the green salt water was seen, and the variations in density (by hydrometer) 1·0247,.248,. 241,. 202, depend on the eddies which sometimes brought up the water from below. At bottom—temperature 72°, density 1·0252; at surface—temperature 75°·9, density 1·0202.

DENSITY OF SEA WATER in HIGHER LATITUDES than 50° North.

Zones.	Sea.	Meridians included.	Specific Gravity at 62° F.	Max.	Min.	Extreme Range.	No of Obs.
North.							
80° to 70°	Arctic -	50° to 100° W.	1·0240	1·0273	1·0190	0083	70
70° „ 60°		0° to 60° W.	1·0261	1·0295	1·0214	0081	100
60° „ 50°	Atlantic	10° E. to 60° W.	1·0262	1·0295	1.0229	0066	900

TEMPERATURE OF SEA WATER in HIGHER LATITUDES than 50° North.

Zones.	Sea.	Meridians included.	Mean Tempera-ture.	Max.	Min.	Extreme Range.	No. of Obs.
North.			°	°	°	°	°
80° to 70°	Arctic -	50° to 100° W.	33·1	41	29	12	70
70° „ 60°		0° to 60° W.	45·7	57	32	25	100
60° „ 50°	Atlantic	10° E. to 60° W.	51·7	68	37	31	900

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6. THE OCEAN—ITS SALTNESS &c.

In the course of the last 20 years the distinguished geologist and chemist FORCHHAMMER has executed about 200 complete analyses of water from all parts of the ocean, but in particular from the Atlantic and the north European seas connected with it. The important results of these laborious researches were communicated at the eighth meeting of the Scandinavian Naturalists, at Copenhagen in 1860, and the following is a summary of them.*

SALTNESS OF THE OCEAN.—The mean of 140 complete analyses gives 3·430 of salt in *one hundred* parts of water, unequally distributed over 16 regions; but the specimens being principally taken at low latitudes, he regards this mean as too high.

The mean saltness of the Atlantic is 3·577; of the Californian Pacific 3·522; of the Japanese Pacific 3·443; and of the Indian Ocean 3·418. These numbers confirm the conclusions of Lenz.†

The Atlantic system of rivers drains by far the greater portion of the continents and has the same position in latitude; thus the evaporation in the Atlantic must be greater than in any other part of the Ocean.

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* Forhandlinger ved de Skandinaviske Naturfurskeres VIII Mode, Kjöbenhavn, Juli 1860 Köjb. 1861, p. 26.
The full detail of the analyses is:—Videnskabernes Selskabs Skrifter, V Række, 1860.

† Poggendorf's Annalen, XX, 73.

The Atlantic is divided into five regions, viz :—

Reg.	III, Arctic region,	mean of 16	analyses,	3·556
,,	II, North temperate,	,, 24	,,	3·595
,,	I, ,, tropical,	,, 14	,,	3·617
,,	X, South, ,,	,, 6	,,	3·647
,,	XI, ,, temperate,	,, 6	,,	3·504
,,	XVI, Antarctic Ocean,	,, 1	,,	2·856

Thus the tropical part of the Atlantic is the saltest, and the amount of salt regularly decreases toward the poles ; yet the northern Atlantic is more salt than the southern (an influence of the Gulf Stream.) *

The first great circulation of terrestrial water is represented in these numbers : only a part of the water evaporated between the tropics directly returns to land and sea in form of rain ; another part is carried to the polar regions, there condensed to snow and ice, returning towards the equatorial belt either in great fresh-water currents or in veritable ice-streams, thus re-establishing the equilibrium.

Saltness of Oceanic Currents.—The equatorial current has, in the bay of Benin, a saltness of 3·488 ; crossing the equator between Long. 25° and 35° W., this successively increases by evaporation to 3·573 and 3·600. On the same Longitude, at Lat. 15° S. the saltness is 3·715 ; Lat. 12° and 14° N. 3·619 and 3·594 ; thus the current is less salt than the ocean near it—indicating the freshening influence of the great rivers of Guinea. Near St. Thomas, West Indies, the saltness is only 3·570—the enormous amount of fresh water from the Amazon and Orinoco reaching thus far—since a few degrees north of the current the saltness of the ocean is again 3·670. At the Bahama Islands the saltness is 3·588—the evaporation in the Gulf has been counterbalanced by the waters of the Mississippi. Northward, the Gulf stream increases to 3·610, 3·628, and 3·636 ; but at Lat. 43° 26′ N, Long. 44° 19′ W. where the St. Lawrence empties, the saltness abruptly sinks to 3·415 (a diminution of 2½ tenths !). From this minimum it slowly rises to 3·589 and at last diminishes again in the higher latitudes. *These regular oscillations in the saltness of the great Atlantic current show the fresh water supply obtained from the great African and American rivers, and the effects of evaporation—and make it very probable that these rivers contribute to give the current its particular direction.* Forchhammer represents these numbers by a proportional *breadth* of the current (dotted for negative values)—thus showing at a glance this most important law.

The mean saltness of the polar current of Baffin's Bay is 3·482, but increasing towards the north,

Latitudes, . .	58° 53′	64°	69°
Saltness, . .	3·558	3·503	3·440

showing how the water of the Arctic sea is freshened by the northern rivers, Greenland glaciers, and the Hudson's Bay rivers.

* The maximum of saltness, 3·690, it is in the north tropical part of the Atlantic, opposite the dry coasts of Sahara, where hot, dry winds prevail, but no fresh water can be obtained, Lat. 24° 13′ N., Long. 23° 11′ W.

The southern polar or *Humboldt's* Current (Region XV.) gave 3·403; it conducts waters from the Antarctic Ocean, where 2·856 (Reg. XVI.) has been observed.

Counter-Currents.—The Sound, between Zealand and Sweden, exhibits the best investigated example of counter-currents: the surface-current being commonly *from* the Baltic, the bottom-current always *into* the Baltic. According to observations made from April to Sept. 1846, the direction and saltness of these currents were:—

		To the Baltic.	From the Baltic.	No Current.
Surface,	days,	23	86	24
	saltness,	1·599	1·334	1·180
Bottom,		1·900		

and mean saltness of Reg. VII, the Baltic, 0·481, of VI, Kattegat and Sound, 1·513, and North Sea (Reg. V.) 3·281.

Thus the bottom current contains constantly by far the greatest amount of salt, even in winter, when its temperature is 2° and 3° F. higher (waters of the Atlantic) than the surface current, partaking of the winter temperature of the Baltic Sea.

The saltness of about 20 points of the ocean has been determined for different depths. A difference of about one thousandth corresponds to the greatest depth observed, Lat. 12° 36′ N., Long. 25° 35′ W., depth 11,100 feet. The saltest water of the surface here evidently is the hottest.

In Davis strait and Baffin Bay, no considerable difference of saltness for different depths is observed; but in the adjacent Atlantic the lower water is less salt than the warmer above it; and this same cold and less salt bottom current may be traced along the Atlantic, except where great quantities of fresh water are introduced by European and American rivers: making the lower strata the saltest.

In the Indian and Pacific Oceans the lowest water everywhere seems to be the saltest (only 4 observations.)

Composition of the Salts.—Twenty-five different elements have been observed in the salt of the ocean, or in plants and animals of the sea: *Oxygen Hydrogen*, *Chlorine*, *Bromine*, Iodine, Fluorine, *Sulphur*, Phosphorus, *Carbon*, Nitrogen, Silicon, Iron, Manganese, *Magnesium*, *Calcium*, Strontium, Barium, *Sodium*, *Potassium*, Silver, Copper, Lead, Zinc, Cobalt, Nickel; but only those printed in *Italic* are predominant. Of these, chlorine, sulphuric acid, lime and magnesia may be determined with great exactitude. Comparing all analyses of *ocean water* (including the North Sea) it is found that the relative proportion of the components is nearly constant, being:—

Chlorine 100, sulphuric acid 11·91, lime 2·95, magnesia 11·08. Total 181·1 (for each 100 of chlorine).

The total is the most constant; yet there are small but constant differences for the different regions of the ocean—differences enlarging with the proximity of land, greatest in gulfs and bays, as may be seen from the following interesting comparison of the composition of the salt from Cronstadt (near St. Petersburgh) through the Baltic to the ocean.

To each 100 of chlorine corresponds :

	Lime.	Sulph. ac.	Total.
Cronstadt Harbour,	7·48	14·97	207·5
Gulf of Finland, middle	5·81	13·31	183·5
Gulf of Finland, mouth,	3·78	12·23	......
Sound (at Copenhagen),	3·28	12·57	181·4
Kattegat, at Anholt Island,	3·10	12·09	
North Sea, 50 miles W. of Jutland,	3·19	12·09	181·6
Ocean, mean	2·95	11·91	181·1

Thus, tho animals extract a great part of the solid matter washed down to the sea by the rain, before it reaches the great ocean.

We have already given (p. 6) the analysis of sea water by REGNAULT, we now append that of the English Channel by DR. SCHWEITZER :—

WATER		96·474
SALINE INGREDIENTS = 3·526.	Chloride of Sodium	2·706
	„ Magnesium	·366
	„ Potassium	·077
	Sulphate of Magnesia	·230
	„ Lime	·141
	Carbonate of Lime	·003
	Bromide of Magnesium	·003
Traces of Iodine and Ammoniacal salt		
		100·000

CHAPTER XVIII.

WHALING GROUNDS IN THE ATLANTIC OCEAN.

The following observations are extracted from Commander WILKES' "Narrative of the United States Exploring Expedition, 1838-1842.

The principal Whaling grounds in the Atlantic Ocean are :—

1. Off the Azores or Western islands.
2. „ Cape de Verdes.
3. North of the Bahama banks.
4. Gulf of Mexico.
5. Caribbean sea.
6. To the eastward of the Windward islands.
7. North coast of Brazil.
8. South coast of Brazil.
9. Carrol ground, or a space of Ocean lying between St. Helena and Africa.

The periods or times allotted to these fisheries coincide with the times at which it might be expected that the food of the whale would be most plentiful, if brought by the polar streams.

The Atlantic fishery is for the most part carried on in a smaller class of vessels than those used in the Pacific; the voyages are of less duration, and less capital is therefore required in this business than the other. In speaking of cruising-grounds, I shall follow the order in which they are visited.

The first in point of time is that near the Azores. This ground does not extend more than 200 miles from these islands, and lies principally to the southward of them. Here whales are found during the summer months, and as late as October. These islands, it will be well to remark here, lie in the route of the Great North Polar Stream, and form an obstruction to its passage; consequently the food is arrested in its progress and is accumulated here.

The next ground visited is off Cape Blanco and the Cape de Verdes, and it is also searched by the outward-bound ships of the Pacific fleet.

The whalers of the Atlantic next pass to the north coast of Brazil, in the months of October, November, and December, and thence to the Brazil bank, and off the mouth of the Rio de la Plata, where they fish in January and February; after this they seek St. Helena and the Carrol Ground, which lies from fifty to two hundred miles south-east of that island, towards the Cape of Good Hope. On the latter ground they remain during the months of March, April, and May; and thence they pass to the westward, along the South American coast, to the eastward of the Windward islands; thence to the Bahama banks, Cape Hatteras, and along the coast of the United States, home.

The smaller class of whalers seldom extend their cruising to the south of the line; but after they have visited the first two whaling-grounds, they usually pass to the westward, towards the islands of Fernando de Noronha, and thence along the South American coast, till they reach the Windward islands. They frequent the Caribbean sea in the months of January and February, and farther to the westward, off the peninsula of Yucatan and Cuba, in April; after which time they proceed through the gulf of Mexico, to cruise off the Bahama banks, and Cape Hatteras, in May. Thence they pass northward, on either side of the Gulf Stream, to the eastern side of the Grand Banks.

CHAPTER XIX.

THE COMPASS AND ITS ERRORS.

1. In "The South Atlantic Directory" a general description is given of the various elements of Magnetism as exhibited in the "Variation" of the compass, in the "Dip" of the needle, and in the "Total Force" of which the *variation* and *dip* are component parts; it is sufficient here to refer the reader to those remarks, and to state that he will find the Variation, Dip and Force

properly represented on the charts of the North Atlantic which accompany this work; observing, however, that on one of the charts it is not the Total Force which is given, for the *total* force being the expression of *two* forces, one "Horizontal," and the other "Vertical," it is only necessary to delineate the former,—a knowledge of which, with the "Dip," enables us to anticipate the changes that take place in a ship's magnetism, and consequently in the deviation.

2. Remarks on the Deviation of the Compass in Iron Ships.

[The majority of Masters of Iron Ships do not read because they cannot understand the two or three works already published on the Deviation of the Compass; and, generally, when they see a book full of *formulæ*, even though they could understand a large part of it with careful reading, they at once close it as *beyond their mark.* The following, however, is the substance of a lecture on the subject delivered by Archibald Smith, Esq., M.A., F.R.S., (February 9th, 1866,) at the Royal Institution of Great Britain,—a high authority on everything relating to the Compass in Iron Ships,—and though short, is nevertheless both *comprehensive and plain*,—and we feel confident will just meet the wants of many a Shipmaster who has heretofore turned away from the subject as one far above his understanding. We therefore recommend the perusal of this paper to every officer in the Mercantile Marine, and hope its substance will be well studied and considered.]

The Deviation of the Compass is a subject of great and increasing importance owing to the great and increasing amount of iron used in the construction of vessels, and the consequent increase in the amount of the deviation and in the apparent irregularity of its laws.

On the present occasion it will be necessary for me to omit altogether some of the most important and most interesting parts of the subject—viz., 1st, the mathematical part, including algebraical formulæ, arithmetical processes, and graphic constructions of great interest and utility; and, secondly, the numerical results for different ships and classes of ships which have been obtained from the reduction and discussion of observations made in a large number of ships of the Royal Navy. I must confine myself to *an attempt to explain the principles on which the forces which cause the deviation act, and the principles on which the deviations produced can be reduced to law*, and to stating generally, what has been accomplished and what remains to be accomplished.

General Considerations.—1. A magnet is a bar of steel, the ends of which have opposite properties. They are generally marked N. and S. (north and south.)

The property is that the N. end of one magnet attracts the S. end and repels the N. end of another magnet, and *vice versâ.*

If we lay two magnets at a little distance in the same line with unlike poles turned to each other, and lay a soft iron rod in the interval between them, the

soft iron rod will be magnetized by *induction*; the end next the S. pole of one magnet will become N., the end next the N. end of the other magnet will become S. If we turn the rod about
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soft iron rod will be magnetized by *induction;* the end next the S. pole of one magnet will become N., the end next the N. end of the other magnet will become S. If we turn the rod about its centre, it will gradually lose its magnetism, till, when at right angles to the line of magnetization, it will be neutral, and if we turn it further, it will become magnetized in the opposite way.

The earth is a magnet, having a S. pole in Lat. 70° N., Long. 96° W., and a N. pole in Lat. 75° S., and Long. 154° E.

The direction of the magnetic force in London at present is the same as if there were a S. pole 20½° to the west of north and 68° below the horizon, and a N. pole 20½° to the east of south and 68° above the horizon. This direction is called the line of force, or the line of "dip." If we hold a soft iron rod in the line of dip, it becomes instantly magnetized, the lower end becoming N. the upper end becoming S. If we hold the rod vertically, the lower end will still be N. but of less intensity; the upper end S. also of less intensity. If we hold the rod horizontally north and south, the north end will be N. but of still lower intensity, the south end S. also of lower intensity. If we now turn the rod in the same horizontal plane, its magnetism will diminish till it becomes east and west, when it will be neutral, and if we turn it still further the magnetism will be reversed; the amount of the changes will be greatly increased by hammering the rod in each position.

A sphere of soft iron will be magnetized in the same way however held. The diameter in the line of dip will be the axis of magnetism, and the lower and north half of the surface will be N., the upper and south half S.

In bodies of any other shape the effects will be similar, though less regular, if the shape be irregular.

In an iron ship, on the stocks, intense magnetism is developed by the process of hammering; N. magnetism being developed in the part of the ship which is below and towards the north, and S. magnetism in the part which is above and towards the south.

As the usual position of the compass is near the stern, it follows that in the case of ships built head north, the compass is in a position where there is an intense S. magnetism drawing the north end of the compass strongly to the stern and downwards, and generally producing a very large deviation, besides a large heeling error. In such ships it is of importance to have a standard compass well forward.

In ships built head south, there will generally be less deviation and little heeling error in the usual position of the compass.

In ships built east and west the amount of deviation is generally small, but is less regular than in ships built head south.*

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* From the special magnetic property developed in a ship according to her position when building, it follows that for a compass *aft*, in the usual place of the steering binnacle, the

Theoretical Representation of the Deviation.—If we place a magnet before the compass with its S. end turned to the compass, it will draw the north end of the needle to the ship's head, and as the ship turns round there will be, in the first or eastern semicircle, a deviation of the north point of the compass to the right hand or east; in the second or western semicircle, a deviation to the left hand or west. This would produce one part of what is called the "semicircular" deviation.

If we place a soft iron rod vertically in front of the compass, with its upper end at the level of the compass, this end, which will be S. will attract the north end of the needle, and produce a deviation of exactly the same kind as the magnet which we have considered. It will, therefore, simply increase the semicircular deviation caused by the first magnet. If the N. end of the imaginary magnet, or the lower end of the imaginary rod, be nearest the compass,—or if the magnet or rod be abaft the compass, an effect of the same kind, but in an opposite direction, will be produced.

A magnet to starboard or port of the compass will produce a similar effect, except that a deviation of one kind will be produced when the ship's head is on the north semicircle, and of the other kind when on the south semicircle. This is the other part of the "semicircular" deviation.

The effect of the two magnets and the one iron rod, which we have considered, make up the whole of what is called the "semicircular" deviation.

If we lay a horizontal soft iron rod in front of and directed to the compass, it will easily be seen that when the ship's head is N., S., E., or W., it produces no deviation. When N.E. and S.W. it produces a deviation to the right hand or E., and when S.E. or N.W. a deviation to the left hand or W.; it therefore produces what is called the "quadrantal" deviation.

A horizontal soft iron rod directed to the compass, but placed to the starboard or port, will produce an effect of exactly the opposite kind, and would correct that produced by the first rod; but if the second rod, instead of being on one side, passes, as it were, through the compass, it would produce exactly the same effect

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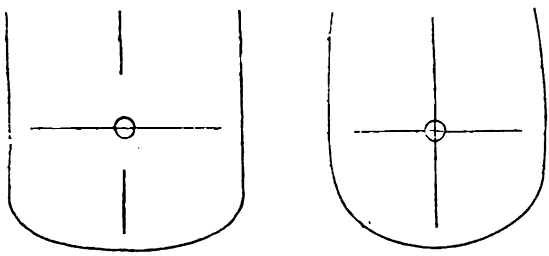
character of the deviation—*though not the amount*—may be approximately represented in a tabular form, as follows :—

Approximate Magnetic Direction of Ship's Head while Building.	Maximum Easterly Deviation occurs when Ship's Head by Compass is near	Maximum Westerly Deviation occurs when Ship's Head by Compass is near
N.	W.	E.
N.E.	N W.	S.E.
E.	N.	S.
S.E.	N.E.	S.W.
S.	E.	W.
S.W.	S.E.	N.W.
W.	S.	N.
N.W.	S.W.	N.E.

as the first rod. The two rods will then conspire to produce the quadrantal deviation.

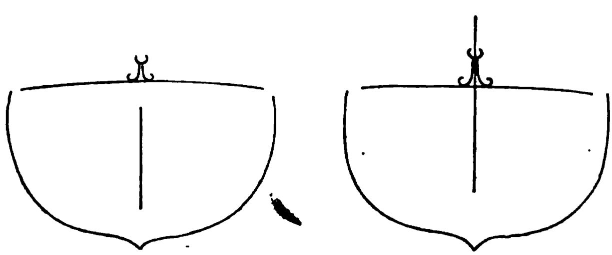
A quadrantal deviation of the same kind will be produced if the first rod instead of being on one side of the compass passes through it, provided always that its *force* is less than that of the transverse rod.

In almost all known ships the quadrantal deviation is what would be produced by two such rods, *i.e.*, rods of one or other of the following types :—



Between these two types there is an important difference, which will be easily traced out. The second type would always diminish the directive force of the needle, while the first type would increase or diminish it according as the *force* of the fore and aft rods is greater or less than that of the transverse rod.

The effect of the magnetism when a ship heels over may be seen by the diagrams which follow :—



It will easily be seen that as the ship heels over, the upper end of the transverse rod becomes S. and attracts the north end of the needle to windward, and also that the upper end of the vertical rod which is below in the first figure, by the effect of heeling, is moved to windward, and draws the north end of the needle to windward, and increases the heeling error caused by the transverse beam, while in the second figure it is moved to leeward and counteracts the heeling error caused by the transverse iron.

Compasses on the upper decks of iron ships, particularly if they have been built head north, are of the first type, and there is generally a large heeling error to windward. Compasses on the main deck, and particularly of ironplated ships, are generally of the second type, and the heeling error is often to leeward.

The amount of error in each case may be easily determined by observations of *vertical force*, and by separating the two parts of the *quadrantal* deviation, without actually heeling the ship.*

The magnets and soft iron rods we have imagined must not be considered as mere possible cases, but as representing truly the actual case in all ships. They are in fact the physical interpretation of Poisson's general formulæ for the action of induced magnetism, which interpreted amounts to this, that the effect of the iron of any body, however irregular, on a magnetic particle, is exactly the same as that of nine soft iron rods and three magnets. When the iron is symmetrically distributed as in a ship, the rods are reduced to five in number, viz., the four we have considered, and a fifth lying fore and aft, with one end below the compass, which would make the heeling error greater or less with the ship's head north than it is with the ship's head south, but this is not an effect of much importance.

Effect in particular Ships.—In wooden ships the semicircular deviation is represented by the effect of a single vertical rod of soft iron in front of the compass, and the quadrantal deviation is very small.

In iron ships the semicircular deviation is generally represented by the effect of a magnet at the part of the ship which was south in building, with its S. end turned to the compass.

Armour-plated ships are generally plated after launching; the semicircular magnetism is greatly affected by the position in which they are plated. If they are plated in the direction opposite to that in which they were built, the deviation is generally diminished; when they are plated in the same position in which they are built, the semicircular deviation is generally increased.

Change of Deviation from Time.—What is called the permanent magnetism is in truth only sub-permanent, and changes much, particularly if the ship is exposed to blows or strains, so that the semicircular deviation generally alters very much in the first year after building. The alteration is generally a diminution, although it might be an increase if the compass had by accident or choice been placed in a position where the semicircular

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* *Summary of Heeling Error.*—The following is perhaps as complete a statement as in the present knowledge of the facts can be made as to Merchant ships:—

The heeling error arises from two causes—

(1.) *Vertical* induction in *transverse iron;* and

(2.) *Vertical force* and induction in *vertical iron:*—

(1.) Draws the north end of the needle to windward in N. latitudes, and to leeward in S. latitudes.

(2.) In the usual position of the Steering Compass, draws the north end of the needle to windward in ships built head north, to leeward in ships built head south.

Therefore an Iron Ship, built head north, will generally have a large heeling error to windward in N latitudes, and a small heeling error, which may be to windward or to leeward, in S. latitudes.

An Iron Ship built head south may be expected to have a small heeling error to windward or to leeward in N. latitudes, and a considerable heeling error to leeward in S. latitudes.

deviation from induced magnetism exactly counteracted that from the permanent magnetism.

In consequence of this change the Government has, on the recommendation of the Superintendent of the Compass Department, laid down a rule that no iron ship shall be taken up as a transport till it has made one long voyage.

There is a very remarkable change in the capacity of the soft iron for receiving magnetism by induction, which seems to indicate some molecular change in the iron, *viz.*, that it becomes less susceptible of induction by the lapse of time. The effect of this on the strength of the iron is one of the most important points to which attention is now directed.

Change of Deviation from Change of Place.—When a ship sailing south reaches the magnetic equator, the earth's magnetism acts horizontally. The vertical soft iron rod which I have imagined will then have no magnetism, and the semicircular deviation arising therefrom will disappear. When she goes into south magnetic Latitudes, the upper end will now become N. and will repel the north end of the needle, and change the direction of the semicircular magnetism caused by the rod.

There will be no corresponding change in the semicircular magnetism caused by the permanent magnetism, except that near the magnetic equator, the directive force of the earth's magnetism being greater than in England, the amount of deviation which the same disturbing force produces will be proportionately diminished.

Careful observations on the changes which take place in the deviation of iron ships in different Latitudes are much wanted. They are being made in some of her Majesty's ships now in the south, but there are no means of procuring such observations from merchant ships.

No change is produced in the quadrantal deviation by a change of the ship's geographical position.

Effects of Special Arrangements of Iron.—The upper or lower ends of all vertical masses of iron produce powerful effects on the needle.

The stern-post, iron stanchions, funnels, gun-turrets, generally produce large deviations, but if the place of the compass is judiciously selected, they or some of them may be used as correctors.

Horizontal masses of iron, such as deck-beams, produce a great effect, generally increasing the quadrantal deviation and diminishing the directive force. Both causes of error may be reduced by having as little iron as possible immediately below the compass, or within a cone traced out by a line passing through the compass, and making an angle of 54° 45′ with the vertical.

History of the Science.—What has been said will make a short account of the history of the science intelligible. Captain Flinders, in his voyage to

Australia in the beginning of the century, was struck by the fact of the north end of the compass being drawn to the ship's head in northern, and to the stern in southern Latitudes. He, with great sagacity, compared it to the effect produced by a vertical rod of soft iron, and corrected it by introducing such a rod abaft the compass.

Afterwards, attention was drawn to the same subject in the voyage of Ross and Parry to Baffin's Bay, to which expeditions General (then Captain) Sabine was attached as astronomer. The very large deviations which were found in high Latitudes attracted attention, and were carefully observed and discussed.

The observations made in these voyages attracted the attention of Poisson, the great French mathematician, who in his memoirs on magnetism, published in the year 1824, first gave the general formulæ for the effect of iron, which we have already adverted to, and applied them to the observations made in these voyages with much success.

About the year 1840 the British Admiralty, on the report of a committee of scientific officers, comprising General Sabine, Sir J. Ross, and the late Captain Johnson, adopted the system ever since followed in the royal navy, of having a standard compass distinct from the steering compass, placed in a position, selected, not with reference to the convenience of the steersman, but for the small and uniform amount of magnetic force at and around it, and of having the deviations of that compass carefully observed by the process of "swinging" the ship, and the deviations of every ship recorded. They also appointed an officer, whose sole or principal duty was the superintendence of the compasses. This office, which has been filled first by Captain Johnson and since his death by Captain Evans, has done more for the advancement of the science than anything else.

No ships in the royal navy have ever been lost from the errors of the compass; and the magnetic history of every ship is so well known, that, in case of the loss of a ship, there would be no difficulty in arriving at a confident opinion as to the effect of the compass error in causing it.

At the same time the attention of Mr. Airy, the Astronomer Royal, was directed to the particular question of the deviation of the compass in iron ships. Mr. Airy proposed a mode of correcting the semicircular deviation by the application of magnets, and of correcting the quadrantal deviation by the application of soft iron cylinders analogous to the soft iron rods we have supposed, which has been subsequently extensively adopted in the mercantile marine.

In the year 1856 the Liverpool Compass Committee commenced those labours which, principally carried on by their able secretary, Mr. Rundell, have produced three valuable reports, which have contributed greatly to the advancement of this science. These labours are, however, now discontinued.

Practice in the Royal Navy.—In the royal navy, as we have said, each ship has a standard compass in a selected position. A ship is swung or turned round and the deviation observed in a certain number of positions, either by comparison with a compass on shore, or by a comparison with a celestial body, or by observing a distant object. A table of errors is thus observed and recorded—they are reduced by obtaining from them the co-efficients of the semicircular and quadrantal deviation. Observations of horizontal force and of vertical force are also made from which the amount of heeling error is obtained—and if the amount is large, the heeling error is corrected by the application of a vertical magnet.

The whole process is described, and all the mathematical formulæ and arithmetical processes, and a number of convenient graphic methods are given in the "Admiralty Manual for ascertaining and applying the Deviations of the Compass caused by the Iron of a Ship."

Practice in the Mercantile Marine.—In the mercantile marine there is no regular superintendence of the adjustment of the compass; it is left to the professional compass adjusters. In many cases there is no separate standard compass, but the steering compass is used for the navigation of the ship, and is often placed so near the stern-post and steering gear that it has originally very large and very irregular deviations. These are corrected by powerful magnets. The consequence is, that the slightest change in the magnetism of the ship produces a large error, which is the more dangerous that the captain believes his compass to be free from error.

This great advantage, from the indiscriminate use of the method of correction by magnets, is, however, an abuse of the method, and not necessarily attendant on it.

Desiderata.—I. *Royal Navy.*—The only desiderata seem to be that greater attention should be paid to the preparing a place for the standard compass, and to the position of the ship in building and plating. The position of the standard compass should be shown in the drawing of every ship, which, before being finally settled, should be submitted for the observations and suggestions of the Superintendent of the Compass Department.

Ships should be built as much as possible head south, and should be plated in the opposite direction to that of building.

Careful recommendations as to the special points to be attended to have been submitted to the Admiralty by the present Superintendent of the Compass Department, and we may hope that much benefit will be derived from them.

A proof of what may be effected in this way has already been given in the case of several of the ships of the Imperial Russian Navy, in which the arrangements made under the superintendence of Captain Belavenetz have greatly reduced the amount of deviation.

Desiderata.—II. *Mercantile Marine.*—This is a more difficult question, from the want of any general superintendence, or any mode of establishing a uniform system, or any opportunity of receiving, recording, reducing, and discussing the observations made.

Till some change takes place in this respect, it is not probable that much improvement will be introduced, or that merchant ships will make their due contributions to the advancement of science.

What seems desirable is—

1. That in all iron steam passenger ships there should be a standard compass distinct from the steering compass, placed in a position selected for the small and uniform amount of the deviation at and around it.

2. That the deviations by the standard compass should be ascertained and returned to a department of the Government.

3. That these deviations should be carefully recorded, reduced, and discussed by a competent superintendent.

Many indirect advantages might be expected to flow from following, in these respects, the example of the Royal Navy.

The attention of Masters is particularly called to the following Abstract, taken from the "Third Report from the Liverpool Compass Committee to the Board to Trade, 1857—1860":—

The Committee, after observing that a "large proportion of the complaints respecting the compasses of iron ships has reference to their sluggishness and want of directive power," proceed to state that "not unfrequently the reported compass errors arise from purely mechanical causes, which have no connection with the ship's magnetism,—these are, cracked or holed agates,"—but more commonly "blunted or worn pivots,"—"pivots longer or shorter than they should be, so that the point of suspension of the card is no longer in the plane of the gimbals,"—and "needles which have never had, or have lost their proper directive power." So long, therefore, as "these causes are prevalent, there will constantly be reports of deviation from the *attraction of the land*, of *compass disturbance from fog*, of *unusual aberration*, of *indraught*, and other *unfounded* or *imaginary pretexts* which are now put forward when an iron ship gets stranded." These remarks also apply to the compasses of wooden ships quite as much as to those of ships built of iron, and the only remedy for these and other errors, "must chiefly depend on the care and attention of the master, on his knowledge of the principles of magnetism, and on his acquaintance with, and his attention to, those mechanical properties which are so essential to the satisfactory working of the compass.

"The Committee having had under consideration the proper time for swinging iron ships, and more particularly steamers, such as those which trade regularly to the Baltic, to the Mediterranean, or to America, think that there appears sufficient reason for requiring that a new iron ship or steamer should be swung immediately before each of the first two or three voyages; that all iron vessels should be swung immediately before the first voyage following any considerable amount of repair; whenever a change has been made in the position of the standard compass; and when there is a change of Captain unless the new Captain had charge of the vessel during the preceding voyage as chief officer. Swinging at any other time may be left to the discretion of the Captain.

"It must not, however, be forgotten that the utility of swinging the ship is chiefly confined to assisting the Captain in first clearing his port and the neighbouring channels in case of thick weather, and ought not to supersede his making observations for himself whenever he has the opportunity; in short, that the deviations observed in port when the ship is upright and at rest should always be considered subordinate to observations made at sea under various degrees of heel of the ship, and in steamers with the addition of the vibration of the screw.

"In cases where compass deviations are supposed to have in part occasioned a casualty, too little has been known of the subject to elicit to what extent they have been in fault, or how a recurrence of the accident might be prevented; but captains of screw steamers should bear in mind that, when under sail, seven distinct causes may have conspired to produce the course which has been made good,—(1) Set of the tide or current. (2) Set of the Screw. (3) Leeway. (4) Good or bad steerage. (5) Variation of the Compass. (6) Deviation of the Compass. (7) Extra Deviation from the *heeling* of the Ship.

"Again, the influence of some of these causes varies with the time occupied on the course; others vary in proportion to the distance gone over; but until the Captain of the Screw Steamer is able to estimate how much each cause is likely to affect the course which is to be steered, and the limits within which his estimate is likely to be erroneous he must ever be subject to much uncertainty as to the result."

It may, however, be set down as an axiom, that, "the best practical corrective of errors of the compass of all kinds is to be found in a competent and careful Captain."

Remarks on Correcting Courses for Deviation.

The following additional remarks are offered on this important subject, which the Navigator, especially when called to the command of an iron vessel for the first time, should carefully read and thoroughly understand.

When the *north* end of the needle is drawn to the right of the *true* North, the variation is said to be *easterly;* when it is drawn to the left of the *true* North, the variation is said to be *westerly*.

The rule to correct magnetic courses and bearings for the variation is simple enough:—Having made a *magnetic course*, or having taken a *bearing by compass* if the variation is *easterly*, apply the *amount* of variation to the *right* of the course, or bearing; if the variation is *westerly*, apply the amount to the *left*.

The converse of this rule holds good in reducing a true course, or a true bearing, to a magnetic course, or bearing,—the centre of a compass card being taken as the position of the observer in each case.

Deviation bears the same relation to *Variation*, that variation does to the true horizon; thus—

When the needle is drawn to the *eastward* of *magnetic* North, the *deviation* of the compass is said to be *easterly;* and when the needle is drawn to the *westward* of the *magnetic* North, the deviation is called *westerly*.

Rule 1.—The rule for the correction of magnetic courses (and bearings) for Variation holds good for the correction of the Deviation also, viz.:—if the Deviation is *easterly*, apply it to the *right;* if *westerly* apply it to the *left* of the compass course,—or of a bearing taken.

Rule 2.—The *converse* of Rule 1 *also* holds good in setting a course, but must be exercised with discrimination,—*it certainly, however, does not apply in the sense in which it is generally taken*, although where so used, and the deviation is very small, the error is also proportionately small, as will be seen presently.

In order to illustrate these rules, in respect to the application of the Deviation, take the following Table as the basis of operations:—

Direction of Ship's Head.	Deviation.	Direction of Ship's Head.	Deviation.
N.	0° 45′ E.	S.	8° 20′ W.
N. by E.	6 45	S. by W.	6 50
N.N.E.	12 30	S.S.W.	10 0
N.E. by N.	17 35	S.W. by S.	14 0
N.E.	21 45	S.W.	15 45
N.E. by E.	24 40	S.W. by W.	18 15
E.N.E.	26 15	W.S.W.	20 30
E. by N.	26 30	W. by S.	22 15
E.	25 25	W.	23 25
E. by S.	23 15	W. by N.	23 50
E.S.E.	20 10	W.N.W.	23 20
S.E. by E.	16 30	N.W. by W.	21 50
S.E.	12 30	N.W.	19 10
S.E. by S.	8 20	N.W. by N.	15 20
S.S.E.	4 5	N.N.W.	10 30
S. by E.	0 15 E.	N. by W.	5 10 W.

I. Let it be required to find the True Courses in the following cases:—

Ex. 1. Given the compass course E.N.E., and variation 24° E.:—
On referring to the table of errors, the deviation on the E.N.E. point is found to

be 26° 15′ E.; and whether the variation and deviation are applied as a correction, separately, or in a lump sum, matters not, the result is the same.

		° ′		° ′
Course E.N.E. =	N.	67 30 E.	Or thus, Deviation	26 15 E.
Deviation =		26 15 E.	Variation	24 0 E.
	N.	93 45 E.	Correction	50 15 E.
Variation		24 E.	E.N.E. = N.	67 30 E.
	. N.	117 45 E.	N.	117 45 E.
True course	S.	62 15 E.	S.	62 15 E.

Ex. 2. Given the compass course N. by E., and variation 22° W.:—
In the table of errors the deviation on the N. by E. point is 6° 45′ E.

		° ′		° ′
Course N. by E: =	N.	11 15 E.	Or thus, Deviation	6 45 E.
Deviation		6 45 E.	Variation	22 0 W.
	N.	18 0 E.	Correction	15 15 W.
Variation		22 W.	N. by E. = N.	11 15 E.
True course	N.	4 0 W.	N.	4 0 W.

Ex. 3. Given the compass course S.W. by W., and variation 18¼° E.:—
The table of errors gives the deviation on S.W. by W. as 18° 15′ W.

		° ′		° ′
Course S.W. by W. =	S.	56 15 W.	Or thus, Deviation	18¼ W.
Deviation		18 15 W.	Variation	18¼ E.
	S.	38 0 W.		0
Variation		18 15 E.	True course S.	56 15 W.
True course	S.	56 15 W.	or S.W.	by W.

The application, in the above cases, of Rule I. will be at once perceived;—also, that whether the two quantities (variation and deviation) be applied separately or together, the results do not differ.

II.—Now let it be required to find a COMPASS COURSE THAT SHALL MAKE GOOD A GIVEN TRUE COURSE.

It is said in Rule 2, that the *converse* of Rule 1 holds good; viz., that when the deviation is *easterly* apply it to the *left*, and when *westerly* apply it to the *right*, to determine the *correct* magnetic course; it is here however, that caution must be exercised in the application of the Deviation.

Ex. 1. Find a compass course that shall make a true course of E.N.E., where the variation is 0:—

The correct course required is E.N.E.,—the deviation on that point of the compass is 26¼° E.; now 26¼° to the *left* of E.N.E. is N. 41¼° E. or approximately N.E. ¼ N.; but if the ship has been sailing on a course N. 41¼° E., it will be obvious that by applying the deviation due to that course, as given in the table of errors, the corrected course will fall short of E.N.E.; for example N. 41¼° E. lies between N.E. by N. and N.E. (nearer the latter), now the error may be taken as 20° E., which applied to N. 41¼° E. gives N. 61¼° E. or N.E. by E. ½ E, which is not the required course by 5° or half a point.

Referring to the table, it will be seen that the deviation on N.E. is 21¾° E. consequently N. 45° E. + 21¾° E. = N. 66¾° E. or E.N.E. nearly; evidently therefore, the course to be steered in this case to make E.N.E. must be N.E. *easterly*.

Ex. 2. Let it be required to find a course which shall make good a correct magnetic course N.W. by N.

The deviation on this point, in the table, is 15° 20′ W. which applied to the *right* of the proposed course gives N. 18¼° W. or N. by W. ¾ W.; but supposing the vessel to have sailed on a N. by W. ¾ W. course, it will be evident, on looking to the table, that the deviation on such a course, cannot be more than abont 9°—being situated between N. by W. and N.N.W., consequently N. 18¼° W. + 9° W. = N. 27¼° W. or N.N.W. ½ W. nearly,—or more than half a point short of the course proposed; but the deviation on N.N.W. is 10¾° W., and such being the case, by steering N.N.W. *westerly*, the course made good would be N.W. by N.

Ex. 3. Thus also by applying 22°, the error on the N.W. by W. point, to the *right* of that point (*i.e.* steering N.W. by N.) in order to make good a magnetic course N.W. by W., it will be seen that since the error on N.W. by N. is only 15° W., the *correct magnetic course* would be about N. 49° W. or N.W. ¼ W., which is 7° short of the course proposed.

III. We shall next proceed to show that *in determining the course to be steered to make good a given* TRUE *course, the variation and deviation must be considered separately:* the single case in which they can be taken conjointly, being where they are of the same numerical value but of different names—when one quantity destroys the other.

Ex. 1. The true course required is N. by E. where the variation is 6¾° W., what is the course to steer?—

From the table, the deviation on N. by E. is 6¾° E.; now 6¾° W. and 6¾° E., being quantities that destroy each other—steer N. by E.;—this is rendered more evident, thus—

	°
Ship's course by compass N. by E. =	N. 11¼ E.
Deviation	6¾ E.
Correct magnetic course	N. 18 E.
Variation	6¾ W.
True course	N. 11¼ E.

The following example might lead to the supposition that no great error arises from using the variation and deviation conjointly, on all occasions:—

Ex. 2. Required the course to steer, to make good a true course of W. by N., where the variation is 1 point E.?—

First, using the variation, it is certain a magnetic course of W. gives W. by N. (true), and on referring to the table of deviation, W.N.W. northerly, which has an error of 23° W., will give the correct magnetic course W.; therefore steer by compass W.N.W.; or more plainly seen, thus:—

		°	
Ship's course by compass W.N.W. =	N.	67½	W.
Deviation		23	W.
Correct magnetic course	N.	90½	W.
Variation		11¼	E.
True course	N.	79¼	W. or W. by N. nearly.

By taking the difference between the variation and deviation on the required point, we have—

		°	
Deviation on W. by N. =		23¾	W.
Variation		11¼	E.
Correction		12½	W.
True course required W. by N. =	N.	78¾	W.
Course to steer by compass	N.	66¼	W. or W.N.W. nearly.

This differs but slightly from the former result:—and that it comes out so correctly must be attributed to the small differences in the errors on the points used on this occasion.

Ex. 3. Required the course to steer to make good a true course of N. by E. where the variation is 1 point E.?—

First, using the variation,—a magnetic course of N. gives (true) N. by E., and referring to the table of errors N. ¾° W. will give the correct magnetic course North; hence steer by compass, *slightly to the westward* of North.

But if deviation and variation are used conjointly as regards the N. by E. point, we have—

		°	
Deviation on N. by E. =		6¾	E.
Variation		11¼	E.
Apparent correction		18	E.
True course required	N.	11¼	E.
Apparent course to steer	N.	6¾	W.

This result is, evidently, greatly erroneous; for since N. by W. has a deviation of 5° W.; by steering N. 6¾° W. the true course would be N. ½ E. instead of N. by E.

Ex. 4. Again, suppose a true N. course is required where the variation is 2 points E.:—

The correct magnetic course will be N.N.W., to obtain which, allowing for 7° W. deviation, the course by compass would be N. by W. ¼ W.; as for example:

	°
N. by W. ¼ W. =	N. 15 W.
Deviation	7 W.
Correct Magnetic course	N. 22 W.
Variation	22½ E.
True course	N. nearly.

The variation and deviation applied as one correction, however, give the following result:—

Deviation on the N. point	1 E.
Variation	22½ E.
Apparent correction	23½ E.

This would indicate that the course to be steered by compass is N.N.W., westerly, but by so doing the true course thus obtained would be about N. by W.; as for example:—

Ship's course by compass N.N.W. 1° W. =	N. 23½ W.
Deviation	10½ W.
	N. 34 W.
Variation	22½ E.
	N. 11½ W.

Ex. 5. One more example will suffice; let it be proposed to make good a true course of S., where the variation is 2 points W.

The deviation with the ship' head S. is 3° W. (see table), which, added to the variation, becomes 25½° W.—the course to steer is *apparently* S. 25½° W. or S.S.W. ¼ W.—but the deviation table tells us that the error with the ship's head on that point (S.S.W. ¼ W.) is about 11° W., consequently the *correct magnetic course* becomes S. 14½° W., to which apply the variation (2 points W.), and the true course made good is S. 8° E. instead of S.; the proper course to steer under the circumstances would be about S.W. ¾° S.; for example:—

		°	′	
Ship's head by compass S.W. ¾ S. =	S.	36	34	W.
Deviation (by table)		14	0	W.
Correct magnetic course	S.	22	34	W.
Variation		22	30	W.
	S.	0	4	W.

Which gives the true course S.

These examples will clearly point out a misapprehension which exists, both as to the application of the deviation to obtain the correct magnetic course,—and as to the error which may arise in applying the deviation and variation as one quantity. To recapitulate,—

1.—*To obtain the correct magnetic course*, although the deviation is to be applied *conversely* to the method adopted when correcting a course on which the ship has already sailed,—yet due regard must be paid to the *numerical value* of the deviation—which differs on each point of the compass; and the amount of deviation to be applied, in order to make good any given correct magnetic course, will be found, where the errors are great, not on the proposed course, but one, two, or even three points on either side of it, according to whether the deviation is E. or W.

2.—*With respect to the application of the deviation and variation*:—The surest method is,—1st, To determine the *correct magnetic course* required to make good the given *true* course,—and—2nd, To ascertain, by the table of deviations, the *compass course* that will make good the required *correct magnetic course.*

One more remark on *setting the course*, and we have done;—An azimuth taken by the Standard Compass of an iron ship includes both deviation and variation;—the error thus obtained, when applied to the *compass course* on which the ship has been sailing, (to the right if E., to the left if W.,) will give the *true* course; will not answer the end proposed, inasmuch as the variation, on any given position of the globe, has the one numerical value and the one name (E. *or* W.) for *every* point of the compass,—while the deviation not only differs numerically on *each* point, but it varies also in name—being E. on one portion, and W. on another portion of the compass. Now although the error obtained by azimuth, when applied to another course, not far distant from that on which the ship was sailing at the time of observation, may produce *(perhaps)* no serious result on the wide ocean,—the case is quite altered when about to make a port; *then*, to ensure safety, azimuths should be obtained to determine the errors on several courses.

The following Tables for the Variation and Dip of the Magnetic Needle will be useful where the Chart is not at hand—

Approximate annual change of the Magnetic Variation.

Latitude.	West Longitude.						E. Long.
	120°	100°	80°	60°	40°	20°	0	20°
65°N.						+2·4		
60°						+3·0	−7·0	−6·5
50°			+7·5	0		+4·5	−6·5	
40°	+0·5		−3·4	+3·5	+2·2		−5·0	−5·0
30°	+0·7	+0·3	−2	+1·7	+2·6	−1·0		−5·0
20°				+1·0	+4·0	+1·5		
10°N.	+2·0		0		+3	+4·0		
0°		+0·5			+5·0	+4·0	+2	

N.B.—The change is given in minutes of Arc, + indicates an annual increase, — an annual decrease.

Table of the Variation of the Compass in the North Atlantic in **1869.**

Lat. N.	Longitude West.																				Long. East.				
	100°	95°	90°	85°	80°	75°	70°	65°	60°	55°	50°	45°	40°	35°	30°	25°	20°	15°	10°	5°	0	5°	10°	15°	20°
70°														°	°	°	−47	−42	−38	−34	−29	−24	−20	−16	−11¼
65								°	°	°	°	°	°	−55	−51	−47	−43	−39	−35	−30	−26	−22½	−19	−14½	−11
60								−56	−56	−56	−55	−53	−51	−48	−45	−42	−39	−35	−31	−27	−24	−21	−16½	−14	−10½
55							°		−45	−46	−46	−45	−44	−43	−41	−38	−35	−32	−28	−25½	−22½	−19		−13½	−10½
50							−23	−28	−32	−35½	−37	−39	−39	−38	−36	−34	−31½	−28¼	−26	−23½	−21	−18¼			
45						°	−14	−19	−23½	−27	−29	−30½	−32	−32	−23	−30	−28	−26	−24	−22	−20				
40						−5	− 9½	−13	−17	−20	−22½	−24½	−26	−27	−27	−26½	−25½	−24	−22½	−20½	−18½	−17			
35		°	°	°	°	−2	− 6	− 9	−12	−15	−18	−20	−22	−23½	−24	−24½	−23½	−22½	−21	−19½					
30	°	+9	+7½	+5½	+3½	+0½	− 2½	− 5	− 8	−11	−13	−15	−18	−20	−21	−22	−22	−21	−20						
25	+9½	+8½	+7½	+6½	+4½	+2½	+ 0½	− 2	− 4¼	− 7	−10	−12	−14	−16½	−19	−20	−20½	−20							
20	+9½	+8½	+7½	+6½	+5½	+4	+ 2½	+ 1	− 2	− 4½	− 7	− 9½	−11½	−14	−16½	−18½	−19½	−19½							
15				+7	+6	+4½	+ 3½	+2½	+ 0½	− 2	− 5	− 7	− 9½	−12	−15	−17½	−18½	−19¼							
10				+7½	+6½	+6	+ 4½	+3½	+ 2	+ 0	− 3	− 5½	− 8	−11	−14	−16½	−18	−19½	−19½						
5										+ 1	− 2½	− 4½	− 7½	−10½	−13	−16	−18	−19½	−20	−19½	−19½	−19½	−19½		
0											− 0½	− 3½	− 6½	− 9½	−12½	−15½	−17½	−20	−21	−22½	−22¼	−22	−21½	−20	

+ Signifies *Easterly* Variation, and — *Westerly* Variation.

Table of the Inclination (Dip) of the Magnetic Needle in the North Atlantic; from Gauss Magnetic Atlas 1835.

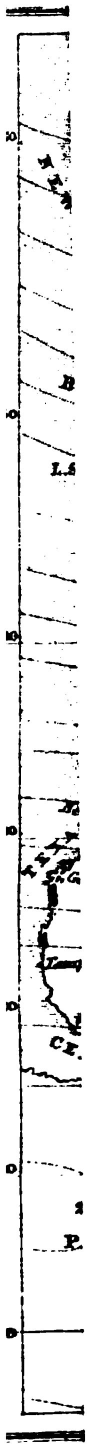
Lat. N.	Longitude West.											Long. East.		
	100°	90°	80°	70°	60°	50°	40°	30°	20°	10°	0°	0°	10°	20°
75°	+89°	+89°	+88°	+87°	+85°	+84°	+83°	+82°	+82°	+81°	+80°	+80°	+80°	+80°
70	+88	+89	+88	+86	+85	+84	+82	+81	+80	+79	+78	+78	+78	+77
65	+86	+87	+87	+86	+84	+83	+81	+80	+78	+77	+76	+76	+75	+74
60	+84	+85	+85	+84	+83	+82	+80	+78	+74	+75	+74	+74	+72	+71
55	+81	+82	+83	+83	+82	+80	+79	+77	+75	+73	+71	+71	+69	+68
50	+78	+79	+80	+80	+79	+78	+77	+75	+73	+70	+68	+68	+66	+64
45	+75	+76	+77	+77	+77	+76	+75	+73	+70	+67	+65	+65	+62	+59
40	+70	+72	+73	+74	+74	+73	+72	+70	+67	+64	+61	+61	+57	+54
35	+66	+67	+69	+70	+70	+70	+69	+67	+64	+60	+56	+56	+52	+48
30	+60	+62	+64	+65	+66	+66	+65	+63	+60	+56	+51	+51	+46	+41
25	+54	+56	+58	+60	+61	+61	+60	+59	+56	+51	+46	+46	+40	+33
20	+48	+50	+52	+54	+55	+56	+55	+54	+50	+46	+40	+40	+32	+25
15	+40	+43	+45	+48	+49	+50	+50	+48	+45	+39	+32	+32	+24	+15
10	+31	+34	+37	+40	+42	+43	+43	+42	+38	+32	+25	+25	+15	+ 6
5	+22	+25	+29	+32	+34	+36	+36	+34	+31	+25	+16	+16	+ 6	— 4
0	+11	+15	+19	+23	+26	+28	+28	+26	+23	+16	+ 8	+ 8	— 3	—13

N.B.—The Inclination to the North of the Magnetic Equator is + (*plus*); to the South of the Magnetic Equator — (*minus*).

ICE IN THE NORTH ATLANTIC.

The limits of ice in the North Atlantic, in the four quarters of the year, are delineated on the charts that accompany this work. Generally, no icebergs are encountered on or near the banks of Newfoundland in the winter months, but the bays and gulfs north of 45° N. are blocked by ice;—much however depends on whether the season is an open one or not in the Arctic regions. It is towards the latter end of spring and during summer that icebergs are met with in large numbers,—though they have been seen in 44° N., 48° W. in the early part of February.

ace p. 28



PART II.

SAILING DIRECTIONS.

MADEIRA AND PORTO SANTO.

THE MADEIRAS are a group of islands lying between Lat. 32° 23′ 15″ and 33° 7′ 50″ N., and Long. 16° 18′ 30″ and 17° 16′ 38″ W. They consist of five islands, Madeira, Pôrto Santo, and the Dezertas; the latter being three barren rocky islets south-eastward of Madeira. Since their discovery in the 15th century they have remained dependencies of Portugal.

The productions of the larger island, Madeira, are various, as in consequence of the altitude of its mountains almost every degree of temperature is obtained. The produce of the vine is the principal export: but corn is grown, although not sufficient to supply other countries. Almost every European vegetable is here cultivated with advantage; nor are the productions of the tropics wanting—guavas, citrons, oranges, bananas, coffee, &c. being obtained in great abundance. But the island is principally famed for the excellence of its climate, which is considered to be the finest in the world, so that it is much resorted to by consumptive patients.

The mean temperature of the hottest months (August and September) is between 73° and 74°; but when the eastern and south-eastern winds bring to the island the hot air from the African desert, the thermometer sometimes rises higher. It may also be observed that rain is not confined to a certain season of the year, but occurs at all seasons; and that hurricanes although sometimes very violent, yet are not frequent. See also page 46.

MADEIRA.—GENERAL DESCRIPTION.—Madeira may be described as a mass of basalt, rising with a rather steep ascent from the south and north towards the interior, where the mountains are of considerable elevation, and interrupted by many deep and narrow valleys, which are frequently traversed by streams of excellent water. It is chiefly in these valleys that the vineyards and gardens are situated, some of them at an elevation of 2000 feet above the sea level. In some parts of the island the rocky sides of the mountains are very steep, and the coasts are occasionally so precipitous that soundings are only to be obtained close to the shore, and even then on a rocky and unequal bottom, and at a depth of 35 to 50 fathoms. It is remarkable that although the island is unquestionably of volcanic origin, yet there are no craters to be seen on any part of it, except San Antonio, a mountain about 1¾ miles west of Machico, which has a smooth shallow basin on its summit.

In approaching the island it appears to consist of a bare rugged rock, of huge dimensions, which, although imposing, is peculiarly dark and gloomy, and it is not until a near approach to the land is made, that you can discover the green patches which are everywhere scattered over its deep red soil, even to the tops of the highest peaks. This mountain verdure is owing to groves of heath and broom, which grow to an extraordinary height, aspiring to the stature of forest trees. In addition to these groves, the terraced acclivities, covered with a luxuriant tropical vegetation, change on a closer approach its distant barren aspect into one of extreme beauty and fertility. The most striking peculiarity in the mountain scenery is, the jagged outline of the ridge, the rudely shaped towers and sharp pyramids of rock, which appear elevated on the tops and sides of the highest peaks as well as on the lower elevations, and the deep precipitous gorges, which cut through the highest mountains almost to their base.

Some of the mountains in the interior of the island are of considerable elevation, and visible at a great distance at sea. The most lofty is that of Ruivo, estimated to be 6056 feet above the sea. It has a well defined but rather rounded summit, and stands on the north edge of the stupendous ravine of the Curral; and, with reference to the coast, it lies nearly 7¾ miles north of Ponta de Cruz, and not quite 5 miles from Ponta San Jorge. It has a continued slope towards the sea in a north and N.E. direction, and on the S.W. side drops abruptly into the Curral. Throughout the western half of the island a central ridge extends, having an elevation of about 5000 feet; on its summit is an extensive plain, named Paul da Serra, which is fertile, and used especially as a breeding place for mules and horses. The eastern portion of the island, although high and containing many lofty peaks, is not so elevated as the western.

The Curral is one of the greatest curiosities of Madeira, and to the lovers of natural scenery it is well worth the trouble of a visit. It is an immense valley, of great depth, enclosed on all sides by magnificent precipices, the almost perpendicular sides of which are broken into every variety of buttress or pinnacle. Round a part of the cliffs is a narrow road, leading to the garden houses and country plantations, cut out of the rock, about 10 or 12 feet wide, on riding along which the Curral seems like an immense abyss, filled only with clouds and vapours, rolling in a constant motion over each other. When viewed on a fine day, the variety of tints is very striking. Occasionally the cliffs are black and craggy, at other times they are covered with turf of the richest green and trees indigenous to the island—while far below smiles a region of cultivation and fruitfulness, the white cabins of the islanders scattered over the surface of the country being almost hidden amongst the rich gardens and orchards.

In 1838, the Curral was visited by Com. Wilkes, of the United States Navy, who remarks:—"This is a very remarkable spot, and it is difficult, if not impossible, to give an idea of its beauty and grandeur. This place is approached by the usual ascent from Funchal, through the narrow roads, or paths edged with roses, &c., the view gradually extending beneath, over the terraced vineyards. Just before reaching it, you mount a small ascent; you are then on the summit or edge of the Curral, and the whole scene suddenly bursts upon you. The eye descends to the depth of 2000 feet, into the immense chasm below, and wanders over the ragged and broken outline of the many peaks that rise from its very bottom; then upwards, following the grey precipitous rocks, till their summits are lost in the clouds, which are passing fitfully across it, occasionally permitting the sunbeams to glance to its very bottom. One feels surprised, on gazing on this scene, that its character of wildness should become softened, and its beauty increased, which is effected in part by the plants and shrubs which cling to or have fastened themselves into the fissures of the rocks. These the eye gradually makes out, and is led by the small and narrow strips of green on the ledges downwards, until it finally rests on the secluded church of Nostra Senora de Livre Monte, and the peasants' cabin embedded in the dark and luxuriant foliage beneath, whose peace and quietness are in such strong contrast with the wildness of nature above. The whole looks more like enchantment than reality. The shape of the Curral and its perpendicular sides give the idea rather of a gorge than of a crater.

In the descent the road winds along the sides of the precipice, turning around sharp and jutting projections, with a frightful gulf yawning below. A misstep of the horse would plunge the rider to destruction. At every turn new and striking views are brought out, almost surpassing in grandeur the first. The descent is so gradual, that one scarcely seems to advance downwards, and the length of time necessary to accomplish it (upwards of an hour) will give some idea of the vastness and grandeur of the scene. Continuing on, the gorge opens to the south, where the streamlet of the Curral, joined by several lateral branches, forms the River Socorridos, which empties itself into the sea near the ancient town of Camara de Lobos."

The *shores of Madeira* are mostly lofty cliffs, occasionally facing the water with a perpendicular front of 1000 or 2000 feet in height. The cliffs are interrupted by a few small bays, where a richly cultivated valley approaches the water between abrupt precipices, or surrounded by an ampitheatre of rugged hills. In these small bays are generally situated some villages.

Off the eastern cape of the island are many isolated rocks, having bold abrupt sides and broken outlines. The character of these rocks is remarkable; they stand quite detached from the adjoining cliffs, and some of them are of a slender form rising to a great height, with extremely rugged surfaces and broken edges.

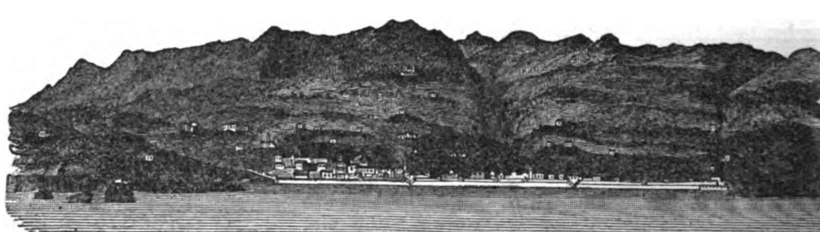
Through some, the waters have worn arched ways of large dimensions, which afford a passage for the breaking surf, and would seem ere long to threaten their destruction. Similar needle rocks are seen off the northern Dezerta, one of which bearing some resemblance to a vessel when viewed from a distance, is often mistaken for such. It stands like a slender broken column, several hundred feet in height, on a base scarcely larger than the summit,

In no part of Madeira is there a sheltered harbour; and the word 'Porto' which is attached to several places on the chart, must be taken as the designation given by the islanders to the little coves, or landing-places, where they haul up their fishing-boats, and the craft of larger construction employed either in the transport of their wines to Funchal, or on the other coasting business of the island.

It may be stated generally, that the south coast of the island has a gradual slope from the mountains in the interior to the sea; and that the north and west coasts, on the contrary, are, with few exceptions, high and bold, and descend precipitously.

The cultivation of the island, on its south side, seldom extends more than from 2 to 2½ miles inland; and on its north side, not half that distance; and it may be remarked, that no cultivation is at present attempted at elevations exceeding 3000 feet, the whole of the mountains above that height, and which constitute so large a portion of the island, being left wild and uninhabited.

Funchal.—The capital of the island is Funchal, on the S.E. coast; it consists of a pretty wide street along the sea-shore, where there are several good buildings, and numerous small streets and lanes extending to a considerable distance up the slope of the hill. The number of inhabitants is 17,870. The town is defended by four forts, and has eight churches and several convents. In the midst of the town is an open square, planted with exotic trees.



Funchal Bay and Town.

The view of Funchal from the harbour is very pleasing, and its situation, in a kind of ampitheatre formed by the mountains, adds to its beauty. The contrast of the white buildings and villas with the green mountains, forms a picture which is much heightened by the bold quadrangular Loo Rock with its embattled summit commanding the harbour in the foreground. The most conspicuous objects on the west side of the bay are the Peak of Ponta da Cruz, the Pontinha with the Loo Rock near it, and the old fortress of the Pico, on a rocky eminence half a mile north of them. Eastward of these are the castle of Lourenzo, the official residence of the governor, on the beach, and the outlet of San Paulo river, the square towers of the ex-Jesuits' college, the cathedral having a small triangular spire, Bangor's pillar on the beach near the custom-house, and on the extreme east, the castle of Santiago with the quintas upon the sloping-land behind it. All these buildings are very conspicuous, and of dazzling whiteness.

When approaching Funchal the island appears rough and mountainous, but the steeps are clothed with rich and luxuriant verdure. Terraces are visible on every side, and every spot that the ingenuity of man can make available has been apparently turned to advantage, and is diligently cultivated. These spots form an interesting scene, particularly when contrasted with the broken and wild background, with the white cottages clustered on the sea-shore, and gradually extending themselves upwards until the eye rests on the highest and most striking building, that of the convent of Nostra Senora de Monte. This stands out conspicuously on one of the mountain ridges which descends from the peak of Arrebentao towards the city. It is 1965 feet above the sea, while the peak itself is 2844 feet high.

The gardens in the vicinity of Funchal are extremely beautiful, abounding as they do in trees, shrubs, and flowers, and so many varieties of delicious fruits and vegetables common to the tropics and to Europe. The markets are, in consequence, well supplied with these good things, and all necessary refreshments; and there is an ample supply of excellent water.

It may be observed that a depôt for steam-vessels has lately been established at Funchal (1848). Its situation is near the beach, at a short distance from the custom-house.

The South-East Coast.—When approaching Madeira from the eastward the first land met with is *Ilheo de Fora*, an islet lying close to Ponta de San Lourenzo, the eastern extremity of the island. This islet is two-fifths of a mile from N.E. to S.W., and is rather more than one-tenth of a mile in breadth. Its coasts are everywhere rocky cliffs, except at its S.E. side, where it slopes to the sea, and offers the easiest landing. On the west side there is a little rocky cove. A sugar-loaf rock marks its south extremity, and there are four low rocks off its S.E. shore, nearly midway between its extreme points. The surface of the islet is of very uneven outline, and covered with a light and stony soil and sand. Near its north end is a peak, 352 feet above the sea, in Lat. 32° 43′ 14″ N., and Long. 16° 39′ 30″ W. The channel which separates the island from San Lourenzo point is 200 yards wide, and the depth in it at low water is from 3 to 4 fathoms over a very rocky bottom; but a swell or strong breeze with opposing tide occasions so great a termoil in it, that it is frequently unsafe for boats to pass through.

Fora is steep in all directions, except its S.E. side, off which are dangerous rocky patches surrounded by deep water. The outer patch, which lies S. 43° E.

0·38 mile from the Islet Peak, is a small rock with 4 fathoms on it, and 18 and 26 fathoms close to it. The inner patch is more extensive, bearing from the peak S. 84° E., three-tenths of a mile; and upon this are several rocks, some with 15, others with only 4½ feet over them. Between the outer and inner patches the least water is 10 fathoms, and between the inner patch and the islet is a narrow channel, the depth of which ranges from 9 to 16 fathoms. Both patches have deep water close up to them, from 15 to 25 fathoms; their distance from the shore is so inconsiderable that sailing vessels would scarcely venture near them; but steam vessels should be cautious not to round the point too closely.*

At Fora the extreme land seen to the westward is the low point of Oliveira, bearing S. 58° 36′ W. distant 10·46 miles; but the bold head of Cabo Garajao, or Brazen Head, being much higher than Ponta Oliveira, is seen over it, and thus appears to be the west extreme point. Vessels bound for Funchal shape their course for these points; but between Fora and Oliveira there is a considerable bay, and the coast presents a variety of outline which it is necessary to describe.

Ponta de San Lourenzo is the easternmost part of Madeira. It is a long narrow ledge of rock, about 4 miles in length, but in no part one mile in breadth. Its surface is exceedingly varied, but its general tendency is that of declivity from the cliffs and peaks on the north side, to a low rocky shore on the south. The cliffs and peaks, though lofty, are not nearly of so great elevation as those of the island in general, but are of a much more broken and fantastic character. Here and there a patch of herbage only affords scanty pasture to a few sheep and goats.

From the extremity of Ponta de San Lourenzo the coast trends to the N.W., and is a rocky shore. For the first 1½ miles it is composed of cliffs and small points with rocks lying out a few yards from them; and above the cliffs is a narrow ridge of hills, of which the most elevated is 348 feet above the sea. A narrow beach of shingle then succeeds, with masses of rock upon it, running out to the N.E. Between these, in two or three places, the seas on the north and south sides of the point meet at high water, and make them islets: and it is probable that in a few years more, they will be actually broken up, and become such permanently. This beach terminates at Ponta Furado, a bold basaltic point, through which the sea has broken a fine lofty arch. A barren hill 550 feet high stands immediately above the point, and from its summit there is a commanding view of the surrounding shores.

On the west of Ponta Furado is a small bay with a fine sandy bottom, in which there is smooth water anchorage with the wind from N.W. and N.E. and tolerably easy landing. The bay is about a mile across, and three-fifths of a mile deep; but it is only available for steam-vessels. Half a mile beyond the western point

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* In this description of the shore of Madeira, which has been taken principally from Captain Vidal's valuable comminucation in the *Nautical Magazine*, 1848, the bearings are true, *not magnetic*.

of it is the Ponta de Piedade crowned by a rocky hill 376 feet above the sea, with a chapel on it dedicated to Nostra Senora de Piedade. The building, though small, is a very conspicuous object, being whitewashed, and roofed with bright red tiles. This chapel in a line with the Sugar-loaf Rock at the south point of Fora leads a few yards clear to the southward of the rocky shoals off that islet. In front of the point is a large flat ledge of rock (having almost the appearance of a fine artifical quay), on which there was found sufficient landing.

From the north side of Piedade hill, quite across the narrow neck of land to the opposite, or N.E. coast, occur those curious fields of fossils mentioned by several travellers who have visited Madeira, and which are similar to those at Porto Santo. It is believed they are not to be found in any other parts of these islands. Immediately on the west of Piedade point is a little bay with a fine sandy beach.

At 1·3 mile S. 74° W. from Piedade point is the village and point of Canical. The coast between them is much lower than that previously described; but broken in like manner into numerous small points, and the land rises from it in a gradual slope to the top of the cliffs on the north shore. There is a little sandy beach east of Canical point, on which the fishing boats of the place are left. At the west end of the beach is a ledge of dry rocks. The bank of soundings follows the coast to the westward: the edge of it passing one mile south of Fora, Piedade, and Canical.

From Canical point the coast runs S. 43° W., 1·45 mile to the north point of Machico bay. Between them the cliffs are high and bold, and there are two projecting points. The southern one is a rocky bluff very steep; and half a mile inland of it is a peak 1969 feet above the sea.

North of Machico point is a telegraph on a hill 1080 feet high. One-tenth of a mile N.E. of the point are several rocks which run out from the shoreS. 22 °E., about 250 yards; and in the same direction is an isolated breaking rock standing in 15 fathoms water. At the rock, Machico north point bears N. 48° W., and is distant two-tenths of a mile. Close to it on the east are 27 fathoms.

Bay of Machico.—The bay of Machico is 700 yards wide, and a stony beach with some little mixture of sand forms its shore, On the north point of it is a small stone fort, and near its centre is a little battery built at the outlet of a mountain stream which originates in the high lands of the interior five or six miles distant, and drains the whole valley of Machico. The village is situated near the shore of the bay, and is celebrated in the traditions of the island as the place where its first discoverer Robert Machim landed with Anna d'Arfet. Its little church is reputed to contain a portion of the cedar cross that marked their grave. The village possesses a considerable number of fishing-boats, and a few of larger dimensions for trade with Funchal.

From Machico the coast runs S.S.E., ½ a mile, to Ponta Queimada, which is a rocky cliff with some flat rocks at its base, and thence S. 82° W., 1·15 mile to the rock off Ponta de Santa Katarina. This rock is 36 feet high, and stands close to the point. The whole coast between it and Queimada is rocky cliffs: and both they and the land behind them are of much less elevation than near Queimada. There are no outlying dangers, but deep water close up to the shore.

From Rocha de Santa Katarina, the next point is Guindante, bearing S. 48° W., 2½ miles, the coast between falls back into a bay ½ a mile in depth. Near the north end of it is the village of *Santa Cruz*, and two large water courses or ribeiras. In front of the village is a stony beach with a rocky point at each end of it crowned with a redoubt, and the water shoals gradually to the beach. Eastward of Santa Cruz, the coast is rather low. Southward of the village the cliffs again increase in height, and have deep water quite up to them.

S. 40° W., nearly a mile, from Ponta Guindante is Ponta de Atalaya. The village of Porto Novo is situated close round Guindante in a small shingle bay where a considerable *ribeira* has its outlet.

From the *ribeira* to Atalaya Point, the cliffs are high and steep. The Point of Atalaya is itself formed by a few large stones at the base of the cliffs, but there is a singular small pointed peak on the cliff close to it which marks its position well. From this point Ponta Oliveira bears S. 51° W., 1 mile. Between them the coast has a slight bend in it; there are two small beaches; and in front of the first one, named Portinha, are some detached flat rocks; behind which some fishing-boats are hauled up: a small redoubt commands it. At the south side of the second beach is a very large *ribeira*; and on the top of its southern bank, a short distance from the edge of the cliff, a fort.

The South Coast.—From Ponta Oliveira, Cabo Garajao (the Brazen Head) bears S. 57° W. distant 1 mile. The former is a clean and steep rocky point upon which you can land, and the ascent from it is easy. The latter is a bold rocky headland jutting out about 350 yards at right angles with the line of coast eastward of it. It is faced by perpendicular cliffs of reddish yellow tufa, and above them is a narrow hilly ridge of land crowned by a rocky knob or knoll, 420 feet above the sea, which particularly distinguishes the head when seen from the westward. Upon the top of the head, a little above the rocky knoll, is a telegraph which commands an extensive view eastward, and reports all vessels in that quarter to the telegraph on the Loo rock. The cape is steep, there being 7½ fathoms within 20 feet of the cliffs; 38 fathoms a ¼ of a mile off; at ½ a mile 75 fathoms; and at six-tenths of a mile off there will be found 200 fathoms: the edge of the bank of soundings between Canical and this head follows the general direction of the coast, at distances varying from six-tenths of a mile to 1 mile.

On the east side of Garajao the coast is formed by high cliffs, on the west, adjoining it, is a small shingle beach, and thence westward the coast line presents a series of rocky cliffs and small stony points to Santiago fort.

FUNCHAL BAY.—From cape Garajao the next extreme point westward is Ponta da Cruz, bearing from it S. 87° 40′ W., distant nearly 5 miles; between is the Bay of Funchal, which is open, exposed to the southward, and considered to be unsafe during south-west gales. Beyond fort Santiago a shingle beach extends nearly a mile westward in front of the town, and terminates at fort St. Lazarus. The shore then becomes rocky, and rises into a bold basaltic bluff, opposite the Loo rock; a little beyond which the bluff turns abruptly inland, and disappears, and the shore slopes to the peninsula of the Pontinha.

The *Pontinha* is an artificial embankment carried out in a south-easterly direction from the land to a small islet which is crowned by the fort of San Jose. The work affords some shelter from south-west winds; and on its eastern side is the most convenient landing-place, there being on the inner side of the islet a flight of steps which lead from the sea to the fort, and to the top of the embankment which joins the road to the city. It also affords considerable protection to the vessels which occasionally seek shelter behind the Loo rock.

The *Loo* is a steep rock 70 feet above the sea, rendered by art quite inaccessible except by steps built up that side of it which is opposite to the land. Its extreme length is about 100 yards, and breadth 85. On the summit of the rock is fort Ilheo which commands the anchorage, and contains barracks, storehouse, magazine, and chapel. It mounts fourteen guns, and is always garrisoned. A telegraph has been erected on the top of the highest building, which communicates with others on the heights east and west of it, and with the city; this telegraph is in latitude 32° 37′ 45″ N., longitude 16° 55′ 20″ W. Also, since December 1866, a *fixed red* light has been exhibited from an iron column on fort Ilheo, at an elevation of 112 feet above the sea; visible about 8 miles.

Vessels sheltered under the Loo are moored with their heads towards it by several cables, secured to the rocks by large ring bolts, or through holes cut in the lower part of it expressly for that purpose. The stern-fasts are secured to the shore opposite. The depth of water in this little port, if port it may be called, varies from 3 to 5 fathoms, and the bottom is generally rocky.

Into Funchal Bay, three rivers which have their sources in the high lands near the centre of the island discharge their waters. Two of them, Joao Gomez and Santa Luzia have their outlets at a fort named Pelorinho, nearly midway between Santiago fort and the castle of San Lourenzo. The third, San Paulo, enter the bay between that castle and Fort St. Lazarus. During summer these streams are generally inconsiderable, but in the heavy rains which occur in winter, they have occasionally come down with overwhelming force, and caused much damage to the city. The depth of water in the bay is said to be gradually decreasing from the quantity of alluvium they bring down.

The soundings over Funchal bay are regular, and the quality of the bottom a fine dark sand with some little mud.

On the meridian of fort Pelorinho, at 300 yards from the beach, there will be found a depth of 11 fathoms; at 400 yards 18 fathoms; at a quarter of a mile 20: at half a mile 40; at nine-tenths of a mile 100; and at 1 mile 200 fathoms.

On the meridian of the Loo rock, at the distance of a quarter of a mile, the depth is 25 fathoms; at half a mile 38; at three-quarters of a mile 58; at one mile 100; and at one mile and one-fifth 200 fathoms.

Anchorage.—In the summer months, when land and sea breezes prevail, vessels may anchor anywhere about the bay, as most convenient, but the best anchorage, especially during the winter months, is off the Loo rock, with the old citadel named the Castello do Pico bearing north, and exactly midway between the Loo and the fort of San Jose on the Pontinha. On this line of bearing steam vessels may anchor in 12 to 18 fathoms, and sailing vessels in 25 to 35. This latter depth is half a mile from the Loo rock. The soundings extend farther out in this direction, with fine sandy bottom; and should any vessel have previously taken up this position, it will be better to anchor westward of her.

A considerable surf very commonly prevails along the whole of the beach, and renders communication between vessels and the shore difficult. It is seldom attempted but in native boats. This is a very serious inconvenience, especially to the numerous invalids who resort annually to the island, and a good landing-place is a great desideratum. Nevertheless nearly all mercantile business is carried on from the beach; and through the experience and dexterity of the boatmen, aided by the build and lightness of their boats, accidents but seldom happen.

The boats of men-of-war and steam-packets usually land at the steps of the Pontinha, but it is at rather an inconvenient distance from the city.

Winds, &c.—The roadstead of Funchal being exposed from West to S.E., the winds from those points will of course be felt most strongly, and ships, on the appearance of a menacing atmosphere to the southward or S.W., ought to take every precaution, and be in readiness to go out of the roads at a moment's warning. See also pp. 65-66.

In summer, there are regular land and sea breezes; the latter setting in from the S.W. in the forenoon, and off shore towards 9 and 10 o'clock in the evening, sometimes as late as midnight. The land breezes do not extend more than 2 or 3 miles from the shore; but when it blows fresh in the offing, the true wind prevails in the road. The rainy season is in January, February, and March, when it blows sometimes excessively hard, at which season it is frequently dangerous to remain at the anchorage; and during this period of the year, the surfs on the beach are so incredibly violent, as to prevent a possibility of landing anywhere but behind the Loo rock.

When sailing from Funchal, you should particularly observe to make sail with the land wind, standing directly out to the offing, on account of calms which prevail under the west and S.W. parts of the island, which have been known to detain vessels for some days.

Although Madeira is an elevated island, with the exception of the eastern end, which is a low rugged point, yet it is so often obscured by clouds as not to be discerned at a distance of 5 leagues; but when abreast of Porto Santo, it commonly appears like a vast mountain, with its summit covered over. The Dezertas are shortly afterwards seen, and when you pass those islands, the ships in the road of Funchal will soon be perceived. From their riding, it will be seen how the wind is in the road, as it is common to have a strong breeze from N.E. or East, in passing the Dezertas, when at the same time the wind in the road is from the S.W. or W.S.W.

Port Regulations ;—The following port regulations were in force a few years since, and may be still observed:—

On anchoring at Funchal Roads, no vessel can have communication with the shore, or the shipping in port, until visited by a flag-boat from the government, or from the health office. But in case of distress, when a vessel does not intend to anchor, and wants to have communication with the shore, her boat, by proceeding to the Loo castle, will avoid being fired at; and after examination, leave is generally given for the officer in her to go into town, and return to the ship without any embarrassment.

The master, purser, or other persons coming in the first boat from any vessel regularly visited, must land at the health office, there to undergo the customary examination; and the captain or purser should proceed immediately to the consul's office, to report the ship: passengers are free from restraint after passing the health office.

Captains or pursers, so landing, must bring with them the vessel's register and Mediterranean pass, and also the manifest of her cargo, as without these documents business cannot be transacted at the Consular and other offices.

No vessel lying in port can have any communication with one that is coming in, or that has already anchored, until such new comer shall have been regularly visited.

No vessel at anchor can change her berth without license from the government.

All boats that pass between the shipping and the shore, after sunset, are subject to pay a pistareen and a half, for a government license.

No seaman or soldier to leave their ships without permission in writing from the captain or commanding officer.

Any seaman or soldier found on shore after sunset, without written leave of absence, is liable to be taken up by the government, and kept in custody until claimed and sent on board ship; which will, exclusive of his maintenance, occasion an expense of two dollars for each individual, to be deducted out of his wages: and even with leave, as above, any disorderly conduct is immediately taken notice of by the government, and punished accordingly.

All captains or commanding officers are requested to read the above two articles to the sailors and soldiers on board their ships, as particularly relating to them.

Captains or pursers must give notice at the consul's office 24 hours, at least, before the time of their intended departure.

No vessel is to carry from Madeira any person or persons, excepting those that came in her, without a regular passport; as, in case of detection in attempting to do so, the master is liable to a fine of 100 dollars, and to 3 months' imprisonment.

In cases where the captain of a vessel shall be judicially notified not to carry away any particular person from the island, and he does receive him on board, notwithstanding such judicial warnings, he becomes liable for all the debts which such person owes.

When vessels are ready to depart, the captains must, through the consul, or their consignees, apply to the government to have its visit sent on board at the hour when they will be ready to proceed to sea.

After a vessel has been visited for the purpose of proceeding on her voyage, and circumstances require her to have communication with the shore, or the shipping in port, she cannot sail until visited a second time.

No vessel can sail after sunset without special license; and in case a ship is visited for departure, and finds she is obliged to remain a night after, she must not attempt to sail till visited a second time.

As vessels are frequently fired at from Loo castle, for attempting to anchor at night, it is recommended to those who make the port too late in the evening, to have their colours seen, to stand off and on till daylight, when the restriction ceases; indeed, at all times it is as well to hoist the colours and merchant's signal as early as possible, for the information of the consignees on shore.

Any vessel attempting to get under way before she is visited will be fired at from the forts, and will be obliged to pay very dearly for the powder and shot. This must also be understood in not observing any of the foregoing rules.

No commander of a vessel can leave any of his crew behind him, excepting in the hospital, without first giving security in the consul's office for their subsistence.

As the greatest attention is necessay on the part of the masters of vessels, for the benefit of the concerned, it will be found much to the interest of all parties, that they by no means sleep on shore,—a caution of this kind is doubly necessary in the winter.

It is necessary that captains and supercargoes should be acquainted, that in case of breakage in the measurement of corn, after allowing 2½ per cent., the vessel must make up the deficiency at the market price in Madeira, according to the long-established regulation of the British factory.

The Loo castle usually fires two guns, without shot, on any vessels breaking the rules of the port: if those are attended to, in general they take no more notice; if not, not only the Loo, but the other forts, fire with ball, till their object is obtained.

As many inconveniences arise from not observing the foregoing regulations, every commander of a vessel will find it to his interest to attend to them, as otherwise he will forfeit the protection of his consul, and find the consequences in the highest degree disagreeable.

To avoid considerable delay and expense, it is absolutely necessary to have a bill of health, endorsed by the Portuguese consul, or his vice-consul, at the last port of clearance.

The South and South-East Coasts.—From the Pontinha, at Funchal, at Ponta da Cruz, the distance is 1¼ miles, and the coast between them has a broken outline of rocky cliffs, points, and bays. At the south-west point of the Pontinha a rocky spur projects to seaward about 80 yards, and in the bay west of it, 250 yards within the point, are two small flat rocks, a few feet above water. The bay is ¼ of a mile across, and the shore of it is composed of steep cliffs, which rise to a high bold bluff at its western extremity. Along the base of these cliffs there is a beach of sand and shingle of some breadth near the inner part of the Pontinha embankment, but narrowing gradually towards the centre of the bay, and terminating near the outlet of a water-course. The whole of this bay is comparatively shallow, the depth not exceeding 8 fathoms between its extreme points; and it appears to offer the best position that can be found at Madeira for any artificial harbour works.

Half a mile westward of this is a detached sugar-loaf rock, named Gorgulho: it stands about 130 yards from the shore, in front of a little bay which has a fort upon its eastern point, and near the centre of it a pretty quinta. Four-tenths of a mile north of this rock is Monte da Cruz, with a telegraph on its summit, 862 feet above the sea, and hence there is a succession of rocky cliffs for another half mile to the *Ponta da Cruz*, at the south-west extremity of which there is a semi-detached pointed rock with a small iron cross upon the top of it. The cliffs opposite are high and perpendicular. This rock forms the southern extreme of Madeira, and is in Lat. 32° 37′ 18″ N., Long. 16° 57′ 11″ W.

The coast from the Pontinho to this point is steep-to, and clear of danger; and the edge of the bank continues nearly parallel with it, at the distance of about a mile.

N. 72° 15′ W., 0·85 mile from Ponta da Cruz, is Ponta d'Agoa, a low point covered with large stones, at the base of some enormous cliffs. The greatest deviation of the coast from the line of the extreme points is four-tenths of a mile. Close round Ponta da Cruz, on its western side, is the Bay of *Praya Formosa*, formed by a shingle beach six-tenths of a mile long, and about two-tenths deep. The high land recedes from each end of the bay towards its centre, and leaves the space between filled with a large bed of shingle. At the west end of Praya Formosa is a small rocky islet, and from thence a line of rocky cliffs of small elevation, fronted by a stony beach, and many detached black rocks, extend six-tenths of a mile farther to the Socorridos river. This mountain stream, perhaps the largest in Madeira, originates at the southern base of Pico Ruiva, amongst the group of highest mountains on the island; and drains the celebrated valley of the Curral. Immediately in front of it is a beach of shingle, and at its west end a small bold rocky point, round which is the village and little boat-harbour of Camara de Lobos.

The eastern side of this inlet is formed by steep rocky cliffs, and the western side by a narrow wavy line of black lava, running out south at right angles with the beach for about 270 yards.

The town of Camara de Lobos is situated at the head of the cove, and behind it is a hill with a telegraph on its highest part. About 100 yards from the western point of this inlet there is a small fort built on a rocky cliff near the sea; and beyond the fort a sandy beach a ¼ of a mile in length, over which the Ribeira of the Jardim de Serra discharges its waters. At the west extremity of this beach commence the magnificent cliffs which terminate the ridge of mountains lying westward of the valley of the Jardim. The highest of them form the bold sea face of Cabo Girao, and upon the high land which crowns the cape is a grove of pine trees, 2079 feet above the sea. Thence the hills continue rising until they reach the head of the valley, their highest point, at which they attain an elevation of 4535 feet. At the base of these high cliffs is a narrow beach of shingle, thickly strewn with large blocks of stone, with here and there some slightly projecting points, produced by the occasional fall of rocky masses from above.

N. 70° 30′ W., 4·68 miles from Ponta d'Agoa, is the outer rock off Ponta do Sol. Intermediate at the distance of 1¼ miles westward of Ponta d'Agoa is a conical shaped rock, named Ilheo da Lapa. It lies in front of the village of Campanario, detached from the shore, though very close to it; and here the continuous line of stony beach covered with large blocks and boulders may be said to terminate; and hence westward this characteristic alternates with clean black rocky points without any beach at all before them. The cliffs become more inclined, and there are some large slips which are cultivated and inhabited.

One mile and a quarter beyond Ilheo da Lapa is the rocky point of Ribeira Brava, with three small black rocks close off it; on the western side of it is a little bay a quarter of a mile across, with a beach of coarse sand, shingle, and boulders. A short distance from the beach is the village of Ribeira Brava; and near it the outlet of a mountain stream of the same name, which drains the valley of the Serra d'Agoa.

Westward of this bay the coast becomes more varied, more irregular in height, and is again fronted with a narrow beach of shingle and boulders; and three-quarters of a mile beyond Ribeira Brava is the small Ribeira of Tabua. Like all these mountain streams its waters are discharged over a beach of shingle, with rocky cliffs on either side of it. At three-fifths of a mile farther is a large cultivated land-slip, and from thence the coast trends a little more westerly, for three-quarters of a mile, to the rock at Ponta do Sol, and a small bay lies between them.

Ponta do Sol is a bluff rocky cliff with a few fragments of rock lying close in front of it. The most conspicuous of these is pointed and has a small wooden cross upon its summit. Three small rocks lie off it to the southward about 40 yards, and two-tenths of a mile N. 66° 30′ W. of it is another. On the west side of the point is a Ribeira with a shingle beach in front of it about 300 yards in length.

The outlet is narrow with steep cliffs on either side, and a stone wall has been constructed across it, leaving a passage for the stream close along the foot of the western cliff. The source of the Ribeira is between 4 and 5 miles inland, to the N.N.E. of the point, amongst the high lands of the southern margin of the Paul da Serra. The village of Ponta do Sol is situated in the ravine a very short distance from the beach, and its church may be seen through the narrow gorge of the outlet, though to a very limited extent in consequence of the cliffs.

From Ponta do Sol, the next extreme point seen westward is Ponta Galera, bearing N. 57° 45′ W., and distant 5·33 miles. The coast between them nowhere falls back half a mile, but is formed by a long wavy line of narrow stony beaches, above which are cliffs of small elevation, much broken by mountain torrents into ravines. There are a few land-slips, and in some places the land slopes to the sea without cliffs; these lands are always inhabited and cultivated, with numerous terraced vineyards. There is a remarkable piece of cliff standing between land of this description, 1¼ miles from Ponta do Sol; its west extremity forms a small black basaltic point. Three-quarters of a mile beyond it is the village of Magdalena at the outlet of a Ribeira.

About half a mile westward of Magdalena is a detached rock lying off 100 yards from the shore in front of a high rocky cliff, at the foot of which is a stony beach. There are 6 fathoms water alongside the rock. Again, 2 miles beyond Magdalena, is another Ribeira; and in the space between is the Arco da Calheta. Arco is a name applied to such hills as present a semi-amphitheatre open towards the sea with a gradual rise of the land from the shore towards their summits. They are generally well cultivated, and dotted with habitations. Six-tenths of a mile westward of this last Ribeira is the town and Ribeira of Calheta. Two or three white houses stand low down near the stony beach in front of it, but the ravine is so narrow that little of the town can be seen, unless when abreast of it.

Above the cliffs on the ridge of land, a quarter of a mile west of Calheta, there is a conspicuous long building like a monastery.

The West Coast.—From Calheta to Ponta Galera the distance is seven-tenths of a mile. The point is formed of flat rocks of black basalt, which run out like a pier about 100 yards from the cliffs of the coast. There are 4½ fathoms 20 feet from it.

From Ponta Galera Ponta Jardim bears N. 56° W., 1·35 miles. The line of coast between them preserves the same general character; and about midway is the waterfall of Ribeira Funda. Ponta Jardim appears to be a land slip; some large boulders lie close round it, so as to render landing difficult. Upon the top of the point is a small village and chapel. Here the coast scenery becomes bolder, and the rise from the shore to the mountains is very steep.

The soundings on this part of the coast are regular, over dark sand, and extend off 1¾ miles. On the meridian of the Jardim chapel, at the distance of a quarter of a mile from the shore, there are 10 fathoms; at ½ a mile 16; at ¾ of a mile 25; and at 1 mile 80 fathoms. At Ponta Jardim the two next points beyond appear in a line bearing N. 87° 50′ W. The first (Paul do Mar) being 1 mile—and the second (Faja da Ovelha) 2·7 miles from it. There is a waterfall 3-10ths of a mile north of the Jardim, and another at the Paul do Mar. The coast between the Jardim and Paul do Mar consists of steep rocky cliffs fronted by a stony beach; but close to the waterfall at the latter point on the west there is a great land slip. The cliffs recede about two-tenths of a mile; and the land between them and the sea, having a steep descent, is cultivated in terraced vineyards.

The village of *Paul do Mar* is built at the eastern end of the land slip close to the waterfall, from which a beach of shingle and large stones extends the whole way to Faja da Ovelha. At that point it is broken through by a little spur of black lava projecting a few yards to seaward, the cliffs become more elevated, and above them the land rises with a steep ascent to the highest peaks on the ridge of the western mountains 4270 feet.

Some idea of the bold character of the scenery at this part of the island may be conveyed by stating that a grove of pines upon the hills above the Paul do Mar is at an elevation of 2080 feet, or ½ of a mile, whilst its horizontal distance from the sea does not exceed ½ a mile. N. 22° 30′ W. 2·66 miles beyond Faja da Ovelha is Ponta Parga, the west extremity of Madeira, in Lat. 32° 48′ 6″, Long. 17° 16′ 38″ W., the coast between these points falls back into a bay 0·34 of a mile in depth. The cliffs are lofty and broken by several mountain torrents, and at their base are many large stones and fragments of rock; one in particular, of a sugar-loaf form, near the centre of the bay, is 72 feet high; two-tenths of a mile north of it is another large rock, frequently used by the fishermen as a landing-place, and they have a ladder from it to the shore.

Between the landing-place and Ponta Pargo the beach is wholly composed of stones, and there is a narrow piece of sloping land between it and the cliffs, upon which are two or three fishermen's huts, and a few boats of a construction peculiar to this point. They are in fact a species of catamaran nearly triangular in form, with a bottom and two sides, but the stern or base of the triangle is wanting.

On the high lands above Faja da Ovelha point, about a ½ of a mile from the cliffs, there is a church, and upon the heights, 1 mile east of Ponta Pargo, another. The former is 1623, and the latter 1511 feet above the sea. The bold rocky cliffs of Ponta Pargo bluff are 935 feet high; and the smooth round-topped hill which is situated ½ a mile eastward of the bluff is 1380.

Some rocks and large stones lie scattered around the base of Ponta Pargo, a few to the distance of 300 yards; and a ridge of rocky ground nearly 1½ miles in extent runs out from the point to the north-west. The soundings on it are very irregular, from 11 to 19 fathoms, and 33 close to its outer end. Strong westerly winds occasion a heavy sea upon it.

From Calheta, the bank of soundings in its progress to the westward increases considerably its distance from the land, and attains its greatest breadth 5½ miles west of Faja da Ovelha point. Thence it sweeps round north-east and gradually diminishes. The edge of it passes little more than 1 mile south of Ponta Galera, 1¾ miles south-west of Ponta Jardim, 2¼ miles south-west of Paul do Mar, and 2 miles south-west of Faja da Ovelha. Thence it turns off to the west, and passes near the parallel of that point at the distance above stated. North-west of Ponta Pargo its extent is 2¾ miles.

All the bank west of Ponta Pargo and Ponta da Ovelha is flat, with 40 to 46 fathoms over it; and from those depths it goes off very suddenly to 200 fathoms.

The bottom is generally a light brown or a dark gray sand, with occasional casts of rock.

The North-West Coast.—At Ponta Pargo the next point seen north-eastward is Ponta Tristao, bearing N. 46° E., and distant 5 miles. The coast between them is formed by a wavy line of coarse stony beach, with high rocky cliffs rising abruptly from it, Above the cliffs the land has a very steep ascent to the ridge of mountains 2 miles distant, some parts of which exceed 4000 feet in elevation.

The cliffs are broken by several mountain torrents, waterfalls, and deep ravines; and there are two extensive land slips which are for the most part terraced and laid out in vineyards; and a few huts show amongst the vines. The shore is clear, without any outlying dangers, and midway between the points, at a ¼ of a mile from the beach, there is a depth of 10 fathoms, at ½ a mile 22 to 25 fathoms, at ¾ of a mile 30, and at 1 mile 30 to 40 fathoms; outside, 50 fathoms; the bank deepens rapidly, and the extreme edge of it is about 1½ miles from the land. The general quality of the bottom is a fine dark sand.

The North Coast.—Ponta Tristao, the north point of Madeira, is a high bold bluff 1070 feet above the sea, in Lat. 32° 51′ 31″ N., and Long. 17° 12′ 25″ W. At the foot of it are a few sunken rocks which extend off 130 yards; but 240 yards north of it there are 7 fathoms, at a ¼ of a mile 8, at ½ a mile 27, at ¾ of a mile 36, at 1 mile 42, and at 2 miles 200 fathoms, fine dark sand.

On the heights, ¾ of a mile southward of the bluff, at an elevation of 1709 feet, is the parish church of Magdalena.

N. 60° 30′ E., 0·86 of a mile from Ponta Tristao, and about ½ a mile from the beach abreast of them, is a singular little cluster of flat rocks, a few feet above the sea, named the Rochas de Rabaçal. The northern one forms a crescent, its horns pointing towards the shore. Other narrow rocks fill up the space in front of the horns, leaving the centre open. In strong winds, or with any swell, the sea rolls over them with heavy breakers; but they are steep, with 10 fathoms within a boat's length of the surf; having no out-lying dangers, and in the channel between them and the coast the greatest depth is 17 fathoms.

From Ponta Tristao to Ponta Moniz is 1½ miles. The coast between the points consists of very high cliffs, with a narrow stony beach along their base, which is broken through by two bold rocky bluffs, the first three-tenths and the second five-tenths of a mile from Ponta Tristao. Nearly midway between the latter bluff and Moniz point there is a deep break or gap in the cliffs and Ribeira; and in front of the Ribeira a few rocks lie out about 100 yards from the beach. A little further eastward, and 1 mile from Ponta Tristao, is a low cliffy point of very rugged black lava, with a rocky flat extending from it 70 yards to seaward; and at the extremity of this flat are numerous small detached rocks, which lie around it to about the same distance. Hence it is three-tenths of a mile to the outer extreme of Ponta Moniz.

Ponta Moniz is formed by a mass of lava running out north-east about 470 yards from the general line of coast, and looks as if it had flowed ever the cliffs into the sea from the heights above them. The base of the point, which is its most elevated part, is about 420 yards broad: thence it slopes to the outer extreme, and becomes low and narrow.

The shores of the point have a very irregular broken outline, especially on the west, where the action of the sea appears to be most violent and the most continued. The cliffs on that side are of a steep iron-bound character, sharp and craggy, and have several rocks lying at their base. On its eastern side, about 160 yards from the extremity of the point, there is a small fort, having a circular tower at its entrance, which is built close to the shore on a little rocky bluff. On either side of it are detached rocks; and right off the bluff are four others lying in a straight line with it. Alongside the outer one there is a depth of 9 fathoms, 140 yards south-west of this is another rocky point, and another round tower, at which is the best landing, as at a jetty, with 4½ fathoms close up to it. Here the low rocky cliffs terminate, and beyond is a sloping shore of rock for about 120 yards, on which the fishing-boats are hauled up. A narrow coarse shingle beach succeeds, with high bold rocky cliffs towering above it to the Janellas.

The town of Moniz is situated on the higher part of the point, the chapel being about one-third of a mile from the landing-place; but there are several small detached dwellings on other parts of it, and nearly the whole point is covered with stone enclosures, and devoted to the cultivation of the vine. A tedious zigzag road leads from the town to the height above it, where there is a village and some good farms.

In front of Ponta Moniz, at the distance of 120 yards, is an islet bearing the same name, composed of yellow tufa, resting on black lava. It measures nearly 300 yards from east to west; about 110 from north to south, and is 205 feet in height. Its shores are precipitous, and its summit, which is difficult of access, is the favourite resort of sea-fowl. The soundings off it are deep, and there are 16 fathoms close up to it. The channel between the point and the islet is obstructed by a large black mass of rock of some elevation, and by various smaller rocks, both above and under water. The bank of soundings on the meridian of Ponta Tristao extends off 2 miles from the land; but after passing the Rabaçal rocks it turns to the south-east, and becomes more contracted, approaching within 0·65 of a mile of Ilheo de Moniz, and continuing eastward about the same distance from the Janellas, and nine-tenths of a mile from Ponta Seisal.

The little bay, locally designated *Porto do Moniz*, has much foul ground in it from Moniz islet along its shore eastward, for the distance of ½ a mile, or half its extent, and to about a ¼ of a mile off the beach. It is in fact a rocky bank, varying in depth from 2 fathoms near the shore to 10 on its margin; and outside 10 fathoms; the quality of the bottom generally is fine dark speckled sand.

On the summit of Ilheo de Moniz, Tristao low extreme point bears N. 87° 55′ W., and is distant 1¼ miles; and Ponta Sao Jorge, the extreme point seen eastward, bears S. 81° 41′ E., distant 18½ miles. In this latter space the coast forms a bay, which at Sao Vicente is 2¾ miles within the points.

The first objects to the eastward which attract attention on quitting point Moniz, are a group of rocks named the Janellas, lying near the outlet of that Ribeira. They are five in number, and the outer one, which is largest, bears from the summit of Moniz islet S. 41° 41′ E., distant 1 mile. Like that islet it is composed of yellow tufa upon a base of black lava, and is about 183 feet in height. The top of it is covered with coarse grass; 70 yards eastward of it is a breaking rock surrounded by deep water; 100 yards west of it is a high narrow shaft of naked black lava, with a hole through it, which, viewed from the north-east, appears like a lofty column; the three other rocks lie near this on the south, and are small and low, the inner one about 60 yards from the beach. The two largest rocks are steep, at their north end having 11 fathoms within 50 yards of them, and there are boat channels between them all.

From Ponta Moniz the north coast of Madeira is generally high, and bordered with lofty cliffs. It is visited by but few vessels, there being no ports or harbours capable of affording shelter; it is consequently unnecessary to add a description of it.

Winds.—For a description of the winds in the vicinity of Madeira, see p 65-66.

When a vessel reaches Cape Garajao too late to avail herself of the land wind, and too near the time when the sea breeze may be expected, she should give the cape an offing of 2 or 3 miles, and keep westward in the stream of the N.E. wind, until she brings Funchal to bear about North. She may then haul in for it, and will soon pass into calm, and shortly after the sea breeze springing up, will carry her under studding sails to the anchorage.

If she reaches cape Garajao when the sea breeze is nearly over, she may keep near the head for the advantage of the coming land wind; and may often derive great assistance from the boats: men-of-war especially may tow into the anchorage during the calms, or land winds, of the night and very early morning.

The land wind comes off usually earlier, and continues longer after rains; and the sea breeze sets in earlier and more steadily during a continuance of fine dry weather, even a few partial showers sensibly affect this.

When the vessels can be seen at anchor in the bay, an intelligent commander may derive some advantage from observing the way they are tending.

The best time to leave the Bay of Funchal is with the first coming of the evening land breeze.

It need scarcely be observed that when vessels pass point Lourenzo, with winds from north round to the westward, they should be prepared for strong gusts from the ravines.

During the winter months every care should be taken to watch the indications of the weather, the swell into the bay, the drift of the clouds, &c., and it will be advisable if these are unfavourable to quit the anchorage before real difficulties arise; for, when they do, they are quick and violent.

The tidal wave strikes these islands nearly at the same time as the Azores; the flood running N. 80° E., at about 1½ miles per hour on springs; and between the narrow channels of the islets, and off point Lourenzo it is sometimes 2 miles per hour.

The Dezertas.—These are three rocky islands off the eastern point of Madeira from which their northern extreme bears S. 84° 8′ E., and is distant 10 miles. The northern island is named Chao; the centre one Dezerta Grande; and the southern one Bugio. They have no permanent inhabitants, but are occasionally visited from Madeira by fishermen, herdsmen with goats, sheep, and cattle; and by parties in quest of orchilla.

From Madeira east point, a bank of soundings extends quite across to Chao; and is about 2 miles wide at its narrowest part. The depth of water along the middle of it, until you draw near the land, ranges from 45 to 75 fathoms; and in moderate weather, fishing-boats may frequently be seen at anchor there. This bank continues entirely round the Dezertas, its southern limit being 1½ miles from their S.E. extreme point.

Chao is nine-tenths of a mile in length, and ¼ of a mile in breadth, at its north end; but, at the south, it terminates in a very narrow point, from which some rocks run out S. 35° E., about 200 yards. It is a table land, surrounded by high rocky cliffs. Off the bold bluff, at the north extremity of this island, in Lat. 32° 34′ 47″ N., Long. 16° 32′ 38″ W., there stands a remarkable detached rock, named by the Portuguese fishermen the Furrilhao, but better known by navigators as the Sail rock. It lies due north of the point, distant from it 100 yards; and is a mere column 160 feet above the sea. There is deep water close around it; but 300 yards outside of it, bearing N. 65° W., there is a breaking rock; and a narrow ridge of irregular soundings, varying from 11 to 19, 16 and 14 fathoms over rocky ground, extends from it N. 30° W., nine-tenths of a mile. The north-west extremity of Chao, also a high bold bluff, has several large rocks scattered about the base of it, some above, others under water; and there is foul ground to the north, the west, and to the south-west of it, for the space of two-tenths of a mile.

The eastern shore of the island runs nearly in a straight line. The western coast is more indented, and on that side, about one-third of its length from the south point, in a small cove, named Santa Maria, will be found the best landing, and the place of easiest access to its summit.

The surface of the island is composed of light soil, mingled with rocks and stones; and at the period of our visit (the middle of May) it was covered with long, coarse, dry grass, and some wild herbs, amongst which the wormwood was abundant. Near its centre was a pond of turbid water, apparently preserved for the animals which sometimes pasture there, when the grass is verdant; but at this time none were found upon it. The most elevated land on Chao is 336 feet above the sea, and is situated 340 yards southward of the north point.

Dezerta Grande is the largest and most elevated of the three islands; its shores are generally steep and rocky, and high bold cliffs of rock characterize the greater part of them. It is 6.33 miles in length, by 1 in breadth, at Ponta de Pedregal, which is its widest part. From the high land, lying due east of this point, in the interior of the island, there is one continuous rocky chain of heights to the south point. Northward of these high lands it has a very different formation, there being a double ridge of high lands. The valley lying between them is drained by a water-course running along the bottom of it, over a rocky bed (quite dry in May), the outlet of which is over the eastern cliffs, about half a mile from the north point of the island. This water-course is turned thus eastward by two hills, standing on the N.W. side of it, near the outlet; and the rain water which falls on these hills makes its way to the sea, down a steep ravine, also running to the northward, and terminating very near the north point of the island, on the west side. This circumstance is particularly mentioned because we found the summit more easily gained from this part than from any other, although the ascent up the dry and rugged bed of the mountain torrent was sufficiently difficult.

The head of the valley lies at the foot of a green hill, near the centre of the island, and about east of Ponta de Pedregal; and it may be useful to the navigator to know that there he will find a small house, and near it two ponds or reservoirs of turbid water; and a few yards from the house, down the valley, a spring of delicious cool water, yielding, however, but a very limited supply. There had been a garden attached to the house, but it was neglected and overgrown with weeds. The soil of the green hill, and all the head of the valley was a deep red earth. A few cattle, some goats, and numerous sheep were found upon the heights; and there were twenty persons from Madeira attending them, and collecting orchilla. These people sometimes land on the little point Castanheira, half a mile northward of Ponta de Pedregal, and climb to the top of the island up broken cliffs; and when the wind is westerly, they scale the heights from the east side; but much skill and local knowledge seem requisite to accomplish it.

The most elevated peak of Dezertas is a rocky hill, standing on the ridge of high land, which may be termed the spine of the island. It bears S. 68° E. 1.1 mile from Ponta de Pedregal, and is 610 feet above the sea. From the north point of Dezerta Grande to the rocks which extend from the south end of Chao, the distance very little exceeds 300 yards, and this channel is narrowed by a breaking rock in the middle of it, lying north from the point. Another breaking rock lies a few yards from the N.E. point of Dezerta Grande, so that, although at low water there are passages of 2½ fathoms in the channel, yet it is only practicable for boats in fine weather; and there are times when the breakers extend entirely across.

From the top of the high land at the south point of Chao, the rocks at the bottom of this channel may be distinctly traced at low water. From the north point of Dezerta Grande, proceeding along its western coast, the next point bears S. 5° W., half a mile. It is formed by several rocks and large stones. S. 6° E., 1.45 mile farther is *Ponta de Pedregal*, a detached rock, with high land towering above it to more than 1200 feet. Between these two points is the little cove of Castanheira, where, as before stated, the boatmen sometimes land to climb the heights. A rock stands off and marks the point.

From Pedregal the outer rock off Ponta de Boqueirao, the south extremity of the island, bears S. 30° E., 4½ miles. The rock has a few stones on its west and south sides, but close to it; the point is steep and clear of dangers; and so is the whole western coast, which consists of high broken cliffs, with here and there a large fragment fallen at its base. Between Pedregal and Boqueirao points these cliffs fall back half a mile from the line joining the extremes, and convey to the eye an idea of greater depth of bay than is really the fact.

At Ponta de Boqueirao the coast turns north for eight-tenths of a mile; thence N. 13° 30′ W., 1.85 mile to the short stony point of Rocha Negra: on the north side of which are several rocks and stones, with shoal water half a mile along the shore, and to the distance of about 300 yards off it. A small stony point lies half way between these two last, but the borders do not extend off 100 yards.

From Ponta de Rocha Negra, the next point northward bears N. 29° W., 2½ miles. This is also a short stony point, and like the Rocha Negra, is apparently formed by fallen portions of the cliffs above it. From this last point to the N.E. extremity of the island is N. 35° W., 1½ miles. Two black rocks lie immediately off this point, and the breaking rock formerly mentioned a few yards north of the outer one. The general character of the east coast of Dezerta Grande is that of a rugged, broken, irregular line of cliffs, having, in many cases, slopes from them to the stony points which originate in occasional land slips from these cliffs.

Bugio.—From Ponta de Boqueirao, the south extreme of Dezerta Grande, the north point of Bugio bears S. 5° E., distant 0·67 of a mile. Both points are clear, and have 7 fathoms water within 30 yards of them. The channel between them is perfectly free from dangers. The deepest water in it is 19 to 20 fathoms; the quality of the bottom varies, being fine brown sand, coral, shells, and rock.

The Bugio from its north point along the west coast southward runs nearly 1·7 mile; thence S. 23° E., 1·65 miles, to a conical detached rock; and thence to Ponta d'Agulha, its south extremity S. 63° E., 1·1 mile. A few rocks lie around this point; but there are 5 fathoms 130 yards off, and at 200 yards a depth of 10 fathoms. It is in Lat. 32° 23′ 15″ N., Long. 16° 27′ 37″ W.

From Ponta d'Agulha the north point of Bugio bears N. 21° 30′ W., 4·05 miles. The coast between the extreme points on the east side forms a crescent ½ a mile in depth. Both shores are rocky cliffs of less altitude than those of the Dezerta Grande, surmounted by a sharp serrated rocky ridge of hills which runs the whole length of the island. There is a gap on this ridge near the centre of it, which at a distance gives the appearance of two islands. The beaches on opposite sides of the gap are not more than 200 yards apart. Its greatest breadth nowhere exceeds ½ a mile.

The highest peak on the northern part of the Bugio is 1349 feet above the sea; that on the southern part is 1070 feet.

The direction of these islands from the Sail Rock to the south point of the Bugio is S. 20° 28′ E. and their whole extent is 12¼ miles.

The bank of soundings around these singular islands is tolerably regular; sweeping across to them in a narrow ridge from Madeira as already stated, it extends along their eastern shores to the average distance of 1¼ miles from the land; and along most parts of the western coast to the distance of 2 miles.

Its greatest breadth is west of Bugio, where it runs off 8 miles; on the south it passes the extreme point at the distance of 1½ miles. The bottom is diversified with fine sand of various colours, brown, white, and grey; coral, broken shells, and rock.

There is much danger to vessels passing close under the lee of these islands with strong breezes, in the violence of the gusts from the high land, which are most variable both in direction and strength. It is no uncommon thing to see the water whirled into the air, and then precipitated on the vessels' masts and decks.

The tide sets by these islands at the springs at the rate of 1½ to 2 miles per hour; the flood N. 81° E.; the ebb S. 81° W., and its rise is 7 feet.

PORTO SANTO.—This island lies north-eastward of Madeira, and is a dependency of that island; it is about 6½ miles in extent, and stands upon an extensive bank of soundings. If from Europe and bound to Madeira, it is recommended to make this island, and then steer south-westward, as by following this plan you will be certain of the exact course you ought to adopt. The island is said to present a somewhat remarkable aspect, and to be easily recognised by its appearing as three large high hummocks, which are visible in fine weather 20 leagues off. It has on its south-west side a roadstead equal in many respects to Funchal, where there is a neat little town affording refreshments, and plenty of water.

Porto Santo distant 14 miles.

With the exception of a few pines and Palms, Porto Santo is destitute of wood, not even producing brushwood, consequently the inhabitants are obliged to depend on Madeira for fuel. This island is used as a place of exile for prisoners from Madeira; and there is a regular commercial communication kept up between the two islands by large boats. Between Madeira and Porto Santo the prevailing wind is from the N.E.

The following description of Porto Santo by Captain Vidal, R.N., is extracted from the *Nautical Magazine*, 1848*:—

"The north-eastern part of Porto Santo consists of numerous rocky pointed mountains, some of which are nearly 1700 feet in height, with bold cliffs upon their sea-board; and all its northern coast is characterized by high rocky cliffs generally inaccessible, with rocks, some above and some under water, lying along their bases.

The central part of the island, though considerably less elevated than the extremities, is high near the cliffs of the north and north-west coasts, where in some places it is 700 feet above the sea. Thence it slopes southward, and terminates in a beautiful sandy beach, which forms its entire south-eastern shore. On this white central part are several sand-fields covered with what appear to be fossil heath stems; a remarkable feature, which has excited the attention of naturalists who have visited the island from Madeira. Various conjectures have been formed as to their origin; but it would seem most probable that they are coral formations.

The south-western end is also rocky and elevated, some of the hills exceeding 900 feet in height; and one peak near it, named Anna Fereira, is distinguished by the columnal structure of its summit.

The *town* is situated near the centre of the bay, about 300 yards from the beach; the church and court-house are conspicuous in it; and a little westward of them is a small battery, and the residence of the military commandant. In this battery observations were made to determine the geographical position of the island, and they place it in Lat. 33° 3′ 30″ N., and Long. 16° 20′ 14″ W.

At a mile, N. 4° 30′ E., from the church there is a pointed hill, the Pico do Castello. Upon its summit, 1447 feet above the sea, are the ruins of several water tanks and long stone buildings. Cordeyro states it to have been used as a stronghold, to which the inhabitants retired on occasions of hostile invasion by the Spaniards during their disputes with Portugal. The two peaks immediately eastward of Castello, called Facho and Guadaya, are the highest on the island; the former having an elevation of 1660 feet.

The largest portion of the island is employed for pasture; the part devoted to agriculture extends principally along the shore of the bay, and over that tract of comparatively low land lying between the heights of the N.E. and S.W. points, though much of it is sandy, dry, and barren; and the whole island suffers greviously from a deficiency of water. It produces wine; and most varieties of grain and vegetables in general use; also oranges and other fruits common to its latitude; but it is remarkably destitute of trees. Live stock and poultry are plentiful.

* The bearings in this description of Porto Santo are *true* bearings.

The island fishermen are few in number; yet the sea around its shores abounds with fish. One of the best fishing-banks is off the south point of Ilheo de Cima; and in the early part of summer it may be seen crowded with fishing-boats from Madeira.

To Madeira there is a considerable annual export of limestone from the quarries of Ilheo Baixo; it is carried in open boats and gives employment to the boatmen of both islands.

The landing at Porto Santo is usually made upon the beach in front of the town, where some fishing-boats and others of larger dimensions used for commercial purposes are hauled up; but there is no pier, nor does any attempt appear to have been made to facilitate the communication with the shore. It is high water here at full and change at 12h. 50m.; and the rise of tide is 7 feet.

Generally vessels should not anchor in the bay within the line joining the south extreme point of Ilheo Baixo, and the low extreme of Ponta do Incao, bearing S. 49° 30′ W., and N. 49° 30′ E.; but there is convenient anchorage near that line, with the church N. 48° W., and the south point of Ilheo de Cima, N. 73° E., 2 miles distant. In this position, which is 1·3 mile from the landing-place, there will be 17 fathoms water over a bottom of small gravel and broken shells. The edge of the bank is something less than ¼ a mile southward of it, and the depth of water increases rapidly.

During the settled weather which usually accompanies the summer months, vessels may anchor nearer to the shore; but care should be taken to avoid being caught in the bay, when it is not settled, for southerly winds of any strength throw a high sea into it. In the present condition of the island it is of little service to the navigator, since any supplies it can afford may be more conveniently and expeditiously obtained at Madeira.

Ponta do Incao, the south-east point of Porto Santo is composed of high rocky cliffs, surmounted by pointed hills. At the base of it is a small low rocky point, and several detached rocks.

The *Ilheo de Cima* lies off the point S. 56° E., two-tenths of a mile. The narrow channel between the point and Ilheo is studded with rocks, some above, some under water; but there are two boat passages in it, the one close to the south side of a large rock off the point, the other close to the island.

Ilheo de Cima may be termed a table-land, although it is not strictly so, there being a small elevation near its eastern cliffs, 360 feet above the sea, sufficiently marked to furnish a station in the survey.

The island has a broken coast line of rocky cliffs with a small cove at its north-east side, where, when the water is smooth, a landing may be effected. Thence a sort of goat track leads to its summit, on which there is some loose stony soil. Its general direction from the N.W. to the S.E. point is S. 62° E. It is six-tenths of a mile long, one quarter of a mile broad; and, except at the north-west point, is everywhere steep.

From the south-east point of Cima the bank of soundings extends off East seven-tenths of a mile, S. 87° E. 2·46 mile, and South 1·2 mile, and terminates in a narrow point. Much of it is coarse ground, coral and broken shells; and it is held in great estimation as a fishing-station by the boatmen of Madeira, as well as those of Porto Santo.

N. 11° E., one mile from Ponta do Incao is Ponta dos Frades, a bold point steep with the Pico do Conselho ½ a mile inland of it. Between these two points is a small sandy bay of Porto dos Frades, and in it the Ribeira, which discharges the waters from the adjoining hills. The land is composed of broken rocky cliffs, with a few rocks scattered along them near the shore. A large round rock, named Penedo Redondo, lies off Ponta dos Frades, bearing from it S. 48° E., distant 800 yards. This rock is a few feet above water, and everywhere steep; having 10 fathoms alongside it. The bay formed by Ilheo de Cima, and Ponta dos Frades has generally a sandy bottom. The edge of the bank of soundings is ¾ of a mile east of this point.

From Pònta dos Frades the east point of Ponta Branca lies N. 8° W., 1¼ miles. The land between these points falls back about four-tenths of a mile, comprising the valley between Pico do Conselho and Pico Branca, and near the centre of the bay is a small sandy beach through which the waters of the Ribeira, which drains the valley, find their outlet.

Ponta Branca is really composed of three bluffs; the southern one has a few large stones lying off it to a distance of 200 yards; the northern bluff of the Ponta is a little more than three-tenths of a mile N. 85° W. from its eastern bluff, and forms a fine bold promontory, the peak immediately over it being 1390 feet above the sea.

Three rocky islets lie off Ponta Branca; the first bearing from the northern extremity of the bluff N. 64° E., three-tenths of a mile, is named Rocha do Pescador. It is about 470 yards in length, by 270 in breadth, with a broken coast above of rocky cliffs. There is a peak at its north side 858 feet in height; and the whole summit of the islet is covered with trees. The second islet, named Roche de San Lourenzo, bears from the Peak of Pescador N. 12° E., 0'·62; it is very small, a mere cluster of rocks with a few trees upon them, 88 feet above the sea. The third and outer islet is Rocha de N.E., bearing N. 5° E., 0·6 mile from San Lourenzo. It is nearly the same size as Pescador, and like that islet its coasts are composed of steep rocky cliffs of very irregular outline; it is thickly wooded, and near the centre of it is a peak 830 feet high.

The islets are all steep, with navigable channels between them. They stand on a rocky bank of unequal soundings, which extends more than a mile N.N.W. of the outer islet. The least water found upon it was 10 fathoms. This rocky patch bears from the peak of Rocha de N.E., N. 32° W., distant 2·8 miles, and is on the meridian of Ponta Branca.

The edge of the bank east of the islets runs nearly parallel with them at the distance of only ½ a mile; and after passing the northern one it trends northwestward.

N. 73° W., 1·4 mile from the north extremity of Ponta Branca is Ponta da

Cruz. It is rather a sharp salient point; and north of it, one-tenth of a mile, is a curious crescent-formed rock, a few feet above the sea, its convex side facing westward.

Between these points are two small bays; the first extends from Ponta Branca to the bold head of Ponta de Ninho de Guisoxe, off which latter about 250 yards lies a breaking-rock; the second bay is west of it; both are full of little rocky points with large stones at their bases, none of them, however, extending more than 100 yards from the cliffs. Directly inland of Ponta da Cruz, about nine-tenths of a mile to the south, is the remarkable sharp-pointed peak of Juliana. It is columnar or basaltic, and rises 1492 feet above the sea.

At Ponta da Cruz the coast trends south-westward. The next extreme that comes to view is Ponta da Fonte, bearing S. 60° W., and distant 1·7 mile. The fountain, from which it takes its name, is situated near the summit of the cliff, three-tenths of a mile S.W. of the point. The intermediate coast consists of high cliffs, much broken into coves, and little points as usual, studded with rocks along their base.

Ilheo da Fonte lies 1 mile N. 56° W. from this point. It is black, of basaltic structure, and terminates in a comparatively sharp peak 270 feet above the sea. At its base it is about 270 yards in length, by 100 in breadth. It is steep, with a clear channel between it and the point; the deepest water being towards the islet; but the bottom is almost all foul ground. Vessels may pass on either side of it, at a distance of 200 yards, in 18 fathoms.

Ponta Varadcas is the next point westward of Fonte, from which it bears S. 54° 30′ W., distant 1·2 mile nearly. The southern extremity of the point lies S. 35° 30′ W., ½ a mile farther, and both extremes are, like the intermediate coast, composed of high rocky cliffs. The hills above this double point are covered with sand; and on their summits are found those curious fields of fossils, resembling petrified stems of heath, before alluded to. S. 26° 30′ W., 2·33 miles beyond the southern point of Varadcas, is the double-headed point of Furado. The point forms two spurs, the one running North, the other S.W., and they are considerably lower than the cliffs on either side of them. The coast between Furado and Ponta Varadcas preserves much the same character as that eastward of the latter point,—viz., high broken rocky cliffs and coves, with large rocks and stones at their bases.

Ilheo de Ferro is of a triangular form, and its sides are about ½ a mile in length. The coasts consist of rugged, and almost inaccessible rocky cliffs, above which is a scanty soil, covered with coarse grass. The most elevated land upon it lies near its north coast, and is 380 feet above the sea. A ledge of flat rock extends from the east point towards Furado. The channel between them is 330 yards wide, and has no danger in it. On the west of the islet there is deep water alongside the cliffs; soundings extend from them seven-tenths of a mile to the edge of the bank.

Ponta Furado is the west point of Porto Santo, and from thence Ponta Malhada bears S. 27° E., distant five-tenths of a mile. The land above this point rises to the height of 890 feet; and the coast between the points is high, rocky, and steep.

From Ponta Malhada, Ponta da Calheta bears S. 50° E., distant 0·92 mile. In this space the high cliffs are much broken into rocky coves, and as you approach the latter point, there are numerous small rocks close to the shore.

At Ponta da Calheta the cliffs terminate, and are succeeded by a low sandy beach, fronted by stones and sunken rocks, which latter extend to some distance round the point.

Ilheo Baixo lies southward of Ponta da Calheta, its northern extremity being about 480 yards from the point. The channel between them is much narrowed by the rocks projecting from Ponta Calheta to the S.W.; and by a small bank, running out eastward from Baixo north point; so that the clear outlet lies east and west, and may be about 180 yards wide. In moderate weather it is a safe boat-channel.

Ilheo Baixo is 1¼ miles from north to south. Its greatest breadth near the centre is seven-tenths of a mile, and it is surrounded by high rocky cliffs, everywhere steep, except at the north point. On the south-west side of it are two small rocky bays, and its whole coast line is very irregular. On the west side of the island, close southward of the rocky head, which forms the north point, there is a cove much used during the summer months by the boatmen of Madeira, who resort to this island for the limestone with which it abounds.

The presence of this mineral on so small an islet is remarkable; the more especially as it is not found either on Porto Santo, the Desertas, or Madeira; a small spot, in the Valley of San Vincente, on the latter island excepted. It is quarried from veins, forming galleries, like coal mines, which, however, are entered from the sides of the cliffs.

Viewed from east to west, the island presents rather a tabled summit, having a little hummock near its northern end, 570 feet above the sea.

The edge of the bank of soundings sweeps round the south point of Baixo, six-tenths of a mile from it to the S.E.; at due south, about seven-tenths of a mile, and at S.W. nine-tenths, and the depth increases rapidly outside 40 fathoms. The lead indicates rocky bottom, generally, in the vicinity of Baixo, with occasional casts of fine white sand.

From Ponta da Calheta, Ponta do Incao bears N. 63° 20′ E., distant 4·9 miles. The coast line between them is formed by a beautiful white sandy beach, which falls back into a bay, about eight-tenths of a mile in depth. from the straight line through the extreme points. A few rocks lie along the beach, or very close to it, from Ponta Calheta to nine-tenths of a mile beyond it. They terminate a short distance eastward of Anna Fereira peak, the remarkable summit of which is 910 feet above the sea.

On the east side of the bay there are also rocks scattered along the coast from Ponta do Incao to the distance of 1·4 mile westward, and in the meridian of Pico

Mázarico, they extend off shore two-tenths of a mile. Between these is an uninterrupted line of white sandy beach.

The edge of soundings, after sweeping round Baixo, so narrows the bank that, when the peak of Anna Fereira bears N.W., it approaches within three-tenths of a mile of the beach. Thence it runs eastward, and with the town bearing north, its edge will be found 1·4 mile from the shore. It continues this easterly direction to the meridian of the north end of Ilheo de Cima, and then turns south-easterly to the extremity of the narrow fishing-bank, extending from the S.E. end of that island. Fine white sand is the general character of the soundings over the bay; but casts of coral, shells, and gravel occur.

From the N.W. coast of Porto Santo, the bank of soundings extends off 8 miles, and from Ilheo da Fonte, its northern extreme, lies about N. 25° W., 6¾ miles. Its general depth is from 25 to 35 fathoms fine white sand, with frequent casts of rock, coral, shells, and gravel.

Falcon Rock.—Near the north-eastern margin of this branch of the bank is the Falcon Rock, a mere knoll, on which there are 4½ fathoms at low water. It stands on a rocky patch, three-tenths of a mile long, and two-tenths broad, on which are 11, 15, and 17 fathoms; and the sea is said to break heavily on it in stormy weather; but this we did not witness. When upon this rock, the highest land of Rocha de N.E. (the outer islet of Ponta Branca), bears S. 60° E. 6·23 miles; of Ilheo da Fonte S. 30° 10′ E., 4·6; and of Ilheo de Ferro S. 5° 30′ W., 8′·4.

Vessels coming from the N.E., with a fair wind, may pass it, keeping the Ilheo da Fonte in line with the high land at the S.W. end of Porto Santo.

Styx Bank.—On the east side of Falcon Rock, the edge of soundings is half a mile distant. On the N.E., only three-tenths of a mile. N. 37° W., nearly nine-tenths of a mile from the Falcon Rock, is another rocky patch of comparatively shoal water, which has been named after the vessel by which it was explored, the "Styx Bank." The least water found upon it was 11 fathoms, with casts of 17 and 20 fathoms. Like the Falcon Rock, it is situated near the eastern margin of soundings, there being 100 fathoms about three-tenths of a mile east of it, in which direction the bank deepens suddenly from 28 fathoms to 100. North of it the soundings extend 1 mile, and deepen rapidly from 45 fathoms; and west of it they run off 2½ miles.

The edge of soundings then runs southward in a waving line, towards Ilheo de Ferro. The whole bank is composed of sand, much interspersed with rock, coral, broken shells, and gravel. The sand is generally white and fine: but some of it is speckled with red, and coarse sand occasionally occurs."

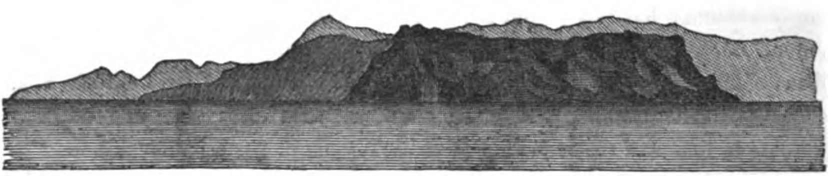
THE SALVAGES.

The **Salvages** are a group of islands lying 156 miles from Funchal, between Madeira and the Canary islands. Although but of small extent, they are inhabited;

but the inhabitants are very poor, and with difficulty obtain a subsistence. It is usual to avoid these rocky islets when sailing in their vicinity, as there is nothing to repay a visit, and access to them is very dangerous on account of outlying dangers.

GRAND SALVAGE.—The principal island of the group, named the Grand Salvage, is about a mile in extent, and can be seen 16 to 18 miles off, and when viewed either from the northward or southward appears in two distinct hills. The shape of this island is very irregular, and its cliffs being high, abrupt, and bordered with many rocky reefs, render landing very dangerous. N.W. of the island about a mile there are several rocks and breakers; some sunken rocks also lie off to the West and N.E. about the same distance; in other respects the island is clear and may be approached with safety to the distance of 2 miles. Most of the dangers show by the sea breaking on them.

The irregular form of the island presents several small bays, the most accessible of which is on the eastern side, where, with a little difficulty, a landing may be effected close to the south-east point of the island. In this bay the depth is from 7 to 40 fathoms; but there are several patches of 2½ to 3 fathoms to be avoided. The west and south bays of the island do not appear to be so convenient.



Salvage Island, bearing N. 5° W.

PITONS.—W.S.W. of the Grand Salvage about 8½ miles are two islands named the Pitons or Little Salvages, the largest of which is nearly 3 miles in extent from N.N.E. to S.S.W., and has in its centre a peaked hill very ragged at the summit. From this hill the land declines in height towards the extremities of the island so unevenly as to give the island the appearance of being composed of several islets when seen from certain positions at a distance of 5 or 6 miles. The width of the island is about 1 mile. When seen at a great distance off it is said to bear some resemblance to a sail.

At about a mile from the western side of the Great Piton is the Little Piton, which is ¾ of a mile in extent, and of but moderate elevation. On its eastern side is a large rock, named *L'Enfant Perdu*, upon which the sea breaks with violence.

These islands are surrounded and connected together by breakers which extend 1½ miles westward of the lesser isle, so that it is very difficult if not impossible to approach them for the purpose of landing; consequently such an attempt should be avoided. Between the Pitons and Grand Salvage there appear to be no dangers; at least such were not found when the islands were examined in 1841 by Lieut. Kerhallet of the French navy.

Between Madeira and the Canaries the current runs S.S.W. at the rate of a half to about 6-10ths of a mile per hour. If steering from Funchal to Teneriffe or any of the Canaries, the course should be South (*true*), in order to avoid the Salvages, which are very dangerous particularly in the night-time. After passing their parallel the course may be changed at convenience. If during the months of December to February, when the prevailing winds are from South, S.W., and West, you are able to pass them to the westward, you may safely run eastward of them, only being careful of the outling dangers, and not to approach them nearer than 2 miles.

The currents in the vicinity of the Salvages are very variable, running S.S.W., S.S.E., and even S.E. at the rate of a ½ to 1 mile per hour. In passing them it will, therefore, be necessary to be careful of their drift.

Piton Islands, bearing N. 85° W.

CANARIAS, OR THE CANARY ISLANDS.

General Remarks.—The Canary islands lie between the parallels of 27° 30′ and 29° 30′ N., and between the meridians of 13° and 18° West. They consist of the following large islands:—Palma, Hierro or Ferro, Gomera, Tenerife, Gran Canaria, Fuerteventura, and Lanzarote; there are also some smaller islands, as Graciosa, Allegranza, and Santa Clara: they belong to Spain and form a province of that kingdom, called Canarias, together they cover an area of 2806 square miles, and the total population in 1864 was 237,036. The coasts of the islands are high and precipitous, but here and there broken by deep clefts. The mountains generally rise towards the centre of the islands, bleak and bare, and are full of pointed rocks. During the winter there is snow several of on the highest summits. The peak of Tenerife, a half extinct volcano, rises to the height of about 12,180 feet, and as it is viewed from the sea at a distance, seems to spring out of the water like a sugar-loaf. They are all of volcanic formation, and in parts extremely fertile; they produce grain and fruits, both tropical and European, in abundance. An active trade is kept up among the islands, and they have large fisheries on the African coast. There are no close harbours, the anchorage being generally open roadsteads, few of which can be considered safe, except during the fine season. The depth of water between the islands is very great, and the passages are good. Supplies of provisions &c., may be obtained from any of them, though some of the islands are without water, and depend on rain which is kept in tanks. Each island has its governor; but the whole group is under a govenorgeneral, who commonly resides at Tenerife, though all the law courts are held at Canaria.

The climate of the Canary Islands is healthy. The only bad months in the year are November and December, which are wet and stormy; fogs also prevail at this time, and S.E. gales are strong and cause heavy and dangerous seas, especially in the narrow channels separating the islands. In consequence, at this season of the year, the bays which are exposed from S.E. to S.W. are extremely hazardous, and should if possible be avoided. In January the weather becomes finer, and in February the summits of the higher mountains are said to become covered with snow. At this season of the year, although the more elevated parts of the islands are cold and subject to slight frosts, yet the lower lands enjoy a moderate and agreeable temperature, not too cold or too warm to interfere with health. During the remainder of the year the prevailing winds are from the N.E., and there are land and sea breezes; the former never extending much from the land, commence at 10h. in the evening and cease at 8h. or 9h. in the morning; there is then an interval of calm until the sea breeze commences. In the channels, the winds, which are usually from N.E. to N.W., blow very strong as soon as you are out of shelter of the land, and maintain a course corresponding with their directions.

All the channels between the islands are safe, and contain no dangers, although such have been reported to exist between Tenerife and Gran Canaria.* All known dangers are situated close to the coasts, and are generally above water, so that there is nothing to prevent a ship from running through the channel which may be most convenient. If wishing to traverse the islands without calling at any of them, the channel between Palma and Ferro, or that between Gomera and Tenerife, is recommended, being not so subject to calms as the passages between the other islands.

The currents of air, divided by the high land of some of the islands, reunite often only at a considerable distance to the southward, and then form a regular wind: thus leaving, in the immediate vicinity of the islands, districts of calm or short and sudden breezes, which are often interrupted by violent and dangerous gusts of wind. There is also a short sea occasioned by these calms, which is at times extremely inconvenient and disagreeable.

When coming from the southward, unless the wind is from the south-eastward it is not advisable to attempt to tack through the channels between the islands, as great difficulty will be experienced from the violence of the wind and the currents which almost always run strongly southward. It is considered better should you wish to gain a northern anchorage to run westward, and then, with the regular wind from N.E. to N.W., to steer at convenience, until you are in such a position

* It may be concluded that this rock does not now exist, as Lieut. Arlett, R.N., when engaged in the survey of the Canaries, sought for it repeatedly, but without success.

as to reach your destination; by so doing the anchorage will be reached more quickly, and with less fatigue.

Currents.—The southerly current which prevails in the vicinity of the Canaries, does not always run through them in that direction, being frequently affected by the wind which almost continually prevails from the North, by the north-east to N.W.

The currents northward of the Canaries, between them and Madeira, westward of the meridian of that island, run S.S.W. (*true*); and eastward of it, to the S.S.E. (*true*), and occasionally S.E. This easterly direction is more marked as it approaches the coast of Africa, until it reaches the meridian of Lanzarote or Fuerteventura.

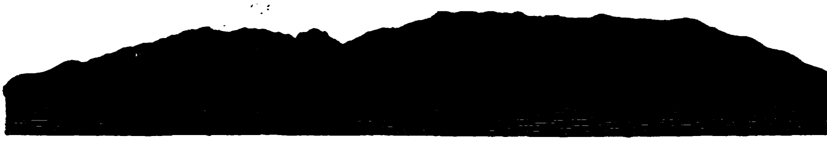
Southward of the Canaries the current runs southward, with a tendency eastward more or less. Near cape Bojador it is often E.S.E. (*true*).

Westward of the Canaries the current runs S.W., S.S.W., and South (*true*), with a force of a half to 6-10ths of a mile.

The easterly current just mentioned is supposed to be an offset from the Polar Current, but observations are wanting to determine this with accuracy. At a short distance from the African coast its direction becomes changed, and it runs southward following the inclination of the land.

It has been observed by Lieut. ARLETT, R.N., that in no part of the world is the barometer more susceptible of atmospheric changes than amongst the Canary Islands. A rapid rise is the sure precursor of an easterly wind, whilst the contrary as certainly indicates a change to West or S.W. The East, S.E. and S.W. winds are accompanied by foggy or hazy weather, but the atmosphere clears immediately on the wind changing in the least to the northward. When it blows strongly from this quarter it is called by the fishermen a *brisa parda*. The temperature of the air is very equal: the average in December is 67°; in January, 67°; in February, 65°; May, 69°; August, 76° of Fahrenheit; and it seldom varies more than 4° or 5° during the twenty-four hours. See also, page 64-65.

PALMA.—This island is the north-westernmost of the Canaries, and contains 31,188 inhabitants. It is remarkably high, and visible at a great distance, hence it can be run for with confidence, and is frequently so even at night. The size of the island is about 25 miles from north to south, and its form is that of a wedge, the base being to the northward. A chain of hills runs through its centre, the highest of which, named the Pico de la Cruz, is 7730 feet high, and situated near the centre of the island; near this are two other peaks, De Muchaco and De Cedro, of the respective elevations of 7690 and 7470 feet above the level of the sea. From these peaks a chain of mountains also runs south-westward, some parts of which are of considerable height, and appear very conspicuous when approaching the island from the westward. The chain of hills running through the island from north to south gradually decreases in elevation as it approaches its southern extremity, where it is terminated by several high hills, extinct volcanoes, which have not been in activity since 1677. On the east side of the island, near its south point, is Mount Viento, 780 feet high, which is very remarkable. Besides these hills there are many isolated peaks, which are conspicuous when sailing along the shores of the island, all of which bear evidence of being formed by volcanic action.



Palma Island, distant 8 leagues to the westward.

The coasts of Palma are in general high and safe to approach within a short distance, there being no dangers but what are situated a little off the shores, and these are usually visible. The bank of soundings extends about three-quarters of a mile off, when it is succeeded by deep water.

The chief port of Palma is that of *Santa Cruz*, on the east side of the island, where, as the land behind the town is high and steep, the shipping can only be discerned at a short distance. In order, therefore, to avoid getting southward of the road, a stranger is recommended to edge in northward, and run down along shore, until the town and shipping come in view. Vessels here ride in 12 to 20 fathoms, during all winds, at less than a musket-shot off the shore; for although it is exposed to the eastward, yet, if you are provided with good anchors and cables, you need be under no apprehension, the ground being clean and good, and the great height of the land, facing the road, repelling any wind, though ever so strong. There is also a port on the S.W. side of Palma, named Tazacorte,* which is exposed to westerly winds, and chiefly frequented by fishing boats.

The lighthouse on point Complida, the north-east extremity of Palma, is 112 feet high, and shows a light *revolving* every minute at 207 feet above the sea, visible 25 miles; the arc illuminated is 289°, or from point Gaviota to point Barlovento.

The channel between Palma and Tenerife is 40 miles in breadth, and is perfectly free from danger, there being on both sides very high land, with a bold shore. Vessels from the northward, and bound to the coast of Africa, are advised to use this passage, as the breeze is usually fresher and more continued than in any other, and the calms are of less duration. It is, however, necessary to keep in mid-channel, borrowing rather towards the Palma shore, in order to avoid getting too soon under the lee of Tenerife.

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* The following was published in January, 1843:—"Several English vessels having lately sent their boats ashore at Tazacorte without receiving the succour they required, notice is given, that the orders of the Spanish government are that no communication be held, or refreshment given, at any other place than Santa Cruz on the north-east side of the island."

FERRO.—This island is the westernmost of the Canaries, and contains 5026 inhabitants; it is of no importance, there being neither road nor harbour in which a vessel can obtain shelter. It is of considerable height, some parts of the central ridge of mountains being nearly 5000 feet high, so that when the weather is clear, the island may be seen far off at sea. The coast is in general high and steep, and bordered in places by outlying rocks, which are usually visible. In no part of the island does the bank of soundings extend a mile off.

Ferro is principally famed for having been selected in former times as the prime meridian from which the longitude was reckoned. Near its N.E. point is the village of Valverde with its church. The inhabitants of the island are very poor, and there is but little communication with the other islands. A little fresh water is procurable, but no supplies, the productions of the island being inconsiderable.

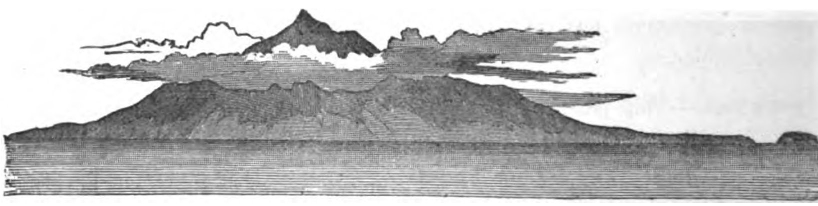
GOMERA.—This island is somewhat larger than Ferro, and lies about 14 miles W.S.W. from Tenerife. Its form is nearly circular, and its extent across is about 14 miles. The interior consists almost entirely of an elevated *plateau;* but near the centre of the island is a lofty ridge, named Alta Garaone, which is estimated to be 4400 feet high. There are besides other peaks of less elevation, one of which, mount Salvador, is near the south coast, and is about 2500 feet above the sea level. The population is 11,360.

The coasts of Gomera are high and steep, and there are no dangers but what are close to their base. Between the rocky points there are occasionally little sandy bays, but they are not deep enough to afford shelter. Around the island there is a bank of soundings of 40 to 60 fathoms, which extends 1½ to 3 miles off, and is immediately succeeded by deep water.

The place usually visited by shipping is San Sebastian, a village situated at the bottom of a commodious bay, on the east side of the island, where vessels may ride in from 15 to 7 fathoms, entirely land-locked from all but S.E. winds. It is essential to be securely moored here, on account of the strong eddies, particularly off the land, which frequently come in severe gales. The best situation for a vessel to lie in, is about a cable's length from the beach, having a full view along the main street of the village.

TENERIFE.—This island is one of the most important of the Canaries, and contains 93,709 inhabitants. It is about 45 miles in length, by 22 miles in breadth in its broadest part, which is at its western extremity. Through its centre is a ridge of very elevated land, descending rapidly on either side, the highest part of which, situated near the celebrated peak, is estimated to be 9400 feet high, and is named Los Azulejos. This central ridge decreases gradually in height towards the north-east extremity of the island, where the mountains are under 3000 feet in height. Here on the south coast is situated the town of Santa Cruz, the principal port of the island.

In nearly the centre of the island, or rather towards the western side, is situated the Peak, which is better known to the inhabitants by the appelation of the Pico de Teyde. It is 12,180 feet high, according to the determination of Captain Vidal, R.N., 1838, and when first seen at a great distance off has the appearance of a mist or cloud over the horizon; it is, generally speaking, overcapped with clouds, although when the weather is clear it can be distinctly seen upwards of 100 miles off. The islanders say it is visible 160 miles, but this appears doubtful, and almost impossible; for although its height might extend beyond the sensible horizon, the atmospheric medium of the intervening distance would totally envelope it, and preclude the possibility of its being seen. The following view will give an idea of its appearance.



Peak of Tenerife, E. 6° S. 67 miles, Palma Island bearing N. 13° W. (true).

Captain Beechy, R.N., visited Tenerife in June, 1825, and writes—"From our anchorage at Santa Cruz we had been daily tantalized with a glimpse only of the very summit of the peak, peeping over a nearer range of mountains, and the hazy state of the weather on the day of our departure made us fearful we should pass on without beholding any more of it; but towards sunset, when we had reached some miles from the coast, we were agreeably disappointed by a fair view of this gigantic cone. The sun set behind it; and as his beams withdrew, the mountain was thrown forward, until it appeared not half its real distance. Then followed a succession of tints, from the glowing colours of a tropical sky, to the sombre purple of the deepest valleys, varying in intensity with every intermediate range, until a landscape was produced, which for beauty of outline and brilliancy of colour is rarely surpassed; and we acknowledge ourselves amply repaid for our days of suspense. Night soon closed upon the view; and, directing our compass to a well-known headland, we took a last look at the island, which was the only one of the Canary group we had seen: not on account of our distance from them, but owing to that mass of clouds which 'navigators behold incessantly piled over this archipelago.'"

The coasts of Tenerife are in general high and steep, with no dangers but what are close-to, or a short distance from their base. A little off the land of cape Anaga, the north-east extremity of the island, and on the north side, are two high black rocks, named the Anaga rocks, having a clear channel of 13 to 14 fathoms between them. There is also an isolated rock off the village Garachico, near Buenavista point, which is directly opposite the houses. The bank of soundings seldom extends more than 1¼ miles off, and is immediately succeeded by deep water.

Cape Anaga will be easily recognised by its lighthouse, a conical gray tower 39 feet high, erected on Roque Bermejo point, 1¾ miles north-westward from the cape. It shows a *fixed* light (*flashing* every half minute) at 810 feet above the sea, visible 35 miles; the arc illuminated is from Drago point to the Anaga rocks.

Santa Cruz.—The principal port of Tenerife is Santa Cruz, situated on the south-east side of the island, at about 9 miles from cape Anaga. The capital of the island is Laguna, built on the central ridge of hills traversing the island; it is 5 miles from Santa Cruz, and a constant communication is kept up with that port, where is the residence of the civil and military authorities and of the governor of the island. The number of inhabitants is 14,146.

A small *red* light has been established on the end of the mole at Santa Cruz, and a *bright fixed* light is also shown from a tower 21 feet high at about 55 yards from the extremity of the mole; the latter light is 34 feet above the sea, and visible from a distance of about 9 miles.

There is but little at Santa Cruz to interest a stranger. The houses are of dazzling whiteness, and are not well built, and there are no public buildings with any pretentions to elegance. Wood and water can be procured, and supplies of provisions may also be obtained. The best road for shipping is between the middle of the town and a fort or castle, about a mile northward of it; here ships anchor in 6 or 8 fathoms, at a cable's length from the shore, or in 25 or 30 fathoms at half a mile distant. Care must be observed, in going in, not to bring any part of the town northward of West, lest calms should be caused by the land under the peak; in the event of being driven ashore, anchors and cables are of no use, as there is no ground on the opposite side of the ship with 200 fathoms. The bottom in some places is foul. Here vessels, if moored with good cables and anchors, may ride securely in all winds, although the bay is exposed and open to those which blow from the N.E., East, and S.E.; but it is said that not above once in the space of 4 or 5 years do they blow so hard as to cause any considerable damage.*

Mr. Bartlett, the English Consul at Santa Cruz, 1844, gives the following instructions for the anchorage:—"A vessel from the northward should endeavour

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* The following is the order for the regulation of quarantine, issued November 20th, 1832, which may still be in force:—"On the appearance of a British ship, a boat with a pilot, and carrying the Royal Spanish flag, will leave the mole, and point out the quarantine anchorage. If, from circumstances, it should be necessary to anchor, before communication can be had with the boat, the line of quarantine anchorage is S.E. and N.W., by compass, with the mole-head (nothing north of it); distance from 2 to 6 cables' lengths from the land; the depth of water 10 to 20 fathoms, rocky. Anchorage north of the line stated, is for vessels admitted to free pratique. No ship is to lower boats, or communicate in any manner whatever, until visited by the health-boat, and permission obtained. Ships bound to any port in any of the Canary islands, from infected countries, must come to this bay, which is exclusively appointed for the observance of quarantine."

to make cape Anaga, the north-east extremity of Tenerife, which is very lofty and easily known by two large high rocks lying close to it. Care should be taken not to get to leeward, the prevalent winds being between N.N.E. and E.N.E. After passing point Antiquerra, 1½ miles southward of Anaga, (there is a small shoal not far from the land between these points, named La Mancha), the town of Santa Cruz will be visible. While running for the anchorage keep both leads going, and bring up to the northward of the mole-head; or bring the clock front of the square church tower, which has a cupola (San Francisco), to bear West (*true*) or W.N.W. by compass, and anchor with this mark on or northward of it.

Ships anchor in 30 fathoms or less. Give a large scope of chain cable, when the northernmost fort (Paso Alto) bears N.N.E., and the tower of San Francisco, as before stated; the depth of water will be about 25 fathoms. The shore may be approached without risk, the water being deep and there being no dangers but what are apparent. The anchorage southward of the mole is reserved for vessels in quarantine."

Lieut. Church, R.N., says of Santa Cruz, "Whilst surveying the Canary islands in the *Ætna*, we had, of course, considerable experience of Santa Cruz, and had no reason to consider it an unsafe anchorage. During the very many times that the *Ætna* was there, in only one instance did we experience a gale from the south-eastward. Most of the shipping slipped at the commencement and got into the offing; but we remained at our anchors, and rode it out well. Although a heavy sea tumbled in, there was much less strain on the cables than might have been expected, arising as it appeared to us from an offset, which, together with there being a great up-hill drag for the anchor, diminishes the chance of driving.

The church tower with the cupola (San Francisco) open a little to the right of the mole-head, is considered the usual anchorage, and vessels congregate here in order to be near the landing-place. But, in a man-of-war, I would (especially if there are many vessels here) anchor considerably north-eastward or windward of this resort, the bank of soundings being wider, and to avoid having merchant ships in the hawse; indeed, I see no reason why ships should not anchor nearly as far north as the Paso Alto fort, the most northern battery, in case the roads are crowded with shipping.*

I have noticed that ships coming from the north-eastward to Santa Cruz, run down at too great a distance from the land, and do not haul in until they get nearly abreast the town. They get a cast or two of the lead with no bottom, and imme-

* Mr. Bartlett says that "there can be no doubt of the goodness of the anchorage to the north, near Paso Alto, but the objection for transports and merchant ships is, that the masters will anchor north of the other vessels to be near the landing-place, and as the line of hills trends westward, and the land from the beach thereabouts is high, the land breeze is not felt (unless strong), and large ships with heavy anchors and few men will often find it difficult to get away, as before the anchors can be weighed and the sails set they will drift among the small vessels. Hence the great superiority of the anchorage I have pointed out, as the land-breeze is more felt and precautions being taken that the ships' head swings to seaward, she is immediately clear of all impediment, and the anchor may be secured leisurely."

diately they get into soundings, the anchor is let go in a hurry, the bank being narrow and the ship's head in-shore, there being little time for consideration.

Instead of this method of proceeding, I think it would be advisable, on making the north-east end of Tenerife, cape Anaga, to haul in upon the bank of soundings immediately on passing point Antiquerra, as from this point to Santa Cruz the bank extends as far out from the land as at the town, and the anchorage is just as good and as safe anywhere when abreast of the barrancos. I would get into the depth nearly that I wished to anchor in, and then run down with the light wind parallel to the shore. Besides having time to anchor leisurely, there is the advantage of being enabled, in case it falls calm, to let go an anchor under foot wherever you may be.

Should it fall calm, while the ship is outside soundings, she may be taken away to leeward by the southerly set, which once caused us twenty-four hours' trouble to get back again. From experience, we latterly adopted the system I have mentioned."

Orotava.—This port is on the north-west side of the island, at about 25 miles from cape Anaga. It is exposed to N.W. winds, which cause a heavy swell, but these, luckily, seldom occur, and in general give sufficient warning to afford time for a vessel to get away. The anchorage is in 40 and 50 fathoms, at about 1½ miles from the shore, with the peak bearing S.W. Considerable damage was done to Orotava and its vicinity, by a dreadful hurricane which occurred in November, 1826. At 2 miles inland from the port is the town, situated in an amphitheatre of hills.

At 11 miles westward of Orotava is the village of Garachico, having before it a rocky islet, which affords protection to small vessels. All this part of the coast is exposed to winds from the northward. See page 65.

Directions to be observed by British Vessels frequenting the Island of Tenerife.—"A Bill of Health is an indispensable document for a vessel's admission here, from whatever port she may arrive. The quarantine laws are very rigorously enforced, and the want of a Bill of Health subjects vessels, even from England direct, to a quarantine, which is never removed without the ceremony of repeated health-visits, and payment of heavy fees. Great care must be taken not to get to leeward of the island, as it is a tedious and difficult matter to get up again, the usual and prevalent winds being between N.N.E. and E.N.E. Cape Anaga should be made, which is the N.E. point of the island; it is very high, and easily known by two large high rocks, close to it, which appear like ships, and may be seen 7 or 8 leagues off. You must then run down till you come within 2 or 3 leagues; and, if bound to port Orotava, must steer down along the north shore (which is very bold, and quite free from danger), keeping 2 or 3 leagues distant; and after running 8 or 9 leagues, if you should not see the peak, which is often clouded, you will see a large white town (Orotava) on the side of the high land, about a league inland, with two small regular-shaped green hills under it, between which you must steer directly in, and, by so doing, will raise, as it were, another town out to sea: this is port Orotava, for which you must steer directly in, until you meet the pratique-boat, which will be about 2 or 3 miles off; it is a low boat and comes with the Spanish colours set upon the staff;—at any rate, you must not be afraid of running in for the land, as it is very deceiving, and you will be 4 or 5 leagues off, when you do not think yourself so many miles; in that case you will not soon get a boat, for they do not come off until you approach very near. The boat, when she comes, brings a pilot and leaves him on board. You must also bring with you your register, pass, clearance, &c.; and you must take care not to deliver either letters, or other papers (except your Bill of Health) to any person who may ask for them, without some document either from your consignee or the consul.

In running down, you must prepare your anchors and cables; it is customary to bend your small bower cable, with which you will bring up, with only one turn round the windlass, in order that it may be run out quick, as the spot where you ride (about half a league off, and westward of the town) is very small; and if there be many vessels there, it is necessary that your anchor go very quick, as you bring up in from 30 to 40 fathoms of water; but there is little or no tide, and she will bring up easily. You must give her the whole cable round the windlass; your buoy ropes should, therefore, be 45 fathoms long. During the summer months, from April to October, all vessels are moored in an inner harbour, or creek, with iron chains kept by merchants, for that purpose. Vessels that fall to leeward very often lose much time by mistaking Garachico for port Orotava, whence it is distant 4½ leagues. There is some similarity in the appearance of these places, Garachico having also above it a white town, inland, named Icod; but besides, by their situation, Garachico being much nearer point Teno, the west point of the island, these places are very easily distinguished by the above mentioned two equally-formed round green hills. Cape Anaga lies in latitude 28° 34′ N., and the Salvages lie true North from the point, distant 28 leagues.

The Grand Salvage is very high, and may be seen 10 to 12 leagues off. Your direct course from the Grand Salvage to port Orotava is S.W. *(by compass)*, and distance 38 leagues; but particular care must be taken not to fall to leeward. The peak of Tenerife may sometimes be seen 40 leagues off, but it is very often hidden by clouds. Should it happen in the winter that you arrive off port Orotava, during a N.W. or N.N.W. gale which rarely occurs, but throws in a very heavy sea upon the coast, and would prevent a boat going off to you, it is best to bear away for Santa Cruz, on the S.E. side of the island, after doubling cape Anaga.

Santa Cruz is the preferable place to touch at, for vessels in want of water, and refreshments. All vessels in approaching these ports ought to hoist their colours, and show their consignee's signal; or, when unconsigned, and only visiting the island, a union jack at the fore, and a white flag with a pennant over it at the main, in order that boats may be early sent off to them by their consignees, or by the consul."—*Advices from Tenerife, dated the 11th November*, 1816.

GRAN CANARIA is about 24 miles in extent, and is the most important island in the Canaries group, as it offers more resources, and better shelter than any island in the archipelago. Its population is 68,970. In the interior it is extremely lofty, the range of mountains named Los Pexos being 6400 feet high, so that the island can be seen a considerable distance in fine weather. Most of the mountains are wooded, and from them flow streams of water, which in the winter time become torrents. It has been observed that Gran Canaria affords more anchorage than any of the other islands, the bank of soundings almost everywhere extending farther out. During the summer, when there is a constant N.E. wind, the high land obstructing its course, causes calms to prevail off the south-west end of the island to the distance of 8 or 9 miles from the land, where the divided currents again unite. The same cause, however, occasions a westerly current close in shore, which the island vessels take advantage of.

The coasts of Gran Canaria are high and steep, and there being scarcely any outlying dangers, may be approached in general with safety. Off the eastern side of the island are a few rocky islets and reefs, mostly visible, and close to the shore. In the open bays a frequent use of the lead is sufficient to avoid danger.

In the north-east part of the island is the Isleta, a peninsula of about 8 miles in circumference, which is connected to the island by a narrow isthmus 2½ miles in length, each side of which forms an extensive bay. That on the east side is named *Puerto de Luz*, and is a spacious sandy bay, with good anchorage for vessels of all burthens, within half a mile to 1½ miles N.E. from the town, but the latter distance is to be preferred, as the ground is better. There are several steep rocks at the entrance, on the N.E., which protect the shipping, and you may lie secure from all winds, with the exception of that from the S.E. to which the bay is quite exposed; however, it but seldom blows sufficiently fresh from that quarter to endanger the shipping. At the bottom of the bay is the town of *Palmas*, the capital of the island, which is a large handsome town, containing about 1800 inhabitants. There is a cathedral, hospital, and college, with convents for monks and nuns of all orders. The city is well supplied with water, having fountains in all the principal streets and squares; the market is also well furnished. There is a mole for shipping, and other conveniences for those visiting the port. Vessels, with cargoes for Palmas, often anchor, in fine weather, within half a mile of the town, but it cannot be considered a good roadstead.

The bay on the west side of the Isleta, named *Confitál*, is open to the N.W., and is used only by small vessels. Along the coast are a number of rocks, through which are passages available for the small coasting vessels which occasionally obtain shelter behind the rocky heads. Near point Confital is a patch of 9 fathoms, upon which the sea sometimes breaks; it lies with a ruined fort in one with the north bastion of the citadel at Palmas. When the wind blows strongly from the S.E., the fishermen quit Palmas bay, and run into Confital bay, where they can anchor in 17 to 25 fathoms, sand, and in smooth water.

The Isleta will now be recognised at night by its *fixed* light, *flashing red every 2 minutes*, which is shown in a tower 80 feet high, erected on the highest of the three hills composing the peninsula. It is 817 feet above the sea, and visible from a distance of about 18 miles; the arc illuminated is 257°, from point Guanaterme to point Melenara,—it can also be seen from Palmas roadstead.

At Palmas a small *fixed* light is shown to guide to the anchorage. It is on the mole and we believe is of *red* colour.

At about 12 miles southward of port Palmas is Gando bay, in which there are soundings of 14 to 20 fathoms. In the north part of the bay is a castle, before which small vessels occasionally anchor. In running into this bay, Gando point, its north point, must not be too closely approached, there being a rock awash a short distance off it. This bay is quite exposed to the eastward; but it is said to afford water and provisions, for which purpose it is sometimes visited.

FUERTEVENTURA.—This is a long narrow island, lying eastward of Gran Canaria nearly 45 miles. Its length is about 52 miles, and its breadth from 6 to 15 miles. Like the islands already described it is very lofty, but the mountains do not rise to so great an altitude as those in Gran Canaria, the highest land, named the Asses Ears, at the south end of the island, being not more than 2770 feet above the sea level. It is very barren, and affords but few supplies either of provisions or water.

When seen from a distance, Fuerteventura has somewhat the appearance of two islands, in consequence of the low peninsula at its southern end. The coasts are in general high and steep, rendering a landing difficult; and there are no safe anchoring-places, the whole being exposed. A bank of soundings surrounds the islands to the distance, on the west side, of about 5 miles, which is immediately succeeded by deep water.

Asses Ears. Matas Blancas.
South-east extremity of Fuerteventura.

The south-west end of Fuerteventura named Jandia, is low and rocky, and has a reef extending from it nearly a mile in the vicinity of which the current flows with considerable strength and forms dangerous eddies; it must, consequently, have a wide berth given to it. The lighthouse on the south-west part of the point is 62 feet high, and shows a light *revolving every minute* at 108 feet above the sea, visible 15 miles; the arc illuminated is 274°, from N.N.E. ¾ E. westward and southward to S.E. by E ¾ E. The building is 110 yards from the sea at low tide, and from it the Griego bank extends one mile in a S.W. direction.

The principal port of the island is *Cabras*, an insignificant place on the east coast. The anchorage is indifferent, and the landing-place, which is a beach of shingles, still worse; nevertheless, the whole exports of the island are shipped hence. These exports consist of barilla, orchilla, corn, camels, honey, and goat-skins.

LIEUT. ARTLETT, R.N., says,—"Although the general feature of Fuerteventura is extreme barrenness, still there are many spots of great fertility; the most conspicuous of these is the valley of Oliva, towards the north end of the island, where is a village of the same name, the residence of the Lieutenant-Governor, who is a lineal descendant of JOHN DE BETHANCOURT, and possesses a very considerable portion of the island. The valley of Oliva is about 15 miles long, and generally from 2 to 3 wide; the only two streams of pure water in the island have their rise in the mountain of Atalaya (or Watch Tower); they are husbanded with great care, and irrigate the whole of the valley. A paved road, about ten miles from Cabras, towards Betancuria, or La Villa, is the only one on the island; the others are mere tracks following the direction of the valley, where the ground is less encumbered with stones, and softer to the camels' feet. Although double the size of Lanzarote, Fuerteventura has not a great population, it being 10,996 scattered in small villages over every part of the island.

The interior formation of Fuerteventura is singular: to the north is a group of extinct volcanoes—some of them, as Monte Mudo, rise to the height of 2160 feet—and which, southward of port Cabras, branch off east and west to the sea, follow the direction of the coast on each side, for about 30 miles, and then again unite, encircling an extensive and arid plain; several villages are scattered about, and, from the summit of the hills, the course of some brackish streams may be traced by the verdure they impart. There are also some date palms, the only tree, except the fig, on the island.

From the southern point of junction of the mountains, one of which, Monte Chilegua, on the western coast, reaches the height of 2160 feet, a narrow sandy isthmus, about 5 miles in length and 2½ in breadth, projects, connecting it with the south extremity of the island, which is a peninsula, occupied by the mountain of Jandia. This mountain offers, perhaps, as remarkable features as any in the world; it presents its precipitous face to the north-west, rising 2820 feet. Spurs, or buttresses, diverge from its centre to the north-east, to the east, and to the south-east, by any of which it may be ascended. I had occasion to take my theodolite to the top of it, and, not aware of its peculiarity, on reaching its summit was running forward, when I perceived that the narrow ridge on which I stood overhung a frightful precipice 2820 feet in depth."

Off the northern extremity of the island is *Lobos*, or *Seal island*, which is about 1½ miles in circumference, uninhabited, and destitute of water. Near it is a good road for shipping; the mark for which is, to bring the east point of the island to bear nearly N.E. by N., and anchor half-way between it and Fuerteventura, or rather nearer to the latter. Although this road seems to be open and exposed, yet it is very safe with the trade-wind, for the water is smooth, and the ground everywhere clean, being a fine sandy bottom. Directly ashore from the road, on Fuerteventura, is a well of good water, of easy access.

On Martino point, the north extremity of Lobos island, is a lighthouse 21 feet high, which shows a *fixed red* light at 95 feet above the sea, visible from a distance of about 9 miles; the arc illuminated is 270° (from N. 76° W. northward and eastward to S. 14° W.,) the light can therefore be seen from all parts of the strait of Bocayna.

The channel between Fuerteventura and Lanzarote, named *Bocayna strait*, is 4 to 6 miles wide, and the depth from 15 to 20 fathoms. Vessels sailing through here, from the eastward, with the trade-wind, will lose the breeze when under the lee of Lanzarote, and find baffling winds at S.W.; you must, therefore, fly to the Lobos side, where you will soon get a steady northerly wind to carry you through. Do not approach too near Lobos, as the ground here is foul and rocky, which causes a heavy swell and breakers of incredible height; the noise they make is sometimes heard 5 or 6 leagues off.

LANZAROTE.—This island runs in a N.E. and S.W. direction about 31 miles with a breadth varying from 5 to 10 miles; it is mountainous, of volcanic origin, and has many extinct volcanoes. Its centre rises about 2000 feet above the sea level. From its northern extremity, point Farion, a barrier of precipitous cliffs, rising to the height of 1500 feet, runs in the direction of S.W., 7 miles, and terminates in an extensive sandy plain, where in 1825, a volcanic eruption took place, and two considerable hills were thrown up, which in 1835 were still burning: a stream of lava from 200 to 300 feet in width, found its way to the sea in the bay. Near point Farion is Monte Carona, 1940 feet high, which is an extinct volcano; and 5 miles more to the south-west, is Monte Famara, situated on the west coast, which is 2244 feet high.

The highest land in the island is Montana Blanca, 1959 feet above the sea, which is situated nearly in the centre, and cultivated to the summit. The wine produced in the island is very superior to that of the other islands. The grapes are superior in flavour; the soil selected for their cultivation is decomposed scoriæ.

The town of *San Miguel de Teguise*, the capital of the island, is situated near its centre, at about 4 miles southward of Monte Famara; it is not of great extent, and can only be seen from the westward. Near it is an isolated peak, having on its summit the castle of Santa Barbara.

The western and southern portions of the island are mainly occupied with isolated mountains, which become a range of considerable elevation as they run southward. Near point Papagayo is Monte de la Hacha Grande, which is estimated to be 1860 feet high; and near point Pechiguera, the south-west extremity of the island, is Monte Roja, 680 feet high, which from its isolation appears from some points of view like an island.

Point Pechiguera has a lighthouse upon it 31 feet high, which exhibits a *fixed* light at 51 feet above the sea, visible 12 miles. The light is shown over the south-western horizon, between point Papagayo and N. 13¼° W., (an arc of 223°); it can consequently be seen from all parts of Bocayna strait.

The western coast of Lanzarote from point Penedo to point Pechiguera, is precipitous in the extreme, with the exception of one little bay, named Januvio, 5 miles from the last-mentioned point, where was once a harbour for small vessels, but which is now converted into a salt-water lake by an eruption which took place in 1765.

The eastern shore of Lanzarote is not so steep as the western; and it is on this side are situated the principal ports in the island. At about half-way down is the port of *Naos*, a small but secure harbour, formed by several rocky islets. It has two entrances, each of which is defended by forts: the northern entrance has a depth of 12, and the eastern of 17½ feet at low water, with a rise of tide of 9 feet. Vessels drawing under 18 feet, may enter this harbour at high water, spring tides, and lie securely in all winds, although, in sailing along the coast, the shipping appear to be at anchor in an open road, the port being formed of a ridge of rocks, seen at only a short distance, as they are mostly under water; these break off the swell of the sea, so that the inside is as smooth as a mill-pond. It is to this harbour that nearly all the island-vessels resort during the winter.

Two small *red* lights have recently been established at port Naos as a leading mark for the south-east entrance to the ports; to sail in, vessels must keep them in line. The arc illuminated by each is 180°, or from E. ⅞ N. southward to W. ⅞ S. As the channel is very narrow and difficult, strangers are recommended to obtain a pilot.

Immediately southward of port Naos is the town of *Arreciffe*. Many of the houses are large, and the streets spacious; its population is 3200, the total population of the island being 15,837. The greater part of the inhabitants of Arreciffe are engaged in the fishery on the opposite coast of Africa, which gives employment to between 400 and 500 men from this island alone, about 250 from Fuerteventura, and proportionally from the other islands.

At the north-eastern extremity of Lanzarote are two remarkable rocks composed of black vitrified matter, which in shape, resemble the Needles off the Isle of Wight, England.

Rio Strait.—This is the strait separating the island of Graciosa from the northern extremity of Lanzarote. It is in most parts rather more than a mile wide, and is the most capacious and only safe port for large ships in the Canaries; the extreme difficulty of communication with Lanzarote presents, however, an insuperable objection to its being resorted to as a harbour for trade. The basaltic cliffs here rise almost perpendicularly to the height of 1500 feet, and can only be climbed by a narrow path which winds along the face of the precipice; half way up the cliff is the only spring of fresh water in the island, but rendered useless from its situation, except to a few goatherds. Through this channel ships of any size may pass in mid-channel, and find a depth of 7 to 4¾ fathoms.

When from the eastward, and having entered the Rio channel, should you require a smooth place to lie in while the trade wind blows, you should run a good way in, and double a shallow point on a starboard hand, which must not be approached to a less depth than 4 fathoms, and when beyond it, you may anchor in any depth you please. The water, however, is not so smooth as at Port Naos, especially if the trade wind happens to blow hard from the East, but it does not often come from that quarter, as those which are most prevalent blow from North and N.N.E. To moor here, care must be taken to have a good anchor, and a good scope towards Lanzarote, for, with East and S.E. winds, heavy squalls come from the high land of that island. In winter, the wind sometimes shifts to the S.W.; in that case, it is necessary to weigh, and run to the eastward, round the shallow point before noticed, until you find shelter.

GRACIOSA, &c.—This island is northward of Lanzarote, being separated from it by the El Rio channel. It is about 4¾ miles in extent, rocky, and apparently destitute of water. The highest part of the island is about its centre, where it is 878 feet above the sea. The shores are bordered by rocks. There are no inhabitants on it, and it is used principally as a pasturage.

On the west side of Graciosa is the MONTANA CLARA, a rocky island about a mile in extent. A little northward of it is a rock on which the sea breaks; it is named the Infierno rock, and appears to be composed of a mass of lava 18 or 20 feet high. From the west side of this rock a reef extends a short distance, and there is apparently a narrow passage between it and Clara.

ALLEGRANZA, northward of Clara, is the northernmost of the Canaries. It is a small island composed of a mass of lava and cinders, the product of a volcano now extinct, which volcano rises to the height of 939 feet above the sea. The edge of the crater is well defined, and two-thirds of a mile across; its bottom is cultivated for barilla. The western cliffs are precipitous, and 700 feet high. Forty persons reside on the island (1885), who are principally employed in collecting orchilla. The only landing-place is on the south side, where a cavern runs for about 500 paces slanting from the sea, and terminates in a little sandy bay, open above; at the entrance the rocks form a natural jetty. The village is situated immediately above, and abreast is the only anchorage, half a mile from the shore.

On Delgada point, the north extremity of Allegranza, is a lighthouse 49 feet high, which exhibits a light *revolving* every 30 seconds, at 57 feet above the sea, visible 18 miles. It is 240 yards within the rocks at the extremity of the point, and the arc illuminated is 270° (from N. 25° W. eastward to S. 65° W).

The islands of Graciosa, Clara, and Allegranza, usually termed the little Canaries, are connected to Lanzarote by a bank of soundings on which there are for the most part 40 fathoms water.

At about 7 miles north-eastward of Lanzarote is the Roquet del Este, or East rock, a craggy isolated rock, having soundings of 10 to 40 fathoms, at a short distance off. Between it and Lanzarote are 60 to 70 fathoms, and 2 miles east of it is no bottom at a depth of 100 fathoms.

General Directions.—If a ship, lying at Palma, is desirous of going to Lanzarote, and will not wait for a fair wind (which indeed seldom blows there, especially in the summer season), let her stand over to the N.W. side of Tenerife, and beat up along shore, until she weathers point Anaga; thence, with the wind that generally prevails in these parts, she will be able to weather Gran Canaria, and fetch the point of Jandia, Fuertaventura, or perhaps Morro Jable (the southern point), whence it is easy to beat up to Pozonegro, along the east side of the island, because the sea there is always smooth. It is not quite so easy to beat up from Pozonegro to the isle of Lobos, yet it may be done, without much difficulty, when the weather is moderate; if the wind should happen to blow hard, she may stop in the bay of Las Playas, until it proves more favourable.

From the isle of Lobos she will find no difficulty in beating up to Port Naos, in Lanzarote. It is not advisable for those who are not perfectly well acquainted with that harbour to attempt to conduct a ship in, because the entrances are very narrow.

It is common for ships, which come loaded from Europe to Santa Cruz, Tenerife, &c., to have part of their cargoes to unload at Orotava. These ships, when the trade-wind blows hard, will sometimes find it impracticable to weather point Anaga; when this is the case, they should bear away to the leeward point of the island, and keep near the shore, where, if they do not meet with a southerly wind, they will be carried by the current, in the space of twenty-four hours, from the S.W. point of the island to point Teno, whence they may easily beat up to Port Orotava; for, when the wind blows strong at point Anaga, it will be moderate weather all the way, until within 2 or 3 leagues of point Anaga. But a ship would not bear away, as above directed, unless when the trade-wind blows so fresh that she cannot weather point Anaga; because, in moderate weather, there is little or no wind stirring on the coast between Teno and Port Orotava.

The coast of Africa, east of the Canaries, is level, and rendered dangerous, and almost inaccessible, by a heavy surf which breaks on it continually. The Canarians, in the sea between this coast and the islands, employ a number of barks in fishing for bream and cod. The passage is about 20 leagues wide, and clear from any known danger.

Winds and Calms peculiar to the Canaries.—In the vicinity of the islands brisk trades are, generally speaking, most prevalent from N.E. to N.N.W. throughout the year. They sometimes give place to N.W. and S.W. breezes, the latter of which not unfrequently blow for a continuance of 10 days. And on account of the enormous height of the mountains, when near the land, you are subject to strong gusts and eddy winds blowing in an opposite direction to that outside, which the navigator ought to avail himself of, when beating to windward. Vessels sailing through, most commonly carry the breeze a few leagues southward of the islands, more or less, according to the strength and direction of the wind, which, if far north, will take you more southward, and the contrary, if eastward.

On approaching the calms, you will find a heavy disagreeable swell: the sea breaks and is very irregular, producing a distressing motion to the ship, which renders it necessary to take advantage of every breath of wind to get to southward. These calms are occasioned by the intervening high land of the Canaries obstructing the regular course of the trades, and extend from 10 to 30 leagues to leeward, in proportion to the power of the breeze outside. And it may further be observed, when the trades are light, the calms are more extensive; at which time, however, light S.W. breezes prevail; and, on the contrary, when they are strong, the calms are very circumscribed, but not the slightest air within for some days. For additional particulars on the winds, see pp. 64—65.

Between the Canaries and the Cape Verde islands, a current runs S.W. at the rate of half a knot, increasing as you approach the islands. In about the parallel of 14° and 16° N., the trades begin to lose their strength, veering round from the northward to the N.W., and thence westward, and S.W., as you draw in with the coast of Africa, in the latitude of 7° and 10° N.

Tides.—Among the Canaries, it is high water at F. and C. of the moon at about 0¾h. to 1¼h., and springs rise from 8 to 10 feet.

CAPE VERDE ISLANDS.

GENERAL REMARKS:—The Cape Verde islands, belonging to Portugal, contain 89,310 inhabitants; they are ten in number, and lie about 100 leagues on a parallel westward of Cape Verde, the nearest point of Africa, whence they derive their name. They were first discovered by the Portuguese, who named them as follows:—Ilha de Sal or Salt island, Bonavista, Mayo, San Jago, Fogo, Brava, San Nicholas, Santa Lucea, San Vincent, and San Antonio; besides these there are several smaller islets. They are of volcanic formation, and boast a climate and vegetation approaching nearly to that of the temperate regions. The largest and most important island is that of San Jago, the chief town of which is the seat of government.

The best course for vessels bound to San Jago, from the Canaries, is to stand southward to about 25 or 30 leagues eastward of Bonavista; and from the latitude of 16°, which is that of the middle of the island, they should sail westward to get sight of it. It has also been observed " though it may seem natural enough not to suspect any errors of consequence in your reckoning, in so short a passage as from the Canaries to the isles of Cape Verde, yet there are instances of such, as well to easting as to westing. It is with respect to errors in our westings that

I advise all vessels to keep 30 leagues to windward of Bonavista, before they stand in to make the land; lest, in keeping a direct course for that island, they should pass between the island of San Nicholas and the island of Sal; and finding themselves westward of Bonavista, when they reckon themselves eastward of it, they should miss of their refreshments at the isle of San Jago,—an accident which has happened to several vessels.

The making of these islands is often difficult, occasioned by the fogs which hang frequently around them. For this reason, those who come from the northward, ought to steer their vessels in this track with all possible precaution.

The most convenient course for vessels which continue their voyage from the Canaries, without touching at the islands of cape Verde or Goeree, is to steer, after they lose sight of the Canaries, so as to pass about 45 leagues west of cape Blanco (or near the meridian of 26°); from this position they will make good their course due south, as far as 12° N., and afterwards S.E. by S., till they meet with those variable winds which succeed the trade-winds. By this they will keep the mid-channel between the islands and cape Verde, and coast along the bank below that cape a sufficient distance, even though they should make an error in their reckoning of 15 to 20 leagues eastward."

All the channels between the islands are safe, there being no dangers but what are in the immediate vicinity of the shores. When running between Bonavista and Mayo there is a dangerous reef to be avoided, named the Leton, which lies about 18 miles W.S.W. of Bonavista.

The prevailing wind among the islands is N.E., except during the winter, at which time South to S.W. winds prevail, and occasionally blow with considerable strength: these latter winds vary in direction, and seldom continue long from the westward. It has also been well ascertained that light winds from the N.E. are never so permanent, or so continuous in their direction, as to the westward of the islands. It even occasionally happens that in approaching the islands calms and variable winds are experienced, especially during the winter months. See also page 64.

BONAVISTA.—This island contains 2647 inhabitants, and as its name implies, presents a beautiful variegated appearance, interspersed with scattered mountains, which terminate in low points to the water. It is the most dangerous of the cape Verde islands, on account of its being surrounded by rocks and shoals, also that the current sets directly on it from the N.E. Off the N.E. point of the island are some dangerous reefs, extending 4 miles from the land, which are attached to three islets, named the Dutch, Braithwaite, and North Cays. Between these is sufficient depth of water for ships, in case of necessity, and anchorage under the lee of the reefs; the best situation is with Braithwaite Cay bearing N.E. by E., and Dutch Cay S. ½ W., or you may moor half a mile from the former in 6 or 7 fathoms, with the ground tolerably good. Mount Ochello, or Orchel, in one with the North Cay, will lead on to the north point of Hartwell reef, and the same mountain West (true), will lead to Braithwaite anchorage; but this latter must always be taken with great care.

The north side of Bonavista island has several sunken rocks about it, particularly between Broyal point and the N.W. reef and point; it will, therefore, be prudent to keep 2½ or 3 miles from land.

English Road lies on the N.W. side of the island, and is a safe anchorage in fine weather. In proceeding for it, it will be proper to give the N.W. point of the island a good berth, keeping a mile from the shore; and about 4 miles southward you will perceive Small island, which forms the N.W. side of the road. It is common for vessels to haul close round Small island, in 6 or 7 fathoms, passing between it and a 10-foot reef, by which they avoid the necessity of tacking for the anchorage : the best mark for the latter is, the town open with the N.E. end of Small island, and the highest part of the same island bearing about N. by E. The reef usually shows itself; but should this happen not to be the case, it will be better, particularly for a stranger, to go southward of it altogether, and endeavour to round it at the distance of 1½ or 2 miles from Small island, taking care not to get into less than 6 fathoms; and observe that, after once opening the town, you do not shut it in again.

The new town is on the middle of the bay, and the second reef (*New Town reef*) lies westward of it, a short distance from the beach. The *Inner reef* lies half a league northward, and is also near the shore.

At about 4½ miles S. by W. from Small island, is coral point, 2½ miles westward of which is Coral reef, which must be left on the port hand when proceeding southward, as the channel between it and the shore is not to be attempted. Vessels leaving English road should steer W.S.W., and may afterwards proceed as they please.

The easternmost extremity of Bonavista is East Sand head, southward of which is Brazen hill point, which is remarkably bluff and perpendicular on each side, with a sandy beach. At somewhat better than 3 leagues southward is South island and point, both of which are low and foul. Westward of this point is *Portuguese Road,* where there is anchorage in 6, 7, or 8 fathoms, with Platform mountain or hill bearing N.N.W., the south point S.E. and the landing N.E. by N. distant 1½ miles. There is a reef that extends 3 miles off, from the point under Platform hill, with the sea breaking on it. The hill bearing E.N.E. clears this danger.

Leton Reef.—This is a dangerous shoal extending north and south, about 1 mile. From its centre the north point of Bonavista bears N.E. ¼ N. (N. 26° E.) 9½ leagues, and the south point E. by N. (N. 64° E.) 7 leagues; it is about even with the surface of the sea, which breaks over it with violence, except in fine weather; and soundings have been found around it, as will be perceived on reference to our particular chart of the Cape Verde islands. The profusion of fish in its vicinity is incredible. The position of the reef is Lat. 15° 47′ 30″ N., and Long. 23° 10′ W.

SAL.—This is a long narrow island, about 16 miles in length, and is the north-easternmost of the Cape Verde islands. Its north-western part appears high and irregular; the hillocks and valleys extend down to the water's edge, both on the eastern and western sides, while its south and south-east points run out in long sandy spits, very low and flat, and scarcely distinguishable at a distance. At a little distance northward of the S.E., or Wreck point, is a rocky reef, stretching out about a mile from the land, on which the sea commonly breaks. Sal island may be seen a great way off, and the Peak of Martinez near its north point will become visible, on a clear day, at the distance of full 60 miles, its height being computed to be 1600 feet.

There are no places of anchorage on the east side of the island; but on its western side are two bays, Palmira and Mordeira, the latter being considered one of the best among the Cape Verde islands. *Palmira Bay* is shallow, and only frequented for its supply of fresh water, which is obtained from a well, affording about half a ton per day.

MORDEIRA BAY is about 4 miles southward of Palmira. In proceeding along the west shore of the island, from the N.W. point to Mordeira bay, you will have soundings all the way; within a mile of the shore are 15, 16, 17, and 18 fathoms; in Palmira bay 5, 6, and 7 fathoms; and close to Bird island, 10 fathoms. Bird island is small, and lies about a quarter of a mile off the shore, but there is no passage for vessels between. Mordeira bay lies southward of Bird island, and being surrounded by low land, it is not so subject to squalls, nor heavy swells of the sea, as the bays in most of the other islands are. Having rounded Bird island, your best anchorage will be with Bird island just shut in with the foot of the Lion's Head, distant 1¼ miles from the bluff land; observe there are many foul spots about, therefore, care should be taken to ascertain the quality of the ground before you let go your anchor. The anchorage is safe during the N.E. breezes; you will ride in 15 or 16 fathoms, or lessen your depth by advancing towards the shore; the bay has plenty of fish and turtle, but there is no fresh water, nor could that article be procured by sinking casks into the sand.

From Mordeira bay to the South point of Sal, is about 6 miles, and there are soundings all the way of 6 and 8 fathoms, at half a mile from the shore. The soundings off Turtle point extend fully 2 miles out, at which distance there are 20 fathoms. Vessels sometimes take a temporary anchorage off the South point in 7 fathoms, within half a mile of the land; but it will require you to be careful in going round the point, as it is very low, and has a spit extending from it, to which you should not approach nearer than into 8 or 9 fathoms water.

Sal island has numerous salt ponds upon it, where the water crystallizes into a beautiful salt, forming an article of commerce; the land is otherwise nearly barren, producing only a few inconsiderable shrubs. The number of inhabitants is 894.

MAYO.—This island is about 4 leagues in length from north to south, rising most towards the centre. On approaching it from the S.E. its appearance is very different to that from the northward, for you first perceive two hummocks towards the north part, appearing like islands, but, as you approach nearer, the land is seen by which they are connected. Southward of these is a mountain, with very low ground to the south, over which are two hillocks. At half a league from the middle of the north side of the island is a reef, extending N.N.E. and S.S.W. three-quarters of a mile, which must be cautiously avoided.

On the S.W. side of Mayo is a sand bay, named *English Road*, within which is the town with its extensive salt-pans. Ships may anchor here in 7 or 8 fathoms, the west point bearing N.N.W. *(true)* and south point S.E.; hence the land appears with three conical hills to the N.E. Fresh water is here extremely scarce, and by no means good. Abreast of the town, and eastward of it, the shore is steep, bluff, and rocky: but westward a low white sandy beach extends to a rounding point, from which a spit of sand and coral stretches outwards, having at a short distance from its extremity no ground at 45 fathoms. The spit may be rounded in 16 or 17 fathoms, and a ship should not anchor further out than in that depth, the edge of the bank being steep. There is anchorage half a mile west from the town, in 11 or 12 fathoms. The total population of the island is 1863.

SAN JAGO.—This is the most considerable of the Cape Verde islands, and being the seat of government is better inhabited, and more frequented than the others; it is about 10 leagues in length and 5 leagues in breadth. The land is very high, and the eastern side is bordered with rocks, which lie near the shore, so that vessels may safely sail along at the distance of 2 miles. The S.E. part appears as a long low point when seen from the northward or southward; and 7 miles S.S.W. from this point lies the east point of Porto Praya. Between the two, but nearer lies a bay which so much resembles Porto Praya that many vessels have been mistaken, and nearly lost, as it is a dangerous place; at the bottom of it are several cocoa-nut trees, and a few houses. Between this place and Porto Praya the land is mostly perpendicular, and though the fort of Porto Praya, which stands on a cliff, is a mark by which the true bay may be distinguished, yet the surest guide will be, that the north or east point of the false bay is surrounded with breakers, whereas the east point of Porto Praya is high, steep, and free from danger; you must haul close round the point, and keep within a cables's length of the shore, to go to the anchorage in 7 or 8 fathoms.

PORTO PRAYA is a fine bay, lying between two points which bear from each other about east and west, 1½ miles apart. As you sail round the east point (Point Bicudas) you will soon open the forts at the bottom of the bay, westward of which, in a valley, are several cocoa-nut trees, and a small house. The winds, except in the tornado season, are generally in the N.E. quarter, with frequent squalls; therefore a ship, on approaching the east side of the bay, should have her top-gallant-sails furled, and a reef or two in her topsails. The eastern shore of the bay is high, and all the land seems parched and barren; in the western part of the bay is a small black island, flat at the top, but rugged at each end, named the isle of Quails, having a rocky projection from its south end, about half a cable's length; there is also a rocky ledge off the north end, where the water is in general shallow, for 8 fathoms is the greatest depth between this isle and the fort. Within, westward of the island, it is only navigable for boats.

From the west point of the bay, Punta de Tamaros, some rocks extend to seaward, which requires caution to avoid when sailing from the anchorage in the night. It is, therefore, more convenient to anchor nearer the N.E. side of the bay, than to the Isle of Quails, for the sake of more readily getting under sail, without running the risk of being carried by the currents upon the point of the rocks to leeward, before the vessel has gained fresh way enough to steer clear of them. The best anchorage is in 7 or 8 fathoms, with the fort bearing N.W. by N. (N.W.) about three-quarters of a mile, the body of Quail's island west, and the point of the bay, opposite Quail's island, E. by S., the ground being coarse sand and gravel, but not holding well, consequently requiring a good scope of cable to bring the ship up: a kedge anchor should be let go to the west, in order to steady the ship, keeping the bower anchor clear when the wind is light from the west.

It has been observed, that "Quail island, though centrically situated, is too near the main land to assist any one in finding the anchorage. Do not approach on any point nearer than half a mile, as the vicinity is rocky, and some rocks do not appear above the surface."

The island of San Jago, when bearing W.N.W. ½ W., 8 leagues, appears very high. Mount San Antonio, rising out of its centre, is of a conical form, and terminates in a peak, which peak, bearing N.N.W., leads to Porto Praya road; and as you advance westward, you will see the east end, which, as already observed, is very low. As a further guide, you will see an opening several miles north-eastward of the harbour, on Signal-post hill, which gradually slopes westward: also Red hill, which is on the port side of the bay, N. by W. The town is situated on an eminence, rather high, and perfectly white, the houses being visible from S. by E. to S.W. by W. The total population of the island is 40,852.

It seldom rains here, but a dry haze is very prevalent. In December and January, the wind hangs sometimes far to eastward, veering at times to the northward. In settled weather there are often regular land and sea breezes in the bay; the sea breeze setting in near noon, and ending at 4 or 5 o'clock in the afternoon; the N.E. wind begins towards evening, and continues during the night. See also page 64.

Ships bound from Pŏrto Praya to Bonavista, should endeavour to sail in the evening, as the current at that time is favourable. They should not stand too far over towards the African coast, nor work between Mayo and San Jago, and they will then get to the eastward very rapidly.

FOGO, or FUEGO.—This island lies 12 leagues westward of San Jago, and appears like an immense mountain rising from the sea to a peak upwards of 7000 feet high. This mountain is volcanic, and its eruptions occasionally have sufficient violence to cause the inhabitants of the island to retreat to the neighbouring islands for safety. The form of the island is nearly circular, and its extent is about 14 miles. The coasts are high and steep, and there is deep water a short distance from their base.

About 4 miles from the north end of the island there is said to be a sunken rock, but its existence is very questionable. The whole of the eastern coast is foul to about 1½ miles off; but the west side of the island, on which the town is situated is clear. This little town is named Luz, and off it, about half a mile, is the anchorage in 25 fathoms; but the ground is foul, which added to its exposure and the indifferent landing, renders the place very unsuitable for riding in. The island contains 14,841 inhabitants.

At Luz, corn, fruit, and cattle may occasionally be purchased, but water is scarce, there being no running stream. The volcano may be sometimes seen at the distance of 34 leagues.

BRAVA.—This is nearly an oval-shaped island, lying 8 miles W.S.W. of Fogo. In comparison with the great height of the latter it appears low, although its land is high, and its mountains rise like pyramids, towering one over the other. In this island there are several bays and harbours, the best of which, named Furna, lies at the N.E. end of the island, and will accomodate small vessels, affording them protection from all winds but the S.W. Along the whole coast there is generally a heavy surf, and the landing is bad. The island produces good water, and an abundant supply of live stock, corn, and fruit; although there is but little wood. There is also an abundance of salt, and more saltpetre is procured here than from any of this group of islands. The population is 6557.

At about 5½ miles northward of Brava are two rocky islets, named *Rombo* or *Romes islands*, which are nearly connected together by a reef; but the passage between them and Brava is clear. The westernmost island is high, and has a peak on it.

SAN NICOLAS.—This island is about 8½ leagues in extent, lying in an east and west direction, and is of very irregular breadth. Its eastern point is distant 19 leagues from the south-west extremity of Sal, and appears like a sail, being a platform point with a high pyramidal rock near it. It contains 6372 inhabitants. At about 4½ miles from the east point of the island is Freshwater bay, on the southern coast, where there is anchorage in 7 fathoms at half a mile from the shore. There is good landing for the boats, with plenty of good water in fine weather, and at neap tides; for as the tides rise here 5 or 6 feet, on the new and full moon, the pond is then overflowed. At this time you are subject to heavy squalls; and, notwithstanding the wind blows off shore, the sea is very high close to the beach. *St. George's Bay*, which is 12 miles westward of the latter, is known by its conic or sugar-loaf mountain, to the left of which there is another mount, with a flag-staff on the summit. Anchor on the north side, in

6 or 7 fathoms, close to the shore, by which a rocky ledge, which stretches from the east point, will be avoided: the best situation will be the sugar-loaf hill bearing N.E. by E., the flag-staff N.W. by N., and the cove, or landing-place distant a quarter of a mile N.W.

Terrafal Bay lies on the south-west side of San Nicolas, and has regular soundings within it, from 14 to 5 and 4 fathoms, near the shore, sandy bottom: the custom-house stands on the south-east corner of the bay. Anchor in 15 to 10 fathoms, bringing the islands of Raza and Branco in one, bearing W.N.W. ¾ N., and the landing-place distant a quarter of a mile E. ½ N. From Terrafal bay to the west point of San Nicolas, there are soundings of from 40 to 20 fathoms, at a short distance from the land: a vessel may anchor in 30 fathoms, at a mile S. by W. from the west point, when it blows from the N.E., but that is the only quarter it is sheltered from. By digging a well almost anywhere on the low land, you may water here, unless the rainy season has failed; but there is always water in the valley, about half a mile from the sea, whence the natives will bring it down on asses for a trifle. From this road you may see, in clear weather, all the leeward islands; but if it be in the least hazy, the isle Raza is not discernible.

RAZA is distant 8½ miles westward of San Nicolas. It is of a square form, about 2 miles in length, and 1½ miles broad, and is of a rugged mountainous nature, and uninhabited. The landing-place is under the N.W. point, facing the west. Between it and Branco, at about one-third from Raza, is a coral reef, extending S.S.W. and N.N.E., and having on its shallow part 6 fathoms of water, but deepening gradually on the west to 15, and on the east to 18 and 20 fathoms. The sea continually breaks over the reef, owing to a strong tide or current setting through between the isles.

BRANCO is a long narrow island, about 2½ miles in length, of a similar description to that of Raza, from which it is divided by a channel of 18 to 6 fathoms, about 3 miles wide. There is no safe landing at Branco, as its shores are all rocky, more particularly towards the S.E. end, from which stretches a sandy spit.

SANTA LUCEA.—About 4 miles northward of Branco lies Santa Lucea; between is a bank of soundings, forming, towards the latter, a regular flat of 10 to 12 fathoms. The south coast trends nearly east and west, 4 miles, and in the middle of it is a good landing-place. A steep bank, half a mile broad, stretches from it, having on its edge 2 to 4 fathoms. In the bay formed by the S.W. coast, small vessels may anchor, being sheltered from all points but the South and S.E. The beach is sandy; the anchorage small pebbles and sand. In the middle of the bay is an islet named Leon, with the ruins of a village on it. The N.W. part of Santa Lucea rises into high mountains.

SAN VINCENT.—This island is separated from Santa Lucea by a channel 5 miles wide. Vessels from Europe generally steer to make San Antonio, the most northerly and westerly of the islands, but owing to the frequent foggy and cloudy weather—notwithstanding the great altitude of the island—it may not be made out until the breakers on the coast are seen at the distance of 6 or 7 miles. Having however observed the Sugar-loaf mountain (7086 feet) which is often visible above the clouds, the position of San Vincent is at once known, but it cannot be seen in fog and haze more than 4 or 5 miles. The N.E. Trade, generally prevalent here, frequently blows with great strength, and produces a high rolling sea, which as the usual current also runs towards the land, requires considerable caution in approaching the island, as vessels have been wrecked on the coast.

Porto Grande, on the N.W. side of the island is considered one of the largest and best bays among the Cape Verdes; the anchorage is safe and good, and tolerably well sheltered both from wind and sea. The wind generally blows from the N.E. over a part of the land, and seaward it is partially protected by San Antonio, which is distant about 8 miles. The church and custom-house stand at the bottom of the bay on the east, and a signal-post is erected on a hill a short distance from the anchorage. Without the entrance of the bay, at about two-thirds of a mile from its north-west point, is Bird island, which is very steep, and appears at a distance like a sugar-loaf; this may be passed on either side, and hence you will find regular soundings towards the shore. The ground is good in most parts of the bay, and you may anchor anywhere in 7 to 6 fathoms sandy bottom.

Porto Grande is now a coaling station, and therefore frequently visited by steamers on the outward voyage; we believe that the coal hulks are moored further in the bay than was the case when first established.

Caution.— H.M.S. *Orontes* on getting under way, October 12th, 1865, at Porto Grande, grounded in 21 feet water to the eastward of the buoy, where the chart showed 4½ fathoms; vessels of large draught are therefore recommended to anchor outside or westward of the buoy.

San Vincent stretches 12 miles east and west, and is about 7 miles in its broadest part. The N.E. coast forms two bays, separated by a low peninsula; but as it is hereabouts altogether dangerous, it needs no further description. On the S.W. side of the island is the bay of San Pedro, having a fine sandy beach, where vessels may anchor in 10 fathoms, near the middle of the bay, or rather more westward. The anchorage is good in the dry season, and the inhabitants say there is plenty of wood and water. On the eastern side of the island is another anchorage, the Praya de Gatta, with a sandy beach, near which vessels may anchor in 6 fathoms; the bottom is clear, but a sea sets directly in when the wind is either N.E. or S.E., the island of Santa Lucea sheltering between these points. This bay and coast are without wood and water. The total population of the island is 1141.

SAN ANTONIO.—This island is divided from the former by a safe channel, 8 miles wide. San Antonio is remarkably high, particularly towards the north-west where there are two high mountains, the highest of which is named the Sugar-loaf, and is generally capped with clouds. The town and bay of Santa Cruz are situated on the south-east side, but the anchorage is bad, with a spit on the side. Terrafal bay, towards the south-west side, is well supplied with good water, and other necessaries may here be purchased. The island contains 14,643 inhabitants.

San Antonio may be descried, in clear weather, 18 leagues off, and appears high, bleak, rocky, and barren, which, in fact, it really is, even when you approach near it. The south-west point is pretty well covered with brushwood, but there is little appearance of verdure or cultivation.

WINDS.—A description of the winds and climate will be found on p. 64.

THE CURRENTS in the neighbourhood are, for the most part, strong to the S.E.; vessels, therefore, bound from the north, ought to make allowances accordingly, making the island of Sal first, whence they may, with facility and greater security, direct their course to any of the others. The current, however, has occasionally been found to run N.E., in which case serious errors will often occur, and which, perhaps, experience only can guard against. The rate of the current is generally about three-quarters of a knot. See also p. 197.

TIDES.—It is high water on the full and change of the moon, among the Cape Verde islands, as follows:—English Road, Bonavista, at 7¼h.—tides rise 5 feet; Mordeira bay, Sal, at 7¾ h.—rise 5 feet; Porto Praya, at 6 h.—vertical rise about 5 feet; San Nicolas, at 7h., and the tide rises 6 feet.

ST. PAUL'S ROCKS.

St. Pauls Rocks (or Penedo de St. Pedro) is the name given to five pinnacles of sharp naked rocks of a remarkable shape, in Lat. 0° 55′ 30″ N., Long. 29° 22′ W.; they are very frequently sighted by outward and homeward-bound Indian and Australian traders, and being under 70 feet high appear extremely small from the distance of 8 miles. They were visited by CAPTAIN FITZROY in the *Beagle*, who says,—that the number of birds which covered the rocks was astonishing, and they suffered themselves to be kicked about and killed with sticks; at the same time, those on the wing even darkened the sky. While one party were scrambling over the rock, a determined struggle was going on in the water between the boats' crews and sharks. Numbers of fine fish, like the groupars (or garopas) of the Bermuda islands, bit eagerly at baited hooks put overboard by the men; but as soon as the fish was caught, a rush of voracious sharks was made at him, and notwithstanding blows with oars and boat-hooks, the ravenous monsters could not be deterred from seizing and taking away more than half the fish that were hooked. From the highest point of the rocks, which is 64 feet above the sea, no discoloured water, nor any breaking of the sea could be discerned, apart from the place itself; and from the soundings taken in the boats, as well as on board the ship, I conclude that it is unconnected with any shoal, being merely the summit of a steep-sided mountain rising from the bottom of the ocean. A slight current was setting to the westward, not amounting to a mile an hour.

St. Paul Rocks were also examined in 1839 by SIR J. C. Ross when on his voyage to the Antarctic Regions; he describes them as a group of rocks scarcely exceeding half a mile in circumference, and states that they are of volcanic origin. At low water, the surface of the rocks present a band of pale red—the work of the coral insects; there is no vegetation, but a solitary species of *conferva;* birds are innumerable, chiefly *pelecanus sula* and *sterna stolida;* there is also a very fierce and active crab, which is a very destructive enemy to the eggs of the birds. Sharks abound on every side; half a mile from the rocks the water is comparatively shallow; at two-thirds of a mile distance soundings may be had on a rocky bottom with 300 fathoms of line, but at 1½ miles from the rocks there is no bottom with 500 fathoms, so that the ascent of the submarine mountain of which these peaks form the summit, must be very steep.

THE AZORES.

The Azores (the Bracix islands of Picigano's map of the world, 1367) were probably discovered by the Northmen long before Colombus navigated the Atlantic. They are situated between the parallels of 39° 45′ and 36° 57′ N., and between the meridians of 31° 10′ and 24° 55′ W.; and consist of nine islands, in three distinct groups, lying in W.N.W. and E.S.E. directions, extending about 330 miles. The north-western group contains the small islands of Corvo and Flores, distant about 114 miles from the central group, which includes Terceira, San Jorge, Pico Fayal, and Graciosa. The third group, 69 miles S.E. of the second, is composed of the two islands of San Miguel and Santa Maria, and the Formigas rocks. The general character of the islands is mountainous, of a conical form, and great bulk: the most remarkable among them is the Peak of Pico, whose small sugar-loaf on its summit is so very regular as to appear the work of art. In clear weather this island can be seen from a distance of more than 20 leagues.

In the official statistics of the kingdom of Portugal, the Azores or Açores constitute three districts, viz. Angra, Horta and Ponta Delgada, containing together an area of 1147 square miles, and a population of 249,941 souls.

On approaching the islands the aspect is unpromising, from the barren appearance of the mountains, and the steep rocky coasts, which nearly everywhere present high and craggy cliffs; but a nearer view exhibits a most luxuriant landscape of vineyards and corn-fields, interspersed with orange and lemon orchards, and open pastures bounded by woods. San Miguel or St. Michael is the largest island, and the residence of the bishop; but Angra, in Terceira, is considered the capital of the group, and the seat of the civil government. Among all the Azores there is not one good port for vessels of burthern, all the anchorages being in open bays or roads, from which ships are often obliged to put to sea at a very short notice. The channels among the islands are clear and deep, but strong currents set through them, and the Florida or Gulf stream is at times sensibly felt here. From the nature of the land, vessels are subject to sudden calms, squalls, and eddy winds, by approaching too close to the shore.

The trade of the Azores was formerly a monopoly of Portugal, but it is now open to all countries; the imports are woollens, hardware, boards, staves, pitch, tar, iron, &c., in return for which wine and fruits are the chief payments.

The climate is mild and pure. The winter, though attended with heavy storms, is not severe, nor are the heats of summer oppressive, surrounded as these islands are by such expanse of ocean. The Portuguese settlers naturally introduced their own religion, manners, and customs, which their almost undisturbed possession, and a similarity of climate to that of their own country have contributed to maintain. Regularly built towns, handsome churches, large convents and monasteries, and the prevalence of whitewashing their buildings, are the same features as are found in Portugal.

In June 1867 the islands of Terceira and Graciosa experienced a series of earthquake shocks, one result of which was considerable disturbance of the sea bottom nine miles N.W. of Serreta point (Terceira island); it was said an islet, 2½ miles long in an east and west direction, had been raised in Lat. 38° 52′ N. Long. 27° 38′ W.; but an official notice issued by the Portugese government in July stated that this had wholly disappeared, and there was no bottom on the spot with 180 fathoms of line.

FLORES, the most westerly of the Azores, lies between the parallels of 39° 22½′ and 39° 31½′ N., and the meridians of 31° 8½′ and 31° 16¾′ W.: it is about 9¼ miles long from north to south, and 6¾ miles broad from east to west. It contains two towns—Santa Cruz (the capital) on the east, and Lages to the S.E.; and four villages. The total population of the island is about 5500.

It is high and mountainous—especially in the central and southern parts, where there are several lofty peaks. The centre of the island is an elevated plateau, out of which, and within an area of 6 square miles, rise Morro Grande (3087 feet) on the north—Caboco (2466 feet) on the south—Lomba da Vaca (2156 feet) on the S.E.—and a peak to the northward of the last named (2110)—these are flanked by others of less height. Pico Casino (1682 feet high) on the east of the island is a little southward of the parallel of Santa Cruz; and opposite to a frequented watering place N.W. of the same town are the Pico da

Se (2366 feet)—and the Pico Francisco, (1434 feet high)—the ridge, of which these two peaks form the most elevated points, is flanked by deep and narrow ravines, and bounded in the interior by a steep escarpment, the whole presenting a very peculiar and marked aspect from seaward. Bold escarpments are common along the coast, which are either repeated in the interior, or they are backed by lofty cones—the evidence of pre-historic volcanic activity.

The island is sufficiently watered, and in the interior there are several small lakes; from two of which, on the central plateau, small streams descend, by the western slope, to the low sandy beach ¾ of a mile north of point Bredos.

The land is well cultivated, producing wheat, yams, fruit, and vegetables in abundance; cattle, sheep and pigs are also bred; and a moss called *Orchil*, used as a dye, may be obtained here. There is little trade, and the superfluous produce is generally exported to the neighbouring islands—occasionally to Portugal.

Point Albernas, on the north-west of Flores, is 270 feet high and of a red colour: it is fronted by a group of islets, and the coast thence to Point Delgada, E. by S. ½ S. distant 1½ miles is steep and rocky. *Point Delgada*, the most northerly point of the island, is moderately high, level on the summit and slightly projecting; there is a cluster of rocks and islets at its base, some of which stretch out in a north-easterly direction upwards of a third of a mile, having clear water around.

S. ½ E. 2½ miles from Point Delgada is *Point Ruiva*, in the vicinity of which is a remarkably shaped islet, variously known as the Sugar-Loaf, or Bottle rock, 100 feet high. The coast between these two points forms an open bay in which there is anchorage in 25 fathoms, sandy bottom, and shelter from all winds between W.S.W. and S.E. round by south. At the north end of the bay is the village of Delgada. Nearly midway between the points is an islet, 385 feet high, to the south-east of which is a sunken rock on which the water generally breaks. Vessels compelled by the wind to leave the eastern side of the island occasionally take shelter in this bay; it is also a resort for water.

From Point Ruiva to Santa Cruz the coast trends irregularly to the southward; it is very precipitous and rocky, but there is anchorage in 35 or 36 fathoms, bottom sandy, S.E. of the islet of Alvaro Rodriguez.

Approaching Santa Cruz point (and town of the same name), the coast becomes less elevated, but the rocks and islets are very numerous, and in front of the town they extend seawards, nearly two cables' lengths, with foul ground for nearly half a mile. On this account, together with the exposed position of the point, the most frequented anchorage for Santa Cruz is southward of the town—between it and Point Cabeira, distant 1¾ miles. The coast here forms a bay into which flows a small stream and there is also a good beach. The best anchorage about the island is in this bay in 35 or 40 fathoms, sandy bottom,—and it is sheltered from all points between N.N.E. to S.W., round by west.

Santa Cruz, the chief town of the island, is built on a rocky plateau of small extent, behind which rises Monte de Cruz (740 feet). The fort or castle is in

Lat. 39° 27′ N., Long. 31° 8½′ W. The population of the town and surrounding villages is 2588.

Supplies such as bullocks, pigs, sheep, fowls, onions, potatoes, flour &c., as well as water, can be procured at Santa Cruz, and at very moderate rates. CAPT. HENRY TOYNBEE, who obtained provisions here, says;— "some will probably think that Santa Cruz can only be visited during a westerly wind when it is on the lee side of the island: still, in a moderate east wind it would be quite as available and the ship easily managed, for she would not be so much affected by eddy winds from the land, but might be turned to windward, keeping within a mile or two of the landing-place."

Point Cabeira is low and rocky, rising with a gentle acclivity to the distance of a mile. S.W. ½ W. 1½ miles from Point Cabeira is Lomba point, which is high, bold, and remarkable by the church of Boa Vista: the coast, between the two points, forms a bay, with a sandy beach,—there is a small river at its northern end. There is anchorage in 25 fathoms, sandy bottom, but being more open to the south it is not so good as that previously described. From Lomba point to Capitao point the distance is 1½ miles, and Lagens, the S.E. point of the island, is ¾ of a mile beyond the latter. The coast for the entire length is bold and rocky. Off point Lagens for a distance of 1½ cables on a bearing south of S.S.E. runs a ridge of rocks,—some only awash. The small town of *Lagens* is west of the point, and being built on a steep acclivity, the large church serves as a useful sea-mark for the coast. The bay between points Capitao and Lagens affords shelter from all winds between North and S.W. by W., round by west, and a vessel may anchor in 25 fathoms, sandy ground. Lagens and the surrounding villages contain 2068 inhabitants.

Escolar Rock.—Less than a mile off the south coast of Flores lies a sunken rock, called the Escolar, in about Lat. 39° 21½′ N., Long. 31° 12½′ W.; and from it Lagens church bears E.N.E. 1½ miles,—Lopez Vas point N. ¾ E., 1 mile, nearly,—and Ilheos point N.W. ½ N., 2¾ miles: it is large and flat on the surface. It carries on it 4½ fathoms, is steep, and has deep water all around, with a good channel between it and the shore.

Flores Island from the Escolar Rock.

From point Lagens to that of Ilheos the coast has a general W.N.W. direction,—bold and frequently abrupt. Lopez Vas, the most southerly point in the island, is low near shore, but at a short distance inland rises very rapidly. Rocha Alta point, 1½ miles more westerly, is lofty and rugged, having a peak 2108 feet high, within ¾ of a mile of the shore. Between Rocha Alta and point Ilheos (the

S.W. extremity of the island) there is an extensive ridge of rocks, frequently steep, and in some parts extending ⅓ of a mile off shore. *Point Ilheos* is low and rocky with several islets at its base: there is a hot mineral spring here. With the point bearing S.E. ¾ E., 1 mile distant, there is anchorage in front of a small bay, in 25 or 26 fathoms, sandy bottom. A small stream flows into the bay.

Laranjeira Rock.—This rock, ⅓ of a mile in diameter, has 11 fathoms on it, and might be dangerous in very heavy weather. It is in Lat. 39° 21′ 10″ N., Long. 31° 16′ 10″ W., very nearly; and from it point Ilheos bears N.E. ¼ N., 1½ miles, and Rocha Alta E.N.E. There is a clear and safe channel of 1 mile between this rock and those projecting from the coast.

From point Ilheos, passing a coast-line wholly rocky and the Peak of Joao Martin 1082 feet high, point Cantarinhas bears N. ¼ W., distant 1½ miles, opposite to which is an islet of the same name. Northward of the point is a bay into which two rivers discharge their waters. There is also an anchorage in 25 fathoms, sandy bottom. Further along the coast there are a few sunken rocks, generally within ⅓ of a mile of the shore.

The next point, 1¾ miles distant, is that of Bredos, which is high sloping land of a whitish appearance, near to which are several islets,—one remarkable for its columnar form. The village of Fajem Grande is ¾ of a mile from the point—and northward of the village is a river. Point Baxio, or Shoal point, is 1¾ miles N. by E. ¾ E. from point Bredos, and in the bay between there is anchorage a mile from shore, in 30 fathoms, sand—with shelter towards the N.N.E., East, and S.E.; with a less depth the bottom is rocky. Baxio point is rocky, having close to it the village of Fajemzinha, and may be known by the church of San Pedro on its summit.

Point Fanaes lies 2¼ miles in a N.E. ¼ N. direction from point Baxio, having the appearance of a mountain of a black colour. The bay between is that of San Pedro, which has anchorage in 24 to 30 fathoms, sandy ground, and where abundance of fresh water may easily be procured from a cascade which falls from the mountains. About N.W. ¾ W., westerly, from point Fanaes is Monchique islet, 110 feet high, and separated from the shore by a deep channel; near the shore there is a rock named Baxio Raza.

The following remarks on the *Bay of Fanaes* are by Mr. E. May, of H.M.S. *Skylark*:—"At daylight we bore up for the bay of Fanaes, and at 5h. 30m., shortened sail and sent a boat for water. Found a great surf on the beach, which consists of large stones, none smaller than a man's head. These stones extend from the beach two or three boats' lengths, making it dangerous for boats to land.

The best landing-place is a passage between a point of rocks that lies to the south of the beach; thence you may procure water from a fountain, about half a mile from the beach, employing small casks, and at the rate of 3 to 5 tons per day, by employing natives, if the weather is fine, and the wind between S.S.E. and N.E. With any other wind, particularly if blowing hard, there would be too much surf, and the passage too narrow in such weather to enter. This place may be known by a very high and steep mountain, a little to the left of the landing-place, from whence the islet Monchique bears N.W., 1½ miles. Between this island and the shore there is a clear passage for ships, but they should borrow towards the rock, as a reef projects about a cable's length from them, although there are no hidden dangers in the passage.

At this place, by the assistance of shore boats, about 4 tons of water were obtained in 10 hours. The place abounds in poultry, sheep, pigs, vegetables o all kinds, and eggs, all very cheap, and were freely exchanged by the natives for old clothes. Those who came off to the ship were well dressed, clean, healthy people. The shore off the island is bold, and may be approached to the distance of a quarter of a mile. When leaving Fanaes, I would recommend vessels to run due West for 2 or 3 miles, to get clear of the high land northward of the landing-place, by which they would avoid being becalmed under this land when the wind is from N.E. to S.E., and would be enabled to run clear of the island. The island of Corvo has also a bold shore and can be seen off deck 55 miles distant, as was proved by us the day after leaving the island, both by log and observation."

N.E. ¾ E., nearly 2 miles from Fanaes point is that of Albernas, already described. In the bay between the two points is a circular islet, called Maria Gadella, 520 feet high: a ridge of rocks runs from the shore to the islet, and and there is anchorage to the westward in 30 to 40 fathoms, sand and gravel.

It is high water, at full and change, at 12h. 24m., and the rise of tide is 3½ feet.

The plateau of soundings follows the general contour of the island except to the northward, where it is slightly more elongated. On the east and south sides the line of 100 fathoms is about 1 to 1¼ miles from the shore, making the nearest approach off Santa Cruz and Cabeiro point; on the S.W. and west it is more removed, varying from 2 to 3 miles; and on the N.W., north, and N.E. coasts it varies from the distance of 3 to 5 miles. The line of 200 fathoms is generally about half a mile beyond that of 100 fathoms, but it reaches a mile on the north-west. Within a mile of the shore the bottom is frequently rocky, beyond that distance, sandy—rarely rock. The only dangers on the plateau are the Escolar and Laranjeira rocks—those on the rock-bound coast are either visible, or close to the shore.

The channel between the westerly and central group of the Azores is safe and free from all dangers: its width in the narrowest part between Flores and Fayal is 118 miles;—between Corva and Graciosa it is 144 miles wide.

CORVO, the most northerly of the Azores,is comprised between the parallels of 39° 39′ 54″ and 39° 43′ 28″ N., and the meridians of 31° 5′ 25″ and 31° 8′ 20″ W. It is the smallest island of the group, being 3½ miles long from north to south, and 2½ miles broad from east to west,—and it does not exceed 9½ miles in circuit. From north to south round by east, the coast line approaches a semi-circle;

towards the west it presents a salient angle, the extremity of which is the most westerly point of the island (Ponta d'Oueste); and the prolongation of the two sides to the southward forms a broad promontory to the S.W.

Corvo is generally lofty and massive, being formed by a single *extinct* volcano—at least, there is no record of its activity since the discovery of the island in the 14th century. The Caldeira (or crater), situated in the north-west and comprising a fourth part of the entire area of the island, is a deep oval basin about 7500 feet across from north to south, 5400 from east to west, and 3¼ miles in circumference. The most elevated part is on its south-west side, where it rises to the height of 2548 feet. On the north some part of the ridge is about 2200 feet high: the eastern and western margins are considerably lower, in some cases not exceeding 1434 feet.

At the bottom of the basin are two small lagoons, the surface of which is 1273 feet above the sea, and 1275 feet below the highest peak on the margin of the Caldeira. To the southward of these lagoons there is space of gently undulating land, covered with grass, on which cattle and sheep are pastured. The easiest access to this crater is by a path leading over a gap in its eastern margin, where the descent is gradual.

The summit of the Caldeira is frequently capped with clouds, even in summer.

The comparatively low land forming the S.W. end of the island appears to be due to an eruption of lava.

The village of *Corvo* stands upon the eastern side of the south point, on rising ground close to the coast, and contains between 160 and 170 houses, generally built of stone, and thatched; though a few are roofed with tiles. There are no other habitations on the island; and these for the most part wear a dirty and uncomfortable appearance, rising above each other in rows on the side of the hill, and separated by filthy lanes—the resort of pigs and poultry.

At the southern limit of the village stands the parish church in Lat. 39° 40′ 9″ N., Long. 31° 7′ 16″ W.; it is a small stone building with a square tower and short spire, which being kept well whitewashed, is a good sea-mark. About 250 yards W. ⅝ S. from the church there is a little rocky hill crowned by an antique horizontal grist mill. The church tower and this mill are the most conspicuous objects on the point.

The greatest portion of the island is used for pasture. Grain, flax, potatoes, and various vegetables are raised in the fields and gardens.

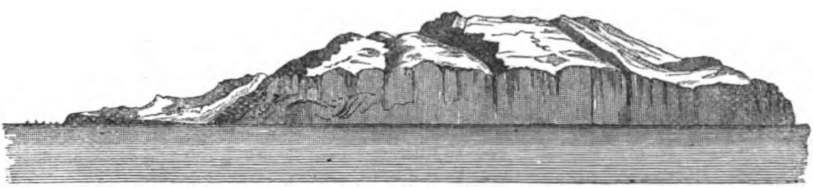
Fuel is scarce—the scanty supply the island affords being obtained from the trees and shrubs growing on the steep sides of ravines on the eastern part of the island.

There are no facilities for watering, and whatever supplies Corvo affords may be obtained more abundantly and conveniently at the neighbouring island of Flores.

Captain (now Admiral) A. T. E. Vidal, R.N., who surveyed the Azores, and whose description of Corvo has been principally used, gives the following particulars:—

The south end of the island bears the name of Ponta de Pesqueiro-alto. On the eastern side of it, in front of the village, there is a stony beach about 200 yards in length, on which a few fishing-boats are usually hauled up. Beyond this beach the coast presents a wavy line of high, bold, rocky cliffs, with a narrow border of thin debris lying at the foot of them, to Ponta de Casa at the distance of one mile and three-tenths.

Immediately off the point, which is sharp and well defined, and at the distance of 60 or 70 yards from it, there is a rock just visible above water, on which the sea breaks violently, and there is a similar rock a quarter of a mile N.E. $\frac{3}{8}$ E. of it. On the top of the point, about 400 yards within the cliffs, is a hill 483 feet above the sea.



Pesqueiro Point. Rosario. N.N.W. $\frac{1}{2}$ W. Corvo Island. (South-east side.) Casa Point.

From Ponta de Casa the next extreme point is that of L'Este, bearing N.E. $\frac{1}{4}$ N., and distant 1 mile. The coast falls back a little northward of the point, but continues very similar in character, only the cliffs are of greater elevation. Ponta de l'Este, as its name implies, is the eastern extreme of the island.

The quality of the bottom, on the parallel of Ponta de Casa, is generally a fine sand, varying much in colour, from light speckled to brown, and almost black: 19 fathoms will be found at the distance of half a mile; thence it deepens rapidly.

On the parallel of Ponta de l'Este the bank extends one-tenth of a mile farther out, and is generally deeper, there being 17 fathoms one quarter of a mile from the point, and at half a mile 40 fathoms, fine sand.

From Ponta de l'Este the *Ponta de Nordeste* bears N. $\frac{7}{8}$ E., distant one mile and one-tenth. Between them, one-third of a mile from the first named point, is the small rocky projection of Cabeça Negra; three little detached rocks lie at the base of it, and above it is a cultivated hill.

The cliffs increase in elevation as you proceed northerly, though a deep ravine breaks through them on the north side of Cabeça Negra. Point Nordeste is a bold bluff 760 feet above the sea. From it some large fragments have fallen, occasioning a little extension of the narrow beach around it. To seaward of this point, bearing from it E. by N. $\frac{1}{8}$ N. and distant three-tenths of a mile, lies a sunken rock, named Baixo de Nordeste. It is a single block of stone of very small extent, steep on all sides, and has a depth of 3 or 4 feet over it at low water.

On the parallel of the point, at a quarter of a mile from the land, the depth is from 17 to 20 fathoms; at half a mile 25 to 30 fathoms; at three-quarters of a mile 32 fathoms; thence it falls rapidly, and at one mile there is no bottom with 200 fathoms. On a north-east bearing from it the soundings are similar at the same distance, and the quality of the bottom generally is a fine sand of various colours, with an occasional cast of rock.

The next point westward is Joao de Moira, bearing N.W. by N. ¼ N. distant about six-tenths of a mile, and from thence Ponta de Norte, the north extreme of the island, bears N.W. ⅝ W., about the same distance. The coast between these points presents a series of high inaccessible cliffs, fronted as before by a narrow belt of stones; and deviates little in the outline.

From the top of the cliffs the land behind them rises with great abruptness to the margin of the Caldeira, a height of 2200 feet, where the horizontal distance from the sea does not exceed 2500 feet.

Ponta de Norte is a hugh rock 368 feet in height, jutting out nearly 150 yards at right angles with the shore on either side of it. It is inaccessible from the sea: and the north, or outer face of it shows an overhanging cliff, which renders it remarkable when viewed from the east or west.

N.W. by W. ⅞ W., three-tenths of a mile beyond Ponta de Norte is a small, black elevated islet of naked lava; the coast between them forms a little bay, the shore of which is profusely scattered with large fragments of rock fallen from the enormous cliffs behind them; and W. by S. ½ S. two-tenths of a mile from the outer point of this islet is Ponta de Torrais, the north-west extreme of the island. This north-west point is very remarkable: it runs directly down from the north edge of the crater into the sea, a sharp serrated ridge of dark lava. There is a large rock at the extreme point of it, and on the north side, in the space between it and the islet, there are several low detached rocks towards which a flat narrow pier of lava projects from the shore. Outside these rocks, 300 yards northward of Ponta Torrais, with Ponta de Norte bearing S.E. by E. ¾ E., there is a sunken rock on which the sea breaks violently in stormy weather. Ponta Torrais is surrounded by inaccessible cliffs, and on its southern side there is a depth of 7 fathoms close along side them.

The soundings around the northern shores of Corvo are irregular near the land, and under 30 fathoms,—generally rocky.

On the meridian of Ponta de Norte there are 4 fathoms close alongside the cliff; and around Ponta Torrais the bottom is always foul. On its meridian, with the sunken rock and point in line, there are 17 fathoms three-tenths of a mile off.

On rounding the island it will be advisable not to near Ponta Torrais in less than 20 fathoms water.

At Ponta Torrais the coast runs southward, and the extreme point seen is Ponta d'Oueste, bearing S.W. ⅜ S., one mile and four-tenths. For about half this distance there is a beach of small shingle, and the high land comes down to it from the margin of the Caldeira, not in cliffs, but presenting an extremely steep declivity covered with shrubs and wild vegetation. As you approach Ponta d'Oueste this declivity, near the sea, assumes the appearance of loose earth cliffs, formed into one or two terraces as they have slipped down, from time to time, by the washing away of their base; and in front of these a narrow beach of large stone and shingle forms the actual coast line.

At this point the island has attained its western limit, and lofty cliffs characterize the remainder of the coast all the way to the north side of Pesqueiro-alto point.

The bank of soundings along the shore last described is comparatively shallow and rocky to the extent of nearly half a mile from the land, where there are 15 fathoms. Outside that the quality of the bottom is generally fine sand, though rocky casts frequently occur. On the parallel of the Ponta d'Oueste at a quarter of a mile from the shore will be found 9 to 12 fathoms; at half a mile 25 fathoms.

Nearly three-quarters of a mile S.S.W. ¼ W. of Ponta d'Oueste is a small low detached rock, named *Ilheo de Mulher*. It is about 50 yards from the beach at the base of the cliffs abreast of it, and has a few rocks above water close to it, to seaward, with 6 fathoms water almost alongside of them.

From Ilheo de Mulher, the coast (a narrow beach of stones with an occasional large rock on it) runs South rather more than a mile to the Sugar Loaf rock, a mass of land standing at the base of a bold cliffy point, behind which there is a small rocky cove almost surrounded by high cliffs, which appear to have once formed the southern extremity of the island.

From this *Sugar Loaf Rock* the coast runs S.W. by W. nearly half a mile, to a bold basaltic bluff of small elevation, and presents in that space a rugged outline of steep cliffs formed into coves, the inner parts of which are filled with large loose stones,—the cliffs decreasing rapidly in elevation as they approach the point.

A low coast of very broken outline then succeeds, running first southward two-tenths of a mile, and then eastward nearly one-third of a mile to the meridian of the old horizontal mill on the little eminence near the church. It is fronted by innumerable rocks which project from the shore in narrow ridges of broken lava to an average distance of about 200 yards. In strong winds the sea rolls over these in enormous breakers; the danger is more limited, however, than it appears to be, since they do not extend under water, but are all visible at low tide, and have 5 or 6 fathoms close up to them.

These reefs terminate about 130 yards westward of the meridian of the mill, where the coast shows three bold basaltic little bluffs, steep-to. The best landing (which is only practicable in fine weather) is in a small cove on the west side ot the most western of these bluffs: and it is advisable to lie off and wait for the assistance of a native boatman to pilot you into it. At the head of the cove is a small dilapidated breast-work designed for a battery, distinguished by a flag-staff; and on the beach near it a few fishing-boats are occasionally hauled up.

Immediately in front of the basaltic bluffs there is a space from 250 to 300 yards in length free from outlying rocks, but beyond this the cliffs gradually rise, trend to the north as far as the little bay and stony beach before the village; and the coast again bristles with detached rocks above and under water, which extend out 200 yards from it.

A short distance seaward of these rocks, the church bearing N. ¾ W., distant about three-tenths of a mile, lie three patches of sunken rocks, on which will be found 3 and 4 fathoms water; they are steep, having 18 fathoms close beside them.

There are no dangerous rocks before the stony beach in front of the villlage but the surf which usually plays upon it makes the cove westward of the mill a preferable landing-place generally.

On the parallel of the Sugar Loaf rock, at the distance of a quarter of a mile, there will be found a depth of 11 fathoms; at half a mile 19 fathoms; at three-quarters 25 fathoms; at 1 mile 30 fathoms; at 1¼ miles 35 to 40 fathoms; and thence to 1¾ miles it deepens rapidly to the edge of the soundings.

On the western side of Ponta de Pesqueiro-alto, off the black basaltic bluff, and close to the rocks that lie at its western extremity will be found 11 fathoms water; W.S.W. ½ W. of the bluff two-tenths of a mile 7 fathoms, and keeping on that bearing at one-quarter of a mile from it 10 fathoms; at half a mile 64 fathoms, rocks: and at less than a mile no bottom with 200 fathoms.

On the meridian of the same bluff the bottom is rocky and uneven, with 6 and 7 fathoms water close to the breaking rocks, which lie in front of it on that bearing; at half a mile off it 23 fathoms, and then it falls suddenly to deep water, the edge of soundings being within 1 mile of the shore. The same kind of rocky uneven bottom continues the characteristic feature of the bank quite round the low point, going off flat in some parts for about half a mile, and then dropping rapidly to deep water.

On the meridian of the church, at a quarter of a mile from the land, are 12 fathoms; at half a mile 38 fathoms; at three-quarters 55 fathoms; and at 1 mile no bottom with 200 fathoms; with the church bearing north-westerly, one-quarter of a mile off shore are 13 fathoms just outside the 3 and 4 fathom patches above-mentioned; at half a mile 23 fathoms; and three-quarters 50 fathoms; and at 1 mile 150 fathoms.

With the church bearing N.W. by W. ⅜ W., and continuing on its parallel at a quarter of a mile from the shore will be found 10 fathoms; at half a mile 14 fathoms; at three-quarters 20 fathoms; at 1 mile 23 fathoms; at 1¼ miles 60 fathoms; at 1½ miles about 100 fathoms; and at 1 mile and six-tenths no bottom with 200 fathoms.

The best *anchorages* are on the western side of the island, between the parallels of the Ilheo de Mulher and the Sugar Loaf rock in 30 to 35 fathoms, fine brown sand, about 1 mile off shore; and on the eastern side in 25 to 30 fathoms, sandy bottom, about half a mile S.E. by E. ¾ E. off Ponta de Casa.

These are the anchorages mentioned by Tofino, but we cannot advise the adoption of them, or of any others the island may afford, except as a matter of necessity, since from the size and form of Corvo it affords little shelter from wind or sea.

The flood tide sets upon the island N.E. by E., and the ebb in the opposite direction, with a velocity at springs, under ordinary circumstances, of about 1½ miles per hour; and when the movement of the waters is in opposition to a gale of wind it occasions a very high confused sea as it sweeps over the rocky uneven bottom at the north and south points.

It is high water, at full and change, at 12h. 25m.; and the rise of tide is 3½ feet.

The bank of soundings around Corvo follows, very nearly, the outline of the shores. On the east and S.E. sides, the line of 100 fathoms is distant about one mile; on the west, about 1¼ to 1¾ miles. On the north and N.W, sides the bank is comparatively shallow for the distance of half a mile from the shore, bottom rocky; and off Pesqueiro-alto point, the edge of soundings is only two-thirds of a mile distant. The line of 200 fathoms is everywhere less than half a mile beyond that of 100 fathoms.

From the southernmost point of Corvo to the rocks of Delgada point in the island of Flores, the channel separating the two islands is 9 miles wide. It is perfectly safe and free from any hidden danger.

FAYAL, the most westerly of the central group of the Azores, lies between the parallels of 38° 30¼′ and 38° 38½′ N., and the meridians of 28° 37′ and 28° 50¾′ W. Its form is that of an irregular polygon, with a projecting tongue of land to westward; and its greatest length from point Espalamaca to point Comprida is 11 miles,—its breadth from point Cedros to point Forte 7½ miles. The shores are generally bold,—and the island attaining a considerable elevation near the centre, gives it the appearance of a truncated cone when seen from a distance.

Near the northern coast is the Serra do Caboca, a ridge of hills running east and west, having on the seaward slope a road parallel with the shores, and lined with habitations. But the most conspicuous object in Fayal is the Caldeira, 3351 feet high at its southern edge, which is called the Pico Grande Gorda: the upper part of this crater is about a mile in diameter, narrowing to two-thirds of a mile; on the floor of the interior are a few small cones, and a lake fed by rivulets descending from the steep sides. On the westerly prolongation of the island are the three peaks of Fogo (1857 feet), Cabeza del Fonte (1614 feet), and Cabeza do Norte (1145 feet), which have been in eruption within the last 250 years—the first in 1672—and the lava is widely spread over the slopes of the peaks from their summit to the sea shores, north and south. The Monte da Guia on the S.E. of Fayal, is a remarkable elevation, 487 feet above the sea, forming a lofty peninsula, united to the island by a narrow strip of sandy beach. In shape it is circular, sloping to the north, but bold and precipitous to the south, where the steep sides embrace the Caldeira Inferno,—now a small bay used by boats, but at one time a formidable crater, the southern wall of which has been broken down and washed away.

Fayal contains about 20,000 inhabitants, distributed in one town (Horta) and nine large villages. Horta contains 8680 inhabitants.

Horta.—The port of Horta, on an open bay of the same name, is situated in the south-eastern part of the island. It is a regular, well-built, and populous town. The Castello de Santa Cruz stands in Lat. 38° 31′ 45″ N., Long. 28° 38′ 24″ W.:—northward of this is the convent of San Francisco; more in the centre of the bay, and close to the shore, is the Jesuits' college; and at the back of the town is the Carmelite Convent;—these are conspicuous buildings, opposite to which is the usual anchoring ground. Vessels on the homeward voyage occasionally call at Horta for supplies, and it is the place of export for the productions of Pico, Corvo, and Flores. It has a good beach of black sand.

The soil of Fayal is rocky but fertile, while the climate is mild and favourable to vegetation. It yields wheat, maize, fruit, and vegetables, with which it supplies the neighbouring islands. The annual produce of wine is scanty, and cattle have to be imported from San Jorge for the consumption of the inhabitants, and for the use of the vessels frequenting the port.

From Point Ribeirinha, on the N.E. of Fayal, to Point Cedros, the coast line has a general N.W. by N. direction for upwards of 6 miles—forming, however, a slight indentation between points Parede and Salao, near which latter there is a landing place. The shores along the entire distance are formed by a cliff, moderately high and fringed with rocks; but the continuity of the cliff is broken at intervals where some small streams discharge their waters into the sea.

From *Point Cedros*, the northernmost extreme of the island, which is bold and high, the coast turns westward for 1½ miles, where point Jorge is conspicuous by a conical peak (470 feet high) half a mile inland:—thence to Praya do Norte bay is 2 miles, S.W. by W. ½ W.

From point Cedros to the head of this bay the cliffs are more steep and lofty than those of the northern coast, but from Praya do Norte the shores decline in height and become low as they trend first W.N.W. and then west, south, and S.E. in rapid succession; this is the westerly projection of Fayal, rising by steep acclivities to the three peaks in the interior; the curved coast line, upwards of 7 miles in extent, includes points Negra, Comprida, and Varador, and is fringed with some hidden dangers and numerous reefs and rocks—one of the latter off point Negra, is sufficiently conspicuous, as are also two other rocks or islets called the Capellhina, one-third of a mile from the shore, and lying between points Negra and Comprida. This part of the island should not be approached too closely even by small craft. Near point Varador there is a landing-place in front of the village of Ribeira do Cabo. The next point is that of Castello Branco, bearing S. ¼ E. 2¾ miles from the last:—the coast between them is slightly curved forming a bay exposed to the west, the shores of which are rocky. From a distance Castello Branco appears as an islet, being lofty on all sides and only joined to the island by a very narrow neck of low land: here is a large village of the same name, but it is more directly opposite point Forte where there is a landing place. From Castello Branco to the head of Pim bay the coast line tends in a general E.S.E. (southerly) direction for 6 miles, extremely rocky for the whole distance. Near point Gaivota, 3½ miles from Castello Branco, are two conspicuous islets close in shore, and about ¾ of a mile further eastward is point Cavernas;—between the two lies the village of Feiteiras, at the head of a small rocky cove. Next beyond is Guarda point, past which is Porto do Pim. The coast road on the south of the island, from Castello Branco to the town of Horta, is closely studdied with houses—similar to that on the northern shores of the island.

Port Pim.—The port and bay of Pim are very small, and open to S.W. winds; but from those in other directions it is well sheltered by Monte da Guia on the south, Monte de Queimada on the east, and the high land of the island itself to the north—and being contiguous to the town of Horta, it is consequently a place of resort for loading and discharging small vessels. The anchorage is rocky.

The small cove formed in the broken crater of Monte da Guia, and known as the *Caldeira Inferno*, is seldom used except by boats. The entrance is between points Caldeira and Inferno; near the latter there are three conspicuous islets. The upper part (or second half) of the cove is shallow, but the first half has from 5½ to 13 fathoms water, with the exception of a shoal spot carrying only 3 fathoms near the middle of the entrance. It is well sheltered, but the bottom is rocky. Thence by Guia and Greta points, having passed a small group of islets and rocks, and the steep cliffs of Queimada point, immediately beyond lies Horta, the chief town of the island and the best port in the Azores. North-eastward from Queimada point there is another group of islets and rocks, stretching 1½ cable's length from the cliffs.

Chapman Shoal.—At the southern entrance of the channel between the islands of Fayal and Pico, but nearer the former island, is the Chapman shoal, lying nearly east and west, having a length of 1½ cables, with the shoalest spot (4 fathoms) on the western end: here, during heavy S.W. gales, the sea breaks with considerable force. From it point Espalamaca bears N. by E. about 2½ miles; Guia Head N.W. ⅛ W. 1½ miles; the Ermida, or chapel on Monte Guia, N.W. ⅝ N.; and the high columnar rock of the Magdalenas E. by N. ⅛ N. 2¾ miles: it is also in line with the southern end of Monte Guia and the peak Monte (437 feet high) on the island of Pico. This shoal has deep water close to. Making for the anchorage of Horta, from the southward, either channel may be taken—that between the Chapman shoal and Fayal, or that between it and Pico, as circumstances admit: in the former case point Espalamaca in one with point Ribeirinha leads clear of the shoal. In approaching the roadstead from the S.W., should the wind be dying away from the eastward, and you intend to tack to gain the anchorage, keep on until within 1½ miles of Pico; farther out the bottom is rocky, and will prevent your anchoring, should you require to do so; you will also be thus free from the variable eddy winds and calms caused by the neighbouring mountains. There is no difficulty in making the port by the channel from the northward.

The usual anchorage, in summer and during fine weather, is in 20 to 25 fathoms, rather more than half a mile from the shore, and nearly opposite to (a little northward of) the Castello de Santa Cruz, and in line with point Espalamaca and the signal station on Monte Guia: this is near the centre of the bay. Another and safer anchorage in unsettled weather is on the same parallel but more to the eastward, bringing point Joao Dias just open of point Espalamaca: this is 1½ miles from the town, in 30 to 40 fathoms with a sandy bottom.

The bay of Horta, as before observed, although the best anchorage in the

Azores, is nevertheless exposed to winds between North and N.E. and those from S.E. to S.W. which are the most frequent winds in the winter months. The S.E. gales are very destructive, and blow right in; on this account it is advisable to be always ready for a start when occasion requires it, and from the anchorage last indicated a ship may leave with the wind from any quarter.

It is high water in the bay at 11h. 45m., and the rise of tide is 4 feet. The flood sets about N.E. and the ebb S.W., with an average strength of 1½ to 2 miles per hour.

Point Espalamaca is high, sloping and rounded, having a small fort with a *vigia* or signal station on its summit. The anchorage off the point and thence towards the Magdalena rocks is bad—the sand merely forming a superficial covering to a rocky bottom. On the same meridian as the point, but 1½ miles more northerly, is point Joao Dias, which is low, black and rocky, having a landing-place in a small cove immediately southward of it: the coasts between the two points is indented, and vessels that have left port Magdalena (on the opposite shore) to beat through the channel with the wind at south, sometimes take shelter here, anchoring off the village of Praya where there is a beach and landing-place —and also a small river.

From point Joao Dias to that of Ribeirinha (before noticed) the distance is nearly 1½ miles: it is high, bold and rounded, with several rocks and islets in its vicinity: there is also an open bay between the two points, with anchorage ¾ of a mile off shore in 24 to 30 fathoms—in front of a small stream which breaks the continuity of the steep cliffs at the back of the bay. Point Ribeirinha bears N.N.E. ¾ E. 2¾ miles from point Espalamaca, and there is a sandy beach of variable width the whole distance.

The width of the plateau of soundings around Fayal is variable, but generally very narrow except in the channel between it and Pico. Between point Cedros and Praya do Norte bay, also from point Salao to that of Ribeirinha the line of 100 fathoms is found at about 1½ miles from the coast; but elsewhere it is generally within ¾ of a mile, and near Varador point scarcely ⅛ of a mile distant: the line of 200 fathoms is not more than from 200 to 300 yards further seaward.

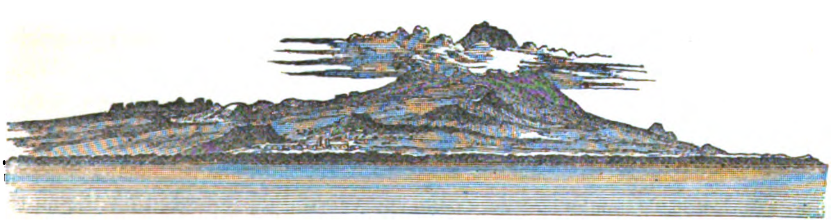
The channel which separates Fayal from Pico indicates, by its comparatively small depth, the close connection of the two islands. From the edge of the 100 fathoms line on the N.E. to that on the S.W. the distance is about 7 miles. The width of the channel in the narrowest part between point Espalamaca (in Fayal) and point Arealarga (in Pico) is about 3½ miles. The only dangers in it are the Chapman rock, and the rocks and shoals between the conspicuous Magdalenas and the main of Pico.

In front of the bay of Horta, and northward of the Chapman is a deep hole of dimensions varying from 1 to 1½ miles in length and breath and usually called the Fayal pit; here the depth averages from 100 to 112 fathoms; elsewhere on this portion of the plateau the depth is less than 100 fathoms—diminishing gradually towards the shores on either side. The bottom is generally sand, sand and shells, or sand and coral.

Shoal.—A shoal spot with only 14 feet water has been discovered at about 400 yards S.E.-ward of Espalamaca point; around it there are soundings of 6 fathoms From the shoal, Ribeirinha point bears N.N.E. ½ E.; Espalamaca point N.W.; and Guia point S.W. ¾ W. Entering or leaving Horta bay, by the northward, pass outside this shoal, which should not be approached nearer than half a cable in 12 fathoms water.

PICO takes its name from the mountain, which is the highest in the whole archipelago. The island is in form very regular—rounded and wide (8½ miles) at the W.N.W. end, but narrow (2½ miles) at the E.S.E. extremity, from point Magdalena to point da Ilha it is 25 miles long. Though the whole island may be said to be high, the west end is the most elevated; it is volcanic, as are all the islands of the Azores group, and over its surface are scattered many extinct volcanoes: but principally in its eastern division. The peak, from whatever point viewed, has the form of a sugar-loaf, and its height, according to the last English survey, is 7613 feet. It can be seen 24 or 25 leagues off; but is frequently so obscured by clouds, as not to be seen at any considerable distance.

Little grain is produced on the island, the soil being stony, so that most of the wheat and maize for consumption is imported from the neighbouring islands. Wine is the staple commodity, and is reputed the best in the Azores; this, with



Pico Island, the Peak bearing E. by S. ½ S., distant 6½ miles.

brandy, is exported in considerable quantities. The island contains numerous excellent cattle, with abundance of fruit and timber.

The south-west and west coasts of Pico are rocky, and distinguished by several rocky islets; towards the N.W. extremity are the Magdalena islands, surrounded by rocks, with 6 to 8 fathoms water near them. Here there is a small port and town, where the chief business between the island and Fayal is carried on. Further to the N.E. is Baixio Grande point, whence breakers extend nearly a league in a gale; from this point to the east end of the island, the coast is so rugged as to be almost inaccessible. Ponta da Ilha is the S.E. extremity of the island; it is low and sloping, having a ridge extending eastward nearly a cable's length: hence westward, the coast continues rocky to point Arrife, which is distant nearly 10 miles; 2½ miles farther is the town and lagoon of Lagens, which are joined to the sea by means of a bar, over which coasters pass at high water. Five miles and a half from Lagens is point Catalina; N.E. of which there is a place of shelter for fishermen.

SAN JORGE or ST. GEORGE.—This is a long narrow island, lying about 10 miles north-eastward of Pico. It is nearly 30 miles in length, while its average breadth does not exceed 2½ miles. Over its surface are many extinct volcanoes, some of them nearly 3000 feet high.

The highest mountain (3498 feet) is situated in the centre of the island; its name is Pico da Esperanza. Wood and fresh water can be obtained here, and supplies almost of every description in abundance.

Rosales Point, in Lat. 38° 45⅛′ N., Long. 28° 20′ W., is at once the most northerly and westerly extremity of San Jorge. It is moderately elevated, and has, in front of it, a large patch of rocky ground, extending from North, round by west and south, to S.W., for a distance of about half a mile from the shore in every direction. There are several shoals and small islets interspersed on this patch—two of the latter are remarkable for their pinnacle-form and height. Rosales itself being 234 feet, and Rosalina 232 feet high. From this point the coast trends, with a slight curvature, to Morro do Lemo, having points Trigo, Feiteiras, and Ruiva between. From Morro do Lemo, the Morro Grande (High Hill) bears S. ¼ W. two-thirds of a mile. They are the most characteristic points of the S.W. side of the island. The Morro Grande is an elevated black mountain, resembling Monte Brazil in Terceira, and is distinguished by a vigia, or look out. Between these two points is a small incommodious, and rocky bay, which has sometimes been mistaken for that of Las Vellas, on the eastern side of Morro Grande —a mistake which has occasionally been fatal since vessels are unable to leave it with the same winds that allow them to enter.

The anchorage of Las Vellas is comprised between Morro Grande on the west and the low point of Quiemada on the east, distant 1½ miles S.E. ¼ S.; on the latter is a small fort. The town and port of Las Vellas, near the head of the bay, is well sheltered from winds between N.W., round by north, to E.S.E.: it has a small mole on the S.E. side, within which are three fathoms, rocky bottom,—but the usual anchorage is south of the mole, in 9 fathoms, bottom of fine black sand; here vessels moor with two anchors—to the N.W. and S.E.—which enables them to double either point of the bay, according to whether it blows from the S.E. or S.W., when the position is rendered unsafe. The bank of soundings in the vicinity of the Villa das Vellas is very narrow—180 fathoms being found at the distance of half a mile, whence the depth diminshes rapidly towards the coast, but seaward the plateau plunges down quickly to 200 and 300 fathoms.

From point Queimada to that of Monteiro, the most southern part of the island, the coast runs S.E. ¼ S. 19 miles, here and there moderately elevated, but often very low, and alternately fringed with rocky or sandy shores. There is an exposed landing-place off point Castellitos, a small creek at Calheta, whence there is a considerable export of wood to the neighbouring islands: and another landing-place between points Forcada and Portal, in front of a river flowing through the valley which separates the elevated central plateau of the island from that on the S.E. here also commences a sandy beach prolonged without interruption to point Morro, 2¼ miles eastward of point Monteiro. There are several villages on the S.W. side of the island, and in fact from opposite point Ruiva, villages and farms are grouped along the coast-road, for a distance of 19 miles, as far as point Bodes. From point Morro the coast turns E. ¼ N. two-thirds of a mile to point Pontinha, near which is the village of Topo: and about half a mile more easterly is the S.E. extremity of San Jorge, in Lat. 38° 32⅝′ N., Long. 27° 46¾′ W. Here is situated the island of Topo, 60 feet high, with several rocks around it, and a patch of rocks between it and the main, in a channel about 380 yards wide.

The N.E. side of the island, from point Topo to point Norte Grande, trends irregularly to the N.W. by N. 15 miles, the entire length consisting of a high cliff, more or less abrupt, at the base of which runs a sandy beach. Eastward of Caldeira point there are a cove and village of the same name; the point itself is projecting, terminated by breakers. Norte Grande, nearly on the meridian of the famous Pico da Esperanza, is fringed by an extensive reef of rocks, and to the eastward of it (formed by it and Norte Pequeno point) is an exposed bay; at a short distance inland a line of houses and farms extends along an elevated road for 5 miles.

From Norte Grande point to that of Gonzalvo, N.W. 8¾ miles, the coast-line preserves the characteristics of that just described,—a steep cliff with a sandy beach at its base, but the shores are more frequently fringed with rocks—one of which, on the western side of Furada point is very conspicuous.

From point Gonzalvo to point Rosales 4½ miles, the shores are still sand, fringed with rocks, but the cliffs have a much less elevation than those to the eastward. The N.E. side of the island is very little frequented, even by the country craft.

It is high water at full and change, at 12h. 30m., and the rise of tide between 4 and 5 feet.

The plateau of soundings around San Jorge is, in parts, very narrow, and especially in the channel between it and the island of Pico, where, from off Trigo to Forcada point, the line of 100 fathoms is generally under half a mile,—and, in many places, less than a quarter of a mile from the coast, particularly near point Queimada. From Forcada point, round by Topo island and thence on the N.E. side of the island to 1½ miles eastward of Norte Pequeno point, it increases in width, but varies irregularly, fluctuating between 1 and 2 miles; from Norte Pequeno to Norte points it diminishes to about three quarters of a mile, and then gradually widens again till off Rosales point, where it forms a narrow tongue running nearly 4 miles in a N.W. direction. The line of 200 fathoms is very close to that of 100,—generally not more than a few hundred yards beyond, except between Forcada and Morro points, where it is 1 to 1¼ miles more distant,—and off the north and S.E. extremities of the island, where the plateau projects in a narrow strip from each point.

The channel separating San Jorge from the island of Pico has a uniform width of about 10 miles, except at the N.W. entrance, where, from the curvature of the coasts, it is a few miles larger: it is deep, and free from any sunken rocks, but has generally a strong current running through it. The navigation is hazardous in unsettled weather, and a sudden calm might be fatal, as the plateau of soundings on the Pico coast is even narrower than on that of San Jorge.

GRACIOSA, the most northerly of the central group of the Azores, is 7 miles long (N.W. and S.E.) by 4 miles broad; it lies between latitudes 39° 6′ and 39° 0½′ N., and longitudes 27° 57′ and 28° 4¾′ W., with a circumference of about 26 miles. The island is what may be termed mountainous, but more lofty in the S.E. and S.W. quarter than elsewhere,—and approaching from the south and S.W. the peaks, seen from a distance, appear like so many islands. Near the south-eastern extremity is the Caldeira, the most elevated portion of which is 1349 feet above the level of the sea. This ancient crater, of an elliptical form—half a mile long, by a quarter of a mile broad—is remarkable for its central depression, the floor of the interior being only 888 feet above the sea; it contains a lake and deep *crevasse*, called El Ferno. N.W. from the Caldeira, about 2 miles, is a peak 1298 feet high: and still further west, is the highest peak in the island, Pedro Botelho, 1378 feet, nearly on the meridian of Branca point: more central is the Serro de Facho, elevated 1226 feet, whence proceeds a ridge towards the N.E. coast, terminating in the Pico de Aquilhino, 1172 feet high. The north-western half of the island is the least elevated, but is studded irregularly with conical hills.

Graciosa, though small, has always been celebrated for its fertility, yielding in abundance barley, wheat, maize, wine, and all kinds of fruits and vegetables—most of the superfluous produce being supplied to the adjacant islands. Cattle, sheep, pigs, and poultry are also bred: but wood is scarce, and procured generally from San Jorge and Pico. Santa Cruz is the chief town, besides which it contains Guadalupe, Praya and several villages. Santa Cruz contains 2758 inhabitants.

The south, S.E., and east points of the island are found within a line of 1¼ miles. The first of these is Sul point bordered by a rocky shore: ¾ of a mile eastward is a small point having a ridge of rocks extending from it for 2 cables' lengths: about a ¼ of a mile still more easterly is the bifurcated point Carapacho—the S.E. end of the island—fringed by a broad patch of rocks and breakers, the outermost of which carry very little water and are dangerous; thence to Ponta de l'Este, N.E. ½ N., is rather more than another ¼ of a mile. About ½ of a mile off point Carapacho is a large and conspicuous rock or islet called Baxo (centre in Lat. 39° 0¼′ N., Long. 27° 56¾′ W.) nearly ¼ of a mile long, having to the E.N.E. of it a small rock which appears from the distance like a broken column, and from its south and east sides stretch a ridge of rocks, reefs, and breakers.

Shoal:—Between Baxo islet and the main there is a channel of 2¼ cables' width, from rock to rock, with a depth of 14 to 18 fathoms, but it cannot be recommended, since, at its S.W. entrance, there is a sunken rock with only 7 feet water on it and from 9 to 14 fathoms, around it, close-to. This danger bears S.W. ⅓ S., ⅓ of a mile from point Carapacho,—and W. ¼ N. ½ a mile from the north end of Baxo island.

There are several streams along the part of the coast above noticed, and some hot springs less than ⅓ of a mile westward from point Carapacho.

N. ¾ E. 1⅓ miles from point de l'Este is Fanais point, off which are two rocks above water; the coast is moderately high, and at the base is a beach of sand and shingle, which, commencing between Sul and Carapacho points, terminates off Fanais point. Hence to point Negra N. ½ W. 1⅓ miles is a rocky coast with a slight indentation forming the *Bay of Praya*, where there is a small town of this name, and in front of which is a sandy strand. Eastward of the town, but off point Negra, is the islet of Praya, entirely surrounded by breakers, and having northward of it, 1⅓ cable's length off, a detached rock carrying only 1 fathom,—and another eastward of the south point, 2⅓ cable's lengths off, with only 4 feet of water. In the bay the soundings are from 7 to 15 fathoms. The anchorage is ⅓ of a mile southward of the islet, in from 11 to 25 fathoms. When passing between the islet and the shore, keep Fanais point in one with Ponta de l'Este, which leads through mid-channel.

Ponta Negra is low and rocky;—from it a steep coast runs N. ⅜ W. 1¾ miles to point Santa Catharina, with the lofty Pico de Aquilhino between. Half a mile beyond point Santa Catharina is that of Ferreira or Josef point, the vicinity of which is low and irregular, with a dangerous bank extending from it to the north-eastward, above ⅓ of a mile,—some parts being above water: the soundings outside the bank vary from 7 to 15 fathoms. Round the bank is the small town of *Santa Cruz*, built on an open bay; on the S.W. side there are three small hills, each crowned by a church, forming good marks for the north side of the island: it is of some considerable extent, but not frequented by shipping from being too much exposed to the northward. The best anchorage about the island is northward of point Negra, with Baxo islet (near the S.E. point) in a line with the westernmost part of Praya islet, or rather a little open: this is eastward of a bold escarpment of rocks flanked by a lofty ridge in the interior: the depths are from 80 to 40 fathoms, sandy bottom, with shelter from South, round by west, to N.W. —being exposed in all other directions.

From point Ferreira, the coast runs nearly N.W. about 1½ miles to point Vermelha, off which are some rocks; thence it takes a slight curvature, for a mile, towards point Pico Negra, round the north of the island, and then trends S.W. by W. 2 miles to Ponta de Fozo do Porto. The coast line between points Vermelha and Fozo do Porto is generally high and irregular, forming here and there small coves, and along the entire length more or less fringed with islets, rocks, and breakers.

From point Fozo do Porto, southward of which is a projecting headland forming the western extremity of Graciosa, the coast, of moderate height, runs half-a-mile to the low rocky point of Gomez: between are two small bights. Off point Gomez there is a brook, and it can be readily distinguished by having near it the conical peak of mount Vermelha, 516 feet high, ¼ of a mile inland. Thence to point Branca the coast is high, trending southward for 3 miles: midway is the village of Esperanza,—and mount Pedro Botelho is a conspicuous object from seaward along this route. Two miles S.E. from point Branca is point Fogo—the coast between bending inwards and forming a bay, the shores of which are bordered with rocks;—one of these larger than the others, is Forte islet, and close by is the landing place. At point Fogo is a small stream of water,—and ¼ a mile inland, the village of La Luz. The coast with a small curve trends thence about S.E. by E. 1¼ miles to point Sul.

Tides;—The time of high water at full and change, is 12h. 15m. at Port Praya and Santa Cruz, and the rise of tide about 4 feet.

The outline of the plateau of soundings is very irregular in contour. Off Fogo point on the south and Fanais point on the N.E. of the island the line of 100 fathoms is about ¾ of a mile from the coast; between the two points, round by Baxo islet, it is distant from 1 to 1¾ mile. On the north, N.W., west, and S.W. it varies between 1½ to 2½ miles distant; but between Frades and Fogo points and nearly opposite Branca point it is prolonged to the S.W., extending fully 3½ miles. The line of 200 fathoms is at no great distance from that of 100: it is most removed on the west, south, and S.E. sides—fluctuating between ¼ a mile and 2 miles—elsewhere it is scarcely half a mile beyond. The character of the bottom is also uncertain—but generally on the N.E., sand, or sand and shells,—and on the S.W., sand, sand and gravel, or rock, within a limited distance.

The channel between Graciosa and San Jorge is 20 miles wide; and that between Graciosa and Terceira 30 miles, estimating from Baxo islet, near the S.E. point of the former to the Serreta rocks on the N.E. of the latter island: both channels are safe and free from hidden dangers.

TERCEIRA.—This is considered the principal island of the Azores: it is the seat of government, and the residence of the civil and military authorities. The chief town of the island is Angra, on the south coast, where there is good shelter from all points, except from S.S.W., by the south, to east.

Terceira is about 16¼ miles in extent, from east to west, and 9 miles broad from north to south: its form is that of an ellipse. The island is very fertile, and produces abundance of corn, wine, and fruits; the pasturage for cattle is also good, and wood and water can be obtained in plenty. Along its shores fish are plentiful, and of good quality. The number of inhabitants, according to the last census, was 30,000.

The coasts of the island are in general high and steep, so that the interior is accessible at only a few places, and these are frequently defended by batteries and fortifications. The interior is very lofty, some of the mountains being over 2000 feet, while the Caldeira de Sta. Barbara, in the western part of the island, is estimated to be 3500 feet above the sea level. The island is eminently volcanic, and scattered over its surface, in almost every direction, are beds of lava, which have flowed from the mountains during periods of convulsion. The western side of the island is higher than the eastern, and the Caldeira de Sta. Barbara may be frequently recognised by a great break on its eastern side, which is seen from seaward at a short distance, or from the N.E.

Angra.—This town is easily recognised by Mount Brazil, a rocky peninsula, sheltering the bay from the westward, which is a steep hill, forked at the summit, having an elevation of 555 feet above the level of the sea. At the summit of the mountain are two lakes; also a tower; and at its foot are the strong forts of San Juan and San Antonio, which are a great defence to the town. On the N.E. side of the bay is also a fort, named San Sebastian. All these objects will serve to point out the situation of the bay; but it may be still farther known by the Cabras, or Goat islands, which lie about 4 miles to the S.E. by E. of the mount. These are two rocky islets, the eastern one of which is higher and larger than the other, being about 480 feet high; they are separated from the shore by a channel about 6½ cables wide, in which are 15 to 20 fathoms water, and from each other by a narrow passage, in which are about 7 fathoms. The larger island is accessible only on its north side, being steep to the south and west; and when seen from the southward or westward it presents somewhat the appearance of a wedge. Close-to all round these rocks is deep water of 8 to 30 fathoms. Angra is a Bishop's see, and contains 10,604 inhabitants.

Frades Islets.—Nearly 2 miles S.S.E. ½ E. from the Cabras rocks are the Frades, two dangerous islets; the highest of these is pyramidal in shape, and has many heads, which, at a distance, appear like several small islets. From the S.E. side of them a shoal extends about a cable's length, over which the sea breaks. In the immediate vicinity of these rocks there are soundings of 10 to 50 fathoms, and between them and the Cabras are 60 to 80 fathoms, gravelly bottom and clear ground.

Shoal:—About E. by S. ½ S. 1½ miles from the Frades is a rocky patch of 28 fathoms, which lies with the Pico de las Contiendas, bearing N. 11° W. (true), and the largest Cabras islet W. 18° N. (true). To avoid it, bring the south end of Cabras in one with the south extremity of mount Brazil, and you will pass it to the northward.

In the anchorage of Angra there is plenty of room, and a depth of water of 9 to 20 fathoms. It is said that ships should moor in a line with the forts of Antonio and San Sebastian; this is necessary, as the anchorage is open to all winds, from the S.S.W., by the south, to East, and therefore unsafe when it blows from those quarters, particularly from the S.W., which causes a tremendous swell. Larger ships anchor eastward of mount Brazil in 30 to 40 fathoms, sandy bottom; but it is necessary to be always ready to start in case of necessity.

On the west side of the fort of San Sebastian is a sandy beach, named Puerta da Pipas, which is a place of shelter for small craft, in case they should be prevented by sea from landing at the mole.

Vessels approaching the bay of Angra from the S.W., south, or S.E. should steer directly for mount Brazil; and, with adverse winds, may tack boldly without the bay, as the water is sufficiently deep up to the shore; a calm, however, is to be dreaded, as the currents are strong and variable; we would not therefore recommend too near an approach under such circumstances, as it is an iron-bound coast, and a ship driven on it would be placed in extreme hazards.*

The following *Instructions to Mariners* were issued by Capt. Victorine Je. da S'Rodovalho, Intendent of the Azores, at the port of Angra, in December, 1864:—" As it has been proved that during gales from S.E., several vessels have been wrecked at the port of Angra, and seeing that the cause of those wrecks has originated through the want of good moorings, in order to avoid as far as possible any accident for the future, I have ordered the pilots to examine the anchors snd chains wherewith they have to anchor vessels,—one of which anchors and chains ought to be of larger dimensions than the proportionate tonnage of the vessel, in order to be the better able to resist any gale, not being excessive.

" When the wind and sea from the S.E. may be such as to endanger the entry of vessels into the port, a broad *red* and *white* burjee will be hoisted at the flag-staff of the custom-house quay, which signal will be repeated at point San Antonio, in order to indicate to the vessels that they should keep off until the weather moderates."

From the bay of Angra the coast runs to the E.S.E. about 6½ miles, to point Contiendas, the south-east extremity of the island, and is high and bold with deep water a short distance off. This point is remarkable, being low and projecting somewhat into the sea, and has on its summit three hills, the western one of which is named Pico da Mino, and the eastern one Pico de las Contiendas; both these are of equal height (493 feet), and serve as good marks by which to recognise the point.

At about one-third of a mile north of point Contiendas is point Mina, having off it four islets close to the shore; and 3½ miles north of this is point San Jorge, which is low and rocky, and surmounted by a battery. On the summit of point San Jorge is the Pico do Capito, 487 feet high; and 2 miles south of it is a small place, named Novo, where boats may land.

* In 1851, notice was given, that a white triangular flag would be hoisted at the battery on point San Antonio, mount Brazil, whenever it is considered imprudent for vessels to anchor. Should a vessel not pay attention to this signal, the commander of the battery is authorised to fire with blank cartridge, which will be repeated at reasonable intervals, in case no attention is paid to it; the expence of such to be borne by the master of the ship. In the event of necessity compelling you to run into the port in order to beach, or should any unwonted circumstance or disaster have happened on board, then the national colours must be hoisted in the rigging, which will be a guide for the officer in command not to fire.

Praya Bay.—Northward of Point San Jorge, about 2 miles, is Malmerendo point, which is high, rocky, and steep, and has at its foot some breakers, and a rock which covers with the tide. Between these points is the bay of Praya, which is considered to contain the best and safest anchorage in the Azores, its only disadvantage being that it is open to easterly winds. The extent of the bay is about 2 miles, and at its head is a large and populous town, which is well defended by batteries. The shores of the bay are low and sandy, and the soundings average from 8 to 10 fathoms, on a bottom of sand, shoaling gradually as you approach the town.

A good mark for approaching the bay, when at a great distance off, and the high lands are not hidden by the clouds, is the chain of mountains in the interior, named Pico Norte and Pico Agudo, which are of the respective elevations of 2685 and 2650 feet above the level of the sea. The southern part of this chain is nearly on the meridian of the bay, and bears from it about W.N.W. ½ N.

The best anchorage in Praya Bay is with point Malmerendo in one with Carneiros island, situated 3 miles northward of the point. Here you will be in about 20 fathoms, and may ride with the two towers at the bottom of the bay in one; or east of the steeple of Santa Cruz, which is the highest in the town, with the town bearing about N.W. In fine weather from June to September, you may anchor still nearer the town, in 8 to 10 fathoms, as winds are not then so strong, and blow generally from the westward. When landing, it is not recommended to attempt it in the south part of the bay, because a bank lines the shore, and would put you to great inconvenience; the best landing place is consequently at the town.

At Porto Praya it is high water at about 12h. 35m. on the days of full and change, with a rise of tide of about 4 feet. Here refreshments of every description can be obtained, and wood and water in plenty.

Upon the parallel of Praya bay the bank of soundings extends outwards about 7 miles. In a depth of 226 fathoms, which will be found at this distance, the ground is generally of rock, but these soundings are not maintained long, as the depth immediately decreases to 90 fathoms, and then gradually diminishes to the entrance of the bay. The bottom is generally of sand, although occasionally rocky ground is met with: and the depth at 3 miles from the town is 70 fathoms; at 1½ miles 35 fathoms; and at 1 mile 20 fathoms.

At 3 miles northward of Malmerendo point is a small islet 62 feet high named Carneiros, which is very steep, and separated from the shore by a channel half a mile wide, in which are soundings of 17 to 20 fathoms. Ships may pass through this passage, as there is no danger except a small rock a little north of point Carneiros, and very near the coast.

The north and west coasts of Terceira being steep and quite inaccessible, it is unnecessary to add a description here; suffice it to say that there is no place of shelter or anchorage, and that generally deep water is found close to the shores.

Shoals:—At nearly 2 miles N.W. by N. from point Serreta, the west point of the island, are two patches of 4¾ fathoms, with 15 to 30 fathoms close to them, deepening rapidly to 80 and 100 fathoms. They lie with point Serreta in one with the middle of the summit of the Caldeira de Santa Barbara, and you will have passed them to the southward when Pico Nigra is in one with the extremity of the point; and to the northward, when the same hill is in one with Negrita point, or with the middle of the summit of Caldeira. Between these patches and the shore there is a good channel of 30 to 60 fathoms water, but it is safer always to pass outside.

Between Terceira and San Miguel a rock was reported in 1850, and attempts were made to discover it, but without success, no bottom having been found at the depths of 200 and 300 fathoms.

The plateau of soundings around Terceira is very irregular. On the west and N.W. coasts the line of 100 fathoms varies from half a mile to 1½ miles from the shore, except off Serreta point and in the vicinity of the Serreta rocks. where it abruptly extends to the distance of 4 miles. On the north and south sides of the island the 100 fathoms line is found no nearer than from 2 to 3 miles from the shore, and extending to 4 miles on the east and S.E. side. The line of 200 fathoms is equally variable, in some places immediately fringing the 100 fathoms' line, but in others, as off Rua Longa point (on the north) and Biscoitos point (on the S.E.), extending to the distance of 4 or 5 miles.

SAN MIGUEL, or St. MICHAEL.—This island, although not the seat of government, yet is the most important, commercially of any of the Azores group of islands. It is about 35 miles long, by 7½ miles wide, in its broadest part, which is at its eaastern end, and has somewhat of a rounded form, the bend being to the southward.

The chief town, Ponta Delgada, is on the west side of a small bay on the south side of the island, and is situated in Lat. 37° 45′ N., and Long. 35° 40′ W. It possesses some good public buildings, and many conveniences for shipping; and the population amounts to 13,088.

There is a mole for the protection of small vessels, and it has lately been proposed to build some docks, at a cost of £150,000, but whether the idea will be carried out remains to be seen, as the private capitalists of the island did not seem willing to encourage it.

San Miguel is undoubtedly volcanic, and presents a great variety of appearance as it is passed from east to west. The east end rises from a bluff sea-cliff of between 1200 and 1400 feet elevation to a lofty inland peak, from which a central range, varying in height between 2000 and 2500 feet, runs westward, terminating in the Serra da Agoa de Pao, 3070 feet above the sea. The sea-coast gradually declines in approaching the east point, where it is not more than about 100 feet high. The part next seen is lower, and its outline, as presented by the summits of numerous volcanic monticules of about 1300 feet elevation, is united in a central ridge more undulating; the western extremity being marked by the conspicuous Serra Gorda, 1570 feet above the sea; its shores on both sides are low, broken, and rocky. Of the remaining part the aspect is that of a vast truncated cone, irregularly cut off, at an elevation of about 1,800 feet, and falling on the north, west, and south sides to a perpendicular coast of between 300 and 800 feet high. The outline is varied by the intervention of peaks, thrown up on the summit and flanks, and round the foot of the mountain, some of which are of considerable elevation.

In the higher parts of the island the surface is generally covered with an undergrowth of heaths, cedar, laurel, laurestinus, and other evergreen shrubs, which give the mountains an exceedingly rich and wooded appearance, notwithstanding the inroads of cultivation and the more destructive demand for fuel. Like all volcanic countries, the face of the island is uneven and irregular, being deeply excavated by numerous ravines, and roughened by streams of semi-vitrified and scoriaceous lava that resist all atmospheric influences and repel vegetation. Heavy rains falling on the mountains afford a constant supply of water to four lakes at the bottom of extinct craters or subsidences, and a number of minor reservoirs, and through them to small streams rapidly running down on all sides into the sea.

The rich level country of the island is well adapted for the growth of wheat, Indian corn, and beans, or callivances. The vine and orange are cultivated in the lava districts, and yield abundance of fruit. The lava in the south-eastern region of the island is generally understood to be older, softer, and to become more speedily fertile than that of the north-western region; and this latter preserves such a degree of hardness as to be, in several places, incapable of yielding to the industry of man. The surface in the intermediate parts, between the volcanic lands and the level country, displays volcanic sand, metallic slag, pumice-stone, &c.

The wild animals peculiar to the island are the rabbit, ferret, weasel, rat, mouse, and bat; to which may be added the frog, which was introduced a few years ago by a landed proprietor, and now inhabits every pool. The fish are mostly the same as those of Madeira. The birds permanently belonging to the island are the buzzard, which gives its name to the "Accres," little owl *(strix passerina)*, starling, blackbird, chaffinch, mountain finch, canary finch, yellow wagtail, redbreast, blackcap, willow wren, gold-crested wren, wood-pigeon, rock-pigeon, red-legged partridge, quail, sanderling, green sand-piper, sandwich tern, herring-gull, common gull, and stormy petrel. In addition to these, of which some are rare, others common, the following are occasional visitants:—the swallow, eagle-owl, raven, crow, pied woodpecker, hoopoe, bullfinch, goldfinch, heron, crane, bittern, spoonbill, curlew, woodcock, snipe, kingfisher, water-rail, coot, puffin, wild swan, widgeon, and teal.

Although the climate is variable both in heat and humidity, it is of the most temperate kind, and the changes do not materially affect health, personal comfort, or the operation of out-door business. As in summer it is seldom that clouds do not float in the atmosphere to offer an occasional mitigation of the sun's heat, so in winter there are few days when this is not felt, and during the whole year there is not one of necessary total suspension of agricultural labour.

The number of inhabitants, by the last census, was 80,809. The people are said to be generally industrious, sober, frugal, and, with an exception common in southern climates, cleanly in their persons. Their address is mild and engaging, but they are of passionate temper and vindictive disposition: and, notwithstanding the familiarity of salutations, they are naturally distrustful of each other, and deficient in real cordiality of feeling. In domestic life they are harsh and cruel; men beating their wives, and mothers their children, with the greatest ferocity. Their moral character is also at a low standard, whether as regards truth, honesty, or chastity; nor in any class are breaches of these virtues sufficiently reprobated to correct the popular neglect of them. As if sensible of their dangerous propensities, it is said they never live in retired situations at a distance from the protection of their neighbours, but construct their habitations in villages where they can at all times command assistance.

The western point of San Miguel is point Ferraria, which is high and steep, and has on its summit a hill named the peak of Camarinhas, which is 687 feet high. From the base of the point, a point of lower elevation and bordered with a reef runs to the N.W. about one-third of a mile, and causes breakers sometimes to a considerable distance. Upon the reef there are several rocks above water, and close to its edge are soundings of 10 to 20 fathoms. At about a mile northward of the point is a small patch of 15 fathoms, the site of the island of Sabrina, which was thrown up on the 11th of June, 1811, and shortly after became submerged; it has soundings of 30 fathoms close to it on the western side, and between it and the shore 17 and 15 fathoms.

At 2½ miles southward of Ferraria point is that of Candelaria, having near it a rock upon which the sea breaks. Hence the coast runs S.S.E. 9½ miles to Ponta Delgada, and is high, abrupt, and rocky, with some detached rocks off its projecting parts.

Bay of Ponta Delgada.—Eastward of Ponta Delgada is the bay of Ponta Delgada, which contains the principal town of the island, and is entirely exposed to the southward, being protected only from the winds which blow off the land. The soundings at 1½ miles off the shore are about 40 and 60 fathoms, thence gradually decreasing to 10 and 8 fathoms; and the bottom is of sand; while outside this depth of 40 and 60 fathoms the bank of soundings is soon lost, there being no ground at the depth of 200 fathoms.

The town of Ponta Delgada is protected by batteries, and well built, the houses and streets standing on a gentle declivity. There are a college, several convents, and a custom-house, and the various public buildings are represented to be commodious and to have some pretension to elegance. At 1½ cable's length from point San Pedro are two rocks, which must be carefully avoided; they stand within the 5 fathoms line.

There is no difficulty in taking the anchorage here; but the best, because it is suitable for all winds, is at about a mile from the town, in a depth of about 40 fathoms, on a bottom of sand. Vessels also anchor nearer the town in 17 to 10 fathoms, at a half to a quarter of a mile from point San Pedro, but only in fine weather. If compelled by a southerly gale to quit this anchorage, it is best to round the western end of the island, and await a shift of wind from the N.W., which usually succeeds a S.W. wind. Thus the roadstead may be easily regained; but, should you run to the south-eastward, it may be ten days, or more, before you can beat back to the road, as the current frequently sets to the S.E. In beating up, keep close in shore, only avoiding some rocks which lie near point Galera.*

There have been five buoys lately moored in this anchorage, which will considerably reduce the risk of vessels leaving their anchors and chains behind them when they leave the road; and signals also have been established, which are made from the flag-staff on the Custom-house quay, in the following manner:—

A red flag.—Vessels must weigh anchor on account of the weather.

A white flag.—Vessels in sight may make for the anchorage.

A red flag with a white border.—Boats must not be sent on shore, the landing being dangerous.

From point San Pedro the coast runs 1¼ miles eastward to point Rosto do Cao, and is rocky and broken; on this point is a small hill. Thence it runs 2¾ miles to point Alagoa, and is of but moderate height, with some rocks close-to, eastward of which is a small cove named Carneyros, and near it the village of Alagoa. It now turns to the S.S.E. 3 miles to point Agoa, and is clear all the way. On the east side of this latter point is port Cabassos, which is merely an open cove suitable for boats, with the village of Agoa do Pao at its head, where there is landing near the stream. Point Galera forms the east side of port Cabassos, and is rocky and abrupt, with rocks standing some distance out; on the summit of the point is a small hill.

From point Galera the coast is high and bold, and runs 2¼ miles to point Pyramida, which has a reef extending from it about a quarter of a mile, and a rock awash with the surface of the water near it, so that a close approach must not be made. Hence to Villa Franca the distance is 1¼ miles.

Villa Franca is a small village close to the shore side, built on land of a moderate height. Near it is a stream of fresh water, having on its east side a rocky point named Arca, from which a reef runs out about 2 cable's lengths. From Arca point the coast runs nearly 3 miles to point Garca, and is high and bold close-to.

Rock:—Off Villa Franca is a remarkable volcanic rock about 80 feet high, named Villa Franca islet, which has a circular basin in its centre, the entrance to which faces the town. This basin is not very extensive, but the depth is sufficient

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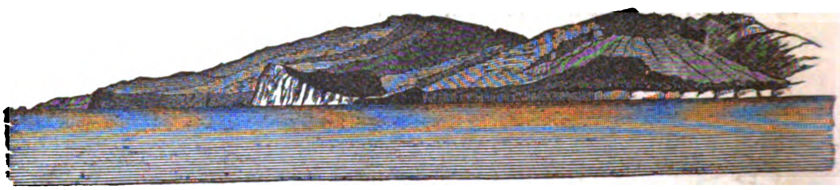
* In 1846 an order was issued by the Governor of San Miguel, directing that a signal gun should be fired, upon any ship approaching the roadstead without hoisting her national flag;—the master to pay the expense of the same.

to admit small vessels to careen, or for purposes of shelter. From recent observations it would seem that it is becoming filled up with sand.



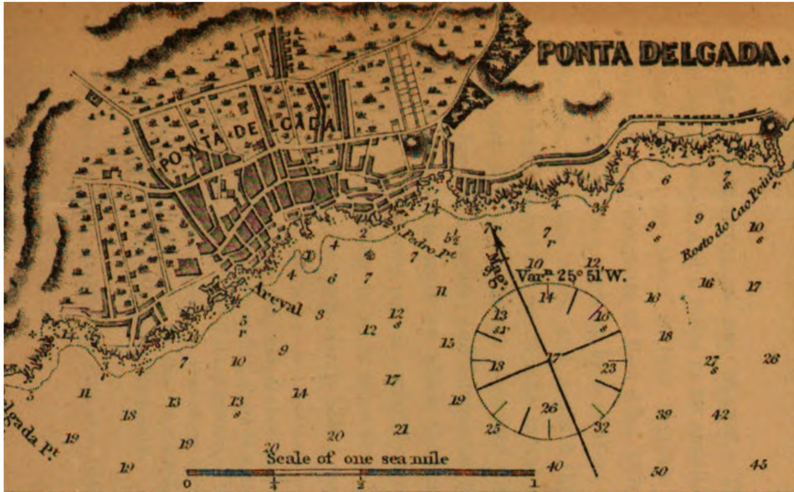
The channel between Villa Franca islet and the shore is of the width of three cable's lengths, and here is the principal anchorage. The depth is from 4 to 10 fathoms, sandy bottom, and vessels moor North and South, with a hawser on shore, on to the islet; but the latter, owing to its diminutive size, does not shelter a vessel from the wind and sea, between E.S.E., by south, to S.S.W.

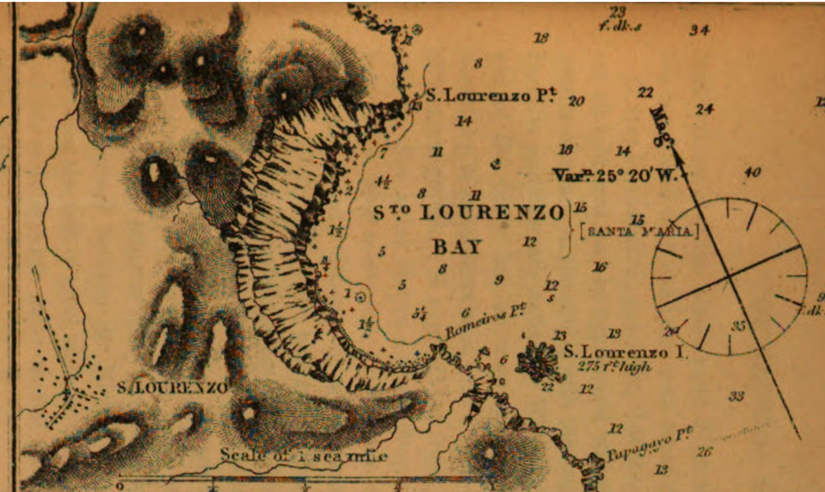
From Villa Franca to point Retorta, the S.E. end of St. Michael's, the distance is 13 miles; the coast maintains its elevated character, and has no dangers but what are close to the shore,—the most prominent being Lobeira rock off a point of the same name. Point Retorta is bold, very elevated, and of a rounded form, with some rocks close to its base, and has over it a high mountain, named Pico de Nunez, of the estimated height of 2220 feet.

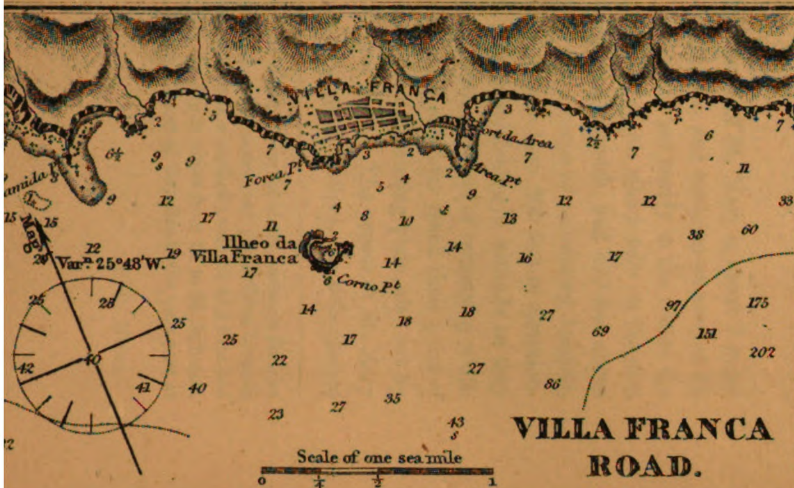
The coast on the east side of the island is all high and bold, with 6 to 8 fathoms a short distance off. About five miles from Retorta point is Arnel point and the hamlet of Nazarete, before which small vessels can anchor, but the shelter is indifferent and the ground bad.

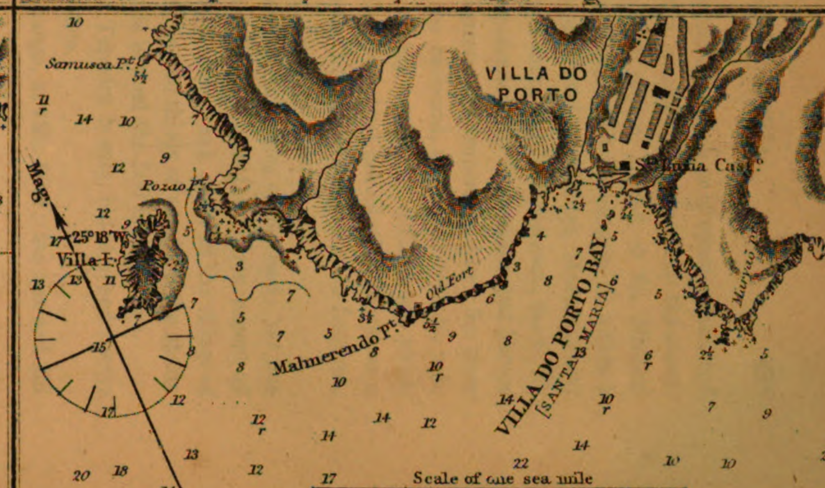
The north side is in general high and bold, and affords no place of shelter whatever, being entirely exposed to the northward. At about 2½ miles north-eastward of Ferraria point, is the little harbour of Mosteiros, with some remarkable islets near it; the largest of which is high, sloped, and smooth at its summit, with an aperture, through which the sea passes from one side to the other. Point Mosteiros has some reefs about it; between it and point Bretanha is the bay of Joao Bom, in the vicinity of which the coast is high and rocky, and is further distinguished by a sharp pointed hill named the Pico da Maffa. Hence 18 miles will bring us to Ribeira Grande, a large town, but there is no anchorage, or harbour, nor even landing, except when the sea is very smooth.* Hence to the

* It having been represented that the bottom on the north side of St. Michael is foul in the anchoring depths, and that no vessel would be likely to recover her anchor if she brought up there, I thought it my duty to take the earliest opportunity of proceeding thither, with the agent for Lloyd's at this port, for the purpose of ascertaining the truth of these assertions.


PONTA DELGADA.
PONTA DELGADA
Pedro Pt.
Areyal
Rosto do Cao Point
Mag.
Varn. 25° 51' W.
Scale of one sea mile
0
1


S. Lourenzo Pt.
Sto. LOURENZO BAY
[SANTA MARIA]
Varn. 25° 20' W.
Mag.
Romeiros Pt.
S. Lourenzo I.
275 ft. high
S. LOURENZO
Papagayo Pt.
Scale of 1 sea mile
0
1


VILLA FRANCA
Forca Pt.
Area Pt.
Ilheo da Villa Franca
Corno Pt.
Mag.
Varn. 25°48' W.
VILLA FRANCA ROAD.
Scale of one sea mile
0
1


Samusca Pt.
Pozao Pt.
Villa I.
Mag.
25°18' W.
VILLA DO PORTO
Old Fort
Malmerendo Pt.
VILLA DO PORTO BAY
[SANTA MARIA]
Scale of one sea mile

N.E. extremity of the island, point Riveira, there is no place of consequence, and the coast is all high and bold, with soundings extending 2 miles from the shore.

It may be remarked, generally, that the coasts of San Miguel or St. Michael are all bold, and may be approached without fear, as all the dangers lie within a quarter of a mile of the shore, with the exception of those between Mosteiros and Ferraria points already noticed. When approaching from the westward, the N.W. end of the island has an unpromising appearance, as it presents but barren mountains of stupendous bulk, with a steep barren coast, surmounted by a few trees of slender growth. If approaching from the eastward, for Ponta Delgada, take care to give point Galera a good offing, not only on account of the rocks, which have before been mentioned, but because the high land behind often occasions a calm thereabout. During the winter months heavy squalls are often frequent, from S.W. to N.W., more particularly from the latter quarter.

The plateau of soundings generally follows the sinuosities of the coast: the line of 100 fathoms is found at from 1 to 3 miles' distance from the shores, except off point Ribeira (east side), where it extends to 6 miles, and again off the village of Albufeira (south side), where it is found within two-thirds of a mile of the shore. The line of 200 fathoms rarely extends a mile beyond the 100 fathoms line.

The channel between St. Michael's and Terceira is safe, but it is and always has been, the seat of great volcanic disturbance.

Tides:—It is high water at full and change, at 12h. 30m; the rise and fall being 6 feet.

SANTA MARIA, or ST. MARY.—The island of St. Mary is about 7 miles in its greatest, and 5 miles in its smallest diameter, and contains an area of 36 square miles, or about 27,000 English acres. It has nearly in the centre the double-peaked mountain of Pico Alto, 1870 feet in height, which falls on the east and west sides to a shelving base of about a mile in breadth, and 850 feet above the sea. To the north and south it throws out a range of undulating heights, which terminate at the sea in lofty mural cliffs of more than 200 feet in elevation. The east side of this range is covered with hills, diminishing in altitude as they recede from the centre, and intersected by numerous gorges of increasing width and depth, the channels by which the heavy rains of winter reach their point of discharge. The west side is a slightly inclining and undulating plain, also cut by ravines, terminating in cliffs more than 100 feet high. The aspect of St. Mary is therefore on all sides perfectly bold; the central peak distinct, the subordinate

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The result of our survey was, that, at about half a mile distant from the shore, between Ribeira Grande and the Morro das Capellas, there is a line which, with occasional projections towards the land, separates the foul and stony bottom of the coast from a perfectly smooth and firm bed of fine sand, sloping to seaward; that along this line the depth varies from 25 to 35 fathoms, and from the rugged nature of the coast itself, the small port of Capellas is the only part at which it would be safe for boats to disembark.

T. C. Hunt.

British Consulate, St. Michael, 24th Dec. 1841.

range high and of varied outline, and the coast abrupt, precipitous, and based by the usual accumulation of fallen masses.

The surface on the west side is much overlaid with stones, and bears a spare vegetation of the grasses and weeds of argillaceous soils; the central range is covered with the common heath, myrtle, and arbutus of the Azores, and the east side is occupied, for the most part, with the agricultural produce of the island. Of trees, there are a few in small plantations, and there is an increasing inclination to extend the culture of the orange; but the shrubs of the mountains, which now contribute most to the wooded appearance of the surface, are fast disappearing under the axes of the fuel-cutters, and the demand for land suited to the cultivation of corn.

The number of inhabitants is about 4000. The people are represented to be well formed and active, and their complexion and cast of features partake more of a northern character than is generally seen in the Portuguese. The men are of good height and muscular, although frequently exposed to scarcity of food. In their manners they are mild and engaging, ready to lend each other services or provisions, and scrupulously exact in salutations, to which they give greater apparent cordiality than is observed in the neighbouring island. They are of grave temperament, and disinclined to popular sports and amusements, owing probably to the constant and sensible difficulties of their existence and the ever-present reflection that they are, in their own words, "very poor." Yet superficially, there are no indications of this poverty: their dress is whole and cleanly, and their houses are well kept, both inside and outside, and in good repair. The cheapness of lime, pottery, and tiles enables them, at a trifling cost, to provide themselves with a sufficient stock of necessary household utensils, as well as to preserve the roofs and plaster of their houses. Indeed, there is perhaps no country of the same resources where the external appearance of the houses lends a more cheerful air to the landscape or shows more outward signs of prosperity and generally diffused wealth.

The produce of the island consists of wheat, Indian corn, oranges, and a small quantity of wine, potatoes, beans, and other articles not registered. About half the wheat and all the oranges are exported; the remaining provisions are consumed on the island. To the growth of this produce is appropriated one-sixth of the whole area; the remainder is sterile. Of the western plain, the greater part is only fit for pasturage, the rest being either barren mountain-land or underwood. There is a good supply of horned cattle, sheep, pigs, goats, horses and asses. For these the grass and other fodder of the island do not afford a sufficient supply of food; and they are, therefore, fed in winter on the bruised leaves of the aloes, which are cultivated for the purpose on the stony ground and the otherwise unprofitable sides of the ravines.

The land communications are extensive, and in dry weather excellent; the nearly exclusive use of ox-carts for transporting produce maintaining a good width, and the firm consistence of the soil giving them a resisting and durable foundation.

The island is on all sides easy of defence against external attack, the various landing-places being close-to and commanded by high positions, and without cover for a disembarking force. The artificial defences are at present insufficient in number and in bad repair, and the number of landing-places would render a large force necessary for the repelling of invasion.

The N.E. end of the island is formed by the bifurcated point of Matos and point Souza; a reef extends a short distance from the base of the former, and on each side of the latter there is a rock on which the water breaks. The points are moderately high and rocky, with high land behind—a character which equally applies to the irregularly curved coast-line extending five-sixths of a mile more southerly, where commences the bay of *Santo Lourenzo.* This bay is about ⅔ of a mile wide from point Santo Lourenzo on the north to point Rameiros and the islet of Santo Lourenzo on the south. Its whole extent is fringed with rocks, here and there alternating with a sandy beach, and the same remarks appertain to the coast some distance north of point Santo Lourenzo. The front of the bay is an elevated cliff rising by a succession of terraces, on one of which are some houses and a church, whence a road leads to the town of Santo Lourenzo, distant rather more than a mile. The continuity of the cliff is broken by two ravines, through which issue two small torrents. The soundings are very regular, and there is anchorage in 16 to 20 fathoms, dark sand; off the western extremity of the islet of Santo Lourenzo bearing S.S.W. ¼ W. distant half a mile, there is 14 fathoms and good ground. This anchorage is opposite the north end of the bay, where will be found the best landing-place, and water of the best quality may be procured by making pits on the beach. In 5 or 6 fathoms water the bottom is frequently rocky. The bay is open to all winds between North and S.E., and especially to those from N.E., which generally produce a heavy, rolling sea; it is, nevertheless, the best anchorage the island of Santa Maria affords. The islet of Santo Lourenzo, 275 feet high, has a small rock north of it, and there is a narrow deep channel (5 to 7 fathoms) between the islet and the main, with a conspicuous rock to westward of each entrance.

From point Rameiros to point Feiteira, 2¼ miles, the coast has a general S.S.E. direction, the most prominent features of which are points Papagayo, Cedros, and Gorda. S. by W. ¾ W., 1⅙ miles from point Feiteira, is point Maya, with a small bay between, and opposite the village of Maya is a low rock (*Matha Rock* or *Baja de Malla*) about a ¼ of a mile from the coast, with a clear passage of 9 fathoms in mid-channel: there are also a few rocks off the point. S.W. by S. ½ S., ¾ of a mile beyond, is the high and bifurcated point of Castello, (Lat. 36° 55½′ N., Long. 25° 1½′ W.) the S.E. extremity of the island, where there is anchorage with the point bearing S.W. by W., about ½ a mile, in 9 to 10 fathoms, sandy bottom.

The coasts between points Rameiros and Castello, is high and in several instances very bold, especially from point Rameiros to that of Cedros, where the continuity is also frequently broken by ravines, down which pour mountain torrents. Numerous peaks present themselves along the whole of the east coast of the island, not far from the shores. The small town of Espirito Santo lies 1½ miles north-eastward of the village of Maya.

From point Castello the coast trends south of west to point Malbusco, 2¾ miles presenting a few salient points with detached rocks at their bases. Half a mile to westward of point Castello is Penedos das Armas, off which, at the distance of a ¼ of a mile, is the *Sul Rock* (Lat. 36° 55¼′ N., Long. 25° 2¼′ W.), with 8 fathoms water between it and the shore. Malbusco point is high, and has 15 to 20 fathoms a short distance off: thence to Marvâo point, 3¼ miles, the coast takes a northerly curvature, forming the bay of Praya, in which the soundings are regular, and on the western side of it is Figueiral point surmounted by Facho peak, 758 feet high.

Pescador Rock:—On the eastern side of the bay of Praya, about ¼ a mile off shore, is Pescador rock, carrying only 3¼ fathoms—dangerous, since it does not always show, and it is steep. If coming from the westward, keep point Castello some degrees open of point Malbusco; and if from the eastward, do not pass within the line of the south end of Villa islet, joining point Malbusco, or keep point Malmorendo in one with the middle of the island, as either of these marks will clear it.

At about three-quarters of a mile westward of Marvao point is Malmerendo point, the coast between bending suddenly inwards and forming the bay of *Villa do Porto*, at the head of which is the chief town of the island. It is very rocky and exposed, as all winds between S.E. and S.W. blow directly in, and if with any strength, cause a heavy sea; consequently it is resorted to, in summer, by small vessels only. In order to be ready for a start, it is usual to anchor S.E. of Marvao point, opposite Figueiral point. The best anchorage known to the pilots is about a mile from the coast upon the line of Malbusco point in one with the old fort near point Malmerendo, when you will be entirely open of Marvao point. Here is a depth of 36 fathoms, bottom of sand; but at a short distance more easterly the ground is foul.

The town of St. Mary or Villa do Porto, containing 2242 inhabitants, stands between two ravines, through which streams from the interior discharge their waters into the head of the bay.

From Malmerendo point to that of Pozao, ¾ of a mile, the coast is rocky, and near the shore the depth of water is irregular. Off Pozao point is the island of Villa, 196 feet high, very abrupt to the westward and rising to a cone in the centre; the passage between it and the shore has a depth of 4½ to 5 fathoms in mid-channel. From the last-named point, the western side of the island of Santa Maria trends about N. by E. 2¼ miles, to point Pendurados, forming a bold and exposed coast—and thence, taking a more easterly curvature for 2¾ miles, the next prominent point is Frades. Along this slightly rounded coast-line, forming the N.W. end of the island, the shores are low, the soundings are by no means regular, and the islets, rocks, and shoals are numerous,—some just awash.

Maldebarca rock lies nearly W. ½ S. a ¼ of a mile from the low point of Cabrestante; another rock, which breaks, bears N.W. (westerly), near ½ a mile from Forte de Risco, and thereabouts the line of 6 fathoms is fully ⅔ of a mile from the nearest shores.

Frades is a conspicuous point, 150 feet high, and appears from seaward like an islet, being situated at the extremity of a low tongue of land. From here, the northern coast of the island becomes more lofty, and is occasionally intersected by ravines. Between point Frades and Matos, a distance of 4 miles, three other prominent headlands occur,—Tamuscal, Ribeira, and Lagoinhas, which, with several of smaller size, contribute to form the coast-line into a series of small open bays. Two streams flow into the bay between points Tamuscal and Ribeira, which may be recognised by a conical peak at its head, and boats ascend the river nearest to the last-named point, for the purpose of procuring water, wood, and provisions. Point Ribeira is bold—ascending to the elevated plateau behind it by a succession of steep terraces. A ridge of rocks running N. ¼ E. ½ a mile from point Lagoinhas, terminates in a precipitous islet of that name, 277 feet high, which, when seen from the westward, is flat towards the northern end, and shows a small peak on the south. There is no channel between the islet and the point.

Shoal:—On a bearing about N. ¼ W. and nearly a mile from Lagoinhas islet, is a sunken rock carrying no more than 6 fathoms; from it point Matros bears S.E. by S. ¼ S., 2 miles,—and point Frades W. ¾ S., 2⅔ miles: Lat. 37° 1⅔′ N., and Long. 25° 6¾′ W. is the approximate position. There is a safe channel, about ⅔ of a mile wide, between the shoal and the islet—19 fathoms in its deepest part, midway between them, but it is safer to borrow on the neighbourhood of the islet than on that of the shoal in passing through.

Between points Ribeira and Lagoinhas commences a line of rocks and breakers which with varying breadth fringes the coast as far as the double point of Matos; the depth immediately outside this line of reefs is not uniform—varying from 5 to 12 fathoms.

It is high water, at full and change, at 12h. 15m., in the bay of Villa do Porto, and the rise of tide is about 5½ feet.

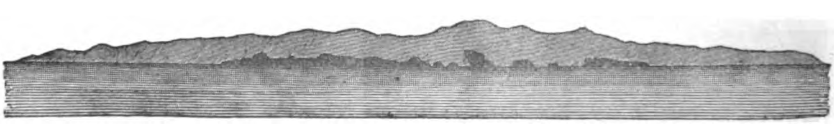
The bank of soundings around Santa Maria does not in general extend far off. On the west side, near point Pendurados—and on the south, between Malbusco point and the Pescador rock, the line of 100 fathoms is only ½ a mile from the shore:—on the east side, off points Castello, Gorda, and Cedros, it is removed from ⅓ to ⅔ of a mile;—elsewhere on those three coasts its distance varies from 1 to 1⅓ miles. On the northern side of the island the plateau is extensive but irregular: nearly 4 miles off point Lagoinhas, and on its meridian, 60 fathoms may be found, and ⅓ of a mile beyond there are 200 fathoms and upwards: on the meridian of point Cabrestante the line of 100 fathoms is distant about 2¾ miles, and westward of this it forms a loop around a rocky bottom carrying only 33 fathoms. With respect to the northern portion of the plateau, it may be said the soundings are tolerably regular up to 60 fathoms, they then increase rapidly to 100, 200 fathoms and upwards.

The character of the bottom all round the island is by no means certain—sometimes sand, sometimes rock, occasionally sand and shell with coral, or sand and gravel.

FORMIGAS AND DOLLABARATS.—At nearly 20 miles, N. 45° 15′ E. (*true*) from point Matos, the N.E. point of Santa Maria, is the bank of the Formigas rocks, which consists of a submarine mountain of very irregular elevation, and which, traced in the depth of 200 fathoms, extend 6½ miles, N.W. and S.E. (*true*) and is about 3 miles in its greatest breadth.

CAPTAIN VIDAL, R.N., says of this bank, "Near its western margin there is a narrow cluster of black rocks, known as the Formigas, which are about 800 yards in length by 150 in extreme breadth; their relative direction being north and south. The southermost of them, for about 350 yards, forms a rather closely connected mass, having a small bay on the west. The northern ones are more separated from each other, and all are comparatively of little elevation, but their profile exhibits a few hummocks. That on their southern extremity, which is 27 feet above low-water springs, afforded a theodolite station, at which the true bearings of some points and heights on Santa Maria and San Miguel were ascertained. It is in Lat. 37° 16′ 14″ N. Long. 24° 47′ 6″ W., and from observations made upon it on two consecutive days of very favourable weather, the following *true* bearings are derived:—Pico-alto, the highest peak on Santa Maria, S. 40° 37′ 39″ W.; Pico Castello, at the S.E. extremity of that island, S. 29° 4′ 9″ W.; and Pico Vara, the highest land near the east end of San Miguel, N. 82° 12′ 21″ W.; the latter peak being 38·1 miles distant, the Pico-alto 23·4 miles.*

The most elevated rock of the group, named by Tofino, *Hermigon*, is 35 feet in height, and stands on their eastern side, about 200 yards from the northernmost rock, somewhat more isolated than the others, and having an inclination to the southward.



S. 57° W.
Formigas Rocks and Sta. Maria Island.

With smooth water there is no difficulty in landing, particularly on the southern rocks, but in strong winds or a high swell, the sea rolls over them all, leaving a black naked surface entirely devoid of vegetation. One hundred and thirty yards south of the southern Formiga is a small rocky shoal, some parts of which are visible at low water: the channel between it and the rock has 5 to 6, and 15 fathoms water over the ridge which connects them, the greatest depth being near

* Throughout this description of the Formigas rocks by CAPTAIN VIDAL, the bearings refer to the *true* meridian.

mid-channel. Again, 600 yards or about three-tenths of a mile south of the southern Formiga is another small rocky patch, having 4½ fathoms upon it at low water. It is steep on the east, west, and south, but, on a line drawn from it to the Formigas, the soundings are very irregular, 11, 8, and 14 fathoms.

On the north the Formigas may be approached within a few yards, but a narrow ridge runs out from them in that direction for about 400 yards, with varying depths upon it, but no dangers. The outer extremity of this ridge has 18 fathoms on it, with the northernmost rock bearing South (*true*) about 300 yards distant. Immediately north of this it drops quickly into 30 and then 50 fathoms. On the meridian of the rocks, soundings extend off to the distance of 1·8 mile. On the east and west they are quite clear, with deep water close up to them; but on the west, the edge of the bank is not more than half a mile off, and at the distance of 200 yards from them the depth on it will be found about 50 fathoms.

S. 47° 7′ E. 3¼ miles from the station on the hummock of the South Formiga, is the western head of a very dangerous shoal, named *Dollabarats*. It consists of two or three rocky heads or knolls, which at low-water springs have only 11 feet water on them. At that time of tide their position is marked by several large white patches, which may be distinctly seen, especially so in bright sunny weather.

This shoal is near the southern end of a rocky ridge, which extends from it N. 15° 30′ E., 1·6 mile. The soundings over it are most irregular, varying from 14 to 28 and 30 fathoms, with 45 and 50 close to its edges; but there are no actual dangers upon it except those comprised within the dotted line which is drawn around the shoal.

The whole bank of the Formigas, as we have already stated, is a submarine mountain, and its varied elevations approach the surface of the ocean in several places. The shoal of the Dollabarats is, however the most eastern of these ridges, and the mountain has a steep and tolerably regular descent from it to the N.E., East, S.E., and South; the south-eastern slope being the most gradual.

The ridge next in extent to that of Dollabarats lies 1·1 mile S.E. of the South Formiga. Its southern limit is on a line drawn from that rock to Dollabarats, and it runs thence one mile N. 15° E., which is nearly the same direction as the Dollabarats ridge.

The least water found upon it was 16 fathoms, but the depths vary from that to 28 fathoms, beyond which it deepens abruptly on all sides. At its north end there are 18 fathoms, and next cast 44. Off its south end are two detached patches very small, the one has 28 and the other 30 fathoms on it.

Another, but smaller ridge, occurs half a mile on the west side of Dollabarats, between it and that last described. It is nearly 0·7 of a mile in length, very narrow, and the depth upon it ranges from 27 to 32 fathoms. Its general direction is about N. 10° E.

The quality of the bottom over the bank of the Formigas is principally rock, with frequent casts of fine white sand, broken shells, and small pieces of the branch coral common in our latitudes.

The Dollabarats is a very insiduous danger in smooth water, but in stormy weather the seas break over it with great violence.

It seemed desirable to ascertain whether this bank was connected with the island of Santa Maria at any fathomable depths, and a line of soundings was tried across the channel between them, but no bottom could be obtained with 300 fathoms of line.

A difference exists in the position of the Formigas as given by us, and that assigned to them by Tofino in his *Derrotero de las islas Azores*. The great Spanish hydrographer states in that work, that from the southern Formiga the Ponta Castello bears S. 24° 30′ W., and Pico-alto S. 34° 30′ W.; the former being 4° 34′ and the latter 6° 7′ less westerly than ours. This discrepancy induced a repetition of our observations on the following day, and they gave the same result. The navigator may therefore put the utmost confidence in the integrity of our position.

THE BERMUDAS, OR SOMERS' ISLAND.

The Bermudas derive their name from the supposed discoverer, Juan Bermudez, a Spaniard, who is said to have touched there in 1522; or according to May's account, from a Spanish ship, the *Bermudas*, being cast away there. The first printed account of them in English seems to be by Henry May, who, being on board a French ship, commanded by M de la Barbotier, was wrecked on them, in 1593. The second and less common appellation is from Sir George Somers, who was driven upon them, in 1609, on his voyage to Virginia. They consist of a numerous group of islands and rocks, being surrounded with dangerous reefs, nearly even with the surface of water, some of which extend 8 and 10 miles northward and north-westward, rendering the access extremely difficult; in addition to which, the land is low, and a current frequently sets towards them from the S.W. The Bermudas extend N.E. by E., and S.W. by W., about 24 miles, and the islands are of various breadths, being shaped in the most irregular manner imaginable. Including the small ones, the number of islands is over 360, but the large ones may be considered to be five in number,—viz., St. George, St. David, Long Island (or Bermuda proper), Somerset, and Ireland. There are two towns, each of which has its mayor and civic officers; St. George, on the island of that name, to the N.E.; and Hamilton, on the large island (or continent, as it is generally called), about the centre of the group; they are both well built of white stone.

St. George is built on the northern shore of the harbour of St. George, and is well sheltered from northerly and easterly winds by the rising ground behind the town; it is the oldest town in the Colony, and was formerly the seat of the legislature. In 1861, the population of the parish of St. George was 1982.

The harbour of St. George is a very fine sheet of water, lying between St. David and St. George islands, and is about two miles long by one mile broad. The main entrance is to the eastward of the town; small craft can enter at the ferry. All vessels drawing a depth of water not exceeding 21 feet can get into St. George harbour. A line of large and commodious wharves runs along the shore. Shipping in distress find a ready refuge in the harbour, and can soon be refitted, there being a marine slip in excellent working order. The harbour dues are, 1d. per ton up to 200 tons; over 200, ½d. per ton.

Hamilton, the capital of the Bermudas, is built on the southern shore of the parish of Pembroke, in Bermuda proper. It is central, and its harbour is a fine sheet of water, well sheltered from all winds by the high lands adjacent, but the entrance is narrow and intricate. Hamilton is near the dockyard, and about a mile from Prospect camp. In 1861 the population of the parish of Pembroke was 2506.

The scattered houses and hamlets are so numerous, that the whole island has the appearance of one continued village. There are no springs or fresh water streams in the islands, and but few wells the water from which its brackish; each house has its own tank, to which the roof serves as a conductor for the rain; and on the island of St. George are large tanks for the supply of shipping.

The climate of Bermudas is that of a perpetual spring, mild, genial and salubrious; though during southerly winds, which are the most prevalent, the atmosphere becomes charged with a humidity unfavourable to constitutions predisposed to rheumatism, gout, or pulmonary affections. The fields and trees are always green; but the predominance of the cedar, while it refreshes the air with its fragrance, imparts its dark hue to the landscape. Snow seldom falls, and rains are not frequent, though heavy while they last. The islands are, however, very subject to tempests, thunder-storms, and hurricanes, especially during the autumn,—a circumstance that may be attributed to their situation on the verge of the trade-wind, where variable and disagreeable weather always occurs.

There is not an insular group on the whole globe so protected by nature from the effects of a boisterous ocean, as the Bermudas. The few channels through the surrounding reefs are thickly studded with coral rocks, but the water is so beautifully clear, that they are visible to the eye; and the pilots, looking down from the bow of the vessel, conduct her through the labyrinth with a skill and confidence only to be acquired by long habit.

There are four signal stations on the islands:—One at St. George, the head-quarters on the east; another at mount Langton, near Hamilton; another on the south-west coast, at 3 miles from the south-west end of the islands; and the other at Gibbs' hill, on the west coast. At each a small party of soldiers is stationed. There is also a flag-staff at the commissioner's house in the dock-yard in Ireland's island, which communicates with mount Langton, and through that to the other stations. The population in 1861 was 11,451, of which 4624 were whites, and 6126 coloured people.

Sailing Directions.—In running from the eastward for these islands, the best parallel is between 32° 10′ and 32° 20′; a ship may then run on boldly, as there are no rocks at any great distance from the land on this side. With a large wind, and approaching land towards the night, no vessel should lie-to, but rather turn to windward under an easy sail till morning, as the current may take you unexpectedly among the rocks. It is also to be observed, that the islands are low, and cannot be discerned far; added to which a thick haze is often prevalent. Under these circumstances, it will be at all times proper to be correct in ascertaining your latitude, as making the land is somewhat difficult, and at times precarious.

As the prevailing winds in these seas are commonly between the south and west, vessels from the westward generally run for these islands in about the parallel of 32° 8′. Steering East, the first land seen will be Gibbs' hill to bear E.N.E.; and when within 8 miles of the land, take care it is not eastward of that bearing, because of the rocks named the Long bar. Steer then so as to pass within 2 miles of the south-east land, and when Wreck hill shuts in behind the south land, you are clear of the south-west breaker, and may steer along the S.E. side, at a mile distant from the shore, until abreast of St. David head.

On coming from the westward, the south-west points of the land ought to bear E.N.E. before you come within 4 leagues of the land, when you may steer directly for it without danger. The breakers on the south side always show themselves, so that a ship may safely approach within gun-shot, from the south-west end to the south-east; and when getting eastward of the castle round into St. George, do not go farther northward than to keep Cooper island open within St. David head, till you take a pilot.

Wreck Hill forms the west point, and St. David head the east. The W.N.W. and north sides are encumbered with a dangerous and continued ledge, beginning at the Long bar, the south part of which lies nearly 8 miles, W. ½ N., from Gibbs' hill; trending then N.E., it is named the Chub-heads, which off Wreck hill lie 6½ miles from shore; it thence extends to the North rock, and rounds East and E.S.E. to Mill's breaker, which dries at low water and lies E. by N. ½ N. 8 miles, from Catharine point. There are soundings round the outer edge of this ledge from 9 to 14 fathoms. There are soundings also 2 miles from the shore, round the N.E., East, and S.E. sides of the Bermudas; and as the water hereabout is deeper, vessels suspecting themselves in the vicinity of the islands, would do well to keep the lead going, being assured that at 13 or 14 fathoms, they will strike the ground in time to avoid danger.

Murray's Anchorage lies on the south-west side of Catharine point, extending from Tobacco bay to the ferry; the common entry is through an intricate narrow passage round the point; the ground consists of stone of the drip-stone kind, as fine as flour, mixed with a shelly substance and chalky clay, and is very heavy. In the event of not getting a pilot off Castle harbour, you may run as far as St.

David head: and when eastward of which, stand no farther northward than to bring the head to bear N.E., or you will see a white sandy bay southward of the head, between it and Castle harbour. In standing northward, care must be taken to shut no part of this bay in behind St. David head. The west land of Bermudas will be shut in behind the land over this bay, before this mark comes on. In the night, when waiting here for a pilot, the best precaution is the lead, for, if care be taken, and the ship is not running too fast through the water, you will be sure of striking ground in time to avoid danger. There is a rocky bank lying from S.S.W. to S.W. from Gibbs' hill, from 3 to 5 leagues distant, with various depths of water, from 16 to 40 and 45 fathoms.

The following particulars are extracted from Cotter's Sketches of Bermuda— The principal places of anchorage are St. George harbour, with a bar, over which at high water spring tides are 19 feet, but deep enough within that for ships of any burthen; Murray's anchorage extending from St. Catharine point to the ferry, the entrance to which is very intricate, but is well marked with buoys; this is the channel to Grassy bay. Off the dock-yard, in Ireland island, is the general rendezvous for H.M. ships; and also at Hamilton, situated at the head of the Little sound. Castle harbour was formerly the place assigned for men of-war, but this has been discontinued since the loss of *Cerberus* frigate, which struck on a rock, in endeavouring to get out to chase an American privateer.

Ships may approach within a mile of the land on the south side, there being no hidden danger; but on the north side there is a reef of coral, about 8 or 10 miles from land, extending from the North rock, bearing true north from St. Catharine, to the western extremity of the colony. There is, however, a passage through, abreast a point named Wreck hill, in Somerset parish, which is only frequented by vessels of light draught of water. There is also a passage near the North rock, but which is never resorted to except in cases of great necessity. The channel from St. Catharine point is almost daily reduced in width and depth of water owing to the influx of seaweed in the Great sound, and the rapid growth of coral; besides, ships have been detained several days in consequence of the wind not answering, to enable them to get through the intricate channel from Murray's anchorage. No stranger of common prudence would attempt any of the anchorages without a pilot, many of whom are always on the look-out, and put to sea when a vessel heaves in sight. Their boats are easily known, being of a peculiar construction and rig. They are of a light draught of water forward, but have what is called a long heel or deep stern-post, and are rigged with one mast and bowspit, carrying a triangular mainsail, a foresail, and jib, and occasionally a gaff topsail and squaresail.

Lighthouse.—A revolving light has been established on the southern part of Bermuda, in Lat. 32° 14′ N., Long. 64° 51′ W. Every minute it brightens up into a strong glare, which continues for 6 or 8 seconds; and as it is 365 feet above the level of the sea, it can be seen 7 or 8 leagues. The light can be seen on all bearings of the compass, except those between N. 64° E., and N. 74° E., where it is intercepted by high land. Within the distance of 7 miles a faint but permanent light can be seen between the brilliant flashes.

At night, or in thick weather, it is advisable not to make Bermuda to the north of 32° 8′ N., until the light or land can be seen. In coming from the eastward, the light should not be brought southward of W. by S., nor approached at night nearer than 6 or 7 miles. While coming from the westward the light should not be approached nearer than 12 miles, unless first brought to bear northward of N.E. by E. A vessel making the light to the southward should haul off immediately, as reefs extend from it to a distance of 16 miles northward.

Winds and Hurricanes:—For a description of the winds, climate, and hurricanes see p. 111, 112. See also Chap. XIII.

The tides are various, both in height and time, at different parts of the island.

SABLE ISLAND, &c.

SABLE ISLAND.—The east end of this remarkable island is situated in Lat. 43° 59′ 5″ N. and Long. 59° 48′ 27″ W. It is almost entirely composed of white sand, of a coarser nature than the soundings about it, but nevertheless sufficiently fine to be easily moved by the winds, which have a considerable effect in altering the features of the land, large sand hills being rapidly formed, and again in a short time removed. There are but a few large stones on the island, such as there are being probably the ballast of wrecked vessels, and there is an entire absence of anything deserving the name of soil, so that no cultivation whatever can be carried on, the sole production of the island being two kinds of grasses, wild peas, strawberries, and cranberries, of which latter the quantity is so great, and the quality so fine, that they have been proposed as an article of export. There are no trees, and fuel is obtained from the drift wood, mostly the product of wrecks. Fresh water is easily obtained by digging a few feet in the sand. The cattle are principally wild horses, besides the domestic animals belonging to the establishment; there are also great numbers of rabbits.

Sable island is about 18 miles long, and 1½ miles broad in its middle but tapers at each end to a narrow point, particularly at its eastern end. The direction of the island is about E. by S. ½ S., and in the greater part of its interior there is a salt lake of 5 to 12 feet water. The climate is said to be healthy, and those who have resided here for a number of years speak of it in terms of high praise, notwithstanding the frequent fogs and consequent humidity of the atmosphere; it appears to be greatly influenced by the proximity of the island to the Gulf stream, which is distant from it only about 70 miles southward. Winds from the southward almost immediately dissolve the snow which may have previously fallen, causing, with the alternating northerly winds, a wider range and yet a higher mean temperature than occurs on the neighbouring continent during the winter months. The southerly winds coming thus from a warm to a comparatively cold sea, are compelled to part with a portion of their moisture, and hence are almost always accompanied with a dense fog. These winds greatly prevail during the summer months, those from the south-west especially; on the contrary, winds from between North and East prevail mostly during the spring and early summer, and are usually attended with fine weather. In autumn and winter the easterly winds bring bad weather, and are accompanied by a falling barometer.

When approaching Sable island from the northward, it appears at the distance of 10 miles to consist of a long range of sand-hills, some of which are very white. From the southward the range of white sand appears more continuous, and very low towards the west end of the island. On a nearer approach many of these sand-hills are seen to be denuded by the waves, so as to form steep cliffs towards the sea; in other parts they are covered with grass and defended by a broad beach, which, however, cannot be reached without passing over ridges of sand, covered with only a few feet of water, and parallel to the shore, at distances not exceeding ¼ of a mile; these form heavy breakers, dangerous to pass in boats when any sea is running. The landing is in general impracticable on the south side, excepting after several days of northerly wind. On the north side boats can land only in southerly winds, and after some continuance of fine weather; but there are surf-boats at the establishment which can land dry when an ordinary boat would be instantly swamped.

The sand-hills at the eastern portion of the island average 60 and 70 feet in height. One of these sand-hills, named the East Hill, at about a mile from the East point, is considered an eligible position for a lighthouse.

The principal establishment on the island (1851) is situated on the north side, between the pond and the sand-hills, and consists of a house for the superintendent and his family, and of various other buildings. Opposite the establishment is the west flag-staff, which is strongly and substantially erected on a sand-hill 40 feet high, and at its summit is a *crow's-nest*, or look-out, 100 feet above the sea; from this look-out it is in contemplation to show a small light occasionally. Eastward of this flag-staff, about 7 miles, is the middle flagstaff, standing on a hill near the east end of the salt lake; but this will probably be soon removed to a more advantageous position on the south side of the island, where there is a house, and where it will be better situated to report wrecks, as well as to render prompt assistance. The east flag-staff is on a sand-hill on the north shore of the island at about 2¼ miles from its east point. Besides the houses at the flag-staffs there is an unoccupied one on the north side, which was distant in August, 1851, about 320 fathoms from the west extreme of the grassy sand-hills. These various flag-staff stations are extremely useful, as no wreck can take place on the island at a greater distance than 6 miles from one of them, and signal is at once made of such a melancholy occurrence to the superintendent at the principal establishment.

Anchorage.—Off the north side of the island, excepting near the east end where the deep water approaches too near the land, the anchorage is good between the depths of 5 and 10 fathoms, and at the distance of 2 and 1 mile from the shore. The bottom is of fine sand holding well, but the sea is so heavy, excepting with off-shore winds, that a vessel should weigh instantly on the first appearance of a wind from sea. Great caution is necessary in approaching from the northward at night or in thick weather, because the east end of the island and the north-east bar are very steep on that side, although the soundings afford sufficient warning further westward.

The south side of the island may be safely approached by the lead, excepting near the bars, where it becomes shallow and dangerous, but it is advisable to have the advantage of a commanding breeze, on account of the strong and uncertain tides and currents. Vessels seldom anchor off this side of the island, because of the prevailing southerly swell, and the consequent difficulty in landing.

The Bars.—At each end of the island are dangerous bars, upon which the sea breaks in bad weather. These bars are extremely difficult to avoid when at a short distance from the north side of the island, and caught with a strong northerly wind, and, if to this we add the suddenness of the dense fogs prevalent at some seasons of the year in the vicinity of the island, a vessel under such circumstances is placed in great peril, and nothing but the most careful navigation is able to extricate it. Their state, as represented by Captain Bayfield in 1851, is as follows:—

"The North-west bar is dry to ¾ of a mile out from the end of the grassy sand hills, but it has several patches of sand nearly dry, about a mile further out, and which are supposed to have collected around the remains of old wrecks.

The North-east bar is dry 4 miles out from the grassy sand-hills; the sea washing over the outer half of that distance only in rough weather. At the distance of 1¾ miles out on this bar a sand-hill, about 10 feet high, and with some grass on it, has accumulated around the wreck of a vessel lost there in the year 1820.

If we add the dry parts of the bars to the length of the island, the whole extent of sand dry at present, will be 22 miles; and if again we add to this distance the still greater length of the bars under water at either end, the whole will form a bow or crescent, concave to the north, and extending over 52 miles of sea. Caught within the horns of this crescent in a strong northerly gale, the situation of a vessel would be extremely perilous; for the ebb-tide sets southward, directly on and over the bars, usually at the rate of 1½ to 2 knots, and when accelerated by winds, much faster; whilst the flood-stream runs at a much less rate in the opposite direction.

The whole extent of the North-west bar, from the end of the grassy sand-hills to the depth of 10 fathoms, is nearly 17 miles; the dry part being succeeded by 9 miles of foaming breakers in bad weather, and the remaining 7 miles, from 5 to 10 fathoms of depth, being usually shown by a great ripple, or a heavy cross sea. The direction of this bar is N.W. ¼ N. for the first 12 miles, then W. by N. for the remaining distance; beyond which the water deepens gradually westward for many miles, The North-east bar extends 14 miles out from the grassy sand-hills to the depth of 10 fathoms. Its direction is N.E. by E ½ E. for the first 7 miles, beyond which it curves gradually till it terminates to E.S.E.

The dry part of nearly 4 miles is succeeded by 8 or 9 miles of breakers when there is any sea running. I have considered this bar as ending at the depth of 10 fathoms, but the ridge of sand continues, with a depth of from 10 to 13 fathoms, and often a heavy breaking sea, 10 miles further to E.S.E., and then ends abruptly; the soundings increasing to 170 fathoms, in a distance of 3 miles further in the same direction. Both bars are extremely steep, and consequently dangerous of approach on the north side; the North-east bar especially so, having 80 fathoms of water close to it. Southward, on the contrary, the water deepens gradually out for so many miles, that it would seem almost impossible for any vessel, using common precaution, to run on shore on that side either of the island or its bars. Yet by far the greater number of shipwrecks have taken place there, affording a sad proof of the culpable neglect of the sounding lead. Some of these vessels came on shore in fine, although foggy weather, after running for many miles in shallow water, when one cast of the lead would have shown them their danger, and in many cases saved both life and property.

In most cases the vessels were thought to be far eastward of the island, when they ran on shore upon it, having been set westward by the currents. That this alleged cause is the true one, there seems little reason to doubt, for the general tendency of the currents, between Newfoundland and Sable island, is westward, although they are greatly modified by the various banks over and between which they flow; and are also rendered inconstant and irregular, both in strength and direction, by winds present and at a distance. These currents are, first, the great northern current along the east coast of Newfoundland, which is deflected westward by the Great bank, and secondly, the current out of the gulf of St. Lawrence composed not only of the stream of the river St. Lawrence, but also of the branch of the northern current which is so generally found entering the gulf through the strait of Belleisle.

I have already mentioned the set of the tidal streams over the bars; they too are doubtless much influenced by winds. It was difficult, on account of the surf, to ascertain the exact time of high water on the full and change days, but it was at 7½ hours nearly, and the rise not exceeding 4 feet. This was on the north side of the island. I am inclined to think that it is high water somewhat earlier on the south side, as has been alleged, and that portions of the flood tide wave, after passing round the bars, converge and meet on the north side, making high water there perhaps an hour or more later; but I am not aware that any precise or sufficient observations have ever been made to ascertain this. It is said by the people of the island, that all floating things which have been lost overboard anywhere in the vicinity of the island, are sure to be found on it sooner or later. This would lead us to suppose a prevailing circular motion in the currents or tidal streams, to which the arrangement of the island, its bars, and the middle ground to the north of it, in their peculiar shape, may in whole or in part be due."

In case of shipwreck, it is of course greater hazard to life to be wrecked on the bars than on the island, and as it is important to know on which bar the vessel is, and the consequent direction in which to seek for safety on the island, you may ascertain this, should the island be obscured by fog or the darkness of night, by observing the direction of the breakers, those on the N.E. bar extending between N.E. by E. and East until near its outer extremity; whilst those on the N.W. bar extend N.W. ½ N.

Fogs, &c.—Captain Bayfield, R.N., says:—"Some of the heaviest gales in these seas have been from the N.E. and East quarters, and they are usually followed, almost immediately after the barometer has reached its lowest point of depression, by an equally strong gale, from between the North and West, and which is always accompanied by clear weather and a rising barometer. Easterly as well as southerly winds are foggy. The latter become less predominant as the summer advances, when westerly winds and clear weather become proportionately of less rare occurrence.

It is the fogs, even more than the irregular tides and currents, that render this island so dangerous; they frequently last many days and nights in succession with the prevalent easterly and southerly winds of early summer: and even as late as the beginning of August, when we were about the island, only 6 days out of 19 were entirely free from fogs. Winds between North and West are, in general, frequent in autumn and winter; they almost always bring fine clear weather, with a rising barometer, but are often of great strength, and in winter accompanied with intense frost." See p. 112.

The flood sets in from the S.S.W. at the rate of ½ a mile an hour; but it alters its course, and increases its velocity, near the ends of the island. At half-flood it streams north, and south at half-ebb, with great swiftness across the North-east and North-west bars: it is, therefore, dangerous to approach them without a commanding breeze.

ADDITIONAL DESCRIPTIONS.—The foregoing describes Sable island as it existed in 1851; we add the following by Mr. DARBY, formerly superintendent of the island, written in 1829, because it affords many interesting particulars not included in it. We remark, generally, that the island has frequently been partially destroyed by the sea washing over it, and great changes in its configuration have from time to time resulted from these inundations—therefore, no reliance ought to be placed on the state of the bars for any length of time.

"The soundings about Sable island decline regularly only on the south side; but approaching the isle from any other bearing whatever there is comparatively deep water (10 fathoms and more) close to danger. In foggy weather, vessels should not approach the north side or point of either bar nearer than 25 fathoms.

Two belts encircle the isle, the outer—a mile from the shore—2½ fathoms.

These belts are increased by gales, and by high winds raking the island, which drift the sand from them to the bars.

The prevailing winds are from East to South, and from South to West, when the north or leeward side of the island is comparatively smooth, and, therefore, should be sought. There is a swashway in each bar to save lives: get to leeward by crossing either bar (according to the wind) at these places. No risk in moderate weather, but if the surf should appear too dangerous, land as you can, or try to weather the bar altogether. Having once gained north of the bar, haul up S.E. or W.S.W. (as the case may be) for the land; and take the boat ashore, as near the house as may be convenient. The semi-circular form of the north side is favourable for boats, as under a windward curve a lee is afforded from east and west winds; but with fresh north winds this form is against a boat getting off the land. Therefore, if ashore on the north side, push the boat right before the sea for the land, rather than risk getting to leeward by crossing either bar; but if ashore on the south edge of either bar, wind north, land on the south side.

If ashore on the north-east bar in tolerable weather, wind about west, you may land at the east end without crossing the bar, and (*vice versâ*) if on the north-west bar, and owing to the inner belt, high water is best landing.

After landing, if owing to fog you cannot judge your situation, so as to shape your course to one of the houses, seek the lake, and then proceed.

The soundings are particularly irregular to the N.W. and N.N.W., with very variable currents. The whole of this bar breaks in bad weather.

South side of the Island.—The current on this side, in shoal water, with prevailing south and south-west winds, sets rapidly eastward until it reaches the end of the north-east bar; it then joins the St. Lawrence stream, which passes the bar in a S.S.W. direction, and runs strongest in April, May, and June. I have sufficient reason to believe that the Gulf stream, in 42° 30′ N., running E.N.E., occasions the St. Lawrence stream, running S.S.W., to glide to westward. The strength of this stream has never been noticed, and three-fourths of the vessels lost have imagined themselves eastward of the island, when in fact they were in the longitude of it."

A subsequent description of the island in 1837, by the same gentleman (Mr. Darby), speaks of it in the following terms. In alluding to the tides, he says:—"Easterly, southerly, and S.S.W. winds, set a rapid current along shore in shoal water, to the W.N.W. and N.W.; that is, along the shore of the western end of the island, but not the eastern or middle, as there the current, with southerly and S.W. winds, sets eastward. The natural tendency of the flood-tide is toward the coast. When it strikes the island it flows eastward, over the north-east bank, and to the westward over the north-west bank, and passes the west end in a north-west direction so rapidly that it carries the sand with it; and the hills of the west end being high and narrow, they are undermined at their base by it, and tumble down some thousands of tons of sand at a time. This the current beneath catches and sweeps away to the N.W., increasing the bank. As soon as this current passes the extreme point of the dry bar, it tends more across the bank to the N.E.; the motion of the sea contributing to keep the sand in motion; the current carries it to the N.E. and spreads to the N.W. Although across the bank from the island, to the distance of 15 or 20 miles to the N.W., there is a flood and ebb tide, the flood setting to the N.N.E., the ebb to the S.S.W., the flood comes over a broad flat bottom until it arrives at the highest ridge of the bar, bringing the sand with it so far. It then finds deep water suddenly eastward of the bar, and its strength is as suddenly lost, the waters pitching over this bank settle gently in deep water, and the sand going with the current does the same, and keeps the eastern edge of the bar and the bank very steep; but to the southward and westward it is flat and shallow.

The ebb tide, setting gently southward and westward, meets the steep side of the bank; and rising above it, passes over and increases in strength, merely levelling the sand that had been brought up by the last flood. It does not carry it back until the next flood comes, which brings up a fresh supply from the washing of the island; and so alternately the sand changes with every flood and ebb tide. The consequence is, that although the west end is several miles eastward of where it was in 1811; yet the shoalest or eastern part of the bar or bank has the same bearing from the dry land that it had then, which plainly shows that the bar and bank have increased eastward as fast as the island has decreased in the same direction. But the distance of the outer breakers has not increased more than about 2 miles; in 1829 their whole distance from the land being from 10 to 14 miles, in rough weather bearing N.W. from the island. There is a passage across the bar inside, about 4 or 5 miles broad, with 3 or 4 fathoms of water. Since 1811, or about 26 years, an extent of 4½ miles of high land has been washed away, which averages rather better than one-sixth of a mile every year. In the last few years it is nearer to ¼ of a mile every year, owing to the land being much narrower than it was the first 15 years of the elapsed time. The whole of the island that does not wash away grows in height; the most windy seasons cause the greatest elevation of parts where loose sands can be blown on to them; but the island in general grows narrower.

The eastern end of the island has not wasted much in length since my knowledge of it—nearly 30 years. The high land (about a mile from it) has blown down with the wind, (but not washed down with the sea, as at the west end,) and now there is a low, bare, sandy beach, extending in a N.E. direction from the high land about 3 miles. I think about one mile of this was high land, or sand-hills, 30 years ago; the other 2 miles were formed by a low sandy beach, as at present; the elevated portion of the one mile of course has been blown into the sea, and gone to increase the shoal water on the bar, being carried there by a strong flood-tide setting to the N.N.E. The bar itself extends from the dry part E.N.E., and at the distance of 12 or 14 miles from the high land, a very shoal spot, always breaks, except when dry, at which times seals may be observed lying on it. Between this spot and the land is a passage about 5 or 6 miles wide, with

3 to 4 fathoms of water in it. This bar and bank is also very steep on the north-western edge, and shallow and flat on the opposite directions. The bar travels northward slowly; the N.W. bar travels northward and eastward rapidly.

Mr. DARBY writes on another occasion, "The most of the wrecks that happen here are in consequence of an error in longitude; for instance, vessels bound eastward think themselves past the island when they get on shore upon it, and vessels bound westward (say from Europe) do not think themselves so far westward when they get on shore upon it. I have known several cases of vessels from Europe that have not made an error in their longitude exceeding half a degree, until they came to the banks of Newfoundland, and thence, in moderate weather and light winds, have made errors of from 60 to 100 miles, which, I think, goes far to prove the existence of a westerly and southerly current between the Great Newfoundland bank and here; and also of the existence of a westerly current between the Sable bank and gulf stream, which will be stronger or weaker according to the distance between the stream and the banks.

When a casualty has occurred, and you find you are on the body of the island, I would recommend that nothing of masts or rigging be cut away, unless the vessel is very tender, and then you may do it to ease her a little; but a vessel of ordinary strength will bear her spars until she heaves upon the beach, or settles in the sand, and lies quiet. Lives and property have often been saved by a vessel having her spars standing, as from them you may often send a line a shore, when it is not possible to work a boat: and by sending a good hawser after that, and securing it well to the shore, a chair, or other more efficient article, may be rigged for conveying passengers, or valuable property, over the breakers in safety. From the nature of the soft sandy bottom, a vessel will not go to pieces so soon as if she were on rocks; and, by the rigging being left standing, it may afterwards be saved; whereas, if the masts are cut away, the whole of the rigging goes with them, and all get tangled and buried in the sand, and are generally totally lost.

If you are on either of the Bars, the first consideration should be to secure the boats, and lighten the ship, and leave her as soon as ever you have to abandon the hopes of getting her off; an endeavour should be made to get to leeward of the breakers, and land on the island, according to circumstances. Endeavour to land on the north side, if possible, as vessels that get on to the bars very soon disappear altogether, either by going to pieces in the irregular sea and strong currents, or by rolling over the steep bank to the northward, and sinking in deep water.

When property can be saved on the island, it is the duty of the master and his crew to do the utmost in their power to save it; they can get the assistance of the people on the island and a boat and a team of horses, not for hire, for they are employed by government, and the island draws a salvage of whatever may be saved on it, which is apportioned by the magistrates at Halifax. The more there is saved by the master and crew, the less salvage will be taken; but it is very often the case, the crews will not assist to save property; and whatever is saved is done exclusively by the establishment, in which case the salvage is pretty high. There are buildings on the island for the shelter of persons cast away, with provisions for those who may have none; also some buildings for the reception of perishable goods; these buildings, and whatever is put into them, are under the charge of the superintendent. All property saved must be sent to Halifax by the first opportunity. The master can keep inventories, and continue with the goods if he likes, but has no control over their destination; but, I believe, by petitioning the Governor of Halifax, he might get permission to take them where he pleases, by paying the duty and salvage.

When any property is saved on the island, it is sent to Halifax, when it is advertised and sold by order of the Commissioners, and the proceeds paid into their hands, out of which they pay the Royal Dues, the salvage apportioned by the magistrates, the expenses of freight, and other small charges; and the residue is paid over to the master, or other authorized agent, for the benefit of the underwriters, and all concerned. The superintendent is under the control of the Governor and the Commissioners, and can take no new step without orders from them. The above and before-mentioned custom is an old and long established rule, and supported by many acts of provincial legislature, and more particularly by an act passed the 4th day of April, 1836, which does more fully explain and set forth the rules for the guidance of the establishment.

The north side of the island is very safe, and a vessel may approach any part of it within a mile; and vessels in distress might, by standing in on the north side, and near the west end, where the principal establishment is, get a supply of fresh water or fuel, or a partial supply of provisions and fresh meat, except in cases of a strong breeze and heavy sea on shore. There is no difficulty in working boats on this side of the island. The south side is also very safe to approach in clear weather; but from the heavy sea that constantly breaks on it, the communication with a vessel, by boats, is extremely difficult, except after a spell of northerly winds for 3 or 4 days, when the sea becomes smooth, and boats may work."

THE RIVER CLYDE, LIVERPOOL, DUBLIN, &c.

Bound to the Clyde, or to Liverpool, Dublin, &c., by the North Channel.— Vessels homeward bound with westerly winds should endeavour to make the *fixed* light on Tory island, off the north-western extremity of Ireland, and pass outside that island because they will then be more out of the influence of the tides, and clear of the dangers of the coast; for as these winds are generally accompanied by heavy seas and thick weather, they might otherwise be perplexed in Tory sound during the night; indeed, it often happens that the winds become baffling, with a short chopping sea, between Tory island and the main. By making the light on a S.E. bearing, in soundings of from 50 to 56 fathoms, they will ensure a good offing along the coast should the wind hang to the northward, and if the reckoning be in error it will diminish the chance of their being caught to southward of Farland point.

If a north-east wind prevail and blow too strong for working, it would be advisable to seek, in a *small* vessel, the anchorage at Downies bay in Sheep haven or to enter Mulroy bay,* but in a *large* vessel, that in Lough Swilly, or, on the south-west side of the largest of the Skerries eastward of Lough Foyle, or, in fact, any convenient place of shelter, for as the sea very quickly gets up on this coast it is scarcely possible for sailing vessels to beat against it to windward. Yet the attempt to anchor should not be too freely made off any part of the north coast of Ireland, nor in any of the bays, except the above, if it can be prudently avoided, as there is no part of the world where more sudden and extraordinary changes take place in the weather, both in summer and winter. See Chap. XII.

When working along shore with easterly or south-easterly winds, vessels should carefully attend to the tides, and not allow themselves to be carried too close in, particularly between Farland point and Lough Swilly; nor should they work through Tory sound by night in winter, because the winds are often very variable there, and raise a cross heavy sea. Especial attention should also be given to the *Limeburner*, an outlying isolated shoal under water, over which the sea frequently breaks; it lies N. by E. ½ E. nearly 2¼ miles from the Melmore signal tower, on the nearest point of the main; the *fixed* light† on Tory island bears from it W.N.W. ⅜ W. about 15½ miles, and Fanad lighthouse S.E. ½ E. about 6 miles. When passing it at night ships should be very cautious how they approach it, and should attend to the bearings of the lights as a guide. In the day the land marks may be generally seen, viz., Templebraga, or Crooknacloggin cliff, the western part of Horn head, kept open of the extreme point of the Horn, being about W. by S., will clear it on the north side. The two cliffs in one will lead directly over the centre. This rock is the only sunken one off this coast beyond the distance of half a mile from it, and is very dangerous; for although there is but a pinnacle on which a vessel would strike, yet the sea breaks on every part of it in blowing weather, or with a heavy swell, and at least a cable's length in extent round it. It breaks more frequently with ebb tide, which, setting westward, is generally in opposition to the wind. With the flood tide it breaks but seldom, unless the wind and the sea are considerable at the time.

Upon Inishtrahull is a light *revolving* once in the space of 2 minutes, and visible at the distance of 18 miles from all parts of the horizon. Unless under certain favourable circumstances it is advisable to pass on the northern side of this island and the adjacent Tor rocks; the south side of the island has deep

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* See "South, West, and North Coasts of Ireland Directions."

† Visible 17 miles in clear weather.

water within a short distance of it, and the channel between it and Garvan islands is safe, and has soundings of from 20 to 40 fathoms in it, with the streams of tide setting directly through, still the heavy westerly swell, which generally prevails there, will in light winds often render a vessel unmanageable under her sails; the velocity of the tides has swept away all the loose soil, and left an irregular bottom at the above depths. The passage between Inishtrahull and the Tor rocks, although the depth is from 15 to 20 fathoms, should not be attempted, especially with light winds, on account of a reef extending ¼ of a mile from the island, and also because the tides run very strongly through it. Neither should any cause but that of extreme emergency induce a vessel to attempt the channel between Garvan islands and the coast, as a sunken rock in the fairway and also the rapidity of the tides offer great obstacles to a safe passage.

The approach to the North channel at night is considerably facilitated by the *flashing* light on Oversay island, off the south-west point of Islay, by the intermittent and fixed lights on Rathlin island, and by the fixed light on the Mull of Cantyre. In the exact fairway of vessels bound through the channel lies the *Middle Bank*, upon which are patches of 15, 16, and 17 fathoms, with 40 and 50 fathoms between and around them; the tide over this bank creates at times a very heavy sea, which indicates its position. Keep as nearly midway between Rathlin island and the Mull of Cantyre as possible, not on account of outlying rocks or shoals (for both shores are free from dangers of that description beyond the distance of a cable's length, and have deep water almost close-to them), but because the great velocity of the tides causes *races*, and in bad weather very heavy and dangerous seas.

If intending to pass through Rathlin sound, and having light winds and an ebb tide, steer for Bull point, the west end of Rathlin, as the stream will then be slack in its vicinity. By not opening Castle head to the northward vessels will avoid the strength of it, and on passing the point may get into Church bay, assisted by the eddy; which, however, does not set into the bay but across it towards Rue point, where it sets at the rate of 4 knots to the southward, close along the shore, rendering Church bay difficult of access, except with a commanding breeze.

When meeting with the ebb tide off Benmore head vessels sometimes heave to in Ballycastle bay: while doing so, much vigilance is required to guard against being set towards the Carrickvaan rock. See the "St. George's Channel Directions."

River Clyde.—From Rathlin sound, to pass southward of the Mull of Cantyre and Sanda for the river Clyde, steer S.E. by E. ½ E.; or, from the north side of Rathlin island, distant 1 or 2 miles, steer S.E. The Mull of Cantyre is a high rocky promontory, forming the south-western extremity of the peninsula of that name. Near its extremity is a lighthouse showing a *fixed* light, which serves as a very useful guide to vessels running through the North channel, into or out of the Irish channel, as it not only prevents too near an approach to the shore of the Mull, which is very steep, there being 24 and 16 fathoms close to the cliffs, but enables vessels to preserve a midchannel course between the coasts of Ireland and Scotland, and thereby keep clear of all danger. About the Mull there is a very strong tide-race, and some rocks lie off the base of the cliffs.

The stream runs past the Mull at the rate of 5 knots, and occasions a heavy, dangerous sea in bad weather; with either tide, quite close in, there is an eddy. Hence the flood takes a direction towards Sanda, and divides off its western end, the outer part passing on for the Clyde, and the other going inside the island and up Kilbrennan sound.

Ship rock, on the south side of Sanda, has a lighthouse upon it, which shows a *fixed red* light.

Paterson Rock, the most formidable danger in this locality, lies on the eastern side of Sanda at the distance of ¾ of a mile from it; it dries at low tide, is surrounded by deep water, and is marked by a buoy. The mark to pass eastward of the rock is Davar island open of the most projecting land southward of it; and southward of it Deas point open south of Sanda island. As Sanda light is not shown northward of the bearing from it of S.E. by E. ¾ E., by keeping it in sight vessels will pass well southward of Paterson rock in the night. This rock is much in the way of vessels approaching the Clyde, and requires the utmost care to avoid. It should always be passed on the east side. The flood tide forms a race eastward of Sheep island, and the ebb a similar one with an eddy westward of Sheep and Sanda, which should be duly considered by masters of small vessels when navigating in this locality.

From abreast Paterson rock to a similar berth off Pladda island the course is E. ½ N. Upon this island are two *fixed* lights, bearing from each other North and South. The stream of flood along the east side of Arran sets northward, and along the south end it sets eastward. It is scarcely perceptible near any part of the island, except Pladda, where it runs about a mile an hour when strongest.

Having rounded Pladda, haul up north-eastward and northward towards Little Cumbrae, which, with the Great Cumbrae, occupy a position midway in the entrance of the firth of Clyde, dividing it into two channels; the wider and deeper passage is on their western side, and is, consequently, that which is generally preferred by vessels bound to or from the river Clyde, as it is more clear and direct. The only danger in this channel is the spit extending from the south-west point of Great Cumbrae, the extremity of which is marked by a red buoy. A *fixed* light is exhibited from the west point of Little Cumbrae, and a *revolving* light from Toward point on the Argyll shore.

Largs Channel, the name given to the passage eastward of the Cumbrae islands is so confined by the banks and rocks extending from the shore of the main, that its free use is considerably impeded; but there are circumstances which render it advisable at times to use it, particularly as Fairlie road offers advantages not obtainable at other places in the firth. The depth of water in the fairway ranges from 16 to 30 fathoms, and the width from ½ to 1¼ miles, the narrowest part being between the south-east side of Great Cumbrae and the Fairlie sands. When sailing through from southward do not approach the shore of Little Cumbrae island nearer than ¼ of a mile to avoid some rocks and a 12-foot spit, which are steep; give the buoy on the edge of the Briguird spit a berth of a cable's length on its west side, or, if it should be washed away, keep Largs church just open of Great Cumbrae, bearing about N.E. ¼ E., and you will pass clear of that danger, and may steer over towards the south-east side of Great Cumbrae, and thence out northward, sailing rather nearer the island than the shore of the main. When tacking eastward hereabout, the Hunterston perch will point out that projecting spit of the Fairlie sands, and the buoy on Fairlie patch will assist in avoiding that shoal and in taking up an anchorage in Fairlie road. If not intending to enter that roadstead, and should the Fairlie buoy be gone, then, when abreast of Fairlie or Kelburn castle, the summit of Knock hill should be kept open westward of Largs pier, as it will lead clear of the patch, and also of the Kelburn bank.

The *Skelmorlie bank* lies in the midway of the firth, and the least water over it does not exceed 16 feet; this shallow spot has a buoy placed upon it. To clear it on the west side, bring Doun hill, in Dumbartonshire (recognised by its conical form), which is about 17 miles distant, just open west of Cloch point light, and bearing about N.E. ¼ E.

The lighthouse on Cloch point leads to the entrance of the river. Hence to the anchorage off Greenock there is nothing in the way of vessels but the *Roseneath patch*, a dangerous shoal of 5 feet water, ¼ of a mile in extent, marked by a buoy, and surrounded with depths of from 6 to 11 fathoms. To avoid the shoal when sailing up or down the river, keep either nearer to Whitefarland point than to Roseneath point, or within ½ a mile of the Roseneath or Dumbarton shore. The flag-staff in the fort (Matilda) on Whitefarland point, open ¼ of a point eastward of Binian peak, clears Roseneath patch on the west side, and if opened ¼ of a point westward of the peak, it clears the shoal on its eastern side.

In the middle of the entrance of the river the flood tide runs for 6½ hours at the rate of 1 knot per hour, which increases to 1½ knots as you approach Greenock, where the velocity on the ebb averages 2½ knots. In a position about equidistant from the mouth of the river and Long and Holy lochs the ebb stream is very irregular, being influenced by the outset from all the three.

Liverpool, Dublin, &c.—Being northward of Benmore head, Ireland, about a mile distant, a S.E. by S. course for 5 miles will lead to a similar distance eastward of Tor point, and although by standing along shore a vessel might turn the eddy tides to account, and pass inside the Maidens (but, when doing so, taking proper care to avoid the Hunter rock), still it will be better for a stranger to go well outside the Maidens by steering S.S.E. from the foregoing position, and having made good this latter course for 20 miles, those islets will be seen on a westerly bearing distant about 5 miles. Hence, in mid-channel, the course is S. ½ E. 80 miles to abreast the Mull of Galloway, leaving the Copeland light 7 miles to the westward. The light on the Mull will now bear about East 10 or 11 miles distant. Thence a vessel may sail towards Liverpool either northward or southward of the Isle of Man, but in taking the former route the dangers presented by the King William, Bahama, and other banks eastward of Ayr point, should, with the sets of the tides, be well considered before the passage is adopted, especially as the lightvessel and buoy are liable to be driven from their moorings by violent gales. With the Mull of Galloway light bearing East 10 or 11 miles, by following an E.S.E. course for about 28 miles, vessels will have Burrow head to the northward, and St. Bees head S.E. by E. distant 23 or 24 miles. As soon as the lighthouse on the latter head is seen on that bearing distant about 9 miles, the ship's head may be put to the S. ½ W., and thus you will pass clear of those banks towards Liverpool bay, but must be careful when tacking eastward not to shoal the water to less than 12 or 10 fathoms, till within sight of the lights or beacons marking the approaches to that port.

The lightvessel, showing a *revolving red* light, moored off the entrance of Morcambe bay, is an additional guide to those already established in this locality. By noting the bearings of the different points from its position, parallel courses may be shaped without further reference. Thus, from the lightvessel, St. Bees head bears N. by E. ¼ E., 38 miles; Foot of Wyre lighthouse E. by S. ½ S. 17 miles; North-west lightvessel (Liverpool bay) S. by W. 26 miles; Skerries lighthouse W. by S. southerly 49 miles; and the Calf of Man lighthouses N.W. by W. 48 miles.

Intending to pass round the south side of the Isle of Man, from the foregoing position with the Mull of Galloway light bearing East 10 or 11 miles, steer S. by W. for 30 miles, when you will be abreast the Calf of Man; after rounding which, at about 5 miles offing a S.E. ½ S. course will lead to Liverpool bay.

With the Mull of Galloway light as before, the direct course and distance to Dublin bay is about S.W. 75 miles. The most prominent dangers in the way of a vessel running along the Irish coast are the rocks and shoals in the vicinity of South rock light, those near the entrances of Carlingford and Dundalk bays, and the Skerries rocks, &c., all which are minutely described in the "St. George's Channel Directions." The above courses, however, will no doubt, by the observing seaman, be altered according to the several advantages which may offer themselves in relation to winds and tides, for which purpose the subsequent remarks will be found of considerable assistance. See also, directions for sailing to Liverpool and Dublin by the South Channel, given on a subsequent page.

Outward bound, and intending to proceed through Rathlin sound, a vessel may, by keeping within half a mile or a mile of the shore, have the tide in her favour two hours earlier than by keeping in the offing, and thus carry eight hours' tide with her. The Carrickvaan rock should, however, be carefully attended to. If an easterly wind springs up while off the north coast of Ireland, a vessel should endeavour to make the most of it, as it seldom lasts long; preserving an offing of 4 or 5 miles from the coast, always passing outside the *Limeburner*, and steering about W. ½ N. through Tory sound. With westerly winds it is expedient to work inshore, and in fine weather this may be done in safety, though the tides run 9 hours with the wind, and only 3 hours against it; but during the winter the most advisable course for a vessel to adopt when encountering a strong westerly wind, is to proceed to the first secure anchorage and wait for a suitable change, as already observed for vessels inward bound.

Tides.—In considering this subject we cannot do better than quote from that admirable authority, Admiral F. W. Beechey. He says, "In the North channel the flood or ingoing stream enters between the Mull of Cantyre and Rathlin island simultaneously with that passing the Tuskar into the Southern channel, but flows in the contrary direction. It runs at the rate of 3 knots at springs, increasing to 5 knots near the Mull, and to 4 near Tor point. The eastern branch of this stream turns round the Mull towards Ailsa and the Clyde, a portion passing round Sanda up Kilbrennan sound, and Loch Fyne. The main body sweeps to the S. by E., taking nearly the general direction of the channel, but pressing more heavily on the Wigtonshire coast; off which it has scooped out a remarkable ditch, upwards of 20 miles long, by about a mile only in breadth, in which the depth is from 70 to 100 fathoms greater than that of the general level of the bottom about it. Near the Mull of Galloway the stream increases in velocity to 5 knots; the eastern portion turns sharply round the promontory towards Solway firth, and splits off St. Bees head, one portion running up the Solway, and the other towards Morecambe bay.

The *central* portion, midway between the Mull of Galloway and Copeland islands, presses on towards the northern half of the Isle of Man, and while one portion of it flows towards Ayr point, the other makes for contrary head, and is there turned back to the N.E. at a right angle nearly to its early course. Passing Jurby point, it reunites with the other portion of the stream, and they jointly rush with a rapidity of from 4 to 5 knots round the point of Ayr, and directly across all the banks lying off there, and catching up the stream from the south channel off Maughold head, they hurry on together towards Morecambe Bay.

The *western* limit of the streams runs at the rate of 4 knots off the pitch of Tor point. Hence it strikes towards the Maidens, boiling over the Highland and Russel rocks, and other reefs in the vicinity of that dangerous group, and takes the direction of the coast from Muck island to Black head, at the entrance of Belfast Lough, which it fills. The portion of the stream which sets into Belfast Lough splits off Grey point; one part flowing towards Garmoyle, while the other bends back along the shore of Bangor, Groomsport, and Orlock, and blends with the general stream which has come on from the Maidens and Black head in nearly a straight line, and passes with it through the sounds of the Copeland islands. Hence it proceeds along the coast, brushes the south rock, and runs on towards St. John's point, off which the stream, like that coming from the southward, expends itself in the large space of still water, which remains almost undisturbed, although pressed upon by streams from various quarters."

The ebbing or outgoing stream does not materially differ from the foregoing. Outside a line joining the Mull of Cantyre and Rathlin island the stream joins that from the sounds of Islay and Jura, and turns sharply round Rathlin to the westward.

IRELAND.

Lough Foyle and Londonderry.—Inishtrahull island is 11 miles N. by W. ½ W. from the entrance of Lough Foyle, and on its north-east end is a lighthouse, showing an excellent *revolving* light, which appears in its greatest lustre once in every 2 minutes, and may be seen from all directions at a distance of 18 miles: the tower is white, 45 feet high, and the light is at an elevation of 181 feet. The position of the lighthouse is Latitude 55° 25′ 55″, Longitude 7° 13′ 37″. Northward of Inishtrahull, at nearly ¾ of a mile, are several islets and rocks above water, called the Tor rocks, extending East and West ¾ of a mile, and around which, close-to, is a depth of from 10 to 18 fathoms.

The two lighthouses on *Inishowen Head*, the northern side of the entrance to Lough Foyle, bear from each other East and West, distant 460 feet, and kept in line lead clear of the Tuns bank. The lights are *fixed*. The eastern tower, in Latitude 55° 13′ 46″ N., and Longitude 6° 56′ W., bears from the north buoy of Tuns bank, W.N.W. 1¼ miles: south-west end of Tuns bank N.E. ¾ E. 2 miles; and the tower on Magilligan point N.E. by E. 2¼ miles. The towers are circular, coloured white; the lights are 67 feet above the mean level of the sea, and in clear weather may be seen at the distance of 13 miles. The eastern light is shown over an arc of about 219° (from N.E. ½ N. eastward to W. by S.); the western light over an arc of about 60° (from N.E. by E. ½ E. eastward to S.E. by E. ½ E.)*

Lough Foyle is a capacious harbour, where the largest ships may ride in safety in all weathers: but the best anchorage for large ships is 3 or 4 miles above the entrance, on the north side of the bay, at about ½ or ¾ of a mile from the shore, in from 4 to 8 fathoms water. Ships that draw not above 12 feet, will ride easiest between Quigley's point and Ture, in 2½ or 3½ fathoms, the least water; or farther down, between Whitecastle and Redcastle, in from 2½ to 6 fathoms.

In sailing into Lough Foyle, the Tuns bank is the only shoal to be avoided; it lies on the south side of the entrance, leaving a channel between it and the land, on its west side of ¾ of a mile in breadth. It is about 2 miles long, E.N.E. and W.S.W., nearly a mile broad, and has a buoy at each end. A

* It is in contemplation to colour the western light *red*.

small patch near the middle of the northern edge of it dries about 2½ hours of ebb; with some neap tides, that part is said to be quite covered; when under water it is always to be distinguished by the sea breaking on it, except in very extraordinary calms. This patch is observed to diminish and increase; and when N.W. gales prevail, to wash away entirely and afterwards form again. To clear it on the north side, keep Redcastle house open with Magilligan point. The west end of the Tuns, near Magilligan point, has also a patch on it which dries; with this exception, there are 2 or 3 feet water on it with low spring-tides, the rest has 6 feet at least, but 9 for the most part.

To sail into Lough Foyle, take flood tide, or a brisk breeze of leading wind for stemming the tide, which runs in the narrows, about 3½ miles an hour; keep Glengad head two or three ships' lengths out by Inishowen head, until the high-water mark of Magilligan point bears on the south end of Sheriff's mountain, which is the south-westernmost but one at the head of the lough, then steer right in for the entrance, keeping about half a mile from the north shore, which will lead clear past between it and the Tuns bank. When up with Magilligan point keep at a greater distance from the shore, and run up for the anchorage before described. If the marks for sailing in cannot be discerned, keep Glengad head fairly out by Inishowen, till you are about half a mile from Inishowen head, then steer right in for the middle of the entrance, between Greencastle and Magilligan point, and keep ¼ a mile, or above 2 cables' lengths from the starboard shore. An iron beacon marks Bluick rock off Ballyloes, ¾ of a mile within the two lights; the channel is southward of this.

Above the anchorage a pilot will be necessary, for hence to Londonderry the channel is very narrow, and a large vessel will have to wait a proper time of tide for sufficient water.

Besides the two Inishowen lights, already mentioned, there are, in the lough and river, ten small *fixed* lights: the first, on the northern side of the channel, at 1½ miles within the Inishowen lights, is a *red* light 30 feet above high water, situated on Warren point, and shown between the bearings of E. by N., by eastward and southward to W. ½ S.; the second is a bright light exhibited from a building of piles, painted red, erected on the outer edge of the ridge, on the northern side of the channel, off Redcastle, and 7 miles above Warren point; the third, also shown from a building of piles, built on the edge of the Great bank, and on the southern side of the channel, off Whitecastle, is 1½ miles within the preceding; the fourth, likewise from a building of piles, painted black, erected on the edge of Ture spit, on the S.E. side of the channel, one-third of a mile off Ture point; the fifth, from another erection of red piles, situated on the edge of the flats, on the western side of the channel, off Cunnyberry, and 3 miles above Ture point; the sixth, on Culmore point, the west point of entrance to the river Foyle, from a red mast; the seventh, on Culkeeragh point, the opposite side of the entrance to the river, from a red brick building; the eighth is a *red* light placed on the western shore, near Boom hall, about 2 miles within

Culmore point; the ninth is shown from a lightvessel, moored on the edge of the flats fronting the south-eastern shore at the Crook: and the tenth, a red one, near Rock mill, on the western side of the river, just before you arrive at Derry or Londonderry. We believe that all these lights are shown only from October to May. From Culmore point the land rises gently towards Derry. Near Derry there are several remarkable hills. There is sufficient depth of water on good ground, close by the town, for large ships.

Galway.—The town of Galway, situated at the bottom of a deep bay, and at the mouth of the outlet of the lakes Corrib and Atalia, is considered to be the capital of the western coast of Ireland. It is a fine old town, and contains many houses of an ancient style of architecture. A fine line of steamers now runs from here to Halifax and New York. A dock has recently been constructed, and it is in contemplation to deepen the entrance to Lough Atalia, sufficiently to admit vessels of a superior class. A breakwater, extending from Mutton island, to shelter the roadstead, has also been spoken of.

Arran Islands.—These, facing the entrance to Galway bay, are named Inisheer, Inishmaan, Inishmore, Brannock, and Eeragh; the two last also have some islets about them on the southern side. They have deep water close off them to the south-westward, the soundings rapidly increasing to 30 fathoms, which depth is at not more than a mile from the cliffs. Inishmore, as its name "more *great*" implies, is the largest of the group. Galway bay can be entered on all sides. The southern passage into it is formed by the main land of Clare and Inisheer island; the only danger in the way is Finnis rock.*

The channel between Inisheer and Inishmaan, named *Foul Sound*, is about 1¼ miles wide, and has a depth of 18 to 20 fathoms. When running through, be careful not to get too close to the shore of Inisheer, on account of the Pipe rocks, a dangerous ledge extending ¼ of a mile from the north-western shore of that island, and having a depth of 6 or 7 fathoms close to its extremity.

Gregory Sound is the passage separating Inishmaan from Inishmore. It is a mile wide, and has soundings in mid-channel of 18 to 20 fathoms. The stream here has a rate of about 1½ knot. From the northern points of Inishmaan, a ledge of rocks, called Portacurra, extends nearly 2 cables' lengths, and has a depth of 2 to 6 fathoms at its extremity; as this ledge is very steep it must be cautiously avoided by vessels running through Gregory sound.

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* Inisheer, the south-easternmost of the Arran islands, is about 1½ miles in extent, and nearly circular in form. Its highest part is 200 feet above the level of high water. From its cliffs a ledge of rocks extends out a short distance, and at 4½ cables' lengths from its south-east side is a dangerous rock, dry at low spring-tides, named *Finnis*; this rock is separated from a shoal-ledge running off from the island by a very narrow channel of 4 fathoms water, and close to its south-east side are soundings of 17 and 18 fathoms; it is consequently a formidable danger. On the south point of Inisheer there is a *fixed* light at 110 feet above the sea, visible 15 miles; the arc illuminated is 245° (from E. by N. by eastward and southward to N.W. ¾ N). A strip or sector of *red* light is shown in the direction of Finnis rock.

The south shore of Inishmore is nearly straight and steep, but its northern shore is very irregular, and should have a berth of about a mile given it.

Brannock and *Eeragh* islands are of but small extent, and surrounded by rocky ledges, which render a close approach dangerous. Between the larger islands there are passages, but to run through these some local knowledge is requisite. The stream of tide in the channel of these islands is said not to run at a rate of more than 2 miles an hour. On Eeragh island, the outermost, there is a lighthouse, which shows a light *revolving every three minutes*, visible 16 miles; the arc illuminated is 326° (from E.S.E. by northward, westward, and southward to S.E. by S).

The *North Sound*, between Inishmore and Gorumna island, is free from danger beyond half a mile from the shores, except the heavy breakers on the bank running off the north-east side of Inishmore; this bank has a depth of from 4 to 10 fathoms water over it.

The courses and distances up Galway bay, to a position in mid-channel off Black head, are, from the middle of South sound, N.E. by E. ½ E. 11 miles: from the inner part of Foul sound, E. ½ N. 11½ miles; from the inner part of Gregory sound E. ½ S. 12½ miles; and from a berth 2½ or 3 miles N.N.E. of Eeragh lighthouse, in North sound* S.E. by E. ½ E. 21 miles. Hence to abreast of Mutton island the course and distance are E. ½ S. 8½ miles.

Black head is a bluff point, the hills on the summit of which rise to the height of 1027 feet, and are, therefore, very conspicuous. Immediately off the head are 11 to 15 fathoms, and you may obtain shelter during S.W. winds at 2 miles S.E. by E. of its extremity, in from 6 to 8 fathoms water.

When standing towards the southern side of Galway bay, it will be requisite to guard against two or three dangers lying off that shore, namely, the Loo rock, Long rock, Aughinish shoals, Deer rock, &c.

The Loo rock, situated in nearly the centre of Ballyvaghan bay, is mostly dry when the tide is down. There is a passage on either side of the Loo rock of 3

* Entering Galway bay by the *North Sound*, vessels should endeavour to make for the light on Eeragh island, and keep well outside the Skird rocks, for the whole of the space between Slyne head and Gorumna island is studded with a multitude of islands and rocks above and under the surface, so that a stranger, forced by the stress of weather to seek shelter, could not avail himself of the accommodation afforded by Kilkieran, Birterbury, or Roundstone bays by any directions that we could give, but must, if obtainable, get the assistance of some one acquainted with the locality, or else bear up for a more frequented and easier made port.

The *Skirds*, the outermost group of these rocks, lie N.W. ¾ W. 8¼ miles from Golam tower, and S. by E. ¼ E., 11¼ miles from the lights on Slyne head. Their southern, western, and northern sides are steep, having from 16 to 26 fathoms at the distance of a quarter of a mile, but off the eastern side there are several shallow patches with deep water between them. The principal rocks are sufficiently elevated to serve as a guide for the neighbouring harbours; the westernmost is the highest and most remarkable. The fixed and revolving lights on Slyne head kept in a line will lead outside these and all the adjacent rocks and shoals. The south shore of Gorumna island, and the coast hence to Galway, require a good berth given them, as the rocks lying off them are steep and shallow.

to 4 fathoms, but care is necessary, particularly in sailing eastward of it, not to run on the shelf extending from Finnavarra point, the north-east point of that bay. Outside Ballyvaghan bay, and on the north side of Finnavarra point, is a ledge of rocks extending ½ a mile outwards from the land, named Long rock. At about a mile north of the entrance to Aughinish inlet is a narrow shoal of 3 to 3½ fathoms, named Aughinish shoal. Immediately off its northern side are soundings of 6 to 7 fathoms. Deer island, or rock, is small and 9 feet in height, lying a mile from the north side of Aughinish tower. It is surrounded by a rocky ledge, and from its eastern side a sandy spit extends and joins the shore to the southward, so that there is no passage between it and the land in this direction. Eastward of this island is what is called the South bay of Galway, which it is here unnecessary to describe.

Kilcolgan point, the north point of South bay, and the south point of the north bay of Galway, is low and surrounded by a rocky ledge. At ¾ of a mile W.N.W. from its extremity is a patch of 2 fathoms, named *Kilcolgan Rocks*, situated on the extremity of the shallows surrounding the point, which patch may be cleared on the west side by bringing the light on Mutton island in one with the college at Galway.

The Henry ledges have, it is believed, a depth of not less than 4½ fathoms over them; they lie about 2 miles W.N.W. from Kilcolgan point. Northward and eastward of these is the *Margaretta Shoal*, which is about ½ a mile in extent, and has 3¼ to 4½ fathoms upon it, except at its eastern extremity, where there is a dangerous patch of 10 feet marked by a buoy. This patch lies with Merlin park house in one with the north end of Hare island, the lighthouse on Mutton island N.E. by E. ¾ E. nearly 2 miles: the beacon on the Black rocks N.N.W. ½ W. one mile; and the extremity of Kilcolgan point S.E. ½ S. 1¼ miles.

The *Tawin Shoals* are some patches of 2¾ and 3 fathoms, lying nearly midway between Mutton island and Kilcolgan point. The mark for them is, the light on Mutton island and college in one, N.E.; and if the college is brought a ¼ of a point open west of the light, it will clear them on the west side.

The *Ardfry Shoal* lies eastward of the Tawin shoals, at a mile N.E. ¾ N. from the extremity of Kilcolgan point. It is a small patch of 2 fathoms, and its mark is Oranmore castle and Saleen point in one, bearing E. ¼ S.

The foregoing are the most prominent dangers on the south side of the passage to Galway.

Opposite the latter shoals and rocks, and projecting from the north shore of Galway bay, are the Carrigna rocks, the Black rock, &c., all of which must be passed on the south side. The first lie off the village of Barna, and are marked by a beacon. The Black rock lies ¾ of a mile S. ¼ W. from the White cliff, and is marked by a perch. It dries only at spring tides, and has round it from 2 to 6 fathoms, its southern side being the steepest. To clear it on the *south* side, bring Merlin park house in one with the north-west corner of the lighthouse wall, E. ½ N.; if compelled to go northward of it, between it and the rocks extending from Seaweed point, bring Ross hill house in one with the south-east corner of the lighthouse wall, or what is nearly the same thing, bring Hare island in one with the south end of Mutton island, and it will lead you through the channel in 4 to 2¾ fathoms;—caution is necessary, however, as the rocks from Seaweed point are under water.

At nearly midway between the Black rock and Mutton island is Foudra rock, which dries at low springs. Its distance from the shore is about ½ a mile.

Mutton Island is a small island on the western side of the entrance to Galway harbour. It is surrounded by rocky ledges, and is connected to the shore by a sandy and rocky flat, dry at low tide. On it is a lighthouse, showing a *fixed* light, visible about 10 miles. The rocks off the island are steep; they may be cleared on the south side by bringing Ross hill house open south of the cliffs of Hare island, E. ½ S., as this mark will lead past them in a depth of 5 to 6 fathoms.

Hare Island is a small island on the eastern side of the entrance to Galway harbour. It is surrounded by a rocky ledge, and connected to the shore by a ridge, composed of sand and shingle, which is 4 feet above the water at low tide. Off the south end of the island is the Trout rock, dry at low water; the mark for it is Galway steeple touching the west end of Hare island.

Galway Road lies between Mutton and Hare islands, and has a depth of 20 to 10 feet. The holding ground is good, but when the wind is between South and W.S.W., a great swell is sent in. Small vessels must anchor on the east side of Mutton island, at about 2 cables' lengths from the shore, with the middle of the island in one with Black head; those drawing 10 or 12 feet anchor more to the south-eastward, so as to have Black head fairly open of Mutton island, and the steeple of Galway bearing North. Vessels of 10 or 12 feet draught may go into the harbour at about high water, by taking the last of the flood, and steering in between the buoys; when in, they lie between the quays.

River Shannon.—This river is easy of access, and deep enough to accommodate vessels of the largest class, though a pilot is very necessary to a stranger. The situation of the river may be known at a great distance by the Brandon mountains, which may be seen from a distance of 15 leagues, and by steering for which from southward, the Blasket islands will be made. The entrance being broad, free from dangers, and lying latitudinally, may be boldly run for. The lighthouse on *Loop Head*, the north side of the river, is also a good land-mark: it stands in Lat. 52° 33′ 39″, Long. 9° 56′ W., and shows a *fixed* light over an arc of 298° (from N.E. by E. ½ E. by westward and southward to S.E. by E.), which can be seen from a distance of 22 miles. Loop head bears from Keery head, the south side of the river, N.E. by N. ½ N. 8½ miles, and the soundings between are 14 to 30 and 24 fathoms on hard bottom, of sand and gravel. Having made the lighthouse, which, from its great elevation, may be seen at least 20 miles, vessels caught in a westerly gale may fearlessly run for shelter to Carrigaholt road, or, if bound up the river, either to Scattery or Tarbert roads.

The Shannnon, however, from the straightness of its course, is very deficient in well sheltered anchorages for small vessels.

From Loop head to Kilcradan head, the bearing and distance are E. by S. ½ S. 8¾ miles. The coast is bold all the way and clear of danger, and may be approached moderately close, as the depth at a ½ of a mile off is 12 to 9 fathoms, excepting at a mile W. by S. ¾ S. from Kilcradan lighthouse, where there is a small knoll of 4 fathoms named *Kilstiffin Bank*, upon which the sea breaks during south-westerly gales. The channel between it and the land has a depth of 7 fathoms, and the mark to sail through is, Kilbaha cliff and Kilclogher head in one.

Kilcradan Head is a bluff rocky headland, 120 to 140 feet high, having a lighthouse upon it, showing a *fixed* light, *red* towards the sea, but towards the land of an ordinary colour. The ebb tide sets strongly from Carrigaholt road, round the point. In the fairway, the flood at springs runs at the rate of 3, and the ebb at 3½ to 4 miles an hour.

Kerry Head is bold and there is deep water of 15 to 16 fathoms at a mile distant from it. Hence the coast trends round eastward about 10 miles to the small river Cashen, off the entrance to which a shallow spit of 1½ to 4½ fathoms, named *Cashen Spit*, runs out about 1½ miles; this may be cleared by bringing Kilconly point open north of Leck point, bearing N.E. by E. ¾ E. From this river the distance to Beal point is 6½ miles, the coast running north-easterly with no sunken dangers off it, but what are close to the shore.

Beal point is low, with sand-hills, conspicuous by the whiteness of the sand of which they are composed; they are 50 to 60 feet high, and covered with rank verdure. Off the point a shallow flat, known as the bar, extends about ¾ of a mile, part of which, nearest the shore, dries at low water; the other part, forming the outer edge, consists mostly of a ledge of stones, which only shows itself at extraordinary springs. The Tail of Beal bar is a stony flat of 2½ to 4½ fathoms, running from the bar in a westerly direction towards Kilcradan head; it extends from the shore nearly a mile, and may be cleared on the west side in 3½ or 4 fathoms, by bringing Ballybunnion point just open westward of the low rocks off Leck point, bearing S.W. by S. To clear Beal bar and spit on the north side, bring Kilclogher head, just touching Kilcradan head, but as this mark is very wide, bring Kilcradan lighthouse in one with the peak of Ray hill, and it will lead more than a cable's length clear in 17 fathoms. The breast-mark for being off the apex of the danger is Doonaha chapel (on the Claire side) just open eastward of Doonaha battery.

Carrigaholt Road lies on the north side of the river, just round Kilcradan head, and is a fine safe anchorage with all winds from westward, but with winds from E.N.E. to South there is a heavy sea, though not heavy enough to endanger a vessel well found in ground tackling. With south-westerly gales a long rolling swell sets in round Kilcradan point, which renders riding here at those times very uneasy. These roads have the advantage of being free from any great strength of tide. The ground is level all over the road, but from 6 fathoms it shoals gradually towards the shores; the bottom, of sand over clay and mud, is generally considered good holding ground. The best anchorage for large ships is with the top of Ray hill in one with the coastguard watch-house, and Shannon View house just open of the point on which Carrigaholt castle stands, in 5½ to 6 fathoms low-water springs.

A small shoal, having only 3 and 3½ fathoms on it at low spring tides, called *Doonaha*, lies with Carrigaholt town bearing W.N.W. ½ N., distant 2 miles, and Beal point sand-hill S. by E., 1¾ miles. There is also a knoll of 4¾ fathoms, lying a mile E. ¾ N. from Kilcradan point, having from 7 to 8 fathoms near it; and a rock with 5 fathoms over it, lying E. by S. ½ S., distant a mile from Doonaha shoal.

Kilrush anchorage is northward of Scattery island, at about 7½ miles eastward of Kilcradan head. The usual place is off the pier, where there is anchorage between Hog island and the shore. The ground not being good for holding and the current running strongly, this place is used but temporarily, previous to going alongside the pier.

At about 3¾ miles E. ⅞ S. from Beal point, and S.W. ½ S. from Rinana point, the south end of Scattery island, lies the *Rinana*, a rocky shoal, on the shoalest part of which, near the north end, is a depth of 2½ fathoms at low water, while on other parts it is 3½ and 4 fathoms. The mark for the south end of the shoal, in 4½ fathoms, is the top of Ray hill just open of Kilcradan cliff. To go clear of the south end, keep the top of Ray hill a little open southward of Kilcradan cliff. None but large ships, when the water is low, need be afraid of this shoal.

Scattery Roads.—On the east side of Scattery island,* vessels anchor with Beal point (but not the castle) shut in with the south point of the island, and Scattery tower N.W. by N.; here the depth is 6 or 7 fathoms on a bottom of strong clay. Between Scattery island and the southern shore, springs run at the rate of 4½ knots on the ebb, and 4 on the flood.

Carrig Island, on the south side of the Shannon, lies 1½ miles southward of Scattery island. From it a shoal extends rather more than half a mile in a northerly direction on the extremity of which is a depth of 2½ fathoms; to clear this shoal in 5 fathoms, do not approach it nearer than when Kilclogher head touches Beal point, bearing W.N.W. ½ W.

At about 6 miles S.E. ½ E. from the south end of Scattery island is *Tarbert Point and Rock;* upon the latter is a lighthouse, showing a *fixed* light. It bears from Rinana shoal, south point, S.E. by E. ½ E., 5½ miles, and from Bowline rock N.W. ½ W. 1½ miles. The light is not shown landward in the arc from it of from S. ½ W. to W. ½ N.

In *Tarbert Roads*, eastward of the island, a ship may anchor at about a cable's length southward of Cook's point, in 4 or 5 fathoms. This place is a better road

* We believe that Scattery roads is the station for all vessels passing up or down to bring-to for the boarding or landing of Custom house officers.

with the flood tide than with the ebb; the former has very little strength, but spring ebbs run at the rate of 3 miles an hour. Eastward of this anchoring place, and at about 2 cable's lengths from the opposite shore, lies Bowline rock, which uncovers at the last quarter of spring; it is marked by a perch. A shoal surrounds the rock a full cable's length on all sides, leaving a narrow channel of 2½ fathoms between it and the northern shore. On the south side of the river there is a bank, named Oyster bank, with 2½ fathoms on it; it extends 3 cable's length from Ballydonoghoe point, thus reducing the channel on the south of Bowline rock to a width of 6 cable's lengths. To go northward of this bank keep Glin church open eastward of Glin castle, bearing S.E. ½ S.

At rather more than 2½ miles eastward of Bowline rock is Long rock on the south shore, stretching fully 3 cable's lengths from the land. To clear it keep Loughel and Gurraun points in one, bearing E. ¾ S., or Glin castle twice its breadth open of Knockranny point, bearing W. by S. ½ S.

At nearly 2 miles eastward of Long rock, and 2½ cables' lengths from the south shore, is a rock, uncovered at low water, named Carrigeen; to clear it on the north side bring mount Trenchard open north of Loughel point.

Labbasheeda Bay is about 4 miles from Tarbert point, and on the northern side of the river. In it there is good anchorage, at about ½ a mile eastward of Red-gap point, and nearly ½ a mile from the shore, in from 8 to 6 fathoms: here ships lie out of the stream of the tide, on good ground and well sheltered.

At about 4 miles from Labbesheeda bay is Foynes island, situated on the south side of the river. The best anchorage for large ships off this island is S.E. from Cahircon house, and south or S.S.W. from a small island which lies about a mile eastward of that house, in from 6 to 12 fathoms; the ground is good, and the tides are moderate.

Beeves or Seal Rocks.—These are 3½ miles eastward of Foynes island, and 1½ miles E. by N. from the north point of Aughinish island. They lie nearly in the mid-channel, and begin to appear at 2 hours ebb. The lighthouse upon the largest and southernmost rock shows a *fixed* light visible from all parts of the horizon; it is *bright* in the arc from it of E. ½ N. southward to N.W. by W. (219°); *red* northward of the rock. Therefore, to steer southward of these rocks, keep the bright light in sight. As the Beeves are steep on their southern side, they may be rounded with safety at the distance of a cable's length from the lighthouse.

At about ½ of a mile eastward from the north point of Aughinish island, is a rock called Crinaan, which dries at half ebb; and at about ½ a mile eastward from this is the Herring rock, which also uncovers at half tide; to clear the latter on the north side, keep the highest part of Foynes island well open of Aughinish point, and the east side, borrow within ½ a mile of Beeves rock lighthouse. There are other rocks in this locality, but out of the way of vessels which pass within this distance of the lighthouse.

From the Beeves rocks to Beagh castle on the south shore the distance is 2½ miles. Abreast of Beagh castle and quay the depths begin to shoal from 5, 4, and 3, to 1 1½, 2, and 2½ fathoms at low water, which depths continue to near

Limerick, with the exception of one or two places, where there are as much as 8½ and even 5 fathoms. The channel also becomes narrowed by extensive banks lining the shores and outlying rocks, so that a pilot is necessary, if not already obtained. The pool of Limerick is about ¼ a mile below the town; vessels that draw 7 or 8 feet may ride afloat in it, and larger vessels may lie aground without sustaining injury, except that of straining, the bottom being of soft mud.

Cork.—Cork harbour is one of the finest harbours on the coast of Ireland, and is capable of accommodating almost any number of vessels. It has a deep and narrow entrance, through which the largest ships may enter at any time, without regard to the tide. Within, the harbour expands into a magnificent basin, interspersed with islands; it is land-locked, by which the greatest protection is afforded to vessels riding in the roadstead. Ships of the largest class come close to the quays at Queenstown, where the anchorage is excellent; and, indeed, it is almost impossible to imagine a finer harbour. The entrance is guarded by forts Camden and Carlisle; and the harbour is further protected by fortifications on Spike and Haulbowline, two small islands opposite Queenstown.

The course from the Land's end to the entrance of Cork harbour is N. by W. ½ W. 46 leagues; from St. Ann's lights, Milford haven, N.W. by W. ½ W. 39½ leagues; and from the north end of Lundy island N.W. ¼ W. 46 leagues. In proceeding for this harbour, from southward, look out for Knockmeldown hill, and having brought it to bear N.E. by N., keep on with this bearing until the Old head of Kinsale appears, which is about 5 leagues W. by S. ½ S. from the entrance of Cork harbour, and is readily distinguished, being a bluff headland with a lighthouse on it.*

The *lighthouse* on Roche point is 49 feet high, and shows a *red* light *revolving every minute* at 98 feet above the sea, visible 10 miles: the arc illuminated is from N. by E. westward to S.E. (237°). A *fixed white* light is also shown from the base of the tower, between the bearings from it of S.W. by W. and S.W. ½ S. (17°) to cover Daunt rock. A fog-bell is sounded eight times in a minute. When off the harbour, a bearing of Roche lighthouse will readily point out the vessel's position. The sunken rocks, Cow and Calf, lie a little outside of the point on the east side of the entrance, and must be carefully guarded against when entering.

* When approaching Cork harbour care must be taken to guard against a sunken rock, named *Daunt*, which lies much in the way of vessels bound to or from this port. It lies ¾ of a mile from Robert head; on the shoalest part of it the depth is not more than 10 feet, although on other parts it is 24 and 30 feet, and close to it on all sides 8 fathoms. This rock trends nearly in an E.N.E. and W.S.W. direction, and is, including the rocky ground which surrounds it, about one-sixth of a mile in length, and one-eighth in breadth. It is the more dangerous as the sea seldom breaks over it, unless under a heavy swell. The rock is now marked by a buoy, and also by a bell-boat buoy; the latter is in 12 fathoms, at 120 fathoms S.S.W. from it. A patch with 22 feet of water upon it is situated about two-thirds of a mile from Reanie head, and one mile S.W. ¼ W. from Robert head. This should be remembered when using the channel between Robert head and Daunt rock. There is also an 18 feet shoal ½ of a mile southward of Flat head.

Cork harbour is very extensive, easy of access, and affords shelter to vessels of any size, against all winds that blow; the ground, too, is good for holding, and the depths of water throughout vary from 4 to 14 fathoms. The anchorage may properly be divided into the inner and outer, the former being within or northward of the Spit bank, and the latter without or south-eastward from it. The first affords a secure station for refitting and equipment of vessels; but the second is merely used as a temporary roadstead. The spit alluded to is a mixture of sand, shingle, and mud, stretching more than a mile from Haulbowline island, in an easterly direction, its northern edge being parallel to the shore of Queenstown.

From the entrance of the harbour and up to the anchorage off Queenstown, the fairway is marked by buoys, red on the western side of the channel and black on the eastern side.

The principal dangers to be apprehended when entering the harbour are, Harbour rock, and Turbot bank, which lie directly in the fairway of the entrance: of these *Harbour Rock* is the outermost. It bears from Roche point lighthouse N.W. ½ N., is distant 3½ cables' lengths from it, and has only 14 feet upon it at low water spring tides. On the eastern end of the Harbour rock, a white and red beacon buoy is placed in about 4 fathoms at low water; a white and black buoy is also moored at a short distance from its western edge.

At ¼ of a mile from Harbour rock, in the direction of N.N.E., lies the south end of *Turbot Rock*, which extends thence in a westerly direction about $\frac{1}{8}$ of a mile. The shoalest water over it is 18 feet. On the outer edges of this rock are two buoys; the eastern red and white is surmounted with a beacon, and lies in about 4 fathoms water; the western black and white is moored in about 3½ fathoms.

Harbour Lights.—On the N.E. point of Haulbowline spit is a *fixed red* light, which illuminates an arc of 270°(from S.S.W. ½ W., eastward to N.W. by W. ½ W). Caution is required not to cross the bank between the lighthouse and Haulbowline island, and to give the lighthouse a sufficient berth when passing. Further in the harbour, between Passage and Cork, there are two small lights in Meelough channel; the southern is *red*, the northern *green*.

The channel into Queenstown harbour is very much narrowed by the steep flats which bound it; no part exceeds in breadth the distance between forts Carlisle and Camden. It winds circuitously between the buoys, narrowing at the same time as you proceed northerly, so that no one leading mark can be taken up and acted upon continuously from the harbour's mouth; though by attention to the buoys and to the lead, a vessel may be worked in or out at any time. The best channel for large ships is that eastward of Harbour rock and Turbot bank.

When running for Queenstown, endeavour to pass between Roche point and Harbour rock, or between the latter and Turbot bank; the first may easily be done by rounding the point within the distance of a quarter of a mile. Having arrived within, or northward of these banks, steer up the channel between the buoys marking the edges of the shoals.

Vessels may anchor anywhere in what is termed the outer road, between the lighthouse of the spit and fort Camden; the best position is with the Spit lighthouse bearing about N.W. distant half a mile.

Vessels beating into or out of Cork harbour, should know that the tide of flood sets, in the first instance, into the bight formed between Roche point, and Dog's Nose, and thence obliquely across towards Carrigaline river, where it is again warped into a north-easterly direction, which produces corresponding counter-tides and eddies along both shores. The tide of ebb has a directly opposite tendency. Roche point, as well as Dog's Nose, on which stands Carlisle fort, are both bold, as is also the western shore, as far up as the Turbot bank.

The above instructions suffice for the navigation of the harbour, but a stranger should obtain a pilot. At present the limits of the ship channel are well defined by buoys.

Waterford.—From the Land's End to Waterford lighthouse the course is N. ½ E. 48 leagues; and from the Great Saltee island to Hook point, the course is W.N.W. ¼ N., 11½ miles; from St. Ann's lights, Milford haven N.W. ⅞ N. 24 leagues; from the north end of Lundy island N.W. by N. ½ N. 34 leagues; and from the Small's lighthouse N.W. ½ N. 18 leagues. Upon the Hook point stands a tower, from which a *bright fixed* light is exhibited, visible 12 or 15 miles.

Upon the Hook point (the eastern side of entrance to the harbour) stands a tower 110 feet high, from which a *fixed* light is exhibited, visible in clear weather about 16 miles; it illuminates an arc of about 294° (from N.N.E. ¾ E. by westward and southward to East, from the lighthouse). The tower is white, with three horizontal red belts painted on it; the lantern dome is red. Bells are tolled in foggy weather.

Waterford harbour, at its entrance, is more than 2 miles wide. Further in, on its western side, is Credan head, a remarkable promontory, the extremity of which bears N. by E. 8½ miles from Hook point. At rather more than two miles southward from Credan head is the little harbour of Dunmore, where a *fixed* light is shown on the extremity of the pier, on the south side of the harbour;—this light is *red* to seaward, and *bright* to the interior of the harbour; it is not visible when descending the river until abreast of Credan head. The arc illuminated is from S. by E. ½ E. eastward to E. by N. (84°), from the lighthouse.

From Dunmore harbour some packets sail for Milford haven. These lie afloat at all times with good shelter; the pier affords a secure anchorage with westerly gales, as well as from the prodigious sea which rolls along the southern coast, but it is not adapted for an asylum harbour, being very confined, and wanting depth, there being only one spot within the pier-head with more than 14 feet, 9 to 12 feet being the ordinary depth at low water. The pier-head is in 4 fathoms water at low spring tides, and a vessel may stop at a cable's length north of it in 3 fathoms, secure from all but southerly winds.

From Credan head to Duncannon fort, on the opposite side, the bearing and distance are N.E. ¾ N., 2½ miles. At about a mile northward of Credan head, there is a *bar* across the harbour, composed of loose shingle, which has with northerly winds only 13 feet water upon it; but with southerly winds the water rises to 26 feet; at low spring ebbs there are only 12 feet.* This bar is connected with an extensive shelf, which stretches off from the coast on each side. The north-eastern part of the shelf, on the western side, is called Drumroe bank; it extends more than a mile from the shore, and narrows the passage abreast of Duncannon fort to about a cable's length;—upon its edge there are 2 fathoms water, and in the channel there are 8 fathoms:—the bank thence trends north-westward, in a direction nearly parallel with the opposite shore, until it joins Passage strand, the shelf extending south-eastward from Passage point, upon the extremity of which is a perch beacon.

A dangerous shelf, called the Ballistraw spit, lies on the eastern side of the harbour southward of Duncannon fort; it extends about a mile from the Fort point in a S.S.W. ½ W. direction. Another shelf, called the *Seedes Bank*, having only 10 feet at low water on its edge, stretches half over the river, between Ballyhack, which is about 1¾ miles above Duncannon fort, on the eastern side, and Buttermilk point. Another shoal, but smaller, and having the same depth of water, extends from the shore, just above Buttermilk point, to the distance of nearly half a mile.

Duncannon fort exhibits two *fixed* lights in one tower; the arc of illumination is from S.S.W. westward to S.W. by S. (11°). The building is white, and the lights being 58 feet above the sea at high water, may be seen in fine weather at 10 miles off.

A lighthouse also stands on the eastern side of Waterford harbour, in a N.N.E. ¾ E. direction from Duncannon fort lighthouse, distance 5½ cables. The tower is circular, white, and exhibits a *fixed* light, at 128 feet above the sea, visible about 16 miles; the arc illuminated is 22° (from S.W. ½ S. southward to S. by W. ¼ W).†

The distance from Duncannon fort to Passage point is 2 miles, and thence to Cheek point, at the entrance of Suir river, is nearly the same distance; here the river divides, one branch taking a northerly direction to New Ross, and named the Barrow river, the other running westerly to the city of Waterford.

Directions.—When approaching Waterford harbour from southward, or eastward, keep Sleanaman mountain (a remarkable mountain inland) N.E. until the Hook lighthouse, on the east side of the entrance, comes in sight.‡ Hook point

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* The most shallow parts of the bar are marked by buoys, two *red* being on the western side, and a *black* buoy on the eastern side of the channel; the passage into the harbour is consequently between the buoys.

† In addition to the lights at Duncannon fort and lighthouse, a small *red* light is shown from a pile lighthouse on the spit off Passage point.

‡ It should be remembered that the entrance to Waterford harbour is marked on its eastern side by the Hook lighthouse, a *single* conspicuous tower. The entrance to Tramore bay, the next inlet westward, is distinguished by *two* towers on Brownstown head, its eastern point,

should not be approached nearer than 3 or 4 cables' lengths, to avoid falling into the irregular streams of tide that set round it. When past the Hook, and intending to proceed for the anchorage at Passage, take a flood-tide, or leading wind, and steer for Credan head, give it a berth of about a cable's length, then steer for Duncanon fort, which is on the opposite side, at about 2¼ miles N.E. ¾ N. from Credan head. The two Duncannon lighthouses in one, lead in the best channel across the bar.

Between Broomhill point and Duncannon fort is Ballistraw bay. The sand on the opposite side is called Drumroe bank; it extends more than a mile from the shore, and narrows the passage abreast of Duncannon fort to about a cable's length. The deepest water is towards the starboard shore. Between the bar and Duncannon fort, are soundings from 2½ to 9 fathoms; the deepest water is nearly abreast of the lights. When above the lights keep near the eastern side, steering about N.¼ E. for the church of Ballyhack, until the perch on the upper end of Drumroe bank comes into view, to which give a good berth. When abreast of this perch, the depth is 6 or 7 fathoms in the middle of the channel; thence steer upwards in mid-channel for the usual anchoring-place, which is about a mile above Passage town, in 5 or 6 fathoms.

There is a very good anchorage at 2 or 3 miles above Passage, where the stream is much weaker than at Passage. In proceeding for this place, avoid the before-mentioned spit of sand, which runs off about W.S.W. from Buttermilk point, and extends about half-way over to the opposite side; the least water on this spit is 9 feet. Avoid also a small bank which extends about 2 cables' lengths from the shore, on the south side of Cheek point; the least water on this bank is 9 feet; at half-tide there are 14 feet. If proceeding at about low water, keep in the middle between the two points, or rather nearer to Buttermilk point; or if the flood tide be running, keep in the rough part of the stream, and you will go clear of the shoal. Such vessels as do not draw above 10 or 11 feet water, may go up to the town of Waterford; the safest channel is on the north side of Little island, the channel on the other side is deeper, but it is narrow and winding, and subject to eddy tides, which makes it both difficult and dangerous.

New Ross.—At Cheek point the river Suir is met by the river Barrow, which comes from the northward, and is navigable for large vessels as far as the town of New Ross, where are numerous corn mills and lime works. Thence there is a communication by means of barges with the town of Athy.

The following instructions for entering Waterford harbour are extracted from the Sailing Directions for the coast of Ireland, Part 1, published at the Hydrographic Office, Admiralty, 1866.

"Coming from the westward beware of the fatal error of mistaking Tramore bay for the entrance to Waterford. Off Tramore bay the water is deeper than at a similar distance from the entrance to Waterford: 2 miles south of Great

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and by *three* towers on Newton head, its western point; on one of these three towers is the colossal figure of a man with his left arm extended in the direction of Waterford harbour. A dangerous set of the current into Tramore bay should likewise be guarded against.

Newtown head there are 16 and 17 fathoms, gravel and stones; at the same distance south of Redhead there are 14 fathoms sand and stones: there is nothing sufficiently distinctive in the character of the bottom to enable a vessel by sounding to ascertain her true position. By not coming into less than 17 fathoms water, she will, however, keep well without the heads of the bay.

Having passed Tramore bay, the shore may be approached to the depth of 10 fathoms. Sheep island kept open of Brownstown head N.W. by W. ½ W., until Broomhill point opens of Redhead, clears the Falskirt rocks. As the first of the flood makes into the harbour earlier close along this shore than further out, small vessels may take advantage of it to make short tacks along the land.

From the eastward the course from the Saltees lightvessel to the entrance of the harbour is N.W. ¾ N. 11½ miles. Working up, between Baginbun head and the Hook, be careful to avoid Brecaun bridge. If the eastern stream is running, which it continues to do until 4 hours after high water by the shore, make short tacks along the land, where there is an eddy as far as the Hook point.

With north-west winds a vessel may stop a tide off the village of Slade, in 5 to 7 fathoms, rocky bottom, with Slade castle W.N.W., half a mile off shore. Rounding the Hook in stormy weather give it a good berth to avoid the race off it.

In fine weather a vessel may bring up anywhere in the entrance of the harbour to wait for tide. Large ships arriving off the port with southerly winds should keep well outside the heads. Some by coming too close in have been carried up by the tide before they had sufficient water, and have suffered injury by striking on the bar, where there is always a swell with these winds.

To cross the bar with a leading wind, having arrived off Credan head, proceed with Duncannon lights in line N.N.E. ½ E. By day bring the low lighthouse on with the west corner of the upper lighthouse wall (the summit of Slieve Coiltia will be seen in the same line), which leads in 14 feet at low water, or a foot more than with the lights in line. Leaving the *black* buoys on the starboard hand, and the *red* on the port, as Duncannon spit buoy is approached, steer N.N.E., gradually opening the high light to the westward of the low, and passing Duncannon fort a cable's distance, run along the eastern shore to above Passage, being careful to leave all the *red* buoys on the Drumroe bank on the port hand. After passing Duncannon spit buoy the water deepens to 6 and 10 fathoms.

With a working wind, after passing the Falskirt rock off Swine point, the west side of the entrance, which is the best to work in on, may be boldly approached to within a cable of the shore as far up as Credan head. Standing to the eastward the Hook point, being moderately bold, may be approached to within 8 cables, until to the northward of Loftus hall, where the lead must be the guide, as it is flat a long way off.

In working over the bar, while to the southward of the buoys, tack in any convenient depth, pass between the *black* buoy and *red* middle buoy. When you can weather the latter a cable's distance, the west shore may be again approached by the lead; standing to the eastward, bear in mind that three-quarters of a cable north-east of the *black* buoy there is a ridge of hard ground with 8 feet over it, and that from this towards Duncannon the eastern bank is steep-to.

Opposite Duncannon fort be very careful to avoid the tail of Drumroe bank, which extends nearly one cable to the southward of the *red* buoy; the south Martello tower over Duncannon open to the southward of the fort, or the south face of the fort open, clears it. Arthurstown pier in line with a remarkable rock to the left of a roadway on the north side of King's bay, bearing N. ¼ E., until the west side of the flat-topped hill over Cheek point comes in line with the low cliff on the eastern shore to the northward of Ballyhack, bearing N. by W. ¾ W., leads to the eastward of the bank, and up to the anchorage off Passage.

In the bight above Duncannon tack the first shoal cast, and stand towards Arthurstown pier with caution. With these exceptions the east shore above Duncannon may be boldly approached.

Above Passage proceed along the western shore at the distance of from half to one cable from the rocks, keeping Arthurstown church open of Ballyhack hill, until East cottage comes in line with Cheek point, in order to clear the Seedes bank.

The river Suir is navigable by vessels of 20 feet draught as far as the city of Waterford, where they may lie afloat in front of the quays. And for several miles beyond this it may be navigated by vessels of considerable burthen.

Cheek point bar, with from 9 to 11 feet water, stretches across the entrance of the Suir. The best water over it, 11 feet, is with the flour mill (a large white building near the water west of Snowhill house) in line with the high-water mark under the house, bearing W. by N.

Drumdowney point is encircled by a mud flat which dries off some distance to the southward. The east shore of the entrance to the Barrow is similarly encumbered, leaving a narrow channel on its western shore, to be described hereafter.

Proceeding up the Suir; after crossing Cheek point bar, the water soon deepens to 10 fathoms in mid-channel. The river winds round in a south-westerly direction, through Glasshouse reach for rather over 2 miles to Little island. The northern or Kilkenny shore is bold-to, but the south shore is skirted by a mud flat, with occasional patches of rock.

At Little island the river channels diverge; the old channel, or natural bed of the river, called Kings channel, encircling the island to the southward, is very tortuous, and 2¼ miles long. The Ford channel, on the north side of the island, is quite direct, and scarcely a mile long, but has 5 feet less water than Kings channel.

Kings channel, with a bar of 13 feet water at its east entrance, is frequently used by steamers, as, if drawing less than 12 feet, it enables them to proceed up to Waterford at all time of tide. To facilitate the passage of sailing vessels through the channel, mooring rings and chains are attached to the rocks at various places, but it is now never used without the assistance of steam.

The Fordchannel, as its name indicates, was fordable at low water before it was deepened. Now it is to be preferred to the Kings channel, being more direct and shorter. It is nearly a mile in length and 210 feet in width, with not less than 8 feet water. About the middle of it there is a hole with from 12 to 13 feet, but the general depth is from 8 to 11 feet. The course through is W. by N. for 2 cables, and then N.W. by W. The channel is well buoyed with *black* buoys on the north side, and *red* on the south.*

Tide gauges are erected on the north of Kilkenny shore at each end of the Ford, to indicate to an approaching vessel the depth of water through. They are placed at a sufficient distance to allow of a vessel anchoring or proceeding by the Kings channel, if there is not water enough on the Ford.

After passing the Ford channel, a vessel may continue on without danger or obstruction to Waterford, a distance of 2 miles. In the bight at the Cove there is a deep hole with 11 and 12 fathoms water, and near Croomwells rock, where the channel is but one cable in width, there is a similar depth. In other parts the depths vary from 3¼ to 7 and 8 fathoms, the whole affording excellent anchorage.

The City reach extends N.W. ¼ N. and S.E. ¼ S., three quarters of a mile in length, Its widest part (opposite the custom-house) is nearly 1¼ cables between the low-water shores. Here vessels of the largest class may lie afloat at their anchors. A flat extends from the shore in front of the quays to near mid-channel, with 13 feet water over it, and 4 fathoms between it and Kilkenny shore. In mid-channel, to the north-west of this flat, there are 6 and 8 fathoms water, and to the south-east of it, near Cromwells rock, 12 fathoms.

The city of Waterford is of considerable size, and was formerly surrounded by a wall, remains of which with some of the towers are still standing. Of its various churches and chapels the spire of the cathedral is most conspicuous. From the Hook light to Waterford, by the river, the distance is 15 miles, from Passage 7¼ miles, and from Cheek point 6 miles. Tramore bay, which is the nearest part of the sea coast, is 6 miles distant."

LIVERPOOL, DUBLIN, &c.

To Liverpool, Dublin, &c., by the South Channel.—The Irish coast from the Saltees to Dublin, and the Welsh and English coasts from the Smalls to Liverpool, have but few harbours accessible at all times of tide ; consequently, a seaman should be prepared to maintain his position at sea in all weathers, rather than run into danger by approaching the land in search of a port of refuge.

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* A further deepening of the Ford channel, to 13 feet at low water spring tides, is now (1866) in progress.

Entering the channel with a disabled ship there are two harbours which may be run for, Waterford and Milford haven; the former has upon its bar only 13 feet at low water spring tides,* which the latter is accessible at all times, though there are some shoals in the entrance which require caution to avoid.

After entering the channel, no port of refuge is reached till in the vicinity of Holyhead or Kingstown. Holyhead is easy of access, especially during day; but Kingstown can only be attained by a due regard for Arklow, India, Codling, Kish Banks, &c. With the object of saving life the nearest beach for that purpose should be sought; yet in such urgent need, or in the event of a ship being entangled in certain neighbourhoods, it may be useful to mention Balliggerry, or Wexford south bay, or St. Tudwall roads, on the south coast of Caernarvon, as capable, according to circumstances, of affording shelter. But it should be remembered that even in a good seaworthy ship, if entangled among the shoals in the vicinity of the former place, or in Caernarvon bay, there is considerable difficulty in bad weather in contending with the flood tide, which rushes round Carnsore point, and also through Bardsey sound, with great velocity; still, by a previous careful study of the coasts, and a consideration of the capabilities of the ship, very acceptable shelter may be found in either of those places.

Having cleared all dangers in the vicinity of the Saltees and Tuskar on the one side, and the Smalls and Bishops on the other, the land-falls to be afterwards made are mostly bold and discernible at long distances by day, and are also well lighted at night. But thick weather sometimes occurs, which conceals the land for days together; therefore, at such a time, and particularly when accompanied by contrary and baffling winds, the necessity for a close attention to the soundings is imperative. With a leading wind, and making a fairway mid-channel course, the set of the current so nearly coincides in direction with the course as to affect the ship only in retarding or assisting its progress; but in any departure from this mid-channel course, some further considerations have to be made, in consequence of the gradual change in direction and force of the currents, which are found in approaching the land.

Considerable judgment is required when taking soundings in this channel, and it is at all times advisable to tack too soon rather than stand towards possible danger. A depth of 40 fathoms is found in the immediate neighbourhood of the Tuskar, the Smalls, the Bishops, and Bardsey island, and 30 fathoms close to the Blackwater, Arklow, and Kish banks. Being in or near their latitudes, and obtaining these depths, it is advisable to put the ship's head from the danger and stand towards the fairway.

The course from a position in 44 fathoms S.E. by S. 5 miles from the Tuskar to where Bardsey lighthouse bears S.E. 10 miles, is E.N.E. nearly, and the

* It is high water at Waterford entrance on full and change days at 5h. 20m.; ordinary springs rise 12¼, and neaps 7 feet. With southerly gales the sea has a send of about 4 feet on the bar, for which allowance must be made.

distance 58½ miles; or from the same position off the Tuskar to a position 5 miles N.W. from the South Stack lighthouse about N.E. by E. ½ E. 81 miles. Caernarvon bay has in most parts a clear sandy bottom, and little stream of tide, so that vessels may stop almost anywhere at a mile or two from the shore in moderate weather and with the wind off the land; but the ground is not strong enough to hold sufficiently in blowing weather, especially with westerly winds, which raise a great sea. If acquainted with the navigation and bound for Liverpool, a passage may be made inside the Skerries, but a stranger should go north-westward of them, where he will have a clear channel and less strength of tide, and besides be better able afterwards to give a good berth to the dangerous rocks off the north shore of Anglesea.

Approaching Liverpool, and having weathered the Skerries, if the land has not been seen, it will be advisable to sight point Lynus, or the Calf of Man, and so obtain a good departure, unless the weather be hazy, when such a proceeding might involve unnecessary risk and loss of time. On the west side of Calf island are two lights, each of which revolves once in 2 minutes. Point Lynus light is a flashing light, visible 8 seconds, dark 2 seconds. During day there is an advantage in seeking Lynus head as a point of departure, because at this place facility is afforded for communicating by telegraph with the port; but proper caution should be observed in doing this to clear the Ethel and Coal rocks, and, although the north shore of Anglesea is bold, great care should be taken to avoid becoming entangled among the outlying rocks and shoals, and in the strong currents, which at spring tides sweep past the point and among the Skerries, at the rate of 5 knots an hour. With point Lynus south, distant 5 miles, the course and distance to the north-west lightvessel are about E.S.E. ½ S. 36 miles, this may be modified according to your distance from the point. The direction of the flood stream is nearly the same, and, therefore, need only be regarded in its effect upon the distance made good. Before running on it is necessary, however, to consider the state of the weather, the ship's draught of water, &c.; also the state of tide and depth of water on the bar at the probable time of arrival off it; care also is necessary to maintain sufficient offing with strong N.W. winds, so as to prevent any risk of being drawn by the flood tide into shoal water before there is the required depth over the bar.

North-westerly and westerly winds in general bring clear weather, which makes running for the port a task of comparatively no great difficulty, especially as the *fixed* light on Great Orme head* is visible hence to Liverpool bay, and point

* This light is visible at a distance of 24 miles; it shows *white* between the bearings from it of N.W. by W. ¾ W. northward and eastward to East (155°) and *red* from East to E. ¾ S. in the direction of Liverpool bay. Hence when standing into Beaumauris bay, it will be found to mask suddenly, if brought to bear eastward of S.E. by E. ¾ E., thus warning the mariner of the approach to shoal water. When eastward of the meridian of Great Orme head, the change from *white* to *red* takes place upon the bearing of the north-west lightvessel from that head. The *red* light disappears if brought to bear northward of W. ¾ N.; it thus gives warning of an approach to the northern edge of the Chester flats and west and east Hoyle banks. If the *red* light be kept in sight, those dangers cannot be approached nearer than about a mile.

Lynus light is scarcely lost sight of before either the point of Air, north-west lightvessel, or the rock light comes in sight, and, as the vessel advances into the bay, the other lights gradually appear, to ease the difficulties of a night navigation, each being designed for a special purpose. The Rock light is shown over the sea horizon, and, can generally be seen from a greater distance than either Bidston or Leasowe lights. The Leasowe and Bidston lights are seen to the greatest advantage when bearing S.E. ¼ S. The upper Hoylake light does not open until it is in line with the north-west lightvessel, bearing S. by E. ¼ E., and the lower one not until it is brought to bear S. ¼ E.

Easterly, southerly, and south-westerly winds frequently bring thick weather, so that often when working in, and when most needed, these lights are obscured, or only seen at a much shorter distance; the careful use of the lead must then be resorted to, and the altered direction of the stream to be experienced in approaching the land be borne in mind. After passing Lynus point a depth of 15 fathoms at low water ensures safety, and less than that indicates the necessity for proceeding with still greater caution. If hazy weather, and daylight, the bold shore of Orme head (having a depth of 7 and 8 fathoms very close to it) affords an opportunity, by standing in to sight it, to take a new departure. Thence along the northern side of the Constable and West Hoyle banks, those acquainted may stand off and on into 8 fathoms, and thus work up to the north-west lightvessel, even in thick weather a stranger should maintain deeper water.

A red nun buoy marks the shoalest (12 feet) part of the Constable bank; it lies on its northern side in 16 feet at low water, with great Orme head light W. ¼ N., and distant 6¼ miles. At the distance of 6¼ miles E. by S. ¾ S. from this buoy is the chequered buoy on the N.W. end of the tail of the middle patch, lying in 2¼ fathoms; and 2¼ miles further on, in an E. ¼ S. direction, lies the black nun buoy on the Chester bar of the Welsh channel, placed in 2 fathoms water. N.E. by E., 1¾ miles from this latter buoy, lies the white buoy, with black perch and ball, in 4 fathoms, off the north extremity of the West Hoyle bank; it is situated a little southward of the track of vessels steering from great Orme head to the north-west lightvessel. These buoys serve to warn mariners to keep to the northward, and in no case should a vessel pass southward of them.

The north-west lightvessel is the most prominent floating* object in Liverpool bay, and in making for the port in hazy weather, when lights are discernible only a very few miles' distance, it is better to steer for it, for then a fresh departure can be made for the Queen's channel Fairway Bell beacon, which bears from it nearly east distant about 8¾ miles. In adopting this latter course a consideration must be given to the set of the current, lest with a flood tide you find yourself upon the banks. The Victoria channel, Fairway buoy, a black nun, with a

* It lies 6¼ fathoms at low water, off the west extreme of the three and four fathom tongue, in a position indicated by the change of the great Orme head light from *white* to *red*, and by the masking or unmasking of the upper Hoylake light, when bearing S. by E. ¼ E.

perch and ball, marked V. Fy., if made out before the beacon is seen, will serve as an additional guide; when in its vicinity a sharp ear should be kept for the sound of the bell attached to the beacon.

Northward of the Bell beacon the flood tide sets towards the river Ribble, and the ebb from it, as already mentioned, on which account a vessel should take the precaution of keeping clear of its influence with the former tide, especially if a westerly wind is blowing, for then she would hardly be able to weather the entrance to the Queen's channel; and drifting with a calm, or with a strong wind and heavy sea, on a lee-shore, would have no alternative but to anchor, in the latter case under very unfavourable circumstances. Consequently, if with westerly and north-westerly winds you are compelled to lie-to in the bay, endeavour should be made to keep to windward of the Bell beacon.

When passing along abreast the entrance of the Welsh channel, the northern edge of the West Hoyle bank, and the Helbre swatch, you will experience, and must provide against, the set of the tides to and from the river Dee. See the " St. George's Channel Directions.

If bound to Kingston or Dublin, the course and distance from the Tuskar lighthouse to Wicklow head, outside the banks, are N.E. ½ N., nearly 46½ miles, observing to make allowance for the set of the tide, whether flood or ebb. When Wicklow head light bears N. by W. ½ W., you will be clear of the Arklow bank; then to sail within the India bank, bring Wicklow light to bear West or W.N.W. distant 2½ miles, and steer N. by E. ½ E. course and it will carry you past Moulditch bank and Dalkey island. If with a westerly or S.W. wind, you may haul close round the Muglins, and proceed along at ½ a mile from shore, but be careful to avoid the Frazer bank, which lies southward of Dalkey island.

Near the shore the stream makes to the southward 1½ hours before high water. It is necessary to observe that, when working up within the banks with a northerly wind and flood tide there is some danger of being set on the outer banks if you are more than 4 miles from the land, because at about that distance the stream branches off towards the N.E.

When sailing outside the banks it is necessary to guard against the effects of the ebb-tide, which sets in a south-westerly direction across them; therefore, do not get into a less depth than 23 fathoms.

In moderate weather vessels may stop almost anywhere within the banks between Wicklow and Dublin, except off the Giant's Bed, where lies the Moulditch bank; the best part, with westerly winds, is between Bray bank and the main, at from a half to 2 miles from the shore. Here is very little stream of tide, and the violence of the sea is considerably broken by the banks. All the shore southward of Bray head is soft beach, and almost steep, so that if a ship is driven on shore, there is very little risk of losing lives. The only safe way or reaching this anchorage is either between Wicklow head and India bank, of between the Kish bank and Howth head. There is a passage, fully 2 miles wide, between the Codling bank and the South ridge, which may be taken in clear weather, by keeping the Great Sugarloaf north of the gap, bearing N.W. ¾ N.; this leads in at about 7 miles northward of Wicklow head.

In Killiney bay, south-westward of Dalkey island, vessels may anchor in 5 or 6 fathoms, sheltered from W.N.W., round northerly, to N.N.E. winds, and also in 7 fathoms off Wicklow church, sheltered from S.W. and westerly winds.

Tides.—The following general remarks upon the tidal streams of the south part of the Irish channel, are the result of a very careful investigation by ADMIRAL F. W. BEECHEY:—

"In the Irish channel experiments have shown that, notwithstanding the variety of times of high water, the turn of the stream over the fair navigable portion of the channel is nearly simultaneous; that the northern and southern streams in the South as well as the North channel commence and end in all parts (practically speaking) at nearly the same time; which time happens to correspond nearly with the time of high and low water on the shore at the entrances of Liverpool and Morecambe bay, a spot remarkable as being the point where the opposite tides coming round the extremities of Ireland terminate. So that it is necessary only to know the times of high and low water at either of these places, to determine the hour when the stream of either tide will commence or terminate in any part of the channel.

The tide enters the Irish channel by two channels, of which Carnsore point and St. David's head are the limits of the southern one; and Rathlin island and the Mull of Cantyre the boundaries of the northern.

The *central* portion of the stream of flood runs nearly in a line from a point midway between the Tuskar and the Bishops to a position 16 miles west of Holyhead: beyond which it begins to expand eastward or westward; but its main body preserves its direction straight forward towards the Calf of Man, which it passes to the eastward with increased velocity as far as Langness point, and then at a very moderate rate on towards Maughold head. Here it is arrested by the flood stream from the North channel coming round the point of Air, and is first turned round to the eastward by it, and then goes on with it at an easy rate direct for Morecambe bay.

The *outer* portions of this stream are necessarily deflected from the course of the great body of the water by the banks on the Irish side of the channel, and by the tortuous form of the coast on the Welsh. The eastern portion passing Linney head rushes with great rapidity between the Smalls, Grassholm, and Milford haven towards the Bishops, which it passes at a rate of between 4 and 5 knots; sets sharply round those rocks in an E.N.E. direction right over the Bass bank, and into Cardigan bay; makes the circuit of that bay, and sets out again towards Bardsey; then sweeping to the N. by W. past the island and through the sound, it gradually takes the course of the shore, round Caernarvon bay, filling the Menai strait as far as Bangor; but the stream still continuing outside towards the South stack, which it rounds, setting towards the

Skerries at a rate of upwards of 4 knots; and, finally, turns sharp round these rocks for Liverpool and Morecambe bay.

The *western* portion of the stream, after passing the Saltees, runs nearly in the direction of the Tuskar, sets sharply round it, and then takes a N.E. ½ N. direction, setting fairly along the coast, but over the banks skirting the shore, so that vessels tacking near the inner edge of the sands on the flood, and on the outer edge on the ebb, have been carried upon them and lost, especially upon the Arklow and Codling banks. Abreast of the Arklow the tide scarcely either rises or falls. The stream, notwithstanding, sweeps past it at the rate of 4 knots at springs, and reaches the parallel of Wicklow head. Here it encounters an extensive projection of the Codling bank; and while the outer portion takes the circuit of the bank, the inner stream sweeps over it, occasioning an overfall and strong rippling all round the edge. Beyond this point the streams unite and flow on towards Howth and Lambay, growing gradually weaker as they proceed, until they ultimately expend themselves in a large space of still water situated between the Isle of Man and Carlingford Lough. There we have not been able to detect any stream, the water rising and falling nevertheless. This space of still water is marked by a bottom of blue mud."

• The outgoing or ebb stream does not materially differ from the reverse of the foregoing, only in pressing rather more over towards the Irish coast.

Additional Remarks.—The stream of flood along the east side of Cardigan bay runs northward, and the ebb southward. Along the north side of the bay the flood runs eastward, and the ebb westward; and throughout the bay its velocity does not exceed one knot when strongest, unless over the shoals, where it runs 2, and sometimes 3 knots. See the article on Bardsey island and sound, in the "St. George's Channel Directions."

Between Braich-y-pwll head and Holyhead island, the flood tide comes from the S.W., and the ebb from the N.E., and within a league of the shore in Caernarvon bay, its velocity does not exceed 1½ knots, when strongest, except in the rivers and narrow channels. The stream of tide near the north shore of Holyhead island runs eastward during the first 3 hours of flood, and then 9 hours westward, within half a mile of the shore. Near the east side of Holyhead bay, it runs southward 3 hours, and northward, or out of the bay, for 9 hours. Within a league of the shore off Holyhead bay, the velocity of the strongest spring tides is about 5 knots: neap tides about 3 knots.*

* One mile westward of the South Stack the flood or northern stream commences just before low water at the pier of the old harbour, setting E. by N., and afterwards more easterly into Holyhead bay; at this distance the influence of the Holyhead race is felt. The stream runs 5 knots with spring tides, and 3 with neaps, producing with northerly winds a very heavy sea, to the distance of 1½ miles off shore, the most turbulent portion being between the two stacks.

The ebb or western stream is of similar strength to the flood, and runs nearly in an opposite direction; but it should be remembered by vessels working into or out of Holyhead bay, that this westerly stream runs 9 hours out of 12 past the Refuge harbour, and on the south-west side of the bay.

Along the north coast of Wales the stream of flood sets in from the westward, but near the shore turns to the southward towards the rivers. The ebb sets from Formby flats to the westward, and with the ebbs from the rivers, turns somewhat to the northward. Between Orme head and Chester bar, it runs about one knot when strongest; and along the north side of Hoyle sand it does not exceed 2 knots when strongest. In Formby channel its greatest velocity never exceeds 3 knots: but off the Black rock, in the stream of the Mersey, and particularly near Seacombe, it runs 4½ knots on springs, and about 1¾ knots on neap tides.

Along the Irish coast, the stream of flood sets in from the south-westward, and runs N.N.E. along the banks, crossing most of them obliquely: the flood without the banks carrying vessels from, and ebb carrying them towards the banks; which all that sail this way through the night ought carefully to attend to, and make proper allowance for in the ship's course.

Near the Tuskar, and in the principal stream of tide from thence, spring tides run about 4 knots an hour when strongest; neaps 1½. On Arklow bank, spring tides when strongest, run 3 knots an hour; within it, about 1 knot. Near Wicklow head, 4½ knots an hour.

Between St. David's head and Carnsore point, *in mid-channel*, the flood stream continues to run north-eastward until ten o'clock;* and at about 4 leagues W.S.W. from Holyhead island, it continues to run until half-past ten o'clock; and it should be noticed that both flood and ebb change sooner near the land than at a distance from it. In rounding the Tuskar at the distance of from 3 to 5 miles, the rise and fall of tide ranges from 6 feet with neaps to 10 and 11 with springs; across the channel towards the Smalls the range increases to 14 or 15 on neaps, and 18 or 19 on springs. From the foregoing remarks, it will be seen that the least rise of the tide takes place where the velocity is greatest, a fact which should have due consideration when tacking towards the shores by the aid of the lead.

In the Fairway of the channel the northerly stream nearly corresponds in time with the rising tide at Liverpool, and the southerly with the falling tide at that place; but there are departures from this general rule in the bays and near certain islets and headlands, as will be seen from a reference to the times already given. No general rule can be given to meet the variations of current which, in approaching the land are to be met with; they should, therefore, be avoided, or only encountered when assisted by competent local experience. The duration of either stream is about 6½ hours, the velocity being least at the former and the latter part of that period, and greatest about the end of the second hour, which it maintains till near the fifth hour, and then slackens gradually. The rate during its greatest strength varies from 3 knots at spring to 1 knot an hour at neap tides.

North to N.W. winds cause the worst sea, and with the height of the springs and a south to S.W. wind, it is dangerous to small vessels. The highest sea in the race will be found ½ a mile N. by W. from the Stack lighthouse; this may be avoided by keeping the Skerries lighthouse to the eastward of E.N.E. ½ N. With easterly winds there is generally a smooth sea.

* Or about 4 hours after high water by the shore.

At any fixed spot the set in opposite directions in two equal periods is nearly equal, but though equal at one place it will be necessary to consider the effect of the current on a ship's progress from one position to another. For instance, near the Tuskar, the Smalls, and Barsdey, the rate increases from 3 miles in the offing to 6 or even 7 miles an hour on the shore: therefore, when standing across the stream towards the land, where a gradually increasing rate and an altered direction will be met with, a vessel should frequently ascertain by bearings, soundings, or otherwise, her exact position, that she may be enabled to verify her course. Great care should be excerised by homeward bound ships when steering from the Tuskar, the Blackwater, or Arklow lights towards Bardsey or Holyhead, and by outward bound ships reaching from Holyhead or Bardsey towards the Tuskar, lest the current force them on to the Arklow or Blackwater banks, or carry them into Cardigan or Caernarvon bays, which might be productive of very serious results.

A correspondent of the *Nautical Magazine* has made the following remarks:—

"On casting an eye over the chart, it will be seen that every vessel in her passage up the Irish channel, for any of the ports to the eastward of her course, such as Liverpool for instance, after taking her departure from the Smalls light, off Milford haven, must steer nearly in a direct line for the Skerries, on the N.W. coast of Anglesea, which must of necessity bring her almost in contact with the south Stack and neighbouring rocks; and that in consequence, the whole flood tide setting into Caernarvon bay, a vessel, even with due allowance for clearing Bardsey island, must be seriously affected by an indraught; but should she avoid this, and have run nearly across Caenarvon bay, another assault is made on her when within three leagues of Holyhead, by the reflux of an ebb tide also making into the bay. These contending currents are probably the predominant causes of that dangerous Holyhead race, the influence of which in gales of wind is by no means confined to the immediate point of collision between the counter currents, but extend far out to sea, over a considerable space.

Those who have experienced eddies of this description can alone appreciate their overwhelming powers; of Holyhead race it is asserted that it once swallowed up a brig, which, by some luckless chance, got entangled in the vortex; after a brief struggle she yielded to her fate, foundering in a sea of foam, before the eyes of a spectator on the heights. It may be feared, indeed, that feats of this appalling nature are not unfrequent in the long dark nights of winter, as scarcely a year passes without the melancholy sight of broken spars and lacerated rigging from time to time thrown up from its frightful caldron. It was stated by by Captain Evans, the harbour-master of Holyhead, that previous to the exhibition of the light on the South Stack, scarcely a winter passed in which the fishermen and neighbouring peasantry have not fallen in with floating fragments, or various articles of merchandize, belonging to vessels which had gone down in the race, unseen, unpitied, and unaccounted for. The dead sets of the currents up-channel were long ago verified by the circumstances of several butts of sherry being drifted on shore, on various parts of this coast, which were ascertained to have been part of the cargo of a ship wrecked off the Scilly islands about a fortnight before. There are many other anecdotes related to confirm the danger of this indraught."

BRISTOL CHANNEL.

Approaching the Bristol Channel.—Vessels bound for the Bristol channel from the Atlantic should preserve the parallel of 50° 33′ N., or that of Trevose head in Cornwall, not only with the view of counteracting the effects of the Irish channel indraught, but because the soundings on approaching it decrease gradually; and also because of its height, lighthouses, and projection to the westward beyond the general direction of the coast. In longitude 10° 53′ the depths are 140 fathoms, brown sand, upon the edge of the bank of soundings in this latitude; 18 miles farther eastward the water suddenly decreases to 93 fathoms, from which as you proceed the soundings are more regular. In longitude 9° 48′ are 76 fathoms, fine sand; 21 miles farther eastward 69 and 71 fathoms, coarse sand and shells, or sand and oaze, which depths will continue nearly the same as far as longitude 8° 25′, where you will meet with as little as 57 or 50 fathoms, oazy ground, and directly afterwards again increase to 66 and 69 fathoms, whence the soundings shoal pretty gradually towards the Cornish coast. At the distance of 28 leagues nearly W.N.W. from Trevose head there are 58 fathoms, mud; and the quality then suddenly changes to coarse hard ground, and afterwards shoals so gradually, that at 9 leagues off there are still 34 fathoms, bottom of sand.

Approaching from south-westward with a south-westerly wind, endeavour to make the land about Trevose head. An approach to the land may be made anywhere between Trevose head and Hartland point, but not nearer than the depth of 30 fathoms water, unless the wind be such as to permit a course to be steered towards Lundy island; the channel will then be open, Barnstaple bay readily crossed, and the Bristol channel entered.

If the wind should incline to northward of West, to N.W., it will be better to steer more northerly, and gain the latitude of 51° 10′ N., which will be that of the southern end of Lundy island. The soundings in this coarse will be mud, and deepen from 52 in longitude 7°, to 60 fathoms in longitude 6° 30′, and then decrease to 45 fathoms, where the bottom changes to sand, at 12 or 13 leagues from the island; it then shoals gradually towards the island, and at 7 miles distant there are but 33 fathoms, whence the light on the island ought clearly to be seen, and, unless obscured by the haze, long before reaching that depth.

It has been observed by Captain Martin White, R.N., that "the soundings in a supposed radius of 16 leagues from the Smalls lighthouse, in any direction between N.W. by W. ½ W. and S.W. ½ S. are nearly wholly oaze, or sand mixed therewith. North-westward as well as eastward of these limits, the bottom suddenly becomes a sort of dark reddish sand, which ground is the peculiar criterion of an approach to the Bristol channel, in running from westward for the mouth of the Bristol channel; therefore, if the ground brought up by the lead be oaze, or sand mixed therewith, vessels cannot be southward of 50° 57′ N., but must be northward of that parallel, and westward of the meridian of Grassholm, let the depth be what it may. If, on the contrary, the soundings are wholly free from oaze, they must be eastward of the latter meridian. The transition from oaze to sand in the neighbourhood is so evident that it cannot be mistaken."

It occasionally happens, without due caution is used, even with northerly winds, that the indraught of the Irish channel will set the mariner northward of the Smalls rocks, which cannot be safely approached by the lead, there being within 5 miles of them, a depth of 60 fathoms; therefore, in thick weather, if near their latitude, it is advisable to haul southward, and endeavour to make Lundy island, or some other landfall. If the Smalls light be made, steer so as to pass at about 2 leagues S.W. of it; then steer about S.E. by S. or S.E., until as high up as St. Govens head,* where the soundings will be the best guide, for a depth of 35 fathoms is nowhere to be found eastward of a line from St. Ann's head to Lundy island; therefore, if a cast of 40 fathoms be had at low-water springs, it is an evidence that the vessel is outside the Bristol channel.

Sailing up the Bristol Channel.—Ships bound for the Bristol channel, and falling in northward of Lundy island,† should be cautious not to stand more than 3 or 4 leagues northward of the island, because there are a number of sand-banks and rocks near the Welsh coast; these are now, however, well lighted and buoyed. The direct bearing and distance from the north end of Lundy island to Flatholm lighthouse is E. by S. ¼ S., about 60 miles; but, if at the distance of 6 miles north from the island, it is nearly E.S.E. In the fairway are soundings of from 30 to 12 fathoms, the depth lessening as you advance easterly, and as you proceed the land on both sides becomes visible.

If the channel southward of Lundy island be adopted, be careful not to be driven into Barnstaple bay, especially when the wind blows strong from northward.‡ The best course is to steer midway between Hartland point and Lundy

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* When tacking to the northward hereabout, in a heavy ship, several patches of 3½ and 4 fathoms, lying between 3 and 4 miles south-westward from St. Govens head, should be guarded against. See the "Bristol Channel directions."

† The Hen and Chicken's rock and race, the Whitehorse race, and the race over the north-west bank, on the northern and western sides of Lundy, should be carefully avoided.

‡ In the channel between Hartland point and Lundy island the flood tide runs at the rate of 3 or 4 even knots an hour with springs, and on neaps at 2 or 2½ knots, turning eastward and westward about the same time that they begin to ebb and flow by the shore. Vessels from the Bristol channel would find considerable difficulty, with a hard north-west wind and a flood tide, in weathering Hartland point; they should, therefore, either turn up channel again for

island, giving Hartland, Baggy, and Morte points a good berth, and then proceed along the southern shore, keeping at about a mile from the land, until abreast of the Foreland, which must be passed at the distance of 2 miles, in 14 or 15 fathoms water; steer then for Flatholm lighthouse, passing northward of the Culver sand (on the west end of which is a red and white beacon buoy), and southward of the old one-fathom bank, near the south-west end of which is a lightvessel bearing a revolving (15 seconds) light, and also a fixed *red* light. The leading mark between the two sands is St. Thomas's head, or Sand point, near Woodspring, open northward of Steepholm, and bearing about east.

In the night, it is in this part of the navigation that the Flatholm light becomes so useful a guide to ships bound eastward, for no one would be justified in proceeding without seeing it, even with a pilot on board, the soundings being so uncertain, and the tides so strong as to render the navigation very dangerous in thick weather.

When approaching Flatholm from westward by day, the lighthouse should be brought to bear northward of E. by N., to clear the old one-fathom bank, then steer to pass in mid-channel between it and Steepholm, to avoid the Mackenzie shoal,* and as soon as the lighthouse is northward of N.E. haul up for it, and round the south side of the island at the distance of ¼ of a mile or less; care must be taken not to shoot so far as to bring the lighthouse westward of W.N.W., unless certain of being fully ¾ of a mile eastward of the island, otherwise there may be difficulty in avoiding the new patch, a knoll of sand with only 6 feet water upon it, on which is a red and white (chequered) buoy. But if it is near low-water, and the buoy not seen, you should not round Flatholm nearer to the eastward than to have Hayes' windmill (which is white) appearing half-way between Sully island and the main, bearing N.W. ¾ W. Vessels may anchor thereabout for a tide, with the lighthouse bearing W. by S. Coasters may anchor closer in, near the N.E. part of the island, in 3 fathoms, mud, abreast of the landing-place.

If bound to King Road, the direct courses and distances are: from mid-channel between Steepholm and Flatholm to the N.W. elbow of the English grounds, E.N.E. ½ N., 6 miles; from the N.W. elbow of the English grounds to the lightvessel, E. ¾ N, 1½ miles; hence towards the Pigeon house E. ¾ S., 5 miles; the Pigeon house to Blacknose point, E.N.E., ¾ E. 1½ miles; Blacknose to Portishead, east, 1 mile; and Portishead or Posset point to King road, E. ½ S. 1½ miles. Or, if when abreast the N.W. elbow of the English grounds, the cottage on Blacknose point be kept in line with the flagstaff near Posset point, E. ½ S., it will lead between the English and Welsh grounds nearly up to the former point, which may be rounded at the distance of ¼ of a mile. Avon light-

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shelter, or seek it under the lee of Lundy island. With an ebb tide and a hard westerly wind, and with the flood and a strong easterly or north-east wind there is a very heavy sea all the way across, and also a tremendous one off Hartland point with a strong northerly wind.

* Distant ¾ of a mile S.W. ½ W. from the lighthouse, and with only 4 feet over its shallowest part.

house in line with Blaize castle about E.S.E. leads in mid-channel between Posset point and the Newcome. When Posset point comes in one with the high water mark at Blacknose, you can steer up the road in from 10 to 4 fathoms, and southward of the Cockburn.

To clear the English grounds to the S.W. bring Worle mill in one with Swallow cliff point, which mark leads in 3 fathoms at low water ; but beware of the tail patch, which has only 1¾ and 2 fathoms over it.

The mark for proceeding over the N.W. and north elbows of the English grounds, south of the lightvessel, is a clump of trees (southward of Knole house) in one with the barrack near Posset point, bearing nearly east, but this mark is difficult to take up, and when doing so it is necessary to be careful not to mistake the trees about Knole house for the clump here intended ; so remark, that the clump is a small cluster of trees appearing to the right of the larger cluster. Knole house is situated amongst the latter.

Captain Beechey says, " If it be low water at Flatholm (high water on the days of full and change of the moon at 6h. 37m.), or even if it be a falling tide at springs, but with a breeze strong enough to run over the stream, the mariner may proceed at once, providing always that the leading marks can be seen ; but if not, or if he does not well know the mark objects, he should by all means wait until the tide has flowed two hours at least. If it should be a matter of such great importance as to warrant a stranger in running up in thick weather, he must proceed very cautiously ; everything will depend on the expertness of the leadsman, and the vessel should not go too fast for quick up and down soundings. He should also minutely calculate the different periods of the tides, and have them by him in a written memorandum. With a vessel drawing 15 feet water, the best pilot would hesitate in thick weather at low water ; a stranger, therefore, should on no account attempt it until the tide has risen at least two hours, because it is absolutely necessary to get hold of the English grounds, and to keep along them, which cannot be done at low water without striking.

From Flatholm, the first course should be eastward of that recommended for clear weather, in order to pick up the English grounds, which must be done before 5 miles are made good from that island, and allowing for a tide carrying the vessel 3½ or 4 miles an hour on springs. If when reckoning the ship to be about 5 miles from Flatholm, the soundings continue deep, haul southward until a cast of 3 or 3½ fathoms is obtained, a sure indication of being on the edge of the English grounds ; then an E. by N. course ought to be steered, yawning northward when the soundings are under 4 fathoms, and southward when above 5 fathoms.

In this manner he must continue feeling his way up to the lightvessel, which he can scarcely miss ; but he must on no account continue longer than three or four casts in more than 5 fathoms water. On perceiving the lightvessel, he should close her, and steer on E. by N. to pick up the north elbow of the English grounds in 3 fathoms (allowing for the rise of he tide). At the first deep cast afterwards, that is, from 7 or 8 fathoms, he should alter the course to E.S.E., but still feeling the edge of the English grounds occasionally in 4 or 5 fathoms, in order to be certain of being on the south-eastern side of the channel. In this cautious but simple manner he may proceed, for unless the weather should thicken to an actual fog, he will be able to perceive the high land about Walton, which is bold; and from the Pigeon house to Portishead he may freely pass within a cable's length of the rocks. Endeavouring to keep in view the south shore, and steering E.N.E. from the Pigeon house to Blacknose point, and east from thence, he must contrive to see Portishead before he runs on to King road, the course to which is E. ¼ S., and distance 2 miles.

Let him keep as near the south shore as the soundings will allow, as it is better to run upon the mud on that side than upon the hard sands of the Welsh grounds, where the tides sweep with great rapidity; but there will be no danger of either, if unremitting attention be paid to the leads, in both chains, observing that in mid-channel there are 5 to 7 fathoms at low water up to the buoys of King road, and recollecting that at about the time of his arrival at King road, it will be nearly high water, provided the foregoing directions have been followed as to the time of leaving Flatholm; so that as spring tides rise 7 fathoms, the ship will be in 13 fathoms, if she is in the proper channel. As soon as the buoys are seen, the vessel can be steered to a berth, and if not seen, she should be anchored when the estimated distance, allowing for the tide, has been run."

If bound to Cardiff, keep along the south shore as before directed, until as far as the Foreland, then haul over to the northward, steering about East; and when Nash point bears N.N.E. keep along the north shore at the distance of 1½ miles, until up to Barry island, then haul more in as you approach Sully island and Lavernock point. Having rounded this point, haul in northward for Cardiff roads, the sands before which are buoyed.

Should the wind be northward, and when passing Lundy island, you wish to shape a course for the Nash point, observe, that by keeping southward of the Skarweather lightvessel, and the Nash lighthouses in one, you will keep to the south of all the sands that are westward of Nash point.

Vessels leaving Newport or Penarth can pass eastward of the Holms; as soon as they have passed the Steepholm the ebb tide will sweep them down abreast of the tail of the Gore, at the entrance to Bridgewater, when they may anchor if they think proper, and this stream will sweep them clear of the Culver; but if they go through between the Holms the ebb tide sweeps them directly towards the Culver; this is a hard, dangerous sand, where the vessel would, by the swell and rapid tide (should she lie on it), be wrenched asunder in a very moderate breeze.

Should it be night or foggy weather when bound up the Bristol channel, it will be advisable, when passing between Hartland point and Lundy island, and until past Morte point, not to approach the shore nearer thon 20 fathoms; but when past Morte point you may continue along the shore to 15 or 16 fathoms, so far as the Foreland; then stretch over to the north shore, and when you see the Nash lights, bring them to bear N.W. ¼ N., and Breaksea lightvessel N.E. when a course can be steered between the old One-Fathom bank and the Culver sand, until the Flatholm light is brought upon a bearing to enable you to steer eastward as heretofore.

If bound to Swansea or Mumbles Road it will be requisite to guard against a too near approach to the Helwick sands, off the western end of which, in 16¼ fathoms, there is a lightvessel showing a revolving light. Westward of the Helwick the soundings shoal suddenly from 10 to 5 fathoms; and along their south side they jump from 18, 16, and 14 fathoms, with coarse ground, to 6 and 8 fathoms on fine sand. To sail southward of them, bring the Mumble light E. ¾ S., open of Oxwich head, which will clear them in 15 fathoms.

At 1 or 2 miles westward of Worms head the course of the streams from half ebb to half flood is influenced by the trend of the Helwick sands, but from half flood to half ebb they set directly over them.

To avoid White Oyster ledge keep Heathfield house* a little open on either side of Mumble lighthouse, or, at night, the light half a point on either side of a N.E. ¾ N. bearing. After passing the White Oyster ledge you should run with Kilvey old windmill over the white elbow of the eastern pier of Swansea, about N.E., till Woodland castle (on the west side of the bay), opens east of Mumble head, about N. by W. ¼ W., in order to clear the Mixon; but, in hauling round the lighthouse head, you ought not to approach it nearer than 3 cables, to avoid the rocks lying off it; then bring Kilvey Old mile over the pier entrance, and the first western point, called Tutt head, in one with the Middle head, between Mumble and Knaves head, bearing West; you may then anchor, and have not less than 8 fathoms water, good ground. The buoy on the west end of the Inner Green grounds will point out the limits of the channel in that direction. Care must be taken, when leaving this anchorage on the ebb, and with light winds, against being drawn into the sounds between the two Mumble heads, or too near the outer head as the western stream begins to run through an hour before high water, and sweeps close by the head, and reaches to the distance of ½ a mile from it.

Vessels from westward, to avoid the Mixon, should, when approaching the Mumble, keep Porth Einon head open a quarter of a point southward of Oxwich head, taking the precaution in tacking southward to guard against the White Oyster ledge, and when Kilvey Old windmill is in line with the white elbow of the eastern pier, should proceed as before to the roadstead.

Bearing up for Mumble road from eastward, after passing Nash point, a vessel should not haul northward, but, in the daytime, keep Worms head open of Porth Einon head, N.W. ¼ N., or, by night, the Nash lights in one, passing southward of the Skarweather lightvessel, which shows a red revolving light, till the Mumble

* A large yellow house to the N.N.W. of Swansea.

lighthouse comes on a bearing eastward of North, by which means they will pass clear southward and westward of the Nash and Scarweather sands.

Tides.—In navigating the St. George's channel and adjacent waters, the greatest attention should be paid to the velocity and direction of the tides, for there is commonly a northerly indraught, which frequently drives a vessel out of her regular course, and considerable mischief has thereby been produced; to guard against this, a proper allowance should always be made, the lead kept constantly going, and a good lookout at all times attended to. When southerly winds prevail, the tides are always augmented at high-water, and kept up at low water; and the contrary effect is produced by northerly winds: the source of this current may be traced to the prevalence of westerly and south-westerly winds for nearly two-thirds of the year, which occasions a great influx of water from the Atlantic Ocean. The source and direction of this current will materially depend on the wind and tide. All vessels, in navigating from the Land's End to Dublin, will find themselves more or less carried to the eastward; and when off the western coast of Wales, during the prevalence of westerly winds, they cannot be too careful in shaping their course; for should they neglect such precaution, they incur the danger of being wrecked on the Welsh coast, at the very time the mariner may consider himself in the fairway of the channel.

In consequence of the above current, during hazy weather, many vessels are driven up the Bristol channel. The tides run from half-ebb to high-water northward, and from high-water to half-ebb southward, and a ground sea comes from the N.W., except after a long continuance of easterly winds, especially between Trevose head and Morte point, into Barnstaple bay; but the effect of the swell is lost when you get beyond Morte point. There is no safe roadstead, with the wind westward of South, from Hartland point to the Flatholms, neither is there any one that can be recommended when the wind comes from the southward of S.E. by E.; for should the wind blow off shore, it is attended with a prodigious swell, and, should the wind shift, the sea will be up before you have possibly time to weigh.

It is advisable, when a vessel is forced into the channel, to run for Milford Haven or Lundy island, where pilots are always on the look-out to take them to Ilfracombe; but by no means to persist in attempting to beat out of the channel, for the swell and indraught are so great that it will be almost impossible for a vessel to get to windward; with an easterly wind, a good resting-place will be found westward of Trevose head, until the tide turns. Spring tides run with great velocity in the Bristol channel, and if bound upwards it is advisable always to keep near to the English shore, but not to go into any of the bays. A less sea will be experienced by sailing between Lundy island and Hartland point, than by sailing northward of that island.

At the outer part or entrance of the channel ordinary spring tides rise from 24 to 28 feet, and as you advance further in, and the channel becomes narrower, the rise becomes greater—so much so, that at King road it rises 6 and 7 fathoms.

The beginning of the flood tide on the west coast of England may be estimated from the Land's End, where the stream divides northward and eastward, flowing full and change at 4h. 30m., and setting 9 hours northward and 3 eastward. Between the Land's End and the Scilly islands, the ebb runs only 3½ hours, which should be particularly remembered. Approaching towards the Bristol channel, spring tides, when strongest off St. Ives, run 3 miles an hour, and neaps 1; but it may here be proper to remark, that in strong gales of wind from the northward, the tides will be kept back an hour or more, and with winds blowing hard from the southward they will flow as much longer, the former also depressing the rise of the water, the latter increasing its height so much, that in stormy weather it will rise to 10 feet above its customary level. These are circumstances which require attention, and a proper allowance must be made accordingly. Between Hartland point and Lundy island, and across the entrance of Barnstaple bay, spring tides run 3 knots, and neaps 2 knots. Between Lundy island and Minehead bluff the flood sets E. ¾ S., and the ebb W. ¾ N.; off Ilfracombe, at a distance of about 4 miles, the streams turn at high and low water by the shore, and run at the rate of 3 knots upon springs, and 2 upon neap tides, but close in shore the western stream runs 9 hours from half-flood to low-water, and the eastern 3 hours from low water to half-flood. From Ilfracombe to Bridgewater, within a distance of 2½ miles of the land, the streams turn an hour before high and low water by the shore.

In mid-channel, or where the flood and ebb streams set fairly up and down, they also turn at high and low water by the shore, with a velocity of 3 knots at the springs, and 2 at the neaps, allowing half an hour for slack water.

From the entrance of Milford haven eastward, at 6 or 7 miles off St. Goven's head, the flood sets S.E. by E., and the ebb N.W. by W., the latter continuing from ¾ flood to ¾ ebb by the shore, and the former from ¾ ebb to ¾ flood; 3 knots at springs and 2 at neaps. While north-westward and westward of the Helwick lightvessel, allowance should be made for the influence of the flood and ebb into and out of Burry inlet; they set east and west, tide and tide by the shore. Also to avoid the effects of the streams over the Scarweather and Nash sands, and to preserve the fair set of the tide, pass southward of the lightvessel, and give Nash lighthouse a berth of 3 miles or more.

From Flatholm to the Welsh grounds the flood sets towards the S.W. patch where it splits; one part sweeping rapidly over the tail of the patch, towards the Usk, the other setting truly along the channel in which the lightvessel is moored, E. ½ S. About the north elbow of the English grounds, before the banks begin to cover, there is a rush of flood from the Swatch,* which passes along the eastern side of the English grounds towards Walton, until turned into the regular course of the stream round the south elbow of the Welsh hook. But after the

* Between the S.W. patch of the Welsh grounds and the Welsh hook.

banks are covered, the flood sets over the Welsh grounds, and will carry a ship upon the S.W. patch, and more especially on the south elbow of the hook, if, when approaching it, sufficient room is not given to counteract its effects. From the south elbow of the Welsh hook the flood tide sets truly along the channel.

The ebb tide sets truly down the main channel until it arrives at the south elbow of the Welsh hook, and then across the channel towards the English grounds, over which it sweeps with great rapidity until towards the end of the tide; it then slackens considerably upon the grounds, but continues to run past along the channel, taking a more north-westerly direction, and near the swatch, striking right through it. The middle of the stream runs in a direct line as far as the lightvessel; but thence it seems to be turned by the S.W. patch, and strikes off towards Steepholm.

Milford Haven.—Milford Haven is considered the most secure and commodious harbour in Wales. Its entrance is wide, but there are several shoals in it that require great care to avoid; inside the depth is sufficient for the largest vessels.

Lights.—St. Ann's point, on the west side of the entrance, lies from cape Cornwall about N.E. ¾ N., 32 leagues, and from Lundy island N. ¾ W., 34 miles. This point has two white lighthouses on it, showing *fixed* lights. When these two lights are in one, bearing N. by W. ¾ W., vessels will pass clear of the Crow and Toe rocks; Linney head may be safely rounded, if the low light is not brought westward of the high light, which, in working round that point, should be particularly attended to. Besides the lighthouses, there are signal staffs on St. Ann's point.

Rocks, Shoals, &c.—Sheep island, on the eastern side of the entrance to Milford haven, bears nearly S.E. ½ E. from St. Ann's point, distant 1¾ miles. Southward and westward of this island are some shoal spots of from 3½ to 5 fathoms, the outermost and shoalest of which, named the Sheep rock, lies ½ a mile west from the island, but the others are all within the distance of 3 cables' lengths; there is deep water of 6 to 10 fathoms close-to all round them. Half a mile within Sheep island is east Blockhouse point, with a small island, named Rat island, lying off it; this point, like Sheep island and the coast between, is rocky, and has shoal water extending from it nearly 2 cables' lengths. About ¾ of a mile N.E. from east Blockhouse point lies Thorn island, on which is a fort; in the small bay between, the coast is lined with rocks, but the water shoals gradually. At 3 cables' lengths W.N.W. ½ N. from Thorn island is the Harbour rock, a shoal of only 6 feet water, marked by a red buoy off its western extremity. The passage between has in it a depth of 5 and 6 fathoms, but is contracted to less than one cable in width by the shoal which surrounds the rock and by that which extends from Thorn island.

Off St. Ann's point shoal water of 2, 3, and 5 fathoms extends to the west and south-westward to the distance of ½ a mile, over which the tide forms a strong race. South-westward of west Blockhouse point, the next within St. Ann's, and fronting a small bay, named Mill bay, is a spot of 3 fathoms with 4½ and 5 fathoms around it, bearing from the low lighthouse East, distant ½ a mile. North-westward of West Blockhouse point are Warwick and Dale points; these points are rocky and bold, with a depth of 5 fathoms at the distance of 1½ cables from them; upon Dale point is a fort. Rounding Dale point you will open Dale roads, in which the water shoals very regularly. Care, however, should be taken not to mistake the bay south-westward of Dale point for Dale road, which has sometimes been done, as that mistake might prove inconvenient, if not dangerous.

In about the middle of the entrance are several shoals. They extend in a W. by S. ½ S. and E. by N. ½ N. direction, about 1½ miles, and vary in depth from 2 and 3 to 5½ fathoms. The outermost patch, named the Middle channel rock, is marked by a red and white beacon buoy. The shoalest spots will be found abreast of East Blockhouse point, where there are as little as 12 feet; these are named the Chapel rocks, and lie about W.N.W., 5½ cables' lengths from the point, and E.S.E. ½ S., 1½ miles from St. Ann's low lighthouse. Thorn island E.N.E. will lead clear southward and eastward of all these shoals. The fairway into the haven is west and north of them.

Off Great Castle head, which bears N.E. by N. from Thorn island, there is a small rocky shoal of 12 feet, at the distance of 1½ cables from the land; over this shoal the sea in blowing weather always breaks at low water. You may anchor between Stack rock and the south shore in from 9 to 13 fathoms with good holding ground. There are 4½ and 5 fathoms within a short distance of the Stack on all sides except the eastern. At this rock an extensive and shallow flat commences, which runs nearly parallel to the shore to above the town of Milford; this flat, together with that which lines the opposite shore, reduces the channel at low water to little more than ½ of a mile in width.

About 1½ miles S.S.E. from Stack rock is Angle bay, forming an extensive soft oaze and mud flat, which dries at low water to its outward points. A broad flat of sand and mud, called Angle shelf, slopes off from this shallow bay, nearly ½ a mile beyond the line of Angle and Sawdern points, with only 6 feet water on it. At ½ of a mile from Angle point there is a patch of flat rocks drying at low water.

The town of Milford lies north-eastward from Angle bay; here there is a pier extending just beyond low water mark, besides other landing-places. North-west of the town, close under the Custom house, there are shipping quays, with 12 feet alongside at high water.

The Milford shelf extends from the Stack rock to above Milford, which, with the Pwlchrohon flats, limit the channel here to ½ of a mile in width at low water. The Pwlchrohon flats are on the south side, between Pompton point and West Pennar point, and dry nearly ½ a mile off, which, with the ledges lining the opposite shore, narrow the channel so much, that when nearing Weare point it is less than 2 cables wide.

Off Weare point is Weare spit with a black buoy upon its extremity. The East Pennar flat is a mud bank lying between Pennar mouth and the Carr rocks; it dries in some places, 8 feet above low water, and is shoal 1½ cables' lengths further out. A vessel having parted her cable in the lower part of the haven would find this flat a convenient place to run for. At high water spring tides there are 18 feet over it.

From the outer part of the Carr rocks a spit extends nearly half-way across the channel, and is or was marked by a white buoy and beacon. On the north-western end of the Dockyard bank is a buoy, and a buoy also marks its south-eastern end.

Above the Weare spit the north shore is pretty bold until you get eastward of Carr spit, when an extensive shelf stretches off from abreast of Llanstadwell church up to Neyland point, which narrows the north channel so much, that abreast the black buoy it is but little more than a cable's length wide. From Weare point to Neyland point, in the channel, are 6, 7, and 8 fathoms, and there is water sufficient for the largest ships to go much higher up; the anchorage is good most part of the way. Small vessels, with spring tides and in charge of a pilot, can go up to Haverfordwest, 11 miles from the dockyard, where ships of 200 tons burthern are sometimes found, and where springs give 12 feet at high water at the bridge, which, at full and change, takes place at 6½h.

Anchorages.—Vessels often stop a tide in Mill bay, between St. Ann's and West Blockhouse point, in 5 and 6 fathoms. West Angle bay, between Rat and Thorn islands, also affords a convenient roadstead for small craft with S.E. winds, in 3 fathoms in sandy bottom. In Dale road there is excellent anchorage for vessels waiting for an easterly wind, in 3 or 4 fathoms, good holding ground, as soon as Dale town appears in sight; but in order to insure complete shelter and still water, with not less than 15 feet, you must borrow on Dale point, and just shut in Sheep island with it. In Sandy Haven bay, northward of Stack rock, vessels can lie snugly with a northerly wind, or wait there for the tide, in 4 fathoms with clean ground; small craft can get into the creek at the head of the bay on spring tides.

Angle bay, S.S.E. from Stack rock, affords shelter to wind-bound coasters, and is a safe resource to such as arrive without anchors, where they can run aground on soft oaze, by keeping in mid-channel between the two points, observing only to guard against the flat rocks before mentioned.

The Quarantine ground lies parallel with Angle shelf, abreast of Angle bay, and contains moorings for men-of-war as well as merchantmen. Milford or man-of-war road is abreast the town of Milford; vessels anchor here in from 9 to 11 fathoms good holding ground. Large ships should moor across the stream to avoid the chance of tailing on either Milford or Pwlchrohon flats at low water, when swinging with a cross wind, as the cables are necessarily slack to allow for a 21 feet rise in the tide, and likewise in order to have two anchors on the ground when blowing hard either up or down, which owing to the long reach of the haven, causes such a trying sea that small vessels are frequently obliged to cut and run up to the dockyard. All vessels thwart the wind however hard it blows because of the strength of the tide.

Directions.—To clear the Smalls, Hats, and Barrels to the southward, you ought not to approach the Smalls on this side within one mile when coming from the westward, until the lighthouse is brought to bear North, in order to avoid the S.W. rock. As the soundings are extremely irregular, varying at that distance from 40 to 25 fathoms, generally gravel and broken shells, no dependence can be placed on the lead. At night you must not bring the Smalls light westward of N.W. ½ N., nor St. Ann's light southward of E.S.E. ½ E.; these bearings will give the Barrels a berth of about 1½ miles: and when the South Bishop bears north of N.E. ¾ E., the shoals will have been passed. Observe well, that the moment St. Ann's light is unmasked southward of Skokham, a vessel is nearly in the line of direction of the shoals.

Vessels bound to the Bristol channel or Milford from the S.W. part of Ireland, are recommended to make Grassholm, generally the first land seen by day, or the Smalls light by night. Should there be a long flood to run, it is best, particularly with the wind to the southward, to pass well south of the light, or to try and make St. Ann's light, upon the bearing of about E. by S. ½ S., passing outside Skokham; but on the ebb, opposite precautions should be taken; and having passed northward of the Smalls, bring St. Ann's light to bear S.E. ½ S., which will lead you through Broad sound, between the islands of Skomer and Skokham; but when between these islands, and rounding the latter, be careful to guard against the rocks off its east point.

When entering Milford haven by day, it is advisable to keep along the western shore, not, however, standing in too close, in order to avoid shoals west and south-westward of St. Ann's point, and the 18-feet patch south-westward of West Blockhouse point. The fairway into the haven is between these and westward of the Middle channel, chapel, and harbour rocks, the leading marks for which are, the Stack rock fort open north of Thorn island, E. ¾ N., until Trewarren house, on the northern shore, comes well open of Dale point, N.N.E. ¾ E., when you must steer for Great Castle head N.E. by E. ½ E. until Hobb's point flagstaff (at the dockyard) comes in one with Weare point, nearly E.S.E., which latter mark will carry you up the haven. If intending only to seek temporary anchorage in Mill or West Angle bays, you should continue on the first of these courses till St. Ann's high lighthouse bears N.W., then bear up N.N.W. and anchor in the former bay as convenient, or continue on the said first course till the low lighthouse bears W. by N., then haul up E. by S. for West Angle bay. When northward of Harbour rock buoy you may steer northward for Dale road, or eastward for Sandy Haven bay, there being no danger in the way, except what lies close to the shore.

If bound for Milford road follow the leading mark, Hobb's point flagstaff in line with Weare point, nearly E.S.E., pretty closely, until abreast the town, then choose a berth as before directed, but if going further up, proceed in the same direction till within ¾ of a mile of Weare point, when, to clear Weare spit, you must bring the tower, near the gas works, in one with the tower of St. John's church; having passed the spit, marked at its extremity by a buoy, steer about

E. by N. $\frac{1}{2}$ N., towards Llanstadwell church, and pass round the Carr white buoy and beacon. If bound to the anchorage off the dockyard the mark to run in between the Carr spit beacon and the red buoy on the dockyard bank, in 12 feet at low water springs, is the dockyard clock its breadth open eastward of the jetty flagstaff, till the mooring buoys come in a line, then haul in towards them and and anchor as most convenient. Above this a pilot's assistance must be had.

By Night.—In entering Milford haven at night,* with a fair wind (any time before half-ebb), you should pass St. Ann's head, in 11 or 12 fathoms, keeping the lead going and steering in about E.N.E. until the low light (which is exclusively in the haven) bears W. $\frac{1}{4}$ S., and then steering E. $\frac{1}{4}$ N., about $\frac{3}{4}$ of a mile, you will shoal your water to 8 or 7 fathoms. Keep your lead going, and a good look-out for Thorn island on your starboard hand, $\frac{1}{2}$ a mile off, keeping the light on the same bearing. When you deepen your water to 9 or 10 fathoms, and Thorn island bears S. by W., steer E.S.E. till the lighthouse disappears behind Thorn island; you may then bring up in 11 or 12 fathoms, well sheltered, between the Stack rock and the N.W. end of the Quarantine ground.

In thick weather a stranger should not attempt to enter Milford haven, but, if at all possible, preserve a good offing till it clears up.

Both flood and ebb streams run at the rate of 3 knots on springs, and 2 with the neaps, more or less according to the freshes.

Lundy Island.—Lundy island lies in the entrance of the Bristol channel, S.S.E. $\frac{1}{4}$ E. 50 miles from the Smalls rock; N.E. by E. 74$\frac{1}{2}$ miles from cape Cornwall; S.S.W. 27 miles from Caldy island; and W. by S. $\frac{3}{4}$ S. 35 miles from Mumbles head. Rat island lies off its S.E. extremity, and is a low green hummock sloping towards the sea; at low water it is joined to Lundy. On the southern part of Lundy there is a substantial farmhouse and some tenements, and the ruins of the castle are conspicuous on the south-eastern bluff; at a little northward of the latter is a jetty, the landing-place.

The East Bank begins about $\frac{3}{4}$ of a mile E. by N. from Rat island and extends rather more than that in a N.E. direction, being in breadth about $\frac{1}{2}$ of a mile, and consisting of fine broken shells and sand, with soundings of from 6$\frac{1}{2}$ to 10 fathoms, and gradually sloping into deep water. At rather more than one mile eastward of the N.E. point of Lundy there is a bank of sand, rising suddenly from 25 to 12 fathoms, with some overfalls, and stretching east a distance of 3 miles. The race on this bank is named the *White Horses*, and it at times breaks with such violence, that all vessels, without some particular motive for the contrary, will find it more prudent to go southward of the island, when, though there are races off Rat island and Shutters point, they are much less formidable than the White Horses.

Off the north end of Lundy island there is a high pyramidal rock named the

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* A *red* light is shown in the high lighthouse between the bearings from it of E. $\frac{1}{4}$ S., and S.E. $\frac{1}{4}$ S. (45°). It is shown over the shoals in the entrance, but does not cover mid-channel rock.

Constable, to the east of which lie the Seal rocks, and to the westward the *Hen and Chickens*. These latter are the only detached rocks about the island that can cause anxiety, although they do not extend beyond 3 cables' lengths from the north point. Being very steep-to they ought to have a wide berth, especially as the flood tide has a tendency to set over them. The race off these rocks sometimes presents an alarming appearance, though there is a depth of not less than 25 or 23 fathoms at ¼ a mile from the island.

The *North-west Bank*, a shoal of 6, 7, and 8 fathoms, fine brown sand, lies one mile W. by N. from the north point of the island. The water over it occasionally appears disturbed, but there is no danger, excepting to vessels deeply laden; on the contrary, with the ebb, a kedge may be dropped upon it out of the stream. It extends a mile E. by N. and W. by S., and is ½ a mile broad. The depths immediately around are from 9 to 12 fathoms, with 25 fathoms, coarse ground, between it and the island, as well as at ½ a mile outside. Strong westerly winds cause a cross-breaking sea upon it. The western side of Lundy island is steep and bold, and has several rocks just off it, but none extending beyond 2 cables' lengths from the shore.

On the south side of the island there is a detached danger, named the *Lee Rock*, which has only a depth of 9 feet over it at low water; the weeds upon it are exposed during a heavy sea or ground swell; from it, the Black rock, off Shutters point, bears W.N.W. 7 cables distant, and the south-east extremity of Rat islet N.E. by E. ½ of a mile. It will be necessary, therefore, in rounding this side of the island for Lundy road, to give it a berth of half a mile.

Lights.—Near the S.W. point of the island is a round tower bearing two lights; the upper revolves, illuminating the whole circle of the horizon once in two minutes, and is 540 feet above high water. The lower is a fixed light, shown only in a westerly direction between the bearings from it of N.N.W. and W.S.W. (90°). The first will, therefore, be visible in fair weather 30 miles off, and the latter about 25 miles; when there is a haze, the lights are frequently obscured, and the island sighted before they are seen; at anchor, in Lundy roads, they are not visible. The lighthouse is in latitude 51° 10′ 7″ N., and in longitude 4° 40′ 15″ W. Vessels on the western side of the island should always keep the lower light in sight, that they may clear all the straggling rocks, including the Hen and Chickens.

Anchorages.—About the middle of the western side of the island, in a small bay, named Jenny's cove, small vessels sometimes anchor in from 9 to 11 fathoms sheltered from N.E., East, and S.E. winds; also on the south side of the island, in a place called the Battles, in a depth of 7 fathoms, with protection from easterly and northerly winds. But the principal place of resort is Lundy road, on the east side of the island, where vessels lying well in are screened from all winds between S.W. by S., round by the west, and north, in depths varying from 6 to 12 fathoms, bottom of sand and mud. Northward of Tibbet point, the depth of water and quality of bottom forbid anchoring, but between this point and Rat isle, both are sufficient for a fleet, subject, of course, to a change of wind; it may, however, be observed, that there is an undertow favourable to riding out an easterly or on-shore wind.

Directions.—Lundy island roadstead affords, to vessels outward bound, and falling in with strong westerly winds, a most eligible stopping place, for there is no other anchorage for a laden ship nearer than Penarth roads or King road (the latter being a distance of 80 miles to leeward, through an intricate navigation; the former is generally resorted to by pilots, when unable to reach Lundy, being a saving of nearly 20 miles in the distance to King road, and a more convenient outlet when the wind shifts); whereas, the anchorage here, properly chosen, according to the size of the vessel, under the lee of the island, she will be able to ride in safety, provision, and water; and without incurring the double risk of the Bristol channel and further pilotage, will be able, the moment the wind changes, to proceed on her voyage. Homeward-bound vessels desirous of obtaining a pilot for Bristol, or any other port in the vicinity, may be certain of doing so here.

Small fore and aft-rigged vessels may come-to in Lundy road, with the farmhouse in the valley open and bearing west, and Rat isle south, at ¼ of a mile from the landing-place, in 7 fathoms, sand. From this spot they may clear Rat island on a sudden change of wind to the eastward, so as to gain the lee of the island, to the Rattles, or to Jenny's Cove, remembering in passing the south side of the island, to guard against the ' ee rock by giving the cliffs a berth of ¼ a mile.

Moderate-sized vessels may bring up in 10 fathoms, sand and mud, at half a mile from the landing-place, with the north end of the island just closing with the rock called the Gannet stone, and bearing N. ½ E., the farmhouse then topping overland W. by S., and Rat island bearing S.S.W. ½ a mile, thus leaving a scope to clear either end of Lundy on a shift of wind. Large ships, are, however, recommended to bring up a little farther out in order to clear the island, with the wind setting on; with the lighthouse in sight, bearing west, and dropping the anchor at the moment when the top of the lighthouse dips out of sight. This rule is equally observable by day and by night. Here you will have a depth of 10 fathoms, sand and mud, at about a mile off shore, and just inside, or on the edge of the east bank. Should the top of Lundy be obscured by flying scud, the taking up a spot for anchorage must depend on the lead and relative bearings of Rat island which should be S.W. by W., and the north end of the island N. by W. ½ W.

Here there are pilots always on the look-out upon the hill, and their skiffs are at anchor on the eastern side. In the winter season there are also skiffs about the island on the look-out for vessels in distress, or that may be forced up the channel. In rough weather, with the wind south or north, when the skiffs cannot lie in the road of Lundy, they may be found at or near Ilfracombe, 1½ leagues eastward of Morte Pointe.

Tides.—The stream of flood div s 8 miles westward of, and branches northward and southward of the island; and the ebb stream splits, at 3 miles east of it, but within that range the flood sets from north to south along the west side of the island, the ebb yielding scarcely any stream there, nor till clearing the extremities of the island has it any considerable effect. On the east side of the island, the ebb, or southerly stream, sets from half-flood till low water, producing 9 hours southern set, and 3 hours northern, but with a velocity of not more than one mile an hour. At, however, the range of 1 mile from the extremities of the island, the strength of tide is 4 or 5 knots, decreasing to 3 knots on springs, and 2 upon neaps, at an offing of 4 miles.

ENGLISH CHANNEL.

General Remarks.—Detailed descriptions of the harbours and dangers of the English and French coasts, are more especially serviceable to coasting craft, but to those vessels passing up and down channel, or bound only to one of its ports, the remarks embodied in this section are, perhaps, as much as may be considered necessary: still, if an approach be made to any part of the coast, reference can be made to the description of that part given in the "Directions for the English Channel."

Winds.—To the observations already given on pages 95-96, and Chap. XII., we may add, that although the winds at the entrance of the English channel are various, and subject to uncertain directions at all times of the year, yet there is a general and somewhat uniform course of them to be expected, which will most commonly be found to prevail at certain periods of the year; thus, from January to May, they are observed to come from the north and north-east, although sometimes in January they may incline to the south and south-westward; and from January to May, south-westers will occasionally occur; yet it will seldom be found to blow long from that quarter, but shifts round westward, and sometimes north and north-east. But from May to December, westerly and south-westerly winds may be said most commonly to prevail.

When strong westerly gales continue, an easterly current is frequently forced up the English channel; but with steady easterly winds, the current has often been found to set out westward; more particularly when the Bay of Biscay is open, a south-westerly current is liable to be experienced.

Storms.—Of the storms incident to the English channel, experience has proved that those from S.S.E. to S.S.W. are the most dangerous; while those from the west, N.E., or E.N.E. seldom turn out so destructive. See p. 96 and 181.

Should a storm arise suddenly with a N.E. wind, vessels riding in the Downs, if outward bound, can get under weigh immediately, and proceed down channel;

or if homeward bound, and not choosing to ride out the gale, they can run in between the Isle of Wight and the main, or into Portsmouth harbour. At the same time ships lying in Margate roads may either purchase their anchor, or slip their cables, and run into the Medway or Thames; but, if they should be unable to weather the fairway buoy, they can enter the east Swale, and anchor in safety.

When the wind blows hard from the S.E. to the S.S.W. vessels in the Downs will be subject to the most danger and inconvenience; for those winds always drive in a heavy sea: there ships often ride very near each other; and the greatest strength of tide commonly happens at high water, when there is the most sea.

Vessels overtaken by a storm, if they are westward of the Isle of Wight, may run into Portland Refuge harbour, where they will ride in safety; but when a ship cannot conveniently run for a safe place of shelter, it will always be advisable to lie to.

Currents, &c.—A current of considerable strength frequently sets across the entrance of the English channel, at some distance from and westward of Ouessant and Scilly, in a N.W. and W.N.W. direction, the breadth and velocity of which is greatly dependent upon the wind most prevalent, and proportioned to its strength and direction; winds blowing from the west and S.W. will be found very much to accelerate its force and render it an object of serious attention. A strong S.W. wind constantly throws a great accumulation of water into the English channel, which tends greatly to increase the force of the flood-tide, while it as considerably retards the ebb, and augments the rise of the water fully 10 feet above its ordinary elevation; therefore, vessels having entered the channel with a strong S.W. gale are liable to be driven a-head of their reckoning, and by taking the first of the flood, will have 10 or 11 hours tide, which at 8 or 10 knots will carry them from off the Start to about Beachy head.

In reference to the foregoing current it has been observed—"It has long been known to mariners that a current constantly sets round the capes Finisterre and Ortegal, into the bay of Biscay; and it has been ascertained that, after a long and continued prevalence of westerly and southerly winds, the water, pent up in the bay, and impelled along its coasts, sets outward in a north-west direction, athwart the entrance of the English channel, although after a long interval of such winds it is almost imperceptible. This current has been found, after the wind had set strongly for some time from different points between south and west, to have had about 60 miles of westing and 12 miles of northing in its course, per day, in the most rapid part of its stream. The westerly current has appeared to extend from about 24 leagues W.S.W. of Scilly to more than 3° west of cape Clear. It is, therefore, supposed to go off to the N.W. in the parallel of 51°, between longitude 14° and 15°, and to the S.W. of Ireland, but its exact direction remains to be determined. The middle of the current appears to preserve its original course in a greater degree than its borders, and to set N.W. by W.; the eastern border more north, and the western more west, so that the northern current is much stronger close to the west of Scilly than further out. If a ship crosses the current obliquely, steering a true E. by S. course, or more southerly, she will continue in it longer, and be more affected by it, than if she steered more directly across it. It will be the same if she crosses it with light winds. Allowance must also be made for the more northerly direction of the eastern border.

After a continuance of westerly gales, even should a good observation of latitude be made, it will be imprudent to run eastward during a long night; for a ship might remain in the current so long as to be drifted from a parallel, deemed a very safe one, to that of the rocks of Scilly. Therefore, keep at the highest, in 48° 45′; for in 49° 30′, the whole of the current may be experienced in the worst situation. But from the current in 48° 45′, a southerly wind will send you into the channel. If it be admitted, as is suspected, that a tide with some degree of northing in it sets a little westward of Scilly, this is another reason for keeping far enough southerly. Ships bound westward from the channel, with the wind near S.W., should prefer the port tack, as they would then have the benefit of the current.

Channel Islands Indraught.—Captain White observes, "The action of the indraught in the Great bight between Normandy and Bretagne, on vessels bound up and down channel, is by no means so universal as has been generally imagined. Between 5 hours' flood and low water (7 hours out of 12), the whole body of water contained in the gulf between cape La Hague and Brehat islands sets out thence north-westward, more northerly along the coast of Normandy, and more westerly along that of Bretagne; and the nearer you approach the islands, the stronger, of course, you will experience the indraught as well as the outset. But there is neither southing nor easting in the course of the tide, except between low water and 5 hours' flood. There is, therefore, no room for apprehension, except during that period, when the stream sets southerly, south-easterly, and easterly, with great velocity; extending its influence between Guernsey and the Start, nearly half-channel over, and as far westward as the meridian of the Ile de Bas."

Tides.—Off the mouth of the channel the stream, although considerably influenced by the indraught and outset of the channel, will be found running southward and westward, while the water is rising at Dover, and northward and eastward, while it is falling at that port. Southward of the parallel of Scilly, the tides of the channel and offing blend together with varying force and direction, and occasion the stream to be constantly changing, and in some places even to make the entire round of the compass in one tide, without remaining long upon one point.

An unequal stream of tide begins about 14 leagues west from Scilly. It first runs N.N.W., and continues to alter until it comes to the E.N.E.; the flood-tide then ceases to run. The flood runs here, on the full and change days, until 40 minutes after 7 o'clock, at which time it is nearly half-ebb at the Scilly islands. The flowing of the tide is rather uncertain. About 7 leagues W.S.W. of Scilly it is known to flow till 25 minutes after 4.

At Scilly it is high water at 4h. 42m. on the days of full and change. In running between these islands and the Lizard point, the set of the tide is of great importance, especially with southerly and south-westerly winds. Between the times of high and the succeeding low water, by the shore, the stream sets south-easterly, southerly, and south-westerly, or away from the Wolf: but from low to the following high water, it runs north-westerly, northerly, and north-easterly, or towards that rock. This peculiarity will be found within a supposed radius of 12 or 14 miles from the Wolf; whence, as you approach Scilly or the Lizard, the tides partake of the influence of the land.

In the fairway of the Channel, from the Lizard to the Isle of Wight, the flood sets East and E. by S., and the ebb West and W. by N.; from the Isle of Wight to Beachy head, the flood sets E.S.E., and the ebb W.N.W.; from Beachy head to Dungeness, the flood runs East and the ebb West. Off Dunnose in mid-channel, the stream of flood continues, on full and change days, till 10¾h.

At the Lizard it is high water full and change at 5h.; at about 7 miles S.W. from the lights the flood and ebb streams on these days are nearly of equal duration, and run E. by S. and W. by N., the stream turning at 7h. 43m.

Off the Lizard, in mid-channel, the stream of tide runs eastward on the full and change days of the moon until 55 minutes past 7 o'clock, or until it is half-ebb by the shore; it then changes and runs westward, until it is half-flood by the shore. Two leagues without the Lizard, the flood runs east, and the ebb west, but within that distance the flood runs southward of the east, and the ebb northward of the west.

About 4 miles S.W. of the Eddystone, the stream, on full and change, begins to run E. by S. at 5h. 43m., and continues so till 8h. 20m., when it begins to slacken and shift southward. At 3¼ hours' ebb on the shore, that is, about 9h. on full and change, it sets W.S.W.; at 4 hours' ebb, W. by N.; and then W.N.W. until low water. During the first two hours of flood on the shore the stream sets N.W. by W., and in the next hour it slackens, running N.W. and North; it then runs E.N.E. and E. by N. till about high water, when it again sets E. by S. as at first.

It is high water at the Start at 6h. 10m., on the days of full and change. At the point and in the offing the stream makes westward 3 hours after high water by the shore, and eastward 3 hours after low water, the greatest velocity being at the time of high and low water, viz., 3 knots. When blowing fresh there is a strong race, both on the flood and ebb, from Start point to ¾ of a mile off shore.

At the Bill of Portland it is high water at full and change at 6¾h. About a mile southward of the Bill, at half-flood by the shore, the tide sets from S.S.E. to S.E. ½ E., and the opposite stream about W.S.W. ½ W.; the rate of both at springs is from 5 to 6 knots; but although the tide runs with such violence near the Race, about a mile S.W. of the Bill the tide has been found very weak. It is very moderate all the way from Weymouth to St. Albans head.

S.S.E. nearly 5 miles from Dunnose (Isle of Wight), on full and change, the stream turns at 10h. 40m. and 4½h., and runs E. ½ S. and W. by N., at the rate of from 4 to 5 knots. About two miles S.E. from the same point the flood sets

E. by N., and turns at the same time as in Portsmouth harbour, and the ebb W. by S., but one hour earlier than in that harbour.

The following remarks are extracted from the "CHANNEL PILOT":—

"As the tidal wave flows eastward or up the channel, and the stream on the south-east coast of England turns at high water at Hastings, whilst at Dungeness and thence to the North Foreland, the eastern stream runs until four hours after high water at that place, it will readily be seen what a long flood a vessel will carry when running up channel. It therefore becomes necessary to study the set and turning of the stream, in order to keep a correct reckoning on account of the peculiarity of the tides eastward of Fairlight.

Accidents of a fatal nature have occurred to ships running up channel by being lost on the coast of France, in the vicinity of Boulogne, which have been attributed to the rotatory action of the stream, but there is more reason to believe that they have been set eastward by the long continuance of the eastern stream, and deeming themselves westward of Dungeness, have been steering East, whilst they have been 10 miles beyond it, when probably the stream to the S.W. has begun to run, and catching them on the port bow, has set them over on the coast of France. Besides a careful watch being kept on the stream, when running in thick weather from the Isle of Wight to Dover, a strict attention should also be paid to the lead.

Between Beachy head and cape Grisnez the rise, velocity, and duration of the tides, on both sides of the channel, are materially affected by local circumstances, as well as by that rotatory disposition which is so remarkable farther westward, though here, the near approach of the opposite coast prevents its being so regular and complete.

It is high water by the ground at Beachy head at 11h. 0m., at full and change, and also at Dieppe. The stream in the offing begins to run eastward at low water, and continues to do so until high water, a similar law applying to the western stream.

Strong gales from the westward will prolong the north-eastern stream nearly an hour, and retard proportionably that to the south-westward; so that, on some occasions, on the ridge especially, 8 hours north-eastern tide, and only 4 hours to the south-westward, have been found.

Between the Vergoyer and the French shore the tide makes on an average one hour sooner than it does in the offing, both on the ebb and flood.

About one mile S.S.E. of the south Foreland lighthouse, the stream begins to set eastward about 1h. 30m. before high water (11h. 12m.) on the shore at Dover, and runs from N.E. by E. to E.N.E. about 5½ hours, or till 4 hours after high water; it then turns and sets W.S.W. ½ W. about 7 hours. At Dover the flowing stream very seldom continues more than 5 hours, and sometimes scarcely as much: it is nearly the same at Ramsgate. Northward of the South Foreland the streams change their direction to N.E. ½ N. and S.W. ½ S.

In the Down the north-eastern stream begins about 1h. 20m. before high water at Dover; and continues to run 5½ hours; it then turns and runs in a contrary direction till 2 hours before the ensuing high water.

In the Gull stream, one mile N.N.W. from the Bunt head, the northern stream begins about 1h. 10m. before high water at Dover, and continues for 6 hours; it then turns and runs in a contrary direction till 1¼ hour before the ensuing high water. Its direction is N.E. ¾ N., but at the last hour changes to E.N.E., and even southward of east; the last hour of the southern stream changes from S.W. ¾ S. to W.S.W., and even northward of west."

The following are CAPTAIN BULLOCK's remarks on the set of the tides:—"As there is a peculiarity in the duration of the flood and ebb the whole length of the coast from the North Foreland to Hastings, so there is a great peculiarity in the times of the turning of the stream, the knowledge of which is most essential to the navigation of this part of the channel. Thus, between the North Foreland and 8 miles westward of Dungeness, the stream commences setting eastward about 2 hours before high water at Dover, and runs north-eastward, taking the form of the channel, until 4 hours after high water. The western stream begins about 4½ hours after high water at Dover, and runs until 2 hours before the following high water. This is a general rule for the strait of Dover; a slight difference, however, takes place in the turning of the stream close in shore, which may sometimes be taken advantage of in turning to windward. Thus it will be seen that the stream from the North Sea, which fills the Thames, runs down channel until it is met and overcome by the stream from the westward, which meeting takes place off Fairlight at about 2 hours before high water, when it begins to turn and set eastward; the greatest velocity being about an hour after high water, and that of the western stream about half an hour after low water, which is 7 hours after the time of high water by the tables.

Off Fairlight, on account of the meeting of the North Sea and channel streams, the tides are sometimes very confused, and have not much strength; farther westward, off Hastings, they run more regularly, but with little force. At 6 miles off Bexhill, the streams run regularly during the whole tide, the flood setting E. by N., which is a slight inset to Rye bay, and the ebb in the contrary direction.

From Dover to Hastings, the duration of the flood is always considerably less than the falling tide, the former flowing 5h. 15m., and the latter ebbing 7h. 8m.; but westward of Hastings, at Eastbourne, the duration of the two tides begins to equalize, the tide flowing 5¾ hours, and ebbing 6¾ hours.

Inshore, between Hythe and Dungeness, there will be found a slack during the strength of the eastern stream; also from Hastings to Beachy head the flood runs easy. During the western stream the tide is easy between Hythe and Sandgate, as far as Mill point; and between Dungeness and Fairlight there is a slack which might be taken advantage of. Between Pevensey bay and the Holywell bank the western stream commences at half an hour before high water; and over the bank, and in Whitbread hole, there is a strong eddy setting down after half-flood. For several miles off Beachy head the tides turn with the high and low water by the shore.

From what has been stated with reference to the stream near Dungeness, and about 8 miles westward of it, it will be seen that, if a vessel carries the eastern stream or flood as far as Fairlight, she will have a continuation of easterly tide for 4 hours longer, and if sailing 8 knots she will carry it to the north Foreland. If turning to windward, and she can get eastward of Fairlight by high water, she may then advance as far as the West road of Dungeness before the tide makes to leeward, but if not to windward of Fairlight by an hour after high water, she will get no farther, and may either keep under weigh, or anchor for the tide, as convenient."

Dangers.—Before arriving at the strait of Dover the principal dangers, and those which a vessel navigating in the offing should particularly take notice of, are, the Scilly islands, the Seven Stones, the Wolf, the Stag rocks, off the Lizard, the Eddystone and Hand deeps, the Skerries, the Shambles, the Shingles, the Owers and the Royal Soverign shoals, on the *English Shore;* and the Chaussèe de Sein, Ouessant and the rocks between it and the main, the rocks about Abervrac'h, the Ile de Bas, the Blanche rocks, the Meloine bank, the Triagoz, the Seven isles, the Dourve and Carnouic banks, on the *French Shore;* with the rocks in the neighbourhood of the Casquets and Guernsey.

Directions.—When coming from the N.W. or west, ships should always endeavour to obtain soundings as early as possible, getting between the latitudes of 49° 15′ and 49° 25′.

The directions given for entering the English channel, by steering eastward, in the parallel of latitude 49° 25′ to 49° 30′ N., seem only applicable to vessels navigated by dead reckoning, or when the longitude is not ascertained by lunar observation, or by chronometers, and even under such circumstances, this seems not to be the best track for approaching the English channel. First, because ships are obliged to make a more circuitous route from the Azores, to get into the parallel of 40° 25′ N. well westward of cape Clear, than would be requisite in steering a direct course for the Lizard point, and as S.W. or westerly winds prevail during a great part of the year, there can seldom be occasion to steer so far northward. Secondly because ships, by keeping in the parallel of latitude of 49° 25′, or 49° 30′ N. have, when near the Scilly islands, frequently encountered sudden shifts of wind from the southward, whereby they were driven north-west of these islands into St. George's channel. From this cause, many ships have been forced to take shelter in Cork, or some of the harbours on the coast of Ireland, where they were detained long by southerly winds; whereas the same winds would have been favourable for them entering and running up the English channel, had they kept a little further southward. And thirdly because when S.W. or southerly winds prevail, the flood-tide sets 8 or 9 hours northward into St. George's channel, and the ebb only 3 or 4 hours southward, by ships pursuing their route in the parallel of latitude 49° 25′, or 49° 30′ N., are liable to be drifted among, or northward of the Scilly islands, during thick foggy weather, when the latitude is not ascertained by correct observation.

In dark thick weather come no nearer to Ouessant, or to the Saints, than 65 fathoms. In these parts, different soundings will be met with, but mostly interspersed with small shells, resembling (and called) Hake's Teeth. Four leagues west of Ouessant there are 59 and 60 fathoms, on pale whitish ground, resembling hardish marl, with mealy surface. Perhaps the most eligible track for vessels is, after passing the Azores, to shape a direct course for the Lizard point, inclining a little more northward, as circumstances may require. From January to May, when N.E. or northerly winds prevail outside, and in the entrance of the English channel, it will be proper to get into about 49° N. latitude, when the meridian of cape Clear is approached; an easterly course for the Lizard point ought then to be followed, and if the wind blows steady from the northward, the parallel of 49° 30′ may be preserved in passing the Scilly islands. From April or May to November or December, S.W. and westerly winds commonly prevail; vessels may then steer so as to get into the latitude of 48° about the meridian of cape Clear, and from this situation a direct course may be steered for the Lizard. But at all times mariners about to enter the English channel ought to act according to the prevailing circumstances, by hauling either northward or southward, as the wind renders it most advisable.

By following the above route, instead of going more northerly, you will save much time, and often escape those southerly gusts of wind which have frequently driven vessels north-westward of the Scilly islands, and even forced some to the harbours in Ireland, where they have been detained by the same winds which would have proved so favourable to a more southerly course; they will also have nothing to fear from the current that sets towards the N.W.

Having entered the channel, it is not considered safe to keep over towards the French shore, for the whole length of this coast is full of sunken rocks and dangers, so that the mariner ought never to approach it nearer than just to discover the land from the masthead; and it is to be observed, that along this shore, and and among the rocks and islands, the flood-tide, at the distance of 10 or 12 leagues off the land, sets S.E., while the ebb does not set N.W., but West along shore, so that vessels driven on the coast with north-westerly gales will not have the tide to help them off, and are most liable to be driven on shore. "Strangers," says M. Dechamps, "looking upon the charts will observe many inlets that appear like harbours, sufficiently capacious to admit ships in case of distress or stormy weather; but this is an error, for there is no safe harbour, easy of access on the whole coast of Brittany and Normandy, excepting Guernsey and Jersey, where vessels can take refuge in safety, before they reach Cherbourg; while the opposite coasts of England afford safe and commodious ports and roadsteads throughout." The mariner will easily know when he is southward by the coarseness of the ground, and the overwhelming of the tide, which whirls round in several places with breakers. Therefore, he should endeavour to keep upon the English coast, at from 5 to 7 leagues' distance, till he gets up as high as Portland.

After you are past Scilly, continue running eastward for 10 or 11 leagues, coming no nearer the English shore than 53 or 54 fathoms, or further southward than 60. After you have run this distance the Lizard will bear N.E., or N.E. by N. about 8 leagues, and you will have from 58 to 55 or 56 fathoms, with sandy bottom with shells.

Ships coming into the channel ought always, if possible, to make the land about the Lizard; for should they afterwards have thick weather, they will know how to steer, or how to advance up the channel. Some, by neglecting this precaution, have, contrary to their expectation, go to the south side of the Channel. This error is greatly owing to the strong indraught between the islands of Guernsey and Jersey, and the coast of Brittany, or Finisterre, which ought always be guarded against, especially in thick weather. It frequently happens that ships coming into the channel have not had an observation for some days back, which, together with the operation scant and contrary winds, and the setting of the tides, tend to perplex and bewilder the most experienced mariner, when thick weather prevents his getting a sight of the land.

Ships from Southward, in thick weather and light winds, frequently get much to the northward of account, and fall into the Bristol channel or the N.W. of Scilly, which may be owing to the tide's running 9 hours northward and only 3 southward.

When coming into the channel in the night, or in thick weather, you should not at any time come nearer to Scilly than 60 fathoms, nor to the Lizard than 46 fathoms.

Course abreast of Scilly.—After you are abreast of Scilly, and southward 5 or 6 leagues, the course to the same distance off the Lizard is E. by S. ¾ S. 15 leagues; then haul in and make the land.

From the Lizard to the Start.—The course from the Lizard to the Start is E. by S. 20¼ leagues. In running up go not into less water than 40 fathoms; for 35 fathoms is in the stream of the Eddystone.

Between the Lizard and the Eddystone, you may stand towards the shore in 40 fathoms, and off to 46. As there are 35 fathoms in the stream of the Eddystone, you will by keeping without that depth, go quite clear of that danger.

From the Eddystone to the Start, you may stand towards the shore in to 32 fathoms, and off to 46. Within half a mile of the Start point are 15 fathoms water. Eight miles southward of the Start lies Start Knoll, with 29 fathoms on it, and 37 fathoms very near it on both sides.

From the Start to Portland.—From the Start to Portland, the course is E. ½ S., nearly, distance 16 leagues. Here you may run up between 30 fathoms in shore to 36 or 38 fathoms water to the southward, most part sand with shells; but if you are inwardly, in 26 or 25 fathoms you will have oaze and sand.

By not standing further southward than 36 fathoms, you will avoid the strong indraught between the islands of Guernsey, Jersey, &c.

From the Start to Dunnose, the course is E. by S. 32 leagues, and you will have 30 to 32 fathoms, as high as Portland; after which approach no nearer to the shore than 25 fathoms, especially when you are above the high land of St.

Albans, as with strong winds southerly, or in little winds, the tide of flood sets directly in for Christchurch, the Needles, and Freshwater bay. When you stand towards the Isle of Wight, in thick weather and light winds, you should keep your lead going.

Dunnose to Beachy Head.—In running up from Dunnose to Beachy head, keep into 18 fathoms water, and without to no more than 30; but off the head you will have 17 and 18 fathoms 5 or 6 miles from the shore. The course up is E. by S. 58 miles.

Beachy Head to Dungeness.—From Beachy head to Dungeness the bearing and distance are east 9½ leagues; but Beachy head must not be brought westward of N.W. ¾ W. until you are 8 leagues eastward of it, in order to clear the Royal Sovereign shoals. When you have run that distance, or have brought the town of Battle on with that of Bexhill, bearing about N.N.E., you may steer E. ¾ N.; about 8 leagues, for Dungeness. There are only 8 fathoms immediately southward of the Royal Sovereign shoals; it then deepens to 12, 14, and 17 fathoms off Dungeness; when in the vicinity of the shoals go not into less than 16 fathoms.

Dungeness to the South Foreland.—From Dungeness to the South Foreland the course and distance are nearly E.N.E. ½ E. 6¾ leagues; keep no further off than 16, nor closer in than 14 and 12 fathoms.

In coming up the channel, after you are as high as the Start, if the land has not been previously seen, endeavour to make the coast of England, to avoid the island of Alderney, the Casquets, &c.; but if you cannot safely do so, with a scant southerly wind, when the tide, both ebb and flood, has an inclination into every bay upon the coast, then keep your lead constantly going, and if you fall into deep water, from 50 to 60 fathoms or more, coarse ground, you are somewhere near the stream of the Casquets, and must run northward, into 40 or 35 fathoms, sand and shells; you will then be northward of them, and in a fair way.

Being too far southward, and mistaking the Casquets lights at first sight for those of Portland, has occasioned the loss of many ships upon the adjacent dangers.

The pit or gully, called *Hurd's Dyke*, is an excellent guide to ships working up or down channel in dark, hazy weather. A ship, from the northward, increasing the depth 10 fathoms suddenly, may be assured of being within 10 miles of the Casquets, Alderney, or cape la Hague.

The Casquets bear from the Start S.E. ¾ S., distant 19 leagues, and from the Bill of Portland S.S.W. ½ S. 16 leagues.

The depths of water south-westward, southward, and south-eastward of the Casquets within the supposed radius of 9 miles, do not materially differ with those in similar directions from Portland, so that it is possible in bad weather, under a combination of disadvantageous circumstances, for the former to be mistaken by a stranger for those of the latter, particularly if hazy weather intervenes so as to prevent the revolving lights of the Casquets from being distinguished, unless, indeed, soundings were accidentally struck on a bank which lies S.W. from the Casquets.

For it must be recollected that there are six different positions in which the three lighthouses on the Casquets will appear as two only, the first of which is only removed about two points from the bearings of those on Portland, viz: N.W. ¾ W., or S.E. ¾ E.; E. ¾ N., or W. ¾ S.; N.E. ½ E., or S.W. ½ W. Secondly, that the variation in the distance from the Lizard, to those two positions, is very trifling; and, lastly, that this is the narrowest part of the channel westward of Beachy head. Should a stranger, therefore, be placed in such a predicament during a winter's night, between the periods of low water and three-quarters flood, with a gale of wind from between N.W. and S.W., the consequences may be easily anticipated. This is a strong and unanswerable argument for a uniform and constant progressive attention to the lead from the instant of first striking soundings, by which such a disastrous situation can alone be successfully avoided.

By altering the courses successively between the meridians of the different headlands as you advance up the channel you will better counteract the direct effects of the stream. In the vicinity of Chesil beach the shore is low, whence the Peninsula of Portland suddenly rises and forms a very remarkable promontory, assuming the form of a wedge, and declining gradually southward.

When you stand towards the Isle of Wight, in thick weather and light winds, you should keep your lead going constantly, because you may, from the depth of 22 fathoms, suddenly get into 18, and then 30 or 40, or more, within 1½ miles of St. Catherine point.

Between the shoals which lie off Beachy head and Dungeness, you may stand towards the shore into 12 fathoms, and off to any convenient distance, according to circumstances, taking care not to go further from the land than 5 leagues, in order to avoid the Western Vergoyer, Boulogne middle, &c. As the soundings hereabout are very irregular, we refer the mariner to the chart itself for the necessary information; observing only that, by not standing nearer the shore than 12 fathoms, you will go clear of the shoals which lie westward and eastward of the Ness point.

When going between Dover and the Downs, observe that 17 fathoms will carry you without the South Sand head; and 13 fathoms will lead you within it; and that 15 fathoms is in the stream of it.

On the Navigation of the Channel by Steamers.—It is of considerable importance that courses should be pursued by steamers up and down channel, to avoid as much as possible the general track of sailing vessels, especially those of the foreign trade; the conducting of which vessels, not being generally attended to with the necessary care in running during the night, and at all times, even when the greatest possible caution is taken, it requires an experienced eye, which is only to be found amongst those used to navigate shipping in the dark, to make out readily what a ship is about, how standing, &c., when suddenly coming upon her. Confusion in these cases is the usual consequence; therefore, steamers should keep a track only used by coasters and themselves, if possible.

From a position off the South Foreland both lights in one, if passing pretty close under them, and then hauling in a little to pass near Dover, a W.S.W. course, 21 miles will carry you to Dungeness, just within the track of all large vessels running up. Passing Dungeness at a short distance, a W. ½ S. course, 30 miles, will carry you to Beachy head bearing North, distant 6 miles. This will take you outside the Royal Sovereign shoals, over which there are sometimes no more than 9 feet water.

Beachy head light is badly placed for stream navigation, and coming from the east, it remains shut in so long, that it is impossible for a navigator wishing to keep in shore to know when it should be opened.

Beachy head may be passed as near as convenient, but with it bearing North, distant 6 miles, a course W. by N., 59 miles, will carry you south of the Isle of Wight, with St. Catherine point light bearing North, 8 miles. In this course you will pass the Owers with its lightvessel at a safe distance, but as the tide, both ebb and flood, has a tendency to set towards these shoals, care should be taken (if with spring tides especially, and fresh southerly breeze, you find the vessel nearer the light than the course steered should take you) to keep out a little, so as to give the Isle of Wight a fair berth. The Bembridge lightvessel also, if seen, which it will be if too far in, is also a good mark for St. Catherine point, which, on a dark night, should not be approached without great caution.

From the before-mentioned berth off St. Catherine point to a corresponding one off the Star point, the direct course will be W. by N., 93 miles, but if in the night time, as soon as the Portland lights are seen, it will be better to edge in a little towards them, and when abreast of them, to make a corresponding allowance on the course for the Start, and thus continue the plan of keeping well within the line of large ships coming up Channel.

From the above position off the Start, a W.N.W. course, 54 miles, will take you to Falmouth, passing outside the Eddystone, from which the entrance to Falmouth is distant 29 miles. St. Anthony's light is a good revolving light but is badly placed, being of no use to vessels coming from the eastward, as it remains shut in under St. Anthony's point, until you are close to it. The point on which the lighthouse is placed may be passed very closely.

With Start point light bearing North 6 miles, the course and distance to a corresponding position off the Lizard lights, are W. ¾ N., 64 miles. Thence southward of the Scilly islands W. by N. ½ N., 45 miles; or just southward of the Wolf rock, N.W. by W. ¼ W., 27 miles; or to the passage between the Wolf rock and the Runnel stone, which is about 7 miles in width, N.W. ½ W., 25 miles. From these two latter positions a N. ½ W. course will lead out between the Longships and Seven stones.

The Courses up channel, given as safe courses, are as follow:—

With St. Agnes light North, 8 miles, to Lizard lights North, 6 miles, E. by S. ½ S., 44 miles. Hence to off the Start, E. ¾ S., 64 miles.

From Falmouth to off the Start, E.S.E. ¼ S., or E.S.E. in fine weather, 54 miles.

With the Start bearing true North to Portland, E. ½ S., 50 miles.

Portland lights true North to Beachy head, E. by S. ¼ S., 105 miles.

With Beachy head light N.N.W., distant 6 miles, the course is E. ½ N., about 30 miles to Dungeness.

Dungeness to South Foreland, E. by N. ¾ N., 21 miles.

FRANCE.

Tidal Signals.—In August, 1855, the French Minister of Commerce and Public Works issued a system of Tidal Signals, and as these are now used at the French ports, we give them here instead of repeating them in the instructions for each place. The same may be said of the buoys and beacons, as a uniform system of colouring is observed throughout France.

In French ports flood and ebb and the height of the tide are signalled at intervals by means of black balls, and by flags; these are hoisted on a mast crossed by a yard.

A ball at the intersection of the mast and yard (fig. 1) indicates a depth of 3 mètres, or 9¾ feet. Each ball *below* this, and in the line of the mast, represents an additional height of 1 mètre,* or 3¼ feet,—but each ball *above* it, an additional height of 2 mètres, or 6½ feet. A ball hoisted at the yard-arm and seen to the left of the mast, indicates 0·25 mètre or ¾ of a foot additional, but seen to the right of the mast, 0·50 mètre, or 1⅔ feet additional.

In order to show the state of the tide in respect to flood and ebb, a white flag crossed with black from corner to corner, and a black pennant will be used. One or both of these will be flying at the masthead so long as there are 2 mètres or 6½ feet of water in the channel; thus, the pennant above the flag indicates flood,—the flag alone, high water,—and the pennant below the flag, ebb.

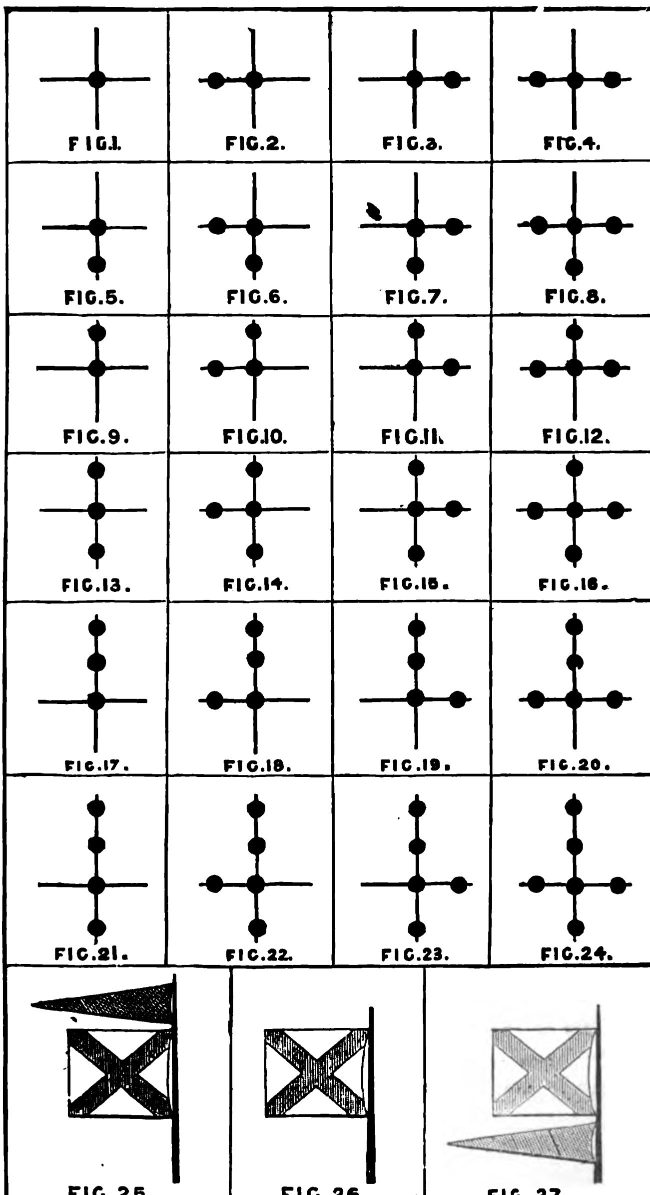
The accompanying woodcut represents the several positions of the balls on the mast or yard, corresponding to the depths indicated below.

Fig. 1.—3 mètres or 9 ft. 10 in.	Fig. 2.—3·25 mètres or 10⅔ ft.
Fig. 3.—3·50 mètres or 11½ ft.	Fig. 4.—3·75 mètres or 12⅓ ft.
Fig. 5.—4 mètres or 13 ft. 1 in.	Fig. 6.—4·25 mètres or 13 ft. 11 in.
Fig. 7.—4·50 mètres or 14¾ ft.	Fig. 8.—4·75 mètres or 15 ft. 7 in.
Fig. 9.—5 mètres or 16½ ft.	Fig. 10.—5·25 mètres or 17 ft. 2 in.
Fig. 11.—5·50 mètres or 18 ft.	Fig. 12.—5·75 mètres or 18 ft. 10 in.
Fig. 13.—6 mètres or 19⅔ ft.	Fig. 14.—6·25 mètres or 20½ ft.

* A mètre is equal to 3·28089920 feet.

Fig. 15.—6·50 mètres or 21⅓ ft.
Fig. 16.—6·75 mètres or 22 ft. 2 in.
Fig. 17.—7 mètres or 22 ft. 11 in.
Fig. 18.—7·25 mètres or 23½ ft.
Fig. 19.—7·50 mètres or 24⅔ ft.
Fig. 20.—7·75 mètres or 25 ft. 5 in
Fig. 21.—8 mètres or 26¼ ft.
Fig. 22.—8·25 mètres or 27 ft. 1 in.
Fig. 23.—8·50 mètres or 27 ft. 10 in.
Fig. 24.—8·75 mètres or 28¾ ft.

Fig. 25.—Pennant above flag,—" Tide flowing."
Fig. 26.—Flag alone,—" High water."
Fig. 27.—Pennant below flag,—" Tide ebbing."



A red flag at the masthead indicates that the state of the tide is such that a vessel cannot enter.

It must however be born in mind that this system of signalizing is not required *in its entirety* in every port; in some it is sufficient to indicate the rise and fall mètre by mètre;—in others, by every 2 mètres—hence, in these, the mast has no yard. But whichever signal is hoisted, it invariably has the one meaning in every port.

Buoys and Beacons.—The following is the system of marking shoals adopted on the coast of France.

On entering a channel from seaward all buoys and beacons painted *red* with a *white* band near the summit must be left to starboard; those painted *black* must be left to port: buoys that can be passed on either side are coloured *red with black horizontal bands.* That part of the beacon *below the level of high water* and all warping buoys are coloured *white.* The small rocky heads in frequented channels are coloured in the same way as the beacons, when they have a surface sufficiently conspicuous.

Each beacon or buoy has upon it, either in full length, or in abbreviation, the name of the danger it is meant to distinguish; likewise its number, commencing from seaward, and thus showing its numerical order in the same channel. The *even* numbers are on the *red* buoys, and the *odd* numbers on the *black* buoys; the buoys and beacons coloured *red with black horizontal bands* are named but not numbered.

The letters and numbers are painted in *white* on the most prominent part of the buoys, and from 10 to 12 inches in length. The masts of the beacons which do not present sufficient surface are surmounted for this purpose by a small board. All the jetty heads and turrets are coloured above the half-tide level, and on the former a scale of *mètres* is marked commencing from the same level.

Brest.—The approach to Brest harbour from northward is much confined by the rocks and shoals between Ouessant and St. Matthew's point, and from southward by the Chaussée de Sein; within these are also numerous isolated dangers. The Goulet de Brest is the only entrance to the harbour; it is narrow, being not more than a mile in width, is defended on both sides by strong forts, and has water deep enough for the largest vessels. The shore on the southern side of this channel being moderately bold, and clear of danger, and that on the northern side being similar, the only hindrance to its free use is some rocks in the fairway.

Brest harbour, one of the finest harbours in Europe, is one of the principal stations of the French Navy. It consists of a large land-locked bay upwards of 20 miles in circumference, with two deep branches, one of which receives the river Landerneau, and the other the river Chateaulin. The water is deep enough for the largest vessels, and there is sufficient room for 500 sail of large ships to ride securely. Ths basin or roadstead is 5 or 6 miles across; the principal anchorage is about a mile from the town.

The thriving town of Brest is situated partly on the slope of a hill, on the north side of the harbour, and about 2 miles within the Goulet. Here there is a magnificent arsenel, vast building slips, docks, magazines, and workshops. The town is separated from the suburb of Recouvrance by a deep tide inlet, alongside of which is the dockyard.

LIGHTS.—Ouessant bears from different parts of the English coast as follows:—

			MILES.
From	St. Catherine point in the Isle of Wight...	W.S.W. ½ W....	191
,,	Bill of Portland..............................	S.W. by W. ½ W.	157
,,	Start point	S.W. ¾ W.	117
,,	Eddystone lighthouse.........................	S.W. ½ S.	106
,,	Lizard lights	S.S.W.	88
,,	Bishop light (Scilly)	S. ¾ E.	99

The lighthouse on the north-eastern end of the island shows a *fixed* light. visible in clear weather to the distance of 20 miles. Its position is in Lat. 48° 28′ 31″ N., and Long. 5° 3′ 32″ W. Another lighthouse on the N.W. end of the island, shows a *revolving* light which appears twice *white* and once *red* at intervals of 20s.; it is 228 feet above the sea, and can be seen from a distance of 24 miles.*

The *Bec du Raz* has a lighthouse on its highest part, which shows a *fixed* light, visible in clear weather from a distance of 20 miles.

The lighthouse on the northern point of the *Ile de Sein* shows a *flashing* light of the first order. A flash appears every 4 minutes, and is preceded and followed by a short eclipse, which, however, is not total, within the distance of 12 miles. The weaker light, which continues about three minutes, between the flashes, is visible in clear weather at a distance of 16 miles. This light is 5½ miles from the Bec du Raz light, in the direction of N. 86° 50′ W. (true). This bearing (likewise the general direction of the whole chain of rocks) passes about 4 cable's lengths southward of the north-western extreme of the chain, which is 9 miles from the Sein light, and 14½ miles from that on the Bec du Raz.

St. Matthew's point is distinguished by a lighthouse which exhibits a revolving light, visible at the distance of 18 miles. The flashes succeed each other every half minute, but the eclipses do not appear total within 7 or 8 miles. The importance of this light will be evident upon an inspection of the chart, as by a single bearing of it the ship's position may be determined, and a course thence steered for Brest harbour, or for the west end of the Chaussée de Sein.

Northward of St. Matthew's point, and on *Kermorvan point* there is another lighthouse, exhibiting a *fixed* light. In clear weather this light is visible 12 miles.

* A fog-trumpet (sounded by compressed air) has been established on the extreme west point of the island. During fogs it will be heard at intervals of about 10 seconds. In *calm* weather the sound will be carried ordinarily to the distance of 3 miles;—the direction and strength of the wind have, of course, a very considerable influence upon the distance at which it can be heard.

Besides the foregoing lights, the approach to the entrance of Brest harbour is facilitated at night by three others; one on point Toulinguet, on the southern side of the entrance to the Goulet; another on point Minou, on the northern side: and the third on Portzic point, at the inner end of the Goulet. The light on point Toulinguet is a *fixed red* light, visible at the distance of 7 miles. Minou point light is *fixed*, and visible at the distance of 15 miles. Portzic point light is *fixed (varied by flashes every three minutes)*; each flash is preceded and followed by a short eclipse, which does not appear total within 8 miles;—this light is visible to the distance of 18 miles. Minou and Portzic lights in one lead to the entrance of the Goulet, avoiding the dangers, named the Coq and Basse Beuzec to the north, and that of the Vendrée, &c., to the south, hereafter described.

DANGERS *outside the Goulet de Brest.*—Between St. Matthew's point and the island of Ouessant there are a number of small islands, rocks, and rocky shoals, with several channels among them, which are useful to the native coasters, but only two can be made use of by strangers, and these require the exercise of considerable care, namely, the Chenel or passage du Four, and the Fromveur passage. The whole of the group will be better understood by an inspection of the chart, than by any description, however plain, that we could give; we, therefore, confine our remarks to the channel on the southern side.

Many of the rocks are extremely steep, especially on the western and southern sides of the group, where almost directly off them are soundings of from 17 to 46 fathoms.

The westernmost patches of the group of rocks lying between Ouessant and St. Matthew's point are *Les Pierres Vertes*, or the Green Stones. These consist of sunken rocks which become dry in several places at low tide, at that time appearing about 7 feet above the surface of the water; their western part is 5¼ miles S.S.W. ¼ S. from Ouessant north lighthouse. About 6 miles S.S.E.-ward from Les Pierres Vertes are the Pierres Noires, or black rocks, which are always above water, and have 17 to 15 fathoms close to them. From the Pierres Noires, a ledge of rocks, some above and some under water, extends eastward almost to St. Matthew's point, and is called the Chaussée des Pierres Noires. The most prominent of this ledge are the Chiminees, le Ranvel Basse Large, &c. But the whole of the south side of this group of islets and rocks will be better understood by an inspection of the chart.

While westward of the Black rocks, you should not approach them nearer than 2½ miles. On their southern side they are so steep, that the soundings along them, at no great distance, vary from 35 to 20 fathoms. At the distance of about 5 miles southward of them there is good anchorage, with easterly winds, in 32 fathoms, fine sand; and at 6 miles distance the depths are from 34 to 40 fathoms, with sand; and nearly the same thence to the southward.

The most south-eastern spot of the group is *Basse Royale*, from which St. Matthew's lighthouse bears E. by N. ¾ N., distant rather more than 3 miles; on it is a depth of 4 fathoms at low water spring tides.

The *Chaussée de Sein* is an extensive ridge of rocks and shoals, occupying a space of 11 or 12 miles long in a S.E. by E. $\frac{1}{2}$ E., and N.W. by W. $\frac{1}{2}$ W. direction, and of an average breadth of 1$\frac{1}{4}$ miles. The Ile de Sein is upon the eastern part of thc Chaussée. Many of the rocks on the Chaussée dry at low water, but should not be approached too near, as little or no warning is given by the lead, there being from 30 to 45 fathoms within a mile of them on a bottom of rock and broken shells. The most dangerous part of the Chaussée is that nearest the Ile de Sein, where for a space of about 4$\frac{1}{2}$ miles the ridge is studded with rocks more or less above water, and which takes the name of the Pont de Sein or Saint's bridge. The outermost point of the Chaussée de Sein bears from St. Matthew's point lighthouse W.S.W. $\frac{1}{2}$ S., distant 20 miles, and from Ouessant fixed light S.W. by S. $\frac{1}{2}$ S., distant 25$\frac{1}{2}$ miles.

The isolated dangers before alluded to as being in the way of vessels approaching Brest harbour, or the anchorage at Bertheaume Camaret, &c., are very numerous. We shall take them in the following order, beginning with the outermost on each side of the main channel :—Le Coq and the Basse Beuzec on the northern side; and the Vendrée, Basse de l'Astrolabe, Le Goemant, La Parquete and Bank, Le Trepied, the Louzaouennou and Banks, Le Corbeau, Basse Pontchou, the Leaches, the Mendufas, and Toulinguet, on the southern side. Coming in from the south-westward, and making for one of the channels among the foregoing rocks, you will meet with the Basse de l'Iroise, du Lis, and Menehom ; or from the southward, the Bouc, the Chevreau, the Chévre, and the rocks off Penhir.

From St. Matthew's lighthouse the coast continues in an E. by S. $\frac{3}{4}$ S. direction, about 2$\frac{1}{2}$ miles to point Crearc'h-meur, the western side of the bay of Bertheaume, and upon which there is a fort and beacon. Midway, at $\frac{3}{4}$ of a mile from the land, is the *Coq rock*, which uncovers at low water, and lies with the beacon near Fort St. Merzan bearing N.N.W., and Bertheaume castle in one with the extremity of point Crearc'h-meur.

About 1$\frac{1}{2}$ mile in an E.S.E. direction from the Coq rock is the *Beuzec*, a bank of 5 feet at low water, marked by a buoy. All around it is deep water of 8 to 10 fathoms. The marks by which to know its position are, the castle of Bertheaume N.N.E., distant a mile; and the lighthouse, chapel, and semaphore on point St. Matthew in a line.

By night the lights on points Minou and Portzic, in one, lead southward of the Coq and Beuzec, and also northward of those on the southern side of the channel.

The outermost of the rocks on the southern side of the channel is *La Vendrée rock*, a small and steep patch of 6 feet water, marked by a buoy, which lies with the two peaks of the Siège rock (in the Ouessant group) open a little to the right of the Chiminees rocks, bearing N.N.W. $\frac{1}{4}$ W., and the tower of Crozon open 9′ left of the Fourche rock, E.S.E. $\frac{1}{4}$ S. About $\frac{1}{2}$ a mile E.S.E. of the shoal part of this rocky bank is the *Goemant*, a small patch of 5 fathoms; and at $\frac{3}{4}$ of a mile N.E. by E. $\frac{1}{4}$ E. from the same shallow part of the Vendrée is the *Astrolabe*, another of similar depth.

The *Parquetes* are situated east of La Vendrée about 2 miles, and bear from St. Matthew's lighthouse S. ½ W. 4⅛ miles; they dry at low water, and appear at that time 6 and 20 feet above the surface; around them there is deep water, except at the distance of ½ a mile E.S.E. of the highest, where a depth of only 7 feet will be found.

Le Trepied rock, distinguished by a buoy, encroaches more into the channel than any of the rocks on the southern side; the highest head of rock is 9 feet above low water. Lochrist steeple in one with Fort St. Merzan, and the southern extremity of the Lignes de Kelernn open a little north of point du Grand Gouin, are the cross marks for its position. At the distance of ½ a mile S.W. by S. from Le Trepied is the *Louzaouennou rock*, which is just a-wash at low water, and has near it two patches of about 8½ fathoms, one about a cable's length from its northern side, and the other a little southward of its southern side.

Le Corbeau is on the western side of the Passage du Corbeau, and is 14 feet high, when the tide is down. It lies S.S.E. ¾ of a mile from Le Trepied, with the church of Lochrist open just eastward of Fort Merzan. On the eastern side, the Passage du Corbeau is bounded by the *Pontchou bank*, upon which the depths are from 6 to 18 feet, the shoalest spot being ¼ of a mile west from a rock always above water. The Corbeau channel is narrow, though deep, and should not be attempted by a stranger.

The *Leaches* are a group of rocks above and under water just eastward of the Pontchou bank; they occupy a space of ½ a mile from north to south, and ¼ of a mile from east to west, and bound the narrow channel of Petit Leach on the northern side. The leading marks for Petit Leach channel, the mill of Roscanvil in one with the rocks off Toulinguet point, E. by N.,* clears the southernmost Leach rock, upon which there is, or was, a beacon; and by not approaching the largest rock nearer than ½ of a mile you will avoid the 12-foot patch on their eastern side.

The Mendufas and *Toulinguet rocks* separate Toulinguet and Petit Leach passages. The former consist mostly of sunken rocks, and lie W.S.W. of the Toulinguet largest rock; they extend N.E. by N. and S.W. by S. ¾ of a mile. There is a narrow channel between these two groups, used by the natives, and the pilots. If intending to run through the Passage du Petit Leach, bring the leading mark on, namely, Roscanvil mill in one with the rocks off Toulinguet point, E. by N., when you are about 2½ or 3 miles from the point, and follow it pretty closely, until nearly abreast of Toulinguet rock, when you should steer north-eastward so as to give it, as well as the point, a good berth. The Passage du Toulinguet is between the rock and point of that name. Approaching it from the westward you must be careful of the southernmost patch (2 feet) of the Mendufas, to avoid

* The best mark for Petit Leach channel is the summit of the road to Paris, behind the town of Brest, seen exactly in the middle of the Goulet, bearing E.N.E., nearly; as this will lead through in mid-channel clear of all danger.

which it is advisable to keep within ¾ of a mile of Penhir point and rocks, which are above water and steep, and then pass through the narrow part of the channel by giving Toulinguet point a berth of ¼ of a mile.

The Basse de l'Iroise is the south-westernmost of the outlying rocks. It is a shoal bank of 4 fathoms, lying 2½ miles S.S.W. ¾ W. of La Vandrée. Its marks are, Lochrist mill open 3′ or 4′ to the right of the chapel of Nôtre Dame de Grace de St. Matthew, about N.N.E. ¾ E.; Roscanvil mill, on Kelerun peninsula, in one with the most northerly rock off point Toulinguet, E. by N., nearly.

The Basse du Lis, E. ¾ S. 2½ miles from the Basse de l'Iroise, is the next rock in coming from the south-westward, after passing that shoal; upon it the depths are 5, 11, and 21 feet; from the first of which the church of Lochrist appears in one with the Pignons de Keravel, and St. Sebastien mill in line with Toulinguet rocks, E. by N. ¾ N. Its length is about ¼ of a mile, and the depths around it 18 and 20 fathoms.

On the *Basse Ménehom* which is 1¾ miles eastward of the Basse du Lis, there are three shallow spots, the S.W. rock having but 13 feet on it, the middle rock 22 feet, and the N.E. rock 19 feet. The first of these lines with Lochrist church bearing north, and Toulinguet rock N.E. by E. ¼ E.; and the last with the same church N. ½ W., and the rock N. ¾ E. They are distant from each other nearly ⅜ of a mile in an E.N.E. and W.S.W. direction. The middle shallow is between them, but rather nearer the S.W. than the N.E. rock.

Le Bouc, le Chevreau and *la Chévre* are three rocks which dry respectively 23, 20, and 22 feet at low water of spring tides, and lie between Cape de la Chévre and Pointe de Dinant, le Bouc, at the distance of 2¾ miles N.W. ¾ N. from the south-west extremity of the cape, le Chevreau 3⅝ miles N. by W. from the same point, and la Chévre, which is ⅜ of a mile within le Chevreau, at 1¼ mile W. ½ N. from the middle of Pointe de Dinant. Toulinguet rock seen clear either eastward or westward of the outermost rock off Penhir will clear le Bouc and le Chevreau.

The Penhir Rocks or Tas de Pois are all above water, and steep; they extend westward from Penhir point a distance of more than ½ a mile. No attempt should be made to pass through the narrow channels among them, but in rounding their southern side be careful of the *Basse de Dinant*, which bears from the outermost S.E. ¾ E. rather more than ½ a mile, and has only 8 feet on it, with from 7 to 11 fathoms inside it.

These comprise the dangers in the way of the approaches to the Goulet de Brest. Among them are numerous passages, but the only one recommended to a stranger is that which is bounded on the south by La Vendrée, Parquetes, Trepied, &c.

Directions.—When sailing in the vicinity of this dangerous reef of rocks the greatest circumspection will be necessary, and a near approach should not be made unless you have on board a good pilot from the Ile de Sein, as it is possible that all the dangers may not yet have been discovered.

Between the Saints and the group of islet and rocks in the space within

Ouessant, is the channel called the *Iroise*, in which is a depth of from 60 to 80 fathoms, soundings of sand, rock, and putrid shells. North and N.W. of the western extremity of the Chaussée de Sein the flood runs north-eastward 1½ miles an hour, and the ebb south-westward about 1 mile an hour, the flood commencing 5h. 50m. after high water at Ouessant.

When approaching these rocks from the westward, the first light seen will be the flashing light on the Ile de Sein, and a single bearing of it will indicate to the mariner whether he is northward or southward of the line of direction of this light and that on the Bec du Raz. In clear weather the Bec du Raz light will not be seen till the vessel is within 4 or 5 miles of the western extreme of the chain of rocks.

When it is intended to pass southward of the rocks, a course should be steered so as to open the light on the Bec du Raz to the right, or southward of that on the Ile de Sein. But if it be intended to pass northward, or to enter the Iroise, no time should be lost in quickly opening the Bec du Raz light to the left, or northward of that on the Ile de Sein.

The Ile de Sein light bears a great resemblance to the Penfret light (on one of the Glenan islands), but this resemblance cannot occasion any mistake, as the light of Penfret is within the horizon of the great light of Penmark, the flashes of which are at half-minute intervals, and which, in fine weather, are seen as far as the Bec du Raz.

About 8½ miles S. by W. from the western extremity of the Chaussée is a small patch of 19 fathoms, called *Fouquet Bank* from the name of the pilot who discovered it. It is of a very small extent, but has deep water of 25 to 30 fathoms close to, with soundings of rock and small shells. The sea breaks on it occasionally, but never so violently as on the Chaussée de Sein.

At night the lights on points Minou and Portzic, kept in one will lead to the entrance of the channel, clear of the Coq and Basse Beuzec on the north, and the Vendrée, Parquetes, &c., on the south side. Or, if in the day-time, you will pass southward of Coq by steering about S.E. by S. from St. Matthew's point, taking care to keep the north end of the isle of Biniguet well open of it, until Lochrist mill, situated upon the land northward, bears N. by W. ½ W. when you will have passed the rock. The Beuzec may be passed on either side; but the best way is to run northward of it, and along shore, at the distance of two cables' lengths from the latter, and thus sailing S.E. by E. ½ E. across the entrance of the bay of Bertheaume.

In sailing through the Goulet, be careful to avoid the Plateau des Fillettes, the Basse Goudron, and Mengam rocks, which lie right in the fairway. The first is the outermost, and has some rocks upon it which uncover, and others with only a few feet over them; they are very steep, lie ¾ of a mile N. ½ W. from a rocky islet off Pointe des Capucins, and are marked by a buoy. The Mengam is 8½ cables E. by N. ½ N. from the dry heads of the Fillettes, and has a beacon upon its highest rock. The Basse Goudron is nearly midway between them, in the same line of direction; it has two shallow spots of 2 and 5 feet only. The Mengam is ½ a mile from the shore at fort Cornouailles.

Having passed these in entering the Rade de Brest, give Pointe des Espagnols a berth of ¼ of a mile to avoid La Cormorandiere rock, a rock which dries 22 feet at low springs, and bears from the extreme of the point E. by N. ½ N., distant 1½ cable's length. When the town of Brest appears open of Portzic point, you may steer for it, and anchor in 8 or 9 fathoms, or more southward, in 15 or 10 fathoms.

Bertheaume Bay is 3½ miles eastward of St. Matthew's point and is free from danger, except a few rocks situated immediately off its western point. The anchorage is in 8, 10, and 12 fathoms, sand and mud. Ships in this road are sheltered from the N.E., N.N.E., and N.W. winds. This is commonly called the outer anchorage.

Nantes and St. Nazaire.—The river Loire has its entrance between points Chemoulin and St. Gildas, which bear from each other S. ¼ W. and N. ¼ E., 6¼ miles; but the navigable channel, which runs along the northern shore, up to *St. Nazaire*, and passes over a bar of 11 or 12 feet water, is in parts very narrow, especially between the towers named Aiguillon and Commerce, where it scarcely exceeds ¼ of a mile in breadth. The south-eastern part of the mouth of this river is occupied by extensive sand-banks, over and among which smaller vessels can pass, but no leading marks can be given, serviceable to a stranger; in addition to which constant changes are going on in the form and size of these banks, as may be seen by a comparison of the surveys of M. Beautemps Beaupré in 1821 and 1822, and of M. Boquet de la Grye in 1853.

Above St. Nazaire the channel turns over and runs along the south side of the river to *Paimbœuf*, and has not less than 9 feet in it at low water all the way. From Paimbœuf to Nantes the channel is both intricate and shallow, in parts only 2 feet deep at low tide; hence only small vessels, and those under the guidance of a pilot, can go up to that city.

At St. Nazaire, spring tides rise 15¼, neaps 11, and neaps range 7¼ feet.

Lights.—Besides the fixed light (flashing every 5 seconds) on Poulains islet, at the north-west end of Belle island, the revolving light on point Goulphar, the south-west point of the same island, the fixed light on Haedik island, and the fixed light on Petite Foule hill at the north-west end of Ile d'Yeu, there are the revolving light on the north end of the Plateau du Four, the fixed *red* light on Le Turc rock, and the flashing light on Pilier island, off the northern end of Noirmoutier, which may be sighted when approaching the river Loire.

Within the river,* the Tour d'Aiguillon is the tower first met with when entering the river; it stands in Lat. 47° 14′ 35″ N., and Long. 2° 16′ W., and

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* On Point de l'Eve, a little south-westward of the Tour d'Aiguillon, there is a small *red* fixed light, visible 6 miles. It is also proposed to place lights upon Mindin tower, St Nicholas island and Pierre à l'Œil.

exhibits a *fixed* light, visible in clear weather 15 miles off. From this lighthouse to the Tour du Commerce the bearing is about N.E. ¾ E., and the distance 2144 yards. The light from this latter building flashes at intervals of 2 minutes; it can be distinctly seen 15 miles off, and the eclipses are not total within the distance of 6 miles.

A *red* light revolving every 30 seconds has been established on the point of Ville-es-Martin, near the Tour du Commerce, and small fixed lights are also shown at St. Nazaire and Paimbœuf.

DANGERS.—The approach to the river Loire is by two channels, named the Grand or South, and North channels,

The Grand or South Channel is bounded on the south-east side by Pilier island, La Couronnée—the western extreme of Kerouars bank, and point St. Gildas; and on the north-western side by La Banche and La Lambarde. Pilier island should not be approached nearer than 2 miles in any direction, and no passage should be attempted between the island and the shore, as sunken rocks are thickly besprinkled about in all directions. The northern part of Noirmoutier island is also surrounded by ledges of rocks, and other dangers, which extend out above 2½ miles.

Point St. Gildas is foul some distance out northward. About 2¼ miles west of the point, is a rock called La Couronnée, which appears at low water, 7 feet above the surface. It lies with La Pierre Percée in one with the western extremity of the sand hills of Escoublac, and has some shallow patches of a ½ to 2 fathoms water, at less than a mile northward and north-westward of it. Within this rock, towards the land, are 6 to 7 fathoms, and outside it 6 to 10 fathoms. The towers of Aiguillon and Commerce in one will carry you about 2½ miles westward of it.

The extensive bank of *La Banche* is extremely dangerous, there being many parts of it which dry at low water. The northern extremity of the bank, a patch of 1½ fathoms, lies with Escoublac church open 1° 15′ to the left of point Pain Chateau, and the tower on the Turc rock bearing S. by E. ¾ E. Hence the bank extends in a S.S.E. direction about 3½ miles, being nearly a mile in breadth, to a spot of 7 feet called the south-east rock, which lies with La Pierre Percée in one with Poulhaut mill bearing E. by N. ½ N., and the Turc light N.W. ¾ W. distant rather more than one mile. The northernmost of the rocks which dry, called the Three Stones, appear from 6 to 9 feet above the surface when the tide is down. Thence to the ledge called the Turc the distance is about 1½ miles, it being all foul ground between. The Turc shows itself at low water; it has a lighthouse upon it. All round this bank are soundings of from 5 to 12 fathoms, but south-west-ward of the tower, at the distance of 1½ miles, are two small spots of 5½ fathoms, named Basses du Turc.

La Lambarde, a shoal of 1½ to 6 fathoms, is nearly 2 miles long by 1 broad, and has from 6 to 10 fathoms close to all round, being steeper on the southern than on the northern side. One part of it is very dangerous, as it uncovers at low water, being then nearly a-wash; the marks for it are, St. Nazaire steeple open 2° 30′ to the right of the Tour d'Aiguillon, and the tower on the Turc rock W.N.W. ½ N. 3¾ miles.

The Chenal du Nord passes between the Banc de l'Astrolabe, La Banche, and La Lambarde, on the southern, and the Plateau du Four and the rocks and shoals extending from the main, on the northern side.

The Basse de l'Astrolabe is a small shoal of 4¾ to 6 fathoms, lying about 2¼ miles westward of La Banche, with the tower on the Turc rock bearing E. by S. ¾ S., nearly 4 miles. It is surrounded on all sides by 7½ to 12 fathoms. The mark to clear it on the west side is Escoublac church open 1° 15′ to the left of point Pain Chateau. La Banche and La Lambarde have just been described.

A small shoal of 4¾ fathoms, called the Basse Michaud, lies with Du Four lighthouse bearing N. ¼ W. distant 5¼ miles, and the extremity of point Croisic N.E. ½ N. 4½ miles. It is about 3 miles from the north end of La Banche shoal, the mark to sail between them being the Tour des Bâts in one with the great church at Guèrande. All round the shoal is a depth of 9½ to 12 fathoms.

The extensive bank called *Plateau du Ford* lies about 3½ miles W.N.W. from point Croisic. It is about 3 miles long and from 1 to 1½ broad, and has on it from ¼ to 3 fathoms, excepting on its northern part, where for a considerable extent it dries at low water. At the southern end of the bank is a patch of 5 feet called Gouè-vas, which lies with the Semaphore de la Romaine open 43′ to the right of Guèrande church.

There are other spots on the bank equally dangerous, so that a good offing must always be given to it when approaching the river Loire.

From point Croisic the land bends south-eastward 5¼ miles to point Pain Chateau, the coast between being moderately clear of dangers, excepting those close in-shore. But half-way, off the Tour des Bâts, there is a rocky patch called the *Basse Lovre,* upon which there is not more than a ½ to 3 fathoms. This extends ¾ of a mile from the land, so that it is prudent when coasting along, not to approach the shore nearer than 1½ miles, so that you may be certain to avoid it. Just round point Pain Chateau the coast takes a sweep and forms an extensive shallow bay, at the back of which are some sand-hills and the church and mill of Escoublac.

In a line nearly S.E. by S. from point Pain Chateau, is a series of rocks and shoals, of which some are above the water at all hours of tide. At less than ½ a mile south-westward of them is a depth of 5 and 6 fathoms.

The first of this series is the Leven, which is almost covered at half-tide, and upon which are three hillocks about 24 feet in height. Near this are several other ledges which are covered at high tide, and are separated from point Pain Chateau only by a narrow channel of 3 fathoms water.

About a mile from the Leven rock are several ridges which dry at low water, at that time appearing from 5 to 6 feet above the surface. These are called the Troves.

La Pierre Percée is a small islet elevated about 30 feet above the surface at low water. Within it, about ¼ a mile northward, is a rock called the Baguenaud, which is nearly covered at half-tide, and has a bank of sand upon it always visible.

At about ¼ of a mile south-eastward from the Pierre Percée is the Longue Folle rock, a sunken reef, upon which there are only from 5 to 9 feet at low water spring tides. And, at about ½ a mile further in the same direction, is another rock called the Grand Charpentier, which is even with the sea at high water of neap tides. Eastward of these towards the shore, are several other banks and rocks, all of which are more or less dangerous.

On the eastern side of the bar is a rock called Le Vert, which appears 7½ feet above the surface when the tide is down. Its position is, we believe, denoted by a buoy.

A little southward of the Vert rock, is another reef called Les Jardinets, which also dries. Within the river, on the east side of the channel, and nearly opposite the Tour du Commerce, is another rock called the Morées, which has a beacon upon it. This uncovers with every tide, and when using the channel you must be careful to avoid getting on it.

Directions.—The course followed by vessels bound for the Loire, has sometimes been northward of the Plateau du Four, and then south-eastward towards Croisic point; but the river may be gained with more facility by entering between the Plateau du Four and La Banche, or by going eastward of the latter.

The south-eastern part of the Plateau du Four will be avoided by keeping the steeple of Guérande eastward of the church of Croisic; and the north-west end of La Banche by keeping the steeple of Guérande a sail's breadth north-westward of the Tour des Bâts. Either of these marks may be kept on until the lighthouse on the Plateau du Four bears N.W. ½ N.; and this line of bearing, or a course S.E. ½ S. will lead directly to the bar of the Loire; when you may run into the river by bringing the Tour du Commerce open a little eastward of the Tour d'Aiguillon.*

The course to abreast the Pierre Percée, or Pierced rock, may, therefore, be made S.E. Steer so as to leave this rock at the distance of ½ a mile on the port side, and then continue a S.E. course (allowing for the tide, which runs strongly) until you bring the Tour du Commerce in one with the Tour d'Aiguillon.

It is advisable for a stranger at all times to avail himself of the assistance of a pilot, in fact, an attempt to enter the river ought not to be made without such assistance. Having entered the river with the Tour du Commerce and the Tour d'Aiguillon as before mentioned, so soon as the red revolving light on Ville-es-Martin point comes in one with the light at St. Nazaire, the latter mark must be followed until Eve and Aiguillon lights come in one. The last mark will then lead through the channel of the river to abreast Ville-es-Martin point, in the best

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* This is necessary to avoid the Charpentiers bank, because the lights in one lead over its east point.

water, and must be very strictly followed, because if Eve light be seen open northward of the Tour d'Aiguillon the vessel is too near the rocks jutting out from the point of Ville-es-Martin,—if southward of it, too near the Morées rocks.

From St. Nazaire you may continue to Mendin road, E.S.E. of St. Nazaire, and anchor in from 6 to 8½ fathoms, or proceed to Nantes.

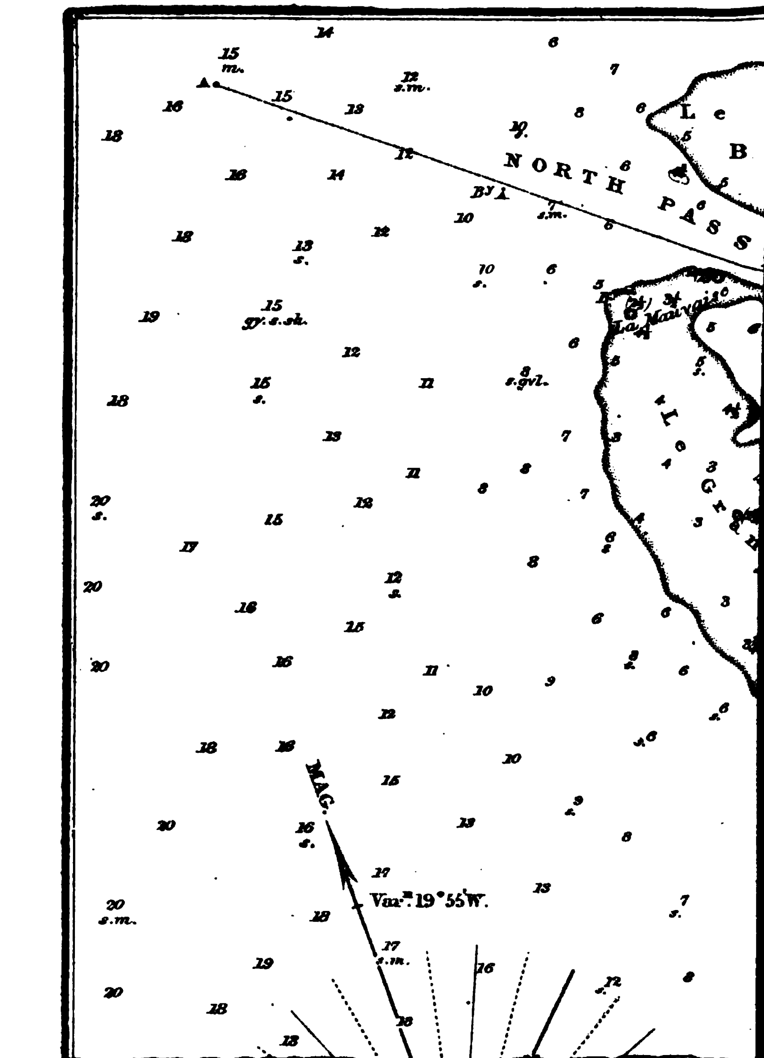
On sailing out of the river, take care to keep midway between point Ville-es-Martin and the tower on the Morées rocks. Point l'Eve may be approached pretty closely. When the Tour du Commerce appears in one with the Tour d'Aiguillon, it leads between the Lambarde and La Couronnée, through the Grand or South channel. In following this course, after having cleared the Lambarde on the one side, and the Couronnée on the other, you will deepen your water to 9, 10, and 12 fathoms, but should beware of approaching too closely to Pilier island.

In a large vessel, as soon as Pilier island bears S. by E., appearing then nearly in one with Pointe de Devin, alter the course to W.S.W. to keep in the Grand channel.

The reverse of the latter portion of these directions, will lead *inwards* through the Grand channel.

Banc de Rochebonne.—This important shoal lies about 12 leagues from the French coast, nearly 42 miles N.W. ¾ W. from Chassiron lighthouse, on the north-west extremity of Oleron island, and S.W. by S. 30 miles from Ile d'Yeu, its south-eastern rock being in Lat. 46° 10′ 38″ N., and Long. 2° 22′ 5′ W.; it may, therefore, be considered as the greatest danger in the way of vessels approaching the ports of Bordeaux and St. Nazaire. It extends S.E. and N.W. about 6 miles, and in fine weather its position can only be distinguished by a slight rippling on the north-east side during the ebb. Three of the rocky heads break in bad weather, and are named Congrée, Pierre-Levee, and the Semées; these have deep and safe passages between them. The least depth found upon the first was 15 feet, while upon the others there were 26 feet of water. The sea breaks on all the shallow spots in blowing weather. Except in the very rare case of a dead calm, not even a boat would be able to pass over La Congrée, as the hollow of the wave diminishes the depth very considerably.

A careful attention is, consequently, very necessary when navigating in the vicinity of this rocky bank, there being deep water close to it all round. A little eastward of it are 25 to 30 fathoms, and northward and westward the soundings deepen quickly to 50 and 60 fathoms. The bottom off the bank, on the east side, is of sand, sometimes mixed with mud and seaweed: and on the west side it consists of sand, gravel, and further out, of mud. The rocky bottom to the northward is called by the fishermen of the neighbourhood the Banche Verte; it is not dangerous, neither is there anything to cause anxiety. Westward of this rocky bottom, the ground consists of soft mud. The rocks which form the plateau are of the same nature as those of the Ile d'Yeu; the depth upon it is variable, and each hollow is filled with a slight layer of grey sand, the tops of the rocks being covered with seaweed.



NORTH PASS
Le B
La Mauvaise
Le Gr
By
MAG.
Varn. 19° 55' W.

It is high water here on the days of full and change at about 5½h., the tide rising 10 to 14 feet. At low water the current runs N.N.W. at the rate of 0·84 miles per hour; it then gradually diminishes its velocity so that at 2½ hours flood it is nearly at a stand. Turning afterwards to the S.W., by the south, and increasing in strength, it has a rate of 1 knot at 8 hours flood, or 2 hours ebb; its direction then becomes W.S.W., after which its velocity again decreases as it veers to the northward. Thus in the course of a tide the current makes the tour of the compass.

As the foregoing particulars were obtained outside the limits of the bank either in light breezes from the land or in calms, they may be considered as representing the normal condition of the waters for a considerable distance around, and may assist in modifying the route of vessels bound to one or other of the neighbouring ports.

Over the heads of rock, especially La Congrée, the currents are considerably stronger. There they turn more rapidly to the W.S.W., and continue in that direction longer; the greatest rate observed was 2½ knots per hour. When the ebb turns to the northward it makes a rippling along the whole length of the bank; this rippling, which shows the sinuosities of the plateau, is very useful in calm weather in assisting to avoid the rocky heads; it is strongest on the northern side, in soundings of from 16 to 20 fathoms, while upon the shallow spots the sea appears like a boiling cauldron of waters.

Lightvessel.—A vessel bearing two *fixed* lights, visible 10 miles, has been moored off the east part of the Banc de Rochebonne in about 56 fathoms water. It has two masts, each of which is surmounted by a ball. A fog-bell is rung continuously for a minute every 3 minutes, but is rung without intermission if a vessel be observed to stand in too closely. This bell will probably be superseded by a trumpet sounded by compressed air. The position of the lightvessel is Lat. 46° 12′ N. Long. 2° 20′ 54″ W.

Bordeaux, &c.—The entrance of the river Gironde is readily distinguished by the tower of *Cordouan*, in Lat. 45° 35′ 12″ N., and Long. 1° 10′ 30″ W., which stands on a bed of rocks in nearly midway of the entrance, and was for many years esteemed the most elegant structure of the kind in Europe. It exhibits a light revolving every minute, visible at the distance of 27 miles. In ordinary weather, the eclipses do not appear total within the distance of 10 miles. Between the bearings of N. by E. ¾ E. and E. by S. (81°) from the lighthouse, the light shows *red*. This arrangement points out to vessels the time when they should discontinue following the leading mark of Falaise and Terre Negre lights in one, and alter their course to S.E. ¾ S. As long as the red light is in sight they will be northward of the shoals extending from Pointe de Grave.

Pointe de la Coubre, the north point of the river, is low, with some sand-hills rising inland. Upon it is a lighthouse, which shows a *fixed* light visible at the distance of 14 miles.* Near the lighthouse is a beacon; at about $\frac{1}{10}$ mile S.S.W. from it is a

* From the Maumusson channel to Pointe de la Coubre the coast runs S.W. ½ S. about 6 miles. The shore is low all the way, and shoal some distance out, so that it is necessary, when

white tower; and at nearly a mile E. by S. ¼ S. from it a black tower. Hence the land bends eastward about 3½ miles, and then runs southerly 2 miles further, forming a small bay in which is a dangerous bank called the Barre á l'Anglais; upon the bank the depth is not more than 1½ to 3½ fathoms, and in some places much less.

At 6 miles within Pointe de la Coubre is *Point Terre Negre*, having a battery upon it, and ½ a mile beyond it is a building showing a small *fixed red* light, named Falaise light. At nearly ½ mile S.E. by E. ½ E. from this light is the Tour de Terre Negre, coloured black and white, which shows a *fixed* light, visible 14 miles. Beyond Terre Negre light tower in an easterly direction are the mill, church, and village of St. Palais, and about a mile further is a wooden tower erected on the high ground of Pontaillac. This tower shows a light alternately *red* and *white*, each of the colours lasting 20 seconds, without intervening eclipses; it is visible at the distance of 15 miles.

Immediately westward of the town of Royan is a fort, near which is the tower of Chay. At Royan there is a small tide light, situated on the point of the *Corps de grade*; this can be seen at about 6 miles distance.

At 2 miles above Royan, at the back of a sandy cove, are the village and mills of St. George de Didonne; and at 1¼ miles southward of this is Suzac point. At 2½ miles above Suzac point, on the shore, are the village, church, mills, and fort of Mechers.

On *Pointe de Valliere*, westward of the village of St. George de Didonne, there is a lighthouse, from which a fixed *red* light is shown at 46 feet above the sea, visible 12 miles. At nearly 1¼ miles S.E. from this, on the sand-hills of *Suzac*, is another lighthouse, which exhibits a fixed *red* light at 121 feet above the sea, visible 12 miles.

Opposite the cove of Royan, on the western bank of the river, is Pointe de Grave with its light, which is visible at the distance of 14 miles.* At nearly 2 miles south-westward from this lighthouse are the beacon and semaphore of St. Nicolas, which serve as a mark for the Passe de Grave; and at 1½ miles southward from it (on the bank of the river) is the village of Verdon, with its mill, &c.†

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making the river from northward to give it a good offing, more especially as a bank of 2 to 3½ fathoms, called the Demi bank, runs out 3 miles north-westward from Ponte de la Coubre. When close to the outer edge of this bank Marennes steeple will be hidden by the sand-hills of Arvert, on the bearing of E. ¾ N.

* Pointe de Grave light shows as a *fixed* light in the direction of the Passe du Nord; as a *quick revolving* (short flashes at intervals of 7 s.) light in the direction of the south channel of the Gironde, and of the lightvessel marking Tallais bank.

† Besides the lights mentioned, there are the following;—A lightvessel on the middle of the eastern edge of the *Tallais Bank*, which forms the western side of the channel, the eastern side being formed by the Talmont bank. It is moored in 16 feet, and exhibits a *fixed* light, visible about 10 miles. It is readily distinguished by a skeleton ball at the mast-head; a bell is also rung during fogs.

On the western bank of the river, at a little below the small port of *Richard*, is a *red fixed* light, visible about 12 miles.

There are many towns and villages upon the banks of the Gironde, but no trading place of consequence until we reach the small town of Pauillac, situated on the western shore, at about 25 miles from Pointe de Grave. About 5 miles further up the river, but on the opposite side, is the town of Blaye, remarkable for its castle; here, the navigation of the river is impeded by a long range of islets and shoals. On the opposite bank of the river is the strong fort of Medoc, which commands the western channel. At 7 miles above Blaye, is the conflux of the rivers Dordogne and Garonne, the united streams of which form the Gironde. Above this junction of the rivers, at the distance of 13 miles, and seated on the western shore of the Garonne, is the commercial city of Bordeaux.

Directions.—The banks at the mouth of the Gironde occupy a space of about 12 miles in a northerly and southerly direction, and are so extremely dangerous throughout their whole extent that a stranger should not attempt to enter the river without the assistance of a pilot. It has also been observed that when the weather is hazy, and there is appearance of a calm, vessels should avoid entering the river, because at such times a heavy swell of the sea frequently arises in an instant. This phenomenon is called by the pilots *Le Brume Seche*, or the *Dry Fog;* it is a kind of mist accompanied by a calm, which is invariably followed by a heavy sea in all the channels.

The *Passe du Nord*, on the northern side of the mouth of the river, has a bar across its entrance, upon which there is a depth of 6 to 5 fathoms at low water; its general breadth is about 2 miles, and within it the water deepens to 8, 12, and 15 fathoms. This channel is bounded on the northern side by the Demi bank, which extends north-westward from Pointe de la Coubre, and by the Barre á l'Anglais, both of which banks have been already described. On the outer edge of this last-mentioned bank, is a depth of from 2 to 3½ fathoms, but within it, in the Bonne Anse, soundings of 6 to 4 fathoms; vessels must carefully avoid getting embayed in this, as it forms a cul-de-sac.

On the south side of the Passe du Nord, off Pointe de la Coubre, is *La Mauvaise Banc*, which contracts the passage here to little more than ½ mile in width. This bank appears to frequently change; on it are soundings of 4 and 4½ fathoms, and in two places of not more than 16 feet (1864). The southerly continuation of this shoal, named Le Grand Banc, joins the plateau de Cordouan, in the midst of which is the celebrated lighthouse. On the northern side of the plateau is the Monrevel bank, which has in one part a depth of only 6 feet; this spot is situated about 2¾ miles W. by S. from Pointe de la Palmyre, and N. ½ W. from Cordouan lighthouse, Hence the channel is wide and clear so far as Pointe de

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A lightvessel on the west bank, off the *Tour de By*, shows a *fixed* light, visible 10 miles.

Another, named the *Mapon* lightvessel, also on the west side of the channel, exhibits a similar light, visible 9 miles.

On the north end of the *Ile de Patiras* is a lighthouse, from which a *fixed* light (flashing every 4 seconds) is shown, visible 18 miles.

And, lastly, a small *fixed* light of 5 miles range, is exhibited on the old chapel of *Trompeloup*, to indicate the northern limit of the anchorage of Pauillac.

Grave, off which is the Platin a shoal of 6 feet, which extends a mile northward from the point. The depth throughout the channel varies from 4½ to 15 fathoms.

The limits of the channel were marked in 1858 by seven buoys, of which the outer one was coloured red and bore a bell; this was placed in 10 fathoms water, outside the bar, at about 5 miles N.W. by W. ½ W. from the lighthouse on Pointe de la Coubre, and with Pontaillac lighthouse in one with that of Terre Negre. At 2 miles S.E. by S. from this was a striped red and white buoy on the outer edge of the Mauvaise bank, moored in 4¾ fathoms with the lighthouse on Pointe de la Coubre bearing E. by S. ½ S. 3½ miles. Two black buoys indicated the southern edge of the Barre á l'Anglais, on the north side of the channel, and two red and white ones the north-eastern edge of the Monrevel bank; the latter bank being part of the extensive Cordouan flats which line the south side of the channel. The seventh and last buoy was situated on the northern end of the Platin bank, at about 1¼ miles N ¾ W. from the lighthouse on Pointe de Grave; this bank is also on the south side of the channel.

According to the survey of 1858 the steeple of St. Pierre de Royan in one with that of St. Palais is a good mark by which to sail into the channel, after having made the outer buoy; but, unfortunately, these objects are so distant that they are occasionally not sufficiently distinct. If through rough weather the buoy be not at its station, this mark should be brought on before Marennes steeple is hidden by the sand-hills of Arvert; also, when approaching from westward or south-westward, in a similar circumstance, the Tour de Bonne Anse (black) should be brought well open northward of the lighthouse, and of the beacon near it, on Pointe de la Coubre, before the leading objects for the channel are brought into one, as the shoal spots of the Mauvaise bank are then likely to be avoided. The shoal around Pointe de la Coubre is very dangerous to approach, being extremely steep on the south side.

Having entered the channel so far that the lighthouse on Pointe de la Coubre bears N.N.E., steer for Cordouan lighthouse, until Falaise and Terre Negre light-towers are on with each other, when the course should be continued with the latter objects in one. When Cordouan lighthouse bears S. by W. ¾ W., steer into the river in a S.E. ¾ S. direction.

During Night.—When making the Gironde during night from north-westward, and abreast the Isle d'Oleron, you will, in clear weather, soon after passing the fixed light on Pointe Chassiron, the northern point of that island, observe the fixed light on Pointe de la Coubre, bearing about S. by E., 18 or 20 miles distant, and shortly afterwards the revolving light shown from the celebrated Cordouan tower will be seen in a southerly direction, distant 24 to 27 miles.

Steer now such a course as will bring Pointe de la Coubre light to bear S.E. by E. ½ E., and Cordouan light S.S.E. ½ E., when you will be off the fairway buoy on the bar. But, before arriving there the red and bright flashing light at Pontaillac, and the fixed light on Terre Negre will most probably be seen; these must be brought in a line about S.E. ½ E. and steered for, as they will lead in over the bar to within the fairway buoy. Having passed this buoy be careful not to open Pontaillac flashing light northward of Terre Negre light, or you may run on the dangerous shoal which surrounds Pointe de la Coubre, and which is marked by a buoy. When Coubre light bears about E. by S., the light of Pontaillac may be opened a little southward of that of Terre Negre. Immediately Coubre light bears N.N.E., steer S.E. ½ S. to clear the edge of the Barre á l'Anglais, which bounds the northern side of the channel.

When abreast the Pointe de la Coubre it is probable that two *fixed red* lights will be sighted; the highest and most distant is that on the sand-hills of Suzac, and the lowest on Pointe de Valliere. These two lights should be kept in one, about S.E., or the higher a little open southward of the lower. There is likewise a *red fixed* light at Falaise, which kept in a line with Terre Negre light leads outside or southward of the Barre á l'Anglais.

If advisable, a more easterly course may now be shaped, but a good look-out must be kept for the change to *red* in the colour of Cordouan light.* When this takes place you will be near the north-eastern part of Monrevel bank.

Having run up the river from Pointe de la Coubre with Suzac and Valliere lights in one, the course should be altered to S.E. ¾ S. immediately the light of Cordouan tower changes to *red*, which it will do on a S. by W. ¾ W. bearing. When Richard and Tallais lights come in one, the latter mark must be followed, and it will lead clear of the Platin shoal off Pointe de Grave.

When abreast the flashing light of Pontaillac, temporary anchorage may be had in 9 or 10 fathoms, with Pointe de Grave light about S. ½ W.; but a vessel should not stop here if there is any swell coming in. Hereabout will be seen the fixed light shown from the vessel moored off Tallais bank, bearing about S. ¾ E. at the same time appearing in one with the red fixed light at Richard. To enter the river the latter mark should be followed till Pointe de Grave light bears N.W. by N., when the anchor may be let go in 7 to 8 fathoms, or, the course may be continued until the lightvessel is passed.

It is very essential to remark that the light of Terre Negre is not of service until Pointe de la Coubre is doubled. Another observation that cannot be too much insisted on is this, notwithstanding the light on Terre Negre is a good mark for avoiding the Barre á l'Anglais, vessels should never attempt to enter the Gironde at night, except when obliged by absolute necessity, seeing that the dangers are then multiplied, and fog often prevents the light from being seen.

Should circumstances require it, vessels may run up and take shelter under Pointe de Grave, which affords a safe retreat during westerly and S.W. winds; the mark is Royan steeple and mills about N.E. by N. At this place, between Verdon and the Taillefer bank, coasting vessels frequently anchor in bad weather.

Passe de Grave.—This the southern entrance to the Gironde, lies between the Chevrier, a patch with only 8 to 10 feet on it at low water, lying nearly 4 miles

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* See page 465.

W. by N. ½ N., from the beacon of St. Nicolas, and the Banc des Olives, a bank extending 2 miles from the shore, on the outer edge of which is a depth of 2 to 4 fathoms: on this bank are some patches of little more than 6 feet water.

This channel is not deep; but shipmasters failing to obtain a pilot occasionally prefer it to the Passe du Nord, because its entrance and direction are well marked by objects on land; it is also of small extent, and can be cleared in a few hours. The entrance is precisely in the direction of St. Nicolas beacon and semaphore in one, and the interior part of the channel is precisely in the direction of the steeple of St. Pierre de Royan open its whole breadth to the right of the Tour du Chay; if these marks are followed exactly, there will be found at least a depth of 12 feet at low water spring tides, in the shoalest parts,—but if it is unavoidable that the true direction be departed from, there must not be a greater depth than 8 feet calculated upon. The nature of the bottom leads to the belief that the depth in the channel varies but little.*

The navigable channel through the Passe de Grave is indicated by buoys, which in 1858 were three in number. At that time the outer buoy, conical and bearing a mast, was moored in 9½ fathoms at about 5 miles from the land, with the beacon at St. Nicolas in one with the semaphore, bearing East 7½ miles, and Cordouan lighthouse N.E. by E. ½ E. 6½ miles; its position was, therefore,

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* M. Beautemps Beaupré in his works, *Avis aux Navigateurs sur l'Actuel des Passes de l'Embouchure de la Gironde*, published in Paris, 1826, advises shipmasters entering the Gironde by the Passe de Grave not to approach the Plateau du Cordouan nearer than when the church of Royan is seen in one with the Tour du Chay; and also to avoid going too far away from this directing mark on the eastern side, because the stream of flood strikes with such force upon the coast of Medoc, that it would be almost impossible to keep the vessel thoroughly under command.

He says further, that "the pilots of the Gironde are not well acquainted with all the dangerous points in the Passe de Grave; but experience has taught them all that are essential, which they know how to avoid. They know and are well aware—

1st. That the two directions of the Passage are well marked—viz., the exterior part of the channel by the semaphore of St. Nicolas and the beacon, placed at the foot of the Downs; and the interior, or northern part of the channel, by the church of St. Royan and the Tour du Chay.

2ndly. That they cannot reckon upon more than 12 feet depth at low water.

3rdly. That they should not, in tacking, incline to the westward of the mark given, of St. Pierre de Royan Church in one with the Tour du Chay, for fear of falling on the rock of the Chevrier, or of the Ruffiat.

4thly. That when the wind is favourable for them to make the direct route, they must steer so as to keep the tower of St. Pierre de Royan open its own breadth to the right of the Tour du Chay.

5thly. That they ought not to venture too near to the coast of Medoc in tacking, on account of the current of flood setting so strongly on that shore, rendering it extremely dangerous to anchor anywhere, although there are many places where the points are sandy.

6thly. That they should never attempt to leave the river by this channel with a large ship, except when the tide is rising, and the wind favourable.

7thly. That they must never anchor in the Passe de Grave, unless unavoidable.

8thly. That at all times a preference should be given to the Passe du Nord, either when entering or leaving the Gironde, if circumstances allow them to take their choice, as the depth in that channel is greater, and particularly as the ground in all parts is good for anchorage."

8½ miles W. ¾ S. from Le Chevrier bank, the outermost of the shoals on the north side of the channel. The second buoy, also bearing a beacon, was moored in 4¾ fathoms midway between the Banc des Olives and Le Chevrier, with Cordouan lighthouse bearing N. by E. ¾ E. 9½ miles, and the semaphore of Nicolas open a little south of the beacon, East, a little northerly. And, the third buoy, named Ruffiat, was in a depth of 3¾ fathoms, in the middle of the channel, at 1¾ miles N.W. ½ W. from the lighthouse on Pointe de Grave, and 8 miles S.E. by E. ¾ E. from the Cordouan lighthouse. These buoys were all so placed that they showed the line of the navigable channel.

Having made the outer buoy of the Passe de Grave, bring the semaphore in one with the beacon of St. Nicolas, and steer in that direction until nearly up with the second buoy, when the steeple of St. Pierre de Royan will appear its own breadth open to the right of the Tour du Chay: continue now in this latter direction, and it will lead through the channel in the best water, past the Ruffiat buoy, and into the main channel of the river. The buoy marking Platin bank must always have a wide berth given to it, passing it on the north side, the space between it and Pointe de Grave being very shoal.

Tides.—At the entrance of the Passe de Grave, with the Cordouan lighthouse bearing N.E., the tides set thus—first of the flood, North ; one-third flood, N.E. ; half and two-thirds flood E.N.E.—first ebb, S.E. ; one-third ebb, South ; half and two-thirds ebb, West. In the channel within, with the Cordouan lighthouse bearing N.N.W., the flood sets generally E.N.E., and the ebb W.S.W. Between the Cordouan bank and Pointe de Grave, the flood sets generally S.E. ; the ebb from West to W.S.W.

The tides, both ebb and flood, set through the different channels with rapidity ; and great caution is, therefore, requisite, on making the river. Should the landmarks be obscured by thick weather, or night comes on, it will be prudent to anchor in the first convenient spot, noticing well the above precautions.

The tides during the months of May, June, and even a part of July, are very small ; but the Magdalen tides (22nd July) are often as high as those of the equinoxes, which rise 17 or 18 feet. The winds have a great influence on the tides ; and, in general, a good tide may be depended upon when the wind blows strongly into the river, and a lesser one with a strong wind blowing seaward.

SPAIN AND PORTUGAL.

Ferrol.—Ferrol harbour, at the north-west extremity of Spain, is one of the best in Europe in point of depth, capacity, and safety ; but it is not with every wind that a ship can leave it, which is considered a disadvantage. Its approach consists of a narrow strait, not quite a ½ of a mile broad, so that but one vessel at a time is able to enter, and this strait has forts on both sides ,which command the entrance. On its eastern side are the arsenal and dockyard; the former is the first and largest in Spain. The docks also are very fine; they are of great extent and admirably constructed. Ferrol is not, however, a place of commerce, the port being intended solely for the use of the navy; still there are some manufactories of hats, paper, leather, naval stores, hardware, &c.; and corn, wine, brandy, vinegar, pilchards, herrings, &c., the produce of its own fisheries are exported.

On the south side of the entrance to Ferrol is point Segano, which is high and steep, and has upon it a battery and a watch-tower. Near its point is a sunken rock called La Muela, covered with weeds, and having only one fathom over it at low water; between the rock and point is a depth of 4½ fathoms, and the passage may be used in case of necessity by a small vessel. Besides this rock there is another on the south side of the channel, lying as we suppose, about midway between Segano point and San Martin castle.*

On the north side of the entrance is point San Carlos, and here the passage is only a ¼ of a mile in breadth. San Felipe castle is ¾ of a mile within that of San Carlos, on the same side; its walls are washed by the sea. The south side of the Narrows is protected by the castle of San Martin, situated on a point which reduces the channel here to ⅓ of a mile. At half a mile within this is the castle of Palma, and next is point Rodonda, or Round point, where the coast forms an inlet called Bano cove. A fixed *red* light is shown from the castle of La Palma, visible 8 miles.

Directions.—When approaching Ferrol, the following lights may be made:—The light with *red* flashes shown from the largest of the Sisargas islets, visible 10 or 12 miles; the *fixed* (and *flashing*) light upon Hercules tower at Corunna, which may be seen at a distance of 12 miles; the *fixed* light on cape Prior, visible 15 miles; and the *fixed* light (*flashing red*) exhibited from a tower on Little cape Priorino, and visible 11 miles.

Ships bound in with an adverse wind, if it be not very strong, may, by a few tacks, gain the bay of Carino, between Little cape Priorino and San Carlos point. Here they may come-to, in from 14 to 8 fathoms, sand, and be sheltered from winds at N.W., North, and N.E. Be ready, however, to take advantage of the first breeze from the S.W. to gain the harbour, as the winds in this direction are

* The following is a copy of the official notice:—" Sept. 7th, 1853. A dangerous rock in the entrance of Port Ferrol, in the way of vessels beating into or out of the harbour, has been recently discovered; it is named the Cabalino, and the following compass bearings give its position:—The south-east angle of San Felipe castle N. 71° E.; south angle of San Carlos castle N. 14° W.; and the north-west angle of San Martin castle N. 85° E. Its distance from the south shore of the channel is not more than half a cable's length. It is nearly circular in form, about 7 feet in diameter, and at low water its surface is a-wash, though concealed by sea-weed. The depth around it is 9 feet close-to, but increases to 18 feet.

At S.E. by E. from the Cabalino, distant 74 yards, is the Cabalo, consisting of three connected masses of rock, the highest and north-westernmost of which is of a tabular form, nearly round, and connected with the Cabalino by a reef. The Cabalo rises 8 feet above the sea, and is nearly 24 feet across from N.W. to S.E."

the most dangerous hereabout. Should the wind prevent the vessel turning into this bay, the only resource is to run for Corunna, and there await more favourable winds, &c.

The winds for entering the harbour are those from between S.W. westward to North, by compass. With these vessels may pass southward of cape Priorino, at the distance of half a mile, or less if required. Hence they should run up in mid-channel, keeping over rather to the north or south shore, according to the wind, and observing that, from San Felipe castle, a small ledge of sunken rocks extends about 80 fathoms to the southward, over which there is at low water only 2 and 2½ fathoms; and from Palmas castle there is a similar one, stretching out to about the same distance. From point Rodonda a reef also extends about 40 fathoms to the N.E., with 1 to 2¼ fathoms over it; and there is a sunken rock just without Bispon point. With the wind large, there will be found no difficulty in keeping clear of these dangers.

Having passed the Narrows, anchorage may be obtained when most convenient. It is usual to moor N.E. and S.W. There is rocky ground about the length of a boat, lying directly in the fairway between the mole of Ferrol and Seixo point, on the opposite side; a leading mark to clear it on the south is, Bispon point in a line with the bottom of San Felipe bay.

With equinoctial gales the tides run in strong, at which times it is almost advisable to enter or leave the harbour one hour before either high or low water, that you may head the current; this is more requisite when many ships are passing, but otherwise the turn of tide may be waited for. In these gales the tides rise nearly 15 feet, being nearly 2 feet more than they do at ordinary spring tides.

Corunna.—This is an excellent seaport, the capital of the province of Galicia. The town is south-westward of Ferrol, on a peninsula, and divided into the upper and lower towns; the former is on the declivity of a hill, and surrounded by walls and bastions, and defended by a citadel; while the latter is situated lower down, on the isthmus joining the peninsula to the mainland, from which it is separated by ramparts and a ditch. There is a fine commodious quay, with a good building-yard, and the harbour is safe and well-sheltered. Its entrance is protected by the castles of Santa Cruz and San Diego; and also by the fortresses of Dormideras and San Antonio, which latter is built on an insulated rock. At the bottom of the harbour is the suburb of San Lucia. The principal manufactures carried on in the town are those of fine table and other linen, and of coarse stuffs, hats, canvas, and cordage. There is also a manufactory of cigars. Corunna is the station for packets between Spain and Havanna, and between Spain and Falmouth, beyond which it has but little foreign commerce.

One of the most striking objects in approaching Corunna is the tower of Hercules, which is a very ancient and singular structure of three sides only. It is situated on the peninsula, and bears S.W. ¾ W. 5¼ miles from cape Priorino.

It now bears a *fixed* light (*flashing* every 3 minutes) visible 12 miles.* Its position is Lat. 43° 23′ 18″ N., and Long. 8° 24′ 24″ W,

At nearly ¾ of a mile northward from the town is Pradeiras point (the north-west point of the bay of Corunna) or the Groyne; a reef extends from it to a short distance. The castle of San Antonio, off Corunna point, at 1¼ miles south of point Pradeiras, is on a great rock, detached from the shore, and forms the N.E. point of the harbour; here a small *fixed* light is shown. Between the point and castle are several large rocks above water, and the ground on the south side of the castle is likewise foul. The most dangerous spot in the harbour is that eastward of the town.

On the eastern side of the bay is the point of Mount Mera, and at the bottom of the bay, on the same side, is the isle and castle of Santa Cruz. In the small bay S.E. of Mera point there is good ground for anchorage, but it should only be used when it is impossible to enter the harbours of Ferrol or Corunna, because a heavy sea is driven into it with the wind at N.W. or north. On the Tonina bank, which lies off it, there are 10 fathoms at low water, yet the sea breaks on it during a swell.

On the western side of the bay is the castle of San Diego, about ½ a mile southward of the castle of San Antonio. These points form the entrance of the harbour of Corunna. About a cable's length northward of the castle of San Diego, is a small shoal, with only 6 feet over it; and at N. by W. from the same castle, and S.W. by W. from that of San Antonio, is another shoal of 3 fathoms. On the Basuril and Cabanes bank, off the entrance of the bay, the sea breaks during a swell, notwithstanding the depth of water upon them, so that it is necessary to be attentive when passing between them and the land.

Directions.—When advancing from sea in easy weather, and fair wind from the N.E. or N.W. quarters, vessels may steer for the points of Seixo Blanco and Mount Mera, until the castle of San Diego comes in one with that of San Antonio, when they steer in with this mark on, taking care, however, to avoid the rocks on the western side as they approach San Antonio castle; when between the castles they may anchor. If the ship be large, bring San Antonio castle N.E. by E., and anchor in 6 or 7 fathoms, oaze and mud; a small vessel may stand further in until that castle bears E.N.E. or E. by N., or smaller vessels may advance still further in, always taking care not to anchor in the parts encumbered by sea-weed, for, with heavy gales, the anchor there will not hold. It is usual to moor North and South.

When attempting the harbour during a gale from northward or N.W., the passage in is between the Basuril bank and the western shore, having the tower of Hercules to the S.W., and at such distance that its base (which should in no case be hidden) is distinctly seen; hence, pass Revaleira point and rocks at the

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* As far as 12 miles a feeble light is visible between the flashes. The light appears thus,—a feeble light during 107 s., eclipse 30 s., flash 13 s., eclipse 30 s., &c. The flash can be seen from a distance of about 20 miles.

distance of two cables' lengths. Now steer S.E., with the hill and battery of Mera ahead, until San Diego castle, near that of San Antonio is brought on, when the course may be continued as before directed.

General Remarks.—In making for the harbours of Ferrol or Corunna, be very careful to keep off the land at night, for the currents may drift the vessel into danger; perhaps you cannot do better than pass the night in the neighbourhood, or westward of Sisargas islands, standing off and on as occasion requires for lying-to may be dangerous, and if the wind be from the S.W. a current sets strongly towards cape Ortegal. Be careful to provide against being driven to leeward of Ferrol, for, with a large ship, no port on this part of the coast can ensure safety.

When the wind is blowing from N.E. vessels may run within 2 miles of cape Prior, and thence steer for cape Priorino: then, if the gale be not too powerful, they may run for Ferrol harbour or Corunna. Some dependence may also be placed on the soundings, for, their regularity enables a vessel in thick and dark weather, to estimate the distance from the land. The sea can also be generally heard breaking upon the shore.

The wind on the N.W. coast of Spain is in the summer time most prevalent from the north-eastward.

Vigo Bay.—Vigo bay is one of the largest, deepest, and best harbours in Spain; the town of Vigo is the general rendezvous of coasting and other trading vessels, and possesses many barques and fishing vessels.*

At about 1½ miles north-eastward from the town, there is a light in the castle of *La Guia*, which flashes every 8 minutes.

The *Cies Islands*, before the inlet, are high and uneven on the summit, very steep on the west side, but less so on the east. Off point Caballo, the north point of the northern island, at a distance of about ¼ of a mile to the N.N.W. is the Roncosa shoal, which appears above the surface at low water. And, at 1½ miles N. 5° W. from the same point, is the Biduido rock, having 2¼ fathoms over it at low water, with 6 to 7 fathoms on the south side, increasing to 15 fathoms at a short distance; on the north side it is steep. Besides these rocks others exist between them.

The northern or largest island is connected to the centre island by a bank at low water, so that there is no passage between. The southern island is about a mile in extent, and like the other islands, is surrounded by a rocky reef. A rock, named Forcado, lies S.W. of its S.W. point, being separated from it by a depth of 10 fathoms; and W.S.W. ¾ of a mile from cape Bicos, its S.E.

* Shipmasters are informed that pilotage is not obligatory on vessels entering the bay of Vigo, and the captain of that port has made it known to all pilots of the district that, unless they see the usual pilot signal (Union-jack with a white border) flying on board British ships, they need not offer their services. Shipmasters are recommended to dismiss the boat from alongside at once, and not to hoist the pilot signal at the pilot's bidding, or even take their boats in tow.

Board of Trade, July 19, 1858.

extremity, are the Boeiro islets, which in a heavy sea are washed over by the waves. There is also a rock ¾ of a mile S.S.W. from these islets, named Los Castros, which has 6 to 7 and 12 fathoms around it.

On *Mount Faro*, at the southern extremity of the centre island, in lat. 42° 12′ 24″ N., and long. 8° 54′ 16″ W., is a lighthouse, which shows a light *revolving* every minute, visible at about 20 miles.

Between the centre and the southern island, there is a narrow passage of 6½ to 4½ fathoms water; but it is necessary when sailing through to be careful of the rocks extending from the islands.

At about 5 miles S.S.W. of cape Vicos (the south end of the southern islands) is cape Silleiro, which has a *fixed* light upon it. This cape is high and rugged, and has at its base a low point, which terminates in a ledge of rocks, extending about ½ a mile N.N.W.; part of this ledge may be seen at low water, but during a swell the sea breaks over it. The southern pass of Vigo is between these two points.

At about 3 miles N.E. by E. from cape Silleiro, and nearly the same distance S.S.E. from cape Vicos, is cape Sentaulo, the western termination of Monte Ferro, which may be known by being round, of a reddish colour, and having a look-out on its summit. Southward of this mountain is the small harbour of Bayona. Fronting this harbour, and westward of cape Sentaulo, are the Estella islands, of moderate height, and surrounded by an extensive reef.

Vigo bay is entirely enclosed with high mountainous land; its most remarkable object at a distance is a sharp pointed hill, on the south side, having on it the chapel of Na. Sa. del Alba, which may be seen at a great distance; this is an excellent land mark.

Within the *South Pass* of Vigo, the first point after passing cape Sentaulo is point Serral which is black, having a reef stretching from it to the distance of two cables' lengths. North-eastward of this point is the little island of Toralla, which is equal to the point in height, and at a distance appears to be a part of it; a ledge runs off from its south-west extremity.

Within point Serral 2½ miles, is cape de Mar, which is low, and of a sandy colour. It projects considerably into the sea, and constitutes a principal mark for leading into the harbour. From it, to the distance of two cables' lengths, a reef extends, part of which is visible at low water, but the whole is covered with the flood, and the sea with a swell breaks over it.

On the opposite or northern side of Vigo bay there are reefs with rocks above water, extending to the distance of nearly ½ a mile from the projecting points between Subrido point and Ruas island, a small island close in shore, and about 7 miles within the point; so that the reefs running from cape de Mar, with those from the opposite point, form what may be considered the bar of the harbour, leaving a channel of about ¾ of a mile wide, with soundings of 20 to 22 fathoms midway.

The beach of Vigo is clean, and there is a good depth before it, wherein is the usual anchorage, in from 18 to 8 fathoms, mud. It is usual to moor with the best anchor North, and the other South, as a ship will lie thus well sheltered from the sea on the west by the Cies islands. It is, however, said, that off the village of Teis, about 2 miles higher, they would be safer; as they may here make fast a cable on shore, and carry out an anchor northward, when lying in 6 fathoms. Eastward of Ronde point, which is two miles above Teis, many vessels may anchor, in from 15 to 6 fathoms, mud, and lie in safety from all winds; and above this part, vessels without anchors or cables may run aground anywhere on the mud, until necessaries can be procured, when they may be lightened and got off safely.

Vigo bay is readily known when approaching from north or south by the islands of Ons and Cies. At a distance in the offing, however, these islands appear to be part of the main land, and it will then only be known, if the weather is clear, by Monte Curota, 28 miles northward of the south entrance, and by Monte Na Señora del Alba, which is a sharp pointed hill with a chapel on its summit about 8 miles inland on the south shore of bay. The land is high and level to the southward of the entrance; and no opening will be seen until at the mouth of the river Miño. The bay may be entered by the north passage between cape Hombre and Caballo point, the north extreme of the Cies islands; or by the south passage between the dangers south-west of the southern island and those extending westward from Monte Ferro. In a case of necessity vessels may, if their draught permit, run through the passage between the Cies islands.

To enter by the north passage, which is the best with a northerly wind, after giving Onza island a berth of about 1¼ or 2 miles to avoid the dangers off its south-west end,* steer about S.S.E. towards the land—taking care not to bring Monte del Alba open westward of Subrido point to avoid the Biduido—until Monte Ferro, the black round hill on the south side of the entrance to the bay, is seen in the middle of the passage, bearing South a little westerly. Keep the latter mount on this bearing until south-ward of Caballo point, when steer in mid-channel and haul gradually into the bay giving a berth to the dangers. Monte Ferro open of the east side of the north Cies island, also clears the Biduido shoal.

The light or chapel on the summit of the hill of La Guia bearing East, leads up the bay to the anchorage off Vigo. This chapel is not readily recognized by a stranger; it is a very small whitewashed building upon a hill, apparently half the height of those beyond it, and is the next projecting land beyond Vigo.

To enter by the south passage, cape Mar in line with the above chapel E. by N. will lead in mid-channel between Castros and Restinga de Laxe shoals in depths of 32 to 27 fathoms, When cape Silleiro bears S.S.W. steer N.E. by E ½ E. until the chapel bears East, when proceed as before. At night, with cape Silleiro light

* Galera point, the south end of this island, is foul to some distance out. At about ¾ mile S.W. ¼ W. from the point there is a rocky patch on which the sea breaks; a patch, on which sea is said to break occasionally, is also reported to exist at about 1¼ miles W.S.W. from the point.

bearing S.E., bring Cies *revolving* light N.E., and then steer E. by N.; should the *flashes* of La Guia light be seen, keep it on this latter bearing until cape Silleiro light bears S.S.W. distant 3¼ miles, then steer about N.E. by E. ½ E. until La Guia light bears East, and proceed as before.

Should the wind prevent the vessel from following these courses, give a good berth to the ledges extending from the different points and to the Zalgueiron rock, and do not approach the shore to a less depth than 8 fathoms. To clear the Borneira reef, keep Caballo point open of Subrido point until Cangos church is well open.

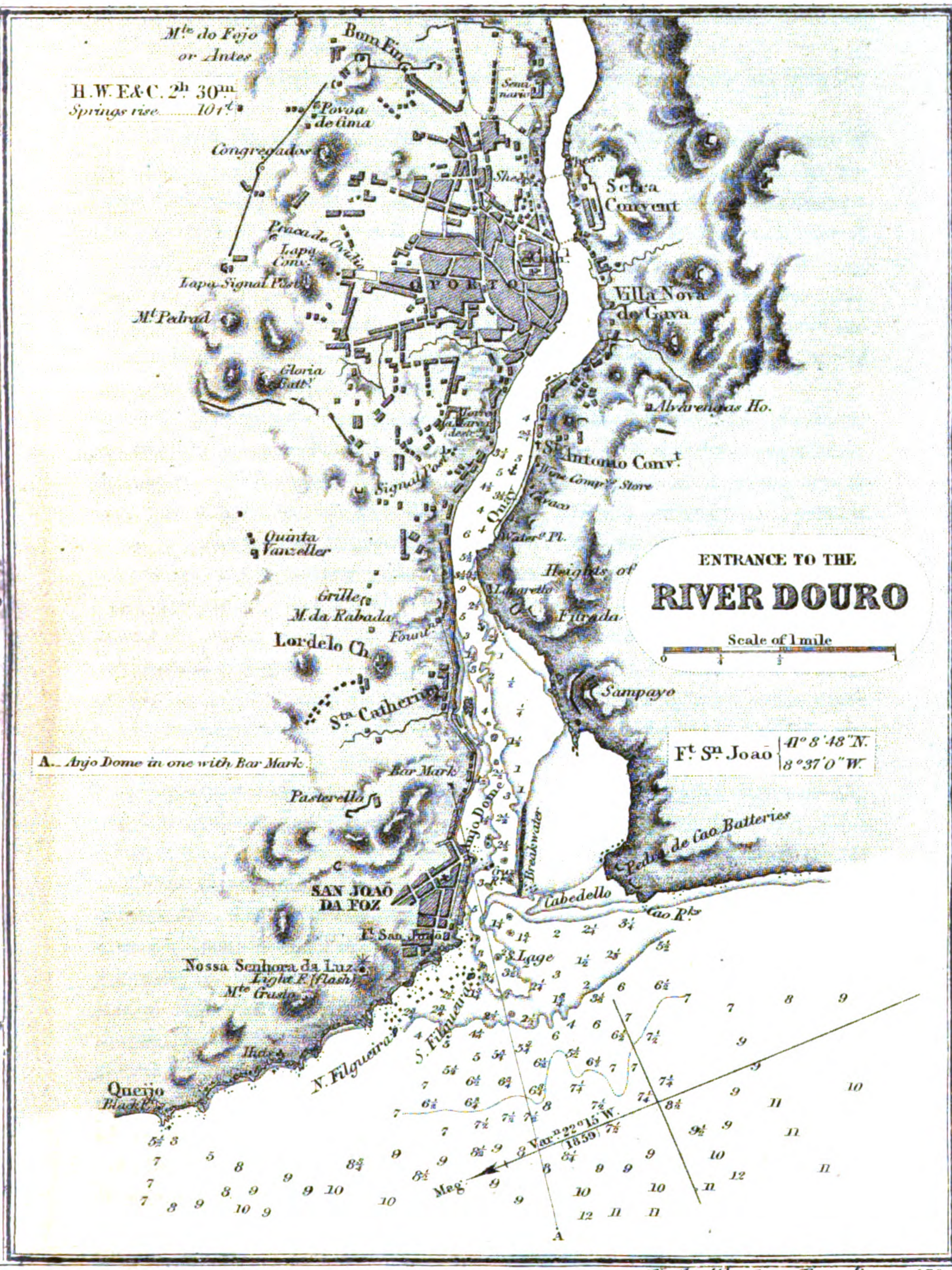
Oporto.—The town of Oporto stands high, having a black steeple near its centre. As the land is approached the church tower of Joao de Foz will be seen near the mouth of the river; also the chapel of Na. Sa. de la Luz, and near it a lighthouse. This latter building is a square white tower, painted with a broad red band; it shows a *fixed* light (*flashing* every minute) at 170 feet above the sea, visible 15 miles.

From the north point of the entrance, a ledge of rocks extends to the S.W., 3 parts of this are always above water. Outside this is another ledge, Filgueira, which is always visible, and to be left on the port-hand when entering the river. Southward of these is a sunken rock, called the North Lage, and farther south, at the distance of 14 to 16 fathoms, is the South Lage; the entrance to the river is between these rocks. After crossing the bar, a rock will be seen at the end of a reef running out from Ango Dome; upon this is built a small round tower, named De Cruz, or Pilar; also another rock, named Agulha; southward of these is a long ridge of rocks, forming a breakwater. Cabadelo, the south point of the entrance, is low and sandy.

When bound to the river it is necessary to know the latitude with accuracy. South-westerly and north-westerly winds send a heavy sea upon the coast.

The bar is liable to considerable changes, occasioned by the sudden swellings of the river, termed 'freshes', and from the heavy westerly gales to which it is exposed. The freshes most frequently take place in the spring of the year, and proceed from the melting of the snow on the mountains of Spain. The rise of the water in the river, at these times, is frequently as much as 40 feet, and the rapidity of the stream is so great as to break vessels adrift from their moorings, and occasion their total loss, it being impossible to afford them the smallest assistance. As no dependence can be placed on the anchors in these times of danger, precautions are generally taken by the masters of vessels to secure the end of a cable to trees on the bank of the river, or to stone pillars, which have been provided for the purpose. They have ample time for preparation, as the approach of one of these freshes is communicated from the interior several days before its arrival; during which time the river gradually swells and attains its greatest height.

The bar being liable to alterations, &c., as before mentioned, renders it *absolutely necessary* to employ a pilot. The pilots are generally fishermen of the


ENTRANCE TO THE
RIVER DOURO
Scale of 1 mile
H. W. F.&C. 2h 30m
Springs rise 10 ft
Mte do Fojo or Antes
Bom Fim
Povoa de Cima
Congregados
Praca de Cordoaria
Lapa Conv.
Lapa Signal Post
Mt Pedrad
Gloria Batt.
OPORTO
Serra Convent
Villa Nova de Gaya
Alvarengas Ho.
St Antonio Convt
Wine Compy Store
Signal Post
Quinta Vanzeller
Water Pt.
Heights of Furada
Grille
M. da Rabada
Lordelo Ch.
Sta Catherina
Sampayo
Ft Sn Joao 41° 8' 48" N. 8° 37' 0" W.
A. _ Anjo Dome in one with Bar Mark
Bar Mark
Pasterella
Anjo Dome
Breakwater
Cabedello
Pedra de Cao Batteries
Cao Rks
SAN JOAO DA FOZ
Ft San Joao
Lage
Nossa Senhora da Luz
Light F. (flash)
Mte Grasto
N. Filgueira
S. Filgueira
Queijo Black Rk
Varn 22° 15' W. 1859
Mag.
A

port, who are always ready to go off when a vessel comes in sight, unless the weather prevents their getting out, or it be so thick that they cannot discern the marks, the land being low and level.

The following observations on the bar and harbour of Oporto are from the *Nautical Magazine*, 1832, page 507:—

"The first precaution to be observed when bound to Oporto, is to be certain of the latitude, as there is a great sameness in the appearance of the land, and the towns northward of Oporto are seen at a great distance. No vessel should attempt the bar without a pilot, as it is constantly shifting, and the freshes render it extremely dangerous. Mr. Charles Gahan, the second master of H.M. brig *Royalist*, informs us that vessels are frequently prevented from entering the river for three or four weeks at a time. In addition to which, Mr. H. J. Strutt, the master of H.M.S. *Victor*, commanded by Captain Ellice, says, that no vessel drawing more than 15½ feet of water, can pass it at any time.

On the extraordinary and dangerous freshes to which the river Douro is subject, Mr. Strutt makes the following useful observations:—"It is perhaps, superfluous to observe, that the great extent of the river, the steepness of its banks, narrow bed, and debouchure, as also the number of streams tributary to it, make it liable to considerable irregularity in rise and strength of current. Now, the seasons here are tolerably regular; the rains are heavy, continuous, and general. Thus the river is occasionally swollen above its customary level. Again, during the prevalence of West and S.W. winds, to which its entrance and principal direction is exposed, its stream is more or less impeded, as those winds cause an accumulation of sand along the shore to seaward, and upon the rocks, which are the fundamental basis of the bar. Thus arises its liability to 'freshes'; the strength, duration, and importance depending upon the conjoined operation of some or all of these causes. The periodical fall of the stream being overcome, and a gradual rise continuing for two or three days, is a certain indication of one being at hand; and, when the waters begin to find vent, before the commencement of the run is perceptible, the middle of the river is covered with rubbish, patches of foam, &c. The *Victor* experienced one, accompanied with about ten days' rain, with few intermissions, and those chiefly drizzling. During that time the wind was westerly, but neither very strong nor steady. The first indication, viz., loss of tide, was observed two days before the rubbish and foam were observed; the day following it attained full strength, and subsided on the third morning afterwards to the usual strength of current. We had 4¾ knots alongside; in the middle of the stream it was of twice that velocity. There can be little doubt that the strength of this fresh is very often much exceeded, especially in the spring of the year, when a sudden thaw on the mountainous tracts which border the river occasions the descent of a great body of water. At all events, the utmost precaution for holding a vessel is indispensable; for the bottom is of light soil, soft, but not tenacious, and appears to be considerably agitated; and, strange as it may be thought, two vessels on the opposite shore had their bowers in the stream washed astern, a circumstance which is stated to be not uncommon at such times, owing to the rapidity of the stream."

Directions.—The following Directions for the Douro, by Commander Belcher, of H.M.S. *Ætna*, 1833, are extracted from the " Sailing Directions for the West Coasts of France, Spain and Portugal " by Staff Commander James Penn R.N. published by the Hydrographic Office, Admiralty, 1867.

" The land in the vicinity of Oporto may be easily recognized, as the heights of Monte da Rabida and of Furada, which form the river gap, being 200 feet high, and only 1¼ miles from the coast, will point out the entrance of the river by the peculiar haze behind them. It may also be known at a considerable distance, if the weather be moderately clear, by the hills of Congregados and Lapa, on the northern limits of the city. The latter hill, which is the nearer of the two, and 500 feet high, may be distinguished by a round tower near a gloomy-looking convent on the heights over Matozinhos. To the northward is the conspicuous chapel of San Joao da Apollonia; it is easily known by its three large umbrella shaped trees, On the southern range, and at nearly the same distance from the Lapa, is San Ovidio, about the same apparent magnitude as the chapel of Santa Apollonia; and, at the entrance close to the water, the church of San Joao de Foz, if the weather be fine, is also very conspicuous.

To a vessel coming from southward, into 12 fathoms water, the probable outline of the land to the northward will be the Queijo fort, black, with four white-capped turrets at its angles; Crastro hill, flat-crowned, and rising close north of the lighthouse; and in the distance the chapel of San Joao da Apollonia, capped by the umbrella trees. The coast to the southward of the Cabedello, or sandspit, is sandy, but may be distinguished from it by the fishermen's huts, which commence a few miles to the southward, and continue a great distance. Should the weather be too hazy to distinguish the outline above described, it will be necessary to pay attention to the soundings, which cannot far mislead, if to the southward of Leichoes.

Off the bar, in 9 fathoms, the bottom is hard and sandy; to the northward or southward of it the sand is mixed with mud. In this depth, if near the bar, the vessel will be a little more than a mile off the land; and here the rollers on the bar, if they top, will be perceived. If to the northward of the bar, the convent of Santa Clara, near Villa de Conde, will be seen in clear weather.

If, on making the land in hazy weather, its higher outline cannot be defined, it will be well to look narrowly to the beach, bearing in mind that, although a considerable range of sandy beach lies to the southward of the Douro, yet it is there studded with huts, whereas none are to be seen near the Douro. Should the beach appear to be sand, with a few boulders, or large rounded rocks, the eye should be carried northerly to ascertain whether the slope of the dark land terminates in sand, with a clump of these boulders there, as well as on the land. If this be the case the vessel will be to the southward of the bar, and off its shoalest part. By tracing the sand (which is a long spit) northerly, the fort of San Joao da Foz will be discerned, and the South Filgueira.

This rock is connected by sunken rocks with the main land at the fort. If, on the other hand, the shore should exhibit rough rocky ledges, with sandy bays between them, the vessel will be to the northward of the bar, and the Black fort (Queijo) will be seen where the long sandy beach commences to the northward. Here the water should not be shoaled to less than 10 fathoms, and it would be advisable to keep to the S.W. to avoid the Leichoes.

Approaching the Bar.—The city of Oporto may be seen in clear weather at the distance of 12 or 14 miles. The steeple of Los Clerigos is a very prominent object, and when brought E.S.E. the land may be approached on this bearing until the water shoals to 9 fathoms. By night a vessel should not go into less than 15 fathoms, unless the weather be very fine, in which case she may run into 12, where it would be advisable to anchor until daylight, as, in the event of calms, currents, morning fogs, or easterly winds, much delay and loss of tide might be occasioned.

If the fog be not very thick the church of Santa Catherina and the white dome of Anjo will probably be seen; keeping these objects in line, vessels of 12 feet draught should not shoal to less than 5 fathoms; but as long as the Black fort is kept open westward of the North Filgueira, four times the length of the latter, there is no risk in this depth, provided the vessel's head be off shore, with steerage way. If there be much swell this will probably be the line of the rollers, when a vessel should not stand so far in.

If the chapel of San Joao da Apollonia be made out, bring it and the lighthouse in one, N.E. by E. ¼ E., and stand on in that direction until Santa Catherina church and Lapa convent are in a line; these cross bearings will place a vessel in 6 fathoms, and in the best position for taking a pilot on board. If compelled to wait, give West to S.W. the preference in laying the ship's head to seaward. A considerable offset will secure her from danger of indraught in this position; the offset, especially during the winter, prevailing until the freshes have been overcome by the ordinary flood tides, which are pretty regular from June until November.

The bar of Oporto is an unsafe lee shore, especially with the wind from West to S.W.; but, with the wind from N.W., vessels may with safety approach to examine the state of the bar, provided always that the latitude be known (or land made out), and the usual precautions of the lead and a good look out be attended to. If the weather should be so hazy that San Joao da Foz fort and the lighthouse cannot be distinguished, it will be unsafe to approach the bar; at the same time it should be borne in mind, that, if the haziness commenced before 10 a.m., and not the result of bad weather, it may be expected to clear off about noon.

It is unsafe to trust boats outside the bar on the ebb, unless they have a vessel to resort to, as the overfalls on freshes or springs would prevent their evading any roller which might follow them in.

The *Anchorage* outside the bar is good in any depth between 10 and 14 fathoms but if bad weather be anticipated the Leichoes should bear at least North from the anchorage. Slip ropes and buoys should always be on, as the swell at times renders weighing dangerous as well as impossible.

The *Bar*.—To give sufficient directions to a stranger for entering the Douro is impossible, for the channel is so intricate that even with a considerable acquaintance with the place much care and promptitude is requisite, and most particularly with regard to the helm. The bar—the great obstruction to its navigation—is a broad and constantly shifting belt of sand, having generally about 20 feet water over it, at ordinary high tides. From November until May the bar is seldom free from rollers. Those which endanger vessels rarely top heavily at the distance of a mile from the shore, unless in gales ; but should the ebb have made, the attempt to enter against it would be attended with extreme danger.

Although the bar may be impassable, it does not follow that there can be no communication with the shore, as even at half-ebb, the worst time of tide for the bar, boats can go off from the beach between Foz and the lighthouse, and nearly at all times from the huts of Monte Crasto. The boats used for this purpose (Catraias) go through very heavy seas safely, when no ships' boats could live. The dangers at and within the bar are much exaggerated by the pilots, whose noise and confusion in bringing a vessel in is intended to produce undue impressions of intricacy and danger, whereas vessels drawing from 9 to 12 feet may safely enter at high water, and even at half-flood, without a pilot, many cases having occurred in which masters who would not be imposed upon have brought the vessels over the bar in defiance of the pilot's assertion that such a step would be impracticable.

Tides.—It is high water at the bar of Oporto, full and change, at 2h. 30m. ; springs rise on an average about 10 feet, and neaps 7 feet, which may be further increased by nine inches or a foot in easterly winds. The pilots affirm that in the heaviest freshes the tide is not increased on the bar more than one foot. The western swell being checked by the freshes from the Douro, the rollers on the bar become terrific, and not unfrequently detain vessels entering or departing for five or six weeks.

The freshes are occasioned more by extensive thaws in the mountainous country which feeds this river, than by heavy rains, and may be expected in their greatest force during the months of March and April,—even as late as May,—but the increased rise and rapidity of the tides which is occasioned by rain alone may occur between November and May. The latter do not produce any dangerous consequences ; but the effect of thaws and rain combined, occasions such an increase in the rapidity of the stream that vessels cannot then trust to their anchors, which are sometimes undermined by the current, and not unfrequently trees and other large bodies are brought down by the stream.

The rise of the river under these circumstances is very great. It is said by actual measurement to be 10 feet above springs, and the velocity from the sudden fall at the bend has been estimated by the pilots at almost 14 miles.

During the freshes the vessels are secured in tiers, the innermost being secured to stone bollards or rings let into the piers for the purpose, and are kept about 40 feet from the shore by brows both forward and aft, and well lashed to admit of rising. During the vernal freshes additional precautionary measures will probably be necessary. It is said that the eddy, during the freshes, has been strong enough to bring a boat from Lazaretto point up to the Cavaco gate.

Life Boats.—A society at Oporto for the rescue and preservation of wrecked seamen, and an establishment with life boats and apparatus for reaching vessels in distress, exists on the banks of the Douro, just within the bar.

Anchorage in the River.—The best anchorage is in the bight of San Antonio, where the freshes cause a kind of eddy, and as near the convent as possible; not allowing the dome of the Serra convent to be seen outside the quay. There will be no danger of grounding at low water springs. A good berth for a vessel of war will be to bring the wine company's store, (a white house, on the starboard bow,) and the eastern red gate of the garden wall of the Cavaco abreast the starboard gangway. It is customary to make the starboard bower cable fast to the shore. The holding-ground in the stream is very loose; however, a bower is usually laid out there at a long scope for the off strain, and as the stream swells, gradually heave in shore, until the starboard cable is nearly ahead. In this position but little strain is experienced, and the port chain will bury itself in the mud, which is very deep.

Directions.—The long leading mark is Santa Catherina church on with the south belfry of Lapa convent, bearing E. ¾ S., and on this course vessels should stand in for the bar, particularly if the bar or pilot-boat is on the look-out. Should the haze prevent the Lapa from being seen, Anjo dome and Santa Catherina will answer the same purpose; and when on the bar, it is rather safer, although the space between those marks is apparently trifling.

Two cross bearings will now come on nearly at the same instant, and even in the thickest navigating weather, can be discovered, viz. Queijo fort and North Filgueira, and the Northern or Pilot's staff of San Joao da Foz over South Filgueira. This is the shallowest part of the bar. Now, edge northerly to bring a building called the Bar Mark and Santa Catherina in one, and stand on, keeping a little northerly withal, but bearing in mind that the cross bearings of Bar Mark and the Cross of Anjo chapel, as well as the two staffs of San Joao da Foz, in line, meet on a very small rock called the Staff rock, which is awash at low water springs, with deep water round it. The moment the line of the two staffs is passed, get into the line of Anjo chapel cross and the Bar Mark, and stand on until abreast the semi-circular stone wall, against which a vessel may almost rub her side.

From thence pass on the south side of the Cruz, but very close, as a rock called the Agulha or Needle, having 1½ feet on it at low water, lies S. ¾ W. from it, distant half a cable. After passing the Cruz (looking astern) keep the centre of South Filgueira in one with the south side of the Cruz until the dome of the

Foz is over the south extremity of the Anjo Battery ruins. The course should then be shaped for the willow-tree at the fountain under the Monte de Rabida, until Santa Catherina is well open of swamp island, when steer direct for Clerigos, recollecting that all the dangers, after passing the fountain steps are on the south side. Merchant vessels anchor above and below these steps; ships of war abreast the steps in the fine season, and higher up, as noticed in the freshes.

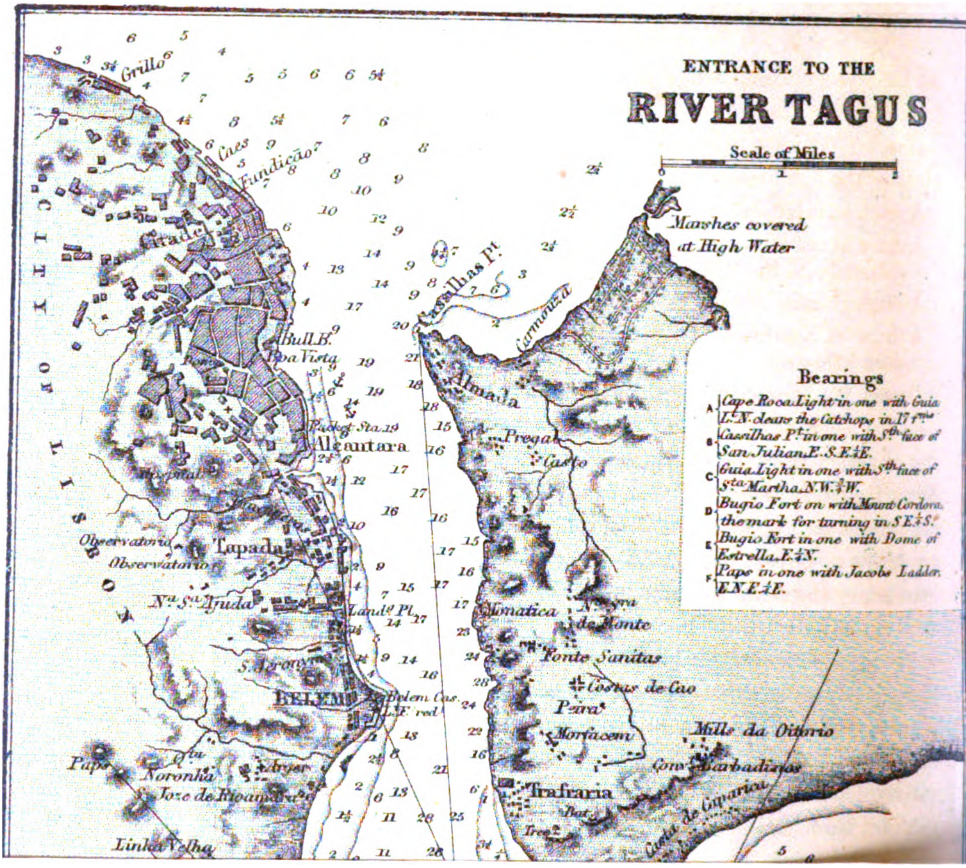
Within the bar the channel between the Lages (flat topped rocks) carries from 3 to 4 fathoms water. This channel is comprised between those rocks, or rather between the line Bar Mark and Anjo chapel, and the Lapa turret and Anjo dome. The South Lage has 9 feet on it at low water, the cross mark for it being the North Filgueira, seen through the gap of the southern.

A little more than a cable inside the North Lage, lies Staff rock, small in size and awash at low water springs, and with deep water round it; it lies in the most dangerous part of the channel, because, on the ebb, particularly in the freshes, the tide sets directly on it, and consequently, by the slightest sheer a vessel would risk being laid broad-side on. Even with the velocity of a steamer a vessel may be detained some minutes at this spot. The marks for it, however, are perfect, viz. the Bar Mark over the Cross of Anjo chapel, and the two staffs of San Joao da Foz in one. To clear it, the south edge of the Bar Mark should be kept on with the Cross, as, the instant it is fairly passed, it is necessary to edge northerly.

The next danger is a patch about 40 fathoms N.N.W. of the Cruz, and dry at low water springs. The marks for it are the south staff of the Foz over the south pillar of the hospital; and Clerigos steeple, just clear of the south edge of the large detached rock between Cruz and Anjo. This patch, however, is generally avoided by hauling over to the Cabedello side, except on a strong ebb, when the course from the circular wall is direct for the Cruz rock which allows the tide to sheer the vessel clear of it. In summer weather, with slack water, there is no danger within the Cabedello bay, and rings are secured in the rocks to admit of vessels mooring in the 6-fathom hole. At 10 yards from the beach there are 3 fathoms water.

The Agulha,—a small pinnacle, with only 1½ feet water, bears S. ¾ W. distant half a cable from the Cruz. The channel is quite clear on either side of it, but that generally preferred is on the north side close to the Cruz. The marks for it are well defined, and always visible except in dense fog. The first is the dome of the Foz over the second pillar of the hospital; the second, the Cross of Anjo church on with the left edge of Anjo dome.

Within the Cruz will be found three patches to be avoided by ships drawing about 12 feet. The first is on the line of Anjo and Foz Domes in one, and may be avoided by bringing in one the South Filgueira and the large rock N.E. of the Cruz, just before bringing the former mark on, so as to pass close to the edge of the Northern flat. The next patch has Anjo chapel cross and Foz dome in one, and may be avoided by hauling northerly the moment the whole church of Santa Catherina comes over the west end of the high water mark of Swamp island. The


ENTRANCE TO THE
RIVER TAGUS
Scale of Miles
0 1 2
Marshes covered at High Water
Bearings
A Cape Roca Light in one with Guia Lt. N. clears the Catchops in 17 fms.
B Cassilhas Pt. in one with Sth. face of San Julian E.S.E. ½ E.
C Guia Light in one with Sth. face of Sta. Martha N.W. ¾ W.
D Bugio Fort on with Mount Cordova the mark for turning in S.E. ¼ S.
E Bugio Fort in one with Dome of Estrella E. ¼ N.
F Paps in one with Jacobs Ladder E.N.E. ½ E.
CITY OF LISBON
Grillo
Caes
Fundição
Bull H.
Boa Vista
Packet Sta.
Alcantara
Tapada
Observatorio
Nª Sª Ajuda
Landg. Pl.
BELEM
Belem Cas.
Paps
Noronha
Joze de Ribamar
Linha Velha
Cassilhas Pt.
Almada
Pregal
Caparica
Monte
Fonte Santas
Costas de Cao
Porta
Morfacem
Mills da Outorio
Trafaria
Caparica

ast patch is a continuation of an irregular flat extending from the Lazaretto; but that side of the channel vessels ought not to approach.

Signals.—The following signals are we believe exhibited from the telegraph adjoining the lighthouse.

A drum at masthead..................	The coast is dangerous; put out to sea.
A drum at masthead and one at the extremity of the right yard-arm	Vessels in sight cannot be piloted.
A drum at each end of yard-arm...	By coming near you may be piloted.
A drum at masthead, and one on each yard-arm......................	Make for the bar.

OPORTO is a large city, built in the form of an amphitheatre, partly on the sides and summits of two hills on the north side of the river Douro, and partly also on a plain near the river, from which it has a strikingly beautiful appearance. Along the whole length of the town is a quay with a strong stone wall, having rings, bolts, &c., to which vessels may be securely attached; and from this quay are streets to various parts of the town. At the east end of the city the houses overhanging the river are built on so steep a declivity as to be accessible only by steps cut into the rock.

The principal export is port wine, which, although taking its name from the place, is not really produced here, nor even in the environs, but comes from the provinces of Tras los Montes and Entre Douro é Minho. Other articles of export are oil, cork, leather, sumach, oranges and linen. The imports are various, but consist principally of woollen, cotton, and other goods from England, fish from Newfoundland, &c.

The climate of Oporto is damp and foggy in winter, less from the vicinity of the Atlantic than from its position in the midst of woods and mountains. The cold is severe for the latitude, though it seldom freezes; and in summer, on the other hand, the heat would be intense, if not moderated by winds blowing regularly from the eastward in the morning, southward at noon, and westward at night.

LISBON.—The River Tagus, the principal river of Portugal, has on its north bank the capital, Lisbon. At its entrance, between Forts San Julian and Bugioe it is not more than a mile wide, yet the depth is considerable, so that the largest vessels are enabled to approach the city. Above Lisbon, it expands into a wide basin, from 2 to 7 miles across, but hitherto vessels have seldom had occasion to ascend so far, there being no place of commercial importance, although the river is navigable as far as Abrantes. The banks of the river are generally steep, its current impetuous, and its waters turbulent and muddy.

From the river, Lisbon presents an imposing appearance, as it covers several hills, and contains numerous palaces, churches, and convents. The exports of Lisbon consist of wine, oil, fruit, and salt. Among the imports are hemp, flax, and linen cloths from Russia; iron, steel, salt fish, timber, pitch, and tar, from the Baltic; linen, cloth, corn, &c., from Holland and Germany; silks from

France; and cotton and woollen goods, cod-fish, hardware, ale, porter, linen, coals, &c., from England. Almost all the trade is in foreign bottoms.

When approaching Lisbon, vessels should observe that *Cape Roca*, or the *Rock of Lisbon*, is situated in Lat. 38° 46′ 30″ N., and Long. 9° 29′ 43″ W. It is broad, moderately high, steep towards the sea, and has a building on its summit, from which is exhibited a *revolving* light visible in clear weather about 21 miles. The colour of the light is *red* for one minute, *white* during 45 seconds.

Near the cape is a high rock, and further out a shoal, over which the sea breaks, although near its outside are 40 fathoms. Within the cape the land suddenly rises to a remarkable mountainous ridge, running easterly, with several irregular risings, having on its northern slope the town of Cintra, from which it takes its name; this mountainous ridge is a good mark to know the coast by.

At 4 miles S. by W. from cape Roca is point Sinchette, having a reef very near it. The intermediate coast forms a bay, enclosed by a high steep coast, excepting near the point, where there is a flat beach. From point Sinchette the coast eastward to Fort San Julian is everywhere steep, but clean, excepting at point Rana (about a musket-shot westward of that fort) where the ground is shoal.

A prominent object on the north shore is the lighthouse of *Guia*, which shows a *fixed* light at 207 feet above the sea, visible 12 miles, and further on, the fort, town and bay of Cascaes*; in the latter there is good anchorage, in from 8 to 12 fathoms, sheltered from N.W., North, and N.E. winds. The bottom of the bay is of sand and mud, and the marks for anchoring are, Guia lighthouse in one with Fort Santa Martha, bearing about N.W. ½ W., and the town of Cascaes nearly open northward of Cascaes fort, as the rocky irregular bottom extending from the fort will be thus avoided. A vessel may lie in these roads generally throughout the summer months, the wind being almost invariably from northward; but immediately the wind comes from southward a heavy swell is thrown into the bay, in which case she should either run to sea, or go through the South channel into the Tagus. Small coasting vessels lie within Cascaes fort bringing it to bear W. by S., being there protected from the westerly swell. Boats are hauled up on a sandy beach, under the wall that continues from Cascaes fort towards the town.

At 4 miles from Cascaes is *Fort San Julian*, at the entrance to the Tagus. This fort is large, and situated on a high, steep, projecting point, having a small reef around it. The light tower near the centre of the fortress, shows a *fixed*

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* A fixed *red* light is now shown from a tower, painted with a blue stripe half way from the base, on Fort Santa Martha, at 52 feet above the sea, visible 5 miles. If kept in one with Guia light it leads through the North channel in 6 to 10 fathoms, sand.

Vessels bound to the Tagus from northward, and passing cape Roca, must, when approaching Guia light, keep off the coast sufficiently to open out Cascaes light, thus avoiding the rocks of Pombeira, Nau, and Ponta da Insua. If intending to anchor opposite Cascaes, they may do so with Cascaes and Guia lighthouses in one, in from 7 to 10 fathoms, sand.

light. At 5 miles eastward of Fort San Julian is the castle of Belem, on the north shore of the Tagus, which stands upon a low sandy point, with a battery about it towards the river.

A strong *red fixed* light is now shown at the custom-house station of *Bom Successo*, a little westward of Belem castle, to enable vessels at night to avoid the spit of sand extending from that point. The light can be easily distinguished from all others in the vicinity.

The lighthouse on cape Espichel is a square tower, which shows a *fixed* light visible 12 miles.

The entrance to the Tagus is encumbered by two shoals, named the northern and southern Cachopos, which form two channels into the river;—the north or little channel is between the northern Cachopo and San Julian fort; the south or great channel is between the two Cachopos.*

The *North Cachopo* is a rocky shoal, with from 1½ to 4 fathoms on it; so that, with a swell from westward, when the ebb-tide is running, the sea breaks over it most furiously. It is shoalest towards its northern part, which is about a musket-shot from Fort San Julian; thence it extends west 8 miles.

The *South Cachopo* is still more shoal than the northern one, for its north-eastern part is always dry. On the bank, at about S.E. by S. 1½ miles from Fort San Julian, is the *Bugio Fort*, on the tower of which (San Lorenzo) is a light which *revolves* in 1¾ minutes; the duration of the strong light is not above 12 seconds, and as it may be clearly seen at the distance of 16 miles when the weather is fine, it is a valuable mark for the river. At low water the Bugio appears to stand upon a dry bank, but on the rising of the tide the water washes the very walls of the fortress. On the bar between the Cachopo shoals the depth is usually about 6 fathoms.

When entering the Tagus the great danger is a strong ebb tide, as with the wind from sea there will sometimes be violent breakers right across the bar. At such times a vessel becomes almost unmanageable. In the South channel, the current is said to set directly through. To enter the river during the ebb would require a brisk gale and all sails set, in order to make any way, or even to stem the current; and it is to be observed that, within the river, the wind comes very irregularly through the valleys on each side, unless it proceeds from the West or S.W. It is, however, tolerably steady when in the direction of the river. The tide draws strongly towards the Bugio bank, and hereabout the waters divide into several counter currents; so that a vessel approaching too near this bank will not obey the helm. From these remarks it will be seen that, to enter the Tagus, a pilot is indispensable, more especially as the tides are so violent as to have caused the loss of many vessels. Off the city the ebb runs down at the rate of

* By an official notice, dated Lisbon, November 26th, 1841, the pilot boats henceforth bear a *blue flag*, hoisted at the extremity of the yard, instead of the pennant hitherto used by them, as the latter may be confounded with the pennant used by them as owners' signals.

7 miles an hour, so that the anchors frequently come home, especially those with buoys, which are of no use, as, from the violence of the current, they are frequently immersed in the water. The flood tide is considerably weaker than the ebb.

North Channel.—The north channel into the Tagus under point San Julian is scarcely more than ¼ of a mile wide, and has a depth of 4 to 5½ fathoms at low water. To run through, a thorough knowledge of the tides, and also a commanding breeze, are required. When about to enter, keep under Cascaes shore, and stand on for the castle of San Julian, until the bastion of the castle of Santa Martha, the southernmost fort in Cascaes bay, is brought in one with the lighthouse of N.S. de la Guia N.W. ¾ W., which direction should be preserved until you have passed point de Rana, which must have a berth of 2 cables, on account of the reef extending from it. When the tower of Bugio comes on with Mount Cordova (a hill of a sugar-loaf form on the southern land) bearing S.E. ¼ S., steer with that mark on until the whole of the north side of the Tagus is open of the castle of San Julian, when you will have passed the north-eastern end of the north Cachopo, and may run along the northern shore of the river as far as the castle of Belem. It should be observed here that the flood sets right on the shoal S.E. of San Julian, while the ebb sets directly on the north Cachopo.

South Channel.—This is the channel between the Cachopos banks. It is about a mile wide, and has a depth of 6 to 15 fathoms, deepening gradually as you approach Fort San Julian. To sail through this channel Mr. Biddlecombe has given the following directions :—

"On entering the south channel with a fair wind, and rounding the southern extremity of the northern Cachopo, keep the Peninha (or western part of Mount Cintra) open westward of Cascaes fort, N. ⅛ E., until Bugio fort comes in one with Estrella dome, E. ¼ N. Then steer towards Bugio, keeping it in one with the Estrella dome, in which line the bar connecting the north and south Cachopos will be crossed in the deepest water, and in not less than 6½ fathoms; and when the Paps are in one with Jacob's Ladder E.N.E. ¼ E., the bar will have been passed, and the depth of water will have increased. Now run up with the Paps in one with Jacob's Ladder, or, if the wind hangs to the northward, borrow as far as the northern turning mark (the Paps in one with Caxias, E.N.E. ½ E). On the contrary, if the wind be from the S.E., borrow towards the southern turning mark, which is the eastern part of the Paps touching the north-western end of the range of buildings at Boaviagem, and bearing about E.N.E., but avoid getting too near Bugio, as the tides there are difficult, and the bank is steep. Having passed between Bugio and San Julian, keep towards the north shore till Belem castle is in one with the south part of the city of Lisbon, bearing E. ¾ S., which clears all the shoals northward of the sandy flat inside of Bugio. Pass Belem castle at the distance of 2 or 3 cables' lengths, and then proceed to the anchorage, keeping the whole of Fort San Julian and all its outworks open southward of the parapet of Belem castle which will clear the shoals of Alcantara, until the vessel arrives off the Packet stairs, where there is anchorage in from 10 to 14 fathoms, or farther up in 12 to 16 fathoms mud.

Turning through the South Channel into the River.—On standing towards the south-west tail of the north Cachopo, keep the Peninha open westward of Cascaes fort (N. ½ E.), by which there will not be found less than 12 fathoms, until the south part of the city of Lisbon is in one with Bugio fort, E. ½ S., and then hauling the wind stand on until the eastern part of the Paps touch the north-western part of the buildings of Boaviagem, bearing E.N.E., which is the southern turning mark. So long as the Peninha is open westward of Fort Velho, you may cross over as far as that southern turning mark, but when the Peninha opens eastward of Fort Velho, it is unsafe to stand quite so far over, on account of the strong eddy which sets towards the South Cachopo. Towards the north Cachopo you may stand till the northern turning mark comes on, the Paps in one with Caxias, about E.N.E. ½ E., where the water is deep, and the flood-tide sets straight up the channel, but remember that the north Cachopo is on that side steep.

The 8½ fathoms shoal off San Julian extends a short distance from the fort, but deepens immediately to 7 fathoms; Fort St. Thomas open of the small battery of Catelazeite, on the point near southward of it, clears this shoal.

Having passed San Julian and Bugio continue to work up the river to Belem, standing over to either shore as far as into 12 fathoms; but a good mark for turning clear of the shoals on the southern shore, inside of Bugio, is Belem castle in one with the Citadel of Lisbon, which stands on the first rise of the land from the south point of Lisbon. The edge of the shoal continues very irregularly along the shore as far as Trafaria; and abreast of Torrao, a large white building in the bight, it stretches out fully ¼ a mile off the shore. Near Trafaria, a rocky ledge extends ¼ of a mile in the direction of Caxias, and has deep water close to it. When above Trafaria the south shore of the river is clear, with deep water the whole distance to Casilhas point.

The shoal water on the north side of the river continues along shore eastward, about ¼ of a mile off shore, where there is a depth of 5 fathoms to within ¼ of a mile of Belem castle, and there the shore becomes so steep, that a depth of 5 fathoms may be had at 200 yards from the castle, and 9 fathoms at 300 yards."

CADIZ.—Cadiz is the most important seaport of Spain. The city occupies the rocky and elevated extremity of a long, narrow, low tongue of land, which runs about 5 miles from the Isle of Leon, and encloses between it and the mainland a spacious bay, which has everywhere good anchorage, with some excellent harbours. This tongue or isthmus, joining the city to the main land, is, in parts, not more than from 200 to 300 yards across, and is very strongly fortified.

The principal articles of import are linen, wool, silk, and cotton, of which, however, a considerable quantity is re-exported; sugar, cocoa, coffee, and other colonial produce; timber, tobacco, hides, salted fish, &c. Wine is the principal export, and is estimated to be of the annual value of upwards of £1,000,000; more than half of this is said to be destined for the English market.

The harbour is surrounded on all sides, except the west, by elevated land. In it the anchorage is excellent, although ships are liable to some inconvenience when a strong wind from the westward sends the swell of the sea into the bay.

In the northern part of the outer harbour is the town of Puerto de Santa Maria, which is about 6 miles from Cadiz, and affords that city its principal supply of fresh water. The town is on the banks of the river Guadalete, on the bar of which there is a depth of not more than one foot at low water.

On the east side of the inner harbour is the town of Puerto Real, said to have a population of 10,000 persons, who are employed in the neighbouring extensive salt-works. Near the town is the Canal del Trocadero, which leads to the arsenal of Carraca.

The town of San Fernando lies on the east side of the isle of Leon, in the southern part of the inner harbour, and is distant from Cadiz about 6 miles; near it is San Carlos, the residence of the Captain-General, and the Intendant of the Marines, the site of the treasury, and other public buildings; and on its western side is the Royal Observatory.* The isle of Leon is separated from the main land by the Rio de Sancti Petri, or river San Pedro, a narrow stream, 9 miles in length, and 3 and 4 fathoms deep. There is a bridge (Puente de Suazo) at the eastern part of San Fernando, which leads from the main land to Cadiz.

Lights.—The lighthouse of San Sebastian stands on the west point of Cadiz, in Lat. 36° 31′ 53″ N., Long. 6° 18′ 10″ W.; it shows a *fixed* light (flashing every 2 min. *red* and *bright*, at 148 feet above the sea, visible 20 miles.† Two small *red* lights are also shown in Cadiz bay, at the entrance to the river Guadalete.

At about 5½ miles S. by E. ¼ E. from Sebastian lighthouse, is the Torre Gorda, or Great Tower (called also the tower of Hercules), situated on the top of a little sand-hill; it is round, and below it is a battery. Care must be taken that it be not mistaken for the lighthouse, especially in thick weather, as the coast between consists of very low beach, outside of which are several reefs. It is also to be observed that at a distance of 12 miles N. ¾ E. from the lighthouse stands the Casa de Beva, a tower on a lofty ridge, which may be seen from the surrounding country at a great distance; it is square, has a cupola on it, and stands between two large houses;—from Rota the bearing and distance to this tower are N. by E. ¼ E. 6 miles.

In the space between the Frayle and the Cochinos, the ebb tide runs strongly through the channels between the shoals, and flood tide, on the contrary, sets towards them.

Rocks and Shoals.—From the point of San Sebastian a reef extends more than

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* Considered to be 6° 12′ 21″ W. from Greenwich Observatory.

† At the entrance to the river Guadalquiver, northward of Cadiz, is a light, which is as conspicuous an object as that at Cadiz. It is shown from a lighthouse erected on the ridge of Perro, between the village of Chipiona and the old convent of Regla, at 130 feet from the beach. It is *fixed* (*flashing* every minute) is 225 feet above the sea, and can be seen from about 23 miles.

½ a mile westward; and at ¼ of a mile from the lighthouse N.W. by W. is La Olla, or Kettle rock, having only 6 feet water over it. N.N.E. ¾ E. about one mile from the same tower, are two small black rocks, called the Cochinos, or Pigs, visible at low water, but covered at full tide; these are in a line with the two towers of the Carmelite church. Within these, and near the shore, is the Friedera shoal, always covered, but the sea breaks on it when there is any swell from without the bay; the distance from the Cochinos to this shoal is 420 fathoms, and it lies with the church of the Carmelites bearing S.E. ½ S.

The Puercas, or Hogs, are a cluster of black rocks extending E. by S. and W. by N.; they are always distinguishable by the breakers at high water, and visible when it is low tide. The bearing and distance of these from the Cochinos are E. ½ N., nearly ½ a mile. La Cruz rock is a rock above water, the largest of a number lying close to the wall at the foot of the bastion of the Bonete or westernmost bastion of Cadiz.

El Frayle or the Friar, is a rocky shoal off the N.W. bastion of the town, behind which may be seen the Carmelite church before mentioned. Its bearing and distance from the Puercas are S.E. by E. 495 fathoms; the least depth over it is 14 feet. When on the east end of this shoal, the Carmelite church will be seen between the two sentry-boxes on the bastion of Candelaria; and when on the west end, La Cruz rock will be in one with the tower of San Sebastian.

El Diamante, or the Diamond, is a rocky shoal extending N.W. and S.E. about 165 fathoms, and has over it 12 feet at low water. The mark for it is the flag-staff of the castle Santa Catalina del Puerto, in one with the easternmost part of the Morro of Xeres; the northern part of Puerto Real will then be in a line with the southern little hill of Medina, and the Puercas in one with fort Santa Catherina.

La Galera, another rocky shoal extending from north to south nearly 400 fathoms, lies at the distance of 412 fathoms north-westward of El Diamante. Its least depth appears to be 9 or 10 feet at low water. On the shoalest part, the southernmost part of Puerto Real will be on with the first top of the Barrueco, a little hill having two peaks on its summit; and the steeple of San Domingo will be covered by the point of San Felipe, about a boat's length; point San Felipe will then be in a line with the ditch of the Land-port of the city.

Los Corrales, or the Coral shoal, is one which extends 780 fathoms from the ditch of the Land-port of Cadiz south-eastward: the depth of water along its outer edge, beginning at the fortifications, is from 4 to 10 feet. The bottom is of rock, with patches of mud.

Between Los Corrales and the castle of Puntales is the shoal bank of San Domingo, on which are 8½ feet; the bottom is of sand and shells. The outer edge of this shoal forms the narrowest part of the harbour, and lies in a line with the castle of Puntales and Torre Gorda, or tower of Hercules.

We believe that these shoals are now marked by buoys.

Directions.—Vessels entering Cadiz harbour between the Puercos rocks and

Diamante shoal, should keep Medina and Puerto Real steeples in line bearing about S.E. ½ E., until the gates of St. Domingo open of the low point of Phillip, which has a flag-staff and saluting battery on its extremity; or the small mole—called the mole of Seville gate—is open of the point; when the lead will be a sufficient guide, and a convenient anchorage may be taken.

With a beating wind, the Diamante should not be approached nearer than to bring the south end of Medina on with the north end of Puerto Real. In standing to the southward the north end of Medina should not be brought open southward of the south end of Puerto Real.

The best anchorage off the city for vessels of moderate size, is with the barracks, in ruins, on the isle of Leon touching or on with Matagorda fort, and the dome of the cathedral twice or thrice its apparent breadth open east or west of St. Domingo gates, in 5 to 6 fathoms water, mud. Small vessels and coasters lie nearer the city. Large vessels should anchor further out, with the high house—the first large building north of the tower—at San Fernando a little open west of Matagorda fort; and the cathedral open eastward of St. Domingo gates.

Vessels running up the harbour, after having opened St. Domingo gates of Phillip point, should steer for Puntales castle, keeping the high tower of San Fernando open of Matagorda, and when abreast St. José church, a remarkable solitary palm tree will be seen on the summit of Martyrs hill—the first rising land eastward of Torre Gorda, with two magazines on it a short distance apart—which just touching the south gable end of a large white building at the water's edge near Santibanez mills leads clear of all the shoal water until abreast of fort Luis. The anchorage between Puntales and the entrance to the Carraca channel is excellent, and requires no other guide than the chart and lead.

Vessels entering Cadiz harbour by the north-east channel, or between the Galera shoal and Santa Catalina castle, should steer with Puerto Real church steeple in line with the southern hummock of Marrucco hill, until St. Domingo steeple in Cadiz is well open eastward of Phillip point, when a vessel will be within the shoals. If turning in, do not open any part of Marrucco hill north or south of Puerto Real.

STRAIT OF GIBRALTAR.—General Directions.—In sailing from the westward for the Strait of Gibraltar, the mariner cannot fail to be struck with the appearance of the rival mountains of Europe and Africa, vieing with each other in grandeur and sublimity; the singular appearance of the almost insulated rock jutting out into the sea; the narrow passage at the entrance can scarcely fail of giving the idea of the waters of the Atlantic having forced their way in spite of every obstacle which nature opposed to them,—and all enlivened by a brilliant sun and a tint of colouring peculiar to southern latitudes,—constitute a panorama of inimitable scenery, of which it is impossible to form any just idea but from actual inspection.

Vessels bound to Gibraltar from the westward, and having passed the Cabezos and shoals, should haul in for the Spanish coast, especially if the wind be northward of West, otherwise the current may carry them eastward of the rock. When the town of San Roque appears well open eastward of the rocks off cape Carnero, they may haul in for the bay, giving the rocks off the cape a good berth. Having run up the bay so far as to open the Devil's tower, which stands at the north end of Gibraltar, steer for it, and anchor in what depth is deemed preferable, mooring S.E. and N.W. so as to have an open hawse with a S.W. wind.

In coming from the westward, and bound up the Mediterranean, the best anchorage will be from abreast of the northern part of Algesiras on towards the river Palmones; you will then be able, with a westerly wind, to clear Europa point. In winter time the best station is from the Palmones to fort Mirador, for there you will be sheltered from S.E. winds, which are considered the most dangerous of any; and if you are between the bridge and Algesiras, moor N.E. and S.W. with two cables on the N.E. anchor; but if between the bridge and Gibraltar, moor N.W. and S.W. with two cables on the S.W. anchor: for there the S.W. winds are the most dangerous: but if unable to get to either of these stations, and the wind within the bay differs from that without, then come-to in that situation most convenient for running out with the wind you are desirous of.

Should you happen to be carried by the current eastward of the rock of Gibraltar you may obtain good anchorage in 20 fathoms water, having the Carnero and Europa points in one, and the Devil's tower just open: there are gradual soundings towards the rock, shoaling to 4 fathoms. From this anchorage, you may, by taking the western tide, turn into Gibraltar bay, only by standing a very little way off Europa point. You will readily perceive the ripple between the current and the tide; and when you think you will be able to weather the point, it is not advisable to stand direct into the bay, but make a short tack or two in the tide that sets from Europa to Carnero point: otherwise you may get into the eddy-tide, which will take you on the weather bow, and disappoint and deceive you.

Captain G. H. P. White, R.N., gives the following directions for this Strait:—

Beating from Tangier to Gibraltar, wind blowing hard from the eastward.— To perform this, a ship should get under weigh at the last quarter-flood, and stand across to Tarifa, or as far northward as the wind will allow. By the time she has arrived off Tarifa, she will get the ebb-tide, which, if strong, will, more than likely, carry her into Gibraltar in three or four tacks. Remember, when working, particularly to the westward, to make very short tacks, keeping very close to the land on the in-shore one.

When intending to anchor off the New mole, with the wind at East, a ship should keep Europa point close on board, and be put under snug but commanding sail, as it will be necessary to brace round at a moment's notice, taking special care to keep as close to the rock as possible. If this be not attended to, it will be more probable that she will be some hours beating about to gain the anchorage. Topsails, jib, and spanker, are the most convenient sails to be under; but it will greatly depend on the tide; for the flood sets from Europa to Cabrita—in fact, sweeping the shores of the bay; therefore, if, with a flood-tide, it be possible to keep her head towards the Mole with the fore-and-aft-sails, particularly in a large ship, it would be advisable, as she would then drift into her anchorage without the disagreeable necessity of bracing round every minute to the flaws and puffs, which are extremely violent in a strong Levanter.

Should it be ebb-tide on approaching Europa point, and the wind at all to the northward of East, carry all convenient sail, working over on the western or Algesiras side of the bay, where the merchant vessels usually anchor; you may then shorten sail, and run down under topsails to the new mole."

It has been remarked by MAJOR RENNEL, that "Navigators who depart from the parallel of the southern part of the Bay of Biscay (say 45°), and sail in the usual track southward, will be assailed first by a S.E. current, and then by an easterly one until they have passed the parallel of cape Finisterre; when the current will again turn to the south of East, and gradually become a S.E. current, till having passed cape San Vicente, it becomes easterly again, owing no doubt, to the indraught of the Strait of Gibraltar; and this easterly current is pretty general across the mouth of the bay, between capes San Vicente and Cantin.

Beyond this bay (which may be termed the funnel, of which the strait itself is the spout), the current again becomes S.E. or rather more southerly (as it is more easterly towards cape Finisterre), and continues as far as the parallel of 25°, and is moreover felt beyond Madeira westward, that is, at least 130 leagues from the coast of Africa; beyond which a S.W. current takes place, owing, doubtless, to the operation of the N.E. trade wind.

The rate or motion of this current varies very considerably at different times, that is, from 12 to 20 or more miles in the 24 hours. I consider 16 as below the mean rate. I have an example of 140 miles in 8 days, in one of H.M. ships,—equal to 17½ miles per day,—and in another of only 12. The direction of the stream also varies, but commonly more towards the South than the East, after passing the mouth of the strait.

Near the coasts of Spain and Portugal, commonly called the Wall, the current is always very much southerly, owing perhaps to the falling in obliquely on the shore of the great mass of water brought by the S.E. current, which can run off only towards the south, and round Cape San Vicente towards the Strait's mouth."

It has also been observed by a correspondent of the *Nautical Magazine*, vol. 8 (new series), page 616, that "the currents and eddies on the coasts of Spain and Portugal are so precarious, that from cape San Vicente, the same course steered will sometimes take a ship to San Lucar, at others to cape Trafalgar. The same error will often be found in a course N.W. by W. from Cadiz, sometimes taking a ship on shore on cape Santa Maria, at another giving her a great offing from cape San Vicente. This navigation is perhaps rendered even more uncertain still with a north wind, and the current coming down the west coast of Portugal. It cannot turn suddenly round cape San Vicente, and must clearly leave the south coast in a state of eddy. The unaccountable losses which are not unfrequent between cape San Vicente and Tarifa may be placed to this cause, which has further been aided in its uncertain nature by the absence of all knowledge of the tides, no one even pretending, as we are informed, to understand anything about them.

On the southern coast of the Strait of Gibraltar, from cape Spartel to Sierra Bullones, another tide runs along shore to the westward, as shown on the charts.

In the middle of the Strait, the current from the Atlantic Ocean generally sets in to the eastward. This is supposed to be occasioned by the great and continual evaporation constantly going on from the surface of the Mediterranean sea, the intermediate rivers not affording a supply sufficient to restore the exhaustion; while also under-currents have been conjectured to return a great portion of these waters into the Atlantic back again; and the changes, counter-currents, and whirlpools, which take place near the shores, caused by varying winds, contribute to restore and keep up the equilibrium. However this may be, it is ascertained, as before stated, that there actually is a tide setting both outward and inward, along each shore: that from beyond the vicinity of Malaga, the flood sets round the coast in a westerly direction towards Gibraltar, and thence along the coast of Spain, until it meets that which comes from the West off cape Trafalgar; and that a similar current, in a similar direction, sets along the African shore, until it passes cape Spartel, and is lost in the Atlantic Ocean.

But, although it has hitherto been asserted that the central stream invariably and unremittingly runs eastward, very rarely, if ever, standing still, yet there is reason to believe that this is not strictly the fact, but that a current is sometimes to be found running outward to the west, occasioned perhaps by an extraordinary tide, a surcharge of water in the Mediterranean, or the prevalence and continuance of an easterly wind, or a union of all these circumstances together. This opinion seems to be strongly corroborated by the observations of several modern navigators; for Captain Malling, of H.M.S. *Cambridge*, says he is one of those persons who can bear testimony to the current running out of the strait with much greater velocity than ever he found it running into the Mediterranean. And Captain Livingstone, in 1822, observed the general current in the strait ran westward, instead of eastward, for some hours, all across the strait, several vessels at this time being carried right out to the westward; and some of them drifted in the centre of the strait, from abreast of Tarifa, to nearly so far as to be opposite cape Spartel.

That under-currents do exist, and run in a direction opposite to the course of the surface, seems generally admitted, and in a great measure confirmed by the following circumstances. A vessel, some years ago, was lost at Ceuta, and afterwards thrown up at Tarifa, on the European shore, a distance of 17 miles to the W.N.W.; and in 1712, the *Phœnix*, of Marseilles, gave chase to a Dutch vessel near Ceuta point, and came up with her in the middle of the strait, between Tarifa and Tangier, where, giving her a broadside, she sank; a few days after, the sunken vessel arose on the shore near Tangier, at least 4 leagues westward of the place where she went down, and directly in opposition to the common surface-current; now this could only be occasioned by a re-currency, or returning current in the deep water, in the middle of the strait, that sets outward to the Atlantic Ocean. CAPTAIN BARRET states that in 1820, when he was off Tangier bay, he felt the current set, for about three hours, decidedly westward, and that, while the water at the surface was going apparently eastward, a westerly current had hold of the bottom of the ship. A London ship, when at anchor at Tarifa, found the tide running at the rate of 5½ knots; and CAPTAIN WALKER says, he has been obliged to have a man at the wheel, steering his vessel for the tide, when at anchor under cape Spartel.

A recent writer, speaking of this under-current, states that the Mediterranean sea is said to be rather salter than the waters of the Atlantic Ocean. That it is not more so, is ascribed to an under-current salter than that of the ocean, which runs out of the strait and unloads the waters of their excess of salt.

From the above it will appear that the current of the strait of Gibraltar is in some measure regulated by the tides, and that its velocity will, according to the tide, vary from 8 to 6 and 7 miles an hour. Westward of Tarifa, about the full and change of the moon, it sometimes sets westward quite across the strait; but eastward of Tarifa it sets, more or less, eastward. Mr. REINER, pilot of Gibraltar, says, that with westerly winds, the current in the middle of the strait, between Europa point and Ceuta, will often equal the rapidity of 7 miles an hour, and that at such times every point in the bay will form an eddy or whirlpool at a considerable distance from the land, which may prove dangerous to approach.

THE COAST OF AFRICA.

CAPE SPARTEL TO THE EQUATOR.

General Remarks.—The West Coast of Africa extends north and south of the Equator, through 70° of latitude, that is, taking as its limits cape Spartel on the north and the cape of Good Hope on the south, from lat. 35° 47′ N. to 34° 21′ S., and has a length, exclusive of the few indentations, of about 5800 miles. Except, perhaps, in Senegambia and the bight of Biafra, throughout its whole extent it is singularly devoid of extensive peninsulas, islands, bays (properly so called), broad and deep estuaries, or large and navigable rivers. There is likewise a comparative freedom from outlying banks and rocks, and an absence of variety in the appearance of the land—its general aspect being low, sandy, and desert-like; there are, however, a few exceptions to this, in the shape of cliffs, prominent capes, and verdant hills, which are of material assistance in determining a ship's position. As a general rule, also, the shores are approachable by the lead, the soundings decreasing gradually towards them.

The coast from cape Spartel to the Equator may be considered as trending in five principal directions, as follows:—

From cape Spartel, in lat. 35° 47′ N., long. 5° 54′ 30″ W., to cape Barbas, in lat. 22° 20′ N., long. 16° 45′ W., nearly S.W. by W. (S.W. by S. *true*) about 1000 miles.

From cape Barbas to cape Verde, the western extreme of Africa, in lat. 14° 43′ 30″ N., and long. 17° 33′ W., S.S.W. (S. ¼ W.) 460 miles.

From cape Verde to cape Palmas, in lat. 4° 23′ 30″ N., long. 7° 42′ W., S.S.E. (S.E. ¾ S.) 860 miles.

From cape Palmas to Mt. Cameroons, in lat. 4° 13′ N., long. 9° 12′ E., E.S.E. (East) 1000 miles.

From Mt. Cameroons to cape Lopez, in 0° 36′ S., long. 8° 43′ E., S.S.W. ½ W. (S. ½ W.) 300 miles.

The following are the principal sub-divisions of the coast among the various people and tribes inhabiting the western part of North Africa; and among several of these European nations have long had settlements established either for the purpose of trade, or for the introduction of civilization and christianity.

MAROCCO.—The N.W. coast of Africa from the confines of Algeria to the river Draa or Draha, with the exception of Tetuan, Ceuta, &c., belongs to the empire of Marocco; south-westward of cape Spartel, the places of most importance are El Araish, Slá or Sali, Rabat, Mazaghan, Safi or Asafi, and Mogador.

SAHARA.—The coast from the river Draa to Portendik forms the western boundary of Sahara or the Great Desert, and throughout its whole extent there is not a single harbour or place of the slightest importance,—indeed, nothing but a succession of sand-stone cliffs, sand hills, and sandy beaches.

SENEGAMBIA extends from Portendik to Shebar river in lat. 7° 22′ N., long. 12° 33′ W.; besides a great number of small native states, peopled by various tribes, there are the settlements of the French, British and Portuguese situated on the coast, and on the rivers Senegal, Gambia, Jeba and Rokelle; these are distributed as follows:—

I. **French Senegambia or Senegal.**—The chief French establishments are 1. On the Senegal river, the island and town of St. Louis, the military ports of Richard Tall and Dagana, and forts Bakel and Podor; 2. The small island of Goree on the coast; 3. The station of Sedhiou on the Casamanza river; and 4. Portendik in Lat. 18° 17′ N.

II. **British Senegambia** including 1. GAMBIA, a settlement occupying the banks of the river of that name as far up as Barraconda; it contains an area of 20 square miles, and the seat of government is at Bathurst,—and 2. Sierra Leone, a colony containing 468 square miles, and a population of 41,800 persons, with the seat of government at Freetown.

III. **Portuguese Senegambia** consists of Bissao island and town at the mouth of the Jeba river.

Within the extent of coast mentioned above are included several large and important rivers.

GUINEA, is a term applied to an immense region of Western Africa extending along both sides of the gulf of that name from the eastern frontier of Sierra Leone to cape Negro. It consists of two great divisions viz., UPPER GUINEA in the north, between the Kong mountains and the gulf of Guinea; and Lower Guinea in the south, extending from the former to cape Negro.

The political divisions of Guinea are fluctuating both in number and extent owing to the barbarism of the people, but the following are the principal.

UPPER GUINEA, contains Liberia, the Gold Coast, Ashantee, Dahomey, Yarriba, Benin, Eggarah and Old Calabar.

LOWER GUINEA contains Biafra, Loango, Congo, Angola and Benguela.

The coast of Upper Guinea is also subdivided into the Grain Coast (so named from its producing the malaghetta, a species of pepper), the Ivory Coast, the Gold Coast, and the Slave Coast. The first extending from Shebar river to the river San Pedro; the second, so called from the quantity of ivory produced by its numerous elephants, from cape Palmas to the Assine river; the third, formerly much frequented by Europeans for gold and slaves, from the Assine river to the Volta; and the fourth from the river Volta to Cameroon mountain.

GOLD COAST.—The principal European establishments on this coast are Accra, Axim, Cape Coast castle, Dixcove, Elmina and Lagos. Cape Coast castle is the chief town and seat of government of the British settlements; and Elmina of the Dutch possessions.

LIBERIA, now included between the meridians of 12° 20′ and 6° 40′ W., contains Gallinas and Cape Mount rivers; the town of Monrovia, the settlements of Marshall, Little Bassa, Middle Bassa, Edina, Grand Bassa, Tobocannee, Young Sesters, Trade Town, Little Culloh, Errick, Grand Culloh, Tembo, Cestos, Rock Cess point, River Sangwin, Little Booton, Grand Booton, Sinou, Little and Settra Krou, King Willis Town, Subono, Baddoo, Katoo, Grand Sesters, Garraway, Fish Town, Harper, Tabou, Bereby, &c.

The Ivory Coast.—Along that portion of the Ivory Coast lying between the river San Pedro and long. 5° W., are situated Drewin, King George Town, and Lahou.

ASHANTEE.—That portion of the coast usually comprised within the kingdom of Ashantee extends from Grand Lahou to the river Volta, that is, from 5° W. to 0° 40′ E., and includes Grand Ivory Town, Grand Bassam, Apollonia, Axim, Dixcove, St. George del Mina, Cape Coast Castle, Anamaboo, Accra, and Fredensborg.

DAHOMEY is supposed to extend from the river Volta to the river Lagos. Here are the towns, villages, and trading places named Quitta, Fish Town, Popo, Whydah, Badagry, and Lagos.

BENIN comprises the coast from the river Lagos to the old Calabar river, between which limits are the rivers Benin, Forcados, Niger, New Calabar, Bonny, &c.

BIAFRA.—The coast of Biafra extends hence to cape Lopez. The principal places are mount and river Cameroons, Binabia, river Gaboon, and the islands Fernando Po, Princes, St. Thomas, and Anno Bon.

Winds and climate;—*see* Chap. VII p.p. 68 to 80.

Currents.—The Polar African Current may be considered as commencing abreast Portugal and the Azores, and to consist of the eastern and south-eastern off-set of the gulf stream amalgamated with the sub-arctic current by an assimilation of temperature, &c. Between capes St. Vicente and Cantin, the entire mass of water, as far as 18° W., flows south-eastward and north-eastward into the Strait of Gibraltar. From the latter cape to cape Bojador, between Madeira and the Canaries, it is directed more easterly and S.E.; but it does not extend in this part and in this direction more than 150 or 180 miles from the coast. Further out to sea its direction is south and S.S.W. From the Canaries to cape Verde its direction is generally between south and S.S.W., and afterwards more westerly towards the Caribbean Sea. A portion of it unites with the Guinea current, and flows southward and eastward, following the African coast, towards cape Palmas, &c.

The western limit of the Polar African current, near cape Verde, is between the island of Sal and that of San Nicolas; afterwards between the island of Mayo and that of San Jago, in the cape Verde group. Its direction is from south to S.W. nearly all throughout its course hereabout.

The velocity of this current varies from 10 to 16 miles per day, and its temperature as far as the cape Verde islands is 8° below that of the waters of the ocean; this difference of temperature is greater northward of those islands, and becomes rapidly less in proportion as the current proceeds southward. See also page 197.

The African or Guinea Current has its origin in the Polar African current; its temperature is raised by a current which flows easterly between the drift of the N.E. Trade-wind and the great equatorial current on either side of it, and mingles with the Polar African current abreast of the coast about Sierra Leone and the coast of Liberia. These unitedly follow the trend of the coast to the south-eastward. Off cape Mesurado the direction of this current is E.S.E.—and even east out at sea; while at a little distance from the coast it is S.E. as far as cape Palmas. Off this cape at sea it runs easterly, and then about E.S.E. towards the gulfs of Benin and Biafra. It there meets with the equatorial current, with which its waters mingle after reaching the vicinity of Prince's and Annabon islands, and they afterwards set to the S.W., W.N.W., and N.W. in one expanding and united stream, which greatly facilitates the passage of ships from Fernando Po to Sierra Leone. See also p. 215-216.

Refraction.—Com. T. Boteler, who surveyed a considerable portion of the coast of Senegal and Senegambia in the year 1829, says, "Navigators should constantly bear in mind that the extraordinary refraction produced by the heated atmosphere along this whole coast is a continued source of error not only in their latitudes but in their chronometic longitudes; and one against which they can make no provision, as the altitudes of the sun are as often found to be too little as too great. Their only resource will be by checking the observations made in the day by altitudes taken at night of the stars and planets. And not only is the seaman thus puzzled in making his land-fall, or in recognising a headland, by means of the latitude, but he is exposed by the same cause to another very serious deception; for this violent and ever varying refraction, sometimes amounting almost to a mirage, renders it impossible to make a correct estimate of the distance of the land. In this case he may indeed have recourse to the lead, as a considerable breadth of bank extends from most parts of Western Africa; or, when any length of coast is in sight, cross bearings will afford an immediate solution of his doubts: and in certain situations, the change of bearing at each end of a short distance measured by the log, will give a close approximation to the real distance. Still he should be on his guard against this species of fallacy, for at times the distant shore will be raised up and brought alarmingly close to the vessel; and at others, the really near land will appear sunk and removed to such a distance as to impose upon the most practised and experienced eye.

General Directions.—Having doubled cape Finisterre at a distance of from 100 to 180 miles, according to the season of the year, a vessel should steer between south and S.W., giving the coast of Portugal a wide berth, particularly in winter, in order to sight the island of Madeira, or to reach the Canaries, which are always sighted by vessels on their passage to the west coast of Africa.

In the passage from the *Bay of Biscay to the Canaries* vessels will frequently find differences in their reckoning to the eastward, which arise most probably frem the set of the currents toward that bay and the Strait of Gibraltar; these influences must be seriously considered, or they may lead to such unfortunate results as many ships have experienced ere they have arrived so far as capes Bojador or Noun. Through their effects some have made the land on the coast of Africa, when they expected to have discovered Tenerife; others have gained sight of Allegranza, off the northern part of Lanzarote, instead of Tenerife; and, though the errors in reckoning may not frequently be so considerable, yet it is safer to be on the look-out, when, from the reckoning, it is considered that the vessel is in the latitudes of these islands, especially in the night time, or when the want of moonlight, or thick and hazy weather, prevents the discovery of dangers at such a distance as to be able to escape them.

The *Canaries* may be passed on either side, the channel between them and the African coast presenting no danger which is not apparent. If it is desirable to pass through them, the préferable channel is that between Palma and Hiero on the west, and Gomera on the east. It is rarely after having passed to the southward by the other channels that calms are not met with, along with a swell which endangers the masts, under the lee of the large islands of the archipélago. This is especially the case with the wind from the North and N.E., which, interrupted by them, does not re-unite in a steady course till far to the southward. In November and December it is preferable in bad weather to pass clear away to the westward of these islands in case of meeting the S.E. winds, which are frequent at that time.

In fact, ships are now generally recommended to pass westward of the Canary and Cape Verde islands; it having been found that, in this route, steadier winds may be expected than those generally prevalent close to or among the islands. On the African coast, W.S.W. and S.W. winds are frequent.

For those desirous of touching at the Canaries, instructions will be found on pages 317 to 334.

Should it be required to touch at St. Louis or Goree, vessels should steer so as to make the coast of Africa near to and northward of cape Blanco (Lat. 20° 46½' N.), as there are soundings at 15 or 18 miles off shore, and no danger in making the land, either by day or night, provided the lead be kept frequently going. Steer then S.W. or S.W. by S., and having passed the parallel of 19° at the southern extremity of the bank of Arguin, haul gradually to the eastward, when the effects of the Polar African current will be to keep the vessel in the proper course.

St. Louis should be made a little northward of its latitude. At about 30 miles from the shore northward of the Senegal the depth is 70 fathoms, bottom of white sand. Thence the depth gradually decreases toward the shore, and at one mile from it there are 7 or 8 fathoms. If at night and in 15 fathoms of water, it is advisable to anchor till daylight, to avoid running past the bar.

There is a source of error connected with the navigation of the African coast which must be carefully guarded against, viz., the optical illusion caused by the great horizontal refraction, which renders any correct estimation of distance almost impossible. Therefore, the moment the coast is discerned, the lead only should be trusted to determine the distance from it. See page 499.

From abreast the bar of the Senegal the course to pass outside cape Verde, during the day, is S.W. by W. ½ W., and at night-time a little more westerly. From cape Verde to Goree the course is direct, that is, merely to coast the shore at the distance of about 2 miles. From Goree to the mouth of the Gambia steer S. ½ E., and use the lead frequently.

If not intending to touch at the Senegal or Goree, after passing the Canaries, steer so as to leave cape Blanco about 45 leagues to the eastward, and thence so as to keep rather nearer to cape Verde than to cape Verde islands. When bound to places south of Goree, such as the Gambia or Sierra Leone, or even to the coast of Liberia, the route as far as cape Verde will be the same; for a vessel must generally pass it unless leaving the cape Verde islands. In all cases should a ship not touch at those islands it is best to steer in such a manner as to pass nearer to cape Verde than to the islands, for the wind is steadier and fresher on the coast. From cape Verde the navigation depends on circumstances, being comparatively easy with N.E. winds in the dry season, but difficult with the S.W. winds of the wet season.

Ships passing *westward of San Antonio* have to gain easting in that tract of sea which, lying contiguous to the southern limit of the N.E. Trade-wind, is so often disturbed by calms, squalls, thunder, lightning, and heavy rain. Again, the making of these islands is often difficult, occasioned by the fogs which frequently hang around them.

When the sun is near the tropic of Cancer, the Trade-wind has often been found to fail within sight of the cape Verde islands. At these times, therefore, ships sailing outside them have been recommended to pass about 30 miles to the westward of San Antonio, in order to preserve a steady wind. When southward of these islands steer S.E., so as to get between the meridians of 18° and 23° W., upon losing the N.E. Trade-wind.

Passing inside the Cape Verde Isles, and having sighted Bonavista, in the months from June to September inclusive, vessels should not be to anxious to make easting; for they will lose the Trade-wind soon after passing the parallel of the island of Santiago, and, after a short interval of calm, fall in with the S.W. wind and its usual companions—heavy squalls and rain. As vessels progress to the southward and eastward, the S.W. winds generally become variable to the westward, and the squalls less frequent.

Bound eastward of Sierra Leone in June, July, August, and September, when the winds blow from S.W., W.S.W., West, and W.N.W., interrupted by calms, it is advisable to give the coast between that town and cape Palmas a berth of 50 or 100 leagues, for the sea sets in so heavily upon it, that making southing when near the land is then attended with much difficulty, and the dangerous shoals of St. Ann cause considerable apprehension.

Between October and May, when the winds are more favourable, the weather fine and the nights cool, serene, and clear, a more direct course from the cape Verdes may be pursued. While within the influence of the Trades, the wind will generally be found steady from N.E. and N.N.E., and the sea smooth. Occasionally, however, tornadoes will be experienced, which, in the neighbourhood of cape Verga and Sierra Leone, blow with terrible fury.

Shape a course now for *Cape Palmas* according to the season. At the distance of 50 or 60 miles seaward of this cape, vessels will find the Guinea current setting to the East and E.N.E. After reaching the parallel of cape Palmas in the months of June to October, they will experience the Trade-wind from S.W. and W.S.W.; winds with a current will then be found favourable for reaching any of the ports of the coast of Guinea. But it should be observed that in these routes vessels should not get further south than 2½° N. lat., in order not to get into the Equatorial Current which sets to the westward. Therefore, when the parallel of cape Palmas is reached, and the cape sighted, vessels bound to any place in the gulf of Guinea should keep in a zone comprised between 2½° N. and the coast of Guinea.

Unless deemed imprudent through adverse winds or other circumstances, the best method by which to navigate this coast is to keep the land in sight, at about the distance of 10 or 16 miles, and to approach it within about 2 or 3 miles, when 30 or 40 miles westward of the port of destination, taking great care not to run beyond it. In estimating the route it is very necessary to consider the velocity of the current, which runs from 20 to 24 miles per day, and sometimes more.

Bound to Fernando Po, St. Thomas, &c., vessels having doubled cape Palmas should steer about East, keeping between 2½° and 4° N. as long as possible according to the place of destination, and then steer obliquely across the zone comprised within 2½° N. and the equator, keeping before the wind so as to make the land to the southward of the port. In the vicinity of the islands in the gulf of Biafra the South Guinea current is met with, setting to the N.E., N.W., and sometimes North. It is therefore necessary, when bound for the Gaboon, generally to make the land southward of that river.

From the Bight of Biafra to Sierra Leone.—The most favourable season for leaving the gulf of Guinea is from May to December. Vessels are then seldom obliged to cross the line; the S.E. winds are generally well-established at this period, and reach beyond the Equator, but from December to May it is better to cross the Equator, and to proceed westward on the parallel of 0° 30′ or 1° S. The general rule, however, is to endeavour to reach the Equator by the most direct route. Continue then westward to 15°, 16°, 17°, or 23° W. long., according to the place of destination.

Mr. J. Finlaison gave the following instructions for the above object:—

"Ships bound from the bight of Biafra to Sierra Leone, if from Calabar river, when the wind does not permit them to proceed by the N.W. of Fernando Po, may pass between that island and Cameroons river, when they will find a strong current setting southward, apparently out of the river del Rey. After they have advanced southward of Fernando Po, they must endeavour to make all the southing and westing they can; passing either eastward or northward of Prince's island, as the winds will permit.

Having arrived southward of Prince's island, if the ship will lie no higher than W.N.W., tack immediately, and try to cross the line; for, by so doing, you will keep out of the strong N.E. current which sets towards the bights of Benin and Biafra. After you have crossed the line, you will find that you are nearly out of the easterly current.

In the parallel of 1° S. you will find the current set to the westward. As you make westing, the wind will be found to haul more to the southward and eastward, and the current to increase in velocity until you arrive as far westward as 15° W.

On proceeding hence to Sierra Leone, come no further eastward than 15° W. until you are as far northward as 8° 30′ N.; then you may steer boldly in for the cape."

If returning to Europe, it will be better to prolong the western course, and leave the Equator in about 23° W., and then make to the northward. Should N.W. and west winds be found near the Equator, which is often the case during winter from May to September, vessels may then cross it in 17° or 18° W., and pass between the cape Verde isles and the coast of Africa. Northward of those islands the N.E. trade will be met with, which will enable them to proceed on the starboard tack.

Leaving one place in the Gulf of Guinea for another further westward, vessels should stand out on the starboard tack until clear of the Guinea current and within the limits of the Equatorial stream; and according to the time of year, they may cross the Equator to the southward for southerly winds. They may then get on the port tack so as to reach well to westward of the port bound to, in order to allow for the effect of the Guinea current, which will be found in about Lat. 2½° N. If it is impossible to make it on this tack they must go about in this Lat., and stand out again on the starboard tack till sufficiently far to the west to be sure of reaching the coast westward of the required port.

If returning to any port more to the northward, such as Bathurst, Goree, or St. Louis, a northerly course should be taken in 16° or 17° W., and a course made good between the meridians of 22° and 28° W., in order to avoid entering the Polar African current until the parallel of the Bissagos is reached. This last course will be especially favourable from May to September.

"*The voyage hence homewards*," says Baron Roussin, "presents no difficulty and calls for no other precautions than those commonly used by all navigators in long voyages on seas void of dangers. These precautions are, not to trifle with the wind, but rather to make a good run in a given time, than to endeavour to make good the proposed course. In all return voyages from places within the tropics, the grand point is to leave the region of the Trade-winds, and get into the variables, and the currents setting to the eastward, as soon as possible. As the winds generally blow from East to N.W. on the coast of Africa, from the month of December to the end of June, a vessel should keep on the starboard tack until out of their influence. The course made good will be about N.W., and you will then be in the neighbourhood of the Azores. It is immaterial whether she passes westward or through the channels of these islands, but it is remarked that the winds are stronger to the westward. It is seldom possible to pass eastward of them. The distance no doubt would be shortened, but this passage can only be effected by keeping close to the wind thus far; and experience has proved that there is little to be gained from that.

Between June and October, after the squalls from the S.E., the wind occasionally veers round to the west, on the coast near the Senegal; and sometimes it is possible to get within sight of cape Mirik by means of this wind, and by keeping along shore on the port tack."

MAROCCO.—That portion of this empire bounded by the Atlantic extends from cape Spartel to the river Noun, as already mentioned in page 356. This part of the African coast is comparatively straight, and so clean that it may be approached to within 1½ or 2 miles in any part whenever such a proceeding is necessary and rendered safe by the influence of winds and currents. At the distance of 12 miles from the shore the soundings range from 100 to 80 and 50 fathoms, and thence decreases pretty regularly towards the land. Throughout its whole extent the general characteristic of the coast is that of barenness; there are here and there several lines of cliffs, but more frequently low sand hills with many patches of rock intermixed with the sand. Inland are some more elevated hills, and further still in places are situated some mountains, the altitudes of whose peaks vary from 2000 to 4400 feet, and serve as prominent distinguishing marks. There are but few places capable of affording shelter to vessels, the whole coast being open and exposed to fully half the compass.*

CURRENTS.—The silent and imperceptible influence of the easterly and south-easterly drift of the current between capes St. Vicente (Portugal) and Cantin, has given rise to many fatal errors in reckoning and judgment; and though happily the wrecks on the coast of Marocco and the Sahara dessert are now not so numerous as formerly, still the cause remains as powerful as ever, and it behoves the masters of vessels always to be on their guard to counteract it, and all caution is most earnestly impressed on their attention.

That excellent authority upon the Ocean currents, the late MAJOR RENNELL, has the following observations on this drift:—

"It must be expected that a ship sailing in the usual track to Madeira or the Canaries, will be carried to the south-eastward, at the rate of 16 miles per day—that is, even if she has a fair wind, she will be carried by the current 150 or 160 miles to the south-eastward, in the course of her voyage to Madeira or the Canaries; and, consequently, on a S.E. by S. course will be carried 80 or 90 miles eastward of her intended port. If we suppose a S.E. course, the error in easting will be no less than 109 miles; which distance, if they are bound to Tenerife, would carry them to Allegranza or Fuerteventura; and if intending to make Allegranza, would place them on shore on the coast of Marocco. It must

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* Mr. E. W. DRUMMOND HAY, H.M. Consul at Tangiers, issued the following notice in 1843:—

"In consequence of several boats' crews having landed lately, from shipping of various nations on the open coast of Marocco, or West Barbary, in search, it is supposed, of water or other provisions, the Moorish authorities are desirous that all persons be cautioned that it is not only against the laws of this land, and against the sanatory regulations, to land on any part of this coast, in places where there is not a port for their reception, but that, in consequence of the strict injunctions given to the people of this country by their Government to prevent any persons whatever setting foot on land, or approaching near to it on the open coast, the lives of those who infringe the laws in such respect are exposed to danger.

I therefore feel it my duty to give all the publicity I can to this notice, for warning all commanders or masters of vessels, and especially those navigating under the flags either of the United Kingdom of Great Britian and Ireland, or of the Kingdom of Hanover, or of the Hanseatic Republics of Lubec, Bremen, and Hamburg, not to venture, upon any account, to land, or to allow any person under their care or orders to land or approach within musket-shot of the coast of Marocco or West Barbary, excepting within the harbours of any of the well-known ports of this country.

be added that, if a ship had a long voyage, the error would be greater in proportion, and might possibly amount to 200 miles of easting.

It would seem advisable, therefore, that every ship going to the Canaries, or intending to sail between those islands and the main land of Africa, should, to every day's reckoning, add 10 miles of easting.

From cape Spartel to Arzila, along the coast, and likewise to a distance of 7 or 8 miles in the offing, a regular tide has been experienced, running parallel to the shore; but its velocity was rather greater to the northward than to the southward. In this distance, at 15 miles from the land, no current has been perceived.

From Arzila, towards the south, the current appeared gradually to diminish in force till it was lost altogether. From the lat. of 34½° N., to the distance of 20 miles off shore, a steady southerly current has been found, which continues without variation to follow the direction of the land, its rate ranging from $\frac{4}{10}$ to 1 mile per hour, according to the strength or duration of the north-easterly winds.

At Mogador the current in-shore is said sometimes to set to the northward; but in the offing always to the south-westward.

Abreast Agadir or Santa Cruz the current is not felt till at the distance of 6 or 7 miles from the land, being deflected by the projection of cape Ghir or Ras Aferni.

For Mogador, south-westward, the current runs in the direction of the coast, namely, to the southward and westward, insomuch that its course may be safely inferred from the bends of the shore. Its greatest velocity is usually at the distance of from 3 to 6 miles in the offing, gradually decreasing both inwards and outwards. The average rate is from ½ to ¾ of a mile in the hour.

From a description of the currents further off the coast see page 197-198. See "Coast of Marocco," page 78, for a description of the winds.

This coast was surveyed in 1835 by Lieut. W. Arlett in H.M.S. *Ætna*, and Lieut. H. Kellett, in the cutter *Raven*, during the months from March to August; and upon their charts and observations the accompanying description is principally based.

General Description of the Coast.—The west coast of Marocco admits of a division into about ten sections, according to the direction in which the land trends. The first, from cape Spartel to El Araish, a distance of 36 miles, trends S.W. ¾ S., and with the exception of a few rocky projections, presents a clean sandy beach with a line of low hills, which, from the distance of ½ a mile inland, slope gradually to the beach. About 12 miles beyond Arzila there is a range of very conspicuous mountains, the loftiest of which (Jebel Habib), is about 3000 feet above the level of the sea, with another of less elevation (2200 feet) 6 miles northward of it, named Raven mountain. At 4 miles southward of Arzila the outer hills rise to an altitude of perhaps 700 feet, and at 8 miles from it in the same direction is a patch of white cliff (Haffat-el-Beida) 300 feet high, presenting in all directions the form of a wedge.

When sailing along this coast, care must be taken not to advance too near, unless a strong easterly wind is blowing; for even in calm weather there is sometimes a heavy swell from the west or N.W., which renders it difficult to get off shore. This remark applies to the Marocco coast generally.

The bank of soundings with 98 fathoms at its edge extends but 8 miles outside cape Spartel. Immediately southward of that cape it rapidly increases in breadth to about 17 miles, and then the 100 fathoms' line continues nearly parallel to the shore to El Araish. On this bank there is a clean tough sandy anchorage, in *Jeremias Bay*, at 2 or 3 miles from the beach southward of cape Spartel. Vessels frequently anchor here, in from 28 to 35 fathoms, during the fiery *levanters* which sweep through Gibraltar strait. Further out there is a ridge of foul ground, with only 25 fathoms; this must be avoided.

Cape Spartel, the south point of the western entrance of the strait of Gibraltar, rises to the height of 1043 feet above the sea.* It may be seen 15 or 18 miles off in clear weather, when it appears as an island, but as it is approached it assumes an uneven appearance, showing several eminences like hummocks. The largest vessel may approach it within a mile, there being no danger but what is visible.

ARZILA is 19 miles southward of cape Spartel, and 17 miles northward of El Araish. On the north side of this town stands the ruins of a castle, and under the southern angle of that portion of its wall which fronts the sea is situated a whitewashed tomb. The country in the neighbourhood is well wooded, and a large portion is laid out in gardens. Good anchorage may be had in 15 fathoms, bottom of sand and small shells, at 1½ miles from the shore, with the town of Arzila bearing S. by W. ¾ W. 5 miles.

EL ARAISH is situated on the steep southern point of the mouth of the river Wad El Khos (or Luccos), and when viewed from sea has an imposing appearance, a large castle on the summit of a hill, a lofty mosque, and several towers standing out prominently, but upon a nearer approach this appearance soon vanishes. Vessels intending to enter the river, anchor in 12 fathoms, sandy bottom, at a mile from its mouth, with a distant conical peak (Jebel Sarsar) appearing in the centre of the entrance. At low water the entrance is very narrow, and at that time there are only 5 or 6 feet over the bar. Inside the depth increases to 4 fathoms. To enter the river bring the south point of the entrance to bear E. ½ N., steer in on this bearing till across the bar, then passing the point as close as possible, get into the midchannel till abreast the pier. Here the river bends abruptly to the northward, in which bend vessels moor.

The next section of the coast, namely, from El Araish to Rabat and Slà, trends S.W. a distance of 77 miles. The first 10 miles of this portion is composed of reddish cliffs, which are succeeded by sand hills partly covered with brushwood.

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* The lighthouse on this cape is 79 feet high; it shows a *fixed* light at 312 feet above the sea, visible 20 miles. Its position is considered to be Lat. 35° 47′ 14″ N., Long. 5° 55′ 41″ W.

In about lat. 34° 55°, on the north side of the outlet of a stream said to flow from an inland lake, are several whitewashed tombs, the chief of which is named after Mulai-Abou-Sallum. Between this place and Slà vessels may anchor anywhere at a very moderate distance from the coast, there being from 20 to 25 fathoms at 1½ miles off; in fact, it is necessary sometimes to anchor here during a calm, to avoid being drifted by the currents which set to the southward along the coast, with a velocity, frequently, especially at the full and change of the moon, of from 1 to 2 miles an hour.

Southward of these tombs as far as Mehediyah the coast is again very clear, a little higher than the former, and readily known, being of white sand as far as about the middle of its declivity, while the upper part appears like cliffs. From Mehediyah to Slà the coast is low, with double land, very even, with a white sandy strand; at about half-way the strand rises, and thence to Slà the shore consists of black and steep rugged rocks with small hills.

Mehediyah, in lat. 34° 18½′ N., stands on the lower slope of a hill 456 feet high, and on the south side of the mouth of the Wadi Sebou, which river, it is said, can only be entered by boats and rafts. There is anchorage at 1½ miles from shore in from 12 to 14 fathoms, sandy ground; but when the wind blows on shore, and occasionally in calm weather, there is a heavy swell all along this coast; the best berth is with the town bearing between S.E. by S. and S.E. by E.

SLA AND RABAT.—These two towns are separated by the entrance of the river Abou Rakrak, the former being situated on the northern, and the latter on the southern side. At Rabat there is a remarkable old stone tower, named *Hassan*, 180 feet high, 35 or 36 feet broad, standing upon a cliff which rises 70 feet above the river, thus serving as a conspicuous land-mark for this place, being recognisable from the deck of a vessel at a distance of 15 or 18 miles.

The best anchorage in the roadstead abreast these places is in 21 fathoms, mud, at 2 miles from the shore, with Hassan's tower just open of the south point of the river; here vessels may lie in safety from April to September, inclusive, but at other times they are often obliged, for safety, to quit their moorings, and run to sea. From the roadstead the water shoals gradually till close to the bar, when it suddenly decreases from 7 to 2 fathoms. There is almost always a heavy surf here, which makes it dangerous for boats landing. The sand which has accumulated in the entrance of the river, leaves (1852) only a narrow and shallow channel, with but 1 foot in it at low-water springs, but there is a rise of tide varying from 9 to 12 feet.

When within the bar vessels proceed to the anchorage under the east side of the citadel of Rabat, and moor in about 9 or 12 feet water.

The third section into which we have divided the Marocco coast, namely from Rabat to Mazighan, extends about W. by S. 93 miles. From Rabat to cape Fedalah it is slightly embayed, but the inland features scarcely vary in appearance,—two lines of barren and gently undulating hills running nearly parallel to the coast. The distant hills are from 200 to 400 feet high, and lie 5 or 6 miles from the sea, while the nearer hills are not more than 200 feet high, nor more than a mile within the beach, on which many patches of rock are intermixed with the sand, and down to which they gradually slope. At 7 miles south-westward of Rabat is *Massa Tower*, very conspicuous; and 22 miles further, in the same direction, the little town of *Mansoriyeh* with its principal mosque, which rises to the height of 180 feet above high water, will be seen.

Five miles further stands the village of *Fedalah*, with its projecting cape, which at a short distance appears like an island; this cape affords some shelter to small vessels in the little bay on its north-eastern side, where they may anchor in 5 or 6 fathoms at a short distance from the shore. At 12 miles south-westward from cape Fedalah is Dar-el-Beida; hence to Mazaghan, the coast, which for the first 2 miles is rocky, consists afterwards of a broad sandy beach, with two parallel ranges of hills with it, of 300 and 400 feet in height, distant 2 and 6 miles from the sea, and partially covered with brushwood.

Dar-el-Beida* (White House), sometimes named *Casa Blanca*, in Lat. 33° 37′ N., and Long. 7° 33½′ W., is situated at the bottom of a small indentation of the coast on the eastern side of a rocky cape of the same name. The towers of three of its mosques are very conspicuous, and one is of a superior height. Reefs extend from it and also from the cape to the distance of nearly ¼ a mile, and further off the cape there is a rocky bank with 6 fathoms over it. The landing-place is sheltered by the reef jutting out from abreast the north end of the town. In many parts of the bay the bottom is rocky, which renders it an unsafe anchorage during the winter, not only because of its foul bottom, but also because of the current, which sets obliquely on the cape, making it difficult for a vessel to get out with an on-shore wind.

The usual position, however, in summer time is in 6 or 7 fathoms, sand, at nearly ½ a mile off shore, with the centre of the tower bearing about W.S.W.

Azamor is situated on a sand-hill, on the south side of the mouth of the river Om-er-biyeh, at 120 feet above the water. The river empties itself into the sea at about 39 miles westward of cape Dar-el-beida; a bar of sand at its mouth dries (nearly across) at low water, though inside it is said to be deep and rapid. The shore hereabout is flat and fringed by a comparatively broad and shallow bank, and the depths at 3 and 4 miles are not more than 8 or 10 fathoms, bottom foul and rocky, so that it is not safe to anchor off here.

Mazaghan lies 8 miles westward of Azamor (on the east side of cape Mazaghan) and in Lat. 33° 15½′ N., and Long. 8° 26½′ W. A lofty building 140 feet high, apparently once a lighthouse, will assist in distinguishing this place, but it is rapidly going to ruin. A reef projects from cape Mazaghan to the north-eastward about a mile, and somewhat shelters the anchorage abreast the town in westerly winds, notwithstanding which, however, a heavy swell will be experienced. In the little bay formed by this reef and the coast, the soundings

* Formerly *Anafi*.

range from 2 to 6 fathoms, bottom seemingly of mud, but immediately below the mud are ledges of hard, smooth stone, making bad holding ground. Further off the town, in the larger bay, the general depth is from 7 to 10 fathoms, fine dark sand, but cannot be recommended for anchoring in during the winter months. In settled weather there is anchorage off the coast in 15 fathoms sandy ground, but the best anchorage is to bring the two flagstaffs on the Sardinian Consuls house in one (1839), and anchor in 5 fathoms.

Mazaghan carries on a little commerce, and provisions of water can be obtained; the latter article is stored in a magnificent and admirably constructed tank, capable of holding several thousand tons.

The coast from cape Mazaghan to cape Cantin trends W.S.W. ¼ S., distance 60 miles. The shore from cape Mazaghan to cape Blanco, a distance of 11½ miles, should not be approached nearer than 1½ miles, as scattered rocks lie off it, and the soundings are very uneven. The beach also, though in some places a broad sand, is generally lined with craggy rocks. Seven miles westward of Mazaghan are the remains of the ancient city of Tett, one of the towers of which has an altitude of 128 feet, and stands 148 feet above the level of the sea, with a white tomb on each side. A barren line of hills 200 feet high slope to the beach throughout this latter interval, and terminate just northward of cape Blanco, in a low, dark, and rocky cliff.

Cape Blanco (*North*) in Lat. 33° 8′ N., and Long. 8° 36′ W., derives its name no doubt from a white cliff, 170 feet high, a little southward of the headland actually forming the cape. A few miles south of cape Blanco there is a dark cliff projecting a little from the shore, and its insular appearance when viewed in some directions may have been the origin of its insertion as *Duksal Island* on some charts.

About 6 miles southward of cape Blanco the hills rise gradually from the beach to the height of 450 feet, and seem to be the highest land on the western shore of Marocco. In Lat. 32° 59½′ there is a black tower with some ruins southward of it, and in Lat. 32° 44½′ may be seen the ruins of El Walidiyeh, with another group 2½ miles westward of them.

At 4 miles before arriving at cape Cantin the profile of the land, which is here about 450 feet high, begins to lower (gently) and then rises again into a hillock just inside the cape. On the outer edge of this hillock is a white patch, seen both from the northward and southward. A singular looking gap, in the profile of the cape itself, presents also the same appearance from both directions.

Cape Cantin or *Ras-ul-Hadik*, that is, cape of Palm Groves, is Lat. 32° 33′ N., and Long. 9° 14′ W., and rises precipitously to 200 feet above the water. A reef or sandy spit runs off more than a mile from the cape, with 5 fathoms on its extremity.

From cape Cantin the coast runs S.S.W. ½ S. 22 miles to Sharf el Judi or Jews cliff. The shore from the former cape to cape Safi, a distance of 12 miles, is a continued line of white cliffs with a broad sandy beach at its foot; the cliff rises gradually till at cape Safi, which may be known by the square tower on its summit, it attains an elevation of about 500 feet. Here the land recedes and forms the bay of Safi, and the cliff drops into a ravine forming the bed of a winter torrent. Hence to Jews cliff the coast consists of sand-hills from 150 to 200 feet high, sometimes terminating in low cliffs and sometimes in sloping points, and backed by a ridge of brushwood hills about 600 feet high. The Jews cliff is of a red colour and rises 200 feet above the sea.

Safi or Asafi, in Lat. 32° 18′ N., and Long. 9° 11′ 20″ W., stands on the sea-slope of a hill which rises from the southward of the ravine mentioned in the previous paragraph, and at the bottom of the bay of the same name. It was formerly a town of much importance, but is now very considerably reduced; the tower of the principal mosque is more than 200 feet above the sea. Good anchorage and smooth water will be found in the bay fronting the town, during the summer months,* better perhaps than on any other part of the coast, but it is entirely exposed to westerly and south-westerly winds; the bottom is of sand and mud, and the depth at a mile from shore about 15 fathoms.

The country in the immediate vicinity of Safi appears, from seaward, to be sandy and barren, but travellers say that it is remarkably fertile, and that the interior abounds in corn. Water is scarce here, and during the summer it has to be procured from wells a short distance southward of the town.

From Jews cliff the land trends S.W. ¾ W. 56 miles to cape Sim or Ras Tegriwelt. From the Jews cliff to the bar of the Tensift (which becomes dry in the summer time) a distance of 10½ miles, the general character of the coast is the same as that northward of the cliff; and 9 miles south-westward from the Tensift will be seen the tomb of Sidi Abd Allah; here the coast, which from the Tensift is barren and uncultivated and from 200 to 300 feet in height, shows renewed signs of cultivation. About 17 miles further south-westward is a sandy spit named *Hadid Point*, projecting a mile beyond the general trend of the coast, and terminating in a sunken reef ½ a mile in length. Within the intermediate coast are the *Iron Mountains* or Jebel Hadid, which constitute a range of 20 miles in extent, the highest peak of which is above 2300 feet above the level of the sea; another peak nearer the sea and 2100 feet high, has the tomb of Sidi Wasman upon it, a very conspicuous object from a great distance.

From Hadid point the sandy beach continues to Mogador, a distance of 12½ miles. The Botof high sand-hills, which run parallel to the beach, about one mile within it, and are capped with dark bushes, bound the prospect inland. From Mogador to cape Sim the shore is a continued line of bare sand-hills, 70 feet high, and sloping to the beach.

Mogador, or Suirah is the principal seaport of Morocco. The bay is formed by an indentation in the coast line, and is fronted by the small and rocky island of Mogador, which somewhat protects the bay from the long Atlantic swell. The town stands upon a low sandy spot, surrounded by the sea at high-water springs, and in Lat. 31° 30′ N., and Long. 9° 44′ W. Mogador island lies

* That is, from March to October.

about $\frac{4}{5}$ of a mile from the beach, and $\frac{9}{10}$ of a mile from the town; its highest part is 94 feet above the sea, and, except upon the inside, is surrounded by some large detached rocks and connecting reefs, covered at high water. The tides ebb and flow regularly, but their direction varies with the wind, and their strength is at all times weak.

The harbour, as it is called, between the town, the island, and the main is but little more than ½ a mile in extent, being contracted to that limit by the reefs from the town point, and the 2-fathom flat which stretches from the main to the south-east side of the island. The actual room for anchorage is even much less than this. Most vessels indeed haul close to the middle of the eastern side of the island, and bring up in a depth of about 2½ and 3½ fathoms, loose sandy bottom, for they are exposed to the swell of the ocean, in a more central position, though in deeper water; and this swell may set in with great violence, even in moderate weather. Vessels should moor with a very short scope of cable, and with an open hawse either to the northward or southward, according to the prevalent winds or seasons of the year. But between November and April this bay can scarcely be considered tenable, even though it has been said that vessels well found in good grounding tackling need be under no apprehension; still the doubtful nature of the bottom shows that no reliance can be placed on the hold of the anchors, and the necessity of veering more cable to a westerly gale only increases the exposure of vessels to the effects of the swell which rolls round both ends of the island, and which again re-acts from the opposite shore. Vessels therefore, of more than 14 or 15 feet draught, unless in summer weather, will find it imprudent to anchor in the harbour.

A very fair temporary anchorage may be had in *Mogador Road*, by those intending to stay but a short time at Mogador, in about 13 fathoms, fine dark sand, at about ¾ of a mile westward of the town, with the extremes of the land N.E. by E. and S.W.; the castle S.E. by E.; and the rocky points at either end of the island S. by E. ¾ E. and S.W. by S.; here vessels are exposed from the S.W. round by west to N.E. by E., and at all times to a long swell, but they are comparatively safe inasmuch as they can slip and stand out to sea. The pilots consider it the best outer anchorage; but the ground is loose.

Provisions of all kinds, including fish, poultry, and game, are abundant and cheap, as are also fruit and vegetables. An aqueduct conveys a stream of water to several large tanks built in different parts of the town, one of which tanks has been placed very conveniently for vessels in the harbour, as it lies close to a jetty inside the fortified bridge, and boats can fill there towards high water, perfectly sheltered from all winds.

Directions.—When approaching Mogador the distant craggy summits of mount Atlas* will be seen, capped with snow, and contrasting with the dark ridges

* From the British Consul's house, at Mogador, the highest peak of Mount Atlas was seen bearing S. 45° E. See page 291, vol. 6, *Royal Geographical Societies Journal.*

of intermediate hills; while to the northward the Jebel Hadid, or iron mountains, appear insulated, and as you draw nearer, a narrow white streak of sand-hills, fringed at the top with verdure, seems to rise out of the sea; and at the distance of 12 or 9 miles, the mosque-towers and castles of Mogador begin to be distinctly seen, as well as its low black island.

The *North Entrance*, between the rocks surrounding Mogador island, and those extending south-westward from the town, is about 3 cables' lengths wide, and from 4 to 6 fathoms deep; further in the water becomes shallower. With the prevalent north-east wind this entrance is so distinct as to require no further directions, than to keep in mid-channel, and to haul round the rock off the north end of the island as closely as may be practicable.

The *South Entrance* is used by vessels drawing not more than 12 feet, which find it more convenient to cross the flat connecting the island to the main, and to run out in that direction with the benefit of the current, than to work out through the northern entrance. The lead will be a good guide in preventing a deviation much from mid-way, where the water is deepest. The following mark, for running over this bar, was communicated to Capt. Evans, R.N., by the captain of a merchant vessel who had used it:—The great mosque of the town, which is near the beach, on with the centre of a house having an angular roof (being the only one of that nature in the town) carries you out in mid-channel over the bar, in 12 feet at low water springs, running out into the southern bay, until you bring an old fort on the sea beach abreast of the island, on with a small mosque, similarly situated a little to the N.E of it—which mark will carry you clear out to seaward. It is necessary to observe, that the sandy bottom of the bay is extremely loose, and at times collects, as Capt. Evans proved, when creeping for anchors which had not been lost six weeks, and were found completely buried; the harbour, he says, notwithstanding, is not filling up, no doubt from the great under-run, after a gale.

Cape Sim, or Ras Tegiewelt is a low sandy point, about 7 miles south-west of Mogador, sloping gradually from a height of nearly 500 feet and terminating in reefs of rocks which surround the point to the distance of nearly a mile.

From cape Sim the coast trends nearly S.S.W. 45 miles to cape Ghir. About 7 miles southward of cape Sim the river Tidsi issues through a picturesque ravine; thence to cape Tefelneh, 10 miles further southward, bold cliffs, apparently of sandstone, come down to the shore, and 7 or 8 miles inland rise into a range of hills between 2000 and 3000 feet high. Cape Tefelneh attains an elevation of 700 feet, and terminates in a point from which a ledge of rocks project ¼ a mile, with deep water at its extremity.

Cape Ghir, or Ras Aferni, is 29 miles southward of cape Tefelneh; the intermediate country rises to nearly 3000 feet above the sea, and appears to be well inhabited, from its numerous villages; there are several conspicuous tombs and scattered woods. The cape itself, which has deep water a short distance from it, shows a bold bluff face, but slopes gradually on each side from the summit, which is about 1200 feet high. Its position is Lat. 30° 38′ N., and Long. 9° 50′ W. The rocky shoal said to have been seen in 1765 by Captain Cleveland, R.N., at 27 miles N.W. by W. from cape Ghir, is of very doubtful existence.*

From cape Ghir the coast line bends inwards, and between it and Santa Cruz or Agadir, forms a deep bay wherein convenient anchorage may be had during the prevalence of the north-east winds. The hilly region which backs this part of the coast, usually named the *Heights of Idautenan*, is the western extremity of the main chain of the Atlas, which ranges hence in an E.N.E. direction, rising, at 9 miles inland, to the height of 4400 feet, and to a remarkable conical hill 3980 feet high.

Santa Cruz or Agadir is situated about 18 miles S.E. by S. ¼ S. from cape Ghir; the bay is clean and affords good shelter, in a moderate depth of water, from north-easterly winds, but is exposed to those from the westward; nevertheless, it is considered one of the best, if not the best roadstead along this part of the Marocco coast. The castle bearing N.N.E., in 7 or 8 fathoms, sandy bottom, at less than a mile off shore, will be found a convenient berth. The town stands upon the summit of a hill about 600 feet above the sea. About half-way down the sea-face of the hill there are the remains of a battery, which was intended not only to command the anchorage, but also to protect a spring of water near the beach. The ruins of the town of *Fonté*, at the foot of the hill, would be scarcely distinguishable, but for the existence of two whitewashed tombs. Provisions are good and plentiful, and water easily procured. The bay is quite alive with fish, immense quantities of which are caught by the natives.

When sailing from cape Ghir to the road be careful to run along by the land of the cape till you are before the castle, because northerly winds are very prevalent here, and if vessels keep too far from the shore, considerable difficulty may then be experienced in working in. Coming in by night, approach no nearer than into 14 or 12 fathoms.

From Agadir the coast runs 39 miles in a S.W. ½ S. direction, with a slight curve, to cape Agulah, and is throughout generally of a low, flat, and sandy description. The *River Sous* discharges itself into the sea at 5 miles southward of Agadir, but its entrance is impeded by a sandy bar nearly dry at low water, and never passable by vessels drawing more than 4 or 5 feet. At 6½ miles further southward are the Sonwaniyeh (Tomeeh or Seven Wells), that is wells of fresh water. The anchorage off this part does not differ from that which can be found on almost any part of this coast.

About 12 miles further in a similar direction is the mouth of the *River Mesa*,

* Lieut. Arlett sought for it in 1835 without success. He says, "Four days were employed in searching for it by both vessels (the *Ætna* and *Raven*) without success, and I can state with confidence that it does not exist in the position hitherto assigned to it. It would be, perhaps, saying too much to assert that it does not exist at all; but the gradual decrease in the depth to seaward, with the nature of the bottom, which is mud and sand, very much favour that supposition."

the bar of which is dry at low water, and probably has not more than 4 or 5 feet over it at high spring tides.

Cape Agulah is only a slight elbow in the coast in Lat. 29° 48½′ N.; the village of the same name stands on a hill about a mile from the beach of a small sandy bay, into which the small river Asa falls. From the river Mesa, southward the beach still continues sandy, but verdant hills approaching the sea, break off into cliffs, apparently of sandstone, about 100 feet in height. In the interior is a ridge of high mountains, at 50 or 60 miles from the coast. The interval between appears like a wooded and well-cultivated country, with many houses and farm-buildings.

From cape Agulah to the Rio de Playa Blanca the general direction of the land is S.W. by W. ¼ W., and the distance is 63 miles. At 12 miles southward of Agulah, the features of the country again change; the hills become barren and abrupt, and form in successive ridges, gradually increasing in height, till they join the line of mountains, which rise to the estimated height of nearly 4000 feet, and appear to be the south-west extremity of an offset of the Atlas. More to the southward, the appearance of the inland country continues the same, but the coast changes to dark red cliffs, broken into coves, on the beaches of which boats may be seen.

In Lat. 29° 22′ N. is a remarkable white cliff, which forms a good mark for the coast; behind it, and standing alone, is a conical shaped mountain, rising to the height of 3900 feet. From this cliff the country assumes a more rugged and barren appearance; the hills steep, with deep and narrow ravines; the coast, alternate cliffs, and sandy bays, with prominences rocky and rugged. In Lat. 29° 9½′ N. is the Regular, or Gueder cove, on each side of which a rocky cliff projects to a short distance, having steep and barren sides; these are separated by a deep and narrow ravine, down which a slender stream finds its way to the sea. In this cove the water is deep, and bottom clean to the beach; a landing may generally be effected in it, but it affords no shelter.

Playa Blanca River.—In about Lat. 29° N. there is a break in the coast, which has the appearance of the dry bed of a river, and is indeed named by the Canary fishermen the Rio de Playa Blanca.

The shore hence to cape Noun runs about W. ¾ S., a distance of 29 miles. In the vicinity of Playa Blanca river the mountainous country terminates, and a sandy desert commences. At 4 miles to the southward of the Rio de Playa Blanca the coast is of bold sandstone cliffs, with sand downs in the interior, devoid of herbage, and thus it continues to cape Noun.

Cape Noun, in Lat. 28° 45′ N., and Long. 11° 2′ W., presents a steep face of sandstone about 170 feet high, but as the cliffs northward and southward are of the same character and elevation, and the country inland an uninterrupted desert, it is difficult to make out the exact projection until very near it. There are no dangers off it, deep water being found at a very short distance, and, upon reference to the soundings as laid down on the chart by Lieut. Arlett, it will be seen that the supposition of the existence of an extensive flat off this cape is erroneous. This supposition, no doubt, has arisen from the discoloured appearance of the water both north and south, as well as seaward of the cape, which here has a red tinge, with a thick muddy semblance, so that the track of a ship is visible for a length of time. This phenomenon is evidently occasioned by the immense volume of very fine sand blown off the desert, and with which everything on board becomes coated, even at a good distance from the land.

The *River Noun* empties its waters into the sea at 5 miles south-west of the cape, and at 32 miles further (in the same direction) is the mouth of another stream, named Wad Noun.* It is said that both rivers are barred, and that within there is ample room and depth for vessels of some burthern; also, that favourable opportunities for crossing the bar are frequent, and large boats are enabled to ascend them to a considerable distance up the country. The features of the coast adjacent to the mouth of each river are singularly alike, so that latitude is the best guide. The former river (the northernmost), when well open, may be recognised by two hills, which will then appear in the centre of the gap; they are both conical, and on one of them there are the remains (probably) of a fortress. When approaching the Wad Noun, or southernmost river, the table-land breaks into detached hills, which will help to identify it.

Between these rivers the coast is a continued line of sandstone cliffs; while the table land just shows above these cliffs when viewed at the distance of 3 miles from the shore. There is a regular depth of 20 fathoms at 4 or 5 miles off, and good anchorage ground, with which, however, it is not safe to make free, except between March and October.

Here it is supposed the Empire of Marocco terminates; though the authority of that empire is reported gradually to lessen as you proceed southward from Agidir. Persons intending to land hereabout should do so with the greatest circumspection.

SAHARA.—The coast from the river Noun to the Senegal is usually considered the western boundary of the Great Sahara, or Sea of Sand. Throughout the whole of this extent the character of the country is most desert-like—either broad and white sandy plains or isolated sand-downs, sometimes terminating at the water's edge in sandstone cliffs, and at others in low beaches whereon there is always a heavy and desolating surf. Nothing indeed can be more dismal than the general monotonous appearance of the land; for miles in some parts there is not a dark spot to break the uniformity of the sand, the fine particles of which mingling with the haze occasioned by the heavy surf, render the shore very

* Some doubt exists as to the correct names of these rivers. We have, however, adopted the above till more positive information has been received. See pages 297 and 482 of the *Royal Geographical Society's Journal* for 1836.

indistinct. Instead, therefore, of describing in detail this uninteresting and barren portion of the Western African shore, we shall notice only the prominent points, land-marks, dangers, and the very few places which are worthy of any observations.

Currents.—The prevailing currents set southward along the whole of this coast, and their influence upon a vessel's way must be carefully considered, as the horrors of shipwreck of these inhospitable shores are increased by the barbarity and treachery of the wandering tribes of the desert, who to this misfortune add those of cruelty, robbery, and slavery. Its velocity varies according to the direction of the wind; and sometimes its direction also, though very rarely.

Lieut. Arlett, after stating that the current follows the direction of the land from Mogador to cape Bojador, says—"Its average rate from Mogador to cape Juby is from ½ to ¾ of a mile per hour. At the latter cape, probably from its stream being in some measure confined by the projecting cape, and, perhaps, by the Canary islands, distant only 58 miles, it increases its rate to 1½ miles per hour; and off cape Bojador its rate is about 1 mile. I did not perceive that this current was in any way influenced by any particular wind, but near the shore a tide was generally perceived."

Along the whole of the western side of the bank of Arguin the southerly direction of the current is constant, and even during the rainy season the exceptions to this rule are rare.

Baron Roussin says—"From cape Bojador to the bay of St. Cyprian the current sets to the S.S.W.; from that bay to cape Blanco, and along the whole extent of the bank of Arguin to its western point, it sets S. by W. Southward of this point the waters, being no longer guided by the edge of the bank, which turns abruptly to the S.E., do not follow in a body, within a certain space, any fixed or determined direction. One part of their mass experiences a number of irregular windings, until, finding itself in the active body of the general current, which left the bank at its most salient point, it rejoins it, and is carried on as before.

In the vicinity of Tanit bay (Lat. 19° 5′ N.) it again resumes its former direction, and follows the trend of the coast."

Winds.—On the southern portion of this coast the winds are said to prevail from East to N.E. from October to May inclusive. During the remaining portion of the year (that is, the winter season) tornadoes and light winds from S.W. to W.S.W. occur. At a moderate distance from the shore, in the fine season, North winds are often found blowing on shore, while, at the same time, further out to sea, the wind may be blowing from N.E.

The inhabitants of the Canaries catch a quantity of fish along the coast from about cape Noun to the bank of Arguin. These fishermen seldom venture northward of the cape, though fish are there equally abundant, because of their dread of the Moors, who, on that part of the coast, possess boats, but southward of the cape there is said not to be a single boat, and they, therefore, not only work the bank close in-shore, but frequently land, as well to barter their fish for orchilla and the fine Barbary wool as to procure water; in this, however, they are always extremely careful.

To return to the coast at the Wad Noun;—

From this river it takes a W. ½ N. direction, a distance of 77 miles to cape Juby. The current which hitherto followed the direction of the land, in this space strikes it obliquely, rendering it the most dangerous part of the coast between capes Spartel and Bojador, and fully accounting for the numerous wrecks which have taken place there. The swell, also, is invariably from the north-west, and, therefore, sets directly into the bight eastward of the cape, so that it is considered almost impossible for a vessel embayed there to work off.

Cape Juby is a projecting elbow of the land in Lat. 27° 57½′ N., Long. 12° 52½′ W., low and sandy, and terminating in a hummock covered with bushes, and having in all directions the appearance of an island. Some rocks project 3 or 4 cables' lengths from the cape, and have 10 fathoms at their extremity.

False Cape of Bojador is 115 miles S.W. by W. from cape Juby. It is low and sandy, and has a reef of rocks extending from it about 1½ miles in a north-west direction. About 6 miles N.W. ½ W. from the cape there is a shoal, whereon the least depth (as at present ascertained) is 7 fathoms, but as a thorough examination of this part has not been made, it is advisable to give it a good berth.

Cape Bojador lies 25 miles W. by S. ¾ S. from the preceding headland, "and," says Baron Roussin, "when seen from the northward, shows a strand of red sand, with a gradual descent towards the sea; and its western extremity, which is very low, forms a small bay with the cliff which immediately follows."

Penha Grande.—This remarkable cliff is 64 miles S.W. ¾ S. from cape Bojador; its height, about 300 feet, so far exceeding that of any other part of this coast, serves as an excellent land-fall. At a mile from the base of the cliff there are 26 fathoms water, bottom of gravel and broken shells.

Hence to the south-westward there is nothing remarkable, except perhaps a hummock in Lat. 23° 54½′, named *Deception cliff*, from its assuming, until close in, the appearance of an island.

River Ouro.—The basin at the mouth of this river may be seen over the low isthmus immediately southward of Deception cliff, as well as over part of the peninsula which separates it from the sea. Dunford point, on the west side of the entrance of this basin, is in Lat. 23° 36½′ N., Long. 16° 1′ W.; thence to the opposite shore of the main the distance is 4 miles, but the navigable channel, over a bar of 12 feet least water, is, however, not more than ½ a mile wide, owing to the extensive sand bank which reaches out from the main, and the spit extending 1¾ miles eastward of the cliff of Durnford point. Within the bar the water deepens to 5, 10, 14, 10, and 7 fathoms, the channel increasing in breadth, and expanding into a fine basin of 1 or 2 miles in width between the off-lying banks; a vessel may find good and safe anchorage over a clean bottom in

7 fathoms, sand. As there are no objects suitable as leading marks, it is advisable before entering to buoy the bar. High water takes place here, on the days of full and change, at noon; rise about 8 feet. Off the entrance the flood sets nearly East, and the ebb West, with about 2 knots' velocity; inside the bar its rate is 2½ knots, and over it and the shoal patches it has a still greater rate, causing a high break, which affords an unerring beacon to the shoalest parts.

A good landing place will be found in the cove on the northern side of the sand-spit projecting eastward of Dunford point, also an abundance of fish; there is good shelter for boats, though much surf rolls across the entrance. Tolerable anchorage may be had in 5 fathoms outside the bar, but Durnford point should not be brought westward of N.N.W.

Hence to Angra de Cintra bay the greater portion of the coast appears to be fronted by a bank extending 3 or 4 miles therefrom, with 5 fathoms on its outer edge and 12 fathoms close-to.

Angra de Cintra Bay, the south point of which is in Lat. 22° 57′ N., is probably shallow, but abounds with fish, and the fishermen* informed LIEUT. VIDAL that good water could be obtained at the foot of the downs, at a short distance within the beach, by digging in the sand. From the south point of the bay a reef projects a considerable distance to the N.E., and from the north point another runs off south-west about 2 miles; the latter point is low and sandy. The entrance of the bay, between these reefs, is about 7 miles wide; in mid-channel there are only 4½ fathoms, sandy bottom, and a little further south-eastward there is a detached shoal. After doubling the northern reef the bay will be seen to extend about four miles north-eastward, within the sandy point which protects it. During the period of the rollers the sea breaks very heavily along this part of the coast, and it has been observed to break in several places at the entrance, but the before-mentioned are the only known shallows.

St. Cyprian Bay.—From Angra de Cintra bay the coast trends S.W. 38 miles to the north-east point of St. Cyprian bay, which is a cliff 150 feet high, with a circular form towards the sea, and a flat top somewhat resembling a fortification. The bay is about 7½ miles wide and 2½ deep, and open from E.N.E. to N.W., consequently unsheltered from the prevailing winds, and the heavy swell that rolls in. The anchorage, though on a bottom of sand and mud in from 10 to 20 fathoms water, offers very little security, and no vessel should enter in unless in case of absolute necessity. The Canary fishermen catch a large quantity of fish here.

Cape Barbas, on the west side of St. Cyprian bay, is the elbow of a steep cliff about 80 feet high, in Lat. 22° 20′ N., and Long. 16° 45′ W.

* The fishermen who frequent this bay attract some few Arabs or Moors to the spot, who seem to have no fixed habitation there, or on any other part of this coast. They belong to and form part of a tribe called the *Tribe of Thieves*, composed of marauders and vagabonds, who are scattered along the shore from cape Bojador to Senegal, and subsist on dried fish and the plunder from wrecks, which formerly were so frequent here.

Galha Point is 9 miles S.W. by W. ½ W. from cape Barbas; the intermediate coast is formed almost by one uninterrupted cliff, about 80 feet high, at the foot of which the sea breaks violently. At one mile from the beach there are from 9 to 12 fathoms; and at 2 miles, as much as 17 fathoms, with a bottom of muddy sand, or sand and broken shells. The coast then declines into the usual white sandy plains, studded here and there with cliffs. Southward of this it forms rather a remarkable little bay, with shore of white sand. This bay is full of reefs, on which there is very little water, leaving an outlying and dangerous rock off each of its points; the northernmost is named Pedra de Galha, and the other La Virginie. The first, which is rather higher on the northern than on the southern side, is about half a mile in circumference; the latter is three times that size, and has some sandy patches. They are in some measure connected by a chain of flats stretching a mile northward of the Pedra, and ½ a mile southward of La Virginie. At one mile westward from these rocks may be found 18 fathoms of water, with muddy sand. The depth increases to the southward, and the bottom becomes harder. From Pedra de Galha to cape Blanco the distance is 29 leagues. The coast in this extent trends S.S.W. ¼ W., is nearly straight, and moderately high; it is one continued down, the whiteness of which becomes more vivid on proceeding southward. All this part of the coast is perfectly safe. The strength of the current along the shore is nearly a knot, but farther out to sea much less.

Cape Blanco (South) is a high white cliff terminating a sandy promontory about 28 miles in length, on the eastern side of which is the extensive bay of Lévrier. Position, Lat. 20° 46′ 27″ N., Long. 17° 5′ 40″ W.

West Bay.—At 5 miles N. ½ W. from cape Blanco there is a high sandy shoulder projecting from the line of coast, forming the northern side of West bay, wherein the anchorage is clean in about 12 fathoms; here shelter may be obtained from the prevailing N.N.E. and N.W. winds. At the bottom of this bay is a beach of white sand, interspersed with cliffs, in one of which the sea has perforated a large hole, resembling an arch in shape, and visible at a considerable distance.

Captain Belcher recommends vessels to take up an anchorage in West bay, where the Canary fishermen resort, in preference to going into Lévrier bay, for there the swell is less, fish abundant, and little chance of losing an anchor; should a strong westerly wind arise they will then have the option of going round eastward of the cape for shelter.

Levrier Bay, between the peninsula, of which cape Blanco is the southern point, and the main, is about 24 miles in extent from north to south, and about 12 miles in average breadth, but the greater portion of this area is occupied by shallow banks, especially on the eastern and northern sides of the bay, leaving, however, a very extensive anchorage with water sufficient for vessels of any size. Within and 5 miles N.N.E.-ward of cape Blanco there is a curve in the peninsula named *Repose Bay,* in which there are from 5 to 2 fathoms, but it affords very little shelter from N.E. winds which blow here with great violence, and are loaded with minute sand which is most injurious to the eyes; even with a light breeze there is a troublesome sea. It is true shelter may be had from N.W. and N.N.W. winds, but the Canarians say that N.N.E. and N.E. winds constantly prevail, and that those winds and the accompanying sea are considerably heavier than those from without cape Blanco.

A shoal extends nearly ½ of a mile from the south-west point of cape Blanco, with 8 fathoms on its extremity; and one of the banks which occupy the greater part of the eastern side of Lévrier bay, approaches to within ¾ of a mile of the east end of the cape, leaving a deep but narrow channel between, which, immediately within the cape and bank, rapidly increases in width. The *Bayadere Shoals* commence 1½ miles S.S.W.-ward from the pitch of cape Blanco, and extend thence 3 or 4 miles in a south-westerly direction; they have not been minutely examined, and though the least water at present found on them is 4½ fathoms, yet the overfalls have been plainly seen during the ebb. When rounding the cape, therefore, give it a berth of about ½ a mile.

Captain Belcher says, "The tides about cape Blanco are irregular, and much influenced by the land near which they run. High water, at full and change, may be looked for about noon; the greatest rise, under every advantage of springs and winds, does not exceed 6 feet. Southward of the parallel of the cape, the indraught has a velocity of 2·6 miles, and the off-set or ebb the same. Eastward of the meridian of the cape, the tide bends northerly; and at 3 miles chord, its velocity appears from S.W. to N.E., about 2½ knots, following the circular course into Greyhound (Lévrier) bay. North of the parallel of the cape, the ebb sets north, and flood south; and, close in shore, the tide is considerably weaker than at 3 miles, when its greatest influence may be expected."

Arguin Bank.—This great and, probably, increasing bank may be said to be a continuation of the broad shoal which fills the eastern side of Lévrier bay, and to extend thence to the southward of cape Mirik, a distance of about 90 miles, its greatest breadth (in about Lat. 20° 5′ N.) being perhaps 40 miles. Its western elbow is considered to be in 17° 10′ W. It is apparently composed superficially of a very hard and flat sand, generally covered with broken shells, but our knowledge of this, or of the interior of the bank, or of the channels by which it is split or crossed is decidedly very little and very imperfect. Baron Roussin has given the conformation of the outer edge, in 7 fathoms, which has been traced from numerous soundings, and which, northward of the parallel of 20° N., trends N.E. by N. and S.W. by S., and to the southward of that latitude S. by E. ½ E. and N. by W. ½ W. The bank should not be approached nearer than into a depth of 7 fathoms, as great risk is incurred by so doing, for a short distance within this depth there are less than 6 fathoms. No part of the edge has hitherto been seen to dry, but close to the breakers (which occur in many places) there are but a few feet of water, and the shallows between them do not appear to carry more than 10 feet. The current and tide set strongly upon this bank.

Vessels in this neighbourhood cannot sound too frequently, and, unless bound to cape Blanco, they should not decrease their water below 15 fathoms by day, nor 25 fathoms by night, especially while southward of 20° N.; BARON ROUSSIN says, "the nature of the bottom outside the bank of Arguin observes a remarkable law, which will be of service to navigators who are obliged to approach it. From the 7-fathoms edge of the bank, out to the depth of 25 fathoms, thus including a belt of more than 15 miles, the lead invariably brings up a mixture of sand and broken shells, and in proportion to the proximity of the bank the shells prevail; while beyond the depth of 25 fathoms and as far as that of 50 fathoms the bottom is entirely of white sand." CAPTAIN BELCHER seems to doubt the *strict uniformity* of this law, but adds, "whether this remarkable distinction in the quality of the soundings be correct or not, the depths will be sure guides.

Cape Mirik is a low sandy point near the southern end of Arguin bank, in Lat. 19° 23′ N., and Long. 16° 33½′ W.; shoals extend from it some 5 or 6 miles, and prevent the approach of all large vessels.

Angel Bank, &c.—The coast southward of cape Mirik should not be approached nearer than into 8 fathoms, so as to avoid all dangers, and amongst them the Angel bank, a shallow flat, spreading out 7 miles from the beach, abreast the Angel hillocks, some flat sand hills rather higher than the rest of the coast, in about Lat. 18° 30′ N. Small vessels, however, will find a convenient anchorage on this bank.

Portendik, a village of temporary bush huts, which exists only while the Moors are trading or fishing, is generally erected on a little shoulder in the beach, in about Lat. 18° 17′ N. The coast northward and southward is a continuous line of sand, with a few hillocks and some scattered bushes, but all so low that nothing can be seen in the clearest weather at a greater distance than 9 miles. Northward of Portendik is or was the stump of a palm tree. Anchorage may be had in 4 or 5 fathoms on sand and shells, where most convenient, according to existing circumstances. High water full and change at 10h.; springs rise 6 feet.

When bound for this place it is usual to make the Angel hillocks, and then run along shore in about 5 fathoms, with careful attention to the lead. The roadstead is between two parallel banks of sand and shells, lying in a N.N.W. and S.S.E. direction, rather more than a mile apart, with from 2 to 3 fathoms water on them. The northernmost is a mile long, its south end being little more than a cable's length from the shore near the village. The north-west end of the southern bank is 1½ miles W. by S. ½ S. from the huts, whence it extends 2 miles in a S.S.E. direction.

From Portendik to St. Louis on the Senegal, a distance of about 135 miles, the coast is low, nearly level, and here and there interspersed with bushes. At the distance of 2 or 3 miles from the beach there are regular soundings of from

12 to 6 fathoms, bottom of fine sand, occasionally mixed with mud, and affording a ready anchorage. Here, as elsewhere, there is always a heavy surf on the shore.

We have considered this as the southern termination of the coast of the Great Desert.

SENEGAL is the name usually given to that portion of the continent of Africa lying between the rivers Senegal and Gambia. It is divided by the French into two arrondissements,—the north consisting of the isles at the mouth of the Senegal, with some few establishments on the banks of that river, and the trading stations along the coast between capes Blanco and Verde; and the south comprising the island of Goree, and the other stations between cape Verde and the river Gambia.

The climate is very unhealthy for Europeans, though not to such an extent as that of Sierra Leone; the heat of summer is relaxing and oppressive, especially during easterly winds, though the thermometer does not stand extremely high. The wet season, that is, from the middle of June to the middle of September, is said to be particularly fatal to Europeans, who are attacked with dysenteries, liver complaints, and various kinds of fevers.

Currents.—As before, the general and almost constant direction of the currents along the coast of Senegal is from north to south,* with a velocity of from 0·6 to 1 mile per hour, as far as the mouth of the Senegal river, where, and for a space of several miles to seaward, the powerful tides in and out of that river affect the general uniformity of the southerly current. Between the river Senegal and cape Verde they also follow the direction of the coast to the southward, but without any peculiar set into the bay of Yof, as has been asserted, though perhaps a little more strongly from the effect produced by the exit of the Senegal river. Similar observations apply to the southward of the cape.

Baron Roussin observes "that the current follows the trend of the coast S.S.W. to the Marigot of Musquitoes. It then sets S. ¼ W. till abreast the bar of the Senegal, where, in a space of 4 leagues in circumference, it is disturbed by the stream of that river. This stream is so strong as to oblige vessels at the anchorage off the bar to attend to it, in spite of the strongest winds. The current, joined by the waters of the Senegal, pursues its course along the coast, which trends to the S.W., observing, a very gentle curve, which forms the bay of Yof, and which terminates at cape Verde. The strong currents hitherto stated as setting into this bay are chimerical. Cape Verde being the most western point of Africa, and hence forming an obstruction to the general direction of the waters which flow along that coast, must occasion a great variety of currents in

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* This direction is nearly constant, except in the wet season, when it will sometimes be found running northward with equal velocity.—*M. Kerhallet.*

its vicinity; this is, in fact, what takes place, and it would, therefore, be difficult to define a particular one. One thing appears certain: vessels passing in sight of cape Verde are not carried on it, as is generally supposed; but, on the contrary are swept off by the prevailing tendency which the waters have to flow seaward. In running close to the Almadic ledge, this repulsion is generally very sensibly felt; it appears that a portion of the waters rushes between these rocks and spreads itself in different directions.

Immediately southward of cape Verde the current is almost imperceptible, and it is scarcely possible to assign any particular direction to it as far as cape Naze. The whole of the coast lying between the latter cape and cape Manuel forms a well-defined bay, totally free from current, and in which there is not a single river. The same is observed with respect to the roadstead of Goree, although, according to the observations of Mr. Adamson, a regular tide exists there, with a rise and fall of 2½ feet. In the offing of cape Verde the current has been always found to set to southward. From cape Naze it again follows the direction of the coast, interrupted only at the mouths of the principal rivers."

Winds.—At a moderate distance from the shore, in the fine season, North winds are often found, while, at the same time, further out at sea, the wind is from N.E. This coast is subject to the Solar Breezes, varying from N.E. to N.N.W. Those from N.N.W. prevail in the afternoon, hauling easterly in the night and towards morning. See "Coast of Senegal," page 73.

The coast for about 8 miles southward of the mouth of the Senegal, is as low as that to the northward, and, though it then becomes rather higher, it preserves throughout the same uniform appearance of a chain of white sand-hills, with scattered brushwood, and here and there a few dwarf trees. At the distance of 30 miles southward of the river's mouth there is a large red sandy elevation, entirely bare. Thence to the southward the coast does not present anything remarkable as far as the *Little Paps*, which are the two highest sand-hills between the Senegal and the Paps of cape Verde; they rise from the beach, and are easily known by a slight undulation on their summit, and by three or four small hills to the southward; the northernmost is in Lat. 14° 56½′ N., and both are visible at the distance of 12 or 15 miles.

About 25 miles W. by S. from the Little Paps are the *Paps of Cape Verde*; both are visible at the same time in fine weather, as the latter may then be seen at a distance of 20 or 22 miles. Here the coast begins to rise, and to show more wood, and the country about cape Verde is covered with trees, amongst which are several of considerable height.

When advancing from Goree bay towards the south-east, the sand-hills progressively rise, and are covered with trees as far as cape Naze. Thence to the Gambia it again declines, and becomes low and thickly wooded, affording no marks sufficiently prominent for a vessel's guidance.

Northward of the river Senegal's mouth, at the distance of 2 or 3 miles from the beach, there are regular soundings of from 6 to 12 fathoms, over a bottom of fine sand occasionally mixed with mud, and affording a ready anchorage. From the Senegal southward as far as the parallel of 15° 20′ N., at the same distance from the shore, the bottom is mud, in from 11 to 27 fathoms; beyond this parallel the depth rapidly increases, for at 6 miles off the Little Paps there are from 57 to 62 fathoms; the same bottom continues, and is so soft that the lead sinks in it, affording good anchorage to any vessel obliged by calms, &c. to bring to. At 2 miles off the village of Yof, 49 fathoms will be found, over a bottom of mud and sand.

The water about cape Verde is very deep, but along the coast to the south-eastward the lead is a good guide, and should be kept going, so as not to get into less than 9 or 8 fathoms.

The River Senegal.—For a distance of 18 miles the river Senegal runs nearly north and south, being separated from the ocean by a narrow tongue of sand, which gradually lowers towards it southern extremity, named Barbarie point, in Lat. 15° 48′ 45″ N., and Long. 16° 31′ 35″ W. This point forms the north side of the river's mouth, which is barred by a bank whereon the depth in 1850, as ascertained by M. Kerhallet, was about 18 feet; but vessels drawing more than 10 feet should not attempt to enter. Once fairly in the river the depths increase to 8 and 6 fathoms, and with the assistance of the tide and a pilot a vessel will speedily beat up to *St. Louis*, 12 miles above the bar, built on a narrow island about 1½ miles long, and which, when seen from the offing, owing to the right bank of the river being so low, appears to stand on the sea-shore. The principal channel of the Senegal is on the east side of the island, that on the west side being narrow and barred at its north end by a bank connecting St. Louis with Thiong island. Hereabout the divided stream of the river forms a number of islands, on which a covering of bushes gives the country some appearance of fertility, offering a striking contrast to the 700 miles of desert to the northward.

About full and change, the rise of the tide is perhaps 6 feet; the highest tide occurring about 48 hours after each. The tides are not felt beyond 3 or 4 miles from the land; the flood runs to the N.N.W. and N.W., the ebb the opposite way, with a velocity of from $\frac{8}{10}$ to 1 mile an hour. But near the mouth of the river when its waters are low, that is, in September and November, the tidal current sometimes attains a velocity of 3 miles.*

There is a small *fixed* light shown from the Government House at St. Louis, visible 5 or 6 miles.

The anchorage off the bar in from 6 to 9 fathoms, mud, is N.W. by N. ¾ N. of a mast erected on one of the sandy hillocks of Moussequiob, and carrying a

* Baron Roussin says that the tides in and out of the river " are so strong as to bring the vessels in the Outer Road (abreast the river's mouth) with their broadsides to the wind in the strongest breezes. And yet these outer tides have no very regular set; the flood, however, generally runs E.N.E., and the ebb W.S.W. Anchoring in the road is, moreover, rendered very inconvenient by the long swell that prevails there in all weathers."

flag. Anchorage may also be had abreast St. Louis, in from 8 to 10 fathoms, at about 2 miles from the beach, with the town bearing about S.E.

About 1¼ miles northward of point Barbarie, and near the Semaphore No. 5, are the houses of the pilots, where signals are made showing whether vessels can safely take the bar or not; in the former case a yellow flag is hoisted, and in the latter a blue flag. When the yellow flag is hoisted above the blue one, the pilots are on the bar, and vessels may steer so as to enter.

Water, wood, beef, mutton, and poultry may be procured, of a moderate quality, and not dear.

Directions.—Vessels bound for the river Senegal should make the land at all times a few miles northward of the parallel of 16°, which is that of St. Louis, because in the fine season both wind and current are from the northward, and in the wet season the southerly and south-west winds are feeble. The lead should always be used, as it will indicate by the diminution in depth the approach to the land, the bank off St. Louis being very regular. At 24 miles from land no bottom will be found with 90 fathoms of line; at 18 miles the soundings range between 70 and 60 fathoms, grey sand; at 10 or 8 miles from 22 to 16 fathoms, green mud; and at 3, 2, and 1 mile from 9 to 5 fathoms. In clear weather the land is visible at the distance of 7 or 8 miles, and the white houses of St. Louis will soon be made out, especially the Government house, and the white tower built at the northern extremity of the St. Louis island,—also the masts of vessels at anchor in the river. When within about 2 miles from the shore, the anchor may be let go in 8 or 9 fathoms, green mud; or according to the season, in 5 or 6 fathoms; a good berth will be found with the tower bearing S.E. easterly.

It is advisable not to approach the land nearer than into a depth of 6 fathoms, because of the rollers, which are frequent in all seasons, especially in November and December. The whole of the shore of the sandy peninsula is bordered by formidable breakers, which commence in the depths of 10 and 12 feet in the fine weather, but in the season of the rollers this surf begins in from 3¼ to 4¼ fathoms, according to their force. Indeed, in the latter period, some vessels have been much exposed when anchored in 5¼ fathoms.

Proceeding to the anchorage at night-time the soundings will be a good guide. As soon as the light of St. Louis is made out, steer so as to bring it to bear about S.E. by S., and drop the anchor in from 8 to 10 fathoms. When it cannot be seen, and there is a doubt concerning the vessel's latitude, the approach to the parallel of St. Louis may be known by the bank of green mud commencing in about 16° 14′ N. and terminating about 14 miles southward of point Barbarie. As soon as this kind of bottom is found it will be only necessary to steer to the eastward and anchor in 9 fathoms a little northward or southward of the parallel of 16°, which parallel nearly divides the bank into two equal parts; you can then take up a more convenient berth at daylight.

The bar of the river Senegal is not stationary; the peninsula forming the right bank below St. Louis is so low in parts as to be covered at very high tides which sometimes act so violently as to open new channels. BARON ROUSSIN states that Barbarie point is gradually advancing southward, a statement that appears very probable, for he gave the Lat. of that point in 1817 as 15° 55″ 18″ N., or 6¼ miles northward of the position assigned to it by Capt. Kerhallet in 1850.

The mouth of the river is not perceptible when coming from the northward, the huge surf which prevails on the whole coast preventing the surf on the bar from being distinguished, and, therefore, vessels might pass without seeing it if they keep at too great a distance from the land. But from abreast of St. Louis they may run safely along it at a mile distant, at which offing everything will be distinct. The flagstaff on the Downs of Moussequiob, abreast the entrance, will help to point it out. Anchorage should be taken up northward of the bar, because the wind generally comes from that quarter, and it is easier to communicate with the shore.

Coming from the southward the mouth of the river is more readily perceived as it opens in that direction.

The dangers of the bar are well known in the rainy season, and even up to March; the great volume of descending water frequently renders the bar impracticable even to decked boats. The waves of surf produced by the impetuosity of the stream meeting the ocean swell are so prodigious, and succeed each other so rapidly, that it is impossible to find a quiet interval. From April to the end of September, it is almost always passable by decked boats, and sometimes even by open boats when under the management of the natives.

Cape Verde.—Between the mouth of the Senegal and that of the Gambia, and nearly at equal distances from each, lies cape Verde, a wide projecting promontory Its western extremity, in Lat. 14° 44′ N., and Long. 17° 33′ W., is a mass of rocks, of moderate elevation and volcanic origin. In its character it greatly resembles the cape Verde islands, which are nearly 500 miles from it, in the Atlantic Ocean. The northern descent of this isolated mass is rather steep, and at its eastern extremity are two hills, rising about 600 feet above the sea; they are named the Paps of cape Verde and serve as a beacon to mariners.* The paps are discernible, in fine weather, at a distance of 25 miles; it is almost unnecessary to warn the mariner not to mistake for them the little Paps, of a similiar form, which lie 9 leagues to the eastward, as the direction of the land is considered sufficient to discriminate. Between the river Senegal and cape Verde, is the bay of Yof, which is too deep to afford anchorage, even close to the shore; vessels bound to the southward, should therefore keep well to the westward, to avoid the Almadie rocks, extending a mile off the cape.

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* On the western pap there is now a lighthouse, coloured white with a black cornice, which shows a light revolving every half minute at 370 feet above the sea, visible 27 miles from all parts of the sea horizon.

A small *red* light is also shown on the point of cape Verde (point Almadie). It is on the west hill of the cape, at nearly 2 miles N. 47° W. *(true)* from the revolving light, and can be seen from an offing of about 8 miles.

The *Almadie Ledge* consists of black rocks extending a mile from the extremity of cape Verde, most of which are awash, but in two or three places some rise 8 or 10 feet above the sea. Over them the sea breaks incessantly, and amongst them are some smooth spots, appearing like channels, fit for boats. The ledge may be coasted at the distance of a mile,there being, on the west, 35 fathoms of water, the bottom is of broken shells. Hence, to the northward, in an extent of 8 miles, the depth increases to 80 fathoms; bottom of mud and sand. To the S.E. the depth is not so much ; in running along these breakers and the coast, to a distance of 2 miles in that direction, which will extend to the meridian of the Paps, the depth varies from 25 to 30 fathoms ; the bottom sand and shells, or sand and rock. The depth continues to decrease to the E.S.E.

Cape Manuel lies 8 miles S.S.E. ¾ E., from cape Verde, the intervening coast being high, covered with trees, and generally terminating at the seaside in basaltic cliffs or sandy rocks. The cape itself is steep and high, formed of columns of basalt and covered with thick brushwood.

The lighthouse on cape Manuel is a square white building, 40 feet high, which shows a *red fixed* light at 170 feet above the sea, visible 8 miles.

The *Madeleine Islets* consist of a group of four rocks, lying 2 miles north-westward of cape Manuel, and about one mile from the main, with a safe channel between, but no stranger should attempt it without a previous knowledge.

GOREE.—Goree bay is an indentation of the coast eastward and northward of cape Manuel, and, except the Belair shoal, is free from outlying danger, which depths decreasing with tolerable regularity from 14 and 12 fathoms to the beach at the head of the bay. Its greatest width is 9, and greatest depth about 5 miles. Goree island lies in the outer part of the bay, at 2¼ miles E.N.E.-ward from cape Manuel, is the seat of the French settlement, and in Lat. 14° 40′ N., and Long. 17° 24′ 40″ W. ; it is merely a rock about ½ a mile in length from north to south, and about 2 cables' lengths in greatest breadth. The southern part, which is the highest, is about 500 feet above the level of the sea, and may be seen at the distance of 15 or 18 miles ; the rest of the island lowers rapidly to the northern point.* The landing-place is at a wooden jetty in a sandy bay on the north-east side of the island, between the northern point and the back of the hill just alluded to, but boats should nevertheless have an anchor and cable with which to veer in, as an awkward swell that frequently tumbles round the point might stave them if this precaution be not adopted.

The chief supply of water is obtained from the village of Hann, on the continent, northward of Goree island, as well as fuel and provisions. It may sometimes happen, therefore, that but a very limited supply of refreshments is obtainable.

The roadstead is north-eastward of the island, and here vessels are sheltered from S.W., by the west, to East, and perfectly safe from the beginning of

* A small *fixed* light is, we believe, shown from the citadel.

November to the beginning of July, but during the rainy season the squalls from the south-eastward are dangerous. The position recommended is ¾ of a mile N.E. from the landing-place, in 11 or 12 fathoms, stiff clay, with cape Manuel open westward of Goree island, where they can conveniently get under way with the wind from any quarter.

Directions.—Bound for this anchorage, in the fine weather, with the winds from north-eastward to north-westward, haul close round cape Manuel and the south end of Goree island keep by the wind on the port tack, with a lead going, and stand on till within a mile of the eastern shore of the bay, tacking there in 9 or at least 7 fathoms. If not able to fetch the road, make short boards along that shore, as the southerly current is less strong there, and sometimes even a northerly eddy will be found.

Should the wind be too far to the eastward to fetch close round cape Manuel, make short tacks up to it from the Madeleine islands, in order to avoid the strong S.W. current which always sets out as soon as Goree island opens.

From the above-mentioned berth, in the tornado season, a vessel may easily get out of the bay if the ground tackle cannot be relied upon; for this purpose it will be prudent to veer away nearly to the end of the cable so as to be able to slip when everything is ready, and before the weight of the squall comes, accompanied, as it generally is, with a deluge of thick rain, neither of which would be very favourable to the expertness requisite on such occasions. Having slipped, pass the north point of Goree in not less than 7 fathoms, and when westward of that point, whatever may be the violence of the squall, which is always from the S.E. by E. or E.S.E., the island will afford sufficient shelter to enable her to keep the wind nearly abeam till abreast the south point, when she may bear up to as far westward as W. by S. and pass cape Manuel. Thence the Atlantic is open, and nothing in the way but the Madeleines and the Almadic reef off cape Verde.

If intending to remain any length of time at the above anchorage, vessels should moor E.N.E. and W.N.W., so as to bring an equal strain on both in the heaviest squalls.

The *Belair Shoal* is a small patch of 2 feet water, with 3 and 4 fathoms close-to all round, lying nearly a mile eastward of Belair point, and 2 miles N. by E. ½ E. from Goree island.

Hann Bay, &c.—Belair point lies 2 miles N. ¾ W. from Goree island, and separates the bays of Dacar and Hann. In the southern part of the former stands the village of Dacar, where the negroes, by whom it is inhabited, will supply vessels with wood for fuel, and with small bullocks; from Dacar point clean ballast may be procured. At the head of Hann bay is the village of Hann, and vessels bound to it for water or supplies must be careful to avoid the Belair shoal, by passing eastward of it in 6½ fathoms, at 1½ miles from the point, or between it and the point at ½ a mile from the latter in about 4 fathoms. The anchorage is in 8½ fathoms at about ½ a mile from the watering-place, or nearer in according to circumstances.

Cape Naze.—From Goree bay the land bends round south-eastward and southward of cape Naze in Lat. 14° 31½′ N., which cape is composed of very high cliffs, the woody summits of which may be seen at a distance of 20 or 24 miles in clear weather. On the coast between Goree bay and this cape several native villages may be seen, which are frequented by the coasting vessels of Goree, for stock, &c.

PORTUDAL, consisting of a number of huts on the shore, is 5½ miles southward of cape Naze, and is frequented by the coasters of Goree. All the coast in its vicinity is bordered with rocks, and must not be approached too near; the roadstead is far from being a good one; and is fit for small vessels only, which lie close to the shore, athwart the little houses between the cliffs. The bank which lies off the village has a width of about a mile, and nearly dries in some parts at low water; the depth between it and the shore-reef is 3 fathoms, and there are 4 fathoms close to its west side.

Amboroo Bank.—About 12 miles southward of Portudal is point Serine, the intervening coast embaying a little; here there are two villages, and in front of them some rocky patches with shallow and irregular soundings, 3 or 4 miles in the offing. The foul and flat ground fringing the shore hereabout is connected with the Amboroo bank, the western elbow of which nearly dries at low water, and lies 5¾ miles W. ¼ N. from Serine point. From this elbow it trends N.E. by N. 3¼ miles, and S.E. 1½ miles, and is about ¼ a mile in average width. The bank may be known by the sea breaking over it in bad weather, or by a strong discoloured line of water. Close to its outer edge there are 5 and 4 fathoms water, but no vessel should approach it nearer than 8 or 7 fathoms. Between it and the shore there is a navigable channel 3 and 4 fathoms deep, used by vessels of light draught, which are beating up to the northward, for there they have smoother water and less current than outside.

Southward of the Amboroo bank the water shoals regularly up to 6 fathoms, which depth is sufficiently near for any ship to approach this coast, as inside that depth there are numerous shallow patches, especially about points Joal and Palmerin, and known to the small coasting craft.

River Salum.—Punshavel point, in about Lat. 13° 50′ N., is on the western side of the mouth of the river Salum, and is said to be gradually extending itself to the southward, owing to the large quantities of silt and sand brought down by the river. This river has a good depth of water in it, and is navigable for vessels of 250 or 300 tons burthen to a considerable distance up, but there is a bar at its entrance whereon are but 12 feet at low water, and subject to frequent changes, so that strangers are compelled to have the assistance of a pilot. The people of Goree are intimate with the river, and can act as pilots.

The River Joombas, like the Salum, is of considerable size, and empties its waters into the sea immediately southward of that river. The quantities of silt and sand brought down by the Joombas have formed immense banks at its mouth, which confine the channels, and make the entrance too difficult for a stranger.

SENEGAMBIA, exclusive of Senegal, comprises the coast between the rivers Gambia and Shebar; it is the most indented, and, from its generally low character and the shoals and reefs which lie off it, perhaps the most dangerous portion of the western coast of Africa. Southward of the entrance to the river Gambia, as far as the river Casamanza, the coast is very low, with a sandy beach covered with trees, which, about the river San Pedro (13° 7′ N.), appear like a continued forest with lofty clumps resembling islands, when at a distance. The land about *Cape Verga* (10° 12′ N.) is unlike the adjacent shores, rising at once from the base of the cape into high hills, and when seen from the southward, in connexion with a conspicuous eastern range of hills, is one of the most remarkable landmarks on the whole coast. South-eastward of cape Verga the shores resume their low and swampy character. The Paps of Soumba, in Lat. 9° 58′ N., rise, from a range of high land, to 1700 feet above the sea, and mount Kakulimah, 11 miles farther south-eastward, attains an altitude of 2900 feet; they cover a large space, and may be seen at a considerable distance.

The land southward of Sierra Leone river appears in a double range of high mountains, the southern end of which is the most elevated, and though its summit is generally enveloped in clouds, it is often seen at a distance of 40 or 45 miles. Southward and northward the coast is of the usual low character. On the south side of Sherbro island the land is thickly wooded, the forest everywhere advancing to within a few yards of the beach.

WINDS.—On the coast of Senegambia, between September or October and May (the fine season), the prevailing winds are from N.E., by the North, to N.W. and W.N.W. From the isles de Los to cape St. Anne they prevail from E.N.E. and W.S.W., passing by the North; in this interval the sea breeze lasts from 10 or 11 o'clock in the morning till midnight, the change taking place round by the north, after an interval of calm, or only a successive change of wind from W.N.W. and N.W. to North and N.E.

The solar breezes are settled and regular on this coast; they are mostly moderate, though occasionally strong, varying from N.N.E. to North in the morning, and from North to N.N.W. and N.W. in the evening.

In the rainy (or winter) season the prevailing winds are from S.W., changing to W.S.W. and W.N.W., blowing sometimes strongly from the West, but generally speaking they are so light as to give way in the afternoon to the N.W. sea breeze.

Tornadoes make their appearance before the rains, sometimes by a month, and again return after the rains have ceased. They blow from East to S.E., and with great fury, but they seldom last more than 3 hours. They are generally preceded by a light arch in the east, with dark clouds and occasional flashes of lightning. A dense white cloud in the centre of the arch denotes a powerful blast. The instant those appearances are perceived, all sail should be furled, and the vessel put before the wind, for which there is barely sufficient time. See also page 68.

Currents.—As far south as cape Roxo the current follows the direction of the coast, interrupted only at the mouths of the principal rivers. From this point, localities of a very different nature produce particular effects in the current. The Bissagos islands here succeed the straight coast which extends to the northward, and in their vicinity several large rivers discharge their waters, forming channels more or less encumbered with sand banks; these obstacles cause a variety of currents of which we have but little reliable detail. In the rainy season, when the winds blow from various directions, the currents are often irregular, so much so that it is impossible to establish any positive law respecting them. It may, however, be generally stated that the easterly current from across the Atlantic strikes the coast southward of the Bissagos archipelago, and near the shore assumes a south-easterly direction, towards Sherbro island and the gulf of Guinea, running with great velocity.

Rollers.—The surf on this coast is extremely heavy, the rollers sometimes curling in 5 fathoms, and breaking tremendously in 3 or even in 4. They may generally be expected at the latter part of the rainy season, and chiefly about the time of new moon; therefore, during this period vessels should avoid anchoring in shallow water in unsheltered places, particularly in the neighbourhood of a large river, as the danger is increased by the influence of the ebb tide.

River Gambia.—This noble river is stated to have its rise in the plateau of Fouta-toro, whence it has a north-westerly course for 700 miles, and empties itself into the Atlantic about 90 miles south-eastward of cape Verde, its embouchure extends from Punshavel point to cape Bald, 27 miles, but soon contracts, between Bird island and cape St. Mary, to 10 miles in width. Between Bathurst and Barra point the breadth decreases to 2 miles, but immediately above the town it expands to 7 miles; at Dog point it is 4; at Albreda, 3; and at Moota point, 1½ miles wide, gradually diminishing, till at Macarthy island (about 150 miles above the entrance) it is not ¼ of a mile across. The course of the river is very tortuous, and divided by several islands, yet large vessels may ascend the whole distance.

Capt. Belcher says—"The Gambia, considered in a mercantile point of view, and as regards supplies, appears to offer more decided advantages than any of our possessions on the coast of Africa; and may, indeed, be said to be the only point where anything approaching to trade can be satisfactorily pursued. Even in its present state it is by far the most healthy part of the coast; and, had a portion of the liberality of Government of Sierra Leone been extended to Bathurst and its dependencies, I feel satisfied that, long ere this, it would have acquired that character which eventually, with infinite labour, it will establish for itself from its own resources."

The town of *Bathurst* stands on the east side of St. Mary island, a fertile, but low and swampy spot about 4½ miles in length and 2 in breadth. It is described as a prosperous-looking town, with several excellent stone houses, especially on the wharf where the houses of the merchants are situated. It is about 6 miles within cape St. Mary, on the south side of the river's entrance, and its flagstaff is in Lat. 13° 28′ N., Long. 16° 35′ 16″ W.

Water is procurable at Bathurst, but only by permission of the merchants, all the wells being private; but it cannot be considered good, except for culinary purposes; a better quality may be had at Jillifree, 16 miles up the river. Wood can also be had at the latter place, or it may be purchased at Bathurst. Provisions are as abundant as on other parts of the coast, and there is a tolerable market every day at 10 A.M. at Bathurst.

The stream continues to flow for 1½ hours after the tide has ceased rising by the shore. The greatest rise in the dry season is 5 feet 11 inches, and during the period of the rains, 9 feet. The velocity often varies considerably. The ebb thrown off by Barra point sets strongly down upon St. Mary shoal, while the main stream runs over the middle ground. Further out, in mid-channel, it sets directly to seaward, but near the northern shore it is influenced by the tides of the various creeks, and by the rivers Joombas and Salum, before they unite and take the general direction of the coast.

Bird Island is the southernmost of four small islands lying on the extensive bank formed between the mouths of the rivers Joombas and Gambia, and is (or was) distinguished by two staffs—one rigged and the other not. Its south end is 9½ miles N.N.E. ½ E. from cape St. Mary, and nearly 2 miles from the shore of the main, thence it trends north-eastward towards the other islands and the coast.

Bird Spit, the western extremity of the great bank whereon are situated the Bird islands, is 4¼ miles W.N.W. ½ W. from the before-mentioned rigged flagstaff on the southernmost of that group, and nearly dries at low water, while immediately without it there are 4 and 4½ fathoms. This spit, and indeed the whole of the bank northward and southward thereof, is particularly dangerous, especially during the period of the Harmattan, because at that time, when estimating the distance of the shore, the haze makes it appear further off than it really is, and also because the soundings afford no guide.

The Horse-shoe Bank is so named on account of its shape, and though CAPTAIN OWEN did not discover less than 3¼ fathoms upon it, report states it to have but 2 fathoms over some parts. The centre of the convexed portion is 5½ miles W. ½ S. from Bird island flagstaff, and N. ½ W. 8¼ miles from cape St. Mary.

The *Bijjols Islands* are two little islands, covered with grass, and surrounded by reefs of rocks; they lie 1¼ miles off cape Bald, but the rocks, over which the swell always breaks, extend 2 miles further out. Some of these outlying dangers uncover at half ebb, but there are 3 or 4 fathoms at ¼ of a mile outside their western extremity, which bears W. ¾ S. 13½ miles from cape St. Mary, and 4 miles W.N.W. from cape Bald.

The whole of the space between these islets and cape St. Mary is interspersed with sunken reefs, extending a considerable distance from the shore, which should, therefore, be approached with caution.

St. Mary Shoal.—The coast from cape St. Mary to the town of Bathurst is fringed by a broad and rocky flat. The north-eastern part, usually named St. Mary shoal, extends in a N. by W. direction 5½ miles from the shore near the flagstaff of Bathurst, being separated therefrom by a very narrow channel of 10 feet water; this portion is extremely shallow, about ½ a mile broad, and steep on its eastern side towards which the ebb tide flows with great strength. On its western side the decrease in depth is more gradual. When upon its north extreme, cape St. Mary bears W. by S. ½ S. 4 miles, and Barra point S.E. ¾ S. 4¾ miles.

The *Middle Ground* is separated from the north end of St. Mary shoal by a channel from 8 to 6 fathoms deep; it extends in a N.W by N. and S.E. by S. direction 1½ miles, and is about ½ of a mile in average width. The soundings over it range from 13 to 18 feet, and when upon its centre Barra point bears S.S.E. about 4½ miles, and cape St. Mary W. by S. ¾ S. distant 5½ miles. On its eastern side there is a white buoy, which must be passed on its eastern side. Soundings of 4 and 5 fathoms will be found at a very short distance off all round.

In the western entrance of the channel formed between St. Mary shoal and the middle ground, there is a patch of 12 feet water, lying in the fairway through; and another of 18 feet at 1 mile further northward, from which cape St. Mary bears S.W., southerly, 4½ miles, and the buoy on African knoll E. ¾ S. 2½ miles. On account of these two small shoals it is advisable for strangers to enter the river by the channel northward of the Middle ground, but in doing so it will be necessary to guard against the African knoll.

The African Knoll occupies the fairway of the channel between the middle ground and the broad flat fringing the shore about the mouths of the rivers Fellaney and Jinnak, and has only from 12 to 18 feet over it; its extent is about ¾ a mile N.W. by W. and S.E. by E., and ½ of a mile broad, and around it close-to are from 4 to 7 fathoms. When upon its centre cape St. Mary bears W.S.W. ½ S., distant 6½ miles; Barra point S. by E. ½ E. 5½ miles; and the eastern extremity of the town of Bathurst S. ½ W. The north-western edge of the knoll has a black buoy upon it, which should be passed on its north side.

The shore of the main hereabout cannot be approached, in some places, nearer than 2¾ miles because of the extensive off-lay therefrom. At Barra point, however, its edge is not distant from high-water mark more than ½ of a mile; but within the point it again increases in width on this, as also on the other side of the river.

Anchorage at Bathurst will be found in 12 fathoms, with the back and outline of the fort appearing as the outer objects. Nearer to the fort the holding ground is bad, but there need be no fear of tailing on the beach, as it is steep-to, and a vessel may ride within 50 yards of the fort, without touching.

Directions.—Approaching the Gambia direct from seaward the depth of 20 to 25 fathoms will be found at the distance of 30 miles from the land, and at 17 miles west from Bird island are only 10 fathoms; at this latter distance, in clear weather, the tops of the trees will be just visible: as the low land upon which they stand gradually rises, the sameness of feature and absence of prominent objects is such, that nothing but the wide open space of the river's mouth serves to indicate the vessel's position, till the flagstaffs on Bird island are discerned. These may be seen in clear weather at the distance of 10 miles, and when once seen they will, with the aid of a cast of the lead, determine the vicinity of the river's mouth.

In proceeding towards the Gambia from the southward, it may be made with the same facility as when approaching from the westward, either of which should be preferred by a stranger to making it from the northward.* Over the Bijjols, the only danger to encounter, the sea always breaks heavily, and, as the adjacent land is high, a good estimate may be formed of its distance. A safe and sure guide is not to approach the land nearer than into a depth of 6 fathoms; observing, also, that the nature of the bottom differs from that to the northward,—the sand being softer, with a mixture of mud.

Having thus passed the Bijjols, vessels should steer for Bird island, so as to obtain a pilot. With a N.W. or N.N.W. wind, there will be no difficulty in fetching this island, especially with the ebb setting out of the river; but if the flood has commenced it will be safer to pass the Bijjols in not less than 8 fathoms. Should the weather be hazy, great care must be taken with the ebb, not to overrun the distance and get thrown upon Bird spit, before the flagstaffs are seen. When the staffs are made out, bring them to bear N.E, by E., and steer in that direction towards them, which will clear the Horse-shoe bank, and when you are within 8 miles, if the pilot signal has been kept flying, one will probably come off. If such should not be the case, and time is of the greatest importance, then the following directions, by Captain Belcher, R.N., may be of assistance in entering the river in fine weather.

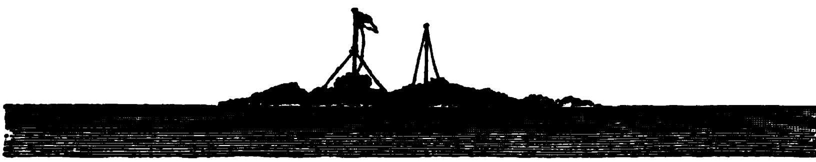
"The best latitude on which to approach the entrance of Gambia is 13° 33′ N. The first soundings, when in a situation to look out for Bird island, will be according to the time of tide, in 5 or 6 fathoms, softish sand. Should mud be found, it will be proper to edge southerly until a cast of sand, or sand and mud mixed, be obtained, which will be on the extreme limits of the bank, and about 10 miles from a shoal named the Middle Ground, but towards the southern side of the channel. From this position the Convalescent house on cape St. Mary will be visible, and Bird island will then bear about E.N.E.; but E. by N. should be made good until the flagstaffs on that island can be clearly discerned.

About the same time that Bird island is perceived, a remarkable round-topped tree will be seen on the mainland to the eastward, between E. by S. and E. by N.; it is one of the principal marks of the pilots, and is noticed in the chart about 8 miles inland of Booniadoo point. Before bearing away for the channel, this tree

* The general colour of the coast about cape St. Mary is variable, becoming whiter to the westward, and then reddish, and further southward changing into grey sands. Bald cape may be easily known by a high tree, in form like an umbrella, and also by a large square bush about ¼ a mile further southward.

should be brought to bear E.S.E. ½ E., and Bird island staffs N.E., with which bearings they will have the following appearance, the centre of the rigged staff being in one with a wild plum bush. The depth there will be 4¾ or 5 fathoms at low water.

Rigged Staff. Black Staff.



Bird Island. Plum Bush in one with Rigged Flag Staff, N.E.

Thence steer directly for the tree, or keep it just over the port cathead, until the two staffs on Bird island are in one, about N. by W.

The mouth of Jinnak creek will now be clearly seen to the left of the tree; and the two projecting points of sand, A and C.* on its northern shore, in one with the intermediate projection from the southern shore B. as shown in the chart, and bearing about E. ½ N., will clear the African knoll to the northward. Pilots seldom attempt the channel to the southward of the African knoll in vessel drawing more than 10 feet. Before bearing up for the channel, the line of the two staffs on Bird island must be crossed to the eastward, and the Black staff brought clearly to the left, or westward of the Rigged staff.

Another confirmatory mark in clear weather (when within the knoll) will be cape St. Mary appearing as below, and bearing nearly S.W. by W. ¾ W. If carefully watched, the point of this cape on which the the Convalescent house is situated will suddenly change its appearance, from the circumstances of its shutting out a low sandy beach (which before rendered the point undefined) so as to become a distinct point with the trees to the horizon.

Convalescent House.

Cape St. Mary, bearing S.W. by W. ¾ W.

Being now clearly within the African Knoll, the vessel may be steered for Barra point till past the middle ground. But it must be observed that both the ebb and flood of the main stream, as well as of the creeks, bear distinctly towards the middle ground and African knoll, and therefore the black staff on Bird island

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* See Admiralty Chart of the River.

must be still carefully kept open to the westward of the other, as before directed. The tendency of those staffs to close, or not, will always show the actual set of the tide. The middle ground having been thus passed, and the lead kept going, steer so as to keep Barra point flag-staff open on the port bow, and not to shoal the water under 6 fathoms, till Bathurst flag-staff is clearly visible. When it bears about S. by W. ½ W. it may be safely brought over the starboard cathead. Should the flood be running, bear in mind that abreast of Bathurst it sweeps up rapidly, therefore clew up and prepare for anchoring east of the staff."

The foregoing remarks are based upon the existence of the Bird island staffs and the buoys; the staffs, however, were blown down and washed away in 1851,* but it is more than probable that those useful guides were replaced as soon as possible after they had been sent adrift or were washed from their stations.

When leaving the Gambia the directions to be followed are, generally speaking, the converse of those for entering. The best time to leave the anchorage at Bathurst is on the last of the flood, so as to gain the mid-channel before the full making of the ebb, which, as it sets directly over the middle ground, would compel you to anchor (with light winds) in order to avoid it. This would occasion the loss of that day's tide, unless the sea-breeze should come in sufficiently strong to enable the vessel to weigh again, and to stem the ebb; with that chance in view, the anchor should be dropped sufficiently soon to preserve room for weighing.

Further down the river, the sea-breeze from north-westward is always a beating wind, and even the land-breeze in the morning has but seldom sufficient easting to lead out without making a tack, especially as when it is the most favourable it has the least strength.

From the anchorage, stand over towards Barra point, and as soon as practicable, get to the eastward of the line of the two flagstaffs on Bird island. Use the lead frequently, and make very short tacks off the eastern bank, particularly when so far advanced as to have the round-topped high tree (before mentioned) bearing East, because near the African knoll the velocity of the ebb is the greatest. The

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* The following is an extract from a letter from Capt. Simmons, of the *Standard*, of Bermuda, received in Sept. 1860:—

"We, the undersigned, do hereby certify and state that all the charts and sailing directions for the coast of Africa, that have come under our notice are incorrect, as regards the entrance to the Gambia; Bird island having now entirely disappeared; the flag-staffs also have been washed down for several years. The high tree that stood out in the Barra country, forming a leading mark for the African knoll, has, also, either decayed, or been cut down by the natives. There are now three large nun buoys indicating the principal dangers of the entrance; one, painted *red*, off Bird spit, which is a guide to the navigator making cape St. Mary from the northward; one, *black*, on the north-east part of the African knoll, which must be left on the starboard hand going in; and one, *white*, on the eastern side of the Middle ground, which must also be left on the starboard hand. All ships bound in will make both buoys about the same time, as she approaches the knoll.

(Signed) Abraham Simmons, Bermuda.

J. A. Johnstone, Bathurst.

rule to avoid that knoll should be remembered—viz., to keep the black-staff westward of the rigged one till the tree bears E. by S., or till the two projecting points of sand on the north side of the mouth of Jinnak creek come in one with the intermediate projection from the southern shore, bearing about E. ¼ N. The ship will then be fairly northward of the African knoll, and then, by bringing the tree to bear E. by S., you may steer out to sea with that bearing over the stern.

River Casamanza.—From cape Bald the coast trends S. by W. ½ W. 48 miles to the mouth of the river Casamanza or Cazamance. The water off this port is very shallow, the bank suddenly curving outwards; and abreast of the river Souta (Lat. 12° 44′ N.) and 15 miles from the land, there is a 4-fathom's bank, 5 or 6 miles in extent. On the north point of the entrance of the river Casamanza, there is a pyramidal beacon, and another on the south side, which, with a tree, is used as the leading mark (1862) for the grand or middle channel into the river. There are two other channels—the Djoque or north channel, and the Guimbering or south channel—but they are all subject to such frequent changes, through the shifting of the extensive banks by which they are bounded, and which extend as far seaward as 4 miles from the river's mouth, that no description of them would be of any utility but for a short time, so that strangers are advised to take a pilot. The middle channel is the deepest, though not more than 15 feet can be carried through it at low water.

On the north point of the river's entrance there is a French establishment, and 30 miles further up, on the southern bank at *Berrin*, there is another; and 9 miles further, on the same side, at Zinghinchor, the Portuguese have a factory, up to which a considerable depth of water may be carried; indeed, the river is navigable by large schooners much farther than Zinghinchor.

Cape Roxo.—From the river Casamanza the coast bends round southward a distance of 14 miles to cape Roxo, a low sandy point with trees and bushes.

River Cacheo.—From cape Roxo to Cayo point (Jatt island), the bearing and distance are S. by E. ¼ E., 37 miles, the intervening coast bends inwards and forms a bay, at the head of which is the mouth of the river Cacheo. This bay is almost wholly occupied by sand banks, which change in shape and extent, and are so numerous, that, in the absence of prominent and known land-marks, a description of them is useless. A line drawn from cape Roxo in a S.S.W. ¾ W. direction, and another N.W. ¼ N. from Cayo point, will give the north-west and south-west or seaward limits of these shoals. There are two main channels between them into the river—viz., the direct channel and the south-west channel. The former has its entrance about 12 miles S.S.W. ¼ W. from cape Roxo, and thence runs in, first E. by S. 14½ miles towards Jufung bush, then E.S.E. easterly, 6 miles, and afterwards S.E. over the bar into the river. The soundings in this channel are 7, 4½, 2½, 6, 4, 7, and 2 fathoms over the bar, liable, of course, to great alterations.

The South-west channel, in about 12° N. and 16° 36′ W., and N.W. ¾ N. 16 miles from Cayo point, thence it runs in N.E. by E. 11 miles, and afterwards east up the river; the least water in it at low tide, 2½ fathoms over the bar.

In the absence of anything like definite instructions for these channels, it may be observed that the best course to adopt is to obtain a pilot, but, if unable so to do, then a very satisfactory rule should be borne in mind, which applies to this as well as to the other rivers on this part of the African coast—viz., that in the channels the bottom is always of soft mud, but on the bank always hard sand; and, therefore, the careful use of the lead will give immediate notice of any deviation from the fairway, when, with a chart of the entrance on a good scale, the proper course can soon be adopted in order to gain it.

Commander Thomas Miller, R.N., says—"The ebb tide in the Cacheo, as also off it, sets to the N.W., and the flood to the S.E.; but the ebb is nearly always running. I was for some time on that part of the coast, and ascertained that the ebb generally ran 8 hours, while the flood rarely ran more than 4, nor could it be called the regular flood tide, but merely a slack water, or cessation of the ebb. Towards December, after the rains are over, and the Harmattan season has set in, the wind generally blows very strong from N.E. and E.S.E., which tends considerably to strengthen the ebb, and during that season vessels at anchor rarely swing to the flood." Bolola point, the north point of the entrance of the Cacheo, is low; here the shore turns abruptly to northward (above a mile) to the village of *Bolola*, where there is a Portuguese resident, and up to which an intricate channel may be found carrying not less than 8 fathoms close to the houses.

Cape Mata, the south point of the river's mouth, has anchorage off it in 5 fathoms, in the middle of the river. At 11 miles above this point is *Cacheo Fort*, on the south bank of the river, off which a vessel may anchor in 5 or 6 fathoms good holding ground.

The town of *Batoor* stands on the south bank of the river Cacheo, about 65 miles above Cacheo fort, is the largest town on the river, and the inhabitants are the most civilized; the population, belonging to the Mandingo tribe, is, however, not numerous.

Farin is situated on the northern bank of the river, 15 miles above Batoor, and is but a small place with a few natives, and in the custody of a Portuguese officer. There is said to be easy communication hence with Bissao on the one hand, and on the other to the Casamanza and the Gambia.

After the two entrance points have been passed, with a chart of the river there appears but little difficulty in navigating it, and vessels of any draught able to pass the bar may freely proceed, not only to fort Cacheo but to Farin, by keeping in mid-channel (and, as in all other rivers, by avoiding the points), and, when abreast Sara creek, by borrowing for a mile or so on the southern shore. The flood-tide is scarcely felt above Salsang, and the current is not very strong in any part of the river, except towards the end of the rainy season, which, it is said, commences in the month of June.

The Jeba River may be said to empty itself into the sea by a number of channels around and among the islands known as the Bijouga or Bissagos group. The principal and northern, named the *Jeba Channel,* flows between Jatt, Bassis, and Bissao islands, on the north,—and Carashe, Corbelha, and Formosa island, on the south side; it is 15 miles wide at its entrance, which gradually decreases in width till it joins the main stream of the river at Bernafel point. The soundings in it range from 5 to 20 fathoms, but its free use is much obstructed by detached and projecting banks and shoals. Most of these, however, are composed of hard sand and are steep-to, so that the unceasing use of the lead is only really efficient by showing the nature of the bottom, which in the channels is generally soft mud, and round the edges of the banks hard sand; and, therefore, instant attention should be paid to the change thus indicated.

Anchorage.—A vessel may anchor anywhere in the Jeba channel, the bottom being of soft mud and excellent holding-ground, with the exception of one place at 3 miles southward of Bassis island; here the depth is from 20 to 22 fathoms, and the bottom of coarse gravel. In all other parts of the channel the depth varies from 18 to 6 fathoms, without any sudden alteration.

Vessels bound for this channel should steer for the land, in the latitude of the Cayo islands, that is, in 11° 50′ N., and then shape a course E.S.E. easterly, across the great Jeba flat in 8, 7, and 6 fathoms, till those islands are seen a little ahead,* or a little on the port bow; leave them to the northward distant one or two miles, and steer S.E. ½ E., passing southward of Arlett bank. When Abreast Arlett point, which, though very low, may be known by a village near the shore, alter the course to E.S.E., so as to preserve the fairway through the passage between the Martinho and Arriscado banks, and when Martinho point bears E.N.E. and Biombo point N.W., they will be in 10 fathoms, a short mile southward of the former bank. From this position steer East a little northerly, so as to keep the northern shore aboard, as well as to avoid a too near approach to the suspicious flats which project northward from the Gancho banks, and a run of 18 miles will carry you abreast of Bernafel point, which should have a berth of 1¾ or 2 miles.

The town and fort of *Bissao* will now be visible, and also two conspicuous islands named Pissaro and Rey; bring the latter half-way out eastward of the former, and steer in that direction, running along the east side of Pissaro, at the distance of ½ a mile or less. Haul up now towards Bissao fort, and anchor either half way between the islands, or proceed at once to the town, off which a good berth may be had in 7 fathoms' water.

Bissao fort is a square building with four bastions and several guns, standing about a cable's length from the beach. The Portuguese garrison consists chiefly

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* The Cayo islands lie close to Cayo point, and appear at a distance like three small hummocks, but at low tide their bases unite. They are not high, but their dark lofty trees stand out very conspicuously from the low land behind them.

of convicts and mulattoes, except the officers. Refreshments of all kinds are obtainable, but at high prices, small bullocks costing from 20 to 25 dollors each, and goats, pigs, and poultry in proportion. Rice, maize, and yams, and several kinds of fruits, such as bananas, water melons, limes, oranges, &c., are cheap, especially if gunpowder, clothes, or brandy are offered in exchange. If strangers require a very large supply they must obtain the sanction of the governor.

The watering-place will be found a little westward of the fort, and consists of pits 3 or 4 feet deep, the produce of which will not allow of more than 30 barrels to be filled in a day, and then it requires to be filtered for drinking. It is, however, said to be wholesome, and to keep well. Wood is obtained only at very high prices, though most part of the country is covered with forest; but the climate, as well as the hostility of the natives, will not allow the crew to land and cut it for themselves.

Tides.—The usual prevailing currents on the coast northward of cape Roxo are found to be completely changed on passing that cape: they have no longer one direction, but, in all the channels of the Bissagos, are superseded by tides, which are more or less regular; those in the Jeba channel are perfectly so. Westward of the isles Cayo the flood sets S.E., and the ebb N.W., each six hours, or nearly so, with the exception that the current gradually assumes these directions, requiring nearly an hour from the change, before it is completely settled in its course. The flood generally sets to the northward, and the ebb to the southward. The greatest difference which has yet been observed between the high and low water marks is 8 feet; and, at the equinoctial full moon, the rate of the flood and ebb is about one mile and two-fifths an hour; at other times it never exceeds one mile.

From the meridian of Cayo, and as far as that of the isle of Boun, the stream follows the direction of the channel; and here the tides are regular. It is not known that the length of the ebb exceeds that of the flood. The greatest rate of either never exceeds 2½ miles per hour, in spring tides; and the rise is found to be 8 feet, as outside the channel.

At the anchorage the eastern stream continues till 12½h.; velocity at springs, 2½ or 3 knots.

The Winds in the Jeba channel nearly follow the direction of the land, and vary their course according to that of the channel. They vary from West to North; while at the anchorage of Bissao they commonly blow from the S.W., except in the morning, when they are from the northward. In the rainy season, which commences in June and continues about 5 months, they blow from the S.E., with the tornadoes, the same as on the coast, and then, passing round by the south, return to the northward.

The Orango Channel leads into the Jeba river, and also into the Bolola river or *Rio Grande* of the Portuguese. This channel has its entrance in Lat. 10° 45′ N., and Long. 15° 55′ W., and runs in between the islands of Orango, Kanabak, and Gallinha, on the west, and the Jamber group, Bulama and Arcas isles, and the mainland, on the eastern side. Its inner part is divided into the Kanabak beach, the Bulama and Arcas channels, and, with the exception of the last, deep water will be found throughout. The Arcas channel is the most intricate as well as the shallowest portion, for not more than 4 fathoms can be relied upon in passing through, though generally the soundings obtained will vary from 5 to 12 fathoms.

The banks at the entrance of the Orango channel are numerous and extensive, but they leave a clear and deep passage between them, 8 miles wide On the western side are the south breaker, and the Ætna patches, and Orango reef, and on the eastern side the Pullam shoals.

The *South Breaker* is believed to be the southern angle of the great bank, whereon the Bijouga islands stand, and will serve as a guide to vessels bound into the Orango channel, for the sea breaks over it at all times very heavily. It has but 2 fathoms least water upon it, and lies 21 miles southward of Orango island, the nearest land, in Lat. 10° 40′ 30″ N., and Long. 16° 8′ 30″ W. Though no dangers have been discovered southward of this, yet there are said to be some suspicious soundings in the offing, and as detached rocks and small knolls are frequent in these parts, it is advisable not to round the breaker in a higher latitude than 11° 35′ N.

North-eastward of the south breaker is another shoal, long and narrow, and covered with only 12 to 18 feet of water; and to the northward are several long ledges of rocks, with some sand banks to the westward of them; the latter are named the Ætna patches, and become dry at low water. There are probably other dangers in this locality, on which account no vessel should go to the northward of the south breaker.

The *Orango Reef* extends S.W. 10 miles from off cape Cameleon, the south-east point of Orango island. Over this reef there are always tremendous breakers, the appearance of which will always keep vessels at a respectful distance. The water shoals rather suddenly on its eastern side, and the tides set rather sharply round it, and in some places across it.

Pullam Shoals, &c.—The islands Jamber, Cavalho, and Mel form a group on the eastern side of the Orango channel; southward of these is the little island named Pullam, so called from the lofty Pullam trees it carries. Reefs and foul ground surround this island in every direction, extending 5½ miles to the southward, 4½ miles to the north-westward, and 11 miles to the northward. The whole space occupied by this group is replete with dangers, and should be avoided, or very cautiously approached. In some places the soundings decrease in one cast of the lead from 24 to 5 fathoms, and then, perhaps, aground.

Directions.—Into the spacious estuary forming the mouth of Orango channel, the most timid stranger may work with perfect security, provided due attention be paid to the set of the tides, that the lead be kept going when nearing either side of it, having in mind the remarks made on p. 540 in reference to the banks and channels of the Jeba river, and also that he adopts the useful precaution of keeping a look-out at the mast-head for ripples or discoloured water.

The fairway course up the channel from abreast the south Breaker is N.E. by E. 38 miles, till up with the south end of Kanabak island. The same course will also lead up to Barel point, which may be known by being higher than the rest of Kanabak, and is also conspicuous from the red rocks of which it is formed. Hence, towards Bolola channel steer N.E. ¼ N. 14 miles, which will bring you to the confluence of that channel and the Bulama. To proceed up the Bolola channel, steer for Nalou point, which appears to be approachable, and give it a berth of 1 or 1½ miles, after which shape a course for passing either east or west of the Mao bank.

Port Beaver is easy of access, the anchoring-ground good, the shelter perfect, and the facilities for landing excellent. It is formed by the eastern side of Bulama island, Calypso, and Biafares, and has from 8 to 20 fathoms of water in it. Fresh water is obtainable, and probably some refreshments.

To proceed through the *Bulama Channel*, in mid-channel, the course is N.N.W. ¾ W. till midway between Bulama point and the opposite extremity of Gallinha island. This will equally avoid the Hacket reefs on the one hand, and, on the other, the eastern prong of the large shoal which seems to connect the islands of Gallinha and Kanabak. These shoals are too steep to admit of being approached by the hand lead; therefore, a large vessels ought not to pass within the depth of 16 or 17 fathoms.

The *Arcas Channel* is formed by the Bulama and Arcas flats on the eastern, and the Gancho banks on the western side. Abreast the Pedralva rocks,* the narrowest part of the channel, it is only 1½ miles wide. Along the edge of the Arcas flats, portions of which dry at low tide, the depths are very irregular, and, consequently, should be very cautiously approached, by having two expert leadsmen in the chains. The bottom throughout the channel is very uneven, which produces, with the tides, overfalls which sometimes appear alarming.

When passing Bulama point give it a berth of a mile, and steer N. ¼ E., and as soon as the principal tree of St. Martin's Grove (Bissao island) bears N. ½ E., bring Passaro island to appear half-way between Middleton point and Rey island, and haul up in that direction, following, when near the Passaro, the directions given on pages 540-541 for proceeding to Bissao. It should be distinctly remembered that the flood in the Arcas channel sets north-eastward and the ebb south-westward, obliquely athwart the banks.

In most parts of this channel the anchorage is good, though there are some deep holes and some shallow spots, which last are probably indicative of foul ground in their vicinity; over them there is generally a strong rippling. Upon the approach of any of the fierce tornadoes so common on this coast, vessels ought to anchor immediately.

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* Capt. Denham, in 1847, placed a wooden beacon on the highest part of these rocks, carrying two cross diamond-shaped vanes, but Com. A. H. Gardiner, R.N., says, in 1851, that the beacon was washed away in the previous year by a tornado. Up to 1862 no information of its replacement had been received.

The WINDS in the Orango channel are generally light in the fine season, particularly in the morning and evening. They set in gradually in the afternoon, and almost blow constantly from S.S.W. round by West, to N.N.W.: they remain but a short time at any intermediate point, and soon follow the direction of the land, which trends nearly N. by E. and S. by W. During the rainy season, easterly winds are prevalent, to which period winds from this quarter are entirely limited.

The TIDES are as regular in the Orango channel as in the Jeba channel. The length of the ebb is equal to that of the flood; the former sets to the northward, the latter to the southward; but the different points of the channel, and the irregularities of the bottom, affect those directions. The strength of the stream varies according to the breadth and depth of the channel, being greater where it is confined than in the wider parts; it is, consequently, more considerable in the strait of Bulamà, and the Jamber pass, than in any other part. Nevertheless, it seldom exceeds 2½ miles an hour, but is frequently as much as 2, at 2 miles to the westward of Pullam island.

BIJOUGA OR BISSAGOS ISLES.—These islands form an extensive archipelago at the mouths of the rivers Jeba and Bolola or Rio Grande, and stand upon a great triangular bank, bounded by the ocean, the Jeba channel, and the Orango channel. With the exception of some few bare and unproductive rocks, they are about 15 in number, the largest being named Orango, Formosa, Carashe, and Kanabak, and occupy a space about 50 miles long and 30 broad. They are of volcanic nature, very fertile, and are considered healthier than the main land, but generally deficient in water. They have not been sufficiently surveyed to enable strangers to make free with the various channels among them; indeed, at present there appears to be no inducement to penetrate this group, or to have any other intercourse than that afforded by the Jeba and Orango channels already described. Their western and south-western side should not be approached nearer than a depth of 10 or 12 fathoms, for, within it, numerous patches of rock, shoals, and the rollers would render the attempt to do so a very dangerous one.

The Commander of H.M. ship *Leven* says :—" The idea we had formed of these islands was extremely erroneous, as, instead of being low and marshy, with scarcely a channel for boats between their muddy shores, we found them a cluster of the most beautiful, fertile, and inviting islands, with moderately high and bold shores, separated by deep water, and containing many fine harbours, most of them being inhabited, and each village having its independent ruler. According to the customs of these people, every vessel stranded upon their shores is forfeited to the chiefs or people, in consequence of which they considered they had a just claim to the Leven, when she lay grounded near Bawack."

Extract from the Nautical Magazine, page 207, *vol.* 2 :—The principal feature in the character of the Bijouga Indians is avarice, which can only be gratified by the possession of whatever they see. By their importunate demands, and the manner in which they received anything given to them, they seem to believe that the visits of strangers are only for the purpose of making them presents. They received a few baubles from us with some expression of pleasure in their features, but thought of no return, and seemed to consider the presents a matter of course. During the last forty years they do not appear to have advanced one step in civilization. Their treatment of strangers, and the difficulty of access to their islands, will long perpetuate their barbarous condition. An inordinate spirit of revenge and retaliation is the spring of all their actions, and kindles frequent animosities. The slightest provocation occasions dispute; the least unintentional wrong must be redressed. The nobler attributes of our nature are unknown to them, and their minds are alienated from all moral improvement. Pretexts for indulging this passion will never be wanting; the restless and inflammable tempers of the Bijougas will always lead them to detect or occasion some cause of offence, and the objects of their revenge will be watched and pursued till the most rigorous atonement shall have been made."

In justice to them, however, it must be observed that there is too much reason to believe that they have not always been treated fairly by the few white people with whom they have had intercourse; and there is little doubt that their history would discover much that might be adduced in extenuation of their singular manners. It is said that the first white man who visited Kanabak imposed on the natives, a circumstance which may account for their behaviour to strangers. The result is that they are insincere and unjust in their communications—one which often obtains among people of more pretensions to civilization.

M. Le Baron Roussin says :—" In proportion to the distance from the mouth of the Jeba, or great channel of Bissagos, either northward or southward, the tides lose their regularity. This interruption in the tides is evident in going to the southward, as at a few miles south of the parallel of the Western or Bijouga breaker (11° 31¼′N.) they are no longer perceptible, even on the edge of the Bissagos. No decided course of the current was ascertained to exist, but it is generally allowed that the waters have a greater inclination to flow to the southward than to the northward; and it may be presumed that it follows the direction of the winds on the western edge of the Archipelago, but it is seldom found to be considerable."

The coast between the mouths of the Bolola and Componee rivers is wholly unknown, and is so low as to be seldom perceptible to vessels going up through the Orango channel. It has several islands before it, though at a great distance off, such as Jamber, Cavalho, Mel, and Pulham, already alluded to, and the little island named Alcatraz, besides a number of shallow and detached banks, rendering it dangerous for vessels coming from the southward for Orango channel, when to the eastward of the proper course.

Alcatraz island is supposed to be about 20 miles from the main land; it is situated in Lat. 10° 38′ N., and Long. 15° 21′ W., is about 40 feet high, and the abode of innumerable boobies, whose eggs might serve for refreshment. Reefs and foul ground extend to the westward from it about 7 miles, and also to the southward.

The Componee Shoals and Conflict Reef form the western side of the approach to Componee and Nunez rivers, and consist of sand and vast beds of rock. The extremity of the western prong lies in Lat. 10° 24′ N.; and South, a little westerly, from Alcatraz island, distant 15 miles. The extremity of the southern prong is in Lat. 10° 21½′ N., and Long. 15° 4′ W.; and E.S.E. ½ S. 12¼ miles from the end of the west prong. This locality is a most dangerous one, for, 5 miles S.W. by S. from the extremity of the south prong, there is a rocky head carrying only 15 feet; and as other insulated knolls may have escaped the vigilance of the surveyors, no vessel should approach these dangers nearer than 14 fathoms.

Componee River discharges its waters into the sea to the north-westward of the river Nunez; in fact, both disembogue into the bay formed between the Componee shoals and Gonzalez flat. Very little is known of Componee river, except that it has deep water in its entrance, which, however, is rendered difficult, owing to the numerous and extensive flats and sand-banks with which it is encumbered. Without leading marks, no directions can be given for entering, except a strong recommendation to use the lead frequently, and proceed with caution, not forgetting to have a good look-out at the mast-head to report the appearance of discoloured water, breakers, &c.

The Nunez River is better known than the Componee, though not to any very great extent. Like that river it has a number of shoals in its mouth, and both banks are fringed with projecting and broad flats. Sand island, situated in the middle of the entrance, is in Lat. 10° 36′ 37″ N., and Long. 14° 42′ W.

The river Nunez, or, as it is named by the natives, Kakoondie, is much inferior in size to those previously mentioned. Its whole course probably does not exceed 250 miles, while the Rio Grande runs more than 400; but it offers a safe navigation to a great distance from the sea. It is said to rise in the chain of hills which separate Senegambia from Sierra Leone, near 13° W. longitude, and its general direction, for about two-thirds of its course, is to the west, and the remainder to the west of south. In the upper part of its course it is full of rapids and falls. It becomes navigable, for vessels of moderate size, below the settlement of Debucko or Rebucko, and up to this place the tide ascends. From this place downward, the general depth of the river may be stated at 2½ to 3 fathoms at low water, with a rise and fall of about 12 feet. The low country, near its mouth, is uninhabited for want of fresh water, though there are said to be natives on the north side who are armed with muskets, and are mischievously disposed to strangers; the first settlement, Rappace, occurs at the distance of 35 miles from the sea, measured along the course of the river.

Anchorage may be had in 5 fathoms at ¼ of a mile S.E. by E. from the south end of Sand island. Here there is good holding ground, convenient landing, and facility for wooding. It is said also to offer an excellent place for a temporary refit, as a vessel may be safely moored within 100 yards of low-water mark, or less, if required; and if small she may be grounded on a clean beach, or hauled up for examination or repair. It will be prudent to have a good warp laid out towards the stream, in preparation for hauling off on the appearance of a tornado.

It is said that 50 years ago Sand island was a small bare sand-bank. So great, indeed, is the quantity of sand blown off the shores, or swept down by the stream, that possibly a few years will make other great changes in the island and neighbouring shoals.

LIEUT. THOMAS H. LYSAGHT, who visited this river in 1848, says:—"Sand island is now reduced to a flat at half-tide, and from the shifting nature of the sands a stranger should not attempt the river without a pilot. The river winds through a long mangrove country, leaving a long island on your starboard hand, and passing many native villages, until you arrive at Ropass factory, on the north bank of the river, which forms a reach just above it. There is a flat of rocky ground, extending from the opposite shore, nearly across to Ropass,* which is impassable, except at high water. Vessels should anchor in the centre of the stream about ¼ of a mile below Ropass, and if to remain, should certainly moor; higher up the river it is necessary to moor head and stern, laying a stream anchor out astern against the flood. All the trading establishments above Ropass are in ruins, except at Debucko, where the French traders have some small stores. The *Grappler* (LIEUT. LYSAGHT's vessel) went up to Cassassey, 70 miles from the entrance, and 5 miles from Debucko, where she lay in the bed of the mud in 2½ fathoms at low water, and, had it been necessary, might have reached as far as that place, grounding, however, at low water. Debucko is the residence of the principal chief of the river, and stands on a commanding eminence on the starboard shore; beyond this, it is said, boats cannot proceed far.

At this season of the year (February) the tides ebb 8 hours and flow 4, the rise being about 8 feet. The bottom is generally stiff mud, the banks steep but soft, and the few rocks in the river may be suspected from the appearance of the shore. Alligators abound. Stock is to be procured at times from the interior. Water is scarce and bad. The wet season commences in May and ends in September, during which time the river is very rapid, and towards the close of the season, as the water subsides, very unhealthy. In January, February, and March Harmattans prevail, and the nights and mornings are very cold, with a thick haze."

Directions.—Bound for the river Nunez, and endeavouring to make the high land of cape Verga, vessels should proceed very cautiously, for at 8 miles westward of the cape there is a long and dangerous shoal, running parallel to the shore, with only 9 feet over some parts, named *Verga Ridge*. Having made the

* Rappace.

cape Verga, a proper course can be shaped for the mouth of the river. Coming from the north-westward, Alcatraz island, or the breakers on the prongs of Conflict reef, will serve as a point of departure. Steer afterwards for Gonzalez island, forming the south point of the river, which will generally be seen from the deck at a distance of 6 miles.

Great vigilance should be exercised while navigating in the bight between Conflict reef and cape Verga, as well as in the offing of the bight; and a vessel working along the coast will, perhaps, find it more prudent, during an adverse tide, to anchor instead of persevering in making a number of tacks which would be of little avail against the stream, and expose her to the chance of striking upon some undiscovered head of rock. In every cast of the lead she must be prepared for great irregularity in the soundings, and should, under manageable sail, keep the leads constantly going.

With Gonzalez about east, and in a depth of 7 fathoms, the land will be distinctly visible, and a N.N.E. course may then be shaped for the mouth of the river. An extensive sand occupies the middle of the river's entrance, dividing it into two channels; the eastern one is to be taken, and with the lead kept going, so as to observe the maxim "keep in the mud." The eastern shore requires a good berth, for the flats and ledges extend from it in some places to the distance of 2 miles, and over them the flood sets obliquely.

Verga Ridge.—Gonzalez and Verga ridges are two very extensive projections from the broad and shallow flat which occupies the whole of the bay between Gonzalez island and cape Verga. They are extremely dangerous, especially the Verga ridge, the southern end of which, in 14 feet, lies 7½ miles W. by N. ¾ N. from cape Verga, and is steep-to; on both sides of this reef are two open bights into which vessels should be careful not to get.

Ponga River is of considerable extent, and discharges its waters into the sea through several mouths. The principal of these are those named the Mud bar and sand bar entrances; the former is distant 16½ miles S.S.E.-ward from cape Verga, and the latter 24 miles.

It is said that neither bullocks nor vegetables are to be had in this river, that stock is scarce, and only to be obtained at the outer islands in exchange for muskets, ammunition, handkerchiefs, tobacco, &c. The fresh water is not good, and boats must go a long way up to obtain it; but as they can conveniently lie alongside the sandy beach at Observation point, the north side of the sand bar entrance, and as the trees grow nearly to the water's edge, wood can easily be procured.

Bound to this river it should be remembered, that it is very probable every gale from without, and every rainy season from within, may alter more or less the shape and extent of the sands forming the approaches to the river, and, therefore, the best directions that can be given for entering are, either to obtain a pilot or, at the proper time of tide, to preserve the channel by a close attention to the constant breakers on either hand and to the maxim "keep in the mud." In

1830, Captain Belcher found not less than 7 feet in the mud bar entrance, nor less than 14 in the sand bar entrance. The sands then extended 5 and 6 miles from the shore, and the many shallow spots upon them gave the appearance of an almost continued line of breakers, and would deprive any one approaching the bars of any inclination to attempt the entrance much before the top of high water.

The first of the flood and the last of the ebb set, it is said, directly in and out through the channel, but at other times their direction is obliquely across them, and hence an expert leadsman in the chains is a great necessity.

There are some French and American factories on the banks of the Ponga, and the native town of *Bangalong*, at 17 miles from observation point. To proceed up to Bangalong a pilot is requisite, though in an emergency a vessel might reach it with a skilful use of a couple of boats, and the help of a flowing tide.

Sangareeah Bay, &c.—The shores of this bay are so intersected with crossing channels and creeks as to be no other than a series of islands, some of which are forming, while others are disappearing. The *River Dembia* is 20 miles south-eastward of the sand bar entrance of the Ponga, and empties itself into the northern part of Sangareeah bay; it is said to allow of the admission of small vessels, but no channel over the bar was found to have more than 4 or 5 feet in it at low water when examined.

The *River Dabreeka* also flows into Sangareeah bay, in about Lat. 9° 40′ N., and has an entrance between large flats and shoals which project from the shores of the bay several miles into the offing, capable of being used by moderate-sized vessels, having a depth of 2 and 2¼ fathoms at low water. It is requisite to wait for a certain time of flood, and to use the lead frequently, or send a boat ahead to mark the edge of the banks.

The bottom along the coast between the Dembia and isles de Los, in less than 10 fathoms, is of soft blue mud, into which the lead sinks deeply. Having decreased the depth to 5 fathoms, the water will be found at times so thick on the surface as to lead one to imagine that the vessel is stirring up the bottom. The muddy tinge, however, of shoal water is of a much lighter cast.

The Isles de Los, or Idolos Islands.—This group of islands is situated in Lat. 9° 28′ N., and Long. 13° 49′ W., and consists of Tamara, Factory, Crawford, Coral, White, and Kid islands. They afford excellent opportunities for trading, being easy of access, and having a communication with the numerous rivers of the adjacent coast of the main. They have likewise the benefit of refreshing breezes morning and evening, and afford a secure anchorage for vessels of any size. Good fishing may be found about all the islands with the seine, and an abundance of turtle, with good fresh water. Beef and vegetables are procured at Crawford island, and fowls and plantains are readily obtained from the natives, at the same rate as at Sierra Leone.*

* The best and the greatest quantity of water is said to be obtainable at the Tamara landing place, 1½ miles northward of the anchorage, at a sandy spot under a great Pullam tree; but it

Tamara or Footabar island is the largest and westernmost of the cluster. When first seen, it appears as two islands, and its northern end, being 465 feet high, may be seen at the distance of 21 or 24 miles. It is nearly 5 miles long, and about, on an average, ¾ of a mile broad, and its curved form protects considerably the vessels at anchor inside it.

Factory Island is 4½ miles in length, and in some parts not ¼ of a mile broad.

Crawford or Rooma Island lies between the two preceding islands, and is less than one mile long, and ¼ of a mile in average width. From its north-east point a broad shoal extends 2 miles to the north-eastward, nearly closing up the channel between this island and Factory island.

The other islands are situated between the south extremes of Tamara and Factory islands.

Anchorage may be had in about 5 fathoms, at a mile or more northward of the west end of Crawford island.

The flood sets to the N.E. and the ebb to the S.W. The tides must always be consulted, so as to enter the channel between Tamara and Crawford from the northward with the ebb, and from the southward with the flood.

Directions for Sailing from Cape Roxo to the Isles de Los.—By Le Baron Roussin.—" A vessel starting from a point at 12 or 15 miles westward of cape Roxo, which will be a little without the meridian of 17° W., to the parallel of 10° 40′ N. which will be outside of all dangers. Hence a course S.E. ½ E. (S. 68° E.), and distance 68 leagues, will lead her to Tamara island. On this course the soundings will never be under 8 fathoms until near the shore of the island, and those on the first course will be considerably more. From the parallel of cape Roxo to that of the western or Bijouga breaker (11° 31′ 32″ N.), at a distance of more than 4 leagues to the westward of the meridian of 17°, the depth will increase progressively from 8 to 28 fathoms, and the bottom be entirely of mud. This remark may be depended on to show that a vessel is not far southward of the parallel of the Jeba, or great channel; she cannot, at the utmost, be more than 10 miles from the positions already given.

From this point, as far as the parallel of 10° 40′ N., the bottom is nearly free from mud, and on passing southward of the parallel of 11° 20′ very slight traces of it remain, but are succeeded by a bottom of fine white sand, sand and gravel, sand and broken shells, with a depth varying from 12 to 50 fathoms. A vessel having left cape Roxo and arrived in latitude 10° 40′, may thence steer a direct course for the isles de Los.

The S.W. edge of the Bissagos follows a gentle curve, from the western breaker as far as the southern one, that of La Bayadere. The bottom in this part presents a singular peculiarity. Amongst the fine white sand, sand and broken shells, sand and gravel, of which it is most frequently composed, a

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cannot be embarked after ¾ ebb. Com. T. Miller, R.N., says, in 1850:—"I found on Factory island the best water on the whole of the west coast of Africa."

greenish-coloured sand is sometimes found. The depth decreases very gradually from 50 to 9 fathoms, from S.W. to N.E. The remainder of the course to the isles de Los passes over deep soundings, as much as 50 fathoms, at the point of departure, and the least depth is 12 fathoms.

No precise rule can be given as to the changes in the depth along this track, nor as to the various characters of the bottom. It is known only that the ground, in the space passed over by this course, seems to be furrowed with channels, which, commencing from the southern extremity of the eastern channel of Bissagos, diverge toward different points between S.W. and S.S.E. *true*. The furrows above mentioned appear to have been caused by the regular tides in the mouth of the Rio Grande, and prove, beyond a doubt, that the outlet of the same channel is partly caused by that river. With respect to the nature of the bottom, it is of fine sand, in some places mixed with broken shells, small pieces of brittle rock, and gravel, which appeared to be only a covering to beds of a whitish volcanic sandstone, into which the lance penetrated but three or four inches, and did not hold. A muddy bottom is not found until about 10 leagues to the westward of the isles de Los, and then only in small quantity, till within a very short distance to the N.W. of those islands." See also p. 72.

If intending to proceed to the anchorage within Tamara island by the North channel, be careful of the reef which projects about ¼ of a mile from the north end of that island, named Arethusa reef, and steer so as to bring Factory island open clear of the north point of Tamara; then endeavour to make good an E.S.E. ¾ E. course, allowing for a tide of 1¾ knots (whether flood or ebb) until the north and south extremes of Factory island are in one, bearing S. ½ W. Now bring the eastern side of Coral island in line with the western end of Crawford island, S.W., and steer in that direction. To be safe, however, from grounding upon the bank connecting Crawford and Factory islands, and to clear the shoals running from Tamara so as to be more secure, in the event of flaws of winds and currents, keep these marks a little open immediately after entering between the heads of the two islands.

To enter by the South channel steer in between Coral island and Topsail point, the south point of Tamara, by bringing the north peak of Factory island in line with the north-west extreme of Crawford island, bearing N.E. by E. ¾ E.; being careful to give Topsail point a berth of over ½ a mile to avoid the shoals which extend eastward from it to nearly that distance; and when within ½ a mile of Crawford island haul up N.N.E. for the anchorage mentioned above.

The *Tumbo Channel* is the passage between Factory island and Tumbo point, of the main, and may be safely used and much time saved by vessels of 12 feet draught and under, if they exercise caution to clear the shoal ground running off more than ½ a mile from the north-east shoulder of Factory island, and enter it with a flowing tide; there are no detached dangers in it, and the bottom being of mud, affords good anchorage if necessary. Still, unless there is a strong reason for hugging the shore, it will always be more prudent to go outside the isles de Los, When approaching this part of the coast, it will be observed that the 8-fathoms' line of soundings extends in some places to a considerable distance from the shore, but the depths decrease so regularly that ample warning is given by the lead. A strong breeze is sometimes accompanied with a tumbling sea, but as no gales but the tornadoes, which are of short duration and off shore, are known upon this coast, a vessel never need be alarmed, for there is always a good anchorage beneath her, and no long swell or current to force her into danger.

From Tumbo point to Matacong island the bearing and distance are S.E. by S., southerly, 28 miles. Tumbo point is the S.W. extremity of an island bearing the same name, and separated by a narrow high-water channel from the main land. Southward of this point, the land falls back to the north-eastward about 7 miles, and afterwards to the south-eastward, forming an extensive but shallow bay, at the bottom of which is an inconsiderable stream, named Tannaney river. In the extensive bay between the isles de Los and Matacong isle, no detached dangers exist. The coast is safe to approach, the soundings being gradual, and always affording good anchorage; and it is in all parts accessible to large ships, to the distance of 6 miles, which generally may be considered sufficiently near to distinguish the land, and often to recognise the mouths of the rivers.

Mahneah River is about 12 miles E.S.E. ½ S. from Tumbo point; it is, at low water, scarcely accessible to the smallest coasting vessels, having only from 4 to 8 feet in the channel way, but the rise of tide exceeds 2 fathoms. To enter this river, it is necessary only to bring the western point of the entrance, while at the distance of 5 miles from it, to bear N.E by E. ½ E. and then steer toward it in that direction, until you get close to the S.W. mud-bank, when you may proceed along by the edge of that bank, in a convenient depth, according to circumstances. Within the river, the depths at low water are from 6 to 10 feet only. The water discharged from this river must be very great, as the ebb tide runs out with rapidity.

River Morebiah.—The mouth of this river is about 20 miles S.E. by E. ¾ E. from the southernmost of the isles de Los, and though its breadth within the points nowhere exceeds half a mile, yet it is far superior to the Mahneah. In approaching the coast abreast of the river, with its opening bearing E.N.E. ½ E. distant 9 miles, and Matacong island S.E. by E. ¼ E., you will have 6 fathoms of water on black mud; from this situation the depth will decrease gradually, on a bottom of the same kind, to 8½ fathoms at the entrance of the channel. With the rounding of the land, between the rivers Mahneah and Morebiah, bearing N.N.E., the east point of the entrance E. ¾ N., and the middle of Matacong island S.S.E. ¾ E., you will have that depth. From this position steer N.E. by E., until the east point of the river bears E. ¼ S., and then stand in toward this point, or about East; but remembering that both flood and ebb set partially over the extensive shoals that form the S.E. side of the channel; some of these, however, being dry at low water, and nearly so at high water, their steep boundary is perfectly discernable. In the elbow of the channel the least depth is 1¼ fathoms at low spring ebbs: this depth, however continues but a short way, and from the time of altering your course to the eastward, or steering straight in, you will seldom have so little as 2 fathoms. Beyond the east point the depth varies from 4 to 6 or 7 fathoms, and for the extent of 7 miles up the river it appears to be clear of all danger. It is high water on full and change days, at 7h. 40m., and spring tides rise 11 feet.

Matacong Island, situated in Lat. 9° 16′ 10″ N., and Long. 13° 26′ 20″ W., is about a mile in extent, and surrounded by banks and rocks in all directions, so that no vessel drawing more than 12 feet can lie nearer it than 2½ or 3 miles. The narrow and muddy channel separating it from the main is dry at low tide. The beauty of this island consists in the luxuriance of the trees, in the verdure of those spots which have been cleared, and in its gentle slopes, which give it an appearance strikingly contrasting with the low swampy tract of the adjacent main land.

River Foreecarreah.—From Matacong island the coast trends eastward a little more than 8 miles, when it turns abruptly northward and forms the west point of the mouth of the river Foreecarreah, the interval being fronted with sand and mud-banks, which extend more than 8 miles southward. The entrance of this river is above 2 miles wide, and the least depth is 1 fathom at low spring ebbs. To sail in, it will be necessary to pass close to the banks which project from the west point, but at the same time to be cautious in approaching them, as they are steep-to, and dry at low water. The outer sand will be apparent, even in fine weather, at any other time than high water; and, if seen, it may be safely skirted in 2 fathoms near low water, or in 4 at high water; and in order that you may not get in at the back of the sand, do not bring the highest part of Matacong island to the westward of N. by W. ¼ W. until the west point of the river bears N.E. You may then safely enter, recollecting, as a guide, that you should always keep the western side aboard, off which, however, you will have to edge occasionally, to avoid the banks; yet this river is of very little consequence, as a ridge of rocks nearly crosses it at a short distance from its mouth. The ebb tide is here extremely rapid, and the overfalls, in the vicinity of the rocks are dangerous to those who do not possess a local knowledge of the river.

The Rivers Mellacoree and Tannah empty themselves into the sea by one common mouth, at about 12 miles south-eastward of Matacong island: the former coming from the eastward, and the latter from the north-eastward. Before the entrance there is an extensive sand, partly dry at low water, named the *Middle Ground*, on each side of which there is a channel into the rivers—that on the north being narrow and only about 9 feet deep at low tide, while that on the south side is nearly a mile wide, where narrowest, with 13 and 14 feet in its shallowest parts. High water on full and change days at 7h. 40m.; springs rise 11 feet.

The Mellacoree River is of considerable importance in the timber trade, and has better objects for marks than any of those already described. In entering by the South channel observe that, at 8 miles off shore, there are 6 fathoms of water, and, with the river's mouth bearing E. by N., it will be fairly open. Steer toward it, in that direction, until the soundings have decreased gradually to about 3 fathoms at low spring ebbs, with the following bearings:—East point of Yellaboi island S. by E., easterly; Sallahtook point, distinguishable by the trees being higher than elsewhere, bearing S.E. ½ S.; Bentee point, situated on the south side of the river, and known by a remarkably large tree, E. by N.; the outer point of Tannah river, E.N.E. ¼ E.; you will then be in the fairway. The Middle ground is steep and dangerous, but the soundings on the southern side are gradual, though the mud-bank from the shore is very wide; borrow, therefore rather on that side, until nearly as far as Bellangsang point, when you must haul over to the mouth of Tannah river, and there anchor. Higher up there are some patches of rocks in the middle of the river, but at low water they are seen as well as the deep water-channel between them, which is ⅓ of a mile in breadth, with a depth of 7 to 9 fathoms. By keeping the east point of the river Tannah bearing N.W. by W. ¼ W., you may pass through this channel in safety; and there being no further danger, you may ascend the river to the factories established below Devil's island, on the south shore; the general depth varies from 5 to 9 fathoms.

To enter by the North channel, when 5 or 6 miles off shore, bring the west point of Tannah river to bear E. ½ S., and by carefully using the lead you may proceed in with safety; for, although at its termination it takes a slight turn round the N.E. corner of the Middle ground, yet this is generally so well indicated that yon can scarcely be deceived.

On account of the soft nature of the bottom, vessels may ground in several places in the vicinity of the Mellacoree river, without being injured; but a patch of foul ground which surrounds the long reef off Sallahtook point, must be carefully avoided.*

The *Tannah River*, though smaller than the foregoing, is navigable for all vessels able to cross the bar, having a good depth of water, and currents not so strong as in the Mellacoree. Each side of this river is covered with high mangrove trees, except at a farm about 13 miles within its entrance.

Yellaboi Island.—From Sallahtook point the coast trends S. by E. 7 miles, to a small river, on the western point of which is situated Sangahtook factory: and about 1½ miles to the westward of this point is Yellaboi island, surrounded by mud-banks that are dry at low water. This island is low and swampy, nearly 2 miles in length and covered with trees, which, towards its western end, give it the appearance of an abrupt cliff, easy to be recognised. Abreast the south-east extreme of Yellaboi is the mouth of the Inglis Pahboyeah river.

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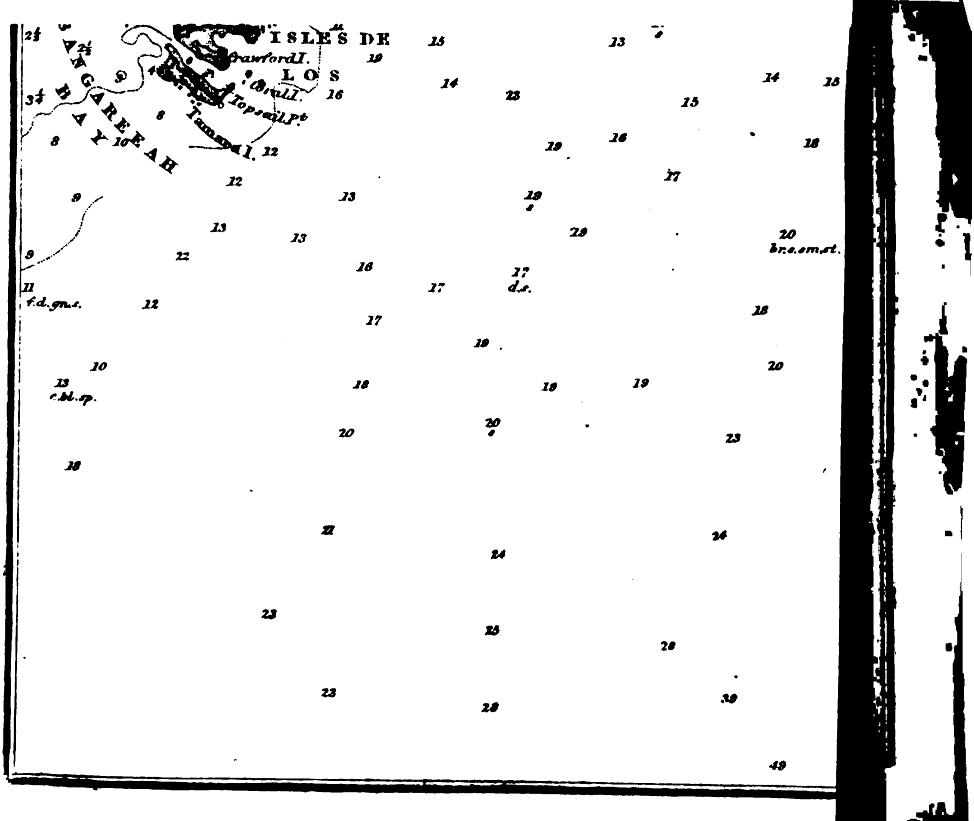
* A pilot should always be taken for these rivers, if one is at all to be had. Indeed, it is recommended at all times to take a pilot for the rivers and harbours on this coast of Africa, as since these directions were written it is probable that a great alteration has taken place, not only in the shape and directions of the shoals, but also in the flat alluvial land forming the shore. Heavy gales are known to produce serious effects on the coast, so that at places where at present there are small flat islands, may, in the course of a few years, have them entirely swept away.

Scarcies Rivers discharge their waters into the Atlantic at about 20 miles northward of Sierra Leone. They have an entrance common to both, but divided into two channels by the island *Corteemo* and the extensive mud and sand-bank which projects from it northward and westward, over many parts of which the sea breaks, while others are dry at low water. In the Northern channel, which is toward it, in that direction, until the soundings have decreased gradually to about 8 fathoms at low spring ebbs, with the following bearings:—East point of Yelkaboi island S. by E., easterly; Sallahtook point, distinguishable by the trees being higher than elsewhere, bearing S.E. ½ S.; Bentee point, sit... south side of the river, and known by a remark...



Scarcies Rivers discharge their waters into the Atlantic at about 20 miles northward of Sierra Leone. They have an entrance common to both, but divided into two channels by the island *Corteemo* and the extensive mud and sand-bank which projects from it northward and westward, over many parts of which the sea breaks, while others are dry at low water. In the Northern channel, which is the widest and deepest, and flows between Corteemo and Yellaboi, there are 12 and 13 feet least water at low tide. The Southern channel, which is the direct channel into these rivers, passes southward of Corteemo island, but leads over about 7 miles of shallow water where not more than 6 feet can be depended upon.

The Great Scarcies river is navigable by large ships, but the Little Scarcies is adapted only to very small vessels, and requires the aid of a skilful pilot.

The Northern channel* into the Great Scarcies river is the best on this part of the coast; for, although the banks are steep, yet it is broad and tolerably deep, and a ship of the line, by taking a proper time of the tide, might moor off the inner point of Yellaboi island. To sail into this anchorage, bring the west end or highest part of Yellaboi island to bear E.N.E., and steer towards it in that direction until you decrease the depth to 5 to 4 fathoms, which will happen suddenly. Now change the course, and, keeping in 4 or 5 fathoms, steer direct for Inglis Pahboyeah river, bearing E. ¼ N., taking care to keep it well open of the inner point of Yellaboi island, until the west point of that island bears N. by E. ¾ E., when you must haul directly in toward it, and, skirting along the steep mud-bank which borders the south side of the island, steer for its S.E. point, close to which you may anchor in 4½ fathoms. In reaching this anchorage the least depth you will have to pass over will be 2½ fathoms at low spring ebbs; and this occurs only after hauling in for the island, and running along the edge of the mud-bank.

SIERRA LEONE.—The mouth of the river Sierra Leone is 66 miles S. by E. from the Isles de Los. The coast between this and the Scarcies rivers is approachable by the lead, having a depth of only 8 fathoms at 5 and 6 miles from shore. The entrance of the Sierra Leone is obstructed by an extensive sand-bank, interspersed with large stones, named the *Middle Ground*, which in many

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* This chanel has been buoyed (1832),—the expense borne equally by MR. HENRY WESTON and myself. The bearings of the inner or bar buoy are to the west end of Yellaboi, N. 2° W., and to where the huts are on the east end, E. ¼ N., compass bearing. The outer buoy is situated on the northern edge of the outward middle bank. The inner buoy is situated on the shallowest part of the bar, having at high water, common tides, 16 feet; but at the distance of a quarter of a mile, due north from the buoy; there are 3½ fathoms at high water, common tides. The earliest opportunity should be taken to remove the inner buoy farther north, which will render the channel safe for vessels drawing 16 feet water, at common tides, and 18 to 19, at high water, spring tides. If you apply the bearings to the chart of the Scarcies, they will give the place to the inner buoy one quarter of a mile further in, as above. In a line with the west point is where I propose to lay it, in 2½ fathoms, low water.—*John MacCormack, Agent to Lloyd's.*

parts becomes dry at low water. There is a channel on either side of it; that on the south side between the bank and cape Sierra Leone and Freetown is 1⅓ of a mile in least width, and from 7 to 20 fathoms deep, and is consequently the proper passage into the river; indeed, that to the northward of the bank is only fit for small vessels, and even by them it is but seldom attempted, as they must cross a 12-feet bar which appears to connect the Middle ground with the flat that fringes the main.

During the rainy season the tide is very regular and strong, running 6 and 7 knots an hour, and the ebb sets rapidly on the Middle ground. In the dry months it commonly flows on shore at 7h. 30m., with 7½ hours ebb, and 4½ flood. In this season the ebb runs 2⅓ miles an hour, the flood only 2 miles.

For a description of the winds, &c., we refer the reader to page 72.

Light.—On the extremity of cape Sierra Leone, in Lat. 8° 30′ N., and Long. 13° 17′ 45″ W., is a lighthouse from which a *fixed* light is exhibited at 96 feet above high water, visible 12 miles in clear weather. From it Carpenter rock bears W. ½ N. distant $\frac{9}{10}$ of a mile; Bromham rock W.S.W. ½ S., ⅝ of a mile; and the west end of the Middle ground, in 8 fathoms, N.E. ½ N., 2⅛ miles.

The Carpenter is a dangerous rock, lying at the distance of $\frac{9}{10}$ of a mile W. ½ N. of the N.W. extremity from the cape Sierra Leone. This rock is clearly seen at half tide, and may always be distinguished by the breakers over it; the flood stream sets directly through the channel formed by it and the cape; and though the rock may safely be approached within half a mile, yet it will be proper for those beating down the river, with the sea-breeze and a strong ebb tide, to be careful and not approach so near.

The Bromham rock has 15 feet over it, is steep, and lies about a cable's length from the shore, and ⅝ of a mile W.S.W. ½ S. from the lighthouse.

The *Anchorage* off Freetown for large vessels is, with fort Thornton bearing about S. by W., and King Tom's point W. by N., at a ½ of a mile from shore, in 12 or 14 fathoms, muddy bottom, where they may moor with an open hawse to the northward.

If bound up the river beyond Freetown it is necessary to take a pilot, for though there is no danger on an E.S.E. course from the above anchorage, yet as soon as that distance is run the channel becomes narrow and intricate.

Freetown, Sierra Leone (seen from the Anchorage).

The colony of Sierra Leone, the most important on this part of the African coast, may be represented as a peninsula, extending from the Sierra Leone (or

Lion mountain) to Yawry bay, and consists of an irregular mass of peaked mountains, with valleys and prairies lying between them. The mountains are covered to their summits with lofty forests, which give the scenery a beautiful, rich and romantic appearance. The river which forms its northern boundary is a noble estuary extending 20 miles inland, varying in width from 10 miles at its entrance to 2½ where it terminates. The settlement was formed in 1787, with the view of commencing the introduction into this part of Africa of the benefits of European civilization. It has been largely colonized by Maroons and Negroes from America and the West Indies, and captured slaves; and in 1833, contained 29,764 inhabitants; but its prosperity has advanced very slowly, and, so far as regards the objects originally intended, the settlement may be pronounced a failure. Throughout the peninsula there are several villages; but the capital is Freetown, at the northern extremity, a well-built place, with regular and spacious streets. The settlement has long laboured under the imputation of extreme unhealthiness, and has been called "The White Man's Grave," but it has of late years very much improved in this respect, and is, indeed, now represented as not more unhealthy than any other place within the tropics, Europeans being indebted for their great mortality more to their improper manner of living than to the character of the climate.

As the coast northward of Sierra Leone as far as Yellaboi island is extremely low and flat, and bordered with a shoal bank 3 to 6 miles in breadth, which has upon it several dangerous rocks, it offers a strong contrast to that on the south side of the river, where the land is higher, the cape itself being the termination of a range of lofty hills named the Sierra Leone, or Lion mountains, which have given name to the river and country.

On the starboard side (on entrance) of the river Sierra Leone, the coast is indented with several inlets, respectively named Cape, Pirate's, Whiteman's, St. George's or Freetown, Susan's, and Thompson's bays; the latter of which is bounded on the east side by Farran point.

Freetown, the capital of the colony, stands on the bay of that name, and is protected by fort Thornton, which stands on the highest ground in its immediate neighbourhood, except that on which the Martello tower is erected at a distance of a ¼ of a mile. The town is situated at the foot of the range of mountains already noticed, whose general height is estimated from 2000 to 3000 feet. A small *green fixed* light is shown at the landing-place.

Directions.—Vessels proceeding from cape Verde to Sierra Leone, and having reached the latitude of 9° 15′ N. should endeavour to gain soundings on the edge of the great bank extending from the Bissagos to cape St. Ann. From a depth of 50 fathoms, gray sand, you may steer a course S.E. ¾ S., until you arrive on the parallel of the cape, in 8° 30′, whence an E. by S. ¾ S. direction will enable you to distinguish the mountains of Sierra Leone, which may be seen at a distance of 40 miles,—though in hazy weather, very prevalent on this coast, they are often invisible at 20 or 15 miles. It is recommended to make a constant use of the lead, when approaching towards the entrance; should the depth gradually vary from 20 towards 14 or 13 fathoms, and suddenly shallow to 7 or 8 fathoms, you will not be more than 9 or 10 miles distant; and should this happen towards evening, it will be better to anchor till daylight. Proceeding as we have thus directed, and having made the high land Sierra Leone, you should bring it to bear E.S.E. ½ E. The cape makes in a small low point, having a ridge of cocoa trees close to the water's edge, and soon after the lighthouse will be distinguished. When within 9 or 10 miles of the cape you may observe the Carpenter rock, with the sea constantly breaking over it. Having passed the lighthouse within a ½ of a mile, in 9 or 10 fathoms, a S.E. by E. ½ E. course, 8¾ miles, will carry you to the anchorage off Freetown. Moor with the best bower to the eastward. The watering-place here is very convenient, and the water excellent.

When approaching from sea you will probably endeavour to strike soundings on the parallel of 8° 30′ N. In a depth of 9 or 10 fathoms you will be at the distance of 10 or 12 miles from the shore, and should bring the Lion mountains to bear E.S.E., when you may proceed as previously directed.

As the lighthouse on cape Sierra Leone bears from the Carpenter rock E. ½ S., and from the western end of the Middle ground S.W. ½ S., vessels should be careful when coming from the westward not to bring the light to bear more eastward than E.S.E. ½ E.; and if coming from the southward, not to alter course until the light is on that bearing. If from the northward, the light should not be brought more to the westward than S.S.W. ½ W., until King Tom's point comes in one with the centre barrack, S.S.E. ¾ E., by which means the Middle ground will be avoided.

In approaching the river by night, it is advisable to anchor in order to make sure of your position, as the tide and current sometimes combine in sweeping you out of sight of the land before morning, or even into the dangerous vicinity of the St. Ann shoals.

In sailing up the river, do not approach nearer the Middle bank than 7 fathoms. Farran point is high, and has a house upon its summit; it has sometimes in hazy weather, been mistaken for cape Sierra Leone, although the cape is 5½ miles to the westward, the consequence of which has been that vessels have touched on the Middle ground. If this point is brought to bear S.E. by E. ½ E., when it will be well open to the north of the cape, it will point out the mid-channel between the Middle ground and the Carpenter.

The **Banana Islands** lie 23 miles southward of cape Sierra Leone, and W.S.W. from cape Shilling; ships may anchor anywhere off the intervening coast. They are three in number, and trend W.S.W. and E.N.E. In appearance they very much resemble the Isles de Los, but the adjacent land is more elevated. They are extremely fertile, have plenty of fresh water, though there are no running streams, and are considered comparatively healthy. They are thus described by Com. Murray, R.N.:—"The Bananas consist of three islands; the largest, which is the north-easternmost, is not lofty. The middle island is volcanic, about

900 feet high, and covered with wood. It is separated from the N.E. island by a narrow unnavigable strait, and from the S.W. island by a passage about 70 yards wide, with a line of soundings not less than 18 feet. The S.W. island is scarcely 70 feet high, and rather more than a mile in circumference; this island being open to the sea-breeze, is considered the most healthy, and thoughts were at one time entertained of establishing a hospital there. The anchorage is good, access to it easy, and it is sheltered from the strong S.W. winds, which prevail during the rainy season, by a reef of half-tide rocks which run off its south-west end to the N.W. A copious and permanent spring of fresh water is said to exist at its S.E. end."

The Bananas are separated from cape Shilling by a channel 2 miles in breadth, but not safe for a stranger to attempt. A vessel may anchor northward of these islands, with the N.E. extremity of the group bearing S.S.E. ½ E., and the western part S.S.W.; here there is a depth of 7 and 8 fathoms towards the islands, but little more than 2 fathoms a cable's length from shore. There is also anchorage to the southward; but the best position is in 5 fathoms, 2 miles from shore, on clayey ground, the N.E. point bearing S. ½ E., and the highest hill S. by W. ½ W. The best landing-place is in a sandy bay, at the S.W. end, where wood and water may be obtained.

Tides.—Northward of False cape (Sierra Leone) the flood runs northward; southward of that point it sets to the south. Hence, at the Banana isles the flood comes from the N.W., and the ebb the contrary; on the days of full and change the tide flows here at 8h. 15m.; during the equinoxes it rises 9 or 10 feet; other springs, 8 or 9 feet.

The *Plantain Islands and Bengal Rocks* lie 16½ miles south-eastward of the Bananas, and form the south point of Yawry bay, and the north point of the entrance of Sherbro river; they are unapproachable except by boats of the smallest craft: as is also Yawry bay, into which a number of rivers and creeks discharge their waters, for the whole of its shore is fringed by a reef, extending 4 miles from the land, and drying in many parts at low water.

Sherbro Inlet is bounded by the main on the north side, and by Sherbro and Turtle islands on the south. At its entrance, that is, from Plantain islands to the Turtle islands, it is 15 miles wide, but at its inner end, namely, abreast Jamaica point, the north-east point of Sherbro island, it is but 8 miles across. All the way from Plantain isles to Bagroo river, a distance of 30 miles, the shore of the main is bordered with an extensive mud-bank, and with a number of detached shoals; and the opposite coast of Sherbro island, forming the south side of the inlet, has a similar bank running from it, which, northward of the Turtle islands and cape St. Ann, bears the name of Turtle and Sherbro bank, and consists of innumerable ridges, knolls, blind channels, and pools, but navigable in almost every part by large boats at high water, and by canoes and light boats at low water. These banks much contract the navigable portion of the inlet, and, together with those occupying positions more in the fairway, especially the extensive *Middle Ground* at its inner part, render a reference to the chart a safer guide to vessels proceeding up the sound than any directions that can be given, bearing in mind the state of the tide; and the more so because it is highly probable that considerable changes have taken place since CAPT. OWEN's survey, which would make a strict reliance upon the soundings an incautious proceeding.

In the channel-way the depths range from 15 to 12, 9, and 4 fathoms up to the entrance of Bagroo river.

Directions.—Vessels bound to Sherbro inlet should steer from the west end of the Bananas, toward the Plantain isles, S.S.E. ¾ E. 14 miles, so as to give them a berth of about 4 miles. Having rounded these rocks at this distance, steer S.E. ¾ S. 15 miles, taking care to avoid the hard sand-bank on the east, which is steep-to. In running on, you may shoal your water to 4 fathoms, on the flat of Yaltucka river, upon the eastern side, and thence continue the same course 10 miles farther to the southern bank, making due allowance for tide, whether ebb or flood. The last course will lead into about 4 fathoms of water, and without the edge of the bank. You may now run up along the southern bank for 10 miles, to Jenkins, taking care to avoid the edge of the middle ground on the north, which here leaves a channel of only ½ a mile between it and the shore.

Bagroo River empties itself into Sherbro sound, opposite Jamaica point, the north-east point of Sherbro island, and has not less than 12 feet water all the way up to Tasso, and a rise of tide varying from 8 to 11 feet. Tasso is about 16 miles within the river's mouth.

SHERBRO ISLAND has a length of 29 or 30 miles, and an average breadth of about 8, and is thickly wooded. The village of *Jenkins*, on its northern side, is 20 miles within cape St. Ann; off this place between it and the extensive Middle ground, is the usual anchorage, in from 4 to 6 fathoms. The western extremity of the island, named *Cape St. Ann*, is a low sandy point, situated in Lat. 7° 34½′ N., and Long. 12° 58′ W. The narrow opening between it and the easternmost of the Turtle islands is choked with sand. The south coast of Sherbro consists of a sandy beach, free from rocks or shoals, but steep, having 5 fathoms close to the low-water shore, over a bottom of fine sand. The forests extend seaward to within a few yards of the beach.

The *Turtle Islands* extend north-westward from Cape St. Ann, and are situated upon the immense flat of sand bounding the south side of the entrance of Sherbro inlet; they appear to be formed by the depositions from the neigbouring rivers, and to be gradually covered with vegetation; some, indeed, are already thickly wooded. Many natives were found upon them, and they seemed well supplied with domestic fowls, fish, and bananas. There are no navigable channels between them.

The Shoals of St. Ann occupy an immense space between the parallels of 8° 0′ 30″ and 7° 35′ 30″ N., and the meridians of 13° 36′ 30″, and 13° 7′ W., being in length, from south-east to north-west, about 33 miles, and in breadth, where broadest, from south-west to north-east, 15 miles. These limits are given from the best authorities, but, from various circumstances, it is well not to place absolute reliance on their correctness. They consist of numerous patches or knolls of fine light-brown sand, apparently depositions from the waters of the various rivers in the vicinity, and scattered about with such profuseness that no description can convey so good an idea as an inspection of the chart. The outermost, or North-west patches, have but 15 feet over them, and lie W. ¼ S., nearly, from the peak of the south-west Banana island, distant respectively 16 and 22 miles.

There are channels among the shallow spots with deep water in them, ranging from 5 to 10 fathoms, but, in the absence of a closer survey, the probable constant increase and decrease in their form, depth, and number, and the doubtful advantage of running so much risk, it is advisable to keep outside them altogether, by observing the following directions :—

Directions.—Leaving Sierra Leone for the southward, steer such a course as will give the north-west patches a good berth, making allowance for the influence of the tides, which set into and from the bays and inlets northward of Sherbro island, and across the St. Ann shoals, with velocities varying from ¾ to 1½ miles per hour during the dry season, and it is most probable that during the rains the ebb may much exceed this. It should also be remembered that the Banana islands are generally obscured by haze during the dry season, so that no object whatever is then left as a leading mark. Having obtained the parallel of 8° N. shape a course to the S.S.W., South, and S.E., gradually steering from one point to the other, and being extremely careful not to decrease the water under 20 fathoms (or 15 fathoms) while in the vicinity of the north-west patches. As soon as the meridian of cape St. Ann is reached, the coast afterwards being comparatively clear, you may proceed along it in any suitable and safe depth.

Shebar River, so called, is actually the eastern entrance to Sherbro sound, which receives the waters of the Boom-Kittam, Jong, and Bagroo rivers, the last of which has been mentioned on page 560. The entrance is between Manna point (the western extreme of General Turner's peninsula) and Argyle point (the south-east end of Sherbro island); the former of these points is in Lat. 7° 22′ 8″ N., and Long. 12° 31′ 5″ W. From Manna point a long sand-spit curves round before the mouth of the river to where it is nearly met by another projecting from Sherbro, leaving but a narrow channel of 10 feet water between them. The extremity of the eastern spit has a patch upon it uncovered at low water, named the east sand head, which may generally be distinguished from other parts of the bank by the greater violence of the breakers. The channel in is close to the westward and northward of this breaker.

At anchor outside the bar in January the flood was observed to run with a velocity of ¾ of a knot, and the ebb 1½ knots; but both tides are much influenced by the season and the winds.

Vessels intending to enter should send a boat or boats ahead to mark the boundaries of the channel, for there is every reason to believe that the above-mentioned sand-spits are not stationary.

When within the bar, plenty of water will be found for all vessels able to cross it, and, under the guidance of local knowledge, they may pass up to Boom-Kittam, Jong, and Bagroo rivers; or round northward and westward into Sherbro inlet, and out northward of St. Ann shoals.

The *Boom-Kittam River*, for a great part of its course, runs nearly parallel with the sea-shore, and immediately within General Turner's peninsula: there are but 6 feet of water at its entrance, which is almost entirely blocked up by sand.

The mouth of the *Jong River* is 9 miles further within Sherbro sound, and has deeper water in it than the Boom-Kittam, but, like the other rivers hereabout, so much sand is brought down by its waters that the depth and direction of its channels are constantly changing. The entrance of the Bagroo river (page 560) is 10 miles northward of the Jong river.

THE COAST OF GUINEA, the general name given to that portion of the African coast between Sherbro river and Mount Cameroons, is variously divided. The political divisions are, Liberia, Ashantee, Dahomey, and Benin, the limits of which have been given on page 498,—as are also the natural divisions, named the Grain, Ivory, and Gold coasts. The part westward of the meridian of 5° W. is sometimes named the *Windward Coast*, and that to the eastward the *Leeward Coast*.

General Remarks by Capt. T. Midgley, extracted from the *Nautical Magazine*, 1848 :—

Among the Canary islands, and in their vicinity, N.N.E. and N.E. winds most prevail; and the general set of the currents between Madeira and these islands has a southerly and S.S.E. tendency. Indeed, the whole surface of the ocean from the 48th to the 30th parallel, has a general tendency to flow to the eastward and south-east quarter; and the mariner will do well to guard against its treacherous and too often fatal influence.

Outward-bound African vessels have of late, very generally, and properly, run through the passage eastward of the cape de Verde isles, for by so doing they avoid a tract of sea which is notoriously subject to violent squalls, calms, and heavy rain. Vessels make this run in the general limits of the north-east trade-wind, and I have myself invariably found the current setting to the southward. I am aware that I have the high authority of Mr. Finlayson, R.N., and of Commander Wilkes of the U.S. Exploring Expedition, against me in this assertion, both of these officers having found currents in this route setting to the north-east. I must add that I have not tried the current by any actual experiments other than the usual method of estimating it by the difference found by an attentive dead-reckoning and actual observation; and in this case it is, of course, very possible that errors creep into the reckoning, by inattention to the steerage, particularly in the night, as well as by an improper allowance for the magnetic variation, an inaccurate log-line, and other causes.

Vessels bound to the coast of Africa, in the wet season, or between May and September inclusive, need not be too anxious to make easting, for they will lose the N.E. Trade-wind very soon after passing the parallel of St. Jago, and after a short interval of calm, will fall in with the variable S.W. winds and their usual accompaniments of squalls, heavy rains, and close, damp, unsettled weather. In proportion as the vessel advances southward, she will find more settled weather, and probably be influenced by a current to the south-eastward; this is a branch of the great Guinea current, which I shall presently attempt to describe. The tract I have just noticed is perhaps the most luminous part of the Atlantic Ocean. In the wet season, vessels should give the shoals of St. Ann a large berth, as the current, as well as the sea, runs with great velocity into the bight of cape Mount; and vessels which may unfortunately happen to fall in with the land to the northward of Sinou, in the wet season, will find considerable difficulty in working southward.

The first influence of the Guinea current will be found in about 9° 30′ N., and inshore of the 22nd meridian, and gradually verges thence in a S.S.E. and S.E. direction, running with considerable velocity in a parallel direction to the trend of the land, and at least 50 leagues from it. On approaching the land the current will be found to increase in velocity, and requires constant and unremitting vigilance to prevent the vessel running to leeward of her destination. On the 18th of January, 1841, in latitude 6° 48′ N., and longitude 14° 58′ W., whilst in the influence of the Guinea current setting true S.E. by E. at the rate of 30 miles in the 24 hours, at daylight in the morning, during a perfect calm, I was surprised to see the vessel surrounded by sprigs of the Sargossa weed, and was still more surprised at its fresh and luxuriant appearance. One of the many sprigs brought on board contained two very lively little crabs, and I observed no marks of decay about any of the weed. I ordered a cast of the deep-sea lead, but found no bottom, at very nearly 100 fathoms. Sir Hans Sloane, in his history of Jamaica, says that this weed has been seen upon the coast of Africa; but I am disposed notwithstanding, to think that it is of rare occurrence, as I had four very intelligent natives of the Kroo coast of Africa on board, and they unanimously declared that they had never seen any Sargossa weed, or indeed, any other weed similar to it, attached to any of the rocks, or floating upon the surface of the water near the coast.

From the shoals of St. Ann (which, by-the-bye, require the exercise of considerable judgment and caution) the Guinea current has an Easterly and E.N.E. tendency towards the bight or bay of cape Mount; southward of this it sets about E.S.E. along the shore; and from Grand Cestos to cape Palmas it runs with a velocity of more than 2 miles an hour. It is this current which has set several vessels upon Coley's rock, and cape Shoal, and Rock Town reef, in the neighbourhood of cape Palmas: and these dangers can only be avoided in the night, by the constant and unremitting use of the lead; for, by keeping in 38 fathoms, or any greater depth of water, the vessel will drift in a fair way round the cape, and be 3 miles clear (southward) of these dangerous reefs. On the meridian of cape Palmas the mean breadth of the easterly stream of current is fully 45 leagues, and it keeps this breadth throughout the whole of its easterly course, until it is lost in the bight of Biafra. The inshore branch of this great stream diverges to the northward and eastward of cape St. Paul, and fills up the bight of Benin, whence it runs with increased velocity round the land of Formoso, and over the great bank of soundings which extends from the mouth of the Nun river to the mountains of Cameroons. Between the meridians of 8½° W. and nearly 9½° E., a distance of more than 1000 miles, we are presented with the somewhat singular anomaly of two mighty streams of water, silently, yet certainly pursuing their course parallel to each other, but in directions diametrically opposite. I of course here allude to the Equatorial current, which sets to the westward, as I shall hereafter show, with considerable velocity. The mean northern boundary of the equatorial current is generally found about the equator, or about 110 miles from the southern border of the opposite stream. In the tract of sea between these streams the current is variable, but has a general tendency to run northward, particularly abreast the bight of Benin.

It is a well-known fact that during the wet season, or from May to October, the Guinea current almost invariably runs to the eastward with increased velocity. I can rationally account for its ingress and egress in the bight of Benin; but the whole of this immense body of water appears to be confined in the bight of Biafra, or at least it has no known outlet, for throughout the whole of the bight, northward of Prince's island, the current, in the wet season, almost invariably sets to the N.E. and E.N.E. with such force that vessels are frequently fourteen days in beating up from Bonny to Prince's island, a distance of only 60 leagues. I am aware that Mr. Finlayson has asserted that a strong current runs to the southward out of the Rio del Rey; but this current is not found to the southward of of Fernando Po. On the contrary, the current upon the east coast of the bight of Biafra generally runs strong to the northward, and I have been three days, in tolerably smart vessels, and with a constant steady breeze, in weathering the island. The only advantage I ever found in beating up through the eastern passage was derived from the smoothness of the water, and not from a southerly current. How then do the accumulated waters of the bight of Biafra escape? Is there an undertow, or is it the great reservoir which supplies the tides of the 23 large rivers in the bights, most of which are so many mouths of the Niger?

The bank of soundings along the Krou coast, from Shebar river to cape Palmas, extends from 4 to 10 leagues from the land; and on its extreme outer edge, which is very abrupt, there is a depth of 55 to 62 fathoms, generally sandy bottom, or sand and oaze. At only one mile westward of this depth there is no bottom at 90 fathoms, and the water continues of the deep-blue oceanic colour, even in 15 fathoms. On this part of the coast no vessel should shoal her water under 32 fathoms in the night, and in the neighbourhood of cape Palmas, as before observed, not less than 38 fathoms. In this depth of water the sand on the beach will be distinctly seen, and the vessel, if in the early part of the day, will be soon surrounded by canoes. A fire on the beach is a signal that the natives are desirous of trading. The natives of this part of the coast are of a mild and gentle demeanour, and any number of them may be allowed to come on board the vessel without the slightest reservation, for they have no spirits in their possession to sell to the crew.

The Kroumen* are in many respects an extraordinary race of people: and CAPT. ADAMS has justly remarked that the tower of Babel might have been built upon the western shores of Africa, as a different language is spoken at every 10 or 12 miles, though these different languages are generally understood by the natives all along the coast. The Kroumen have a singular custom peculiar to themselves, which is a system of apprenticeship. A number of young men will attach themselves for a certain period to a headman : this headman has made one or more voyages to leeward to the Oil rivers, before he can obtain a name, or be allowed to build a house, or to trade ; and it is the duty of the headman to ship the boys off for the Oil rivers on board of any vessel he can, and for this service the headman is entitled to the one month's advance always paid by the ship ; he is also entitled to a certain portion of the boy's wages on his return. When the boy has made two or three voyages, and speaks English fluently, he becomes a headman himself. The language of the Kroumen is principally a combination of vowels, and from the peculiar nasal pronunciation can rarely be acquired by Europeans. The Krouman is generally found faithful in a strange country, but must not be trusted in his own.

In proportion as the vessel advances eastward, the natives will be found more barbarous and consequently more treacherous; and about Drewin—(about 6° 20′ W.)—and St. Andrew's they were formerly a fierce, unruly, and sanguinary race, notorious for their treachery, and repeated attacks upon vessels. I have had no intercourse with these people for the last seven or eight years, but am assured that their condition and manners are very much improved, and that small

* In matters of trade they generally possess sufficient acumen ; and it has been especially intimated to the European visitor, that, in trading with them, punctuality is of the utmost importance ; for confidence once lost by breach of contract, or unfair dealing, is not to be regained. It has been said that vessels in want of *Kroumen* should call at Grand Cestos, for they are described as the most willing and best disposed men upon the Krou coast, and, if well used, are faithful to their employer in every difficulty he may have to contend with to leeward. Every vessel should take four or five, or more of them, in proportion to her size ; for, in the Oil rivers, if white men are exposed in the boats or canoes, landing or taking in casks, they very often soon fall victims to the climate. The Kroumen prefer rice to any other diet, and a good supply can generally be procured at a cheap rate, except between January and June ; but, considering the detention of lying-to, in order to procure it, the rice may be exported from England, for ship's use, at very nearly as cheap a rate. One Krouman is of more real service in the Oil rivers than two Europeans.

vessels may now trade there for ivory and palm oil in perfect safety, by adopting only common precautions. The St. Andrew's people have been repeatedly fired upon by the crews of different vessels, for various acts of theft and treachery; and it was formerly very unsafe to allow more than five or six of them on deck at once, as they generally came on board armed with a long knife, in the use of which they were very dexterous. Upon one occasion, I very suddenly dispersed a multitude of them off the deck, upon the very point of open warfare, by merely throwing about a dozen heads of leaf tobacco over the sides, for they all immediately jumped overboard after it. Upon another occasion, the plentiful distribution of boiling water amongst a crowd of them proved quite as efficacious. On board a French barque, where two of the crew had been wounded by the knives of the natives, they were beaten off with empty glass bottles, a large quantity of which happened to be on deck at the time for trading with. Harsh as these measures may appear, they are surely more humane than the use of cutlasses and muskets.

The natives of cape Lahou, in many respects, resemble the Kroumen in their manners and disposition, and, like them, are almost amphibious. Cape Lahou may be considered the western extremity of civilization on this part of the coast of Africa, for the Gold coast may be here said to commence. The first Englishman who visited this part of the coast for the purpose of trade, was Captain John Look, in 1554, but it is very probable that this coast was known to the Portuguese at a much earlier period; for it is on record that they settled at Accra in 1492, and much about the same period, or about the latter end of the 15th century, the Portuguese discovered Fernando Po.

The best gold upon the coast of Africa is found in the neighbourhood of Grand Bassam and cape Apollonia. It is tolerably good at Dixcove, cape Coast Castle, and Anamaboe, and the Accra gold is generally considered of inferior quality; but little, if any, gold is found eastward of the river Volta.

From Ningo (0°) to old Calabar river, an extent of coast of several hundred miles, there is not a single stone to be found that is as large as a walnut. And from the river Shebar to Cameroons, an extent of 1500 miles of sea-coast, there are only four eminences which exceed the height of 800 feet, and these are the high lands of capes Mount and Mesurado, and the Cook's loaf, and Devil's hill, near Winnebah. A very old authority, Governor Dalziel, has truly said, that from the river Shebar to Benin, a tract of 1400 miles of sea-coast, there is not one navigable river, bay, or harbour, into which a ship can enter. Nor is there one river or creek (the Volta and Lagos excepted) into which a sailing-boat can advance 10 miles from the sea. Very few of the creeks will even admit a boat, and not one on the Gold coast, except at Chama and Elmina; a small boat may row up Chama creek about 2 miles, and up Elmina creek about a quarter of a mile. The shores are almost in every part difficult of access from the heavy surf which breaks upon the beach; it is scarcely possible to land anywhere but in a light canoe, and even in that way it is frequently impracticable for days together;

in many parts, besides, there is near the shore scarcely water enough for a canoe, and the breaking of the waves becomes there so impetuous that all communication between the shore and the shipping is frequently interrupted for three weeks together, and can seldom be effected with safety.

A most extraordinary refraction prevails upon the whole line of this coast, which is very likely to mislead the mariner, and induce him to neglect the frequent use of the lead, which is the only unerring guide and sure safeguard all along it. Tornadoes are very prevalent along this coast, from October to April or May, except during the season of the Harmattan or easterly winds, which generally occur in January. They commence with a heavy dark cloud in the south-east quarter, attended with awful lightning and thunder, and always give the mariner ample time to prepare to encounter their dreadful impetuosity. Every common squall from the south-east must not be taken for a tornado, although they are called by that name. There are very seldom more than three or four tornadoes in a season, and when once experienced, are not very liable to be afterwards mistaken. As a general rule, it may be considered, that as the arch of the rising squall is well defined, so in proportion will be the violence of the tornado.

The homeward passage from Africa may be made on two different tracks—the one may be called the precarious, and the other the certain track. The precarious track is to run along the coast, and on giving cape Palmas a berth of about 100 miles, steer to the N.W., towards the cape de Verde islands. This track, owing to the prevalent calms, can only be pursued with advantage when the sun has northern declination; and then the mariner must be particularly careful he does not fall to the eastward of cape Palmas, or into the Guinea current, against which he will find it a very hard matter to work to windward. The certain route, at all times of the year, is to get into the Equatorial current as soon as possible, and, aided by its powerful influence, you will find the ship gain very fast to the westward; and I think it advisable to cross the equator in from 20° to 21° W., near which meridian a current is very generally found setting to the northward, and from this position the homeward navigation is generally well understood.

Southerly and south-west winds are generally most prevalent between the trades, and these winds are strongest between May and August inclusive. In July, particularly, these winds blow in excessively violent squalls, and the heavy short sea which they occasion, added to the almost ceaseless rain which falls in these parallels, renders the navigation in this track peculiarly annoying and unpleasant. On the 17th December, 1836, in latitude 9° 31′ N., and longitude 24° 18′ W., about 326 miles due south of Fogo, when in the brig *Caledonia*, of Glasgow, I fell in with a very extraordinary kind of weed, and which I never but in one solitary instance ever before heard of. The instance I allude to was noticed by the talented HUMBOLDT, who fell in with similar weed, in the channel between Clara and Allegranza. The weed was of a brownish green, with thick, friable circular leaves, indented at the edges, with stems about three inches long. The weed appeared tolerably fresh, with a gelatinous substance, and very minute barnacles adhering to it. HUMBOLDT brought similar weed from the bottom, in a depth of 80 fathoms; but when I fell in with this weed, I found no bottom at 80 fathoms, and there was no perceptible current.

In another place CAPT. MIDGLEY observes also, "that too much attention cannot be paid to the lead upon any part of the coast of Africa, as the current frequently sets directly in upon the land; and from careful observation, upon the windward coast, I can confidently assert, that the thermometer is no guide whatever on approaching the land. In more than 100 experiments upon the surface water, I could never detect any sensible difference in the temperature when sailing toward the land from no bottom into 45 and 40, and then close in shore into 14 or 15 fathoms on the Krou coast. In the dry season there is little difference hereabout in the temperature of the air and water; the former averaging 77° to 81° (in the shade) and the latter 74° or 75° of Fahrenheit."

Some general observations in reference to the winds and currents, and some general directions will be found on pages 68—80 and 500-504.

LIBERIA.—The history of the Liberian Republic commences about the year 1817, when the Colonization Society of the United States took measures for founding a colony of free blacks on the western coast of Africa. After several unsuccessful attempts to obtain a settlement, they commenced upon Sherbro island, but owing to the insalubrity of the climate it turned out a failure. In 1821 settlers again arrived and established themselves on the banks of the river Mesurado, where the settlement of Monrovia was founded. They extended themselves on both sides of the river, with much opposition from the natives, the war with whom was continued until the latter part of 1828. In 1824 the settlers turned their attention to commerce, and still extended their operations. In 1835 the colonists were attacked by some tribes, who stormed a frontier settlement named fort Cressin, and massacred a number of inhabitants. At the same time Edina, another settlement, was likewise threatened.

Since that period there has been a very considerable increase in the territory of the republic, acquired at different times by purchase and otherwise, so that the whole of the coast from Shebar river to the river San Pedro, a distance of upwards of 400 miles, is now under its jurisdiction. It was acknowledged as an independent republic by Great Britain in 1847.

From the account of the promoters we extract the following:—

"The settlements of Liberia contain large tracts of fertile land, which have been obtained by purchase or treaty. Cotton, coffee, indigo, and the sugar-cane are the spontaneous productions of the forest. Rice, Indian and Guinea corn, millet, and a great variety of fruit and vegetables, may be cultivated to any extent. Cattle, swine, fowls, ducks. goats, and sheep thrive, and they require no other care than to keep them from straying. Besides timber, of an inexhaustible variety and abundance, there are good building stone, shells for lime, and clay for bricks. The exports of the colony, consisting of rice, palm oil, ivory, tortoise-shell, dye-woods, gold hides, wax, and coffee, bring in return the products and manufactures of other countries. The climate, though unhealthy to all whites, seems to suit the Negro settlers very well.*

Currents.—Com. Murray, R.N., says, "The currents along the coast S.E. of St. Ann's shoals, during the rainy season, from May till the end of October, are influenced entirely by the wind. When the breeze is fresh, a current of at least 2 miles an hour may be expected; if the wind is south of S.W., the direction will be N.W.; if to the west of S.W., an easterly or S.E. current running strong may almost be depended upon. During the month of November the set appears to be strong and invariable to the N.W. After the middle of December until May, the current may be expected to be found running to S.E., perhaps one mile an hour, on an average."

Gallinas.—From the Shebar river the coast trends in a straight line S.E. ¼ E., 56 miles to the mouth of Gallinas river, which, though low and sandy, is free from shoals, and steep, with very regular soundings from the offing. Before the entrance of the river are several low sandy islands, situated in a long and narrow lagoon, separated from the ocean by a thin barrier of sand 5 or 6 miles long. One or two shifting openings in this barrier allow the escape of the river water, and through them are the only channels by which boats can communicate with the lagoon and the shore. The depths decrease regularly from the offing, and vessels may anchor a mile outside the above islands in 7 fathoms.

The Solyman river, 2½ miles south-eastward of the Gallinas, empties itself into the same lagoon.

Six miles further in a similar direction is the river Manna, into which boats may pass, through a narrow opening between the sand-spits extending from both sides.

Manna point, 4½ miles further, is low and rocky, with many scattered rocks, both above and under water, surrounding it to the distance of ½ a mile.

Southward of the point there are several small factories, established principally for the trade in Camwood.

Cape Mount is 9 miles south of Manna point; the intervening coast forming a bay about 2 miles deep, into which the rivers Sugery and cape Mount discharge themselves, but their entrances are almost entirely blocked up by a narrow strip of sand, with openings at times suitable for boats. The headland of cape Mount consists of several hills which attain an altitude of 1060 feet above the sea, and have the appearance of a large island when viewed at a distance.

To fall in with cape Mount, you ought to keep in the latitude of 6° 40′, having on account of the current which sets toward the shore, frequent recourse to the

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* An instructive and interesting account of this Republic will be found in the *Nautical Magazine* for 1862.

lead, when you think yourself near the land. In the night, you ought not to approach it nearer than 26 fathoms, unless well acquainted. The roadstead lies to the westward, where you may anchor in 10 to 15 fathoms, bringing the extremity of the cape to bear South, or S. by E. In fine weather, vessels may ride securely between cape Mount and the river of that name to the north-eastward; but in the rainy season, during southerly and south-west winds, there is a tremendous sea and breakers on the shore, so that, during these months, vessels should lie well out, as otherwise it may be difficult to get to windward.

Hence the coast trends south-eastward 24 miles to the entrance of the Half cape Mount river, which in the dry season is quite closed by a bank of sand across its mouth.

St. Paul's River.—The coast from here bends round to cape Mesurado, distant 18 miles, but 4 miles before you arrive at the cape there is a fine wide river, named St. Paul's river, from the south point of which a dry sandy spit shoots out to the north-west, and from its extremity a shallow bar curves inwards towards the northern shore, leaving a narrow channel for boats, with 7 feet in it at low water. On the banks of this river are some factories, as well as a large settlement named *Caldwell.*

MONROVIA.—The river Mesurado, communicating with St. Paul's river, by means of Stockton creek, discharges its waters into the sea immediately northward of cape Mesurado. Just within its entrance, and on the south side of the river, is the town of Monrovia, the principal settlement in Liberia. No directions can be given for entering, because the depth and direction of the channel over the bar is varied alternately by the western swell and by the heavy freshes produced by the periodic rains breaking through the sand-banks, sometimes close to the foot of the cape and at others ½ a mile to the northward, but generally leaving from 8 to 9 feet on the bar.

Anchorage may be had in Monrovia bay in 7 or 4 fathoms; in the former depth, with the lighthouse on cape Mesurado S. ½ W., and the church at Monrovia S.S.E.; in the latter depth at ¾ of a mile nearer the entrance of the Mesurado.

The cape is composed of rocks covered with vegetation, and is steep, but the soundings are regular, and the bottom a fine light-brown sand. In the bay there are no dangers, and the water is shallower, but the lead will give indication of an approach to the land.

Light.—On cape Mesurado, which is high in comparison with the adjacent land, there is a lighthouse 240 feet above the sea, exhibiting a *fixed* light of a *red* colour, visible 15 miles. It stands in Lat. 6° 19′ 15″ N., and Long. 10° 49′ 25″ W. It has been reported to be in bad order, and not to be depended upon.

Wood and water can be procured here, but it is necessary to obtain the sanction of the authorities before you send Kroumen for the former, in order to avoid any trespass. The casks may be filled from the river about 2 miles above the town. Fresh meat, vegetables, and small stores are occasionally to be had.

Directions.—Cape Mesurado is high, and distant about 43 miles S.E. by S. from cape Mount: the coast between is low, having a white sandy beach. At the distance of 2 miles from the shore is a depth of 10 and 12 fathoms. Vessels may lie in any depth from 5 to 15 fathoms, off the river St. Paul; there is also anchorage in 10 to 15 fathoms, muddy ground, with the cape bearing about S.E. by S., distant 2 or 3 miles. The rainy season, between cape St. Ann and cape Mesurado, usually commences about May, and terminates in October; it is generally accompanied with thunder and lightning, and the sea sets so hard to the N.E. along the shore, as to cause a most violent surf.

Cape Mesurado is an elevated promontory, almost perpendicular on the north side, but with a gradual declivity towards the sea on the south. There are regular soundings, of 20 to 15 fathoms, muddy bottom, at 3 miles off shore, along which the current sets strongly. With the cape bearing N.E., the land appears like an island, with trees rising out of the water to the north; and at 7 leagues off, it appears in its insular form, the land on each side being very low. In the winter months here, as at cape Mount, vessels should lie out, on account of the heavy sea in the bay, and southerly winds, which would otherwise render it very difficult to to get out to windward. To anchor at the cape in the rainy season, bring the mount to bear S.E., distance off shore 3 or 3½ miles, and come to in 14 fathoms of water.

Junk River and Marshall.—The entrances* of the Junk and Little Bassa river are 29 miles S.E. of cape Mesurado; the intervening coast is low, with a sandy beach, and the whole country is covered with forest. From Marshall point, the west point of the entrance of the Junk river, a tongue of sand partly dry and partly covered with violent breakers, stretches nearly ¾ of a mile in a southerly direction; close round the edges of these breakers is the entrance to the Junk river, over the bar of which are only 8 feet at low water, and this depth is confined within very narrow limits; inside, the water deepens to 9 and 12 feet, and 18 feet will be found abreast the town of Marshall, which is situated nearly a mile within the bar, and on the west side of the river.

The entrance of the Little Bassa river is 1 mile southward of Marshall point, but is inaccessible even to boats.

Anchorage may be had off either of these rivers in 7 or 8 fathoms, over a clear bottom of sand and mud, but it will be necessary to avoid two rocky patches in this vicinity. The one named Hooper's patch is between 2½ and 3½ miles westward of Marshall, and about a mile from shore; upon it are 2½ and 3 fathoms. The other patch lies 1½ miles south-westward of Marshall, and is small with only 3 fathoms upon it; the ground immediately around it is coarse, and in some places foul. To avoid these patches, vessels passing along shore should not come within the 10-fathoms line. Vessels may also anchor in 15 fathoms clear sandy ground,

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* Inland from their entrances, distant 10 miles in an E.N.E. direction, is a remarkable Saddle Hill 1078 feet high, which appears to be the western extremity of a range of high land extending in a south-east direction (24 miles) to Mount St. John.

with the entrance of the river bearing N.N.E., and the Saddle hill N.E., distant 4 miles from the shore; this will be found convenient during the rainy season; but in fine weather, you may lie nearer the shore in 12 fathoms, or as above.

At 10½ miles south-east of Marshall is Middle Bassa, where there is an American factory, and 3 miles further is Long Reef point, so named from its being surrounded by barriers of rocks. S. by W. ½ W. 2 miles from the point, and in the stream of 10 fathoms, lies a sunken rock with 4¼ fathoms over it.

EDINA AND GRAND BASSA.—At 8½ miles south-eastward of Long Reef point, and in about Long. 10° 4½′ W., the river St. John and two small streams, named Mechlen and Benson, discharge their waters through one opening into the sea; but the entrance is blocked up by a shallow bar, the least dangerous passage over which is close to the sandy shoulders of the eastern or Macdowell point; wherein there are perhaps 6 feet at low water; within the bar the depths are greater up to the settlements of Grand Bassa, on the eastern, and Edina on the western side.

Good anchorage will be found in 6 or 7 fathoms, black mud, about a mile W. by S. of the entrance of these rivers. North-westward of this position are several patches of foul ground, and the Niobe reefs—on which the sea breaks furiously. In Waterhouse bay, formed between Macdowell and Grand Bassa points, there are a number of detached rocks and reefs, and off Grand Bassa point rocks above and under water extend to the north-west more than ½ a mile.

Tobocannee, a large native town, is 4 miles S.S.E. from Grand Bassa point, and nearly a mile beyond the village there is a low point with a projecting reef which ends in a detached block of stone a few feet above the water, named Tobocannee rock: and nearly a mile W. by S. from the point there is a sunken rock on which the sea constantly breaks.

From Tobocannee to Trade town, a distance of 9 miles, the coast is in general rocky, with some sandy bays between the points, and these are fronted by numerous reefs, which extend off in some places ½ a mile from the shore, but leave a boat channel within them. The continuity of these reefs is broken at Young Sesters, a place with which trading vessels sometimes communicate.

Trade Town, in about Long. 9° 54′ W., is a large and populous place, and has both a Liberian and an English factory. At 1¾ miles S.S.E. from Trade town, and about a mile from shore there is a single detached rock on which the sea always breaks.

Little Culloh River entrance is above 4 miles south-eastward of Trade town, but can only be used by boats; here fresh water may be obtained from wells and springs; and good landing may be had at the town, a mile to the south-eastward, under the shelter of a rocky point. At 1¾ miles further are the Little Culloh rocks, ½ a mile off shore; they are two in number, and have an inner channel of 8 fathoms between them and the land.

Grand Culloh river, 4½ miles from that of little Culloh, is closed by rocks and sand. Errick and grand Culloh towns are further south-eastward.

TEMBO.—The little river Tembo discharges its waters through an opening only accessible to boats, which is nearly due South from a remarkable conical hill 880 feet high, named Tobacco mountain, distant 13 miles from it. Tembo is a little to the southward; here there is a British factory. Hence the coast trends south-eastward and southward to Cestos, a distance of 11 miles; in the interval there are two small streams, named Fen and Manna.

Fen and Manna Rocks.—About ¾ of a mile S.S.W. from the mouth of the river Fen are the Fen rocks, on which the sea breaks; further eastward are others, and the soundings are very irregular for 5 miles between them and the Manna rocks, which lie more than a mile from the shore, and 4 miles N.N.W. Cestos point, and show themselves a little above water; several sunken rocks will be found in their vicinity, but all will be avoided by keeping outside the depth of 12 fathoms.

CESTOS OR CESTROS.—The river Cestos has its entrance between St. George* and Isaac point, in Long. 9° 34′ 45″ W. The bar curves round from St. George point to the northern shore with a terrific surf. In the middle of the bar there is a patch which divides the channel into two narrow parts, but in neither of these are there more than 9 feet at low water. The rainy season, and the surf, however, produce such fluctuations in the spits which project from the patch or from the opposite points, that it is always advisable to employ a pilot. Within the bar the depths increase. Wood and water may be easily procured.

In Cestos bay convenient anchorage may be had in 5½ or 6 fathoms, with St. George point bearing S.E. ¾ of a mile, and Cestos point South.

From St. George point to Cestos point the coast is fronted with rocks; and around the latter there is much foul ground, with a broad reef projecting from it ½ a mile in length; a single 3-foot rock lies just outside the reef, and 1⅛ miles S.S.W. from the point, on or near a patch of 5 fathoms, a schooner is said to have struck in 11 feet. Spence rock has 2 fathoms over it, and usually shows itself by a breaking sea; from it Cestos point bears E. ¾ N. distant 1½ miles. All these dangers are steep, and, therefore, the lead will give but little warning of an approach. On this account passing vessels should not shallow their water below 14 fathoms.

Rock Cess and New River.—About 8 miles S.S.E. ½ E. from Cestos point is the river and factory of Rock Cess, and a mile beyond the factory the New river. Before arriving at Rock Cess you will pass the rivers Pooah and Pobamo; the former of which is closed by rocks and sand in the dry season, but during the rains it may be entered by canoes; the latter carries 6 feet of water, and small craft can go into it by keeping close to the beach on the north-west side. Outside the reef which from Pobamo river to Rock Cess factory, there are several rocks,—two always above water, namely, the Pobamo, low and black, and the white rock

* A cotton-tree of gigantic dimensions stands (or stood) on St. George point, close to a white house (a palm-oil factory).

8 feet above water, steep and detached. N.E. distant ¼ a mile, and N.W. ½ N. from the Pobamo are two small sunken dangers.

A small river runs into the sea at Rock Cess point, where the factory will be seen a little farther to the S.E.; and a mile beyond the factory, the New river. The intermediate bay is sprinkled with concealed rocks, with 4 and 5 fathoms between them; it is also sheltered by an extensive reef, which retains the Portuguese name,—Diabolitos. Foul ground with irregular soundings reach out for fully 2 miles to seaward of that reef; and though nothing less than 8 fathoms has been found, yet on two patches where 4 and 5 are marked, the sea was seen to break.

At 8 miles from New river a long spit has been formed by the Broonee river, the entrance to which is always open to light boats and canoes, though much obstructed by rocks and sands.

Baï Yah Rocks.—Off Broonee river there are rocks above and under water; the most conspicuous of them is the Baï Yah, standing 60 feet above the sea, capped with dark shrubs, and lying above a mile from the shore. Northward of it there are three sunken patches of rocks which generally break; eastward, between it and Mr. Spence's factory, there is a cluster of dry rocks, with a detached reef more to the southward; and outside of it, there are four other patches. The first, which is dry, lies ½ a mile S.W. ½ W.; the second bears S.W. ¼ S. more then a mile distant, and partly shows above water; the third, bearing W.S.W. ½ W. and nearly 1½ miles off, carries only 8 feet water; and the fourth, N.W. by N. not quite a mile, is only seen by its breakers.

Sangwin River.—The mouth of this river is situated in Lat. 5° 12′ 42″ N., Long. 9° 20′ 16″ W. It is one of the principal rivers watering this part of the coast. At first sight it is difficult to perceive the entrance, as a long ledge of rocks from the eastern point, and a high sandy spit from the northern point, seem both to cross over to the opposite shores; but it is said that it is possible to carry 10 feet water into the river, by keeping in the best channel, which will be found between Wilson point on the east, and the rocky patch a quarter of a mile westward of it. The channel is very narrow, and on rounding Wilson point it deepens to 5 fathoms till the narrows are passed. Towards the last quarter of the ebb, the water at Sangwin point, on the north side, just within the entrance, is fresh and good; and when the bar is smooth, it will be found a convenient place for obtaining wood and water.

Baffou Point lies nearly 5 miles S.S.E. from the mouth of the Sangwin; into the intermediate bay two small rivers discharge themselves, close behind the point. Baffou rock, on which there are but 12 feet, lies in the stream of the point, bearing from it N.W. ¾ N. 2 miles, and from Wilson point, at the mouth of the Sangwin, S. ¾ E. 2¾ miles.

The northernmost of the two rivers is called the Baffnee; it has a very narrow entrance, with 6 feet water in it; the other is closed by a shallow sand-bar. Baffou point should not be approached within ½ mile to the westward, as there is a sunken rock off its pitch; another lies close to the southward of it, and irregular reefs of nearly a mile in length project northward. A fair anchorage, however, may be taken in 8 fathoms, in mud and sand, with the point S.E. ½ S. about a mile distant.*

From Baffou point the coast trends 6½ miles S.E. to *Tassou;* many confused heaps of rocks lie strewed along the intervening shore, as well as at a short distance in the offing. In the river Toobah at low water there are not more than 8 feet.

Sha, Wya, Keoba Rocks, &c.—Off Tassou, and in the stream of 9 or 10 fathoms, there is a long range of rocks; three of them are above water, the Sha, the Wya, and the Keoba. The Sha rock lies 2 miles W.N.W. ½ W. from Tassou point; deep water surrounds it, except to the northward, where breakers extend about 800 yards. The Wya bears S.S.E. ¾ E. from the Sha not quite 2 miles, and S.W. by W. from Tassou point; it is a large rock, with reefs ½ a mile long, both northward and southward. Upwards of a mile S.E. from that southern reef, and S. by W. ½ W. from Tassou point, there is a single rock with 9 feet over it; and at another mile, still farther S.E., the large dry rock called the Keoba shows itself. S.E. 1 mile from the Keoba there are breakers; and 3 miles S.S.E. ¾ E. from it, with Bootou point bearing E. by N., lies Yule rock, the last link of this chain of dangers, which extends almost 7 miles from the Sha rock, in a direction nearly parallel to the coast.

The Bootous.—Little Bootou is a large village upwards of 2 miles S.E. from Tassou point, and 4 miles farther is Grand Bootou on a projecting point of the coast, behind which is the mouth of the Bootou river. In the space included between the line of the Keoba and Yule rocks and the shore, and between the two Bootous, the general depth is 6, 7, and 8 fathoms, but interspersed with many rocks. The shore is likewise strewn with large rocks, and the whole coast is thickly peopled. Grand Bootou point is easily known by its projecting form, by its town, and by a hill a mile to the south-eastward, which, with the lofty trees that cover it, measures 265 feet in height. The river winds round the foot of this hill, after having run for several miles parallel to the shore.

A few rocks hang about Grand Bootou point, but from hence to Sinou bay, the coast has a clean sandy beach, and between Yule rock and Bloobara point there are no detached shoals, so that vessels may stand in with safety; but the soundings are irregular, with occasional patches of rocky ground, requiring care in anchoring.

SINOU.—Bloobara point, in Lat. 4° 59′ 15″ N., and Long. 9° 2′ 5″ W., forms the southern extremity of Sinou bay; it is composed of three small rocky points, with sandy bays between them. On the Middle point there is a small English

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* About this part of the coast the *Krou Country* begins; and its inhabitants, whose superior industry and docile habits, when compared with other African tribes, are proverbially known, seem very numerous. Parties will probably come off from almost every village, and express a desire to trade, and display their little wares, among which most likely will be some fishing-lines, made from the fibres of the palm-tree.

factory. About ¾ of a cable north of North point there is a dry patch of rock called the Allens, leaving a clear between them and the point into Sinou river; another open passage will be found between the Allens and Middle reef; and a third between this and North reef, which stretches nearly across to the northern shore. These reefs were the only dangers discovered in Sinou bay; and vessels may safely anchor ½ a mile W.N.W. of Bloobara point in 8 fathoms, but the bottom should be previously tried, for it contains several small foul patches, though generally a clean sand.

Boats may enter Sinou river between North point and the Allens, between the Allens and a large oval sand-bank eastward of them, and between that bank and Fishtown beach. The first is the best, and by rounding North point pretty closely, they may carry 5 or 6 feet over the bar at low water. The bar is very narrow, and, when crossed, the river suddenly deepens to 3 and 4 fathoms, but shoals again quickly after hauling up round Fishtown point to the northward, where the deepest water will be found close along the Fishtown shore. Water and wood may be obtained here.

South-eastward of Bloobara point the coast, with one exception, preserves its straight, low, and sandy character for 11 miles to Little Krou. Thence it bends outwards to the rocky point of Settra Krou.

Krou Rocks, &c.—In the eastern half of the interval between Bloobara point and Settra Krou, there are several off-lying rocks. The westernmost of them lies a long mile from the beach, with mount Plassa E. by N.; it is very small, steep, and generally breaks. W.N.W. of the large tree at Little Krou, there is a wide patch of rocks, some showing above water, some covered, and some only breaking, but all steep. A mile S. by W. from this patch there is a single rocky head which generally breaks; it may be easily avoided by keeping the Krou rock eastward of S.E. The Krou rock is a bare irregular mass of stones, with 5 fathoms close round it, except to the eastward where it is connected with other rocks and long reefs which stretch over in the form of an S nearly to the point of Settra Krou. The outer mass bears W. by N. 2 miles from that point, and though it is sufficiently obvious during the day, and the breakers generally audible at night, yet vessels are recommended to keep in the stream of 16 fathoms (at least) after dark. From these S-shaped reefs connected with the Krou rock, other branches diverge to the N.W. and N.E. so as nearly to fill up the space between Little Krou and Settra Krou.

At Little Krou there is an English palm-oil factory; and ships' boats may conveniently land under the shelter of a ledge of rock which projects from the point. The large tree which marks the position of this village stands on its eastern side, and may be plainly seen from the offing. At Settra Krou likewise there is a remarkable tree, which may be distinguished a long way off; and boats may land there safely on the north side of the point.

Distant 8 miles from Settra Krou is the village and river of Kroubah, which in the rainy season is open, and at which cattle may be obtained.

S.S.W. of Settra Krou, ¾ of a mile, there is a rock which breaks, with 7 fathoms close to it; a long mile W. by N. from Neatano point, there is another breaker, in 10 fathoms; and in the interval between those two rocks, but nearer to the shore, there are several detached shoals with deep water close alongsid e

S. by W. ¾ W. fully 2½ miles from Neatano in the stream of 14 fathoms, is a rocky patch with 8 fathoms over it; and 1½ miles E.S.E. of this, in the stream of 11 fathoms, the natives allege that there is another nearly awash; the surveyers however, could not find it, nor do the soundings indicate any rise in the ground, yet on this extraordinary coast, it is very possible that such a rock may exist, as most of the dangers are steep. Vessels, therefore, whose business leads them in-shore, must keep a sharp look-out, but those who are merely running along the coast should not approach it within 3 or 4 miles, nor into water less than 25 fathoms.

From Neatano ¾ of a mile south-eastward lies Tootoo point with a reef extending from it ½ a mile westward. Thence to Nanna Krou, the coast is a low sandy beach with many rocks in front.

King Wills Town.—The coast from Nanna Krou bends outwards, and forms King Wills bay; near the centre of the bay is a small islet about 15 feet high, covered with brushwood. The shore appears to be very populous, and there are two English factories here for the collection of palm oil, there being tolerably good landing near them on either side of the islet; which affords some little shelter. There are a few rocks 2 cables' lengths off the point of King Wills Town;* and again off the point ¾ of a mile further eastward.

The Swallow Rocks are steep, and lie above 1½ miles from the shore, and 3½ miles S.S.E.-ward of King Wills point; they consist of two ledges, which generally break, and have a 4-fathoms rock ½ a mile S.W. of them. From the southern ledge a hill 260 feet in height, which stands a couple of miles in-shore, bears N.E. by E. ½ E.

The eastern branch of the *Ooro* falls into the sea 3 miles from the western branch, and the space between is occupied by successive chains of rocks which stretch out more than a mile from the beach. Subono, or little Wappi, a large native village, stands on the right bank of the eastern branch near its mouth.

South-eastward 1½ miles from little Wappi is Wappi point. South about a mile from the outer end of the ledge, which stretches about a mile westward from Wappi point, there is a rock called flat island or Totwarrah. There are 10 fathoms within ½ a mile of it westward and southward; but from the bearing of S.E. by S. all round its eastern side, confused masses of reefs and shoals extend nearly to middle Nifou, sweeping round far southward, and almost filling up the

* H.M.S. *Crane* anchored off King Wills point, bearing E.N.E. 1½ miles in 10 fathoms. On getting under way, observed a heavy break; cast towards it, and saw distinctly the sea breaking over a small patch of rock, not continually, but at intervals of 5 or 6 minutes. The bearing of King Wills point from it was E.S.E. about 3½ miles.—Mr. W. P. Braund, Master, Sept. 9, 1852.

whole space between the exterior reef and the shore. Inside these reefs, and, therefore, sheltered by them, there is good landing at little Nifou, on the western side of its rocky point.

The Nifous.—At middle Nifou there are two small rivers, the outlet of which is open only in the rainy months. A mile farther there is another native town called Great Nifou, off which a shallow reef projects ¾ of a mile S.W. ½ W., with a detached 3-fathoms rock ½ a mile westward of the end of the reef.

Droo River, 2 miles from Great Nifou, is a stream of some magnitude, and carries 6 feet over its bar, inside of which it deepens to 4 fathoms. The best entrance is round the southern point, which is low and rocky, with some large outliers; the opposite point is a sandy spit, which stretches well over towards those rocks. Off its mouth there are several dangers; one of them, the Drootah, is a large block of stone which shows itself. But a sunken reef stretches out from it westward; and northward there is a large path of foul ground. A ledge of ¾ of a mile in length lies outside of the south point of the river. Two breaking rocks may be seen eastward of this ledge; and all the soundings in its vicinity as well as round the Drootah are so irregular, that, unless with a view of communicating with the shore, no vessel should venture to approach it within 20 fathoms.

BADDOO, on the coast westward of the Esereoos river, which is 3 miles south-eastward of Droo river, and in Long. 6° 28′ 40″ W., consists of four towns. Close to the mouth of the river there is a large rock, and some scattered rocks a little westward of it, as well as a patch on which the sea breaks—but there is a channel 2 fathoms deep close along the coast inside of all these rocks. In this vicinity the ground produces abundance of rice. There is tolerably good landing under the lee of the large rock. The entrance of the river is only passable by canoes.

Baddoo point curves out southward from the mouth of the river; it is low and sandy, but ½ a mile off its pitch there are several dry rocks, the largest of which is called *Dead Islet*, with several outlying reefs. The outermost of them bears W. ¾ N. from the islet 2½ miles; another N.W. by W. nearly a mile; they are all known by the general name of the *Baddoo Shoals*. The Monkey rock lies S. by E. 2½ miles from Dead islet, and between them there are several reefs and rocks, some above water; the Monkey is 1½ miles from the shore, and there is a breaker westward of it; all the soundings for ½ a mile south-westward are irregular, and the bottom foul and rocky.

A large rock named the castle bears S.E. by E. ½ E. from the Monkey 2½ miles; it rises perpendicularly at about ¾ of a mile from the beach; vessels should not stand so far in as to bring these two rocks on opposite bearings.

Feroowah River—The reefs and dry rocks terminate about a mile eastward of the Castle rock, and thence to the river Feroowah, the sandy beach is straight and safe. That river, with its apparently large opening, is only accessible to boats and canoes when the bar is smooth; its western point is a low spit of sand, the eastern point a bold rock, on which stands the native town of Katoo. The rocks and boulders recommence at this river, there being three near its entrance, and reefs extend from them nearly ½ a mile southward. There is a large rocky patch 2 miles W. by S. of Katoo point with only 6 fathoms on it. The Pashoo rock shows two rocky heads above water, and bears S. by W. 1½ miles from the mouth of the Feroowah.

From Katoo point to Subboo point the coast forms four sandy bays with rocky points, and many large dry rocks and breakers. In front of the native town of Wayako, nearly a mile from the shore and ¾ of a mile E.S.E. of Pashoo rock, there is a shoal patch of 8 fathoms, with deep water on either side of it. The Subboo, a large black rock, lies N.W. by W. ¾ of a mile from Subboo point, with a sunken rock between them. A dangerous rock will also be found about a mile S.W. by W. ½ W. from the point, with 10 fathoms round it, and also two patches S.S.W. from the point, with 2½ and 8 fathoms upon them.

GRAND SESTERS.—From Subboo point the coast trends south-eastward 4 miles to Sesters; in the latter part of this distance there is the usual accompaniment of shoals and off-lying rocks. Of these the large rock called the Carpenter will be easily seen bearing S. by W. ¾ W. from the highest part of Sesters hill. It may be safely approached from the southward; but a long chain of rocks, above and under water, stretches from it toward Sesters point. Behind Sesters point the hill rises 210 feet above the sea. The mouth of Grand Sesters river is about a mile eastward of the point, in Long. 8° 14′ 15″ W.: its western point is low and sandy, while the eastern point is rocky, and pushes a ledge almost across to the opposite shore, so as to leave a very narrow entrance, through which boats can pass only when the water is tolerably smooth. On a rising ground near the eastern point stands the large native town of Grand Sesters, and two English factories, in front of which a large rock, called Factory island, sufficiently breaks the swell to allow boats to run upon the beach with tolerable security. Vessels generally anchor in 13 or 14 fathoms on a muddy bottom, with Factory island N.N.E. upwards of a mile distant.

GARRAWAY.—From Grand Sesters the coast runs about S.E. by E. 17 miles to Garraway river, and is nearly, throughout, an uninterrupted sandy beach. The northern side of the entrance to the river is formed by a long low spit of sand, with two straggling native villages called Bushmans towns, and in front of them a shallow reef extends off shore ½ a mile. Two rocky patches lie W.N.W. of this reef, one at ½ a mile, and the other a mile from it; the latter is ¾ of a mile from the shore, and there is a depth of 6 fathoms in the channels between them.

Garraway point on the eastern side of the entrance, is rocky, but a cluster of large rocks, some above and some under water, covers it from the sea; and outside this cluster, with a narrow interposing channel of deep water, there is an irregular reef of considerable extent, called the Long patch, its two ends bearing from Garraway point W. by N. and S. ½ W., and its southern angle S.W. by S. a mile distant. Another reef, but of a more compact form, lies immediately westward of Garraway point: it has been named the Tryh rocks, and there is a channel in the river both east and west of it. There is likewise a solitary rock bearing from the point W. ¾ N. distant 1½ miles. Garraway river is accessible to canoes, and to boats in moderate weather, and the usual channel into it lies between the north sand spit and a large rock near the middle of the entrance, which is connected with Garraway point by a chain of smaller rocks. Green islet lies a mile eastward of Garraway point, in the middle of a large breaking shoal.

From Garraway point it is 8 miles S.E. by S. to Fish Town point. In this space are three small rivers; the first, the Jidah, which is closely barred by sand during the dry season; and a mile westward of which there is a steep and rocky patch a ¼ of a mile off shore. The town of New Garraway is on the eastern side of the Jidah's entrance. Secondly, the Deeah, a small stream, the entrance to which is open, and sometimes passable for boats. From the mouth of the Deeah, a long and steep reef, on which the sea breaks with violence, extends W. ¾ N. 2½ miles. Thirdly, in the bight of the bay, the river Manoh, which also is open, though but seldom accessible, from the high surf that rolls in along Fish point. About half-way between the two last rivers a reef, which is steep, lies more than ½ a mile from the beach.

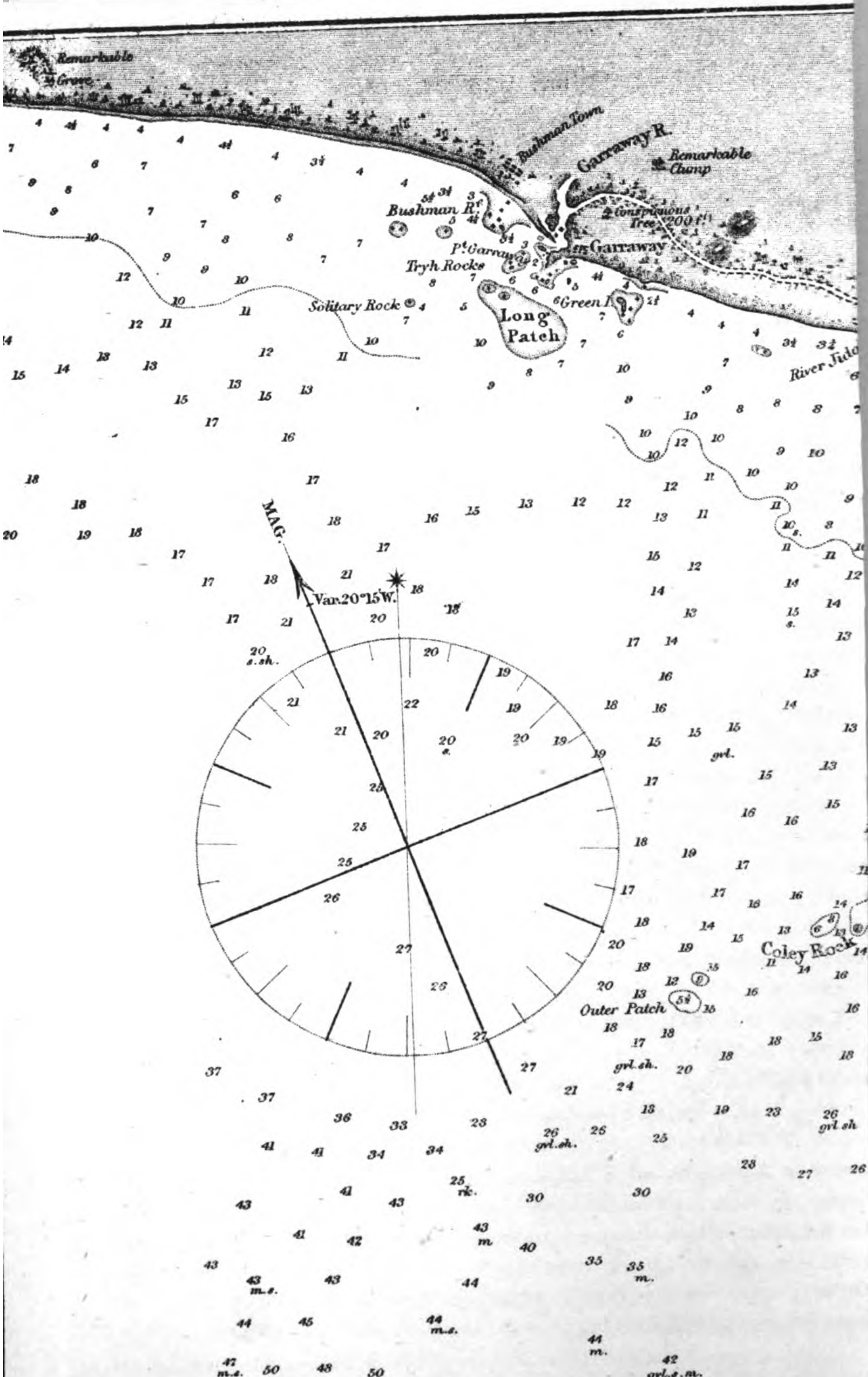
On Fish Town point stands the large native town of that name, and near it a factory for collecting rice, which is abundant in this part of the country. A reef projects ¾ of a mile from the point on the bearing of West, with 7 fathoms close round it; and there is a detached breaker in 10 fathoms a mile N.W. ½ W. from that point.

Outside of these, at 2 miles S.W. by W. ½ W. from Fish Town point, is the *Cape Shoal*, a ledge of rocks always visible, the sea generally breaking on them with great violence, and sometimes on two straggling heads a little eastward of the shoal. The channel between Fish Town reef and these rocks is rather more than a mile wide, and the depth in it varies from 5½ to 8 fathoms, with 7 fathoms close to the points of the reef.

At 2¾ miles W. ½ S. from the Cape shoal, the *Coley Rock* will be found; it is a mere pinnacle, on which the least water is 6 feet; with 10 fathoms eastward, and 13 close to its other sides. From this very dangerous rock, Kablah hill bears E. by N.; Rock Town point E. by S.; and cape Palmas E.S.E. 9½ miles. The ground between Coley rock and the Cape shoal is very uneven, having several rocky heads with 4, 5 or 6 fathoms, and deeper water close around them; two others will be found outside of the Coley, W. by N. ½ of a mile, and W. nearly 2 miles. The quality of the bottom is as variable as the depth, being of rock, coarse sand, gravel, and coral.

Vessels bound to cape Palmas with a leading wind may safely pass inside the Cape shoal, which is always distinguishable by its breakers; and by keeping nearly mid-channel between it and Fish Town reef, they will have 7 fathoms; but at night it will be advisable to pass outside of all, with Palmas Light E. ½ S., or if the light be not seen, in 25 or 30 fathoms.

At Middle point, which is to the eastward of Fish town, a reef projects about a ¼ of a mile W.S.W.



Remarkable Grove
Bushman Town
Garraway R.
Remarkable Clump
Conspicuous Tree 200 ft
Bushman Rf.
Pt. Garraway
Garraway
Tryh Rocks
Solitary Rock
Long Patch
Green I.
River Jido
MAG.
Var. 20°15′W.
Coley Rock
Outer Patch

Rock Town Point, where there is a large native settlement on each side of a small river, which is quite barred in the dry season, makes very distinctly to vessels in the offing. A succession of reefs extends from the point nearly a mile West and W.N.W.

From Rock Town point a sandy beach of about 4 miles in length terminates at Palmas river. In this space there are two small detached and steep reefs which show themselves by heavy breakers. The outer one is a mile S.S.E. ½ E. from Rock Town, and rather more than ½ a mile off shore; the other is not quite a ¼ of a mile distant.

CAPE PALMAS.—Cape Palmas is a rocky peninsular, joined to the main by a low sandy isthmus. Its eastern end is covered by a large collection of native houses called Grand town, but on the remainder of the peninsula is a settlement named *Harper*. Palmas river washes the northern side of the peninsular; its entrance is about 100 yards wide, but several rocks lie in the channel. At low water a depth of 8 feet may generally be found across the bar; and inside about a fathom.

In the direction of the peninsular there are some patches of rock; the first lies a cable's length from the cape, with 10 feet at low water; the second is partially uncovered at low water, and lies two cables' lengths from the cape; and the third or outer rock, which is very small, and carries 9 feet water, lies about ½ a mile from the extremity of the cape. Strangers, however, should not make free with the narrow channels between these rocks, even when coming from the eastward and bound to Harper anchorage, but should round all in 9 or 10 fathoms.

On the south side of cape Palmas a small rocky island has been named Russwurm island. A ledge of rocks extends 100 yards from its eastern end, and terminates in a large rock above water; and ½ a mile eastward of the island, and nearly a ¼ of a mile from the shore there are some breakers with 4½ fathoms close to their south side. Not quite 2 cables' lengths W. ¼ S. from the western end of the island there is a dangerous rock with only 8 feet of water.

The outer edge of the bank of soundings approaches the cape within 18 miles.

The inhabitants of this colony have erected a lighthouse on the pitch of cape Palmas; the light is *fixed*, stands about 100 feet above the sea, and is visible about 9 miles.

Athol Rock.—The beach eastward of cape Palmas is steep, with some rocks at a distance in the offing. Of the latter, one bears S.E. ¼ E. from the lighthouse nearly 2 miles, carrying 8 fathoms. In the same direction, but ¾ of a mile farther off, there is a 5-fathom rock. And S.E. ¼ S. 4 miles from the lighthouse lies the Athol rock, its distance from the nearest shore being 2 miles, with Growa point bearing East. A long series of reefs projects nearly 2 miles westward from Growa point. The sea breaks violently on these reefs, which are steep, and towards which no vessel should approach at night nearer than 15 fathoms.

At 1½ miles eastward of Growa, Cavally point forms the southern extremity of this part of Africa, in Lat. 4° 21′ 12″ N., Long. 7° 35′ 35″ W. The point which may be distinguished from the adjacent sandy shore by its black rocky appearance, is encompassed by reefs extending ½ a mile seaward. At 1½ mile from Cavally point there is a large rock which rises from a reef more than a of a mile from the beach; and a mile farther there is another ledge, about ½ a mile from the shore, with another large dry rock. Sunken reefs lie close along the coast abreast of this ledge. These rocks lie comparatively out of the track of navigation, but between the point and river of Cavally there is a large and dangerous ledge, the outer point of which rises suddenly from 10 fathoms, and stretches from thence towards the river. From that outer point, Cavally point bears N.W. by W. ½ W. more than 2 miles, and the white house at the mouth of the river E.N.E. about the same distance.

Cavally River issues between two low and sandy points, with a bar before it, which is not always passable by boats. On the western point there is a native town, and near it a white house, which belongs to Harper.

About 8 miles eastward of Cavally river, there is a small rocky islet, ½ a mile off shore, with a long reef extending from it W.S.W.; and from the point of the reef to the beach the space is filled with a succession of breakers and ledges of rocks.

Tafou point, in Long. 7°21½′ W., was formerly, and may perhaps now, be distinguished by four tall palms; it is a little bold cliff with 8 fathoms close to its foot. A small river issues about 250 yards eastward of the point, through a narrow channel, not more than 55 yards in breadth. From Willson point a bed of sand and rocks, some of which are dry, stretch out S.E. and nearly to Tafou point; and on the bar between it and William point there are only 8 feet water. This shallow channel lies along the eastern shore till a spit of sand projecting from Willson point is rounded, and even then the water scarcely deepens for a mile within the entrance; nevertheless this little river is a convenient place for wooding and watering, being easy of access to a ship's boats, as the bar is generally smooth, and having good anchorage in 7 fathoms within a ¼ of a mile of its mouth. At the last of the ebb tide good fresh water may be obtained in any part of the river; but it is more prudent to procure it about ½ a mile up, abreast of a little detached sand-bank, where the boats may anchor in the middle of the stream and fill their casks alongside.

From Tafou point the coast trends about E. ½ N. to Tabou point, which is low and foul; and S. ½ W. from which at ¾ of a mile distance there is a rock with only 2½ fathoms, but steep.

A mile beyond the point there is the large native village of Grand Tabou, with an insulated reef in front of it, about a ¼ of a mile from the shore.

BASHA.—Basha point is tipped with rock, and the town* upon it stands 50 feet above the sea. A chain of reefs commences ½ a mile westward of the point, and continues 1¾ miles north-eastward. They extend more than ½ a mile off shore, and lie in detached patches, steep on the outside. About a mile east-

* In 1853, the *Penelope* struck on a rock situated about 1¾ miles E. by S. ½ S. from this town.

ward of the point, Grand Básha river makes its exit; and, like the major part of the rivers on this coast, forms a junction with another stream just at the sea-shore. There is a bar before it, and also two reefs a short distance outside of the bar, leaving a narrow boat-channel between them.

Thence 8½ miles of a broad and nearly straight beach leads to Wappoo point, a small rocky cliff on which a native town stands about 60 or 70 feet above the sea; and quite safe and bold on its southern face. There is no permanent opening through the beach at Wappoo, but a large body of water that accumulates there sometimes issues just to the westward of the cliff.

Poor Point, nearly 9 miles eastward of Wappoo cliff, is on the western side of the river: it is low and rocky, and some rocks lie off to the eastward more than a ¼ of a mile in front of the entrance, which is very narrow, but not entirely closed. These rocks, many of which are above water, are steep.

From the river Poor to the rocky bluff of Kadahboo the distance is 10 miles E.N.E. ½ E. The coast between them consists of a succession of sandy bights with rocky points. The native town of Half Bereby stands upon the second point from Poor river, and the numerous villages near the shore show it to be thickly peopled. At the third point, 8 miles from Poor river, commences an extensive line of reefs lying parallel to the coast for 4½ miles, and terminating rather more than ½ a mile S.W. of Divile rock. The average breadth of this chain of reefs is about a mile. The whole chain is steep.

Divile rock is a large oval mass, rising 46 feet above the sea; the base is dark, but the numerous sea-fowl of which it is the constant resort have blanched its flat summit. It lies about 2½ miles W.S.W. of Kadahboo bluff, and ¾ of a mile from the shore abreast of it. E.N.E. from it, ¼ of a mile, there is a sunken rock upon which the sea breaks. Both these rocks are steep on the south side.

GRAND BEREBY.—Kadahboo bluff is a bold rocky point, in Lat. 4° 39′ N., and Long. 6° 54′ 15″ W. The S.E. extreme is cleared of trees; and the bare summit on which stands the native town of Yeh, is 120 feet above the level of the sea. From the Bluff the shore makes a sudden turn northward, for about a mile, to the mouth of the Nahno river; and on a rising ground in the interval stands Grand Bereby. Abreast of this town and a ¼ of a mile off shore there are some rocks named the *Goomarah Reef*, with a boat-channel between them and the beach. The Nahno river pours out a small volume of water, but its sheltered position enables it to keep down the bar so as to be always open for boats. There are some rocks immediately off its mouth, with 2 fathoms inside of them.

Katum rock, a large white rock, lies 1¼ miles E.N.E. from Kadahboo bluff.

From Grand Bereby there is a long waving line of sandy beach trending about E. by S. 18 miles to Tahou point, which is rocky. In this extent of coast there are many rocks, large and small, above and under water; the first group occurs 1¼ miles eastward of the large white rock of Katum; it is more than 2 miles in length, and continues off ¾ of a mile from the shore. About 5 miles from the

Katum, and 1½ miles from the shore, is a large white rock with 9 fathoms round it, named the Brooni, or white man. There are some breakers rather more than a mile W.S.W. from the Brooni, and abreast of it, near the shore, there is a patch of dry rocks. At 8½ miles westward of Tahou point, and about ½ a mile from the beach, is a sunken rock, and a mile farther eastward another patch. Just westward of Tahou point a series of rocks commences which nearly surrounds the point, and in one place stretches off nearly a mile. Some of them are large masses of dark stone above water, and all are steep on the outside.

Tahou point is steep, with 4 fathoms close off it; and here the shore changes its character, broken and irregular hills coming down to the beach.

The *River San Pedro*, which is 8 miles eastward of the point, appears to be a large sheet of water with a little islet in its centre, but during the survey it was entirely barred up by a broad bank of sand.

This is at present the eastern limit of the Liberian Republic.

THE IVORY COAST (to which we have already referred on page 498) regarded as a political division, commences at the San Pedro river and terminates at Grand Lahou, the western coast boundary of the kingdom of Ashantee. It was formerly more extensive, but portions of it have been merged in Ashantee and the Liberian Republic. Throughout the whole of this extent there are no dangers beyond a mile off shore, and the soundings are very regular.

Highland River.—San Pedro point intervenes between that river and Highland river, which is a fine open stream issuing from behind Highland point, and into which, it is said, boats can enter by a channel carrying 6 feet at low water. From Tahou point to this place the shore is fringed by a succession of rocks and breakers, called the shoals of San Pedro: they are all steep on the outer face and do not project more than ½ a mile. Highland point, which by its shelter, leaves the bar of the river generally passable, is a rocky peninsula, quite bold and safe in its approach. Another small river empties itself westward of the point.

Drewin Point lies 11 miles eastward of Highland river, and in the interval there are but few deflections in the coast, and but two dangers running off a short distance. The approach from the offing is, however, everywhere safe, with regular soundings.

The land here gradually attains a little higher elevation, and is more diversified with hill and dale; and the whole range, which extends 27 miles along the coast to St. Andrew's river, has received the name of the Highland of Drewin.

On the north side of Drewin point there is a small bay with the two villages of Little Drewin at the base of the hills. The Kroumen call the inhabitants "The Saucy Drewins," from their rough and noisy habits. From this bay a succession of small rocky points, with slightly embayed sandy beaches, extends in a straight line E. ½ S. 13 miles to Enframa point; several patches of rocks show themselves by breakers, but they are generally very near the shore, and all have 6 fathoms close-to.

Cassi point is 4 miles eastward of Enframa: in the bay between them is a large village called Drewin.

From Cassi point to Swarton corner the coast trends E. ¼ N. 7 miles, and still retains the same character. The town of Grand Drewin, or Drewin Ehbiensa (Drewin the third) lies 1½ miles eastward of Cassi point; and off the town there is a detached rock, about ½ a mile from the shore. Half-way between this rock and Swarton there is a reef with two patches outside of it, which break a mile from the shore; but thence to Swarton corner the coast is clear of all danger.

King George Town.—Swarton corner is a bold headland forming the eastern extremity of the high land of Drewin; and there are 5 fathoms close up to the rocks scattered round its base. It is in Lat. 4° 57′ 12″ N. and Long. 6° 8′ 40″ W. King George town stands on the shore about ½ a mile round Swarton corner, and at the head of the little sandy bay into which the rivers Sassandra (St. Andrew), Tabeta, Beyh, and Gapeh, pour their waters. The two long sandy spits which form the opening are probably submerged during the rainy season; and then, a large rock 8 feet high, which stands on the end of the western spit, will appear like an islet in the middle of the entrance. On the bar which stretches across this opening the surf is so heavy that no boats can enter.

Fresco River is 30½ miles eastward of King George town. The mouths of this river are barred-up in the dry season, but are stated to be open in May. The delta spreads 1½ miles from west to east, and is divided into several wooded islets. On the sandy point eastward of the river stands a large native town named Fresco; and the main body of water is evidently discharged at that point.

Between the Fresco and the river of Grand Lahou, for a distance of 35 miles E.S.E. ¾ E., the coast is low, thickly wooded, and not thickly inhabited. The beach is everywhere a clean light-brown sand, void of rocks; it is nearly straight and constantly lashed by a high surf. Picaninny Lahou is 14 miles eastward of Fresco.

Half Lahou is 15½ miles east of Picaninny Lahou; and Salt Town 2 miles further.

Grand Lahou.—The town of Grand Lahou is upwards of a mile in length, and stands on the western point of the entrance of the river. This entrance is very narrow, with a dangerous bar in front, on which the sea breaks with so much violence that it is not passable by boats; and even the native canoes are frequently upset in their efforts to bring off their pigs and cocoa-nuts. Both points of the river are extremely low and sandy; on the eastern point there is another, but smaller, town. The two towns contain a very numerous population.

ASHANTEE.—The seaward limits of this extensive native kingdom have already been mentioned on page 498, as well as the principal places on the coast, along which are found the embouchures of several important streams, the various affluents of which intersect the country in every direction. Gold is said to be more abundant in Ashantee than in any other part of Africa. That portion of the Ashantee territory named the *Gold Coast* is included between Apollonia and the river Volta.

From *Grand Lahou* a high sandy beach continues in a straight line E.S.E. ¾ E. nearly 60 miles to Picaninny Bassam. The land is everywhere low, without any remarkable objects. The beach is everywhere steep; 3½ and 4 fathoms being found as close to the surf as it is prudent to venture.

Bottomless Pit.—Near Picaninny Bassam, in the longitude of 3° 57′ W., there is an extraordinary feature of this coast, named the "Bottomless Pit." The great bank of soundings which surrounds the continent of Africa, and which extends to various breadths, and therefore with various degrees of declivity, but even when steepest preserving a regular descent, here falls in close to the coast, and divides itself into two parts by a narrow ravine or gully of very great depth. East and west of this place the outer edge of the bank is 14 or 15 miles from the land, but here it turns in gradually towards the coast in a funnel shape: at 8 miles off the shore, the two lines of 100 fathoms are 8 miles apart, with very deep water between; at 3 miles they approach each other within less than a mile, preserving 200 fathoms depth in the channel. At a mile from the shore the channel is scarcely a quarter of a mile wide; at a third of a mile there are still 100 fathoms; and finally, at the head of this singular submarine valley there are 20 fathoms water at the very head of the beach. The bottom is generally a soft bluish mud, but at 190 and at 220 fathoms some coral rock was brought up by the lead.

The land continues very low for some distance in-shore, and when viewed from the offing, in connexion with the two ranges of hills, eastward and westward, the mind can scarcely resist the impression that there has been a corresponding subsidence there.

During the survey no eddies or ebullition in the sea could be observed, such as would countenance the supposition of a subterranean river here finding an outlet; and while at anchor in 18 fathoms, ¾ of a mile off the eastern village, there was no tide or current, nor any discoloration of the water.

Grand Bassam.—From Picaninny Bassam the coast trends S.E. by E. 15 miles to the mouth of the river Costa, on the eastern side of which are the several villages of Grand Bassam. The entrance to the river is between two low sandy points, very narrow, and with a heavy surf upon the bar. The river is connected on both sides with the stagnant lagoons which occupy so large a portion of this coast; and its volume of turbid water must be considerable, as it discolours the sea for 4 miles from the shore.

The *River Assini* is 27 miles from the Costa; the intermediate beach is nearly straight, with several villages, but the surf generally runs so high as to render landing impracticable. The Assini does not directly communicate with the sea, but after falling into the lagoon, runs 8 miles to the westward before it bursts through the bank and escapes over a bar, upon which the sea usually breaks with such violence as to be impassable to any boats. The sandy ridge, which is about 250 yards wide, between the lagoon and the sea, carries only a few shrubs with occasional clumps of trees.

From the river Assini a sandy beach runs S.E. by E. ¼ E. 30 miles, and nearly in a straight line to the river Albanee; and there the narrow parallel lagoon, which has accompanied this shore for so great a distance, ceases.

Fort Apollonia, the first European fort met with after leaving Sierra Leone, stands on the beach in Long. 2° 35′ W.; it was erected by the English, but having been some years abandoned, it is now rapidly going to decay.

A straight and safe coast of 12 miles leads from fort Apollonia to the river Abmousso: the entrance of which is very narrow, with a high surf breaking across it.

Seven miles more of this straight sandy beach terminates it; the Ancobra river divides it from the knot of hills and rough ground which form cape Three Points, and the whole aspect of the coast is at once changed. The river pours out a considerable volume of water through an opening of 300 yards wide, but so full of large stones and rocks that the canoes cannot venture out except in the most tranquil state of the surf.

Acrumassi point, which forms the east side of the entrance to the Ancobra, throws out a ridge of rocks and stones about a ¼ of a mile; at ½ a mile S.W. ¾ W. from the point there is a detached ledge of rocks, some above and some under water; and W. by N., 1 mile from the same point, there is a solitary breaker.

Axim Bay.—From Acrumassi point to Pepré point the distance is nearly 3 miles S. by E.; between is Axim bay, the well-known fort of that name standing about ¾ of a mile northward of Pepré point. This fort was originally built by the Portuguese, and by them called after St. Anthony, but it long since fell into the hands of the Dutch: it stands on a low rocky point, with a sandy bay and native town on either side, and some rocky ledges in front. The landing here is safe, being protected from the heavy swell by the rocky ledges and islets which lie in its vicinity.

Saiaba island lies a mile N.W. by N. from the fort, and ½ a mile off Ronda point, with which it is partly connected by a chain of rocks; but between these rocks there are deep passages for boats. There is a ledge projecting from Quebrada point to the S.W. about a cable's length, which, with two large patches of rock lying immediately in front of the fort, afford protection and shelter to the adjacent beach. Between Giba and Bobowassi island and the shore, as far as Pepré point, the space is nearly filled with a confused assemblage of rocks and ledges. These islets and ledges are all steep on the sea side, having 4 fathoms close to them.

In March, 1850, the Dutch schooner *Governor* struck upon a dangerous rock in Axim bay, having only 12 feet water over it, a pinnacle with 5 fathoms around it. It lies N.W. 5½ cables from the S.W. point of Bobowassi, and S.S.W. 7½ cables from the middle of Saiaba island. To avoid it bring Axim fort to bear northward of E. by N., when you may anchor in safety in 6 fathoms.

From Pepré point to a point called the Peninsula the distance is 6 miles.

Eastward of the Peninsula, a long straight beach is interrupted by a projecting rock, on which stands the ruin of fort Brandenburg, at the height of 115 feet; and which, being overgrown with dark trees and shrubs, is the more conspicuous from its contrast with the white sandy shore on either side.

The shore then turns southward towards Frederick and West points, which latter is a rocky bluff with some rocks at its base, and forms the southern extremity of Brandenburg bay, as well as the western extremity of a projecting mass of land, named Cape Three Points.

Cape Three Points is 1½ mile S.E. by S. from West point, and projects from the main in a S.W. direction about ½ a mile, with a large rock 100 yards off its pitch, called the Boidan: this rock, which is remarkable whether seen from the westward or eastward, is steep, and is 20 feet high. It stands in 4° 44′ 40″ N. and 2° 5′ 45″ W.

The Cape Shoals.—At ¾ of a mile off Cape Three Points, between the bearing of W. by S. and S.W. by S., there are some dangerous patches of rock called the Cape shoals. The least water on them is 2½ and 3 fathoms, but the soundings all round are very irregular, and the bottom everywhere rock—the shallow parts appearing to be large detached masses with deep intervening fissures. The lead is a bad guide to clear them, as to the westward, at little more than a cable's length, there is from 16 to 8 fathoms; and to the southward, from14 to 5 fathoms. These shoals are the more dangerous as the sea does not always break, and even when heavy rollers break in succession there is occasionally a considerable interval of time before another batch of sufficient volume comes up. West point and Frederick point in one, N. ¾ E., just clear their western edge, and therefore the former should be kept well open of the latter; and in the night no ship should approach them on the western or southern sides nearer than 19 fathoms.

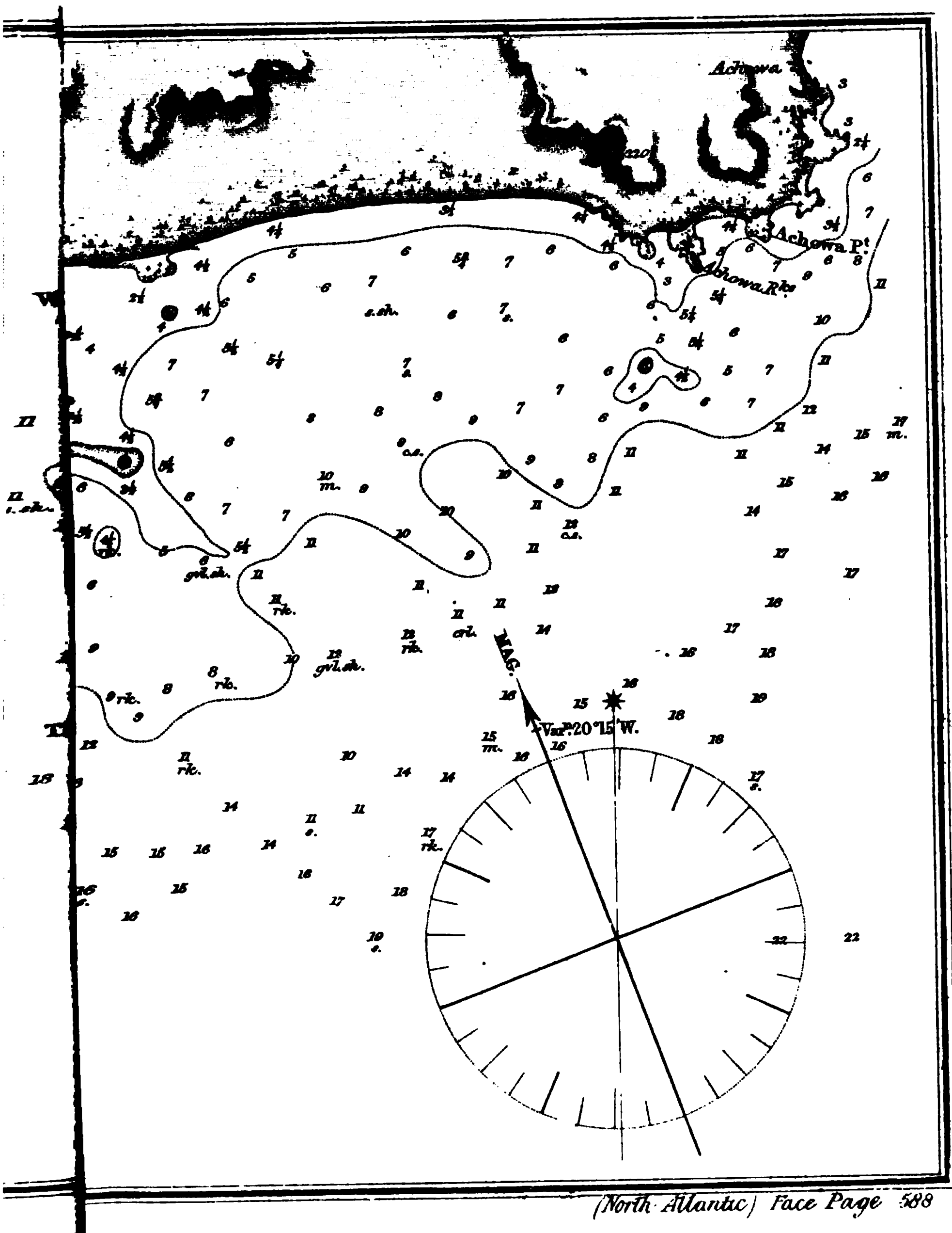
There is a channel ½ a mile wide between the cape and cape shoals, but the ground is very uneven, with some rocky heads carrying only 4 and 4½ fathoms.

The East point of Cape Three Points bears from it E.S.E. ½ E. 2½ miles, and forms a high salient headland having 4 or 5 fathoms close-to on all sides. The whole front of Cape Three Points, that is to say, the space from West point to East point, is a series of hills with abrupt sides and rocky points, and its dangers, the cape shoals excepted, are visible at all times.

From East point the coast continues of the same character for ¾ of a mile; the higher lands then recede from it, leaving an undulating country of less elevation, and the shore forming a sandy bay as far as Stephen point—a rocky knoll at the western side of Aquidah cove. The eastern side of this cove is a small peninsula crowned by the ruins of Aquidah fort, belonging to the Dutch, but no longer occupied.

Aquidah Cove is divided into two little sandy bays, the western one full of rocks; but the other affording tolerably good landing on the beach at high water, close up to a village. In the rainy season there is a small stream called the Alligator, with its outlet close to the point which separates the bays. The entrance of the cove is not more than 800 yards wide, with 8½ fathoms mid-channel, on a sandy bottom, but shoaling rapidly to the beach. From each of the outer points rocks run out to the S.W. about 800 yards.

From Aquidah a sandy beach of 3 miles in length, about E.S.E. ½ E., terminates at Achowa, a broad point consisting of



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of the cove is not more than 800 yards wide, with 8¼ fathoms mid-channel, on a sandy bottom, but shoaling rapidly to the beach. From each of the outer points rocks run out to the S.W. about 800 yards.

From Aquidah a sandy beach of 8 miles in length, about E.S.E. ¼ E., terminates at Achowa, a broad point consisting of several rocky projections.

The soundings in this space are very irregular as far out as 18 fathoms, within which depth strangers would do well not to approach. That space contains also some rocks near the shore which are to be seen above water; while others lie farther out, which carry but 8 feet water, and give little or no warning by the lead. The Aquidah rock, which lies upwards of a mile from the fort, on a S. ½ E. bearing, and on which there are but 8 feet, has 7 fathoms close to it; the East rock ¾ of a mile S.W. ¼ S. from the fort, is similarly circumstanced: and there are others which need not be particularized, as they are shown in the charts.

Dix Cove, in Long. 1° 56′ 40″W., is nearly 400 yards wide, and about the same length, but full of rocks; they leave, however, sufficient room in some places to moor boats or very small vessels. A conical heap of rocks, forming a little islet, lies W.S.W. of the fort, and a reef of rock stretches out from it 280 yards to the S.S.E., forming a narrow channel on each side of it. Ahanta point, on the S.W. side, is surrounded by a belt of rocks which occupies half the cove; and from Swanzy point, on the eastern side, a similar belt reaches to Hood point, about a ¼ of a mile. On it, and 100 yards southward of the point, there is a black rock called by the natives Koombrini, or the white-man's-death-rock, in allusion to an accident which happened there. There are two boat-channels in the cove: one between Koombrini and the islet reef, in which at low water there are only 8 feet abreast of the islet; and the other between it and Ahanta point, with 6 feet; they are both very narrow, but the eastern one is generally preferred, though passing close to the Koombrini rock. At low water and with fresh southerly breezes, the sea breaks entirely across the cove, but it seldom happens that the natives cannot get off to a vessel in their canoes; and in fine weather the ships' boats can generally land and find shelter in the cove, the bottom being sandy with a depth of 8 or 4 feet among the rocks.

The town is on the north side of the cove, and the fort, which is British, is of a square form, standing on ground about 80 feet above the sea, and its battlements about 60. It has a large tank for its own use. Very long hoses are required to lead the water from the fort to a boat at anchor in the small bight at its base. Although the country is covered with forest, the natives object to its being cut anywhere near the town, so that Dix cove is not a good place for wooding. Some refreshments may however be procured here for money or barter, but not in sufficient quantity for a vessel of war of any magnitude.

About a mile eastward of Dix cove is a small low rocky islet called Abokori, some parts of which are covered with coarse grass. The channel between this islet and the coast is ½ a mile wide, but near the middle there is a rocky patch with only 2¾ fathoms, but with a narrow passage on either side of 8 ro 4 fathoms in depth. A few rocks surround the islet, but not extending farther than 180 yards.

In the small sandy bay opposite Abokori stands the little village of Bushau, close to the beach; and the bay terminates 1½ miles farther eastward, at Bootry point, which is bold and rocky. N.N.E. of this point there is a rivulet, on the western side of which stands the small Dutch fort of *Bootry* or *Bartenstein*, close to the beach, and still occupied as a trading-station.

At 1½ miles eastward of Bootry, a sandy angle of the shore terminates in Adoblo rock, a large black mass shaped like a haystack; and there the character of the coast changes, from being almost steep-to, to reefs and irregular soundings with projecting rocky patches. Adoblo rock is surrounded for a ½ of a mile by one of these reefs; and 1½ miles farther eastward another reef reaches out more than a mile.

About 3½ miles beyond Adoblo stands the town of Pompendi, on a projecting point consisting of two stony hillocks with a sandy bay between them; there are several outlying rocks on which the sea at times breaks heavily. With the point bearing N.E. ½ E. and somewhat more than a mile from the shore there is a small 3-fathom reef lying in the stream of 8 fathoms. The pitch of another reef will be found at ¾ of a mile from Pompendi point, into the stream of 6 fathoms; and a patch of foul ground extends eastward of the point for nearly a mile.

At 1½ miles E.N.E. of Pompendi is the village and low rocky point of Adjuah, and hence a wavy line of white beach extends 4 miles to the low sandy point of Tacorady. In this space there are two foul patches with 2½ and 3 fathoms, bearing S. by E. from Adjuah—the outer one ¾ of a mile off shore, and a little farther eastward a broad belt of reefs fringes the beach, and continues all the way to Tacorady point—its average distance from the shore being more than ½ a mile. On reaching that point it turns suddenly in towards the shore, in a N.N.E. line, from whence it again suddenly branches off to the eastward about ¾ of a mile. Another reef, but detached from those, lies still farther out: its shape is circular, its diameter ½ of a mile, and its centre bears S.E. by E. from Tacorady point. Several of its rocks show above water, and though it will be safer for vessels not to approach it within 10 fathoms, yet the lead will lead into 8. Five fathoms will be found at the edge of the surf, being a long mile from the point. In navigating from Dix cove to Tacorady point vessels should not come nearer to the shore than 11 fathoms, unless desirous of trading.

Tacorady Bay.—From Tacorady point to Secondee point it is 4½ miles N.E. by E. ½ E. The coast falls back and forms Tacorady bay, which is composed of several small bights, and all divided by rocky points. The ruins of a fort stand N.N.E. a short mile from Tacorady point: it was once a well-known Dutch settlement. At Appoassi boats may land with facility under the protection of the adjacent reefs. From Appoassi, with the exception of one spot close to the shore, the beach is clean as far as Secondee point; and a vessel may beat up in this bay when working to the westward by common attention to the lead; the bottom is sand and mud, but rocky near the reefs of Tacorady point. The rollers, which westward of that point generally break in upwards of two fathoms, are here comparatively feeble.

Fort Orange.—Secondee point is surmounted by fort Orange, belonging to the Dutch. The fort is a square of about 180 feet in the sides, with bastions at the angles. The English also had formerly a fort at this place, about 250 yards northward of the Dutch fort, but it was blown up by the French in the war of 1780, and nothing now remains of it but a heap of ruins. The population in this vicinity are industrious, and the yams are supposed to be the finest on the Gold Coast; the native fishermen cure much fish, with which they traffic in the interior. A ledge of rocks, on which the sea breaks, extends 200 or 300 yards N.N.E. from the point; but there are 2 fathoms inside of it, and it produces a tranquil landing on the beach at the village. In every other direction a vessel may almost lie alongside the point, at which there are 5 fathoms, but the soundings are very irregular in approaching it.

Abboaddi is the next salient point to Secondee, and bears from it E. ¾ N. 4½ miles, the coast between them being a bay about a mile in depth, and containing within it several sandy beaches and abrupt rocky points, off which there are generally a few rocks. Abboaddi is a double point of low rocks, from which a narrow reef runs out ½ a mile E.S.E. ¼ E., and shows several of its heads above water, one of which has a white top, and stands 300 yards from the point. There is a village at the foot of the hillock which rises from Abboaddi point, and the landing eastward of it is good.

Chama Bay.—At ¾ of a mile E.N.E. of Abboaddi stands the Bassaboo rocks, and from them a reef projects nearly ½ a mile E.S.E. Half a mile farther northward there is another foul point with a similar reef; and thence to Chama there is a succession of reefs with 3½ fathoms close to them. They lie within ½ of a mile from the shore; but there is a single rock, which generally breaks, and which bears S.S.E. ½ E. a long mile from the fort of Chama. The fort of Chama stands upon a rising ground about 300 yards from the beach, in Long. 1° 37′ 35″ W., and behind the native town. It was originally built by the Portuguese, and called by them San Sebastian, but it has long been in possession of the Dutch. The approach to it is covered by reefs of rocks, through which there is a narrow passage for boats at low water, provided the surf be not high, as the winding channel between them may then be perceived from a boat outside. At high water they are all covered except a few large boulders, and the sea breaks so heavily as to present to a stranger no apparent channel. The landing is to the eastward, though the canoes safely wind their way among the western rocks.

A mile beyond the fort the river Boosum Prah falls into the bay between two lagoons. There are but 2 feet on the bar, which is, of course, impassable by the ship's boats, so heavy are the rollers that sweep over it. The natives, nevertheless, most adroitly paddle their canoes both in and out of the river.

The Prah rock, on which there are but 6 feet, with 3 fathoms close round, is very small, and bears E. by S. a mile from Chama fort, and S.S.E. ½ E. ½ a mile from the mouth of the Boosum Prah. Vessels may freely anchor in this bay in 7 fathoms, sand and mud.

A straight beach of about 8 miles in length leads to Commenda point; the shore, in parts, is low, and fronted by rocks. The point is also low and rocky, and just eastward of it the river Soosn comes down the hill and passes between the forts of Commenda. The English fort, standing on the western side of the river, is square, with bastions at the angles; but having been for some years abandoned, it is rapidly going to decay. On the opposite bank of the Soosn, about 500 yards from the British fort, are the ruins of a Dutch fort; and though only a few blackened walls remain, the Dutch still claim the territory, and cause their flag to be occasionally shown. A native town stands at the foot of each fort: and tolerably good landing will be found in the little recess of the beach between them, under the high bar of the Soosn, the waters of which seldom break through it in the heaviest rains, but spread into a shallow pestilential lagoon.

From the rocky point of Commenda, Ampene point bears E. by S. 3 miles. A patch of rocks protrudes from this point about 800 yards, and the Cassee reefs stretch off E.S.E. 1½ miles. Between these reefs and the beach the chart shows a single line of soundings of 3½ fathoms, muddy bottom, and outside them there is the same depth close to their edge, so that the surf at times breaks over them in high rollers.

The town of *Ampenee*, which stands on the shore, is ½ a mile eastward of the point, and contains a large population; a little farther eastward there is another town, Akimfoo, which is built on the summit of a small hill. Between the two towns the river of Akiaboo comes down to the back of the beach; and ¾ of a mile beyond Akimfoo there is another of these pent-up rivers, the Branoo.

The village of Amquana stands on the beach about 1½ miles farther eastward; and a little beyond the village, another stagnant river, the Bebo. The Accra reefs, which fringe the coast hereabout, show themselves in three distinct patches, on which the rollers break with tremendous fury. There are 4 fathoms close to their outer face, and their eastern extreme is at least ½ a mile from the shore.

ELMINA.—In Long. 1° 20′ 15″ W. stands the castle of St. George, which was the first European settlement on the coast of Guinea, having been erected by the Portuguese in 1481. It was captured by the Dutch in 1637, and was finally ceded to that nation by the crown of Portugal in 1641, together with some other similar and dependant settlements of the Portuguese. The Dutch soon strengthened their position, built a commanding fortress on the adjacent hill of St. Jago, and successfully repelled the repeated attacks of the whole force of the king of Ashantee. It is now their head quarters on this coast.

The castle stands obliquely on a low rocky peninsula, along the eastern side of the small river Beyah. This peninsula is connected by a wooden bridge with the opposite bank; and from this bridge to the sea the river is confined by two stone embankments. A large native town, Elmina, which occupies the whole breadth

$\frac{1}{4}$ W. and about $1\frac{1}{2}$ miles from the castle.

From Cape Coast Castle to point Moree the distance is $2\frac{3}{4}$ miles. On an eminence above the point are the ruins of the square fort of Nassau, which belongs to the Dutch, though now abandoned. A rock lies 400 yards eastward of the

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of the isthmus, extends along the beach westward of the castle, and communicates with it by a drawbridge.

Elmina point is surrounded by a bed of rocks, which extends eastward as well as southward, about 2 cable's lengths, and on which the sea breaks with great violence, especially when the sea-breeze sets in. These rocks are of essential service in sheltering the landing-place at the mouth of the Beyah, where the water is, however, very shoal; the ship's boats ground at some distance from the beach, and nothing drawing more than 15 inches can enter between the stone embankments.

The usual anchorage off Elmina is in 7 or 8 fathoms, sand or shells and mud, and a mile or more from the castle, with Mount Egnoffo a little open eastward of St. Jago.

Cape Coast Castle.—is 6¼ miles eastward of Elmina, in Long. 1° 13′ 40″ W., and Lat. 5° 6′ 5″ N., and stands on a rock which forms an obtuse angle in the line of the shore. It was one of the early settlements of the Portuguese, but was ceded to the Dutch in 1641, in whose hands it remained till 1665, when it was taken by the English, and finally secured to them by the treaty of Breda in 1667.

The landing-place is in a small bay under the north-east bastions, and just behind some rocks which generally afford much shelter from the sea. From the landing-place the ground rises gradually to the castle, which contains the Governor's and officers' houses, with a chapel, school, hospital, and storehouse, besides the Hall of Justice. There are also several spacious water-tanks from which vessels are occasionally supplied, but only by permission of the Governor. At a short distance from the castle there are three detached forts on commanding hills, fort Victoria, fort Macarthy, and fort William.

On the latter a *fixed* light is shown at 192 feet above the sea, and all vessels in the road are enabled to rate their chronometers by a ball which is dropped from the flagstaff every day at the instant of mean noon.

The town occupies a considerable space northward of the castle; and, besides its long lines of huts, contains a chapel and some handsome well-furnished houses; a few of them, belonging to the merchants, display much taste, both inside and out, and the residence of the native chief has a most respectable appearance. A huge solitary stone that rises through the beach, westward of the castle, is called Tabara's Wife.

During the dry season, vessels may anchor anywhere off the castle, as the ground is clear of rocks, the bottom being generally fine dark sand, with sometimes minute broken shells, and the depth decreases regularly and slowly to the shore; but in the rainy season, when there is usually a long swell, it will be prudent to anchor in 10 fathoms, with the castle and fort William in one, bearing N. by W. ½ W. and about 1¼ miles from the castle.

From Cape Coast Castle to point Moree the distance is 2¾ miles. On an eminence above the point are the ruins of the square fort of Nassau, which belongs to the Dutch, though now abandoned. A rock lies 400 yards eastward of the point, showing two black heads, on which the sea breaks. Eastward of the point there are two barred-up rivulets, the Epper and the Amfoor, and thence a clean shore, partly sand and partly rock, as far as the bold commanding point of Anashun.

Nearly a mile eastward of Anashun point, and ¼ of a mile S. by E. from the trading house on an eminence in the village of Brewah, there is a breaking rock, with 4 fathoms close to its outer side.

Along the coast from Anashun point to Anamaboe, a distance of 3 miles, the beach is very foul, with off-lying rocks to the distance of a ¼ of a mile in some places.

Anamaboe.—The British fort of Anamaboe stands in Long. 1° 6½′ W., in a little cove upon a flat sandy beach. It is a square, with regular bastions at the angles, and contains good barracks and storehouses, as well as a handsome hall, and other buildings for the accomodation of the garrison. The westernmost of the five hills of Cormantine in one with Anamaboe fort, is a good mark for anchoring, as the ground in that line is excellent, all blue mud with sand and shells; and the approach to the shore quite regular from 9 fathoms at 2 miles to 6 fathoms at 1 mile, so that a vessel can take any berth she chooses, according to the season.

Not quite a mile eastward of Anamaboe the hill and foul point of Agah, with a small native town, projects into the sea; and some confused ledges of rocks project a ¼ of a mile farther.

On a hill which rises from a bold rocky base about a mile E.N.E. of Agah stands the ruins of fort Cormantine. On the south-west side of the fortress there is or was a tower 146 feet above the sea. The ruin is said to be at present the most picturesque of any on the coast. It is now entirely abandoned, though the sovereignty is still claimed by the crown of the Netherlands. On the western side of the fort, down the slope of the hill, there is a small native village; and on the eastern side a winding path leads to a little sandy bay, which is the usual landing-place. The small river Etsin, barred up in the dry season, discharges its waters by two branches during the rains, one into this bay, and the other nearly a mile farther eastward; and across the valley which the Etsin drains, at the distance of about a mile from the fort, the large native town of Cormantine stands at the corner of a ridge of high ground.

At Cormantine the character of the coast again changes, turning suddenly E.S.E. ½ E., and preserving an unknown line of straight sandy beach for 15 miles to the village of Koontanquerry. In this extent the approach to the coast is clear, without a single rock, and the soundings are perfectly regular over a bottom of fine sand and broken shells. The coast is very low, and on its margin are 10 villages, each standing in a dark clump of cocoa-nut trees. It possesses also a few streams, of which the Amissa and the Nacqua are the largest.

Tantamquerry.—About 2 miles beyond Koontanquerry is Tantamquerry point, where there is a native village called Tooam, with a conspicuous whitewashed house in front of it; but the landing there is difficult. The old English castle of Tantamquerry stands on the crest of a rocky hill, a ¼ of a mile eastward of the point; it has long been abandoned, and is now a complete ruin, choked with jungle.

Babli point, 1½ miles farther east, is a large black rock, on both sides of which there is a good deal of foul ground. On each side of it also there is a stagnant lagoon; and a ¼ of a mile inland from the point the village of Leggoo appears on a rising ground.

Gammah.—From Leggoo the coast trends E.N.E. 2¾ miles to Gammah, which stands on the eastern part of a high double point of rock; the English once had a fort or trading-house here, called Mumfort, but no vestige of it now remains. A mile beyond Gammah, and 2 cables' lengths from the shore, there is a breaking rock, with 2½ fathoms close round it.

A mile farther, the point of Apam forms like a small hummock on the eastern side of a saddle-shaped hill, which rises immediately from the sea, and which is surrounded by rocks above and under water: these rocks extend nearly ½ a mile along the coast on either side, but not outwards more than ½ a mile. On the hummock there is a native town, as well as the ruins of the old Dutch fort of Apam. The bay eastward of Apam point is smooth, though shallow, being sheltered by the point and its surrounding rocks; the landing is good and dry, and a canoe is employed, for it is too shoal for ship's boats. The little river of Apam has its entrance at the head of the bay, but the bar is only passable in canoes.

Eastward of the river Apam there is a sandy beach 1¾ miles in length as far as the rocky point of Kitchoroo; and in the interval there are some detached rocks, which stretch out nearly ½ a mile from the shore. Two of them show their black heads above water, and are called the Assakri.

Eastward of Kitchoroo there is a long ledge of rocks, on which the sea breaks heavily; it is a ¼ of a mile in breadth, and accompanies the beach for a mile, to the foot of Mamquady hill. The natives of the village of Mamquady ply their canoes among these breakers with great dexterity, and beach and launch them freely under the shelter they afford.

Winnebah.—The point of Winnebah bears E. ½ N. distant 7 miles from fort Apam. The town stands on the beach of a small bay on the eastern side of the point, and above the town are the ruins of a British fort. Two white-washed trading-houses on the point are easily seen when approaching from the westward. At low water the landing here is good for canoes, being sheltered by the reefs off the point, which are then uncovered; but at high water it is very difficult. The river Ayhnsoo falls into the sea a mile eastward of Winnebah, and being somewhat sheltered by that point, as well as by the adjacent rocks, its mouth is always open.

From the Ayhnsoo river a straight sandy beach runs E. ½ S. 6½ miles to Meredith point, when the coast again becomes rocky and turns more to the northward.

Barracoe.—Barracoe point, which lies ¾ of a mile E.N.E. of Meredith point, is high and rugged, and of a dirty-red colour. On an eminence above it stands the native town of Seniah, as well as the abandoned Dutch fort of Barracoe, which is in a state of rapid decay; but some patches of whitewash still remain upon the walls, and render the building visible from the offing when the sun shines upon it. Seniah is large, and much cleaner than most of the towns on this coast

Fettah Point, 2½ miles north-eastward of Barracoe, is sandy on the western side, but eastward a rocky cliff turns at right angles to the coast, and forms a bay ½ a mile across, at the head of which the town of Fettah stands upon a rising ground, with the little river Kahkoo winding round its foot. When closed in the dry season, this river spreads itself into a lagoon beneath the town. Fettah affords better landing than any place on the coast, except Dix Cove and Elmina. About ½ a mile eastward of Fettah, a reef projects from the shore 2 or 3 cables' lengths; the remainder of the shore is clean as far as *Nyanyano,* which stands in a grove of high trees, and at the foot of the village a little river passes from behind a small rocky point into the sea. A few rocks lie close off the mouth of the river; and to the eastward a long beach, but slightly curved and everywhere safe, extends for 12 miles to Akrah.

AKRAH.—Akrah point is a rock situated in Long. 0° 11′ 25″ W., but its outer extremity, on which Fort James is built, rises only 36 feet above the sea. A few scattered rocks lie round its base; and the landing-place is a little patch of sand scarcely sheltered by those rocks. The surf is so high, and it requires so much skill as well as local experience to pass through it with success, that no ships' boats should ever attempt to land; but the natives in their canoes have from long practice acquired the habit of landing and embarking with ease and safety. The town spreads N.E. and N.W. of the fort; it consists of several narrow streets of native dwellings, but it can also boast of some good houses, belonging to the English merchants. Water, cattle, small stock, fruit, vegetables, and other supplies may be obtained here; but application should immediately be made to some merchant of respectability. There is a constant communication between Akrah and the Ashantees, who bring from the interior much of the gold exported from this place; and as the country, as far as the high range of hills recently mentioned, is a fine open plain with a light soil, studded with shrubs, and not much heavy timber, agreeable and healthy rides may be made in all directions.

On the eastern side of Fort James, between 600 and 700 yards from it, are the ruins of the Dutch fort of Crevecœur.

CHRISTIANSBORG.—Two miles eastward of Fort James the castle of Christiansborg stands upon a rocky point about 35 feet above the sea. On each side of it the beach forms a slight sandy bay, and in front there are a few scattered ledges of rock, on which the sea breaks heavily. The castle was originally built by the Portuguese, but after several times changing masters it was confirmed to the Danes in 1694, who ceded it to Great Britain in 1850; it has from time to time received various additions until it has become a considerable and imposing, but very irregular, structure. Within it are several buildings such as a chapel, hospital, and storehouses, with spacious and airy quarters for the Governor and officers.

The native town, which lies northward of the castle, has not a very cleanly appearance, and the adjacent pool of stagnant water does not much contribute to the salubrity of the place. Westward there is a Martello tower on a small sandy eminence, and also a black wooden-framed windmill. Further inland there are a few detached dwelling-houses, belonging to the merchants.

The landing at the Castle point, which is usually effected under the imperfect shelter of the rocks, is very difficult, and seldom attempted, except by the natives in their canoes.

The merchants of British and Danish Akrah have made a handsome road between those places, with trees on each side, which render it an agreeable walk or drive.

From Christiansborg a sandy beach with a few rocky patches runs East a couple of miles to the village of Labadee. Three miles farther there is a large native town called Tassy, and westward of the town may be seen the British fort, named *Augustenborg.*

Little Ningo, 2 miles eastward of Tassy, stands on a rising ground, ¼ of a mile from the shore: and Temma, 5 miles farther, has a similar position, with a fine green slope down its eastern bay. In the interval between Tassy and Temma, about 1½ miles short of the latter, there is a small black rock on the eastern end of a long ledge, and detached from the shore nearly 300 yards, which lies exactly on the meridian of Greenwich.

At 1½ miles beyond Temma, the beach forms a point from which a short reef projects southward; and another 1½ miles brings us to Grove point, with a similar reef projecting eastward. From this point likewise a spit or tongue, which has been named the *Vernon Bank,* runs off fully 12 miles in an E. by S. direction, and consequently at an angle of about 1½ points with the general trend of the shore. Its formation is very irregular, some casts of the lead showing sand, others gravel, stones, and narrow ledges of rock. The average depth on it is between 5 and 6 fathoms, and on the shoalest part 4½ fathoms, which is south of Ponee. There are 10 fathoms close to it on its southern side, and on the northern 8 or 9 fathoms, with regular soundings thence to the shore, consisting of brown sand with minute broken shells. It is believed that there is no danger on any part of this bank, but vessels would do well not to approach it unnecessarily within 12 or 13 fathoms.

In a bay 1¾ miles eastward of Grove point is the town of Ponee, on a rising ground ¼ of a mile from the beach. The usual landing-place for Ponee is on the beach close northward of Grove point, the reefs off which afford some little shelter.

About 3½ miles eastward of Ponee stands the town of Prampram, near the summit of a low hill, ¾ of a mile from the beach. Near the beach below the town may be seen some native houses, and the ruins of fort Vernon, which formerly belonged to the British, but has been for some years abandoned. The landing-place is opposite the fort, on a clear bit of the beach between two patches of rocks which extend a mile on each side, and on which the sea breaks violently.

FREDENSBORG.—From Prampram the coast trends E. by N. 4 miles to the

Ningo river, which, though small, is said to be always open, and navigable for canoes, whenever the heavy surf which rolls in upon the bar allows them access. Its entrance is very narrow, between two low sandy points. On the eastern point, the British fort of Fredensborg appears to be nearly smothered in a thick tope (grove) of cocoa-nut trees.

For nearly 4 miles eastward of the Ningo the beach is accompanied by a broad ledge of rocks, over which the small river Mumo discharges itself, and being protected by them, its mouth is probably always open. The ledge has 4 fathoms as close as a rowboat can approach the heavy surf which rolls over it incessantly. These rocks are the last seen upon this coast.

From the above ledge of rocks to the entrance of the river Volta there is an uninterrupted beach of 26 miles in length, and so slightly curved as not to recede more than 2 miles from the straight course, which is E.S.E. ½ E.

The shore soon breaks down into a mere ridge of sand with a few bushes. This ridge is not more than 12 or 15 feet in height, and continues for 13 miles to Occo, separating throughout that space the sea from the great salt lagoon and the swamps which are produced by the overflowing of the Volta. From the mast-head the whole face of the country appears a wooded morass, as far as the eye can reach; and the surface of the lagoon is broken by large tracts of swamps, some of which are covered with grass, and others by jungle, with here and there a few high trees.

The village of *Occo* is 200 or 300 yards from the beach, near the eastern extremity of the lake; and surrounded by cocoa-nut trees, which, as there are no others near it on either side, give it the appearance of an island when seen from a distance. At a ¼ of a mile eastward of Occo, the ground, though intersected by swamps, is again covered with verdure and is again succeeded by thick groves of palm-trees mixed with jungle, which extend to the banks of the Volta.

The River Volta.—This river is said to come from a long distance in the interior, and, separating the great kingdoms of Ashantee and Dahomey, passes near the northern base of the Ningo Grande peak; thence it takes a south-easterly direction towards the coast, and enters the sea between two low spits of sand, in Long, 0° 41′ 15″ E. The western spit is nearly 2½ miles in length, and leaves only an entrance (between it and the eastern point) of ½ of a mile in breadth. The bar, upon which are about 10 feet of water, sweeps round in a semicircle before the outlet of the river, to the distance of nearly a mile from the coast, and sometimes the surf upon it is too heavy for any boats to attempt to cross.

Immediately within the two sandy spits which form the entrance, it expands into a wide basin, both banks of which appear to be formed by small islands covered with mangroves down to the water's edge. The greater part of this basin is occupied by a mass of islands partially covered at high water; these divide the river into two branches. Northward of this the branches are united, and form a reach of considerable magnitude with a northern direction.

About 4 miles within the entrance, and on the western branch of the river, is the town of *Adda*, which is said to contain 8000 inhabitants; near it are the ruins of the fort of Kongensteen, ceded to the British in 1850.

In front of the bar there is a depth of 5 fathoms within 75 fathoms of the actual breakers, an the bottom being composed of mud and sand, affords good anchorage.

DAHOMEY AND BENIN.—That portion of the Gulf of Guinea coast which belongs to the former of these kingdoms, is said to be bounded westward by the river Volta, and eastward by the river Lagos. Concerning Benin there is almost an equal absence of positive information, but its sea-front is generally considered to extend from the river Lagos to that of Old Calabar. Within these limits is the celebrated "Bight of Benin," the great theatre of the slave trade in former years.

The Bight of Benin, proper, is comprised between cape St. Paul* and cape Formosa,† which bear from each other S. 73° 25′ E. and N. 73° 25′ W. (true) or nearly S.E. ¾ E. and N.W. ¾ W., 318 miles, from which chord line, at two-thirds of a mile the distance from cape St. Paul, the curve of the shore recedes 96 miles northward to Odi.

The length of the shore is about 380 miles; a long monotonous range of sandy beach, and so uniformly low and flat, that not a single inland eminence is visible from the offing; indeed, every object on the shore dips at a 12 miles offing; jungle, with groups of trees, covers the whole of the western division of the bight, but interspersed with numerous villages and straggling beachmen's huts; and through this long portion of the coast, there is but one permanent outfall for the lagoon waters, namely, at Lagos.

The distinguishing characteristic of the south-eastern division of the bight, is a continuous dense mass of trees, no longer fringed by a bright sandy beach, but growing up from the high.water margin of the sea, and the many rivers and creeks which cross the Delta of the Niger. Much vegetable matter and silt are discharged at every ebb-tide, which discolour the blue ocean water with a filthy scum of a brown colour, and accompanied by a sickening smell, for the distance of several miles.

Soundings.—The average breadth of the bank of soundings is here upwards of 30 miles, while off the western part it is but 16; and abreast of cape St. Paul there are 200 fathoms with no bottom, dropping from 16 fathoms at only 6 miles off shore. This broad bank of soundings, however, affords a useful warning to the mariner, if he will use his lead on a part of the coast which is skirted with

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* In Lat. 5° 47′ 36″ N., and Long. 0° 55′ 43″ E.

† At the mouth of the Quarra Branch of the Niger, in Lat. 4° 16′ 21″ N., and Long. 6° 4′ 34″ E.

muddy shallows to such a distance that the surf is not heard, while along the western portion, you may stand in to 6 fathoms, or ¼ of a mile from the beach. In the eastern portion also the land is frequently obscured by exhalation (locally termed *smokes*), which, in the dry season, especially from November to May, prevails throughout the bight; but with less perplexing effects on the western coast, where the bright sandy beach, with its fringe of foaming surf, is easily seen through the haze, or makes itself heard in time to warn him of his proximity to the shore. Even there, however, the lead should always assist the look-out, lest he should unexpectedly find himself within the baffling influence of the swell and rollers,—the sagging leeway effect of which should be allowed for at the rate of half a knot an hour, when shaping courses at night, or in hazy weather by day. Let it be borne in mind that the hurling action of the swell, at the back of the surf, will sometimes seize a vessel at ¾ of a mile off the beach, when ground tackle would little avail, should she miss stays. Even steamers ought not to shoal the soundings below 8 fathoms, for unless their paddle-noise is occasionally stopped, the surf roar will not be heard in time, though audible long before the foam can be seen on foggy mornings. If there be no particular motive for hugging the shore at night along the western coast, the best rule for preserving a 4 or 5 miles offing, is to keep in 12 fathoms.

Along the eastern arm of the bight, that depth will give an offing of 9 miles, which is desirable, not only on account of its shallows, but from the heavy ground swell that is perpetually rolling in; and therefore, if the land be not visible, and if with the vessel's head off shore, she is decreasing her soundings below 12 fathoms, she should be anchored; and the more especially if supposed to be opposite any of the river entrances, as the indraught of the flood-tide extends 6 or 9 miles.

Tornadoes.—Amid the anxieties of the commander of a ship in such a deleterious climate, and on such an inhospitable coast, without a lighthouse, or a single harbour of refuge, it will be no small relief to be assured, that, throughout the bight of Benin, there does not exist a detached shoal of any description, and that no lasting gale of wind ever occurs. She has only to be kept clear of the actual beach on the western side of the bight, as well as off the river bars on the eastern side, which common vigilance can ensure; and to be prepared for the tornadoes which periodically will assail her with more or less fury,—and which otherwise may dismast, or throw her on her beam ends. These visitations, however, give ample warning, they are of brief duration, and always blow off shore;* but they may take place during any period of the 24 hours from the beginning of March to the end of June. Thunder precedes the gathering arch of clouds, which darkens the horizon in the direction from whence the burst of wind and rain is to come. The barometer indeed gives no indication of their approach, and maintains its uniform quiescent state, which in this region varies but a line

* See also page 75.

above or below 30 inches throughout the year; but the thermometer soon falls 5° as the tornado sweeps along, and continues to indicate its cooling effects for some hours after, which, with the acceptable supply of rain-water, somewhat requites the anxious bustle upon deck, and the terrible increase of heat below, as all scuttles are necessarily closed.

The tornado begins by agitating the surface of the sea, so as to be seen by day, or heard by night; rain sometimes accompanies the first furious burst, and is driven with such force as to render it impossible to look to windward, or discern anything beyond a few yards' distance, and its noise so overcomes the loudest voice, that all orders necessary to meet the exigency (particularly if it assumes a whirlwind character) must be conveyed by messengers.

In order to sustain the first impression of a severe tornado, it is in general prudent to bear up from the indicated quarter—to furl all, including the awnings, to strike top-gallant masts, get up the lightning conductors, and boom them well out, bar in all ports and scuttles, and to hoist the fore-staysail, for it is essential that the ship does not receive the outburst on her broadside.

If at anchor (the best condition in which to receive a tornado), furl the awnings until the wind has expended itself, and keep the fore-staysail ready, to cast her in case of parting; then loose and slope the awnings directly the wind ceases, in order to carry the succeeding deluge of rain to the water-ways, and to shelter the people and the hatchways. During this lull, and while the wind is resuming its usual moderate force from the offing (a period sometimes of 3 hours), the perpendicular stream of rain is attended by rapid peals of crashing thunder, which jars the glass and bells throughout the ship with scarcely an interval between them, and by vivid forked lightning, which seems to proceed from all quarters at once.

In April and May, tornadoes may be expected at intervals of 48 hours, and twice sometimes on the same day. In June or July they occur almost daily or nightly, but in a milder form as respects wind, until, in August and September, the weather resolves itself into almost continuous rain, with strong sea breezes and heavy swell from the S.W. In October it gradually clears up, leaving November, December, January, and February, the most settled and healthy months of the year. During these four months, the temperature scarcely varies night or day, above or below the limits of 85° and 90° in the shade. It is at this season, the exhalations for about three hours after sunrise prevail, and completely shroud the coast in what African navigators call the smokes, which give way to the sea breeze about 10 A.M.

The coolest period of the year is June, when also strong double-reef-topsail breezes prevail from the S.W., which, with the thermometer down to 77°, give life and elasticity to the mariner.

The *Avons Deep*, 30 miles eastward of Lagos, is a wedge-like gap in the shelf of mud which outlies the coast, and enters nearly at right angles to the bank, where its mouth is 10 miles wide; from whence it narrows to a point at 6¼ miles from the beach-huts at Palma. The sides of this extraordinary cleft are almost perpendicular; deepening at a cast from 40 fathoms to 133, black mud, and then to 200, no bottom. There is no overfall, nor anything on the surface to indicate the existence of this singular conformation at the bottom; nor is there any aperture in the adjacent coast or any apparent change in its character. The prudent navigator, however, should be upon his guard when in its neighbourhood, for if he should be approaching the shore at nightfall, or in hazy weather, in dependence on his lead, and intending to be close in at daylight, he might be fatally deceived by a cast with no bottom in this deep, imagining himself outside the bank instead of within 6 or 7 miles of the beach. In some cases, however, it may be of material service to the seaman at night by giving him a fresh departure.

Winds.—The prevailing winds are from S.W. and West in this region; and the current so uniformly runs in the same direction along the western part of the bight that both tend to sweep a vessel towards its south-eastern shores; and the influence of the weather-tide is so weak as scarcely to require any attention in working to windward.

When working to windward in the bight of Benin, it is recommended by Mr. Earl to stand off on the starboard tack during the day, and in-shore on the port tack by night; tacking should the wind veer towards the west, and allowing a mile an hour easterly current as a general rule.

Currents.—With the exception of the tidal influence off the opening of Lagos, there is only the current to affect a vessel's easting and westing along the westward division of the bight, and that seldom exceeds ¾ of a knot for 10 months of the year. This current rounds cape St. Paul on a north-easterly set, parallel to the sweep of coast-line for about 25 miles; it then gradually assumes the E.S.E. trend of the coast for the next 180 miles, until abreast of the termination of the sandy beach near Odi, and without any inshore eddy.

During the Harmattan, the current yields to its impulse and sets with increased velocity, about 1 knot; but even during the westerly winds, when they have freshened up for three or four days, and thus pressed a superabundance of ocean water against the eastern arm of the bight, a reaction takes place, and a western current will be produced for 12 and sometimes 24 hours.

Attention to these fluctuations of the current-set is especially necessary along the eastern arm of the bight when within the influence of the river tides, which are felt about 10 miles from their mouths, or when in 12 fathoms water, mud and broken shells. The force of the flood stream, however, is very much less than that of the ebb, as might be naturally expected from the vast outfalls of the freshes being added to the discharge of tidal water, and the combined effects of which diverge right and left, over a radius of 3 leagues, at a velocity of 3 knots at the mouth and 1 knot in the offing; and at half-ebb, bring forth a volume of turbid, brownish water, bearing up-rooted trees, bushes, leaves, and jungle. Frequently this discharge consists of a scum of nearly 3 feet deep, resembling the lees of an oil cask, and from its levity, and deep brown colour, so contrasts with the ocean-blue, as to present a remarkably defined and frothy margin, with all the appearance of a shoal. On approaching it a stranger would be much inclined to tack or anchor, but if he consults his lead he will be saved much unnecessary trouble; and when he crosses its edge he will find that, though its onward motion would sweep away a boat, it has no effect on a vessel of any draught.

This discoloration of the water during the rainy season, extends sometimes as far westward as Jackin and Whydah, and to a 10-miles offing: while in-shore, the volumes that pour out of the lagoons give the sea a light green tint. This lagoon water breaks out through periodical openings in the beach, beginning with the month of April, when the tornado rains have swollen the lagoons, and so continuing throughout the rainy season until October.

Anchorage.—Excellent holding-ground is afforded, throughout the whole Bight, from close in-shore out to 15 fathoms. The bottom is throughout stiff black mud with broken shells, and is well calculated for working the stream anchor, but with a bower cable, as the stream chain might not sustain the demand of the irregular swell which, at intervals of an hour or so, assumes the turbulence of the roller. Towards the edge of soundings, however, from 15 and 20 fathoms, the bottom is composed of so soft a compound of olive-coloured mud, broken shells, and decayed vegetable matter, as to require a bower anchor. In-shore, although the lead-arming may present nothing but the sand which covers the bottom to the depth of a few inches, yet from cape St. Paul to the Avons deep the anchor will instantly bury itself up to the crown in mud.

Anchoring anywhere in the Bight of Benin must be prompted by necessity and not from any hopes of tranquillity; for as the ship tends obliquely to the swell, more or less according to the strength of the current, so unceasing heavy rolling is the sure result. If requisite, however, for the purpose of transporting stores between ship and ship, choose a four-leagues offing at least; and, if consistent with the purpose in view, choose the western arm of the Bight, and as far westward towards cape St. Paul as possible; for its waters there are less turbulent, and its climate less uncomfortable. In fact, several dry sunny days together, during the rainy season, may be enjoyed westward of Lagos, while it is incessantly raining eastward.

A few merchant vessels anchor outside the bar of the Benin river, where they sometimes wait for nine months treating for palm oil, cask by cask, and patiently enduring the caprice and dilatory ways of the natives, as well as the baneful exhalations of the adjacent jungles.

Landing.—It should be borne in mind that, however practicable a surf may occasionally appear, nothing ought to induce an attempt to land in the ships' boats anywhere between cape St. Paul and the termination of sandy beach at Odi, by other than local canoes, and even they require much skill and the assistance of extra hands to receive and haul them up as well as to launch them. The signal gun, with ensign at the fore, will be at once understood, though it may be very tardily obeyed. There is no accelerating their movements, but sooner or later a couple, perhaps, of stout canoes with a dozen paddles each will dart off, cheering you with a beautifully-timed though unintelligible song, and accounting for their delay by pointing to their collection of refreshments, which being disposed of the padroon undertakes your landing* at a dollar a trip.

Supplies.—Vessels in want of food and water anywhere in the Bight should prefer to obtain them at Fernando Po and Princess island, which are within three days' run to the southward. In cases of necessity, however, the natives will bring off water at a dollar a puncheon, and merchant vessels generally so provide themselves.

With attention an ample quantity of rain water may be saved during two-thirds of the year, for cooking and washing.

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* When embarking, passengers will find the canoe ready with her prow outwards, and hauled up her length on the beach; and they will now take their seat at the narrow uncovered part abaft; while the crew of athletic naked fellows are ranged on either side, reaching down to her thwarts so as to lift her out of her sand-dock, as well as to drag her down, which they begin to do with the assistance of the beach men, as soon as the second of the three heavy waves has broken. The steersman now watches with experienced eye for the following swell, when, with energetic exclamations and gestures, she is floated off on the expended wave, each man jumping into his place with his paddle, and so simultaneously and expertly as not to over-balance her. Her head is then dexterously kept to the sea, but not propelled forward until the steersman again gives the word; and sometimes a long interval is occupied in watching the swell and in moving her a little backward or forward, or perhaps sideways, which they cleverly do by a sculling motion of the paddles without altering the direction of her head, which must be kept towards the surf. Many anxious minutes are passed in this way, till the state of the outer swell seems all at once to justify a dash, and then, with mighty urging at one moment and expertly checking her at another, the buoyant little shell is passed from dell to ridge, and then down again into the trough of the sea at a frightful angle of inclination; sometimes, as she meets the topping wall-like crest, her prow nearly pointing to the zenith. Strangers should then hold on well to prevent being pitched from the seat, and maintain a perfect composure, although from the jargon-clamour fore and aft, he might well imagine that there was a difference amongst the men in those pregnant moments when decision is so absolutely necessary to safety. But in a few minutes the struggle is over—the boat is outside the breakers—the paddles are laid across the thighs of each man—all now breathe freely—the water that has just been shipped is baled out—and to the vehement and discordant jabbering succeeds the merry laugh and jokes at the expense of "Massa Cappun," whom they are sure they have astonished, if not alarmed. They are now invited to the prow-end, every man presenting his arm, as a safe hand-rail, while they step from thwart to thwart. She then steers for the ship under some joyous song, in which frequent reference is made to the "Cappun" and the "bot-a-rum," and by which time and vigour are given to the paddles, while, at certain turns of the tune, they are made to flourish over the head. Though clear of the surf she is still in a heavy swell, that produces a flopping and fatiguing confusion as the flat-shaped prow falls on the surface; and it is, therefore, always prudent to have the ships' boats waiting at the back of the surf. Two other precautions may be here recommended: no stranger should walk on shore in the heat of the day without an umbrella to guard against the fierce rays of the sun; and also to head-up in a small cask such things as it may be desirable to pass dry through the surf.

Very few accidents occur to these canoes when freighted with passengers only; but with cargo they often capsize, especially when embarking with such top-weight as casks of palm-oil and oxen, or in landing with crates and dry goods in cases.—*African Pilot.*

Abundance of stock, and a moderate supply of vegetables, can be obtained at several stations on the western coast, viz., Awey, Quitta, Elmina Chica, Little Popo, Whydah, and Badagry. The three first-named places are the most convenient, as the water is generally smoother, from the vicinity of cape St. Paul and the people are more anxious to get rid of their stock than at the populous and slave-intriguing stations to the eastward; but at Badagry they are so well disposed that nothing but the troublesome surf in July and August is allowed to restrict the supplies that may be desired; here, too, that important element of health and comfort, washing one's linen, can be always accomplished. Fernando Po is the next convenient place for that purpose, and at Quitta they attempt it, but not so well. Excellent yams are to be had at Fernando Po at 1d. per lb.; and if whitewashed and stowed in a dry tank, will keep for a couple of months. The production of yams should be encouraged, and unsparingly allowed to ships' companies as a substitute for biscuit, which becomes speedily injured in that climate. The Spanish dollar is better understood round the Bight of Benin than any other coin, but the *cowrie* shell* forms the usual currency.

Description of the Coast.—Eight miles eastward of the mouth of the Volta is the town of *Atakoo*, once a notorious slave mart.

Cape St. Paul.—From Atakoo the coast-line bends gradually eastward, towards cape St. Paul, and then more to the northward, past the village of Wyee; after which it sweeps round rapidly to the N.N.E. ½ E. for 5 miles, to the town of Quitta. The curve of the shore being so gentle and equable, it is difficult to say what part of it should be called cape St. Paul. At Wyee the obtuse angle of the coast appears to obtain its greatest south-eastern prominency, hence the name has been assigned to that spot of the beach which lies eastward of Wyee in 5° 49′ 56″ N., and 0° 58′ 30″ E. It separates what in the maps is named the Gold coast from the Slave coast; which latter extends round the Bight of Benin.

Awey or *Wyee*.—At this place canoe communication may be had with the shore, and plenty of stock. It may be known by a group of huts and a flagstaff.

Jellu Kofi is a station northward of Awey.

Quitta.—The whole face of Cape St. Paul is only a narrow ridge or barrier of sand, which separates the sea from a great lagoon connected with the river Volta. On this narrow strip of sand, 5½ miles northward of Wyee, stands the native town of Quitta, and a fort belonging to Great Britain. The town is large, and on the western side of the fort; the huts are built principally of clay, and neatly thatched with long grass; but the houses of the wealthier natives generally occupy the side of a square, the enclosed area or court being common to three or

* The scale of valuation, as understood by the natives, is, that 40 cowries of all sizes make one *string*; 50 strings are equal to one *head* (the common name for a dollar); 20 heads are equal to an ounce of gold dust; and an ounce of gold dust represents £4 currency. Thus a dollar is worth 2000 shells, of which it would be most tedious to count any large number, if that were required by the natives; but on showing them that a 5 lb. weight is equivalent to an average of 2000 cowries, they will take the rest by weight.

four of them. There are several narrow streets of such buildings with these little picketed enclosures, and some appeared to be neatly kept.

There is no good place between Acra and Quitta for obtaining either wood or water; but cattle and stock are abundant in the vicinity of cape St. Paul, and may be procured without difficulty from the natives at Wyee and Quitta. The surf is, however, much too high along the beach to employ the ships' boats for this purpose. Vessels desirous of communicating with the shore may anchor at any distance they please, as there are no dangers whatever.

Quitta is easily indentified by its whitened fort and clustering trees, and standing a ¼ of a mile from the beach; the lagoon comes to within 353 yards of it to the north-westward. The people at Quitta are extremely civil, and assiduously meet every demand for refreshments. From the walls of Quitta, the banks of the lagoon are seen stretching away eastward towards Popo, a distance of upwards of 30 miles; and the country on the other side of the lagoon is described as being very productive. The inhabitants of the long intervening ridge between the lagoon and the sea derive all their supplies of provisions thence, which occasions a very considerable canoe traffic between the opposite shores.

From Quitta the coast-line takes a straight bearing of N.E. ½ E. for 8½ miles to Elmina Chica, with, like the previous shore, clean ground in 6 fathoms, at ½ a mile off the surf. Between Quitta and Elmina Chica stand the villages of Acquijah and Blookoos.

From Elmina Chica the coast, with the same general appearance, bends gently outwards for 5 miles, to a beach village, named Adaffi. A flagstaff with occasionally a white flag, a short distance westward of the huts, serves to distinguish it from the next coast village, which is named Flohow or Porourah, and which bears East 3 miles.

Little Popo.—From Porourah the beach is nearly straight for 25 miles on the bearing of about East to Little Popo, before arriving at which are the villages of Fish Town and Gomalouta or Porto Seguro. Here a signal for a canoe will be faithfully answered, and a supply of poultry, pigs, yams, and fruit can be supplied, even small quantities of water.

Little Popo presents an imposing front of beach store-houses, and signal poles, which display the British ensign at three positions, one of which marks the residence of the native chief.

A convenient berth for anchoring may be taken with the eastern end of the beach-stores bearing N. by E. ½ E. in 8 fathoms, fine sand, about a mile off the heavy beach surf. A night should not be passed closer in, and, even at that distance, on any part of this coast, a second anchor should be ready in case of a roller-surge snapping the cable when there is no land breeze.

Leaving Little Popo, the coast, after a gentle deflection, runs E. ¾ S. for 4 miles to another group of storehouses named Ahgwey, where the British flag is displayed.

Great Popo.—After 13 miles of a bushy surface, with scattered palm-trees, we arrive at Great Popo, where the sand ridge is broken through by the occasional outfall of the lagoon. No indication of the town is seen from the offing, as it lies at the back of the sand-ridge.

WHYDAH.—The coast thence for 10½ miles, on the bearing of E. ¾ S., resumes its former appearance as far as Whydah. The beach station of this town presents to the view from seaward but half-a-dozen storehouses, sheds and huts, with a flagstaff, all of which, when the staff bears north, make out clear of the western fall of a high grove of trees in the background. The town of Whydah lies 1½ miles inland on the northern shore of the lagoon, which, coming here to within ½ a mile of the beach, is only ¼ of a mile wide, and 4 feet deep.

When convenient, the natives will bring off supplies of live stock, vegetables, fruit, and, if desired, small casks of water. The surf is heavier here than to the westward; and Whydah is considered to be more liable to intermittent fever than the other places on the western arm of the Bight. Anchorage, convenient for canoe communication, can be taken up a mile off in 7 fathoms, brown sand, with the highest storehouse bearing North. It is said that the best mark for anchoring here is the English fort, bearing about N.W. by N. In this position the canoes can fetch easily off and back again, the current taking them on the bows.

From Whydah the coast runs E. by S. 9½ miles to Jackin. With a gentle flexure the same character of coast continues 10 miles to Appi.

PORTO NOVO.—Nine miles eastward of Appi, in Long. 2° 35½′ E., with two small villages intervening and dividing the space nearly into thirds, is Porto Novo. There is good anchorage in 8 fathoms, sand and mud, at 2 miles S. by W. of the single hut which constitutes this place. At 5½ miles inland and northward of Porto Novo there is a large town of the same name, on the banks of a river which drains a lagoon, flows past Badagry, almost parallel to and about a mile within the sea-shore, and discharges itself into the river Lagos.

BADAGRY.—With the same description of foreground, the coast is nearly straight from Porto Novo for 18 miles to Badagry, the landing-place of which is rendered conspicuous by a couple of barrel-posts, a store-shed, a flag-staff, and a whitewashed cottage; there are two groups of beachmen's huts at 3 and 6 miles to the westward.

Convenient anchorage may be taken in 8 fathoms, mud and shells, with the white cottage bearing N. by E. about a mile. The signal for a canoe will be promptly obeyed here, and every attention paid to applications for stock and refreshments. Even clothes will be washed, and sundry other civilities offered through the kindness of the missionaries, who have great influence in the town, which stands on the inner side of the lagoon at the distance of a mile from the landing-place, and out of sight of either the anchorage or beach. The lagoon is ½ of a mile wide and 4 fathoms deep, and the intervening ridge of sand is also ½ of a mile across.

There is an English trading agent here, who is always ready to render any acceptable service to his countrymen, at least whenever the surf permits communication with the anchorage.

The coast from Badagry presents the same character and soundings, with one village and some rows of salt-pans, as far as Soozoo, a distance of 8½ miles.

LAGOS.—From Soozoo the coast trends about E.S.E. ½ E., 24 miles to the opening of Lagos, the eastern point of which lies in latitude 6° 26′ 20″ N., longitude 3° 26′ 12″ E. Lagos is the first permanent break in the coast-line eastward of cape St. Paul; and through it the periodic accumulation of the freshes in the lagoons finds a vent to the sea, and produces against the surf a struggle of no ordinary kind upon the bar.* As there is however, a rise of 5 and 6 feet at the full and change of the moon, so there are occasions on which an attempt to enter that singular estuary might reasonably be made; and in the dry season of December, January, and February, with frequent success. But even then a vessel of more than 5 feet draught should not risk it, nor ever, without the precaution of employing a canoe to ascertain and buoy the best channel through its fluctuating bar. A tide-guage should also be placed in the smooth water within, so that the instant of the maximum rise of the tide might be indicated by signal. The bar is least accessible at other periods of the year, when the swollen outfall would yield a greater depth because it would be then met by the heavy ocean swell and rollers which break fearfully as far out as 8 fathoms water, on the radius of a mile from the middle of the entrance.

The average breadth of the channel is ½ a mile, and through it the lagoon pours out, about half ebb, such a volume of surface scum, of a deep brown tint and of a sickening odour, as to spread over a sweep of 3 miles, the edge of which is marked by a well-defined margin as it rolls forward on the deep-blue water of the offing.

Vessels intending to communicate with the shore by means of a canoe should anchor in 6 fathoms, sand and mud, about a mile from the beach and 1½ miles eastward of the entrance, with the outermost of the two flagstaffs on the eastern point bearing N.W. Thence the usual process of landing goods is effected on the outer beach; they are then transported across the seaboard strip of land which divides it from the eastern lagoon. No buildings are seen, nor is their any evidence of the immediate region being inhabited, except the three flagstaffs (on which are usually hoisted French, Sardinian, and Hamburgh colours), and two or three canoes lying on the eastern beach.

The bar and the river Lagos were surveyed in January and February, 1852, by Mr. THOMAS EARL, H.M.S. *Harlequin*. The following are his remarks:—"Should it be desirable to enter the river, you must wait your opportunity; this will soon be apparent (I speak of the fine season) by the innermost bank becoming dry; between this bank and the beach is the boat passage. Then wait till it is nearly covered again, when you will be sure of having the flood on the surface, when you can easily pull through the passage, keeping just outside the rollers and close to the beach, and passing within a few yards of Wilmot's point. This

* The entrance is subject to continual changes, particularly during the rainy season.

is the best and only safe passage that can be constantly used (tide permitting) throughout the year.

The deep passage is only used by boats and canoes during the dry season or in very fine weather. When the sea-breeze blows strong, the sea breaks right across it; and when this is the case you must be very careful in attempting the inner or boat passage, which should not be done without local knowledge, for the danger of upsetting is great. During the dry or fine season, from November to the end of January, and sometimes February, there are numerous passages for boats between the sand-banks at the mouth of the river which can be used with safety. Within the river the rise of the tide in the fine season is not more than one foot; during the rains the river is swollen (so I am informed) to nearly 8 feet. When the ebb makes, the rush is so great that large masses of the banks are swept away, sometimes carrying men and cattle with them.

The ebb makes down about three hours beneath the surface while the tide is running strong into the river. The flood makes but is not perceptible till within an hour or 1½ hours of high water; then it runs with great rapidity, as much as a boat can pull against.

A vessel intending to enter this river should first anchor in 7 or 8 fathoms a mile from the beach, with a western Big tree bearing N.N.W. so as to overlook the passage; then place a buoy close under the outer roller to mark the entrance, for there is no object on shore for a leading mark. Having entered the passage, keep close to the outer or weather roller, and so continue gradually keeping more to the northward.

After passing Beecroft point, keep the western shore close aboard until the water shoals to 18 feet, than haul over to point Wilmot on the eastern shore, and continue up the river on that side. Take care in crossing over to allow for the tide.

Lagos was attacked by the British forces in December, 1861, the king dethroned, and another set up with whom a treaty was made for the abolition of the slave trade. Since then legal trade has flourished, and the influence of the Abbeo Kuta missionaries has increased. A British consul also has been appointed, so that it may be hoped that this worst stronghold of the slave trade is about to become a scene of better things."

The *Victoria Lagoon* empties itself into the river abreast the town of Lagos. As before observed, it runs in westward from this river, nearly parallel to and about a mile within the coast, a distance of 32 miles to Badagry; thence towards Porto Novo, a distance of 16 miles, the breadth of the peninsula, separating it from the ocean, gradually increases.

The coast immediately eastward of Lagos resumes its usual characteristics. The first object of notice lies at 7 miles distance on the bearing of E.S.E.; it is named the Quoin village.

From the Quoin village the shore is nearly straight for 17½ miles on an E.S.E. trend to Jacknah, a place showing but a few huts. This is the northernmost

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spot of the whole bight of Benin, the leeward arm of which begins there to recede to the southward; and after passing two small collections of huts, leads on a course of E.S.E. ¾ E., 6 miles, to Palma village. Off this place is the extraordinary Deep named after the surveying vessel commanded by CAPT. DENHAM, and before described on page 601-602.

From Palma the average direction of the coast-line is E.S.E. for 36 miles to the termination of the sandy beach. A village will be found 8 miles eastward of Palma; and at 7½ miles beyond is the village of Jaboo.

Pursuing the coast about S.E. by E. ½ E. you pass a straggling village at 8½ miles from Jaboo; next a single hut at 2½ miles farther; and then another hut and flagstaff at 2½ miles more.

Odi.—At 10½ miles south-eastward stands the village of Odi; and a ¼ of a mile farther an abrupt and remarkable change occurs in the complexion of the coast; the beach altering at once from sand to mud; and the dry-soil palm and brushwood being succeeded by the swampy mangrove.

Thus far a vessel may fearlessly run along the coast at the distance of a mile, except at the projecting bar of Lagos, but after passing Odi Vista, muddy shallows of 3 or 4 fathoms will be found within 2½ miles of the shore: and the coast for 6 miles beyond the village becomes a dreary mud-flat; no background trees there give effect to those that are scattered along the margin of the sea; and the surf which is seen breaking a full mile off shore is no longer heard. This terminus of the sandy beach is a striking feature in the navigation of the bight, and lies in 6° 20′ N., and 1° 31′ 45″ E.

From the southern end of the above-mentioned six miles of mud-flat, the shore assumes a somewhat firmer character, and is interspersed with clumps of trees and scattered huts, as far as the group of villages called Town. From Odi the general direction of the coast is S.S.E. and distance 47 miles to the mouth of Benin river.

Benin River.*—The northern point of the mouth of the Benin forms a well-defined elbow, while on the southern side it is only an obtuse curve; but from abreast of the former, the opposite shores take a parallel direction for 4 miles, about N.E. ½ E. and 1½ miles apart. Both of them are flat and swampy, but inhabited. There is a trade from this river in palm-oil and ivory; the palm-oil factory being on Factory point, which is steep-to, carrying 10 feet water up to the factory jetty. This point is 4 miles up on the southern shore, and 1½ miles above the village called Obobi; besides which there are three villages on the north shore, one of them, Fish town, standing just opposite the factory: and on the round of the south point stands a fifth village, called Salt town.

The north shore is bold, having 8 and 6 fathoms within a cable and a half of its margin. Close to that side, and opposite the jetty, an old merchant-vessel is stationed as a hospital for such Europeans as cannot be retained in their

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* Sometimes named "Formoso."

languishing state, with safety or convenience to others at the factory, or on board the ships outside the bar. She also serves as a refuge for any boat's crew, who through temerity or stress of weather, have to remain during the night in this baneful atmosphere, wherein, if the malaria should be escaped, a frenzied state of excitement, the forerunner of fever, is almost certainly produced by the combined effects of *prickly heat* and *mosquito bites;* the latter generally ulcerating in 24 hours. It is never justifiable to remain inside the bar after sunset: the trading agents may endure it from habit and from their precautionary contrivances, but even they are to be pitied.

On the bar of sand which encloses the Benin, there are generally only 9 feet of water, and both of its wings are so shallow and covered with such furious breakers as to preclude any approach to within 2 miles of either point; but at nearly midway between those breaking spits there is a gully or channel, of a mile in breadth and about ¾ of a mile across the bar, where 12 feet will be found at low water of spring tides; and which, with a spring-tide rise of 7 feet, would, in a tranquil sea, afford a 19 feet depth at high water. But in this region, where an incessant ocean swell causes an undulation that gives the stern-post a send of 11 or 12 feet, no craft of more than 8 or 9 feet draught ought to attempt the bar; and even then the state of the sea should be well considered, as it sometimes unexpectedly breaks, and with overwhelming force, from the arrival of an inopportune roller. Ships have been lightened and rashly taken into the baffling turbulence of this bar, where in one send they have lost the rudder and sustained a broken back; though sometimes a successive sea has fortunately thrown them into the smooth estuary, where the crew have saved themselves in the boats. It has indeed happened that a vessel, impelled by tide and swell, has been carried over the bar without touching, and then, after discharging her cargo and taking in a small portion of a return cargo, got out to her original anchorage to receive the rest of it by lighters. Some persons, however, have been tempted to load as deep as when bound inwards, and so were necessarily wrecked in trying to get out.

The roadstead, then, is the obvious position for all trading voyagers to adopt; and there the agents and natives will receive or deliver a cargo in local craft, aided perhaps by a small steamer. In this road much rolling and pitching must be expected, but it is good holding ground; and the most convenient position will be found in 4½ fathoms, black mud, with the north point N.E. by E., which line of bearing will lead over the deepest part of the bar. This anchorage is 3 miles outside the bar, and 5½ miles from the river's mouth.

The lower 4-miles reach of the river will appear right open, and up the centre of that reach there are 3, 4, and 5 fathoms until abreast of the factory, for which craft or boats should steer, upon an E.N.E. course, as soon as the shoalest part of the bar is crossed. The flood runs but 3 hours at 2 knots, and the ebb as much as 9½ hours at 3 knots; the discoloured water discharges itself over a range of a 9 miles' radius from the mouth of the river.

Escardos River.—From Salt town the coast-line bends round to about S.S.E. for 10 miles to the funnel-shaped opening of the river Escardos, which, unlike that of the Benin, has its southern point the best defined. Heavy breakers outlie this point for 3 miles to the N.W., and at first sight appear to join those from the opposite point, but there is an occasional space at a fourth of the distance from the latter, where 8 feet water may be found, but too precarious and uncertain to be safely used. At present indeed there is no object for running such a risk, but should any rational enterprise ever induce some small vessel to enter this river, let her cross the bar with the north point E. by S., and then rounding that point closely, keep well off the southern side.

Forcados River.—The heavy breakers which outlie the south point of Escardos, range on a S. ¾ E. trend, at 2 and 4 miles off shore, and join the bar of the river Forcados at the distance of 11 miles. These heavy breakers do not continue all the way into the Forcados river, but stop short at a circular knoll of sand of 1¼ miles diameter, the centre of which is a mile off the main land and nearly half-way between the rivers. From this knoll heavy breakers stretch off W.S.W., about 1½ miles, and from them the bar of Forcados may be said to spring. This bar is a mile broad, and 3 miles in length, from the breakers off the knoll to those which project 4 miles from the south point of the river at a right angle to the coast line. It carries 13 feet at low water, and from its great length between spit and spit, as well as from the narrowness of its ridge from 3 fathoms to 3 fathoms, Forcados may be considered the most accessible estuary of any on this coast, with a noble sound of smooth water 5 fathoms deep immediately within the bar; and though the treacherous disposition of the natives prevents all trading intercourse there at present, yet small craft of 10 feet draught might avail themselves of that smooth water to caulk topsides, refit rigging, &c., always providing they are well armed.

The water is smooth along the margin of the coast to the south-eastward of the sand-knoll; and a considerable village, with a number of large canoes on the narrow sandy beach, will be seen as the knoll is brought northward of East.

The fairway-course over the bar is with the centre of the opening E.S.E. The flood stream runs 3 hours at 2 knots, the ebb 9½ hours at 3 knots, propelling the discoloured water 18 miles seaward. Its mouth is 1¾ miles wide, and the bar lies 4½ miles outside of the north elbow of the entrance.

River Ramos.—The coast southward of the Forcados has the same monotonous features as that northward; a dense forest and a tangled jungle rising from a narrow sandy beach on which the surf but feebly breaks. In the whole interval between that river and the Dodo, there is no sign of habitation, no huts, no canoes, and no back-ground, until, on opening the river Ramos, the receding plain and its thick forests are perceptible. The distance of this opening from Forcados is 13 miles; the intermediate shore lying S. ½ W. No columns of smoke are to be seen by day, nor fires by night to give animation to the gloomy and forbidding aspect of this neighbourhood; an aspect, however, which is quite in keeping with the character of its treacherous and murderous inhabitants. A course E.S.E. ½ E. leads through the very limited channel over the bar.

A belt of heavy breakers occupies a sweep of 2½ miles in front of the Ramos, but leaving occasionally in the middle a smooth space of ½ of a mile in width. This part of the bar is a mile across, with 9 feet at low water, and therefore subject to a dangerous send of the swell. Inside of the points, the estuary is straight-sided and steep for 2 miles, with 3, 5, and 7 fathoms smooth water.

The tidal stream is 2½ knots on the 9½ hours ebb, and 1½ knots on the 3 hours flood.

Should it be necessary to visit this river, the bar is most tranquil in the dry season, and may be crossed as above stated in the best water, and the first reach passed through by steering E.S.E. ½ E. The best anchorage outside the bar will be likewise found on this bearing in 5 fathoms, black mud, at 3 miles off the bar, and 5 miles from the river mouth.

River Dodo.—From the Ramos the coast maintains the same repulsive appearance, and the same straight course of S. ½ W. for 18 miles further, where another river named the Dodo issues through an oblique opening with Walker island in its mouth. It is only ¾ of a mile wide in its lower reach, though the opening in the shore at its mouth appears to be nearly 3 miles.

Walker island is thickly wooded at its eastern angle. All access to this river is apparently denied, by the ceaseless foam which spreads for three miles right and left of the island; and for 1½ miles to seaward. Should, however, any object lead to a boat expedition into this uninviting place, an opening in the breakers may be sought in the dry season close over on the northern side, of a third of a mile wide and 8 feet deep, by bringing the river-reach open northward of the island, and on the bearing S.S.E. ½ E.; wait, however, for the last hour of the flood on spring tides, and look out too for the bar seas as you approach a low point which projects ½ a mile right out (west) from the northern elbow of the entrance: and look out also for the troublesome and dangerous natives.

The anchorage to be taken up for the purpose of despatching the boats, should be in 4 fathoms, black mud, with the northern extremity of the trees on Walker island, bearing E.S.E.

River Pennington.—From the Dodo southward for 9 miles the coast is of the same featureless character, but bends nearly two points more eastward. The Pennington river opens to view on a S.E. by E. bearing, and is ½ of a mile wide, with 6 fathoms water a mile within the points, but has only 6 feet depth upon the bar, which spreads over an area of 1½ miles. A narrow passage between heavy and dangerous breakers will be found upon the above bearing.

Middleton River.—Pursuing the same coast-trend of S. by E. ½ E. for 14 miles farther, you will arive at the river Middleton, which from the offing has the appearance of a wide-mouthed estuary, with an island stretching across its entrance, and leaving channels of equal breadth on either side. But the southern opening, only giving vent to a superabundant outfall of freshes, is not a real channel, and being faced with impassable breakers, is named *False Entrance.* Those breakers apparently sweep round the northern entrance, also in a semicircle of 2 miles' radius, and it is through them and over a bar-flat of sand, of 1½ miles reach, with as little as 6 feet at low water, that any attempt to enter the river can be made. Steer for the north point when bearing E.N.E. ½ E., during the last hour of the flood, and in the tranquil period of the dry season, a good whale-boat may thread her way into this desolate place; inside, 6 fathoms water and a lake-like surface will be found for a mile, in an E. by N. direction, whence it branches into dark mangrove recesses, N.E. and South.

At 3 miles southward of the *False Entrance*, there is another inaccessible opening, named *Blind Creek*, from which breakers project nearly a mile. At 7 miles from Blind creek on the bearing of S.E. by S. two apparent river entrances, named the Winstanley Outfalls, appear. They are a mile apart, and both barred by most furious breakers, which are occasioned by the outpouring of the rivers combating with the ocean swell.

The Sengana mouth of the Niger, after 8 miles more of the same dull mangrove shore, on the bearing of S.E. ½ S., makes, with the Benin, ten river openings in the western face of this great alluvial projection of the shore. This branch is, however, so chocked up at its orifice by a sandbank in the centre, and by the turbulent breakers which reach a mile out, that although presenting a rather inviting appearance at first sight, it is not accessible.

River Niger, Nun, or Quorra.—At 6 miles distance from the Sengana opening, and 819 miles S.E. ¾ E. from Cape St. Paul is the mouth of the river Niger, or as it has at various times been named, the Nun, the Quorra, or Kowara; its eastern, or Palm point, lying in Lat. 4° 16′ 21″ N., and Long. 6° 4′ 34″ E., bears N.N.E. ¾ E. 2½ miles from the outer bend of the bar, and is the fairway line for crossing the bar.

The bar-breakers spring out S.S.W. almost at right angles to the coast-line, and then curving sharply eastward, form a sack-like belt of sand and breakers of ½ a mile in breadth, on which there are 13 feet at low water, and this depth extends for ½ a mile right and left of the above-mentioned leading line.

As the tide rises here 6 feet on ordinary springs, it will be easy to select the most favourable moment for entering this river; but it should be recollected that, at the driest and best season, a heavy swell fearfully undulates, if not breaks upon the bar. Once over it, borrow towards the eastern shore, as a sandy spit projects from the island, half a mile into the fairway, just opposite to and W.N.W. of Palm point. After passing them you will find a clean smooth water reach of a mile wide, with 5, 6, and 7 fathoms for 3 miles up, and carrying 4 fathoms to within 2 cable's lengths of the eastern shore.

The ebb-stream runs 9½ hours at 3 knots, and the flood, 3 hours at 2 knots.

It should be remarked that, although the mouth of the Niger is stated to be one mile wide, yet its two points are 1½ miles apart, by reason of the eastern one stretching out ¾ of a mile seaward of the other. A canoe village stands on the margin of the eastern shore a mile within Palm point; and the chief's village, Accassa, a mile inland of that. No refreshments are to be expected here any more than at the other rivers in the Bight. The shores are thickly wooded, and are so near upon the level of the river, as to be little better than a vast pestilential swamp. Good holding ground in 5 fathoms will be found at 1½ miles outside the bar on the above leading line.

From the eastern point of the Niger, the mouth of the river Bento bears about E.S.E. ½ E. 10 miles; and the general coast line of that vast delta, which projects 70 miles to the southward of a line drawn from the head of the Bight of Benin to that of Biafra, sweeps round in a curve of 60 miles radius; and, although it presents no very distinct termination, yet its most projecting segment, which contains the mouth of the Niger, bears the name of cape Formoso.

BIGHT OF BIAFRA.—Cape Formoso forms the northern boundary and cape Lopez the southern boundary of the Bight of Biafra. These points bear from each other N.N.W. ½ W., aud S.S.E. ½ E. (true), and are distant about 330 miles. From a point near Princes island, in the imaginary line joining these capes, the coast recedes north-eastward about 175 miles. The line of coast from cape Formoso to the Cameroons shore, where it turns abruptly southward, trends E. by S. ½ S. nearly, for 165 miles. It is intersected by several rivers, of which the more important are, the Bonny, the New and Old Calabar.

The general direction of the current is easterly, and its strength one mile an hour throughout the year, excepting during the Harmattan, when the direction is changed to W.S.W.; a heavy tornado will sometimes change the set of the current for a day or two. Vessels therefore bound to the Bonny, if overtaken by night, should either anchor or work to windward until the morning; for if once to leeward, especially during the rains, a heavy sailing ship will have great difficulty in getting again to windward.

A ship may anchor off this coast at all times of the year, but never in less than 7 fathoms except in case of necessity, because, in less than that depth, the swell begins to assume the character of rollers, and causes the ship to ride very uneasily; indeed 10 fathoms is a better depth, so that the anchor may be weighed and stowed before making sail.

The River Brass.—The Rio Bento or St. John has its entrance between two bluff capes. The bar, with heavy breakers, extends 3 miles from shore, but owing to its liability to change, a previous examination should be made with a boat, before the vessel enters. It is advisable that boats should go in at the last of the flood towards high water, or with the first of the ebb, but at no other time during spring tides. Within the bar the river expands into a broad and deep estuary. CAPT. BURTON and LIEUT. DOLBEN crossed the bar in 15 feet at low water in 1861.

In 1838 the boats of H.M.S. *Viper* ascended this river for about 60 miles, and found it 400 yards wide, and 9 or 10 fathoms deep, its banks fringed with impenetrable mangrove. On returning they kept along the western shore with a current running 7 knots.

The river San Nicholas, 10 miles east of the Bento, between the coast line boldly convexes seawards. Its eastern bank is terminated by a large rounded point. The western bank is higher, and slopes as a point towards the sea. The two points are very distinct with the mouth of the river open and bearing N.N.W., but as it soon bends to the N.N.E. it appears from the offing as if closed by distant wooded land.

The entrance of the *Santa Barbara*, 10 miles farther eastward, opens out on a N.N.E. bearing. The western point is perpendicular; the eastern forms a slight slope, having a small part broken into steps.

The Rio San Bartholomeo.—As far as the river Santa Barbara a vessel may run without fear at a distance of 3 or 4 miles from the coast in 4 and 5 fathoms, but at the same distance from the land abreast of the river San Bartholomeo, about 7 miles south-eastward of the Santa Barbara, there is a bank thrown up off the entrance, on to which a vessel is likely to be carried rapidly by the flood tide. It is the more necessary to be on the guard against this bank, as the coast-line as far as the San Bartholomeo changes its direction rather more to the south-eastward after passing the Santa Barbara.

The western point of the San Bartholomeo is low and hardly distinguishable; the entrance of the river does not open out until it bears North. The eastern point is higher, and bluff. The shoal ground extends 4 miles from the entrance, outside which the depth is 3 and 4 fathoms.

The *River Sombreiro* lies 10 miles farther eastward: it does not open out until its meridian is passed. It has a passage over its bar, but it is rendered dangerous by a considerable shoal off its mouth, on which a heavy sea breaks. This extends from 3½ to 4½ miles off shore, and is about a mile in length. CAPT. VIDAL came suddenly upon it without warning from the lead. A furious surf prevailed on the bar, which would apparently prohibit access at all times.

New Calabar and Bonny Rivers.—Fouche point forms the western limit of a large bay or estuary, into which the New Calabar and the Bonny (Obáne or Okulma) discharge their waters; its eastern limit is Rough Corner point. It is 7 miles wide, and encumbered with sandbanks, between which are the channels leading to the rivers; but from the constant changes in them, and the little depth of water, a pilot is indispensable.*

The entrance is obstructed by some extensive banks, between which are two or three channels into the rivers, but none so fixed as to render written instructions available for any length of time. Since the survey of CAPT. VIDAL in 1826, very material alterations have taken place, and the buoys placed by Mr. F.

* This duty is performed generally by the masters of the Liverpool merchant ships engaged in the palm-oil trade, who are far better acquainted with the navigation and more trustworthy than the native pilots. These latter are stationed on Ju-ju point, a mile north of the Rough Corner point, and if it can be seen, the usual signal with a gun will be attended to; or a boat may be sent up the river for one of the masters of the merchant ships; the boat must not leave the ship later than 4 p.m.

Johnson in 1854 to mark the channels are frequently washed away, so that vessels bound to either rivers should endeavour to anchor near the Fairway buoy (*black* beacon buoy) in 5 fathoms, with Fouché point bearing N. by E. ¼ E., and Rough corner N.E. by E. ¼ E.; though Capt. Vidal recommended that no vessel should at any time of the year anchor off the entrance in less than 7 fathoms, with Fouché point North or N. ½ W., and with not less than 50 fathoms of cable. Lieut. Roberts says of the breakers on the outermost sand, that "at high water, in fine weather, they may not be seen, therefore it is necessary to keep the lead going constantly when approaching with light winds, but with a sea on and blowing fresh they always show."

The anchorage for men-of-war is off the village of Bonny, in 6½ fathoms, outside the merchantmen. It is necessary to moor with open hawse to the eastward, in the event of a tornado.

In the river the ebb stream runs an hour longer than the flood and a knot faster, or at the springs 3 or 4 knots.

The town of Bonny or Obáne contains about 6000 people, but the country under the rule of the king and chiefs about 40,000.

The natives are exclusively devoted to the palm-oil trade. To seek for that article they ascend the numerous creeks of the delta of the Niger for 40 or 50 miles in their large canoes. Provisions, poultry, meat, and fruit are scarce. The river abounds in fish. Yams, kids, and dry fish constitute the food of the population, who, finding the trade in palm-oil more lucrative than that in provisions, sell but little of the latter, and at high prices.

Every possible precaution should be taken against fever, as it is rarely that a ship can fill up with palm-oil in less than 3 or 4 months. She should, therefore, take in a quantity of salt at the cape Verde islands; ship Kroumen on the Krou coast, and touch at Fernando Po to complete water and purchase provisions. Once in the river the ship is roofed over, the oil casks landed, and the holds cleaned, fumigated, and whitewashed.

The *New Calabar* has not so much water, and is not so much frequented as the Bonny; however, it is equally resorted to by the trader in search of palm-oil.

The *River Antonio* is 15 miles eastward of Rough Corner point. The mouth is nearly chocked up with sand, which permits a passage for boats only. Great care should be taken at all times when standing in for Antonio river, as the shoal ground extends 7 or 8 miles off the mouth, and a flood tide often throws a vessel in at the rate of 2 miles an hour; but all dangers may be avoided by paying attention to the lead.

Old Calabar River.—From the river Antonio the coast retains the same general feature, and extends about E. by S. 58 miles to the Old Calabar river, the entrance to which lies between Tom Shots point (on the west) and the East head, about 10 miles apart. Fourteen miles S.E. from Tom Shots point is Backasey gap, which is very conspicuous, and will first attract attention from seaward in making the land eastward of the river. The opening is about ½ of a mile in width; it is the entrance of a creek which communicates with the Backasey rivers.

When approaching the Old Calabar from the westward, great care must be taken, as there are several knolls, with not more than 15 feet on them, extending for upwards of 12 miles from the land: they are a considerable distance outside, or south of the extremity of the continuous line of breakers off the mouth of the river. Should a vessel which is not sure of her position find herself with hard bottom, it would be prudent to haul up to the S.E. and make the land about Backasey gap, where a cross bearing with the East head, if it can be seen, will place the ship nearly in her true position. The weather is generally so hazy that the mountain peaks cannot be seen, except after a tornado.

When making Backasey gap coming from the westward, do not bring it to bear east of N.E. by E., so as to clear the knolls before-mentioned; and when with the gap on that bearing, in a depth of 3½ or 4 fathoms, the ship will be in the fairway for running over the bar in from 3 to 4 fathoms.

If the eastern side of the mouth of the river be made, the depth of 3½ fathoms only will be met with very far off. This is the bank of mud and sand which projects from the east head of Backasey gap; and far to the S.E., even in this shallow water, the land may not be seen, causing doubt and uneasiness. Hence it is preferable to make the land from the southward, having first sighted Fernando Po.

If at this point a tornado should threaten, it is best to anchor until it blows over. On this coast they come from the S.E.

To enter the river it is necessary either to send a boat or boats ahead to point out the channel, or obtain the aid of local knowledge. A large palm-oil trade is carried on in this river, and ships of 800 or 900 tons lie many months off Duke town, a considerable distance up.

In the "Description Nautique des Côtes de l'Afrique Occidentale, par M. LE COMTE E. BOUET WILLAUMEZ," published in Paris, in 1848, considerable information upon this part of the coast will be obtained.

From that work we learn that the distance from the southern end of the breakers to the S.E. end of Parrot island is 22 miles: from the north end of Parrot island to Seven Fathom point 18 miles, from the same point to Duke town* 28 or 30 miles.

At the bar the tide does not run more than a mile an hour during the dry season, setting towards Tom Shots point and over the shoals to the westward; this requires particular attention in turning out with the ebb, or at any time with light winds.

This brings us to what is considered the eastern limit of Benin.

BIAFRA is supposed to extend from Old Calabar river to cape Lopez, but, like most of the political divisions on this coast, is either very changeable or uncertainly defined. The coast, which trends South, a distance of about

* The position of Duke town is stated by MR. HEATH, master of H.M.S. *Favourite*, to be Lat. 5° 8' N., Long. 8° 24' E.; but by COMMANDER STRANGE, of H.M.S. *Archer*, Lat. 4° 56' N., Long. 8° 15' E.

300 miles from the river to the point, has been surveyed by CAPTAINS OWEN and VIDALL, and LIEUT. BEDFORD, R.N., but of its interior our knowledge at present is extremely limited.

The current prevailing off this coast does not appear to be in any way connected with the equatorial current of the Atlantic Ocean, which commences near the island of Annabon, but to be a continuation of that current which comes up from the Cape of Good Hope, along the Western shores of Africa; for CAPT. BOTELER says, that all the currents along Prince's island set strong, and in the dry season commonly between N.N.W. and N.N.E. The wind generally blows from the S.W. or South. The current, however, is changed by the tornadoes, whenever they occur at full or change; at which time, blowing from the S.E. or N.E. with great violence, they alter the direction of the current to W.S.W. or W.N.W.

Rio del Rey.—After being clear of the Old Calabar, and having passed Backasey gap, an E.S.E. course for 10 miles from the East head along the bank extending off the peninsula of Backasey brings a ship to the entrance of the Rio del Rey.

The Rio del Rey is generally represented on the charts as of considerable magnitude, which is in fact the impression it naturally conveys on being approached; but that which is taken for the river is, in reality, but an open shallow bay, with several creeks branching from it, and one larger than the rest 4½ miles wide at its entrance, but rapidly decreasing into a narrow channel. The bay is formed on the eastern side by the lofty Cameroon mountains. The shores are thickly peopled; the inhabitants appear to live principally upon fish. The villages are large, and, unlike those further south, are built on the skirts of the bay, and exposed to view from the water. These people are a timid race, and there is said to be great difficulty in holding any intercourse with them.

At a few miles eastward of the Rio del Rey, the line of coast turns abruptly southward along the foot of the Cameroon mountains.

The Cameroon Mountains occupy a space of nearly 20 miles in diameter, the highest peak, named Mongo-na Lobah, being 13,760 feet above the level of the sea, covered with trees of luxuriant growth nearly to the summit; but one bare brown ridge, running from the eastern side towards the sea, at a short distance appears like lava. The peak of the Cameroons stands so boldly above the surrounding pinnacles that the descent seems unbroken, giving to the whole the appearance of one vast mountain rising from a single base, although a conspicuous peak, about 2 miles inland from the nearest part of the coast, named Mongo-ma Etindeh, rises 5820 feet.

AMBAS ISLANDS, &c.—On the southern side of mount Cameroon, at the base of the peak, is Ambas bay and islands.

The largest island, named Mondoleh, is ½ a mile long. and lies in the S.E. part of the bay; it is high and rocky, but with a level surface of the richest soil imaginable, of decomposed basalt, and the steep sides are clothed with beautiful wood. There are three or four springs of water half way up the side of the island, which, though scanty, are said to flow always. The landing is bad, but might be improved.

The outer or western island, Domeh or Ambas, is smaller and nearly barren; the rocky slopes and summit only are clothed with a little brushwood and grass. It is, in fact, a narrow ridge of rock, elevated at the outer extremity; but although nature has here provided no means of subsistence, about 300 or 400 people have made it their home. They exchange their fish with the natives of the mainland for plantains and yams. They have also many goats and pigs, which feed on the precipitous sides of the island. The only landing-place is difficult on account of the rugged rocks and incessant swell. There is only one scanty spring, and the inhabitants must therefore catch rain water, and during the dry season get supplies from the mainland.

The island of Bobya, named also the Pirate island, is 1¾ miles N.W. ¼ N. of Ambas; it is even more barren, a mere wreck of a larger island, as the numerous isolated fragments, perforated by the sea, and lying in its vicinity, bear witness of its having been formerly much more extensive. The progress of destruction is still going on, as enormous fragments of rocks are lying at the north end of the island. Although this is much smaller than the other two islands, it is thickly peopled, almost every available spot on its rugged surface being occupied by a hut. It is perpendicular on all sides, and the only access to the summit is by clambering up what appears to be a projection of a basaltic dike—a fearful path, passable only for one at a time, and which might be defended by a child. The inhabitants probably owe to their impregnable position the bad character they have among their neighbours.

These islanders are the principal fishermen of the bay, which in fine weather they cover with their light canoes. This enables them to obtain by barter from the mainland, with which they are in constant communication, the scanty clothing they require, and supplies of yams, plantains, &c.

The anchorage is excellent in all parts of the bay as to holding ground and depth; and although it is a lee shore, and there is an incessant swell, it is said never to blow home so as to endanger ships, and the landing is not so bad as at Ascension. The prevalent wind is S.W., to which the bay is quite open; and the worst months are July and August, but there is shelter behind Mondoleh. Wood, vegetables, and live stock may be had in abundance. Excellent water can also be had near Kieh, but only at low tide, as the water gushes out at the foot of a rock. By excavating, however, above high-water mark, a very convenient watering-place might be made.

The disadvantage of being a lee shore is amply compensated by the purity of the sea breeze, which blows across the Atlantic. The adjacent mainland, too, is nearly devoid of mangrove and swamp; and as the land wind passes over the lofty mountain, it is rendered cool and refreshing. Indeed, from the peculiarity of its situation, and from local circumstances, the bay of Ambas will, perhaps, be found to be the most healthy position on the coast of Africa.

The River Bimbia.—After quitting the anchorage in Ambas bay, and continuing near the coast, a series of points are passed, which indent the shore into small coves, more or less deep and sheltered, and then appears the entrance of the river Bimbia or Little Cameroon. The last may be known by Nicoll island, which is situated N.E. of the most southern point of the land at the foot of Cameroon mountains. Nicoll island is ⅛ a mile from the shore, on the western side of the mouth of the Bimbia river. Between it and the shore on its western side, and rather nearer the latter, there is a sheltered anchorage off King William town, but which has only 2½ and 2¾ fathoms depth, and there is a watering-place ¾ of a mile to the northward.

The channels of the river Bimbia are obstructed by a bar, on which there is only a depth of 18 feet, but within there are 4½ to 6½ fathoms. The anchorage is perfectly safe, but the radiation from the mountain causes the heat to be very oppressive. The magnificent amphitheatre which forms the eastern side of Cameroon mountains is crowned with numerous villages, the inhabitants of which mostly follow the palm-oil trade.

River Cameroon.—From the river Bimbia to cape Cameroon, the distance is 12½ miles S.E., but the shore is rounded towards the sea; it is low and covered with mangrove, and is intersected by two creeks, Matumal and Mordecai, which connect the Bimbia with the river Cameroon. The river Cameroon is an estuary into which several streams discharge their waters. That branch which comes from E.N.E. is the most considerable, and named the Cameroon river, from the abundance of shrimps found in it.

The entrance of the bay of Cameroon is 5 miles wide from N.N.W. to S.S.E., being bounded on the north by cape Cameroon, a land of middling height, which can be seen 12 miles off. The southern head is called Suellaba point, and is nearly of the same height. Off each of these points are banks which narrow the channel; its breadth in the most contracted part is about 1¼ miles; and its greatest depth 12 fathoms. Off cape Cameroon the 3-fathom edge is distant 1¼ miles, where the shelf suddenly drops into 8 and 10 fathoms: great caution, therefore, is requisite as the lead gives no warning. The banks to the southward extend N.N.W. from Suellaba point 3½ miles, and are named the Dogsheads; they almost always break with a noise, and can be seen from afar.

In a ship from the westward, bound to the Cameroon river, you should not approach the low land of Bimbia nearer than 6 fathoms; run to S.S.E. until cape Cameroon bears N.E. ¾ E., and steer for it, keeping in 4½ to 5½ fathoms muddy bottom. At 6 miles from the cape you will have from 5½ to 7 fathoms, and when at 2 miles from the land you must keep in that depth along it, until cape Cameroon bears N.W. ¾ W.; then steer for Malimba point about E. ½ N., until Green Patch point, which is the N.E. point of Matumal creek, bears North, when you may anchor in 5½ fathoms, muddy bottom, and send up the river for a pilot to take you over the bar. This bar, or bank, in the middle of the bay, is formed by sediments from the river, and has 9 feet least water over it

When opening from False patch to Green Patch point, should the lead give less than 4½ fathoms, and not a muddy bottom, you must keep more to the southward.

The *Dogshead Banks*, which form the southern boundary of the entrance channel, are steep; on their N.W. side, ½ a mile from them, will be found from 10 to 12 fathoms; care should therefore be taken not to approach them too close, on account of the sudden change in the soundings, which increase rapidly from the westward to the eastward in this passage. The soundings will sufficiently show the action of the current, and the changes necessary to be adopted in the course. These banks are especially dangerous to vessels caught in the passage by the ebb tide, which rushes with great velocity over them, especially at spring tides.

Should you be obliged to anchor outside, she may ride easy anywhere in 6½ fathoms, and be out of the strength of the tide.

In the event of a boat being sent up the river for a pilot from the anchorage south of Green patch, it should be directed to keep along the northern shore for 6 or 7 miles until it passes the mouth of Mordecai creek, when, if there are any vessels there, their masts will be perceived off King Bell's town, which is 6 or 7 miles above Malimba point, on the left or S.E. bank of the Cameroon; boats that have not been so directed have found themselves on the south side of Malimba point.

The towns of King Bell and King Aqua are of great extent. The houses are neatly built of bamboo, in wide and regular streets, but the number of plantain and cocoa-nut trees, and even of large fields of maize, render it impossible to form an estimate of their size and population. They are situated on a plain, which, being elevated at least 50 feet above the river, and being of a sandy nature, may be considered as comparatively healthy. A considerable trade has been carried on here for many years; the activity of the settlers in collecting palm-oil, and their intercourse with Europeans, has made them a very large and important community.

The River Borea has its entrance about 16 miles S. ½ E. from Suellaba point; the coast between is low and well wooded, and continues so to point Garajam, the termination of the Bight of Pannavia, 38 miles S. by E. from Borea river. Borea river is only navigable for boats, being rendered impassable by a bar at the entrance.

In the bottom of Pannavia Bight a vessel may safely anchor near the shore in 4 or 5 fathoms, muddy ground.

The River Campo.—From point Garajam, known by its cascade, the coast trends to the Rio Campo, S.S.W. ½ W. 39 miles; this river may be recognised by two mountains to the northward, named, from their similitude, the Saddle and Table hills, the former lying northward of the latter. On the south point of the river the sea breaks with much violence on a shallow stone bank that shows at low water. There is good anchorage in 4 to 6 fathoms, 13 or 14 miles southward of the river Campo, in the Cove of Bata. At this place you will see the Seven hills, lying in a row, about 6 leagues inland, the middle one appearing higher than the others.

The *River Benoit* lies about 48 miles S.W. by S. from the Rio Campo; its entrance is narrow, but it has not less than 3 or 4 fathoms which extends 4 miles within it. The Heybern is a high hill which renders the north point remarkable; the south point is distant 2 miles from it, and is steep; a reef extends along the coast, having rocks over and under water.

From the river Benoit to cape St. John, bearing S.W. ¾ W. 30 miles, the coast is irregular, rocky, and foul, and is distinguished by a high mountain inland, named the Mitre hill. As you approach about half-way to the cape, the coast, from being low and woody, is rocky, and the cape itself is surrounded by a ridge of rocks, and has a small stony bank of 6 or 8 fathoms lying 2 or 3 miles from it.

CORISCO BAY.—The northern point of Corisco bay bears S. by E. ½ E. 4½ miles from cape St. John; southward lies Corisco, or Thunderbolt island, which is about 3 miles long and 2 miles broad. It is a low island, overgrown with high trees, that seem to stand in the water; about a mile from its south-west side is a small islet, named Laval, encompassed with a reef; from the S.E. point of Corisco extends a narrow reef 1½ miles to the eastward, and a shelf also extends from the northern shore. The north part of Corisco bay assumes a semicircular form, 12 miles in breadth, and into it falls the river Mooney, or Rio de Angra; this river is a mile wide, and at a distance of 4 miles outside it lie a cluster of islets, rocks, and shoals, named the Elobey, or Mosquito islets. In the direct course to the river, between these islets and the northern point of the bay, the depths are from 6 to 5, 4½ to 3 fathoms; but on the flat, extending N.N.W.-ward 4 miles from the Elobey isles, which flat forms the southern side of the fairway channel, there are some spots of only 2½ and 1½ fathoms. The water is deep at the entrance of the river Mooney.

On the north-eastern, or little Elobey island, there are some factories, up to the anchorage off which there is a narrow and winding channel, 15 feet deep, running between the two islands.

Corisco bay trends nearly due South (true) from the river Mooney, 20 miles to the river Moondah, which is 5 miles in breadth at its mouth; the water is shoal at the distance of 3 miles from the coast in this space. At the entrance of the Moondah are 3 to 5 fathoms, The entrance bears S. ¼ W. 24 miles from the northern point of the bay; and from the western point of the river to cape Esterras the coast trends W. ½ N. 12 miles. Little Corisco island (Mount Baynya) bears S. ½ E. 5 miles from the S.E. point of Corisco, and is surrounded by several shoals, as well as by a flat that stands 5 miles to the S.W.

Between Little Corisco and the coast northward of cape Esterras, a distance of 9½ miles, there is a channel 5 and 6 fathoms deep, but only 1½ miles wide; in the remaining space the water is shoal, and the coast about the cape is foul and rocky; but thence to point Clara, at the entrance of Gaboon river, it is in general bold, distinguished by trees, and at 1½ miles distance the water varies in depth from 7 to 6 and 5 fathoms.

Gaboon River.—Point Joinville or Clara is distant 7 miles S. by W. ½ W. from cape Esterras; and although the coast between is pretty clear, yet about the point itself are several sunken rocks. On the south side of the river is Sandy or Pongara point, which bears S. ¾ W. 9 miles from that of Clara. Qua Bens town stands on the eastern shore, facing the sea, S.E. by S. ½ S. 8½ miles from point Clara; and King Glass town stands 3 miles S. by E. ½ E. from the former. Around Sandy point, and in the mouth of the river, are several shoal spots, which vessels must avoid. Coming from the northward or southward for the Gaboon, ships should not decrease their water below 10 or 8 fathoms, which depths will be found at the distance of 2 or 3 miles from the coast. When abreast of the river's mouth with the northernmost of two hills on the eastern shore bearing about E.S.E., and in a position nearly equidistant from cape Sta. Clara and Pongara point, bring the south point of Coniquet or Cone island open of Owëendo point, S.E. ¾ S.; steer in on this course, and when Pongara point bears W.N.W. you will be within all the shoals, and may haul up East or E.N.E. for King Glass town or Qua Bens town, as required. Owëendo or Red point is 10¾ miles S.E. of Pongara point; Cone island is 2½ miles further in the same direction; and 3½ miles south-westward of this is Parrot or Embene island, between which and Cone island in mid-channel, are 6 and 7 fathoms.

Round Corner point is 4 miles S.W. by W. from Pongara point, and is distinguished on each side by elevated land, which serves as good marks for the Gaboon. Vessels coming from the southward should give this point a good berth, and steer towards point Clara, in order to avoid the shoals lying in the mouth of the river. There is anchorage in 4 to 6 fathoms, at the distance of 1½ to 2 miles from the shore anywhere between cape Clara and King Glass town, taking care to avoid the shoals near the mouth of the river, for which recourse must be had to the chart.*

From Round Corner point to Fãnaes islet the coast runs to the S.S.W. above 40 miles, and is safe and clean. The islet is small, and stands near the shore. Hence to the river Nazareth, the distance is 16 miles S.W. by W., the coast maintaining the same general character. About midway between, shoal water of 3 and 2 fathoms will be found at distances varying from 3½ to 6 miles from the land. The west point of the river is low and sandy, and is distinguished by a small native town, named Fetishe. Cape Lopez bears from Fetishe W.N.W. 17½ miles, and the intermediate coast is low and sandy, and covered with trees and bushes. Shoals also extend from it about 5 or 6 miles off.

Cape Lopez, in Lat. 0° 36½′ S., Long. 8° 43½′ E. is low drowned land, and at first appears all rugged with bushes, which seem to stand in the water; it is

* "Chart of the River Gaboon." Published by the Admiralty. No. 1877.

steep on the western side, free from flats and reefs, and may be approached sufficiently near. The inner coast trends S.S.E. 12 miles to the northern entrance of a channel, the southern entrance of which is 21 miles southward of the cape, thus forming an island. A spit of 2 to 8 fathoms extends to the N.E. about 5 miles from the inner part of cape Lopez; and in a bay within this are 20 to 12 and 9 fathoms, affording anchorage in 8 to 10 fathoms. The spit must be carefully avoided in coming from the northward to cape Lopez, as it is not noticed until you approach very near it, for you may have 10 or 12 fathoms at 4½ miles north-east of the cape, and with the next cast find yourself aground. When you are sailing from cape St. John to cape Lopez, always observe which way the *trovado* drives the water; and should you lie at anchor when it arises, you must weigh immediately, and get off; if it be in the morning, with a south-west or south wind, keep to seaward till noon, then stand again toward the shore with a sea wind; but if the wind does not alter at noon, tack about for all that, and go to the shore, there to anchor in oozy, and sometimes sandy ground.

FERNANDO PO, PRINCES, ST. THOMAS, AND ANNOBON ISLANDS.

These islands, situated in the easternmost part of the Gulf of Guinea, bear from each other about N,E. by N., and S.W. by S. (true), and if this line of direction be compared with that of the mountains on and in the interior of the continent to the north-east-ward, which appear broken into isolated masses like islands in the sea, a very interesting geological query presents itself, namely, whether these islands are not a continuation of this range, and whether there are not similar submarine elevations in the same direction? Capt. Owen, after referring to the Cameroon, Rumby, and Qua mountains, says—"Most of these are extinct volcanoes, as well as the whole of Fernando Po, which is immediately opposite this part of the main. The sea-boundary of the Cameroon presents some singular evidences in support of this; amongst them may be mentioned two rocky cliffs, at some distance apart, but which are connected by means of a gallery, perforated at equal distances by a line of holes answering the purpose of windows, resembling the work of an expert engineer in the excavation of a fort.

Fernando Po, now under the jurisdiction of Spain, is about 86 miles long, from north-east to south-west, and about 19 miles in average breadth; it is extremely mountainous, the highest peak (Clarence Mountain) attaining an elevation of 10,190 feet above the sea-level, and situated in Lat. 3° 35′ N., and Long. 8° 46½′ E. Deep water will be found at a short distance from its shores, and there are no outlying dangers, except the Goat, Boteler, and Leven Rocks, &c.,

which are all visible. The principal places are port Clarence on the north side and George Bay on the western side of the island.

An English settlement was established at the former place in 1827, but has since been abandoned. It has been stated that the island of Fernando Po makes in three hummocks, but this mistake has been occasioned by the high land of Cameroons, which may be taken for the island at a distance. On coming from N.W. it makes in two high peaks, the eastern one (Clarence) being the highest, and terminating in a sharp point; the westernmost is round in the top, sloping gradually to the water's edge.

George Bay, on the west side of the island, is situated about 12 miles north-eastward of cape Badgley, the south-west point of Fernando Po, between point Kelly on the north-east and Charles Folly on the south-west, which are 6 miles distant from each other; the bay is of a semicircular form, much exposed to the N.W., and the depth decreases from 30 to 20 and 10 fathoms. Goat and Kid islands lie about 1½ miles northward of point Kelly and are encompassed with several rocks, but the ground on the S.E. is clear, and affords convenient shelter. Vessels from Bonny river, bound to George bay, should make the west end of the island, as a strong current sets to E.N.E., and, with baffling winds, may take you several days to get up, if you once get to leeward. In making the island, you will perceive its appearance as already stated; but should you fall to leeward, so as to bring the eastern peak to bear East, or E. by S., you must tack, and close in with the westernmost shore, giving it a berth of 1 or 2 miles, until you get in sight of Goat island,* the soundings gradually diminishing to 16 or 15 fathoms. Anchor with Clarence peak bearing E. ½ N., Goat island N. by E. or touching point Kelly (the N.E. point of the bay), and Charles Folly W. by N. ¾ of a mile from the shore. Water and wood may be had here in abundance, and fish is also plentiful and various.

Maidstone Bay and Clarence Cove.—Maidstone or N.W. bay lies eastward of cape Bullen, the N.W. point of the island, and is a shallow 2½ miles in extent and bounded on the eastern side by a tongue of land, now named point William, between which and point Adelaide, distant ½ a mile S.W. by W. ½ W. is *Clarence Cove:* this latter is a small bay of a semicircular shape, having soundings in the middle from 14 to 12 fathoms. Cockburn cove lies on the west of point Adelaide, and is not so large as that of Clarence. Adelaide islets lie in a cluster, about $\frac{1}{10}$ of a mile northward of the point, being divided from it by a passage of 9 and 10 fathoms; a bank extends some distance from the islets, but it has not less than 8 or 8½ fathoms; a shoal also extends westward of point Williams; and on the east side of this point is Gooderich bay, not more than ¾ of a mile in extent, indented by several small coves, and in which are some rivulets, two of which are named Hay brook and Horton brook.

* About 6½ miles northward of Goat island, and above a mile off shore, are the Boteler rocks, which are very steep all round.

The following remarks are by Com. Fishbourne, H.M. *Alban*, 3rd December, 1841:—"The anchorage of *Clarence Cove*, the principal anchorage of Fernando Po, is very good, though the depth is from 10 to 15 fathoms; indeed, it is so abundantly sheltered, that considerable facility is afforded to vessels loading or unloading, while the perfect tranquility and smoothness of the water, and rise of 7 feet, admit of vessels being beached for repairs, without danger. It must be borne in mind, that the current runs to the East and N.E. generally, 1 mile to 1½ miles per hour; and due allowance must be made for this, in steering either for the settlement by day, or the light by night, depending on the preceding winds. Change in the bearings would give notice of this, and they should be attended to strictly.

The water is good, and may be obtained in any quantity without difficulty. Wood is plentiful, and of very superior quality, quite equal to the mangrove, 340 inches per horse-power, per hour, being sufficient to keep steam with our engines working expansively at half-stroke, yet still an efficient fuel. We paid 6s. 6d. for 100 pieces, containing about 33 cubic feet; but were a contract entered into for a large quantity, it might be obtained at a much more reasonable price. The landing-place is convenient at a wooden pier, which has been built at the expense of the West African company, and extending out to depth of water that admits of vessels of 7 or 8 feet draught to go alongside. The ascent to the plateau, upon which the town stands, being about 100 feet, and the road ill made, occasions much difficulty in the transfer of goods to the town, but this objection might be materially removed, and without much expense. There is a strip of land, and on either side of the landing-place (from which the cliffs rise nearly perpendicular) now partly occupied by miserable coal and store sheds, but of sufficient width, and generally adapted for good store room."—*Nautical Magazine for* 1843, *page* 83.

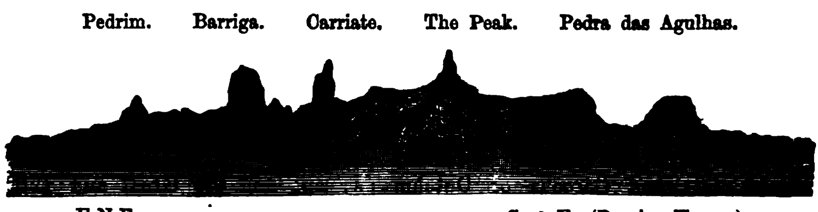
PRINCES ISLAND.—Princes island, in Lat. 1° 36′ N., and Long. 7° 24′ E., is 115 miles S.W. by W. from Fernando Po, and is an irregular-shaped island, 9¼ miles in extent from north to south, and about 5 miles wide. In its neighbourhood are several visible rocks, named Pedra de Gallé and Diamond, on its northern side, and Carocha or Dutchman's cap, and the Great and Little Brothers, on the southern, the latter at a considerable distance; but there are no known and hidden dangers beyond a short distance from the land.

Should the current, on approaching the island, be found running to the N.E. it will be best to make it on the south side, or you may be swept to leeward, and experience some difficulty in making the harbour; but it will be better to make it on the north side with a south-westerly current. Vessels approaching the north side of the island will see a high peak towards the S.W. end, appearing like a sentry box; and, more to the eastward, a remarkable round-topped hill, of a sugar-loaf shape, named the Parrot's bill. When approaching the south side, the Dutchman's cap appears as a high white rock, lying 1¼ miles from the south point. The Brothers are from 9½ to 12½ miles south-westward from the south side of Princes island—small, and steep.

Port San Antonio lies on the north-east side of the island, the entrance being 8 miles N.E. ½ N. from the Dutchman's cap. The anchorage is clear, and the depth of water regular from 20 to 4 fathoms. It is exposed to tornadoes, but as the entrance is narrow, accidents rarely occur; it is, however, necessary for vessels to be well secured, for they blow directly in. The entrance is defended by two small forts, and is of easy access; when approaching you may stand to the south shore in 6 fathoms,—and to the north shore, it being steep-to, in 7 fathoms. There is a coral reef of 3¾ fathoms, 2½ cables eastward of the fort on the south side; about a cable's length without that, are 5 and 6 fathoms, soft mud, and good holding ground, to one or two miles farther in. Ships should moor with an open hawse to the sea, in order to be prepared for the tornadoes. The town stands at the bottom of the harbour.

On arrival, the vessel must be reported to the governor, who sends custom-house officers on board, at the ship's expense; and, on quitting the harbour, 40 dollars are exacted for port dues and anchorage; in addition to which, if coming to trade the customs demand 40 more.

Agulhas, or West Bay, lies about half-way down on the western side of Princes island. It is about 2 miles in extent, from N.E. to S.W., shoaling in depth from 20 to 4 fathoms. Some small rocks under water extend from its south point. The best situation to anchor in this bay, is with the extremity of its west point bearing W.N.W. distant a mile, the north point N.E. ½ N., and a peak on the island S.E. by E. ¾ E. There are several good streams of water on the south side of the bay. This place is secure from *trovadoes*, though open to N.W. winds, but the latter seldom occur.

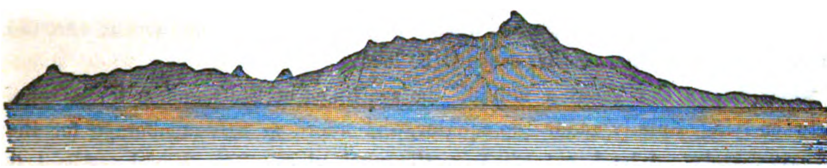


Princes Island, West Bay (taken from the Anchorage).

In the vicinity of Princes island, the winds are generally between the south, and west; in sailing, therefore, out of the harbour, or port San Antonio, with a land wind, endeavour to get under weigh with this breeze, keeping well over towards the south shore, for, on advancing outward, the wind will be found to draw gradually to the southward, which, with the swell, may set you over to the north side, near the Diamond rocks. If bound to the westward, you need not beat to the southward of St. Thomas; but if to windward of Princes island, and the wind admits of your making westing without northing, keep on the port tack, and so proceed as to take advantage of the equatorial current.

On Princes island are several rivulets of excellent water, but it does not equal St. Thomas for the goodness and abundance of its provisions.

ST. THOMAS.—This island bears about S.W. ½ W. 80 miles from Princes island. It is 25 miles in extent from north-east to south-west, of an oval form, with the south point nearly on the equator, and in Long. 6° 30′ E. It is high, conical and well wooded; its highest peak is usually covered with a cloud, and appears like smoke. Vessels from the windward and Gold coasts, bound to St. Thomas, must choose the time of the *ventanias*, or hard breezes, which blow from April to September, and make proper allowance for the currents.



St. Thomas Island, bearing W.S.W. 7 leagues.

Man-of-War Bay, on the north-east side of St. Thomas island, is considered a safer anchorage than that of St. Anna de Chaves which is more to the south-eastward. Vessels coming in along the north end of St. Thomas, will perceive the land mountainous and very high; when abreast of the island, it sometimes seems divided in two. Ilha das Cabras or Cabrita island separates one anchorage from the other. Man-of-War bay is a safe place for small vessels, but large vessels are obliged to lie out in the open road, in 10 to 18 fathoms, which is a safe place, except during the season of the tornadoes, as they prevail from N.E. directly upon the shore. Anchor in the bay, with Cabrita island (which makes like a saddle) bearing S.E. ¼ S.; Misericorda chapel, seated on a hill, on with a black rock on the shore, S. by W.; and the white mansion, named Fernandilla house, S.W. ¼ W. The ground in the bay is good, and the water in general smooth, except during the season before mentioned; the soundings are irregular, from 30 to 6 fathoms, which latter depth is about one mile from the shore. From the anchorage the watering-place is about ¼ of a mile to the eastward, and is easily obtained.

St. Anna de Chaves Bay, or Roadstead, is defended by a stone fort, standing on its southern point of entrance. In sailing to this place you will find it best and most convenient to stretch round the south part of the island, for then you will be favoured by both wind and current, which latter sets strongly to the northward; and the shore, to the southward of the fort, may be approached with greater safety than that to the northward, though not within the distance of 1½ miles, until you get the fort to bear W. by N. About 2 miles eastward of the town lies a shoal of white sand, with only 2½ fathoms over it, on which the *Chesterfield* struck in 1781. This ship went round the northern part of the island, obtaining no ground at 60 and 50 fathoms, until the rocks were seen alongside of the vessel; soon after this she sounded in 16 fathoms, and suddenly grounded. When aground, the fort bore W. by S., Cabrita island N.W., and the eastern point of the island S. by W., distant from shore about 4 or 5 miles, and from Cabrita nearly 8 miles. Being hove off this shoal, she steered for the road, bringing the fort to bear from W. to W. by S., anchoring in 6 fathoms, sand, shells, and coral rock, the fort bearing W.S.W., and Cabrita island N. by W. ½ W. about 2 miles distant from the shore.

The *Tartar* anchored in 5½ fathoms, the fort bearing S.W. by W. only one mile from shore; the *Blandford* much farther out, and the *Grampus* found good anchorage in 6 fathoms, the fort bearing West and Cabrita island N.N.E. It thus appears that vessels coming in from the northward, must not depend upon the lead, because, from no ground a ship may have 12 fathoms, and be aground before they can obtain another cast of the lead.

Rolas Island lies about a mile off the south end of St. Thomas, the channel between lying directly under the equator, and affording safe anchorage for the largest vessels. A bank extends from the north shore of the island. About 6 miles eastward from Rolas island, is a cluster of high rocks, appearing from the northward like ships under full sail, named the *Seven Stones*, or Brothers, which are sometimes mistaken for part of the island itself.

Vessels from the northward, and bound to St. Anna de Chaves bay, should make St. Anna's isle, or Postilion cap, which lies off the eastern coast; and when this comes in sight, you will perceive a small black fort in ruins, on the shore towards the S.W.: steer for the latter, until St. Anna's isle comes in a line with the low green point, to the southward of the black fort; and with this mark on, bring the new fort or castle, on the S.E. point of the bay, to bear W.S.W.: here you will have 6 or 7 fathoms, sandy bottom, distant 1½ miles from the castle, with Cabrita island bearing N. by W. ½ W. Ships should not approach Cabrita nearer than to bring the new fort to bear S.W., for beyond that bearing the water is shallow, full of coral branches, the depth not more than 10 or 12 feet.

Annobon.—This island, sometimes named Anno Bona, is in Lat. 1° 25′ S., and Long. 5° 37′ E., 100 miles S.W. ½ W. from St. Thomas, and is of picturesque appearance and conical form, about 27 miles in circumference, high and visible at the distance of 30 or 36 miles, and abounds in fertile valleys surrounding the mountains, which are ornamented with rich and perpetual verdure. Around that part of the island next the sea is a narrow margin about a ½ of a mile in breadth, which is covered with groves of cocoa-nut and plantain.

Its shores may be approached with safety as near as one mile in any direction. The population does not exceed 800 or 900; nearly the whole of whom are blacks, who obtain their subsistence chiefly from the sea, and are described as simple and inoffensive. The town, situated on the margin of an open bay on the north-east side of the island, is prettily placed in a grove of cocoa-nut trees, and may have 500 or 600 people in it. The only anchorage is abreast this town in from 7 to 16 fathoms, on a white sandy bottom, which holds well; here you ride in very smooth water, and have a convenient landing-place close at hand. The bank on which vessels anchor is narrow, and great caution is required, but to an experienced seaman—notwithstanding what has been said to the contrary—it cannot be considered dangerous.

COM. W. B. OLIVER says, "When anchoring, open the low rocky point, to the westward of Pyramid rock, with the east end of the church (the eastern building detached from the village); you may then, by keeping Pyramid rock on with a high rock over it, resembling a fort, steer in on that line, and carry sandy bottom from 19 to 8½ fathoms, within 2 cables' length of the beach, when Islet point will bear W. ¼ N.; Pyramid rock S.E. by S., and Turtle island S.E. by E."

The *Vansittart* anchored in May, 1821, at Annobon, in 11½ fathoms, rocky bottom, with a conspicuous peak in the centre of the island bearing W. ½ S., off shore about ¾ of a mile. Ships touching here should keep the lead going, the soundings being very irregular, with great overfalls from 19 to 11 fathoms, then 8½ fathoms. Although the vessel here stated lay in 11½ fathoms, a small anchor was necessary to steady her, and keep the bower anchor clear; for half a cable's length in shore there was only ¼ less 8 fathoms, rock.

Turtle and Passage rocks, on the north-east side of the island, are small, steep, and visible, as are also the rocks off the south side of the island, named Santarem, Fernando Po, and Escobar.

Further particulars of this island are given in the "South Atlantic Directory."

TO NEWFOUNDLAND, NOVA SCOTIA, UNITED STATES, &c.

If bound to St. John's Harbour, it is advisable to keep on the parallel of 46° N., or 1½ degrees southward of the parallel of that port, until soundings be obtained on the Great Bank, in Longitude 48° 30′ or 49° W., whence a course may be directed for cape Spear;* but if bound to the gulf of St. Lawrence, it is advisable to cross the Bank in Latitude 45° 30′, and when in Longitude 55° or 56°, shape a course north-westerly for St. Paul island, or cape North, the north extremity of Breton island.

In thick weather the lead should be kept going when in the vicinity of the western edge of the Green Bank, to strike soundings in the deep gully of 80 to 90 fathoms, mud, which runs N.N.E. and S.S.W., about 60 miles, between St.

* Cape Spear is rather low and ragged, and may be known by the land north of it trending away to the N.W.; it is the easternmost point of Newfoundland, and estimated to be in Lat. 47° 31′ 11″ N., Long. 52° 36′ 59″ W. The lighthouse on this cape is coloured red and white horizontally, and exhibits a light *revolving* every minute, visible about 20 miles.

Pierre and the Green Bank. The middle of the gully is in Lat. 45° 35′, Long. 55° 10′; by sounding in it and feeling the edges of the banks on each side of it, the position of the vessel may be ascertained with considerable accuracy.

If bound to St. Pierre, adopt the following course, which is that of the French fishing vessels. From Long. 52°, in Lat. 45°, steer N.W. across the Green Bank in about 48 fathoms water, and when on the meridian of 55° 10′, in about Latitude 45° 50′, the depth will suddenly increase to 90 fathoms. A further run on the same course for about 10 miles, will carry across this gully, when the depth will decrease to 85 and 80 fathoms; after a further run of 23 miles, a course about N.N.E. may be steered for the island.

During spring or summer, vessels from Great Britain should keep well to the northward: for it has been long observed that vessels from the Pentland frith and the Clyde, have always made quicker passages than those from the Bristol or English channels. During winter the American packets always keep well to the northward.

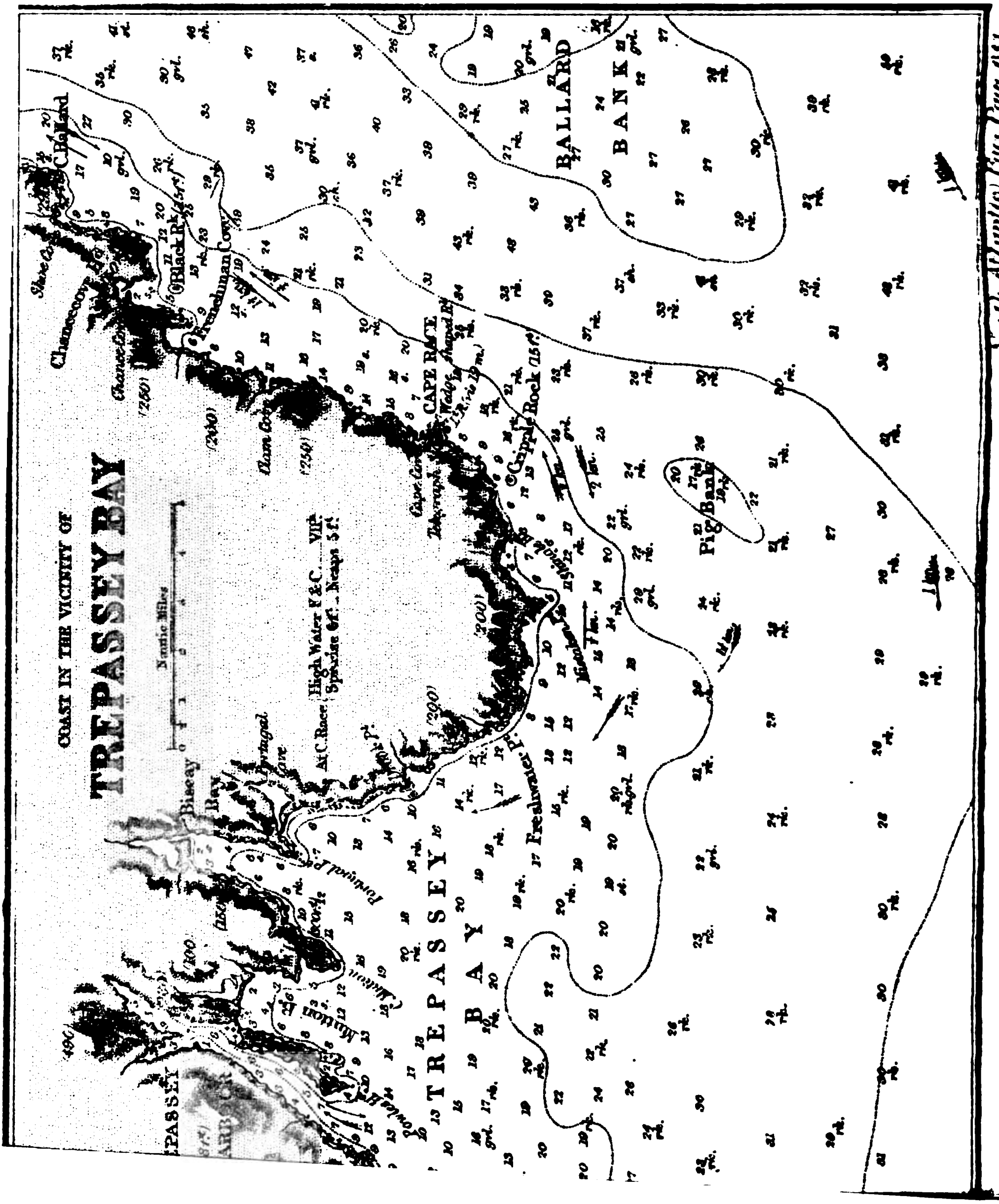
Bound to the Bay of Fundy.—The preferable course for vessels bound to the bay of Fundy, during summer, is to keep as far northward as Lat. 47°, until Long. 40° is attained, then to edge away so as to cross the tail of the bank in about Lat. 43° 30′. At this season of the year the fishing vessels that resort to the banks will be less frequently encountered; a strict look-out for ice is, however, always necessary;—when westward of the banks, endeavour to keep in Lat. 43°, to avoid the northern edge of the Gulf stream. During winter the bank should be crossed well to the northward to guard against the north-westers, which blow very heavily.

Two vessels bound to the lower ports in the St. Lawrence have been known to pass through the Pentland frith together, in the month of April; the one had a passage of 21 days, and the other, the faster sailer, of 7 weeks. In comparing logs afterwards, it appeared that they were both in about Long. 30° on the same day, but one was about 100 miles to the southward, with a gale at West, while the other to the northward was running 9 knots, with a fresh gale at N.E. All the ships which kept to the northward had fine passages.

The following remarks are by a correspondent of the *Nautical Magazine*, 1833, p. 329.

"Although the voyage to and from North America, between the parallels of 60° and 40°, has always been attended with a degree of peril, from masses of ice which drift southward, during the summer months, from the polar regions, yet many an unwary mariner makes his run across the Atlantic without apprehension of meeting these floating dangers, or without sufficiently exercising proper discretion and vigilance to guard against collision with them. This is not mere conjecture, but the information of persons who annually perform the voyage, beside the result of my own observation, in accidents which have repeatedly occurred to vessels between Newfoundland and England, and in the number of missing ships on this route. Shipmasters should therefore bear in mind that

. . . . . . by the news-boat,
. . . . . . advices at once telegraphed to all parts of America. The news-boat carries a *red*



missing ships on this route. Shipmasters should therefore bear in mind that there is an imperative necessity for using the utmost vigilance and attention when crossing the above-named parallels, especially between the Longitudes 30° and 60°, to guard against contact with these formidable dangers of the ocean.

The *New York packet ships*, when making the winter voyage from Liverpool, keep in high latitudes until near Newfoundland. This they do for the twofold object of avoiding the tempestuous weather so generally experienced to the southward, and of obtaining fairer winds; and then by slipping within the mighty stream from the Florida channel, they evade its retarding influence. The voyage by this route is shortened; and, although bad weather must be expected, it is not so violent as farther south; besides which, the eastern current is avoided. I believe it is an unusual thing to meet with ice in this part of the Atlantic in winter; but we have the following instance to the contrary, so that a look-out should be kept in that season, as well as in summer, by vessels making the voyage.

It appears that the *Emulous* packet, on the 26th Feb. 1833, met with much field-ice on the coast of Nova Scotia; and when in Lat. 43°, Long. 49°, those on board were much surprised by falling in with a large quantity of strongly *packed ice*, which from sailing at the rate of 9 knots under close-reefed main-topsail and reefed foresail, reduced the vessel's way to 6½ and 7 knots. On the 4th March, she fell in with three bergs, of large dimensions, in a run of 95 miles; and at 9h. the same evening she was obliged to pass between the two easternmost of these before heaving-to for the night; after which, by keeping a more northerly course, no more of these dangerous floating masses were seen.

From all accounts it seems that the greatest danger is to be apprehended in the vicinity of the Banks of Newfoundland; and this, as every navigator knows, is increased by a dense fog which generally pervades the atmosphere in that quarter, and, of course, reduces the distance of vision to a very circumscribed limit."

Bound to the Gulf of St. Lawrence.—It is recommended to make the coast of Newfoundland in the vicinity of cape Race, in Lat. 46° 39′ 12″, Long. 53° 2′ 28″, but such a course should be steered as will not carry the vessel northward of that headland or there will be danger of running on shore in thick weather.*

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* *Cape Race*, the south-east point of Newfoundland is a table land of moderate height. A black rock lies near it, and several smaller ones around it. This important land-fall may now be distinguished by its beacon and lighthouse; the latter consists of a circular structure of iron, painted in red and white vertical stripes, standing at 35 yards westward of the old beacon, which has a height of 24 feet, and is covered with a pointed roof, and also painted in red and white stripes. The light revolves every 30 seconds, and is visible in clear weather at the distance of about 19 miles.

The New York and Newfoundland Telegraph Company's lines extend to cape Race, where they have a station. Steamers making that point, bound eastward, are promptly reported to New York, free of charge, and, when practicable, the latest American news is put on board. Steamers bound westward, when within practicable distance, are boarded by the news-boat, and their advices at once telegraphed to all parts of America. The news-boat carries a *red*

Supposing cape Race light bears N. by E. ½ E. distant 15 miles, the vessel will then be in Lat. 46° 26′, Long. 53° 0′, and should steer N.W. by W. ½ W. 130 miles to be in a corresponding position with respect to Galentry head light, St. Pierre island; thence to St. Paul island the course will be about N.W. ½ W. 177 miles,—this island may be safely passed on its north or south side.

North cape (the north end of Breton island), and cape Ray, the south-west point of Newfoundland, form the two points of entrance to the gulf of St. Lawrence; they lie about E. by N. and W. by S., distant 57 miles from each other.*

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flag, with a *black* ball in the centre. The American ensign hoisted on the telegraph building, near the lighthouse, signifies that the steamer is recognised, and that a boat is coming out. Passengers who put private messages into the boat may rely on their messages going forward.

The south coast of Newfoundland between cape Race and St. Pierre island is now well lighted, there being lighthouses on cape Pine, cape St. Mary and Dodding head.

Cape Pine lighthouse is 56 feet high, coloured red and white in bands, and shows a *fixed* light at 314 feet above the sea, visible about 24 miles; its geographical position is Lat. 46° 37′ 4″, Long. 53° 31′ 45″. A reef of 3 fathoms, named Freels rock, lies 3 miles W. ½ S. from the light; this reef is very steep, the depth at almost close to its southern side being 18 fathoms.

Cape St. Mary lighthouse is 40 feet high, and its light *revolves* every minute, appearing red and white alternately; it is shown at 390 feet above the sea, and can be seen from about 26 miles. Its geographical position is Lat. 46° 49′ 30″, Long. 54° 11′ 34″. Some rocks awash at high tide and very steep, known as St. Mary's cays, lie 6½ miles S.W. ½ S. from the lighthouse. A rock, the False cay, 12 feet under water, is distant nearly 1½ miles from these cays in a N.E. by E. direction.

Dodding head lighthouse is on the south end of Great Burin island, in Lat. 47° 0′ 26″, Long. 55° 8′ 3″. The light, at 430 feet above the sea, *revolves* every 20 seconds, and can be seen from a distance of about 27 miles.

The island of *St. Pierre* consists of a mass of rugged hummocks rising to a height of 400 or 500 feet directly from the sea, and destitute of trees. When seen from westward, *Galentry Head*, the south-east point of the island, makes in a round hummock, and the land near it being low, causes it to bear the appearance of an island; it may also be recognised by its light (flashing every 20 seconds), which is visible at the distance of 20 miles. A *red* flash is succeeded by two *white* flashes. Near the lighthouse, in foggy weather, from April 1st to November 1st, two guns are fired every 2 hours, with an interval of 3 minutes between each, from 6 in the morning to 6 in the evening; besides these regular signals, gun for gun is returned to vessels desirous of ascertaining their position by these means.

* *Cape North* is a lofty promontory at the north-east extremity of Breton island, in Lat. 47° 2′ 40″, Long. 60° 25′ 23″. When approaching Breton island, from any direction, it is not possible to be too careful, for the current sets about cape North alternately westward and eastward according to the winds at sea.

Cape Ray, or Split cape, the south-west extremity of Newfoundland, is situated in Lat. 47° 37′, Long. 59° 18′. The land of the cape is very remarkable; near the shore it is low, but at 3 miles inland is a very high table mountain, which rises almost perpendicularly from the low land, and appears to be quite flat at the top, excepting a small hillock on the south-west point of it. This land may be seen, in clear weather, from the distance of 16 or 18 leagues. Close to the foot of the table mountain, between it and the point of the cape, is a high round hill, resembling a sugar-loaf (named the Sugar-Loaf of cape Ray) whose summit is a little lower than that of the table mountain; and northward of this hill under the table mountain, are two other conical hills, resembling sugar-loaves, which are not so high as the former; one or other of these sugar-loaf hills are, from all points of view, seen detached from the table mountain. Near cape Ray the current is strong, and at times sets quite contrary to what might be expected from the ordinary course of the tides, and much stronger at one time than at another; these irregularities apparently depend on the winds.

Between them and about 18 miles from cape North, is the island of St. Paul, appearing with three hills upon it; it has deep water all round it, but at about 11 or 12 miles N.N.W.-ward from it is a fishing bank of 25 and 30 fathoms water, while at nearly the same distance from it in a N.N.E. direction is a depth of 140 and farther eastward 186 fathoms. Cape Ray bears from St. Paul island E. ¾ N., distant 41¼ miles.

After passing St. Pierre and Miguelon islands endeavour to steer a middle course between Newfoundland and Breton island, and pass on either side of St. Paul island, but do not run beyond latitude 47° 33′, until well past cape Ray, for the harbours on the south coast of Newfoundland westward of Fortune bay, are full of dangers, and but imperfectly known; while the whole shore is frequently enveloped in thick fogs, and the rocks cannot then be perceived before the vessel has become irrecoverably entangled among them. In this part also shifts of wind are common, and it will often happen that, after blowing a gale from one point of the compass, it will suddenly vary to the opposite point, and continue equally strong; thus it has been known that while one vessel has been lying-to with a heavy gale, another, not more than 30 leagues distant, has been in another gale equally heavy, but with the wind in a direct contrary direction. The winds within the gulf are not so liable to such sudden changes as outside, or eastward of Breton island.

ST. PAUL ISLAND is nearly 3 miles long and 1 mile broad. Its margin is rocky and precipitous almost all round, and indented by coves, in which shelter, during the prevalence of certain winds, may be obtained.

Two white lighthouses are established on this island; one on the northern end and the other on the southern point, one of which will always be visible, unless to a vessel very near the central rocks. The northern light is *fixed*, and visible about 20 miles from all parts of the horizon except between N. by E, and E.N.E., in which arc it will be obscured by the hills southward of it. The southern light *revolves* every minute, and is also visible about 20 miles from all parts of the horizon, except between West and S.S.E., the land in that arc hiding it from view. At the southern lighthouse a bell is kept tolling in foggy weather, and a gun is fired every 4 hours, commencing at 4 A.M.

On the west side of the island, at a mile from the south point is Trinity cove, at the northern part of which is a provision post; and on the opposite side of the island is Atlantic cove;—a landing may be effected in either of these. In the cove on the north-west side of the island is a small and bold beach, about 150 feet long, where a landing may be effected, but generally with difficulty, by reason of the continual swell of the sea.

There is anchorage all round the island and close in shore, which circumstance enables vessels to lie there with any winds, by shifting their stations as the wind and weather require. There are tolerably regular soundings off the north side, at the distance of ¼ or ¾ of a mile; on the north-east side a bank lies off about ¾ of a mile, with from 7 to 8 fathoms water. The general depth of the soundings around the island, at ½ a mile from the shore, is from 20 to 40 fathoms, but it soon increases to 100 fathoms, so that there is little or no warning by the lead when approaching it in foggy weather.

STRAIT OF BELLE ISLE.—The eligibility of the strait of Belle Isle as a route to and from Quebec has been the subject of an interesting discussion, from which we give the following opinions:—

CAPT. BALLANTINE, in a letter to the *Nautical Magazine*, 1861, page 475, says—

"While I admit that the Belle Isle route ought to be avoided when there is a risk of field-ice being encountered in it, I feel confident that, at all other times, it is by far safer than the route south of Newfoundland.

Dangers arising from ice, from irregular currents, and from collision with other vessels, are greatly multiplied by dense fogs; and in these respects the northern route has a great advantage over the southern, for the fogs are seldom of long continuance in the north, while off cape Race they form the general rule in the summer months.

At the lighthouse on Belle Isle* in the six summer months of 1859 they experienced 1168 hours of fog. The average is about 8 days per month. A considerable portion of these fogs would be moderate, involving little risk in navigating through them. Moreover, as the island is high, the upper part of it is frequently enveloped in fog (and, of course, registered), while it is clear weather near the surface of the sea. I have frequently observed this; and Mr. Vaughan's (the lighthouse-keeper) published statements are to the same effect. I have no positive data as to the proportion of fogs to clear weather on the Grand Bank and in the vicinity of cape Race; but my impression is that fogs prevail there half of the time during the summer months. They certainly are very frequent, often of long continuance, and extending at times from 800 to 1000 miles, with scarcely a break in them.

The steamer *Anglo-Saxon*, in the early part of July, got enveloped in a fog as she left the gulf of St. Lawrence by the south route; and from there to longitude

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* *Belle Isle* lies at the entrance of the strait, and is distant from cape Bauld, Quirpon island, about 14 miles, and from the coast of Labrador 12 miles; it is moderately high, and wears an uniform sterile appearance. On its north-western coast there is a small harbour named Lark cove, which is only fit for small craft; and at the eastern side of the island is another cove named Batteaux creek. At about two miles north-eastward from this island there is a ledge of rocks, part of which appears above water, and over these the sea breaks very high; this, named the north-east ledge, has soundings of 20 to 15 fathoms close to it, and 55 between it and the north part of the island. The soundings about Belle Isle are very irregular, near the island is seldom less than 20 fathoms, except on a small bank, said to lie to the northward, distant 4 miles from its northern part, whereon are only 5 fathoms. On its extreme south point there is a lighthouse, built of stone, and faced externally with fire-bricks, of a light colour: it stands in Lat. 51° 53', Long. 55° 22' 15"., and exhibits a *fixed* light at 470 feet above the sea, visible at a distance of about 28 miles from all parts of the horizon. The light is not shown from December 15th to April 1st. Signals are made by means of a nine-pounder gun fired every hour during fogs. There is a depôt of provisions for ship-wrecked persons.

40° had not 4 hours of clear weather, having passed over a space of 900 miles. Both last year and the year before, at about the same season, dense fog was experienced on board of her in passing over that track, and her experience is no exceptional case.

Now, danger from icebergs can be, in a great measure, avoided by going slow, or stopping altogether if the fog is very dense. But in the ice track, and that of many vessels at the same time, even extreme caution does not insure safety; for, by going dead slow or stopping altogether, to avoid Scylla you may fall into Charybdis, or rather Charybdis may fall into you, in the shape of a ship running into a steamer amidships, her weakest and most dangerous part. But icebergs wont run into a steamer if a steamer does not run into them. Danger from icebergs is much less than danger from other vessels in their vicinity.

There is, perhaps, not above a score of vessels pass to and from Europe by the Belle Isle route in the whole season. There are no fishermen outside the strait, and few inside, in the steamer's track. But by the southern route, over the Grand Bank, they are very numerous, many of them of considerable size, with large crews on board for fishing purposes. Then a great proportion of the United States traffic, by steamers and sailing vessels, pass over that track, as well as the New Brunswick and Nova Scotia trade from Europe, and all the gulf of St. Lawrence trade from Europe, less the few by Belle Isle.

The Quebec fleets alone average over 1000 vessels a season, and all these ships and steamers pass over this south track, which, by usage, is not very broad, and a portion of it is obstructed by field-ice in the early summer, and by icebergs throughout all the summer months.

The loss of the mail-steamer *Canadian* is referred to, and the strait of Belle Isle blamed for it; but she was lost after passing through the strait in safety; and the same cause would have produced the same effect off cape Race, viz., crushing her bilge in by falling heavily on heavy ice in a swell of the sea. And I have already shown there was field-ice abreast of cape Race, and 300 miles east of it, on June 27th, 23 days after the *Canadian* was lost on the northern route.

Danger arising from irregular currents is alike common to both routes. Freedom from danger arising from sailing in the vicinity of land is also in favour of the Belle Isle route, for the distance by that route is 226 miles less than by cape Race, 125 of which is the coasting part of the passage. If some parts of the coast of Labrador are more dangerous than the south coast of Newfoundland, both are dangerous in thick weather, if too closely shaved. In clear weather there is danger in neither, and clear weather is much more prevalent on the Labrador coast than on the south coast of Newfoundland.

The strait of Belle Isle is only 80 miles long; it is some 10 miles broad at its narrowest part; the passage is free from rocks, except one or two close to the shore. There are soundings throughout, and in many parts a vessel can anchor if necessary. There are also several harbours in the strait: Forteau bay a spacious one. There are first-rate lights at each end.

If the strait be attempted too early, there is a risk of more field-ice being met with outside Belle Isle on the north route than on the south one, and this is the only real advantage that the south route has over the north one, in my opinion. For although the icebergs are more numerous north than south, there is a little risk incurred when a steamer can go slowly in a fog without any danger from other vessels. In 1857 the strait was clear of field-ice on April 9th; in 1858, on June 10th; in 1859, on 12th May; for 1860 I have no data at hand; this year it was after June 4th, and it was in considerable quantities 150 miles east of Belle Isle on July 5th; I am not aware if any has been seen since. But this was an exceptional bad year for ice both north and south—the worst since 1856.

Lieut. Ashe seeing icebergs near Belle Isle on August 7th is not a sufficient reason for the passage of the strait being avoided until September, for icebergs do not block the way as field-ice frequently does, and by waiting until June is over, the risk of encountering field-ice is very small indeed. We might as well avoid going south of cape Race, for there will be icebergs on that route in a season like this until the end of September. Even as a general rule, icebergs are encountered on both routes throughout the summer and autumn months."

Admiral Bayfield, however, in the same magazine, page 511, writes as follows:—

"I was consulted years ago respecting the passage through the strait of Belle Isle, and gave my decided opinion that the advantage of a few miles less distance from Liverpool to Quebec was not a sufficient compensation for the danger of passing through a strait 65 miles long, and in its narrowest part only 9 miles wide, and which *may* be full of icebergs *at any season of the year*. In August, 1838, I counted no less than 200 bergs and large pieces of ice in the strait. In the following year 6 or 7 large bergs were all that could be seen in the same month. I once found the western entrance of the strait to freeze across in a calm night on June 20th, which will give some idea of the climate. Of course, it was only a very thin covering of ice, which disappeared soon after sunrise. The main entrance of the gulf, between cape Breton and Newfoundland, is free from ice, excepting in the spring of the year.

As to the proper time of passing the strait, I think the fall of the year—after the middle of August—the least dangerous, because then northerly winds, attended with clear weather and smooth water, are more frequent; whereas, in June, July, and the early part of August, southerly and easterly winds and fog prevail, and render the ice far more dangerous."

In crossing the strait of Belle Isle from Quirpon to Chateau bay, the soundings will be irregular, from 20 to 30, and in some places from 30 to 38 fathoms. In the stream, or middle of the strait, the depth is 25 and 35 fathoms, coarse sand and broken shells, and towards Chateau bay 45 to 80 fathoms; within a mile of the Labrador coast 35, 30, and 25 fathoms. To the northward, between Belle Isle and St. Peter's bay, the depth is 59, 86, 90, 96, 65, and 30 fathoms.

Admiral Bayfield says—"The soundings in the strait are so irregular that they afford very little assistance to a vessel at night, or during the fogs which so frequently prevail. In general the deepest water is on the Labrador side, as, for instance, from York point to Red bay, where, however, it is interrupted by the shallow water off Wreck bay. It is also very deep on that side, from Black bay to Forteau bay inclusive; but the line of deep water is not direct, nor, I believe, continuous through the strait; and it is still more perplexing, that there is as deep water within 2 miles of the dangerous Flower ledge on the Newfoundland side, opposite Forteau bay, as in any part of the strait. The depth of water varies in different parts from between 60 and 70 to 20 fathoms, and the nature of the bottom is as various as the depths, being sometimes of rock, and at others of sand, broken shells, pieces of coral, or gravel. Fogs occur with all southerly and easterly winds, and they are frequent likewise with the S.W. wind; it is only when the wind is from between the North and West that clear weather can be safely reckoned on.

Near the shores on either side there is usually a regular alternation of flood and ebb in fine weather, but it is not constant. The flood comes from northward along the coast of Labrador, and also from south-eastward from cape Bauld to cape Norman. The latter stream, I have reason to believe, is often turned off to the northward by cape Norman, and the same thing takes place at Green island, on the Newfoundland side towards Greenly or Greenlet island, on the opposite side of the strait. There is, moreover, at times, a stream running from the south-westward for several days together, along the west coast of Newfoundland. This stream occasionally sets from point Ferolle obliquely across the strait towards Forteau bay. Sometimes, and especially with N.E. winds, the current runs directly in an opposite direction along the west coast of Newfoundland, from point Ferolle past point Rich. In short, there is no constancy either in the rate or set of these streams, for the winds and the irregular tides modify the set and rate of the equally irregular currents in a manner which it is extremely difficult, if not impossible, to calculate upon with any degree of certainty. The prevalent current from northward comes from between Belle Isle and the coast of Labrador. It is often at the temperature of the *freezing point*, bringing many icebergs into the strait, and frequently carrying them through it many miles up the gulf. Some of these bergs ground in deep water, whilst others are continually changing their position.

I have observed this current from northward and eastward, assisted by the N.E. wind, running 2 miles an hour, whilst at other times it was almost imperceptible. It is even reported that there is sometimes a current in the opposite direction, and I believe that this report of the fishermen is correct, especially during the ebb tide and when S.W. winds prevail in the gulf. At the same time that this current is running westward, there is at times a stream of warmer water running out eastward on the Newfoundland side, especially during the ebb tide.

Navigation of the Strait at Night.—From these remarks it will plainly appear that the navigation of the strait is attended with very great danger in dark or foggy nights, during which no vessel should attempt to run through; for I have found that, with all our experience, we could not be sure of the vessel's position within 10 miles under such circumstances. On the approach of a dark or foggy night, therefore, it would be prudent to anchor in some one of the bays on the north side of the strait, rather than continue under way. A vessel bound into the Gulf, and running with an easterly wind, will, however, find no place fit for that purpose until she arrives at Black bay, and that is not a very good anchorage, for Red bay cannot be entered by a large vessel with an easterly wind. Loup bay is the first good anchorage under such circumstances, and there the vessel would be so far advanced in her run through the strait that it would not be worth while to stop, since she might easily clear everything in the remaining short distance. But with a S.W. wind, at the approach of night, and appearance of a fog, a vessel bound out (eastward) through the strait had better stand off and on under easy sail, tacking by her deep-sea lead from the Newfoundland side till morning, if she be not farther eastward than point Ferolle. If she be farther advanced, she had better endeavour to make Forteau bay before dark, and anchor there for the night. In light winds or calms, during dark nights or foggy weather, it is better to bring up with a stream anchor anywhere in the strait than to drive about with the tides, without knowing whither,—but then a look-out must be kept for drifting icebergs."

ST. JOHN'S. Newfoundland.—The city of St. John's is the capital of the island, and the seat of government. Although its approach is narrow, the harbour is excellent, and its situation readily known, both by the Blockhouse on Signal hill at the north side, and fort Amherst on its south side. A *fixed* light is shown from the top of the light-keeper's dwelling at fort Amherst; it is at 114 feet above the sea, and visible from an offing of about 16 miles.* The channel, from point to point, is only about ⅛ of a mile wide; but it is wider just within the points than between them, decreasing again at the Chain rock, for, from the latter to the Pancake rock, the distance is only 97 fathoms,—these rocks are both above water and steep; Chain is the northern rock, and Pancake the southern. A shoal of 18 feet extends a very short distance from Chain rock; close to its edge is a depth of 6 fathoms.

At about 50 fathoms farther in, and nearly in the middle of the channel, lies the Merlin rock upon which is a depth of 24 feet at low water; the soundings close to this rock are 5 and 6 fathoms.

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* The arc illuminated is 135° (from E.N.E. southward to S.S.W.); *bearings from the lighthouse*. When cape Spear or St. John's harbour is enveloped in fog, a gun is fired every hour during day. The geographical position of Chain Rock battery is Lat. 47° 34′ 2″ N., Long. 52° 40′ 50″ W. It has been proposed to remove Amherst light to the north head of the harbour.

Inside the harbour are two *red fixed* lights. The easternmost is on the custom-house, at 50 feet above the sea; the westernmost (near the Congregational chapel at 420 yards from the easternmost light) is at 225 feet above the sea.

When approaching St. John's with a large ship, care must be taken to avoid the Vestal rock a patch of 12 feet, distant about 50 fathoms from fort Amherst light in an E.S.E. direction. This rock is very steep; the mark for it is fort William, or the old garrison, just open of the South head. Some rocks named the Wash-balls also lie close to the northern point of the harbour; as they are always above water, they are not dangerous.

When entering the harbour bring the custom-house in one with the right side of the Congregational church, bearing N.W. ¾ W.; or, at *night* the two *red* lights in the town on the same bearing. Either of these marks will lead through the Narrows in mid-channel, and should be strictly followed because at about 1¼ cables westward from the Pancake rock, and on the same side (the south) of the entrance there is a dangerous rock known as the Prosser; this rock has but 5 feet water on its edges, but in its centre 18 feet (being shaped like a saddle), and it is also very steep the depth immediately outside it being 4 to 8 fathoms. When westward of this rock, the harbour will be open and an anchorage can be selected where convenient. The depths in the harbour are from 17 to 4 fathoms on mud and gravel. The harbour is almost land-locked, as it is only winds from S.E. that blow directly through the Narrows.

Strangers bound to St. John's must be careful not to mistake *Quiddy Viddy* (a small place, fit only for boats, lying about a mile northward of the Narrows) for St. John's harbour, as at a distance it has the appearance of a good harbour. Observe, that on the south side of Quiddy Viddy there is a round hill, shaped like a haycock, standing upon Cuckold's head;—St. John's harbour may be distinguished by fort Amherst, which appears white, and by the flagstaff on the hill, over the north point of the entrance.

HALIFAX, Nova Scotia.—Halifax harbour is situated about 120 miles westward of cape Canso, and 118 miles eastward of cape Sable, and is one of the finest in British America.* It is easy of approach and accessible at all seasons, and is large enough to accommodate almost any number of vessels in security. Its direction is nearly North and South, and its length about 14 miles. The channel to the town is nowhere less than ½ a mile broad, nor under 6 fathoms in depth, except in two places where there are only 4½ fathoms; these are named the Neverfail and Middle shoals. The town of Halifax is the capital of Nova Scotia, and contains about 18,000 inhabitants.

The entrance of the harbour is between Chebucto head and Sambro island on the western, and Devil and Macnab islands on the eastern side. *Sambro island* is small and rocky, lies 4 miles south-westward from Chebucto head, and is surrounded by a multitude of rocks and shoals, bearing the general name of Sambro ledges, through and among which are deep water passages, but too intricate for a

* The longitude of the Dockyard Observatory at Halifax is 63° 35′ 14″ W., according to Admiral Bayfield; and 63° 35′ 15″ W., according to Professor Bond, of Cambridge Observatory, U.S., and Lieut. Shortland, R.N., whose observations were made by means of the electric telegraph, and based upon the known position of the latter observatory.

stranger to attempt. To avoid them, give the island a berth of at least 3 miles. Pilots may be obtained from Sambro island, and if a vessel fires a gun during a fog, it will be answered therefrom. *Devil island* lies close off Hartland point, is small and rocky, and joined to the main by a flat nearly dry at low tide; this island should not be approached nearer than half a mile. *Macnab island*, forms the eastern side of the channel into the harbour, and is connected with the eastern shore by a flat of 8 to 12 feet, upon which is situated a little island named Lawler; the passage on this side of the island, named the South-east passage, is too shallow and confined to be used by any but boats, so that vessels always use the western passage into the harbour. From the south end of the island a shoal extends about 1¼ miles southward, and upon this flat there is a small island, named Thrumcap. Northward of Macnab island is *George island*, a small island lying nearly in mid-channel opposite the town. The depth close off it is 4 to 8 fathoms, and in the channel between it and the town 8 and 14 fathoms, while eastward of it there are from 10 to 14 fathoms; both channels are free from danger to within a cable's length of either shore.

Lights.—Sambro island has a white octagon-shaped lighthouse upon the middle of it, showing a *fixed* light, visible 20 or 21 miles. At about 100 yards southward from it is a Daboll's fog-trumpet, the blast of which (continuing 5 seconds) can be heard from a distance of about 10 miles.

On the southern end of Devil island there is a building painted brown, with a white belt, from which a *fixed* light, appearing *red* towards the sea, is shown, visible about 8 miles. From this island pilots may be obtained.

Near the extremity of Maugher beach, a gravel spit extending from the middle of the western side of Macnab island, there is a white circular tower having a red roof, from which a *fixed* light is shown, visible 10 miles. When this light bears North, it clears the Portuguese, Rock head, and Thrumcap shoals.

Dangers.—The rocky promontory of Chebucto head (south-westward of which, and around Sambro island, are numerous rocks and shoals) must always be carefully approached when entering the harbour from westward. A stranger should give Sambro island a berth of 3 or 4 miles in passing, and not attempt any of the channels inside it.

Bell Rock.—This is a small rock of 6 feet, lying $\frac{4}{10}$ of a mile from the shore, nearly midway between the entrance to Catch harbour and Chebucto head. In a northerly direction, towards the coast, it has a spit of 4½ fathoms extending from it a short distance, but in other respects it is steep, there being a depth of 7 and 8 fathoms close to its eastern, and 13 and 24 fathoms close to its western side. No ship should attempt to pass inside it, on account of the dangerous rocks, named Duck and Duncan reefs, which extend from the land and nearly block up the passage. Bell rock bears from the extremity of Chebucto head nearly S.S.W. ¼ W. one mile, and from White head, the east point of Catch harbour, E. ¼ N. about ½ a mile. To avoid it on the east side, do not go westward of the line of Sandwich point in one with Chebucto head, about N. ¼ E., as that mark will carry clear of it, and also eastward of the Sisters, and the other ledges in the vicinity of Sambro island.

Portuguese Shoal.—This small shoal of 4½ or 5 fathoms is the outermost of the shoals fronting the entrance to the harbour. It lies 3 miles S.W. ½ W. from stranger to attempt. To avoid them, give the island a berth of at least 8 miles. Pilots may be obtained from Sambro island, and if a vessel fires a gun during a fog, it will be answered therefrom. *Devil island* lies close off Hartland point, is will carry clear of it, and also eastward of the Sisters, and the other ledges in the vicinity of Sambro island.

Portuguese Shoal.—This small shoal of 4½ or 5 fathoms is the outermost of the shoals fronting the entrance to the harbour. It lies 3 miles S.W. ¼ W. from the lighthouse on Devil island; 4 miles S. ½ E. from the lighthouse on Maugher beach; and 2½ miles N.E. ½ N. from the extremity of Chebucto head. Close-to it all round is a depth of 6 and 7 fathoms. Its western side is marked by a *black* buoy, lying with George island open a little westward of the light on Maugher beach.

Rock Head Shoal lies nearly ¾ of a mile E.N.E. from the buoy on Portuguese shoal. It is about ½ of a mile in extent, and has soundings of 3½ to 4½ fathoms, upon it, with 6 to 10 fathoms close-to all around. To clear it, as well as the Portuguese shoal on the east side, bring Sambro Lighthouse island open east of White head, bringing S.W. ½ W. A *black* buoy with white bell and frame is placed on its south-eastern side.

Lichfield Rock lies on the western side of the approach to the harbour at rather more than ¾ of a mile from the shore, in the direction of S.E. by S. ½ S. from the mouth of Herring cove. It has upon it 2½ fathoms, and there is a depth of 9 to 16 and 17 fathoms at a short distance eastward from it; the deepest water is between it and the coast, where there is as much as 20 fathoms. It is marked by a *white* beacon buoy, moored on its eastern side.

Neverfail Shoal.—This is a shoal of 4½ fathoms, situated in the middle of the approach to the harbour, at nearly midway between the Lichfield rock and the Thrumcap shoal. The depth immediately around it is 5 and 6 fathoms, and, we believe, is not at present (1869) marked by a buoy. Vessels may sail between it and the Lichfield rock by bringing the flagstaff of the Citadel just touching Sandwich point, bearing N. ½ W.; or, between it and Thrumcap shoal, by bringing George island open a little westward of Maugher beach lighthouse.

Mars Rock lies southward of and under Sandwich point, the western point of the harbour, at from ¼ to ½ a mile from the land. On its shoalest part the depth is 3½ fathoms, and immediately around it 8 and 10, deepening to 19 and 20 fathoms. Its eastern edge is marked by a white beacon buoy.

Thrumcap Shoal is a shallow flat of 1½ to 3 fathoms, extending a mile S.S.W. from the south end of Macnab island, on the eastern side of the harbour. It must be carefully avoided when making the harbour from eastward; the *red* beacon buoy on its edge should always be passed on its south side.

Maugher Beach.—From the south side of this beach a flat of 2½ to 4½ fathoms extends about ½ a mile, and has on it, near the extremity, a patch of 3½ fathoms. To clear this flat, bring the Roman Catholic chapel, at Dartmouth, in one with the east point of George island, bearing North, and it will be avoided in 10 or 11 fathoms. There is also a shoal named the Horse Shoe running 1½ cables from the northern side of the beach.

Middle Ground.—This is a small gravelly patch of 4½ fathoms, lying directly in the fairway of the channel, with Maugher Beach lighthouse bearing S.E. by S. ½ S., distant ¾ of a mile; close to it all round is a depth of 6 and 7 fathoms. It extends East and West a cable's length, and is about 80 fathoms broad; eastward of it the soundings increase from 7 to 18 fathoms water, muddy bottom, while on its west side the depth is from 10 to 14 fathoms, coarse and rocky bottom.

Pleasant Shoal extends from Pleasant point nearly half way over the channel towards the north-west end of Macnab island. The depth over it is but 8 and 4 feet in many parts;—its extremity is marked by a *white* buoy, which should always be passed on its east side.

Reed Rock, with 4 feet over it, lies in-shore, at about half way between point Pleasant and Halifax. The thwart-mark for it is a farmhouse in the wood over a black rock on the shore, bearing W. by S. The depth around it is 5 and 7 fathoms. A *white* beacon buoy is moored off its eastern side.

Ives Knoll has but one foot of water over its centre, and from 9 to 15 feet on other parts. It lies off the north end of Macnab island, and is separated therefrom by a narrow channel 4 and 5 fathoms deep. On its western side there is a *red* buoy, moored opposite the white one marking Reed rock.

Belle-isle Spit extends ¼ of a mile from the shore at the south end of Halifax, opposite the south point of George island, and has a *white* beacon buoy on its outer edge. One-fourth of a mile further in, on the same side, is the *white* beacon buoy on the edge of the Leopard shoal.

Directions.—Vessels ought not to attempt to enter the harbour of Halifax without having a local pilot on board. In the event of not being able to get one, the following directions may be serviceable.

Approaching from westward.—Advance eastward of Sambro lighthouse to the distance of a league, taking care not to approach it nearer on account of the various dangers in its vicinity. When the lighthouse on that island is westward of N.N.W. a course of N.E. or N.E. ½ N. about 4½ miles, will take to a berth off Chebucto head, when the leading mark should be brought on; namely, the Citadel flagstaff, just open of point Sandwich, N. ¼ W. This mark leads between the Portuguese *black* buoy, and the Neverfail and Thrumcap shoals on the starboard hand, and Lichfield *white* beacon buoy on the port hand, up to the *white* beacon buoy on the edge of Mars rock, which must be left also on the port side by opening the flagstaff a little more to eastward. Sandwich point, which is bold, may now be approached and passed at the distance of a cable, and by keeping Chebucto head a little open of Sandwich point, about S. ¾ W., the fairway will be maintained up to George island, leaving the Middle ground a short distance on the eastern side, and the *white* buoys on Pleasant shoal and Reed rock on the western. Or, when up with Mars rock buoy, haul to the eastward and bring Dartmouth Roman Catholic chapel in one with the east point of George island, N. ½ E., and it will lead in between Maugher beach and the Middle ground, to abreast the town, passing the *red* buoy on Ives knoll on the starboard side, and the *white* buoys on Pleasant shoal, Reed rock, and Belleisle spit on the port side.

Or, when abreast of Chebucto head, or when Sambro light bears W.S.W., the light on Maugher beach should not be brought westward of North. Keeping the latter light from North to N. by E. will lead in clear of all the shoals, except the Neverfail, up to abreast Sandwich point. Vessels advancing from westward will see the light on Maugher beach when they are as far up as Chebucto head; it is then a good mark as far as Sandwich head.

*Approaching Halifax Harbour from eastward,** especially with an easterly wind, and intending to pass in between the Rock head and Thrumcap shoals, steer towards Devil island, pass it at the distance of ¼ a mile on its south side, and steer West, making allowance for the influence of the tide. If this course be made good it will lead in at rather more than a mile northward of the bell buoy on the south end of Rock Head shoal, and ¼ of a mile southward of the *red* buoy off the south-west end of the Thrumcap. As soon as George island appears open westward of Maugher lighthouse, haul up and proceed on that line of bearing, and as Sandwich point is approached, open the island gradually more westward, till the Roman Catholic chapel comes in line with the east end of George island, then proceed as before directed.

In turning to windward, give the upper or inner part of Maugher beach a berth of 2 cables, to avoid the Horse-shoe reef. Vessels may stand to the Sandwich point side to within two ships' length, that side of the harbour being bold; but should not get nearer to Point Pleasant shoal, than to keep Chebucto head well in sight open of Sandwich point.

When up with George island pass it on either side, as most convenient, giving it a berth of 80 or 100 fathoms. The anchorage may be chosen at pleasure, in from 13 to 6 fathoms, muddy bottom.

Capt. Orlebar, R.N., says that "a rock, with 14 feet least water over it, lies 50 fathoms from the end of Lyle's wharf, and bears from Government house E. 12° S., distant 180 fathoms. It lies within the depth of 5 fathoms, but in

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* It is said that there is great difficulty in making Halifax from eastward, particularly in the winter season, in consequence of the winds being too frequently from W.S.W. to N.W., and blowing so hard as to reduce a ship to very low canvas, if not to bare poles, and should the wind veer to the eastward, it is invariably attended with such thick weather as to prevent an observation, or seeing to any great distance; hence, under such circumstances, it would be imprudent to run for the shore, more particularly in winter, when the easterly winds are attended with sleet and snow, which lodge about the masts, sails, rigging, and every part of the ship, becoming a solid body of ice so soon as the wind shifts round to the N.W., which it does suddenly from the eastward. These are circumstances of real difficulty; and it has been recommended, in such a case, to run far to the south-westward (avoiding the Gulf Stream) and thence from the S.W. coast to keep the shore on board all the way to Halifax.

Admiral Bayfield says, "In the present very imperfect state of our knowledge of the banks which lie off this coast (Nova Scotia), of the depth and nature of the soundings on them, and between them and the shore, no further directions can be safely given to vessels approaching the land during a dark night or in a thick fog, than not to go nearer than the depth of 40 fathoms, at the same time bearing in mind that there is that depth at a less distance than 3 miles from some of the most formidable of the dangers between Canso and Halifax.

passing up the harbour no vessel of size should approach the wharves until well past this bearing from Government house. If York redoubt be kept open of the wharves this rock will be cleared."

ST. JOHN'S, New Brunswick.—The entrance to this harbour bears from Digby gut N. ¼ W. 34 miles, and may be distinguished by the lighthouse on Partridge island, which shows a *fixed* light visible 20 miles. The tower is painted red and white, in vertical stripes. Its position is Lat. 45° 14′ 3″ N., Long. 66° 3′ 5″ W. During fog a steam whistle is sounded every minute for 10 seconds.

As a guide to vessels making the harbour, a large bell-buoy has lately been placed in 8 fathoms, off the north-east side of Partridge island; it should be passed on the east side.

A *beacon light* is shown within Partridge island, from a tower erected upon a spit or bar which runs out from Sand point S.S.E. about ¼ a mile, and which dries at ¾ ebb.*

North-eastward from the beacon light, just off the town, is a ridge of rocks which is covered at 2 hours' flood; from this ridge and eastward of the town are extensive flats of sand and mud, which dry at low water, and extend along the road to Cranberry point, stretching off about 2 cables.

The bottom, for several miles southward of Partridge island, is muddy, and the depths gradual, from 7 to 20 fathoms, affording excellent anchorage; the passage westward of this island has in it a depth of only 6 to 10 feet; that eastward of it 16 to 22 feet. Abreast the city are soundings of 7 to 12 fathoms.

A breakwater has been erected on the eastern side of the entrance to the harbour, below the town, for the purpose of reducing the inset of the sea; this inset is very strong during southerly gales.

St. John.—The city of St, John stands on the river St. John (near its mouth) and carries on a considerable trade; many ships are built here. Within the harbour is a valuable fishery, where large quantities of salmon, herrings, and chad are cured for exportation. In the most severe winter it is free from the incumbrance of ice. The country on the banks of the river abounds in excellent timber, coal, limestone, and other minerals. Partridge island is about 2 miles southward of the city, answering the double purpose of protecting the harbour, and by its lighthouse, guiding and directing the mariner to its entrance.

Directions.—Vessels approaching the bay of Fundy from south-eastward should keep well outside to the southward of Seal island, say at about 35 miles, passing at the distance of 20 miles westward of it; thus the bay of Fundy will be open, and the course up, first N.N.W., till on the parallel of cape Fourchu light, and then about N.N.E. for the entrance of the bay, guarding against the Lurcher and Trinity ledges. This will carry outside the Lurcher, but the tide

* The tower of the beacon light was destroyed by fire in 1867; consequently the light may not now be shown. It is intended to build another tower. (April 1869).

will make a difference in these courses, as it sets in a south-easterly and north-westerly direction; near the Manan ledges the ebb runs W.S.W. and the flood E.N.E., at the rate of 4 knots an hour, which must be allowed for.

From Seal island to cape St. Mary the land is level and well wooded, and the soundings, under 60 fathoms, extend fully 25 and 30 miles from the land, and only 5 miles westward of Bryer island. At the Manan ledges the depths of 60, 80, and 100 fathoms are at only 3 and 6 miles distance from them, therefore the lead should always be kept going.

If a chart of the South-west coast of Nova Scotia be examined, and the relative situation of that coast, as exposed to the Atlantic Ocean, with the consequent and variable set of the tides about it, as well as about the Manan islands, &c., be considered, the mariner will be naturally led to consider that its navigation, involved in occasional difficulties, requires very great attention; and the supposition is justified in consequence of the great number of ships lost hereabout; yet there are few obstacles which a moderate exercise of skill and resolution would not overcome, and it is to be feared that the absence of these qualifications occasions such losses to a greater extent than the actual dangers of the navigation.*

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* The following are the principal Lights that will be seen when making St. John's from southward.

Cape Sable.—This lighthouse consists of a white conical building 50 feet high, which shows a *fixed red* light at 58 feet above the sea, visible 12 miles. Its geographical position is Lat. 43° 23′ 19″ N., Long. 65° 37′ 11″ W. From it, Brazil rock (12 feet under water) bears S.E. by E. ½ E. nearly 8 miles; Columbia rock (pinnacle, 7 feet under water) S. by E. ¾ E. one mile; and the south rock of South-west Ledge W. by S. ½ S. 1¾ miles. The cape should have a berth of at least 3 miles.

Seal Island.—Seal island is the outermost island off this part of the coast of Nova Scotia; its southern extremity bears from cape Sable about W.N.W. ½ W., distant 17 miles. The lighthouse on the south point of the island is of an octagonal shape, built of wood, and painted white; it shows a *fixed* light, which may be seen from every point of the compass, at the distance of about 18 miles. The building must not be approached by strangers nearer than at least 5 miles while it bears between W.N.W., northerly, and E.N.E., and then only with great care, because of the various dangers in the vicinity of the island; the outermost (most to southward) of these rocks is the Blonde, a patch which dries at low tide distant 3½ miles from the lighthouse in a S. ½ E. direction. The geographical position of the lighthouse is Lat. 43° 23′ 34″ N., Long. 66° 0′ 52″ W.

Cape Fourchu.—Cape Fourchu or the Forked cape is very remarkable, being rocky, barren, and high, and is so named from the island, which forms it, having two narrow prongs running out to the southward. Just within the extremity of the East cape or Prong, and on the western side of the harbour's entrance, there is a lighthouse, which exhibits a brilliant *revolving* light (visible for 1½ minutes, and invisible ½ a minute) to the distance of 20 miles. The building is painted red and white, in vertical stripes, is 58 feet high, and stands in Lat. 43° 47′ 28″ N., Long. 66° 9′ 21″ W. During fine weather the light may be approached to within ½ a mile, and anchorage may then be obtained eastward and westward of it; but care is required. During fog a steam whistle is sounded once every minute; the blast continues 10 seconds.

Cape St. Mary.—This lighthouse is 46 feet high and coloured white; it shows a light *revolving* every minute (appearing *red* and *white* alternately) at 100 feet above the sea, visible from all parts of the sea horizon at the distance of about 16 miles;—its geographical position

"In order," says Mr. LOCKWOOD, "to lessen these accidents, if not totally to prevent such fatal occurrences in future, let the mariner be fully convinced of the necessity of frequently sounding with the deep-sea lead, and see the expediency

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is Lat. 44° 5′ 6″ N., Long. 66° 12′ 30″ W. A reef extends south-westward from the cape nearly ½ a mile. Trinity ledge (dry at low water spring tides) lies 6¾ miles S.W. ¾ W. from the light.

Bryer Island.—Bryer island on the south-west side of the entrance to the bay of Fundy, has deep water at less than a ¼ of a mile from it, except on its south-west side, yet, the approach to it should be carefully made, on account of the outlying rocks in its vicinity. A lighthouse of an octagonal shape, painted white, stands on the western side of the island, and exhibits a *fixed* light, visible 15 miles; the arc illuminated is 219½° (from S. by W. ½ W. westerly and northerly to N.E. by E.). Here the tides are very strong, rendering great care necessary when sailing in this vicinity. Pilots can usually be obtained. The geographical position of the lighthouse is Lat. 44° 14′ 57″ N., Long. 66° 23′ 33″ W. Some rocks extend from the shore of Bryer island north-eastward from the lighthouse about a quarter of a mile. The outlying reefs in the vicinity bear from the lighthouse as follows;—South-west ledge (2 fathoms) S.W. by S. 3¾ miles; Beatson ledge (two patches of 12 feet) N. ½ W. 3¾ miles; and North-west ledge (6 feet) N. by E. 4½ miles.

Gannet Rock.—The Gannet is a small rock about 25 feet above water at high tide, near which are many sunken rocks and ledges, whose positions are generally indicated by breakers. The lighthouse is painted in vertical stripes, black and white, and stands in Lat. 44° 30′ 38″ N., Long. 66° 47′ 1″ W. A gun is fired to answer signals during a fog. The light appears thus;—fixed 45 s., eclipsed 5½ s., flashing 4½ s., eclipsed 5½ s., fixed 45 s., &c.

This light, from its proximity to several dangerous ledges and shoals, ought not to be run for; it is intended to give timely warning to vessels which are, by the rapid tides about these ledges, frequently drawn into danger, and too often wrecked. Neither ought vessels, except in cases of extremity, to attempt to run between this rock and the Old Proprietor, as there are some dangers in the way; the ground is rocky, and the tides run with great velocity.

From the lighthouse the Old Proprietor (dry at low water) lies 5⅝ miles E. ¾ N.; a 12-foot shoal ½ mile S.E. ½ S.; Half-tide rock ⅝ mile W. ½ N.; St. Mary ledge (generally dry) 2¾ miles W. by S. ¾ S.; Yellow ledge (dry) 3⅛ miles W. ⅞ S.; Cross Jack ledge (generally dry) 2 miles W. by N.; &c. &c.

Machias Seal Islands.—These islands are distant 13½ miles W. by N. ½ N. from Gannet rock. The lighthouses are 36 feet high, coloured white, and each exhibits a *fixed* light visible about 15 miles; when in one they bear W. by N. ½ N. and E. by S. ½ S. A gun is fired every 4 hours during foggy weather. Pilots generally cruize about in the neighbourhood. To clear the Murr ledges on the south side, keep the western lighthouse open southward of the eastern. Many reefs lie eastward from the lights; hence vessels approaching them from northward, eastward and southward must take great precaution. From the *eastern* lighthouse, North shoal (8 feet) lies 1⅜ miles N. ½ E.; North rock (4 feet above water at high tide) 2½ miles N.E. by N.; Middle shoal (3 fathoms) 5⅛ miles E.N.E.; Bull rock (2 feet under water) 6¾ miles E. by S. ½ S.; a shoal of 13 feet ⅜ mile S.E. ½ E.; South-east shoal (8 feet) 1¼ miles S.E. ½ S.; South-east ledge (5 fathoms?) 5¾ miles S.E. ½ S.; &c. &c. The geographical position of the eastern light is Lat. 44° 30′ 7″ N., Long. 67° 6′ 13″ W.

Swallow Tail.—This lighthouse is on the north-east part of Grand Manan island. It is a white octagonal building 50 feet high; the light, *fixed*, is at 148 feet above the sea, and visible from the distance of about 17 miles. Its geographical position is Lat. 44° 45′ 52″ N., Long. 66° 44′ 6″ W. The light is, we believe, shown over an arc of 270° (from S.W. southward to N.W.).

Point Lepreau.—The lighthouse on this point is 31 feet high and striped red and white horizontally. It shows *two fixed* lights at 81 and 53 feet above the sea, visible 15 and 13 miles, between the bearings from it of W.N.W. southward to E. by N. (214°). Its geographical position is Lat. 45° 3′ 31″ N., Long. 66° 27′ 39″ W.

of having his anchors and cables fit for immediate use ; this cannot be too strongly impressed upon his mind, for vessels well equipped and perfect in gear, with their anchors stowed as in the middle of the Atlantic Ocean, have been here wrecked in moderate weather, and so frequently, that such gross neglect cannot be too much reprobated ; such serious losses will, we trust, be hereafter prevented, more especially as it is so dependent upon the mariner himself, and may be, in most cases, remedied by only sounding in time, and keeping the lead in continual action."

If from Europe, and bound to the bay of Fundy, endeavour to keep in about 43° or 43° 5′ N., and having obtained soundings on the western part of Sable island bank, keep the deep-sea lead going as you proceed westward, sounding progressively on the Le Have and cape Sable banks: the former may be known by the hard rocky bottom, and the latter by being generally black gravel. These precautions are very necessary, because a fair wind is frequently accompanied by a thick fog, often for several days together.

In thick weather, by a careful attention to the soundings as you approach towards cape Sable, and keeping the vessel under commanding canvass for getting soundings, you may round the cape with safety in 55 or 60 fathoms: the bottom off the cape consists of small black stones, sand, and gravel. From a position about midway between Bryer island and Gannet rock, the course to St. John's is N.E. ½ N. and distance 58 miles.

The following directions are based on the chart of the survey by Lieutenants Harding and Kortright, acting under the orders of Captain W. F. W. Owen of the Royal Navy, in 1844.

When running for St. John's avoid the rocky ledge extending from Inner Mispick point, the eastern side of the entrance to the distance of 2½ cables ; this is steep, with a depth of 30 to 40 feet close to it. Having brought the stone barracks in one with the Wesleyan chapel,* at the back of the town, bearing N. ¾ E., steer in with this mark on, and it will carry outside the shoal water extending from the eastern side of Partridge island. When Carleton church comes in one with the cliff end (the termination of the cliffs forming Negro point), bearing about N.W. ¾ N., change the course to this direction, and it will lead in from 15 to 22 feet water at 1½ cables northward of the shoal ground connecting Partridge island with Negro point. Continue in this direction, until the stone church at the back of the town comes in one with the end of the breakwater, when you must run up (with this mark) past the beacon-light into the harbour. When just above the beacon-light steer N. by W. or N. by W. ½ W., and anchor off the town. Be careful to keep the lead going when following these directions, that you do not strike on the shoal spots.

North-eastward of the beacon-light, and just off the town, is a ridge of rocks which is covered at 2 hours' flood. From this ridge, and eastward of the town,

* This building will be known by its octagonal tower with a circular top. It is situated in the north-east part of the town.

there is an extensive flat of mud and sand that dries at low water; this extends along the coast to Cranberry point, and runs about 2 cables from the shore. Cranberry point is cliffy, and has some rocks running off it.

Signals.—The following signals are or were shown at Partridge island, on the approach of vessels:—

One ball close for	1	square-rigged vessel.
One ball half-hoisted for	2	square-rigged vessels.
Two balls close for	3	,,
Two balls separated for	4	,,
A pennant of any colour for	5	,,
A pennant under a ball for	6	,,
A pennant over a ball half-hoisted for...	7	,,
A pennant under two balls close for ...	8	,,
A pennant under two balls separated for	9	,,
A flag of any colour for	10 or more	,,

The above are displayed at the east or west yard-arm, according to the direction in which the vessels are first observed; and as soon as their rig can be distinguished, descriptive colours will be hoisted at the masthead in the following order:—

A union jack, with a white pennant over...	for	a small armed vessel.
A blue pennant................................	,,	merchant ship.
A red ditto	,,	merchant brig.
A white and blue ditto	,,	foreign vessel.
A white ditto (without a ball)	,,	top-sail schooner or sloop.
A red flag, pierced white	,,	steamboat from St. Andrew's and Eastport.

A ball at the masthead........................ vessel is on shore, or in distress.

Should immediate aid be necessary, guns to be fired. In foggy weather, a gun will be fired on Partridge island in return for each gun heard at sea. Should a vessel require a pilot, her descriptive pennant will be displayed at a yard-arm, in the place of a ball.

Portland.—Portland harbour is situated at the outfall of the river Stroudwater, and has an extent of about 1¼ miles, with a depth at low water of 1¼ to 5 fathoms, the latter being immediately off the wharves of the city. The approach to it is through the channel formed by the islands Bang, House, Ram, Peak, Great and Little Hog (all more or less connected together by a shallow flat) and the main land, which channel is nearly ½ a mile wide, lies in a N. by W. and S. by E. direction, and has a depth decreasing from 10 to 7 fathoms. The harbour is consequently land-locked, and affords ample and secure protection to vessels from all winds. It is high water on the days of full and change of the moon at 11h. 25m.:—mean rise of springs 9¾ feet and neaps 7½ feet.*

* On Fort hill, Portland, there is an observatory, from which vessels approaching the coast can be seen even at a distance of about 40 miles. Shipmasters requiring assistance should place

The coast southward of Portland to cape Elizabeth, a distance of 3¼ miles, is rocky, and has a depth of about 6 fathoms almost immediately off it. At 2¼ miles southward from Portland lighthouse there is a slight projection of the land, from which a reef named Trundys ledge extends out nearly a mile in a N.E. by E. direction; this reef is awash near the land at low water, but in other parts the depth over it is 3 to 2 fathoms at the same period of tide. As the lead drops from the reef at once into 5 and 6 fathoms water, great circumspection is necessary when navigating in its vicinity.

Cape Elizabeth is a bold point which may be easily recognised by its two lighthouses. It should not be closely approached because of the numerous reefs in its vicinity; those nearest it consisting of three patches of 2¼ to 3 fathoms, are known by the name of Taylors reef, and are situated about half a mile from the land. The depth close to the rocks at the base of the cape is about 6 fathoms, and there is a passage sufficiently deep for the largest vessels between the reefs just mentioned and the land, but this, it is almost needless to say, should only be attempted by those having an intimate knowledge of the locality.

Lights.—The lights on cape Elizabeth are as follows:—They are 300 yards apart and each exhibits the light over an arc of 245° (from North-eastward, and southward to S. 65° W.). A fog-bell is struck by machinery.

Eastern Tower is 58 feet high, and coloured white with four broad horizontal stripes. The light *(fixed)* is 143 feet above the sea, and visible about 17 miles. Its geographical position is Lat. 43° 33′ 50″ N., Long. 70° 11′ 49″ W.

Western Tower is 53 feet high, and coloured white with one vertical stripe on its seaward face. It shows a light *revolving* every minute at 143 feet above the sea, visible 17 miles. Its geographical position is Lat. 43° 33′ 56″ N., Long. 70° 11′ 41″ W.

The lighthouse on Portland head is a white tower 69 feet high, which shows a *fixed* light at 101 feet above the sea, visible 17 miles. The arc illuminated is 201° (from N. 24° W. northward and eastward to S. 3° E.). A fog-bell is struck by machinery. Its geographical position is Lat. 43° 37′ 22″ N., Long. 70° 12′ 9″ W.

A *fixed red* light is shown on the north-east end of the breakwater in the harbour. It is at 23 feet above the water, and illuminates an arc of 279° (from S. 53° W. westward, northward and eastward to S. 28° E.).

Shoals and Buoys.—In the entrance to Portland bay, and at various distances from cape Elizabeth, are numerous patches of rock, all of which are steep and have deep water of 7 to 12 fathoms in their immediate vicinity. Strangers should consequently employ a pilot, for it is not safe to attempt to enter the harbour without such assistance. It is recommended in thick weather, when there is any doubt of the vessel's position, to keep in soundings of 40 fathoms or

their ensign over the private signals, and if they are sufficiently near to be clearly seen, information of their situation will be conveyed to the owners.

more, with soft bottom. The reefs most dangerous to shipping are now (1868) buoyed in the following manner:—

Bulwark, a patch of 14 feet. The buoy (*red* and *black* horizontal stripes) is in 8 fathoms at about ⅛ mile south-eastward from the shoalest part of the ledge. From it cape Elizabeth lighthouses bear W. by S. ¼ S. 6 miles, and Green island N.N.W. 5 miles.

Witch, a patch of 18 feet. The buoy (*red*, with WR on it) is in 8 fathoms, at about 40 yards south-eastward from its shoalest part. From it Portland head lighthouse bears W. ½ N. 1¾ miles, and White head N.N.W. 1¾ miles.

East Hue and Cry, a ledge of 16 feet. The buoy (*black*) is in 6 fathoms, at 126 feet E.S.E. from the ledge; strangers approaching Portland should always pass it and Alden rock buoy on the *east* side. From it the eastern lighthouse on cape Elizabeth bears N.W. by N. 4 miles, and Alden rock buoy N. ½ W. 2 miles.

The West Hue and Cry, a rock of 27 feet water, is about a mile westward from this buoy. From it, cape Elizabeth eastern lighthouse bears N.N.W. 2¾ miles; a barn on Richmond island N.W. by W. ½ W. 8½ miles; and Alden rock buoy N.E. by N. ¾ N. 1½ miles.

Old Anthony or *Vapor*, a rock of 18 feet. The buoy (*red* and *black* horizontal stripes marked OA, and bearing a rod and ball) is moored in 8 fathoms at a short distance South from the shoalest part of the ledge. Its marks are, cape Elizabeth eastern lighthouse N. by W. ½ W. 2½ miles, and a house on Richmond island W. by N. ½ N. 8½ miles.

Corwin, a patch of 18 to 20 feet. The buoy (*black* and *red* horizontal stripes, and with CR on it) is moored in 8 fathoms at about 80 yards south-eastward from the reef. Its marks are, cape Elizabeth western lighthouse W.N.W. 8 miles, and Portland head lighthouse N.N.W. 6 miles.

The West Cod, a ledge of 83 feet, lies about 1½ miles north-eastward from the Corwin. From it Portland head lighthouse bears N.W. ¾ N. 4⅝ miles; the eastern lighthouse on cape Elizabeth W. ½ N. 8½ miles; and the buoy marking Alden rock S.W. by W. 1⅝ miles.

Alden, a patch of 4½ feet. The buoy (*black*, with AR on it) is about a ¼ mile southward from the rock. It is moored in 11 fathoms, and from it the centre of the ledge bears North ¼ mile; the eastern lighthouse on cape Elizabeth N.W. by W. ½ W.; and Portland head lighthouse N.N.W. ½ W. 6½ miles.*

* Lieut. Woodhull, U.S. Navy, who surveyed Alden reef in 1854, reports as follows:—"It lies about N.E. and S.W., and by compass the north light on cape Elizabeth bears from it N.W. by W. 2 miles; barn on Richmond island, West; Portland light N. by W. ½ W. 4¾ miles; and the light on Wood island S.W. by W. ¾ W. about 9½ miles. It is about 950 feet long and 250 wide. Its shoalest part is on the west side, and through its centre from north to south the water is quite deep; which circumstance doubtless gave rise to the belief that there were *two* distinct rocks or ledges, which supposition, I think, is entirely disproved by my recent survey. The rock, as it is called, but which more properly should be considered

Taylor Reef, the shoalest part of which has 11 feet of water upon it. The buoy (*black*, with TR on it) is in 8 fathoms, at about 60 yards south-eastward from the reef. Its marks are, the house on Richmond island West 8 miles, and the western lighthouse on cape Elizabeth N.W. by N. ½ N. one mile.

Broad Cove, a rock of 6 feet. The buoy (*black*) is in 4 fathoms, at about 200 yards E.S.E. from the rock. From it, cape Elizabeth lighthouse bears S.W. ½ S. 1½ miles, and Portland head lighthouse N. ¾ W. 3½ miles. This rock is southward from Trundys reef buoy.

Watts Ledge, off Richmond island. A *black* buoy at about a ¼ mile south-eastward from the ledge. Its marks are, a house on Richmond island W. by N. ½ N. one mile, and cape Elizabeth western lighthouse N.E. ¾ N. 1¾ miles.

Trundys Reef, a reef extending from the buoy south-westward to the coast. The buoy (*black* with TR upon it) is moored in 4 fathoms with the following marks, cape Elizabeth lighthouse S.S.W. 2½ miles, and Portland head lighthouse N.N.W. 2½ miles.

The Willard, a small patch of 31½ feet, lies about ½ mile north-eastward from Trundys reef buoy. Its marks are, Portland lighthouse N.W. by N. ½ N. (nearly) 1¾ miles; the east lighthouse on cape Elizabeth S.W. by S. ½ S. 2½ miles; and Trundys reef buoy S.W. ½ W. ⅜ mile.

Jordan Reef or *Bell Rock*, a ledge of 18 feet, in nearly mid-channel of the entrance to the harbour. The nun buoy (*red* and *black* in horizontal stripes) is moored in 7 fathoms at about 150 feet south-eastward from the ledge. Its marks are, Portland head lighthouse N.W. by W. ½ a mile, and the eastern lighthouse on cape Elizabeth S.W. by S. ½ S. 4¾ miles.

Catfish, a rock of 18 feet, on the east side of the channel. The buoy (*red*) is in 4 fathoms at about 80 yards southward from the shoalest part of the rock. Its marks are, Portland head lighthouse S. by W. ½ W. one mile; fort Preble N.W. by N. ½ N. 1½ miles; and Bang island point East 140 yards.

Spring Point, a ledge bare at half tide. The buoy (*black* with SPL upon it) is in 18 feet, at about 300 feet E.N.E. from the ledge. Its marks are, Portland head lighthouse S. by E. 2 miles, and House island S.E. by E. ½ a mile.

Stanford Ledge, a rocky ledge surrounding the breakwater. The nun buoy (*black* with SL upon it) is in 17 feet at about 500 feet N. by E. ½ E. from the

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a reef, is of immense dimensions, extremely irregular in form, having shoal projections on it from 4½ to 24 feet, at low water. I discovered but one rubble with 4½ feet water on it, one with 6, several with 8, and a very considerable number of shoal spots with 11, 12, 13, 14, 15, &c. feet, all estimated at low water.

The reef lies immediately in the way of all navigation and particularly of vessels bound westward or of those leaving the harbour at Richmond island. I considered this the 'great danger' when approaching Portland harbour, and the 'key' to the lesser ones of the *Hue and Cry*, *Old Anthony*, and *Taylor* reefs. It is the cause of much anxiety and care to the navigator, and one that is avoided with the greatest difficulty in thick weather, and during the prevalence of the terrible easterly storms by which the coast of Maine is so frequently visited."

breakwater lighthouse. It lies with House island bearing S.E. by E. 1⅛ miles.

Middle Ground (*East End of*).—A *red* spar buoy in 17 feet, moored S.E. ½ E. from the Observatory and N. ½ E. ⅜ mile from the breakwater lighthouse. There is good anchorage for small vessels on the Middle ground.

Middle Ground.—A *red* spar buoy in 16 feet, at about 300 feet west from the shoalest part of the Middle ground, which has 8 feet on it at low tide. Its marks are, the Observatory N.W. by N. and the breakwater lighthouse S.E. by S. ½ S. half a mile.

The two last-mentioned buoys are moored where the Middle ground shoal commences.

Upper Harbour.—A *black* spar buoy is moored in 12 feet at about 20 feet N.W. from rocks having a depth upon them of only 4 feet at low tides. Its marks are, the end of Union wharf N.W. ½ N. distant 500 yards, and the Draw in the bridge S.W. half a mile.

Directions.—The following sailing directions for the port were published officially in 1868.

"CHANNEL BETWEEN WEST COD LEDGE AND CORWIN ROCK:—*From Eastward.*—Bring cape Elizabeth light to bear W. by N. ½ N., and run for them on that bearing until Portland head light bears N.W. by N. ⅜ N. This cross-bearing is about ¾ of a mile S.W. by S. from West Cod ledge (4½ fathoms), and ¾ of a mile E. by N. from Corwin rock (3½ fathoms). Run for Portland head light on the bearing of N.W. by N. ⅜ N. for 2½ miles, until cape Elizabeth lights are in range; then stand N. by E. nearly ½ a mile, until Portland head light bears N.W. ¾ N. when run for it until within ½ a mile. These courses leave Willard rock (5½ fathoms) a ½ of a mile to the southward, and westward, Pine tree ledge (3½ fathoms) a ½ of a mile, and Jordan ledge (3¾ fathoms) ½ of a mile to the northward and eastward. The course N.W. by N. ⅜ N. on Portland head light leads close to Willard rock, (5½ fathoms) and is safe with a smooth sea; with a swell on, the courses given above should be followed. When within ½ a mile of Portland head light, as above, steer N. by W. up the harbour until abreast the city.

From Southward.—Keep 5 miles from cape Elizabeth lights. This distance clears well all dangers, with the lights between the bearings of N.E. by E. and W. ½ N. Bring Portland head light to bear N.W. by N. ⅜ N. and run in as before.

CHANNEL BETWEEN WEST COD LEDGE AND BACHE ROCK:—With cape Elizabeth lights bearing W. by N. ½ N., bring Portland head light to bear N.W. ½ W.

Run in on this last bearing (leaving West Cod ledge, 4½ fathoms, 1 mile to the southward and westward, and Bache rock, 4½ fathoms, 1 mile to the northward and eastward), until the cape Elizabeth lights are in range; then steer N.W. by W. ½ W. about 1½ miles, until Portland head light bears N.W. ¾ N., when run in on this bearing (leaving Willard rock, 5½ fathoms, ½ of a mile to the southward and westward, Pine tree ledge, 3½ fathoms, a ½ of a mile, and

Jordan reef, 3¾ fathoms, ¼ of a mile to the northward and eastward), until within ½ a mile of the light, when follow directions given above.

To pass Northward of Bulwark and Round Shoals :—Run in with Portland head light on a bearing of W. by¾N. ¾ N., leaving Round shoal (4¾ fathoms) ½ a mile and Bulwark shoal (14 feet) ¾ of a mile to the southward, and passing between, and a ½ of a mile from Jordan reef (3¾ fathoms) to the southward and westward, and Witch rock (4 fathoms) to the northward and eastward.

Courses along the Coast from Eastward :—When 2 miles south of Small point, if the weather is clear, Portland head light should be seen bearing W. ½ N., distance 16½ miles. This bearing leads to the southward of Temple ledge (5 fathoms) nearly 1¼ miles; Lumbo ledge (4½ fathoms) nearly 1½ miles; Half-way rock ¾ of a mile; Junk of Pork and Outer Green island, ¾ of a mile; to the northward of Witch rock (4 fathoms) a ½ of a mile, and to the southward of Ram island ledge, ½ of a mile.

The range of Cape Elizabeth Lights (bearing S.W. by W.), leads clear of all dangers, between Mitchell and Willard rocks to the eastward of Junk of Pork, between Jewell island and Half-way rock, up to the entrance of Harpswell sound.

In thick weather strangers should not approach from southward and eastward, inside of 45 fathoms water, with soft or sticky bottom."

Anchorage.—Having entered the harbour so far as to be abreast of the end of the breakwater, steer W.S.W. ½ W. and it will take to the anchorage off the wharves. But, if instead of the anchorage off the wharves the roadstead of Hog island be preferred, steer N.E. so soon as fort Preble bears S.W. by W. ¾ W., and it will carry you into it, the depth here is 4 to 7 fathoms, and there is excellent shelter from all winds.

Whitehead Passage to Portland.—The channel just referred to, is that followed by large vessels, but there is another narrow channel north-eastward of it between Bang island (the island that bounds the channel on the north-east side) and Peak island, by which Portland harbour may be approached in a small vessel. This channel has a depth of 4 to 5 fathoms, and is seldom used except by coasters. In the approach to it from eastward, the following shoals will be encountered.

Webster (in Casco bay), a rock of only 8 feet water, distant 200 yards from Half-way rock.* It is marked by a *black* spar buoy, moored in 18 feet, at about

* *Half-way Rock.*—The Half-way rock is high and black, about 600 feet in diameter, and elevated about 16 feet above the level of the sea. At a short distance from the rock, on the North-west, North, North-east, East, and South-east sides, the depth is 5 and 6 fathoms, which deepens gradually to 25 fathoms, within ¾ of a mile. From it a reef extends W. by S. ½ of a mile; the depth is 10 fathoms within a cable of it. Vessels may approach this rock on all sides within a ¼ of a mile, and find from 15 to 25 fathoms; the Webster rock, must, of course, be carefully guarded against. *It is intended. we believe, to erect a lighthouse on Half-way rock.*

20 feet N. ½ E. from the rock, with the following marks,—centre of Half-way rock S. ½ W.; and Mark island monument N. by E. The channel inside it has a depth of 10 fathoms.

Green Island Reef, the reef extending south-westerly about a mile from Inner Green island. The spar buoy (*red*) on its south-west point, is moored in 20 feet, with Outer Green island bearing S.W. ⅞ mile, and Half-way rock E. by S. ½ S. 6 miles.

Hussey, a rock of 12 feet water, having a depth of 7 to 13 fathoms close to it on all sides. It is marked on its south-west side by a buoy (*red* and *black* horizontal stripes), which is moored in 10 fathoms at about 25 feet S.W. from it. From this buoy, the middle of Outer Green island bears S.E ½ E. 1 mile, and Portland head lighthouse S.W. by W. 2½ miles.

Whitehead Ledge, the ledge extending from the north-east point of Bang island; on the south side of the channel. This ledge is bare at low water, and the spindle marking it (iron, *black*, with basket top) must be left on the port hand when entering. From the spindle the north point of Bang island bears South 200 feet.

Trotts Rock, on the ledge extending southward from Peak island; north side of the channel. The rock is bare at low water; it must be left on the starboard hand when entering. It is marked by a spindle (iron, *red*, with basket top) from which Whitehead spindle bears South ⅛ mile.

BOSTON HARBOUR, although it affords a sufficient depth of water for the largest ships, is far from easy to enter by reason of the numerous islands and reefs scattered over its surface. The assistance of a pilot is therefore always necessary, and strangers ought not to attempt to run in without.*

The islets and sunken rocks in Boston bay are separated by channels of various depths, and are moreover so thickly scattered about that an attempt to describe them in detail would be useless. Suffice it then to say that there are three principal channels, Broad Sound, Main Ship, and Back or Western Way, and that these are entered through several minor channels, of which those named North, South, Hypocrite, and Black Rock, are the most important.

Lights.—The lighthouse on Little Brewster island is coloured white, and shows a light *revolving* every 30 seconds, visible from all parts of the horizon at the distance of 15 miles; attached to the lighthouse is a fog-bell. There is also a screw-pile lighthouse on the west end of the spit (abreast the Narrows) a reef which extends westward one mile from Great Brewster island; this building shows a *red fixed* light, visible 7 miles.

In addition, there is a lighthouse on the north-east end of Long island, one of the islands in Boston bay, westward of Brewster island. It is of iron, and shows a *fixed* light, visible 16 miles.

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* See the Admiralty chart 2871; a copy of the chart by the officers of the U.S. Coast Survey.

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Rocks and Shoals.—The principal dangers in and about Boston harbour are the rocks and ledges near the shore, under the surface, and surrounded by deep water. They are distinctly marked on the chart we have referred to, and ship-masters ignorant of the locality are cautioned not to approach them without a pilot. The following are particularly to be avoided. *Outside.*—Davis ledge near the Minots; Harding ledge; Martin ledge and Tewksbury rock, near Outer Brewster island; and Maffitt ledge, north of the Devil's back; which are dangerous to vessels beating into Boston bay and Broad sound. The rule is, firstly, to keep eastward of Cohasset light* bearing South: secondly, not to approach Outer Brewster island nearer than a mile on the east side; and, thirdly, to keep westward of Maffitt ledge, giving it a good berth when passing. *Inside.*—Nash, Kelly, and Tower rocks.

Directions.—*If from eastward,* endeavour to keep in about Lat. 42° 20′, the parallel of Boston harbour; or, should you be in the immediate vicinity of cape Cod,† bring the lighthouse on Race point to bear South, 8 miles, and steer N.W. ¼ W.,‡ as that course will carry you well clear of Cohasset rocks to a position in front of Brewster island lighthouse. When following the latter course it is necessary to keep northward of the direct bearing (N.W. ¼ W.) if the wind

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* The lighthouse on the Outer Minots or Cohasset rocks consists of a granite tower surmounted by a bronze lantern. The light, *fixed*, is shown over an arc of 217° (from N. 54° W. eastward to S. 17° E.) and visible from a distance of about 15 miles; attached to the tower is a fog-bell which is rung by machinery,—its geographical position is Lat. 42° 16′ 9″ N., Long. 70° 45′ 14″ W.

Cohasset light should not be closely approached on the eastern side, because a reef named Davis ledge lies nearly ½ a mile from the lighthouse on an E. by S. ¾ S. bearing. This reef has, we believe, a depth of 10 feet over it at low tide, has soundings of 13 to 9½ fathoms close to it, and is marked on its eastern side by a black nun buoy.

† *Cape Cod.*—Race point, the extremity of cape Cod, is low and flat, with marshes behind it. The lighthouse stands on a gentle rise of the land, close to the beach, and is a white building, which shows a *fixed* light *flashing* every 1½ minutes, visible 11 miles; the arc illuminated is 261° (from S. 28° E. westward to N. 53° E.). A fog-bell has been placed at a short distance from the lighthouse. Vessels caught by a gale from north-eastward may anchor under Race point, at from ½ to ¾ of a mile from the lighthouse, in 10 to 4 fathoms water, and find shelter. The ground is stated to be moderately good for holding. It is not prudent to remain long, nor must the shore be closely approached, because the bank of 10 to 15 feet, running off from the beach, extends ¼ of a mile out and is steep. It is preferable to enter the harbour of Province-town.

‡ *Stellwagen Bank* is an extensive bank of 13 to 18 fathoms fronting Massachusetts bay, and situated almost immediately in front of the harbour of Boston. It commences at about 6½ miles N.N.W. from the lighthouse on Race point, where is situated a small shoal spot of 9 fathoms, thence it extends in a curved form (the curve being to the eastward) 18 miles in a northerly direction to its north end (13 fathoms), which is distant 16 miles S. by E. ½ E. from Thatcher island, cape Ann. The soundings close to its edge are 30 to 20 fathoms, deepening rapidly eastward and westward, the 100 fathoms line being at little more than 10 miles from its eastern side; between its northern end and cape Ann the depth is 40 to 55 fathoms. It forms an extremely valuable guide to vessels making Boston in thick weather, as a single cast of the lead upon it, the soundings eastward of it being so deep, is sufficient to determine a vessel's position with some degree of certainty.

be from N.E., and westward of it if it be from S.W., and allowance should be made for the set of the tide; with a leading wind and flood tide the direct course may be made good, but not so with the ebb, as that sets towards Minot light.

If from north-eastward or the vicinity of Cape Ann, no particular instructions are necessary, for unless the weather be very thick, the various *fixed* lights of Thatcher island, Gloucester harbour, Marblehead neck, Baker island, and Egg rock will prevent too near an approach to the land; in any case the lead should be freely hove. In the almost improbable event of getting close up to Cohasset light without having seen those just mentioned, steer from the coast with it bearing South until the depth of 15 to 17 fathoms is attained, when you may steer W.N.W. for Boston light.

It may here be remarked that the bottom in the vicinity of cape Ann is rocky, but towards cape Cod fine sand.

To Clear Shoals outside the Channels.—To keep eastward of Davis ledge near Cohasset rocks, keep northward of the line of bearing of Cohasset light West.*

To go north of Harding ledge† steer N.W. from the light on Cohasset rocks, until point Allerton bears W. ¼ N. whence steer W.N.W. into Nantasket roads; but make allowance for wind and tide.

From Nahant Head, if bound for the Main Ship Channel, steer S.S.E., or such a course as will give the Graves rocks a berth of ½ a mile, passing them on their eastern side; and, from the Graves steer S.S.W. or S. by W. ¼ W. until up with the bearing that takes into the channel. When steering the latter courses great care is required to avoid Tewksbury rock (10 feet under water) and Martin and Boston ledges.‡

If convenient the Graves may be passed on their western side by giving their south-west point a berth of a cable.

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* This ledge is a very dangerous reef. *See* note at foot of page 657. Unfortunately the bottom immediately eastward from it is so irregular that the lead is not a good guide when in its vicinity.

† Some parts of this ledge are dry at low water. Its east side is now marked by a bell-boat moored in 45 feet water at about 100 yards northward of the north point of the ledge.—from it Boston light bears N.W.; the light on Long island head N.W. by W. ¼ W.; point Allerton W.N.W. ¼ W.; the barn on Strawberry hill W.S.W.; and Cohasset lighthouse S.E. ¼ E.

‡ The *Graves* form a very dangerous reef, which should not be approached in thick weather into a less depth than 14 fathoms. The bell-buoy off its north-east end is moored in 10 fathoms, at about 100 fathoms distance from its north-east ledge;—from it Cohasset lighthouse bears S.S.E. ½ E.; Boston light S.W. ¼ S.; Long Island light W.S.W. ¼ W.; Deer Island hospital West; Nahant hotel N. by W. ¾ W.; and Baker Island lighthouses N.E. by N.

Martin Ledge has 13 feet water over it at low tide. It is marked on its east side by a *red* nun buoy which is moored in 6 fathoms;—from it, the bell-buoy off the north-east end of Graves ledge bears N. ¼ E.; Harding bell-boat S. ¼ E.; point Allerton buoy S.W. ¼ S.; and Boston ledge buoy S.W. by S.

Boston ledge has only 11 feet water over it at low tide. Its *red* nun buoy (moored in 6 fathoms on its north-east side) lies with Martin ledge buoy bearing N.E. by N.; Harding bell-boat S. by E. ¼ E.; point Allerton buoy S.W.; and the south point of Shag rock W.S.W. ¾ W.

Tacking in Boston Bay.—A vessel working up to Boston harbour during the day, may safely stretch anywhere from Cohasset rocks to Nahant head, until up with the Graves on the one side and Harding ledge on the other. Inside of the line from the Graves to the Harding vessels may stand southward to within ½ a mile of the shore, and northward to within ¾ of a mile of the east end of the Outer Brewster, or the east end of Shag rocks.

When up with Shag rocks vessels must not go further northward than to bring Boston and Long island lights in one, when passing point Allerton must be careful not to go southward of the buoy.* A stranger may beat up to the anchorage inside the light on Brewster island during *day* by making short tacks and keeping at about 2 cables from that island, and there wait for a pilot.

When working up to the harbour during *night*, the rocks off Cohasset and also Harding ledge will be avoided by not going southward of the bearing of Brewster island light W.N.W. When within 2 miles of that light, vessels must not go farther northward than to bring it to bear S.W. ¼ W.,† and when near Shag rocks they must not pass northward of Long and Brewster islands lights in range.

Main Ship Channel.—After making Boston light (that on Brewster island) if the weather be bad, or the vessel one of heavy draught, it must be brought to bear W.N.W. to approach it, as this will lead southward of Thieves' ledge and northward of Harding ledge. A vessel of light draught may run for it when bearing anything between S.W. and W.N.W., until within ¾‡ of a mile of the light, when it must be brought to bear W.N.W. to enter the channel. When abreast of the lighthouse bearing North, and in mid-channel, or half-way between it and point Allerton buoy, a W. ¾ N. course made good leads to the beacon on False spit; but if the tide be ebb, or the vessel on the north side of the channel, steer West or West (southerly), to avoid going on False spit. The beacon on

* The shoal extending from point Allerton dries at low water. It has a beacon upon it, consisting of a square granite pyramid surmounted by a black cone. The shoal runs off from the land about 200 feet.

At a short distance northward from the shoal just mentioned there is a small patch of only 8 feet depth at low tide. It is marked on its north side by a *black* nun buoy moored in 8½ fathoms, from which Harding bell-boat bears S.E. by E. ¼ E.; Boston light N. by W. ½ W.; and Spit beacon and Long Island lighthouse in one N.W. by W. ¾ W. From this buoy the course into Nantasket roads, between Hunt ledge and Toddy rocks buoy, is West.

† Such are the instructions by the United States Coast Surveyors; but we should say that the bearing S.W. ¼ W. is safe only *beyond* the distance of 2 miles from the light, for the Shag rocks, Boston ledge, Martin ledge, and Tewkesbury rock are all within 2 miles of it. It appears to us from the chart that if vessels keep eastward of the line of bearing Cohasset light S.S.E., they will clear all these dangers, and also the Graves rocks; and that if intending to enter Nantasket roads they must keep southward of the line of Long island light and Brewster light in one, or southward of Brewster island light W. ¾ N.

‡ It is so stated on the chart of Boston harbour, published by the U.S. Coast Survey, but it does not appear to us that a vessel would be in safety if she stood so close in as ¾ of a mile with the light bearing S.W. to W.N.W. Martin ledge, Tewksbury rock, and Boston ledge are all within this arc at various distances; Martin ledge, the outermost, is distant 1 miles N.E. by E. ¾ E. from the light.

that spit must be left on the starboard hand. The course by George island is N.W. ½ W.* with the beacon on Nicks mate and the middle of the monument on Bunker hill in range, until up with the eastern end of Gallops island. From this point the course through the Narrows is N.W. by N., keeping in mid-channel and steering for the high land on Deer island until up with Nicks mate, which is left on the port hand. Nicks mate should be passed with Deer island beacon on with the north-east end of Apple island by a vessel of light draught, and with it on with the south end of the island by a vessel of heavy draught, to avoid the shoal ground about it.†

As soon as Nicks mate is passed, steer W. ½ N. into President roads, and continue thus until the west side of Long island is just clear of the north-east bank of Spectacle island, when the course must be changed to N.W., keeping this range on until abreast of the buoy on the south-east part of Bird island. This range leads safely by the lower middle, Castle Island rocks, Governor Island point, the Upper middle, and in the best water over the shoal ground above the Upper middle. When up with the buoy on Bird island the course is N.W. by W. ½ W., towards the State house, until abreast of the buoy on Slate ledge, and then N.W. by N. for the anchorage.

Hypocrite Channel.—This channel is between the Outer Brewster and Sunken rocks, Graves ledge, &c., thence it runs between Green island and Little Calf island, and afterwards to Ram head, where it enters Broad Sound channel, leaving the buoys on Half-tide rocks, Devil's back and Alderidge ledge on the starboard hand. It is unsafe to strangers.

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* This course, N.W. ½ W., leads over or close to a rock which has recently been discovered in the Narrows, in nearly mid-channel, and in about 4 fathoms water. Its position is so dangerous to navigation that it ought to be removed by blasting. The published report of it is as follows:—

"Tower rock or ledge, upon which many vessels are supposed to have struck, is much nearer False spit, and the sailing line passes between the two rocks, the distance between them being 85 yards. The following are the bearings from it: False spit beacon E. ¼ N. (N. 74° E.); Narrows lighthouse N.E. ½ N. (N. 33° E.); and Nicks Mate beacon N.W. ½ W. (N. 61° W.).

Ranges.—South-west corner of Nicks Mate beacon and Foundry chimney in Navy yard; False spit beacon and Boston lighthouse.

The rock is of irregular shape with a base of about 130 feet in circumference, and rises to a peak, with a depth on the crest of 17 feet at near low water, 15$\frac{6}{10}$ feet at spring tides low water."

† The beacon on Nicks Mate consists of an octagonal pyramid on a large square granite base. It bears from Nahant rock S.W. by S.; Barrel rock buoy S.W. ½ W.; Spit beacon N.W. by W.; and Deer island point beacon S.E. by S. ½ S. A *black* nun buoy has been moored off the north-east part of the shoal of Nicks mate, in about 2½ fathoms hard bottom;—its marks are Narrows light S.E. ½ E.; Nicks Mate beacon S.W. by W. ½ W.; Long Island light W. ½ S.; and the buoy marking the south-east end of Lower Middle W.N.W. ½ W. From this buoy the course into President roads is W. by N. There is good anchorage in that roadstead in from 6 to 8 fathoms, sticky bottom.

Deer island beacon consists of a square granite pyramid painted red. The shoal upon which it stands becomes dry at low tide; it is covered at ½ flood. From the beacon, Great Fawn buoy bears N.E. by E. ¾ E.; the south-west point of Lovells island S.E.; Long Island lighthouse S. by W. ¾ W.; and the centre of fort Independence, Castle island, W. ¾ N.

If bound for this channel bring the Graves to bear North, and the south point of Green island West, and thence steer for the passage between Green island and Little Calf island, through which you should run in mid-channel. After passing Green island steer S.W. by W., keeping the south part of the Graves open southward of Green island, until the light on Brewster island is shut in with the Great Brewster, when the Half-tide rocks will have been passed; then haul up West towards Long island light, leaving the buoy on Alderidge ledge on the starboard hand. When up with the buoy at Ram head leave it on the port hand at 50 fathoms distance.*

Black Rock Channel.—This channel leads from the Main Ship channel at the beacon on the Spit into the Hypocrite channel, and is never used by large vessels except to avoid ice in the Narrows. It is narrow, dangerous, and unsafe to strangers.

On leaving the Main Ship channel pass close to the beacon, and steer about N.E. for the outer point of Green island, keeping George island and the west end of Paddock island well open. Both the flood and the ebb tides set across this channel. There is a passage on each side of Whiting ledge.

Broad Sound Channels.—Vessels intending to enter by the *South Channel* may enter the Sound anywhere between Nahant head and the Graves. The course is southward of West until Nicks mate bears S.W. by W. ¼ W. when they may run for it. The range for this channel is Nicks mate on with the middle of the northern and highest of the Blue hills. The channel is short and straight; its range is perfect, and vessels of the largest draught may resort to it with safety and convenience at half or three-quarters flood, especially when going out. Vessels going out this way will leave Ram head, Alderidge ledge, and Devil's Back buoys on the starboard hand; and Little Fawn, Great Fawn, and Barrel rock buoys on the port hand; and when running out of Broad sound will keep Egg rock open of Nahant head.†

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* *Half-tide Rocks* as their name implies are very dangerous. They are marked on the south side by a red spar buoy, from which Boston light bears S. by E. ½ E.; Long Island light W.S.W. ¾ W.; Ram Head buoy W. ½ S. and Deer Island point buoy West.

Devil's Back or *Limb* is an extensive bed of rocks. It is marked by a black nun buoy moored in 3 fathoms on its N.N.E. side. The marks for this buoy are,—Barrel Rock buoy N.W.; Graves ledge bell buoy E.N.E.; Long Island lighthouse W.S.W.; and Deer Island point beacon W. by S.

Alderidge Ledge has only 2 feet over it at low tide. It is marked on its W.N.W. side by a black can buoy, moored in 5 fathoms, with Devil's Limb bearing N.E. by E.; Barrel Rock buoy N. ½ E.; Long Island lighthouse W.S.W. ½ W.; and Deer Island point beacon W. ½ S.

Ram Head is the shoal extending northward from the north end of Lovells island. The black buoy marking its extremity is moored in 4 fathoms; From it Nahant head bears N.N.E. ½ E.; Devil's Limb buoy E.N.E.; Long Island lighthouse W.S.W. ½ W.; and Deer Island point beacon W. ½ N.

† *Little Fawn* is the shoal extending eastward from Deer island. The red buoy marking its east side is moored in 15 feet;—from it Great Fawn buoy bears N.E. by E. ¾ E.; Barrel Rock buoy E. by N. ½ N.; Long Island lighthouse S.W. ½ S.; and Deer Island point beacon S.W. by W. ¾ W.

North Channel.—Vessels, even those of lightest draught, should not attempt North channel in bad weather; this channel passes nearer Deer island than South channel, from which it is separated by a middle ground. The buoys are left in the same manner as those of that channel, except that on Barrel rock, which, in going out, is left on the starboard hand. The range for this channel is the north head of Long island (on which the lighthouse stands) in line with the second bluff on the west side.

Back or Western Way.—This channel is used in light winds on the ebb, to escape being set out into the sound at Nicks mate or the east end of Lovells island. Leaving President roads steer S.S.E. to run between Spectacle and Thompson islands, keeping nearly in mid-channel and passing about halfway between Moon island and the west end of Long island. The bottom is soft in mid-channel. When well past Long island the course is S.E. until Long island light is open southward of the middle head; it then changes to N.E. by E., leading about halfway between Bass point and Rainsford island. When well clear of Rainsford island steer for the south part of George island, leaving the buoy on Rainsford island shoal and Wilson's rock on the starboard hand, which will lead into Nantasket road.

Nantasket Road.—If desirous to enter Nantasket Road from outside, when Boston light (Brewster island) bears North distant $\frac{3}{8}$ of a mile, steer W. $\frac{1}{2}$ S., which brings up with the buoys on the Centurion; leave these on the starboard hand in passing, and steer W.S.W. until Long Island light opens clear of the south-west part of George island, then haul up for the light, and run in for the anchorage.

NEW YORK BAY and HARBOUR.—Generally speaking, New York bay is formed by the shores of New Jersey, including Sandy Hook and Staten island, on the south and west, and by the west end of Long island on the east side. Its entrance, which is open to eastward, is 6 miles wide, between Long island and Sandy Hook, but a free ingress and egress is prevented by an extensive accumulation of sand, forming banks whereon are only a few feet of water, and,

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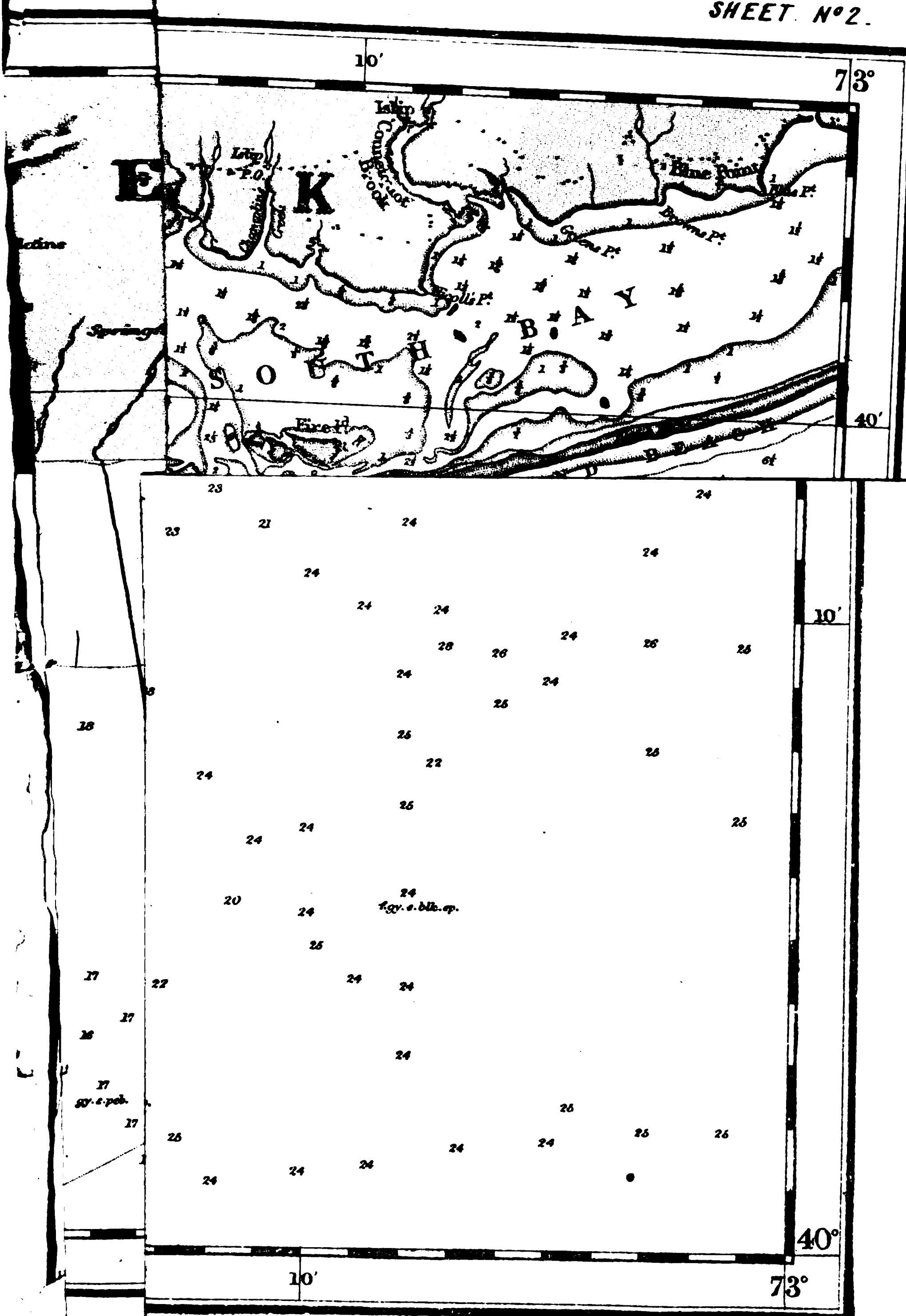
Great Fawn is the rocky ground northward of Little Fawn, and also extending eastward from Deer island. It becomes dry over a considerable part of its surface at low tide, and upon this dry part there is a red beacon consisting of a square granite base and granite cone with an iron spindle and cage at the top. From this beacon Nahant head bears N.E. by N.; Barrel Rock buoy E. $\frac{1}{2}$ S.; and Long Island lighthouse S.W. by S.

The east end of the shoal extending from the beacon just mentioned is marked at its extremity by a red can buoy moored in 3 fathoms. From it, Barrel Rock buoy bears E. $\frac{1}{4}$ N.; Deer Island point beacon S.S.W.; Graves bell buoy E. $\frac{3}{4}$ N.; Long Island light S.W. $\frac{1}{4}$ W.; and Nahant head N.N.E. $\frac{1}{2}$ E.

Barrel Rock; a small patch of 4 feet water at low tide. The buoy (striped red and black, horizontally) is moored in 21 feet;—from it Nahant head bears N. by E. $\frac{3}{4}$ E.; Long Island lighthouse S.W. by W. $\frac{1}{4}$ W.; and Deer Island point beacon W.S.W. $\frac{1}{4}$ W.. At half-flood the buoy is over the rock; when passing it is necessary to give it a wide berth, because with an ebb tide and strong wind it swings from the rock.

SHEET No 2.



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in some places, patches which dry at low tide. The navigation is, therefore, confined to the several channels in and among these banks, the principal of which are Gedneys, where the least depth is 23 feet; North channel, least water 21 feet; South channel, with not less than 22 feet; False Hook channel, which has 18 feet and upwards in it; Main Ship channel, with 21 feet least water; Swash channel, through which 17 feet can be carried; East channel, wherein are 18 or 19 feet; and Fourteen Feet channel. These, however, are so liable to change both in direction and depth, that the aid of a pilot should always be obtained by strangers. Within and to northward, through the Narrows and as far as to the city, there is plenty of water for the largest vessels. That portion of New York outer or lower bay which is immediately within Sandy Hook bears the name of Sandy Hook bay; here the depths gradually decrease from 4 to 2½ fathoms, and the bottom consists principally of mud. The western part of the same, named Raritan bay, is much shoaler, though a winding channel of 12 or 13 feet least water leads through it to the mouth of Raritan river, Perth, Amboy, and the southern entrance of Staten island sound, the narrow passage inside that island to Newark bay and New York. New York bay, proper, communicates by a narrow channel between Staten island and Bergen Neck, named Kill Van Kull, with Elizabeth port, at the northern end of Staten Island sound, and, through the shallow bay of Newark, with Passaic river and the important town of Newark on its right bank; to which, however, only small vessels can go, as in the bay and river not more than 5 or 6 feet can be carried throughout. The bay is likewise in communication with the city of Albany, &c., by means of Hudson river, which has a sufficient depth to allow large vessels to ascend to that place; and, with Long Island sound, through what is termed the East river, by which any vessel may proceed to sea.

The city of New York is the largest, wealthiest, and most flourishing town in North America. It occupies the southern portion of Manhattan, a narrow island, 14 miles long, formed by the Hudson and East rivers, and extends 8 miles along the bank of the former, and 4 miles along the bank of the latter river, at their junction with New York inner bay; these together form an excellent land-locked harbour, of easy access, sheltered from storms, deep enough for the largest ships, and sufficiently large to contain all the navies in the world. No city possesses greater advantages for foreign commerce and inland trade; long lines of canals, with an elaborate system of railways, have increased its natural advantages, and, connecting it with the remotest West, have rendered it the great mart of a vast region, now occupied by a large population, while its facilities of communication with all parts of the world have made it the great thoroughfare of the continent.

On the opposite shore of the Hudson stands Jersey city; and on Long island is the city of Brooklyn; north-east of Brooklyn is Williamsburgh, another suburb of the great emporium; and in Wallabout bay, lying between these, is the United States' Navy yard.

Lights.—*Sandy Hook lightvessel* is moored in 15 fathoms water, at 6¾ miles

E. by S. from Sandy Hook lighthouse. It is painted red, has the name of the station in white letters on each side, and exhibits two *fixed* lights, visible 10 miles. A fog-bell is rung and a fog-horn sounded in thick weather every alternate five minutes. Hence to the entrance buoy of Gedney channel the bearing and distance are N.W. ½ W. 4 miles; to South channel W.N.W. also 4 miles; and to East beacon W. by N. ½ N.

Highlands of Navesink lights are situated on the mainland of Jersey, southward of Sandy Hook. They are two in number, the lighthouses are coloured white, and the lights, both of which are *fixed*, may be seen at a distance of 22 miles. The arc of illumination is 209° (N. 45° W. eastward to S. 16° E.); the lights are 100 yards apart, and the geographical position of the northern lighthouse is Lat. 40° 23′ 45″ N., Long. 73° 58′ 51″ W.

Sandy Hook Lighthouse, &c.—Sandy Hook lighthouse, coloured white, is ¾ of a mile within the northern extremity of Sandy Hook, and 4 miles N. ½ W. from Navesink lights; it is 77 feet high and shows a *fixed* light at 90 feet above the sea, visible 15 miles from all parts of the sea horizon. A bell is struck by machinery seven times every minute in foggy weather. From the telegraph in its vicinity signals are made, announcing the arrival or departure of vessels to New York. The geographical position of the lighthouse is Lat. 40° 27′ 39″ N., Long. 73° 59′ 49″ W.

There are also two small lights on Sandy Hook, named East and West beacons, the former of which is at the north extremity of the Hook, and the latter about ½ mile north-westward from the lighthouse and close to the inner shore; they are coloured white, and show *fixed* lights, visible from the distance of 10 miles. The East beacon is provided with a fog-horn (worked by a steam-engine). The West beacon, when obscured by the screen, marks the outer edge of the bar, and when just clear northward of the lighthouse it shows the turning-point round the South-west spit into the Main Ship channel.

Main Ship Channel Range lights.—Two *fixed* lights are located on the New Jersey shore, westward of the highlands of Navesink. The front one is shown from a tower near the beach, painted with horizontal bands (two white and one red); the rear light is shown at the height of 224 feet above the sea,—it is on the north side of Chapel hill, at nearly 1¼ miles S. by W. from the northern light. When in one these lights lead through the Main Ship channel from the South-west spit to the Narrows, being visible throughout the whole distance.

Gedney Channel Range lights are both *fixed*, and situated near point Comfort, on the New Jersey shore, about 5 miles within Sandy Hook. The eastern or front light is shown from the top of the keeper's dwelling, which stands near the beach, and is painted white. The inner or western light is exhibited from a white tower with a black top nearly ¾ of a mile W. by S. from the former. During the day the rear light tower can be recognised by the lantern being projected on the sky above the trees. They are visible in clear weather outside the bar, and when in line lead in from the inner part of Gedney channel to where the Main Ship channel lights are brought in range.

Princess Bay.—The white lighthouse on the west side of Princess bay (south side of Staten island) exhibits a *fixed* light varied by *flashes* every two minutes, visible 16 miles. It is 33 feet high, and shows the light at 106 feet above the sea over an arc of 157° (N. 77° E. southward to S. 54° W.); its geographical position is Lat. 40° 30′ 25″ N., Long. 74° 12′ 30″ W. From Sandy Hook lighthouse it bears W.N.W. distant 10 miles. This light serves as a guide to vessels bound to Perth Amboy (Raritan river) or Staten Island sound;—when seen on a W. by N. bearing it also guides through Gedney channel till the two lights at point Comfort come in one, or till the Swash channel range lights are in line.

Swash Channel Range lights are erected on Staten island, 7 miles north-westward from Sandy Hook. They are both *fixed* lights and visible outside the bar. The tower of the front light has two white and one red horizontal bands painted on it. The rear light is shown from a lantern on the top of the keeper's dwelling, situated on a hill near New Dorp, 1¾ miles N.W. ¼ N. from the outer light, and is coloured white. These are sometimes named the Elm Tree lights; when in a line they lead over the bar of the South channel in not less than 18 feet at low water, and through the Swash channel till the Main Ship channel lights are in one; or, if entering by Gedney channel with Princess Bay light W. by N., that course should be discontinued as soon as they come in one, and their direction then followed.

Fort Tompkins light (Staten island) is exhibited from a white building a little southward of the Fort, and on the west side of the Narrows. It is a *fixed* light at 89 feet above the sea, and may be seen at the distance of 15 miles. The arc illuminated is 281° (N. 8° W. eastward to S. 48° W.).

Robin Reef light (in the S.W. part of New York Inner bay, just above Tompkinsville, and on the west side of the channel to the city) is shown from a white tower, and may be seen at the distance of 18 miles. The passage into Kill Van Kull channel is southward of this lighthouse. When proceeding towards the Narrows with the Main Ship channel range lights in line, that course should be discontinued as soon as this light bears N. by W., and the latter direction followed.* In foggy weather a bell is rung.

Bergen Point, at the inner part of Kill Van Kull channel, forming the south-east point of entrance to the shallow bay of Newark, has a reef of rocks extending ¼ mile south-westward from it, on which a white building is erected serving as the keeper's dwelling. On the top of this dwelling there is a *fixed* light, visible 10 miles; the arc illuminated is 307° (N. 88° E. westward to S. 89° E.). Here also a fog-bell is rung in thick weather.

Elizabeth Port.—A small *fixed red* light is shown at Corner Stake opposite Elizabeth port, at the northern end of Staten island sound.

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* A small shoal with 18 feet over it, bottom of sand and shells, lies one mile S.S.E. ¾ E. from Fort Tompkins light, and with Robin's reef light N. ¾ W., so that the above bearing (N. by W.) should not be made too free with while southward of Fort Tompkins. The shoal is, we believe, marked by a buoy, which should be passed on its east side.

Passaic lighthouse is intended as a guide to clear the mud flats on the western side of the channel through Newark bay. It is 3½ miles above Bergen point, and rather more than a mile below the mouth of Passaic river, and should be passed on its eastern side. The light, *fixed*, is shown from the top of a white building which serves as the keeper's dwelling; it may be seen at a distance of 10 miles. During foggy weather a bell is tolled.

The *Elbow Beacon* light serves the same purpose as the light just mentioned. It is a small *fixed* light, ¼ mile northward of Passaic light, and should also be passed on its eastern side.

Buoys.—Throughout the harbour the shoals and channels are marked by buoys, which are shifted as occasion requires; it is therefore useless to describe them with more particularity. On entering the channels from seaward the *red* buoys must be left on the starboard, and *black* buoys on the port hand. Buoys with *red* and *black* horizontal stripes mark obstructions, and may be passed on either side. Buoys with *white* and *black* perpendicular stripes will be found in mid-channel, and must be passed on either side close-to.

Tides.—By observing the times of high and low water, it will be seen that they are very nearly the same all the way from Delaware river to Block island and south of Nantucket; of course, not in the bays and harbours and up the rivers, but on the outer coast. Consequently, vessels bound to New York and making the land in the vicinity of either of these places, and sailing thence in the customary routes towards Sandy Hook, will have the same succession of tides, within some 15 minutes, as if they remained off these points. So that leaving, for example, at high water, they would have, according to the elapsed time, the ebb and flood alternating every 6¼ hours, as if they had anchored off these positions. As the flood tide sets in generally to the northward and on shore, and the ebb the contrary, they will know by the time that elapses from their departure, and the period of tide at which they started, what tidal currents they may expect to meet with as they approach New York.

In New York bay it is high water at Sandy Hook (corrected establishment) at 7h. 29m.; springs rise 6¼ feet, neaps 3¾ feet;—at Governor island at 8h. 19m.; springs rise 5¾ feet, neaps 3¾ feet. The mean duration of flood and ebb tides, reckoning from the middle of one slack water to the middle of the next, from observations made in 1844,—is at Sandy Hook, flood 5h. 59m., ebb 6h. 1m., slack-water at flood 0h. 22m., slack-water at ebb 0h. 20m.; at Governor island, flood 5h. 57m., ebb 6h. 17m., slack-water at flood 0h. 29m., slack-water at ebb 0h. 28m.

The stream at half ebb, in the Swash channel, sets strongly eastward; care should therefore be taken to avoid being drifted on to the Dry Romer. In East channel the flood sets towards the Romer, and the ebb towards East bank, for which due allowance should be made.

Anchorage may be had in Sandy Hook bay. When as far in as the point of the Hook where the East beacon stands, haul into the bay S.W., giving the

Hook a berth of ½ mile, until the lighthouse bears East or E. by N., when the anchor may be cast in from 4 to 6 fathoms, muddy bottom.

Pilots.—New York pilots generally board vessels from southward between Delaware river and Barnegat inlet, at from 10 to 80 miles off shore; and those from eastward between Nantucket shoals and Fire Island lighthouse, at from 10 to 15 miles from shore. Boats having pilots on board are always found near Sandy Hook. When approaching New York bay in thick weather, or during night, without a pilot, it is recommended to bring-to in 12 or 15 fathoms, unless the weather is threatening from eastward, when it is most prudent to avoid a lee shore.

Directions.—*Soundings, &c.*—The Gulf stream by its high temperature, gives the first warning of an approach to the coast. In Lat. 38½° N. it is nearly 360 miles from the land, measuring on a parallel of latitude, and immediately after passing through it the temperature will be observed to begin to fall. There is also a fall of temperature on striking soundings, which will indicate the time when the deep-sea lead ought to be used. With the decrease of soundings the colour of the water will change,—as from a dark blue in a depth of 150 fathoms the colour alters to a light blue in 50 fathoms, which again becomes of a greenish tint as the coast is approached.

The depth of 90 and 100 fathoms is at about 80 miles from the coasts of Long island and New Jersey, and outside this the soundings are rapidly lost. A depth of 40 fathoms is met with at about 45 miles from the eastern portion of Long island, and 60 miles from New Jersey, the soundings more gradually decreasing towards the latter coast than the former. When eastward of the Delaware the bottom between 100 fathoms and 40 fathoms is most frequently of sand and broken shells, while inside the latter depth there is gray or yellow sand with black specks. Northward of this parallel the bottom is as often of mud as of sand, mud being more frequently met with when going to the N.E. until off Block island, where the bottom from 100 to 20 fathoms being mostly of green sand and ooze, has obtained the name of the "Block Island soundings." It should also be remarked that green mud or ooze is not found within the distance of 15 miles of Block island, and seldom westward of the meridian of Montauk point, in less than 80 fathoms water.

In general the soundings decrease regularly and more or less gradually from 100 or 80 fathoms to the shore, but there are some remarkable exceptions, among which may be mentioned the Five Fathom and other banks at the entrance to the Delaware. The principal exceptions are, however, the *mud-holes*, which extend in a S.E. direction from Sandy Hook, and form a very remarkable gorge. These holes are not very large, but as they are frequently met with, a description of them appears to be necessary. When passing over them, the least distance from New York at which a depth of 100 fathoms is found is 100 miles.

Mud-Holes.—The first holes met with after leaving New York are the Twenty-three, Twenty-one, and Thirty-two Fathom holes, which lie at the distance of 11, 12½, and 17½ miles from Sandy Hook lighthouse, in a south-easterly direction. They are not very extensive, but you may know when you are over them by the lead dropping suddenly into them from a depth of 16, 13, or 17 fathoms. Between these holes and the New Jersey coast the soundings decrease from 15 to 13 and 7 fathoms, the latter depth being close to the shore.

The next hole, that with which seamen are more particularly acquainted, is called the First Thirty-seven Fathom hole. It is about 8 miles long and 1½ miles wide. The depth immediately outside it is 22 fathoms, and close to its south-western extremity 20 and 19. Its centre is distant from Sandy Hook lighthouse 28 miles in a S.E. ¾ S. direction.

The Second Thirty-seven Fathom hole lies 7 miles south-eastward from the First, with Sandy Hook bearing N.W. ½ N., distant 39 miles. It is about 5 miles in extent, and has a depth of 27 fathoms outside it in a N.E. direction, but only 21 fathoms in a southerly direction.

The Thirty-eight Fathom hole lies 11 miles to the S.E. by E. ½ E. from the Hole last mentioned, in Lat. 39° 55′ N., Long. 73° 10′ W. Its length is 8½ miles from North to South, and its width 2½ miles. From it Sandy Hook bears N.W., distant 50 miles. Close to it is a depth of 25 to 29 fathoms, and near its northern end 25 and 24 fathoms.

At 11 miles south (true) from the Thirty-eight Fathom hole is another of Thirty-five Fathoms, which is about 4 miles in extent, and lies with Sandy Hook bearing N.W. by N. 63 miles. The depth close to it outside is 27 fathoms, which deepens rapidly to 30 and 34 fathoms.

The Fifty Fathom hole lies in Lat. 40° N., Long. 72° 30′ W., at about 50 miles from the shore of Long island. It is 4 miles in extent, and has a depth of 35 to 38 fathoms close to it all round. From it Sandy Hook bears N.W. by W. ½ W., distant 74 miles.

The ninth and last of the mud holes is the most extraordinary of the whole series, as the lead at once falls from 55 or 60 fathoms into a depth of 145 fathoms. It is situated about 12 miles within the edge of soundings of 100 fathoms, and lies in Lat. 39° 38′ N., Long. 72° 23′ W. Its extent is not more than 2½ miles, and from it Sandy Hook bears N.W. ½ W. distant 89 miles.

It has been observed that in approaching Sandy Hook, the soundings to the southward are full of black specks, between the depths of 10 and 20 fathoms; in the true channel they are of mud; while to the northward, near Long island, they are of black and white sand.

Foggy Weather, &c.—The instructions deduced from the foregoing observations will doubtless be of considerable service to masters of vessels during night or in thick and hazy weather. Therefore, when approaching from eastward and striking soundings in more than 35 fathoms, green mud, steer to the northward of West, shoaling the water very gradually on that course. If beating against a westerly wind, do not stand into a less depth than 18 fathoms on the northerly tack, till nearly up with Fire Island lighthouse, for the soundings inside of 25 fathoms decrease very rapidly towards the Long island shore, but very slowly towards that of New Jersey, a distinction that should be carefully borne in mind.

When approaching from southward soundings of 15 fathoms and upwards should be maintained, for northward of Barnegat inlet a depth of 10 or 12 fathoms is found within 1½ miles of the beach. When the water has decreased to 15 fathoms, the lead should be kept constantly going, and the bottom examined; gravelly bottom indicates too near an approach to the land.

Remarks on approaching the land.—The appearance of Long island is generally low and level, excepting a few hills, which lie 40 miles westward of Montauk point. Along the south side of the island a flat extends from the shore, and at the mouths of some of the inlets, especially those westward of Fire island, runs off about a mile. The course from Montauk point to Sandy Hook is S.W. by W. ¾ W., 60 miles, and then W. ½ N., 45 miles. At 12 miles southward of Montauk point the depth is 20 and 23 fathoms, coarse gray sand and gravel with black specks, which depth is maintained at the same distance from the land to about 20 miles eastward of Fire Island lighthouse, when soundings of 20 to 18 fathoms will be met with, thence decreasing to 16, 15, 14, and 13 fathoms, and again deepening to 16 fathoms as the harbour of New York is approached. Within this distance from the shore (12 miles) it is not safe for a large ship to approach without a commanding breeze, because the coast of Long island is steep, the depth at much less than a mile from the beach being 7 fathoms,—and the line of 20 fathoms also approaches Montauk point to within 7 miles, the soundings between decreasing very rapidly. In the vicinity of Fire Island inlet, the depth is shoaler, there being 12 to 15 fathoms at 8 miles from the shore. Outside the depth of 20 and thence to 40 fathoms, the character of the bottom changes so rapidly that constant reference must be made to the chart, as no general description would be at all applicable. The difference in latitude between Montauk point and Sandy Hook is only about 37 miles, but there should be no difficulty in determining which of the two you are approaching, as the character of the lights and that of the soundings affords an infallible distinction.

When passing the Nantucket shoals between latitudes 39° and 39° 29′, observe if possible when you have crossed the Gulf stream, because at the distance of 10 leagues, within it, you may expect soundings, and possibly experience a S.W. current.

If the course now be for the New Jersey coast, northward of Great and Little Egg harbours, the lead may suddenly drop into one of the Mud holes previously mentioned as existing in a south-easterly direction from Sandy Hook. In that event it will be necessary to take particular notice of your position, because many ship-masters have been deceived, especially by the holes near Sandy Hook, and fancying themselves at a greater distance from the coast of New Jersey than they really were, have run on and put themselves to considerable inconvenience, and even danger. It should be remembered that the coast of New Jersey is steep, there being a depth of 6 to 10 fathoms immediately off it.

In beating to windward of Sandy Hook, in from 12 to 15 fathoms, when waiting for a pilot or a wind, either by day or night, you will be sufficiently near to Long island, when the lighthouse bears nearly West.

Should you fall in so far to the southward as to approach Cape Hatteras, be very cautious of its shoals, and bear away to the N.N.E., to obtain soundings on the Jersey shore. When in 28 or 26 fathoms (in latitude 40°), haul in to make the land.

It has been remarked that ships from sea, approaching any part of the American coast between Long island and cape Hatteras, if in doubt about their reckoning, should take notice of what is commonly named the Gulf weed, which is more plentiful, and in larger clusters eastward of the Gulf stream than in it, where the sprigs are but small and few. Within the stream there is no weed, unless in rare instances, and there, as before observed, the colour of the water changes to a still darker and muddy colour.

If you fall in to the northward of the Chesapeake, approach the Chincoteague shoals not nearer than the depth of 15 fathoms: from this steer N.E. by N. until nearly up with Great Egg harbour, keeping the lead going. Vessels may advance towards this place, and northward of it, to the depth of 15 fathoms. From Great Egg harbour to latitude 39° 45′, the shore trends about N.E. ½ N., and thence to the high lands of Navesink nearly N. by E. ½ E.

If you fall in so as to make the Capes of the Delaware, keep above 6 leagues from the land, or, in not less than 15 fathoms, in order to avoid the Five-Fathom bank, which lies 15 miles E. by S. from Cape May lighthouse, and is marked by a lightvessel moored in 12 fathoms S.E. ½ S. from its shoalest (13 feet) spot; this vessel exhibits two *fixed* lights, and is provided with a bell and fog-horn. After passing the bank, which is steep, you may haul up N.E. for 45 miles, which will lead into 15 fathoms, off Little Egg harbour, and by altering the course to N.N.E. for 18 miles, will reach Barnegat. Here the soundings will be coarse grey sand, with a few shells and gravel; and having these soundings, you may steer along in the direction of the land N. by E., on which course you will have from 16 to 18 fathoms. In the day-time you will notice the Woodlands, between Barnegat and Sandy Hook, which is a remarkable part of the coast, resembling, it is said, no other land between cape May and the high lands of Navesink. It is in this part of the coast of New Jersey, between Barnegat and Shrewsbury inlets, that so many fatal shipwrecks occur from approaching too near the land; they principally take place on Squan and Long Branch beaches.*

* The lights on the coast between the Delaware and New York harbour are as follows:—

Cape May.—A gray tower 145 feet high, which shows a light *revolving* every 30 seconds at 152 feet above the sea, visible 19 miles from all parts of the sea horizon. Its geographical position is Lat. 38° 55′ 50″ N., Long. 74° 57′ 16″ W.

Absecom Inlet.—A *fixed* light shown from a brick tower 150 feet high, at 167 feet above the sea. It is on the south side of the inlet, in Lat. 39° 21′ 55″ N., Long. 74° 24′ 32″ W., It is said that Barnegat may be readily known during day, even when the breakers are not seen, as there is a long grove of wood, back in the country, apparently 3 or 4 miles long, directly within the inlet named the Little Swamp. With the north end of this land directly abreast, you will be to the northward of Barnegat.

There is another grove, directly in the rear of Egg harbour, which is known by the name of the Great Swamp; this is much higher than the former, the Little Swamp, and is 8 or 10 miles in length. These swamps cannot be seen at one time, as the distance between Egg harbour and Barnegat is 6 leagues.

Barnegat lies S. by W. ½ W., 43 miles from Sandy Hook. When hauling in for the Woodlands already mentioned, with the wind off shore, you may, in a small ship and exercising great care, keep within a short distance of the coast, until up with the Highlands; and, should the vessel not draw more than 10 feet, may continue the course until up with the northernmost part of the cedars on Sandy Hook; after which steer according to the subsequent instructions. When approaching Sandy Hook there are some shoal spots of 10 and 20 feet, about 2½ miles before reaching the entrance of Shrewsbury inlet; and also along the shore of Sandy Hook there are some banks of 10 to 17 feet, named Middle Ground, Oil Spot, &c., all which must be cautiously avoided.

On the southern side of the entrance to New York harbour are the highlands of Navesink, the highest part of which, mount Mitchell, is estimated to be 282 feet above the sea. This high land of Navesink is a very important mark when approaching the coast, as it can be seen from the First Thirty-seven hole, when you are 8 leagues off, and in a depth of 30 or 36 fathoms water. It appears at first like an island, being pretty level on the summit, excepting some irregular risings towards point Comfort, on the west end or inland side. As you approach nearer to the harbour, you will see some other high land, situated more at the back of the bay, the first of which may be Hempstead hill in Long island, the summit of which is about 320 feet above the sea level. On Staten island is Tompkins' hill, at the back of the small village of Tompkinsville, which is estimated to be 307 feet high. Both these hills will be seen after you have made Navesink.

To enter the harbour.—Having made the lightvessel, which should be the

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and visible from the distance of 20 miles. The arc illuminated is 189° (from N. 38° E. eastward to S. 47° W.).

Tuckers Beach.—A white lighthouse, 44 feet high, near the entrance to Little Egg harbour, in Lat. 39° 30′ 18″ N., Long. 74° 16′ 48″ W. The light (*fixed, varied by a flash every minute*) is shown at 50 feet above the sea, and visible from the distance of 12 miles. The arc illuminated is 315° (N. 18½° W. eastward and southward to N. 63½° W.).

Barnegat.—A tower, 159 feet high, of which the lower part is white and the upper red, stands on the south side of Barnegat inlet, in Lat. 39° 45′ 49″ N., Long. 74° 6′ 4″ W. The light *revolves* every 10 seconds, is 165 feet above the sea, and can be seen from the distance of 20 miles from all parts of the sea horizon.

Navesink and Sandy Hook Lights have already been described, *see* page 664.

object sought for, especially by a stranger, and still without and waiting for a pilot, be careful when tacking towards either the Jersey or Long island shores not to decrease the soundings below 10 fathoms. Should no pilot be obtainable and it becomes advisable to run in, the following directions will be of service. The only channels recommended to those ignorant of the navigation are Gedney and the Main Ship (in each of which the depth is 23 feet at mean low water), or, the South and Swash (21 and 17 feet deep respectively).

Entering by *Gedney* and the *Main Ship channels*, steer N.W. ½ W. from the lightvessel for the *black* and *white* perpendicular *striped* nun buoy at the entrance of the former, then W.N.W. ¾ W. 1½ miles, or till the two range lights near point Comfort* come in line, bearing about W. by S. The latter mark leads in past Sandy Hook and must be followed till the two Main channel lights, just westward of the highlands of Navesink, are brought in range, nearly S. by W., which will also be shown by the main light on Sandy Hook being open south of West beacon. Steer now, with these latter lights in line over the stern, about N. by E., and it will lead up towards the Narrows, clear of West bank and Craven shoal. As soon as Robin reef light bears N. by W., shape a course for it, passing in mid-channel through the Narrows (*see* Note at foot of page 665), and when about ¾ of a mile from the lighthouse haul up N.E. by N. for the city.

Entering by the *South* and *Swash channels*, steer from the lightvessel W. by N., until the Elm tree or Swash channel range lights on Staten island (which can be seen outside the bar) come in a line bearing about N.W. ½ N., then steer towards them till the Main Ship channel range lights come in one, nearly S. by W., when haul up on that range towards the Narrows, and proceed as before. Vessels drawing more than 17 feet should not be taken through the Swash channel on the above range at low water.

Having proceeded on the line of the Elm Tree lights from the South channel bar to where the point Comfort lights are in one, the direction of the latter may be followed, and the Main channel lights brought in line as before, if drawing too much water to pass through the Swash channel.

The False Hook Channel, safe though narrow, runs along the eastern side of Sandy Hook, between it and the Outer Middle, the Oil Spot, and False Hook shoals. A depth of from 6 to 4¾ fathoms prevails through this channel at the distance of ¼ of a mile or so from the shore; but as no good ranges can be given, this passage should only be attempted by those acquainted. The shoalest part of the shoals, namely 12 feet (on the Oil Spot) lies ¾ of a mile off shore, and S.E. by E. ¼ E. from the lighthouse on the Hook.

The *East Channel* has its entrance about one mile northward of Gedney channel and runs in nearly parallel to that and Swash channel, being separated

* A stranger, when up with the buoy at the entrance of Gedney channel, may cross the bar in 16 to 21 feet water by bringing the East beacon on Sandy Hook in line with the inner (or Wilson's) light at point Comfort, nearly W. ¾ S. When the water deepens again to 4 fathoms, steer northward to bring Gedney *range* lights on, to pass the Hook.

from them by the Dry Romer, &c.; it is safe for vessels of light draught, but is very little used, as the ranges are distant and uncertain, and the East bank shoals up very suddenly.

The Fourteen Feet Channel, about 2½ miles from the shore of Coney island, is narrow, winding, and without leading marks or buoys. It is the northernmost of the channels into New York bay, and but very seldom used.

DELAWARE BAY TO CHESAPEAKE BAY.—The lighthouse on cape May has been referred to on page 670. The soundings opposite the entrance to the Delaware are very unequal, there being in the channel near cape Henlopen from 14 to 16 fathoms, while at 5 leagues east from the cape there are only 8 to 9 fathoms. The greatest danger to a vessel hereabout is the shoal, named the

Five-fathom, or *Cape Mary Bank*, the shoalest part of which lies about 15½ miles, E. by S., from the lighthouse on cape May, and 22½ miles E. by N. ½ N., from the lighthouse on cape Henlopen, its geographical position being Lat. 38° 53′ 30″ N., Long. 74° 38′ 30″ W. This shoalest part is about a mile in extent, and has but 13 to 18 feet water upon it; thence the bank runs to the N. by W., about 2½ miles, and has soundings over it of 4 and 4¾ fathoms, 5 fathoms being on its outer edge. Close to this shoal the soundings are steep, and particularly off its southern edge, near the 13-foot spot, where at a less distance than ⅛ of a mile the depth is 7½ to 8 fathoms. Between the Five-fathom bank and the shore the soundings are from 7½ to 5 fathoms, decreasing as the land is approached, on a bottom of fine white, grey, and black sand, with specks;—it is not advisable for strangers to run within the bank.

Off the south end of the Five-fathom bank is the lightvessel to which reference is made on page 670. The lights are visible from an offing of about 10 miles.

When steering for the Delaware, it is recommended not to get into a less depth than 12 fathoms after the land northward of cape Henlopen is sighted, nor into a higher latitude than 38° 45′, on account of the Five-fathom bank. The lightvessel off the southern end of the bank affords excellent protection against running into danger particularly as it bears a bell, which is sounded in foggy weather.

M'Crie's Shoal.—This is a dangerous shoal lying between the Five-fathom bank and the entrance of the Delaware, upon which the depth is 17 to 18 feet. It is about a mile in extent, and lies with cape May lighthouse bearing N.W. ½ N., distant 7 miles. It is at present (1869) marked by a red buoy moored in 30 feet, from which cape Henlopen lighthouse bears W. by S. ½ S. Close all round this shoal are soundings of 3½ to 6 fathoms, on a bottom of fine grey sand and yellowish black specks.

About 1½ miles W. by N. from M'Crie's shoal there is a small patch of 18 feet water; the soundings between are 3½ to 4 fathoms. There is also a bank of 4½ fathoms outside the entrance of the river, from which the lighthouse on cape Henlopen bears N.W. by W. ½ W. distant 14 miles; the depth close to it is 8 to 12 fathoms.

Southward of cape May the entrance of the Delaware is obstructed for a distance of about 6 miles, by numerous shoals, named the Overfalls, upon which the depth is generally 12 to 17 feet, and occasionally much less, there being in some places only 8 and 6 feet water. Among these shoals there are some narrow navigable channels suitable only for the coasters, as they are too intricate to be run for by any but those who are well acquainted with them. The channel within, immediately round the cape, named Cape May channel, has in it a depth of from 4½ to 5 fathoms; but it is narrow and confined by the shoals. Ship channel, which is used by the large traders, is the best passage into the river, as it is about 4 miles wide, and has a general depth of 9 to 12 and 15 fathoms, fine yellow and white sand, with black specks and shells. This channel lies westward of the shoals, between them and cape Henlopen, and in running in there is little or no danger if the lead be kept properly going.*

The southern edge of the Overfalls lies N.E. ¼ E., 6¼ miles from the lighthouse on cape Henlopen; hence they extend to within a mile of cape May, from the lighthouse on which their southern edge bears S. by W. ¼ W., 5½ miles. In many places there are breakers and tide-rips, hence the name of "The Overfalls." These shoals are in general so steep that there is a depth of 4 to 5 fathoms close to their edges.

Cape Henlopen on the western side of the entrance to the Delaware, has a white lighthouse upon it 82 feet high, which shows a *fixed* light at 128 feet above the sea, visible 17 miles. The arc illuminated is 214° (from N. 40° W. eastward to S. 6° E.). The position of the lighthouse is Lat. 38° 46′ 38″ N., Long. 75° 4′ 43″ W. Close to the lighthouse there are some large white sand-hills.

The *fixed* beacon light on cape Henlopen is on screw piles, shown at 45 feet above the sea, and visible about 9 miles; it is in line with the main light and the pile lighthouse on Brandywine shoal. Vessels approaching from southward or eastward and intending to enter Breakwater harbour, after passing the Hen and Chickens shoal, should keep the light in range with the light on the breakwater, until they shoal the water to say about 5 fathoms, when they will be about ¾ mile from the point of the cape; they should then haul up, and leave the light on the port hand at not less than 200 yards.

Along the coast south of cape Henlopen, a shoal named the Hen and Chickens, extends a distance of about 8 miles from the lighthouse, and has on it in some

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* The following notice was issued in March, 1823, and we believe is still in force; it should therefore be attended to by all vessels approaching the Delaware from seaward:—

"The risk of entering this river would be much lessened if commanders of ships would put a signal for a pilot as soon as they discover either of the lighthouses; for the Chamber of Commerce and the Insurance Offices have established repeating signals at the lighthouses, upon seeing which, the pilots will attend and meet the vessels about the lighthouses. If the signal is not hoisted until you get abreast of the lighthouse, the vessel will be under the necessity of lying-to, which will occasion delay and sometimes danger. The pilot vessels will generally be found cruising about the entrance of the Delaware; whenever that is not the case, the above caution may be of some importance."

parts about 5 feet water. The depth in the narrow channel between it and the coast is from 5 to 4 fathoms, and immediately outside of it 9 to 10 fathoms water. When approaching this shoal on the east side, it is not advisable to get into less than 11 or 12 fathoms, and the lead should be kept going, by which means it will be avoided; or approach the light not nearer than 2 miles on a West bearing. The southern point of this shoal lies S.E. ½ S. 2¼ miles, and the northern point N.N.E. ¾ mile from the lighthouse. The south point of the shoal is now marked by a buoy, painted red and black in stripes, which lies in 25 feet water, at about 1¼ miles from the shore, with cape Henlopen lighthouse bearing N.W. ¾ N. distant 2⅜ miles.

Immediately round the north end of the cape there is a breakwater, west of which is another pile of masonry, named the Ice Breaker; the latter has been built for the purpose of protecting the anchorage within the breakwater from ice, which at certain periods of the year comes down the river in large quantities. The lighthouse on the west end of the principal breakwater, shows a small *fixed* light (flashing every 45 seconds) at 47 feet above the sea, visible about 10 miles from all parts of the sea horizon; attached to it is a fog-bell.

From Delaware bay the coast runs S.S.W., about 110 miles, to cape Charles, at the entrance to Chesapeake bay, and has off it at various distances several small shallow patches, the first of which, named the Hen and Chickens, immediately south of cape Henlopen, has been mentioned. At nearly 8 miles southward from cape Henlopen there is a flat of 15 feet extending about a mile from the shore; and 8 miles beyond this is the entrance to Rehoboth and Indian River bays, which will admit only the smallest craft. In Lat. 38° 27′ 30″ N., Long. 74° 56′ 9″ W., there is a shoal, about 2 miles long, in a S.W. and N.E. direction, named Fenwick island shoal, on which the least water is 2¼ fathoms; it bears S.E. by S. ¼ S., 11 miles, from Indian River inlet, and East 6 miles from the lighthouse on Fenwick island, and is marked (1868) on its north-east side by a nun buoy striped red and black.* On the seaward side of this shoal the soundings change suddenly from 10 to 2¼ fathoms, and there is a depth of 10 fathoms at about 2 miles westward of it. The Fenwick Island shoal is about 5¼ miles from the land, and appears to be extending on the west side and towards the north.

At about 1¼ miles southward of Fenwick island shoal, there is a small patch of 8¼ fathoms, and at nearly 2 miles farther southward there is a bank of about 1 mile in extent, named the Isle of Wight shoal, upon which the depth is 8 fathoms. This shoal lies about 6¼ miles from the shore, with the Isle of Wight woods bearing West, and has on all sides of it a depth of 10 fathoms within the distance of a mile.

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* The lighthouse on Fenwick island in Lat. 38° 27′ 1″ N., Long. 75° 2′ 59″ W., is 82 feet high, and shows a *fixed* light (*flashing every* 2 *minutes*) at 86 feet above the sea, visible 15 miles. The arc illuminated is 207° (from N. 3° E. eastward to S. 30° W.).

In Lat. 38° 18′ N., Long. 75° 4′ W., and at about 1¾ miles from the shore, is situated a narrow bank, 2 miles long, of 12 to 17 feet water, named Little Gull, which has from 5 to 8 fathoms immediately on its edges; and at 2¼ miles southward of this, but separated from it by soundings of 7½ to 10 fathoms water, is another small patch of 3½ fathoms, named Great Gull bank. Northward of the Gull banks along the shore are various small shoals of 3 and 3½ fathoms, lying within 2 miles of the coast; and, along the shore southward, as far as the Green Run inlet, are a similar series of shoal patches. In the direction of E. ½ N. 9½ miles from Green Run inlet are two small shoals of 3½ and 4 fathoms, having close to them a depth of 7½ to 9 fathoms;—in this neighbourhood the ground is very uneven. As there is nothing on this coast to indicate the position of the various outlying shoals, it ought to be avoided as much as possible.

Green Run inlet in Lat. 38° 8′ N. is the entrance to some extensive lakes named Assateague, Sinepuxent, Isle of Wight, and Little Bays, which extend along the coast almost from the Delaware to Assateague island, being separated from the sea by a narrow beach. This coast is so low that even masters of coasting vessels experience difficulty in ascertaining their correct position when running along it.

At about 6½ miles S.E. ¾ S. from Green Run inlet, and E. by N. ½ N. 11½ miles from Assateague lighthouse, is the centre of the *Winter Quarter shoal*, which is 1½ miles long and ¼ of a mile wide, running in the direction of E. by N. ¾ N. Over it the depth is 12 feet to 3½ fathoms, and as its edge is steep, the sea breaks upon it occasionally with considerable violence. It is 6½ miles from the land, and extremely dangerous, as it lies directly in the track of vessels running along the coast, and the soundings change suddenly on the seaward side from 9 to 4, and then to 2 fathoms. Between it and the shore is a depth of 10 fathoms, and 5 miles eastward of it 13 and 14 fathoms.

This shoal is at present (1868) marked by a red and black nun buoy (marked W.Q.S.) which is moored in 12 feet; from it Green Run bears N.W. ¾ N.

South-westward from the Winter Quarter shoal, nearly 6 miles, is the northern end of the *Black Fish bank*, a series of ridges running in a S.W. ½ W. direction, about 4¾ miles. They are 4½ to 6 miles from the shore, and have an average width of ½ mile. On them the depth is 3½ to 5 fathoms, and close to them, on either side, are soundings of 5¾ to 9 fathoms, the deepest water being on the seaward side, where, at a mile off, are 10 and 11 fathoms. From their northern end, Assateague lighthouse bears W. by N., distant 7½ miles; and from their southern end, the same building N.W. ½ W., 5¾ miles.

The *Chincoteague Shoals* are a cluster of dangerous shoals surrounding the southern point of Assateague island. They extend 3¾ and 4½ miles S. ½ W. to S.E. by E. ¾ E. (six points of the compass) from the lighthouse, and have over them a depth of 9 to 17 feet. At a little southward of them are soundings of 4¾ and 5 fathoms.

Assateague Lighthouse, situated about 2 miles from the south-west point of the island, is in Lat. 37° 54′ 37″ N., Long. 75° 21′ 4″ W. It bears a *fixed* light at 150 feet above the sea, visible in clear weather from an offing of about 20 miles; within the greater part of this distance the ground is very uneven and broken. The arc illuminated is 225° (from N. 31° E. eastward to S. 76° W.). Hereabouts the general direction of the current is southward and westward.

Within the Chincoteague shoals there is anchorage in 8½ fathoms, which is sometimes run for by the small coasting vessels. The best position is at about 2½ miles S. by W. from the lighthouse.

Assateague inlet is shallow, so also is Chincoteague inlet, but into the latter, vessels drawing not more than 12 feet can enter.

Hog Lighthouse, &c.—The coast between Assateague island and Chesapeake bay, consists of low, sandy, marshy land, trending in a S.S.W. ½ W. direction, and with but few conspicuous marks that can be useful to strangers. In Lat. 37° 23′ 6″ N., Long. 75° 41′ 35″ W., there is a white lighthouse 45 feet high, erected on the south point of Hog island; it shows a *fixed* light at 60 feet above the sea, visible 13 miles,—the arc illuminated is 235° (from N. 10° E. eastward to S. 45° W.). South of this 18 miles is Smith island (off cape Charles) upon which is also a lighthouse. The whole of this coast is bordered by a number of low islets, on which are the houses of a few fishermen, who haul their vessels up through the creeks formed by the islands.

Chesapeake Bay.—Chesapeake bay has its entrance between capes Charles and Henry, and is one of the finest estuaries in the world, having an average width of 14 or 15 miles, and a length of 160 miles, being comprised between Latitudes 36° 55′ and 39° 27′ N. Its greatest breadth, 27 miles, is near the parallel of Smith point, the south point of the entrance of the Potomac, and the least, 2½ miles, just above the mouth of Bush river, and near the head of the bay. For so extensive a bay its general direction is remarkably straight; the comparatively slight deviations, however, will admit of its devision into six different reaches; the first, commencing at cape Henry, trends N.W. by N., 10 miles; the second North, 48 miles; the third N. by W. ½ W., 52 miles; the fourth N. by E. ¾ E., 27 miles; the fifth N.N.E. ¾ E., 18 miles; and the sixth N.E. by E., 10 miles, to Turkey point, at the junction of the Susquehanna, North-east, and Elk rivers, at the head of the bay. About 7½ miles up the Elk river from Turkey point, is Back creek, the western outlet of the ship canal connecting Chesapeake and Delaware bays; this canal is 66 feet wide, and 10 feet deep, and enters the latter bay at Delaware city.

The depth of water in the channel-way of Chesapeake bay is not less than 5 fathoms, till up with Pool island, above the entrance of Patapsco or Baltimore river, but ranges from that depth to 10, 20, and even 25 fathoms. There are, however, a few interruptions to this general rule, caused by the existence of detached and projecting banks, lying in or extending into the fairway, whereon are from 3½, to 4½ fathoms, but they are easily avoided by a slight departure from the prescribed course. Above Pool island the soundings decrease from 5 to 4½, 3½, and 2½ fathoms at the mouth of the Susquehanna.

Both shores of the bay are low, and much indented, particularly the eastern, by the embouchures of large and important rivers, and a number of bays and inlets more or less extensive. Of the rivers, those on the western side are of the greatest length, besides which, their breadth, depth, and the cities and towns on their banks, demand for some of them a special notice; the principal are, the *Susquehanna*, which empties itself into the head of the bay, and has the town of Havre de Grace on the west side of its entrance; the *Patapsco*, whereon is the important city of Baltimore, situated about 9 miles within its mouth; the *Severn*, with Annapolis just within the entrance; the *Patuxent*; the *Potomac*, a deep and winding river, having on its left bank the city of Washington, and Alexandria on the right; the *Rappahannock*, with several thriving places on its banks—namely, Frederiksburg, Port Royal, &c.; the *York River*; the *James River*, leading to Richmond and its suburb Manchester, to Petersburg, &c.; *Nansemond River*, leading to Suffolk; and *Elizabeth River*, upon which stands the towns of Norfolk, Portsmouth, and Gosport. At the confluence of the three last rivers is *Hampton Roads*, an anchorage very much resorted to.

On the eastern side, the chief places worthy of mention are Chestertown, on the banks of the *River Chester*, and Easton, at the head of *Third Haven Creek*.

Lights, &c.—The deep-water channel above referred to is narrowed very considerably by the extensive and steep banks, which extend from both shores, in many places, to the distance of several miles, and require on the part of the shipmaster the exercise of great care to avoid. To assist in preserving a safe course up the bay, lighthouses have been erected on many of the most prominent points, and lightvessels and buoys moored at the extremities, or on the edges of these banks. As a general rule when approaching from seaward, red buoys (with even numbers) will be found on the starboard, and black buoys (with odd numbers) on the port hand. At the entrance of the bay are two excellent lights, by which vessels are enabled to run for it with certainty.

Cape Henry light is *fixed* and exhibited from a white building, 82 feet high, erected on the south point of the entrance in Lat. 36° 55′ 29″ N., Long. 76° 0′ 12″ W. It is 129 feet above the level of the sea, and may be seen at the distance of 17 miles in clear weather; the arc illuminated is 241° (N. 80° W. eastward to S. 19° E.).

Cape Charles light (shown at an altitude of 160 feet above the sea) is from a white tower, built on Smith island, an islet on the east side of the cape, and with it forming the north side of the entrance. The light is *fixed (varied by a flash every minute)*, and is visible about 20 miles from all parts of the sea horizon. Its geographical position is Lat. 37° 7′ 8″ N., Long. 75° 58′ 12″ W.

Willoughby Spit.—This lightvessel, painted red, lies on the north side of the spit, and on the south side of the channel to Hampton roads, with the light on Old Point Comfort bearing West, distant 2½ miles. It carries two *fixed* lights, one on each mast, at the heights of 35 and 48 feet, both visible about 11 miles. A bell is rung and a horn sounded alternately every 5 minutes during thick or foggy weather.

Willoughby bank is the north-eastern portion of the flat, which extends northward and north-eastward from Sewell point and Willoughby spit, and forms the south side of the entrance to Hampton roads. Near the north-western edge of this flat stands fort Calhoun or the Rip Raps, opposite and distant $\frac{9}{10}$ of a mile from the now celebrated fort Monroe, which latter, with the inner part of the Horse-shoe bank, constitutes the north side of the entrance. Upon the bank north-eastward of the Rip Raps, the depths range from 6 to 14 and 18 feet; south-westward from them 4 to 10 feet; while close to its edge the depth is 4 to 8 fathoms, which renders great precaution necessary when standing towards it. The edge of the Horse-shoe and Old Point Comfort are likewise steep, and require similar care. The intervening channel has a width of about $\frac{3}{4}$ of a mile, and a depth of from 5 to 15 fathoms.

Old Point Comfort, on which stands fort Monroe, has a white lighthouse upon it 40 feet high. The light is *fixed*, at an altitude of 48 feet above the sea, and visible about 12 miles; the arc illuminated is 210° (N. 25° E. eastward to S. 55° W.). A bell is rung in foggy weather. A small beacon light is also shown near the main light, to guide vessels to the anchorage inside Hampton bar.

Back River Point, $5\frac{1}{2}$ miles N.N.E. from fort Monroe, and 15 miles N.W. by W. from the entrance of Chesapeake bay, is distinguished by a white lighthouse 30 feet high, from which a light *revolving every* $1\frac{1}{2}$ *minutes* is shown at 35 feet above the sea, visible 10 miles; the arc illuminated is 225° (N. 25° W. east ward to S. 20° W.). The 3-fathom edge of the Horse-shoe bank is distant $1\frac{1}{2}$ miles, and the 5-fathom $4\frac{1}{2}$ miles eastward from Back River lighthouse. The western edge of the Middle-ground, which here forms the eastern side of the main ship-channel up the Chesapeake is $8\frac{3}{4}$ miles eastward from the light.

York Spit *Lightvessel* is moored in 4 fathoms off the south-east extremity of the spit. It shows a *fixed* light, at 40 feet above the water, visible about 11 miles. A fog-bell and horn are sounded every alternate 5 minutes in thick and hazy weather. From this vessel New Point Comfort lighthouse bears N.W. by N. $\frac{1}{2}$ N.; Back River lighthouse S.W by S. $\frac{1}{2}$ S.; and Tewes point W. $\frac{1}{2}$ N.*

York spit separates the entrances of York river and Mob Jack bay, and extends S.E. $\frac{1}{2}$ E. $6\frac{1}{2}$ miles from the Hog islands. The general depths upon it are from 12 to 18 feet, but there are several shoal patches with as little as 9, 5, and 2 feet upon them, especially near the Hog islands. The depth almost close to its south-west side is 5 and 6 fathoms; it is not so steep on its north-east side.

Cherrystone Inlet lighthouse is upon screw-piles, erected in about 4 feet at low water, on the south-west side of the entrance to the inlet, and on the east

* These particulars are from the public Notice of 1867. In the U.S. Lighthouse list 1869, the vessel is stated to show two fixed lights.

side of Chesapeake bay at 1½ miles southward from Sandy point. The light is *fixed*, 36 feet above the water, and visible about 10 miles; the arc illuminated 207° (N. 12° E. westward to S. 15° E.), and its geographical position is Lat. 37° 15′ 36″ N., Long. 76° 1′ 47″ W. Hereabout the 3-fathom edge of the off-lying bank is distant 2 miles from the land, and is very steep.

New Point Comfort, the north point of entrance to Mob Jack bay, on the west side of Chesapeake bay, has a white lighthouse upon it 56 feet high, which exhibits a *fixed* light at 60 feet above the sea, visible 13 miles; the arc illuminated is 297° (N. 17° E. eastward to N. 46° W.).

The shoal known as New Point shoal has a depth over it of 18 to 16 feet; it is 1¼ miles long, and ¾ of a mile wide, extending in an E.N.E. and W.S.W. direction;—the 16-foot shoal or south-west part lies S.E. ¾ S., 4 miles from New Point Comfort lighthouse, and the north-east end 4¼ miles S.E. ¾ E. from the same object. The depth in the channel between the shoal and the bank extending from New Point Comfort is about 4 fathoms.

Wolf Trap Spit *Lightvessel* shows a *fixed* light at 39 feet above the water, which is visible about 10 miles. It lies in 5 fathoms off the east edge of the Wolf Trap shoal, at 7½ miles N.E. from New Point Comfort, and 8¼ miles from the western shore. In foggy weather a bell is rung and a horn sounded on board alternately every 5 minutes. Vessels should pass it on its eastern side, where there is plenty of room, the channel being 7½ miles wide (from the lightvessel to the bank running 1½ miles from the eastern shore) and not less than 5½ fathoms deep, except on a narrow bank commencing at 1 mile E. by N. from the lightvessel, and extending thence 2½ miles in a N. ½ W. direction, whereon is a depth of 4½ fathoms.

The whole of the coast from Mob Jack bay to Piankatank river is fringed with a broad shoal, which about midway attains its greatest width, where it is named the Wolf Trap spit. Here a depth of 2 and 2½ fathoms will be found at nearly 8 miles from the land, towards which it decreases after crossing a deep gully of 4 and 4½ fathoms. The above lightship, therefore, should always be passed on its east side.

Stingray Point lighthouse is built upon iron screw-piles, driven into the bank at about a mile east of the point, and on the south side of the entrance to Rappahannock river. The light, *fixed red*, may be seen at a distance of 11 miles, being 36 feet above the sea; the arc illuminated is 245° (N. 74° W. eastward to S. 9° E.). The geographical position of this lighthouse is Lat. 37° 33′ 38″ N., Long. 76° 15′ 54″ W. When rounding it and steering into the Rappahannock give it a berth of a mile or more.

Windmill Point *Lightvessel* lies at the south-east extremity of the extensive flat which extends in a south-easterly direction from the point; it is 4½ miles S.E. by E. ¾ E. from the point; 11¾ miles N. ½ W. from Wolf Trap lightship; and S.W. ½ W. 13½ miles from the 15-foot spot on the outer edge of the shoal projecting 4½ miles westward from the south end of Tangier island. It bears one *fixed* light, 84 feet high, visible 10 miles, and in foggy weather a bell and horn are sounded alternately every 5 minutes. Vessels sailing up the Chesapeake must pass it on its east side.

The soundings upon the western part of Windmill spit are 6, 7, and 8 feet; on its south-eastern portion they vary from 12 to 18 feet. Its southern edge is steep, there being a depth of 4½ to 6 fathoms almost close to it; towards its northern side the water shoals more gradually.

TANGIER SOUND is the channel bounded by Tangier, Smith, South Marshes, and Bloodsworth islands on the western, and the mainland on the eastern side. It has a deep but winding channel, and several rivers discharge their waters into it. The deepest entrance is from southward (between Tangier and Watt's islands), the middle entrance (Kedge strait) having a depth of 1½ fathoms in it, and the northern (Hooper strait) only 11 or 12 feet. As a general rule, the deepest water will be found in the middle of the sound, between the broad and shallow banks fringing both shores. Its navigation is much facilitated by the lights at Watt's, Jane, and Clay islands, hereafter described.

Watt's Island divides the entrances of Tangier and Pocomoke sounds. It is surrounded by extensive shallows, and on an islet off its south point there is a white lighthouse 40 feet high, which shows a *fixed* light *(varied by flashes)* at 46 feet above the sea, visible 12 miles. The shoal from Watt's island extends nearly 5 miles S.W. ½ W. from the lighthouse to a depth of 17 feet, at 7 miles in the same direction the depth is 29 feet. The greatest danger to large vessels hereabout is the flat running off from the south end of Tangier island to the distance of 4½ miles in a W. ½ S. direction; this flat is broad, has but 11 to 15 feet over it, and is still further prolonged for a distance of 4 or 5 miles in a south-westerly direction by soundings ranging from 21 to 30 feet, which serve as an excellent guide to vessels standing towards Tangier island on a north-easterly bearing. During night additional guidance is afforded by the lightvessel off the spit extending from Windmill point and by the light on the shoal surrounding Smith point, as one becomes visible before the other is lost to view.*

SMITH POINT.—A screw-pile lighthouse stands on the edge of the shoal sur-

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* Tangier sound has the following lights on its eastern shore;—

A screw-pile lighthouse (the iron work of the foundation of which is red, and the building white) on the shoal extending from the south-west of Jane island, in Lat. 37° 57′ 51″ N., Long. 75° 54′ 35″ W.; it is in 5½ feet water, mean tide. The light (*fixed*) is 35 feet above the sea, visible 10 miles. A fog-bell is attached to the lighthouse.

A pile lighthouse at Somers' cove, at the mouth of Little Annamessix river. It is in 9 feet water, mean tide, on the north side of the channel and about 45 yards from its edge; it serves also to indicate the turning point in the channel leading to the terminus of the Eastern Shore railroad. The light *(fixed)* is 32 feet above the sea at the ordinary tidal level, and visible 8 miles. A fog-bell is attached to the lighthouse.

A lighthouse also marks the north end of the sound in Lat. 38° 13′ 53″ N., Long. 75° 58′ 8″ W. It is on Clay island, at the mouth of Nanticoke river, and consists of a white building 30 feet high. The light *(fixed)* is at 36 feet above the sea, and visible about 11 miles. The arc illuminated is 286° (N. 21° W. southward to N. 53° E.).

rounding this point, in about 2 fathoms at low tide; its geographical position is Lat. 37° 53′ 38″ N., Long. 76° 11′ 24″ W. It shows a *fixed* light, at 37 feet above the sea at high tide, visible 11 miles from all parts of the sea horizon. A fog-bell is sounded in thick weather at intervals of 15 seconds. Soundings of 4 to 6 fathoms will be found within 150 yards to the eastward, and 2 fathoms on the shoal extending about a mile westward from the lighthouse between N.W. and S.W.

Vessels drawing 12 to 14 feet when passing up or down the bay or into the river Potomac, may approach the lighthouse safely to within a distance of 250 yards; those of heavier draught should give it a berth of ½ mile.

Smith Island (east side of the Chesapeake). A white building, 30 feet high, on Fog point, the north-west extremity of Smith island. It shows a *fixed* light at 35 feet above the sea, visible 10 miles; the arc illuminated is 271° (S. 80° E. northward and westward to S. 9° W.), and its geographical position is Lat. 38° 2′ 4″ N., Long. 76° 2′ 15″ W.

This light points out the entrance to *Kedge strait*, the middle passage into Tangier sound, wherein is a depth of from 9 to 12 feet at low tide; and also assists heavily laden vessels in clearing the extensive bank on the eastern side of the main channel up the bay. This bank trends N. by W. and S. by E. 5½ miles, is 1½ miles broad, and has a general depth over it of from 16 to 18 feet; between it and the shoal extending from Smith and South Marsh islands, there is a channel 20 feet deep and upwards. The fairway through Chesapeake bay is between this bank and Lookout point; it may be maintained by giving the above islands a berth of 6½ or 7 miles, or by keeping within 5 miles of Lookout point, and preserving a depth of not less than 5½ and 6 fathoms.

Lookout Point, the north point of the mouth of the Potomac, has a white building upon it, which shows a *fixed* light, at 37 feet above the sea, visible 10 miles; the arc illuminated is 292° (N. 2° E. eastward to N. 66° W.). The three-fathom edge of the off-lying bank is ¾ of a mile from the lighthouse.

Hooper Strait, the northern passage into Tangier sound, has a depth in it of 11 and 12 feet and upwards. It is marked on its south side by a screw pile lighthouse erected on the shoal ground extending from Bloodsworth island, in Lat. 38° 12′ 57″ N., Long. 76° 4′ 48″ W. This building stands in 6 feet water and shows a *fixed* light at 35 feet above the sea, visible 10 miles. The arc illuminated is 298° (from S. 12° W. westward to S. 50° E.). A fog-bell is attached to it.

Cove Point, 4 miles northward of the mouth of the Patuxent, on the western side of Chesapeake bay, is distinguished by a *fixed* light (*varied by a flash every 1½ minutes*) shown from a white lighthouse, at 46 feet above the sea, and visible 11 miles. The arc illuminated is 234° (N. 37° W. eastward to S. 17° W.). In foggy weather a bell is rung by machinery.

Sharp Island, 13 miles above Cove point and on the eastern side of Chesapeake bay, is on the north side of the main entrance to Choptank river. The lighthouse is situated at about ¼ mile from the north end of the island, and consists of a screw pile building standing in 7½ feet water,—its geographical position is Lat. 38° 37′ 54″ N., Long. 76° 22′ 19″ W. The light (*fixed*) is 35 feet above the sea, and visible at the distance of about 10 miles. The arc illuminated is 274° (S. 6° W. westward to S. 80° E.).

Shoal water surrounds Sharp island and extends about 1½ miles westward from it. In the channel between it and Lows island the depth is only 15 feet; in that southward of it, between its surrounding shoal and the shallow flats extending northward and westward from James island, it is 5 to 6½ fathoms.

Thomas Point is on the north side of the entrance to South river and may be recognised by its *fixed* light. This is shown from a white building at 63 feet above the sea, and can be seen from about 13 miles. The arc illuminated is 292° (N. 2° W. eastward to N. 70° W.). Its geographical position is Lat. 38° 54′ 25″ N., Long. 76° 26′ 53″ W.

A shallow spit projects a mile eastward from Thomas point, and is marked on its south-east end by a buoy. From Tally point, 2 miles further northward, a similar danger runs out, the extremity of which is likewise marked by a buoy.

Greenberry Point.—On this point a *fixed* light is shown from the top of the keeper's dwelling, at 50 feet above the sea, which is visible 11 miles. Greenberry point is the northern side of the entrance to Annapolis or Severn river, and eastward of it there are very extensive flats which form the northern boundary of Annapolis roadstead. Between these flats and the shoal extending from the opposite shore of the bay the channel is 2½ miles wide, and above 8 fathoms deep.

Sandy Point lies 8½ miles further northward, and on the same side of Chesapeake bay. The light upon this point is *fixed* (*varied by a flash every* 1½ *minutes*); it is shown from the keeper's dwelling, at an altitude of 50 feet, and may be seen at the distance of about 12 miles,—the arc illuminated is 208° (N. 7° W. eastward to S. 21° W.). Its geographical position is Lat. 39° 1′ 8″ N., Long. 76° 23′ 29″ W. Attached to it is a fog-bell.

The steep edge of the flat extending from Sandy point is marked by a buoy.

At about 3 miles above Sandy point the hitherto broad, deep, and straight channel, becomes narrow, shallower, and winding, and continues so to the head of the bay, the banks which extend from both shores being very extensive particularly those from the western shore, and fronting the entrance to Patapsco or Baltimore river. Buoys are placed on the most prominent knolls and projections; these with the lighthouses on Seven-foot knoll, North point, Pool island, and Turkey point, are considerable aids to the navigation, though not sufficient to enable a stranger to dispense with the services of a pilot.

Seven-foot Knoll lighthouse is on iron-screw piles, driven into the sand on a 7-foot patch, situated on the south side of the principal channel into Baltimore harbour, at nearly 4 miles westward of the main-channel up the bay, and 8½ miles North from Sandy point light. It is painted black, of a circular form, and shows a *fixed* light, at 43 feet above water, visible 11 miles. Attached to the lighthouse is a fog-bell which is struck by machinery; a fog-horn is also sounded every 5 minutes during hazy weather.

NORTH POINT lighthouses are upon piers, and when in line range with the entrance of the main-channel into Baltimore harbour. These two lights are *fixed*, at 33 and 42 feet above the sea, and visible 10 miles. North point is on the north side of the mouth of Patapsco river.

POOL ISLAND is on the western side of Chesapeake bay, at about 8 miles above Baltimore river. It has on its north-west point a white lighthouse 30 feet high, from which a *fixed* light is exhibited at an altitude of 35 feet, visible 10 miles. A fog-bell is rung by machinery.

TURKEY POINT.—From Pool island to Turkey point the distance is 15 miles. This point, the lighthouse upon which is in Lat. 39° 26′ 56″ N., Long. 76° 0′ 12″ W., may be considered as the head of Chesapeake bay, the rivers Susquehanna and Elk disemboging into it on each side. The light, *fixed*, is 65 feet above the sea, and may be seen at the distance of 12 miles.

Tides.—It is high water at cape Charles on the days of full and change, at 7h. 45m.; mean rise and fall of springs 5 feet, neaps 3½ feet. The tide varies considerably in its direction, according to the time from high or low water. The flood sets in towards and over the tail of the Horse-shoe, and the ebb from James and York rivers sets towards and over the Middle Ground. It is very necessary to be cautious, particularly with a northerly wind, when standing towards the Horse-shoe, as the ebb tide down the bay sets over it strongly and irregularly in a southerly direction. At point Lookout (entrance of the Potomac), high water takes place on full and change days at 12h. 32m.; mean rise of springs 1·9 feet, and of neaps 0·7 feet; the mean duration of the flood tide is 5h. 59m., of the ebb 6h. 25m., and of the intervening stand 35m. At point Bodkin (the south point of entrance to Baltimore river), on the days of full and change, it is high water at 5h. 42m.; here springs rise 1¼ feet, neaps ¾ foot; the duration of flood tide, is 5h. 23m., of ebb 7h. 8m., and of the intervening still water 15m.

In a bay where so many and such large rivers discharge their waters as in Chesapeake bay, the force and direction of the currents are subject to varied and complicated influences, so that when in the vicinity of any of their mouths, the effect of the outset or indraught upon the vessel's way must be duly considered according to the volume of water, the direction of the river's channel, and the proximity of neighbouring banks. In the absence of details and until the completion of observations bearing upon these particulars, the safest reliance will be found in practical and local knowledge, for, though the bay is well lighted and buoyed, and a frequent use of the hand-lead may be resorted to, the steepness of the edges of some of the banks may defeat every care on the part of a stranger.

Directions.—From cape Henry southward the shore is generally steep, as far as the Wimble shoals. The greatest extent of off-shore soundings is eastward of cape Henry, where they extend 70 and 75 miles from the land to a depth of 100 fathoms, with various depths intervening. At the distance of from 3 to 15 miles from and in the latitude (36° 55′ N.) of the cape, there is a bank of 5½ and 9 fathoms, between which and the cape the depth is 9 to 12 fathoms, and there is the same depth to a considerable distance outside it. The bank is of great extent: eastward of it the water deepens gradually to 25 fathoms, then shoals suddenly to 20, and again in like manner, suddenly deepens to the edge of soundings. The ground off cape Henry is mostly of fine sand, with, occasionally, pebbles and broken shells; thence to cape Hatteras it is commonly fine sand and ooze.

Ships falling in with the land northward of the entrance of Chesapeake bay, should not stand in into a less depth than 8 or 9 fathoms, especially in about the latitude of Smith Island lighthouse, namely 37° 7′ N., in order to avoid the Shark and Smith Island shoals. When running along shore from southward, it will be proper to keep in not less than 7 fathoms, until up with cape Henry.

Southward of cape Henry the water is deeper than when in its latitude; at 12 leagues off the depth is upwards of 20 fathoms, fine gray sand. The land is low, sandy, and seldom visible at a greater distance than 20 miles. Cape Henry is also low, but bluff, and has or had a few trees on the seaward side, at a short distance from the water. It is moderately steep on the north side, and off its east side a shoal extends about 4 cables; it may, therefore, be rounded with safety at a less distance than a mile. The 5-fathom edge of the banks running southward from cape Charles, is distant 2¾ miles north-eastward from cape Henry; the southern part of the Middle Ground (17 feet) is distant from cape Henry 5½ miles;—the intervening space forms the main channel into Chesapeake bay,

North Channel.—This entrance to Chesapeake bay is immediately southward and westward of Smith, Isaacs, and Fisherman islands off cape Charles, as it runs between them and Nautilus and Inner Middle shoals. Its eastern part is obstructed by a bar of 15 feet water, which curves round from the Nautilus shoal in a northerly direction and joins the bank extending easterly from Smith island.

This channel is more convenient to steamers than sailing vessels, as the ebb tide runs strongly and there are cross tides. Bring Smith Island lighthouse to bear North distant 3 miles, when the depth will be 3 fathoms; steer then W. ½ S., keeping the breakers on the starboard hand at from ¾ to a mile distant. This course leads across the bar in 15 feet water, and about midway between the Isaacs breakers and Nautilus shoal. When Guys point (the northernmost point of trees in sight) just opens westward of the north end of Fisherman island, haul to the northward, and steer with the point a little on the starboard bow (passing Fisherman island at the distance of about ½ mile on the starboard hand) till abreast of Butler's bluff, then haul to the northward and westward.

Keep the lead going while passing through the channel, and bear in mind that there is a shoal of 11 feet on the range of the east end of Fisherman island in one with the west end of the Isaacs.

Entering North channel from southward and westward, keep Richardson's house (the nearest to cape Charles, with a poplar tree near it) over and eastward of the north end of Fisherman island, and it will lead clear of the south end of the Inner Middle. To avoid the north end of the Inner Middle keep the southwest end of Smith island shut in with the point of woods at cape Charles (1856).

Middle Ground.—This shoal commences at about 6 miles N.N.E. from cape Henry lighthouse (at which spot the depth gradually decreases from seaward to 8 fathoms) and extends westward and north-westward up the bay for 10 miles. It is very steep on the western side, as the lead suddenly falls from 2½ fathoms into 6½ fathoms. Its edge is we believe marked by red buoys.

Inner Middle Shoals.—These shoals are north-eastward from the Middle Ground. They extend 4½ miles in a N.N.W. and S.S.E. direction, and are from 1 to 1½ miles wide; the depth upon them varies from 8 to 12 and 18 feet. Their south end is 1½ miles W. by S., from the west end of Isaacs island. The sea breaks on the shoalest part only when there is a swell setting in from seaward.

Nautilus.—This shoal lies 2 miles S. by E. ¼ E., from the east end of Isaacs island. The point of woods at cape Charles on with Guys point is a range for its shoalest part, which is 10 feet.

MAIN CHANNEL.—When approaching the entrance keep the lead going constantly after striking in 12 fathoms, and steer so as to bring cape Henry lighthouse on a bearing between W.S.W. and W.N.W.; then haul in W.N.W. ½ W., passing it at between 1½ and 2 miles distant. The cape Henry shore should not be approached nearer than a mile in moderate weather, and with a N.W. gale into a depth of not less than 8 fathoms, for then the ebb sets strongly to the southward along the shore.

Approaching from northward and eastward in a large vessel, Smith island lighthouse should have a berth given to it of at least 10 miles on account of Smith island and Shark shoals, the former (the outermost) of which is distant 7½ miles from the lighthouse in an E. ⅜ S. direction, and is very steep on its south-eastern side.

If standing southward in a small vessel, within or westward of Smith island and Shark shoals, keep in not less than 3½ fathoms, to clear the Nautilus shoal, on the shoalest part of which the depth is only 10 feet, and direct the course S.W., steering on that bearing for the lighthouse on cape Henry, and it will take across the shallow ground which extends southward from cape Charles almost as far as cape Henry; as soon as the soundings increase to 7 and 10 fathoms the Main Channel will be attained, and the bay may be entered as before. The lead should be kept going throughout this route, that too near an approach be not made to the flat of 11 to 15 feet which borders the shore of cape Charles.

When in-shore, approaching from southward, stand to the northward till the woods of Willoughby point open northward of cape Henry; the soundings will then increase from 7 to 10 fathoms, and the bottom change from hard to sticky and soft ground.

Having continued on a W.N.W. ½ W. course till Cape Henry lighthouse bears

S. ¾ E., distant about 2½ miles, the depth will have decreased to 10 or 8 fathoms, and a N.W. by N. course may be steered, which will lead up in 6½, 7, and 8 fathoms, in mid-channel between the Tail of the Horse-shoe and the Middle Ground. When obliged to tack it should be remembered that towards the Horse-shoe the soundings decrease pretty gradually, but towards the Middle Ground very abruptly.

As soon as Back river light bears W. by S. ½ S., distant 6 miles, change the course to N. ¼ E., and it will carry up Chesapeake bay eastward of York spit lightvessel, the buoy off New Point shoal, Wolf Trap lightvessel, and the lightvessel marking the extremity of Rappahannock spit (the shoal extending from Windmill point, north side of the entrance to Rappahannock river). Continue this course until abreast of the screw-pile lighthouse on the spit extending from Smith point, the south point of Potomac river. This course (N. ¼ E.) will thus have been followed for a distance of 45 miles, and in a depth up to Windmill point lightvessel of 5, 6, and 7 fathoms, and thence to Smith point lighthouse, of 7, 8, 4½, 11, and 18 fathoms.

The soundings off the west shore of the Chesapeake, between the Middle Ground and Rappahannock spit are regular, except at the north-east extremity of New Point shoal, where from 6 fathoms the lead will almost immediately strike in 3 fathoms (on the shoal);—on the west side of Wolf Trap lightvessel the soundings suddenly decrease from 36 and 30 feet to 12 feet and thence to the land it is still more shallow,—the lightvessel must therefore be always passed on its east side. On the eastern shore they are irregular, and that side of the bay should, therefore, be approached with caution, particularly in the vicinity of Cherrystone inlet lighthouse. As a general rule, however, if the depth of 5 fathoms and upwards be maintained, the shore-banks will be avoided. Between Rappahannock spit and Smith point, the soundings in the channel vary from 3¾ to 20 fathoms, the banks fringing the western shore are steeper,—from the south end of Tangier island a shoal of 11 to 15 feet extends into the bay a considerable distance.

From abreast Smith point pile lighthouse change the course to N. by W. ¾ W., and run in that direction, in soundings decreasing from 10 and 15 to 7 fathoms, muddy bottom, until point Lookout lighthouse bears West, distant 4 miles, then steer N. by W., and it will take you about 1½ miles eastward of Cove point lighthouse, in depths varying but little from 7 fathoms. If obliged to tack, observe that, generally speaking, the western shore of the bay is clean and regular in its soundings, but that the eastern side has many shoals and flats making well out into the bay, especially opposite Lookout point, which should be approached with care by a vessel of large draught.

With Cove point light bearing West distant 1½ miles, steer N. by W. ½ W., in from 9 to 12 and 6 fathoms, till the lighthouse on the north end of Sharp island bears East. The bank along the western side of the bay is only from ¼ to ¾ of a mile wide, and has in many parts of it a depth of 5 and 6 fathoms close to its edge, so that the land should have a berth of a mile or more on that side; the western sides of James and Sharp islands, at the entrance to Choptank river, require a berth of 2 miles, for the shoals from them project 1¾ miles, and are very shallow and steep.

Having arrived at the above position, namely, with Sharp island lighthouse East, distant 4 miles, steer N. ¼ E. 8½ miles, keeping in a depth of 5 and 6 fathoms, and upwards, and it will take you to abreast the middle of Poplar island. In this part of the bay the shore-banks are broadest on the eastern side, and are very steep off Poplar island, where from 17 fathoms the lead strikes in 6, and then 1½ fathoms, the latter being 1¼ miles from the island. The shoal is likewise broad off Holland point, the south side of Herring bay, on the western shore of the Chesapeake.

From the middle of the bay at Poplar island steer N. by E. ¾ E., as far as Sandy point lighthouse, and pass eastward of the buoys moored at the extremities of the spits running off from Thomas, Tally, and Sandy points, preserving as nearly as possible the middle of the channel. Above Sandy point the channel becomes narrow and winding, and can only be safely navigated with the aid of local knowledge.

Hampton Roads, formed at the confluence of the rivers James, Nansemond, and Elizabeth, constitute one of the most important anchorages in the United States. The channel varies from ¾ mile in width at its entrance, between fort Monroe and the Rip Raps shoal, to 2 miles at its inner end, and is over 4 miles in length; within this space the depth is 4½ to 18 fathoms on a bottom mostly of mud and sand. The approach to it from the entrance of Chesapeake bay, is between the bank fringing the shore from cape Henry to Willoughby spit (on the south side), and the Horse-shoe bank and its tail (on the north side); it has a width of ⅜ mile where narrowest, a depth of not less than 5 fathoms, and trends first W.N.W. ½ W. 10 miles, and then W. ½ S. 1¾ miles, to fort Monroe, on Old Point Comfort. At this point it is high water on the days of full and change at 8h. 17m.; springs rise and fall 3 feet, neaps 2 feet;—the mean duration of the flood stream is 6h. 1m.; of the ebb 6h. 25m., and of the intervening still water 14m.

In addition to the lightvessel on the north side of Willoughby bank, and the light on Old Point Comfort, mentioned on page 679, there is a small *fixed* (beacon) light on the south-west end of that point, at 21 feet above the sea, visible 9 miles, which is useful as a guide to small vessels proceeding to the anchorage inside Hampton bar to abreast Hampton creek.

When bound into Hampton roads, and being on the channel course of W.N.W. ½ W. (*see* page 686), continue in that direction (making allowance, however, for the tides, by steering ¼ a point more southerly on the flood, and ¼ a point more northerly on the ebb) until up with Willoughby lightship which pass on its north side. From the lightvessel steer for fort Monroe until it is distant about ¾ mile, when the course may be steered (about S.W. ¾ W.) into the roadstead.

When tacking in the course from cape Henry it should be remembered that both Willoughby and Horse-shoe banks are steep, and that the channel is here only ¾ mile wide. If Old Point Comfort lighthouse be kept a little open southward of Willoughby lightvessel, it will clear the shoalest part (17 feet) of the Tail of the Horse-shoe; and, when within 3 or 4 miles of the lightvessel, if the latter be kept in range with the lighthouse it will clear the southern edge of the Horse-shoe in 23 feet. Small vessels coming down Chesapeake bay for Hampton roads can cross the Horse-shoe in 17 feet by bringing the lightvessel in one with the Rip Raps, about W.S.W.

When the east end of the Rip Raps is on with Sewall point, S.S.W. ¾ W., the course may be altered to S.W. ¾ W., which will carry in midway between Old Point Comfort lighthouse and the Rip Raps. Within the forts anchor in from 7 to 10 fathoms, with the lighthouse bearing from N.E. ½ N. to N.E. ½ E., distant 1, 2, or 3 miles; and moor with an open hawse to the northward and eastward.

NORFOLK.—Elizabeth river empties itself into Hampton roads at about 3 miles south-westward from fort Monroe. The distance from the roadstead to the city of Norfolk is 7 miles; on the opposite bank of the river are the towns of Portsmouth and Gosport. A depth of not less than 3½ fathoms can be carried all the way up, but the channel from 18 feet water on each side, is only 2 to 1 cable in width, and is well defined by buoys and a lighthouse, which latter is built on the western side of the channel, at ⅜ of a mile N.E. from the east end of Craney island, and 4 miles above Hampton roads, and bears a *fixed* light elevated 52 feet above the water and visible 12 miles; a fog horn and bell are sounded alternately every 5 minutes in thick and hazy weather.* There are extensive ship-building works at Norfolk, and a small *fixed* light, visible 6 miles, is shown from the wharf at the Naval hospital.

Here, on the days of full and change it is high water at 8h. 49m., springs rise 3½, and neaps 2½ feet. The mean duration of the flood tide is 5h. 48m., of the ebb 6h. 43m., and of the intervening stand 42m.

When proceeding from the anchorage in Hampton roads up Elizabeth river to Norfolk, keep Willoughby lightship a little open northward of the Rip Raps, to clear the shoal between the latter and Sewall point, and do not get into a less depth than 4½ fathoms, as the bank is steep. When the fort on the east end of Craney island bears S. ¾ W., the channel will be open, and may be entered on that bearing;—proceed on about S. ½ W., steering from buoy to buoy, and pass the lighthouse on its east side.

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* This lighthouse is a square wooden building with watch room and lantern above its centre. It is erected on an iron screw-pile foundation, octagonal in plan, 21½ feet above high water, ordinary springs, and painted red. The sides of the building, and the watch room below the lantern are painted white, and the roof slate colour. The light is shown over an arc of 277° (N. 13° E. eastward to N. 70° W.).

James River;—the survey of this river has, we believe, not been completed (1869). From Newport News point, the distance up the river to City point, where the Appomattox empties itself, is 56 miles, and to Richmond 87 miles. On, and about 9½ miles within the mouth of the Appomattox stands the town of Petersburg. The river is wide and deep at its entrance, but is very narrow at Richmond, which city can only be reached by vessels of very light draught. At City point, on full and change days it is high water at 2h. 11m.; springs rise 3 feet, neaps 2½. Here the mean duration of the flood is 5h. 14m., of the ebb 6h. 58m., and of the intervening stand 32m.

At 7½ miles above Newport News point, and below Sandy point, on the lower end of the shoal, and on the starboard side of the main channel going up the river, there is a *fixed* light, shown from a screw-pile structure, visible 9 miles. Nearly 5½ miles further up, also on the starboard side of the main channel, and on the Point of Shoals in about the centre of the curve of the river forming Burwell bay, is another of the same description. Five miles still further stands a third of a like character, placed on the Deep Water shoals, and likewise on the starboard hand. The fourth (on the port side of the river) is exhibited from the light-keeper's house on Jordan point, 36 miles above the third light, at 35 feet above the water, and visible 10 miles. All these lighthouses are furnished with fog bells.

Lynn Haven Roads.—This roadstead is just within the entrance of the Chesapeake, westward of cape Henry. When intending to anchor here, it is only necessary to double the cape at the distance of about a mile, and then haul in to the westward. The best anchorage is in from 7 to 4 fathoms, abreast the entrance of Lynn Haven river. Westward of and before the river's mouth, the shore-bank extends off ¾ mile to the depth of 18 feet.

York River has its entrance bounded on the north side by the Hog islands and the extensive York spit, and on the south side by the Drum island and Poquosin flats, which form a continuation of the Horse-shoe bank to the north-westward. The fairway into the river is only ¾ mile wide, from the depth of 5 fathoms on each side, and a depth of not less than 6½ fathoms can be carried in as far as, and even considerably above Yorktown and Gloucester point. West point (usually considered the western termination of York river, being the point where the rivers Matapony and Pamunkey enter it) is 22 miles above Yorktown; the channel to it is very narrow and gradually decreases in depth from 13 fathoms at the entrance to 3½ fathoms. At Moody's wharf, 14 miles above Yorktown, it is high water on the days of full and change at 9h. 35m.; springs rise 3 feet.

Having followed the before-mentioned (page 686) N.W. by N. course, from cape Henry, till Back River light bears W. by S. ½ S., steer N.W. ½ W., and pass in between the red and black buoys, with the latter on the port side. The lead and compass must, however, be the chief reliance. If obliged to tack keep to the southern side of the channel as the soundings there decrease gradually, whilst on the York spit side they change suddenly.

Mobjack Bay is immediately northward of York river. Its entrance is between York spit and New Point Comfort, and is divided into two channels by the New Point shoal. Four rivers fall into the bay, namely, the Severn, Ware, North, and East rivers; these are navigable by vessels of 50 to 60 tons burden. In the middle of the bay the general depth is 8 and 8½ fathoms. The anchorage is exposed to winds blowing between E.S.E. and S.S.E. The Severn river may be left with winds between N.W. and S.W.

Rappahannock River.—The entrance of this river is 24½ miles northward of that of the York river, and lies between Stingray and Windmill points and the shoals projecting therefrom. The channel in has a width of 1½ miles, and a depth of from 4½ to 5½ fathoms; further up the water is deeper and the breadth of the channel is less. At Tappahannock, which is situated on the west bank of the river, 36 miles within Windmill point, it is high water on the days of full and change at 0h. 32m.; springs rise 2, neaps 1½ feet. The flood-tide continues to run for 5h. 21m., and the ebb 7h. 6m.

When entering this river, it is advisable to keep over more to the south shore than the north, Rappahannock spit being steep. The course up the bay, as already noticed, is N. ½ E. When Stingray lighthouse bears N.W. by N., steer N.N.W. for the river, and pass the lighthouse on its north side keeping in not less than 4 fathoms. The river will now be open, and may be safely entered, provided a mid-channel course be followed. Strangers should employ a pilot.

Potomac River.—This river divides Virginia and Maryland, and upon its left bank, at 90 miles within its mouth, is the city of Washington, with the town of Alexandria nearly opposite, both of which can be reached even by vessels of large draught. At point Lookout on the days of full and change it is high water at 0h. 32m.; mean rise of springs nearly 2 feet, of neaps ¾ of a foot. The mean duration of the rising tide is 5h. 59m., of the falling tide 6h. 19m., and of the intervening still water, or stand, 35m.

When bound into this river, the course up Chesapeake bay to abreast Smith point lighthouse is N. ½ E. This lighthouse should have a good berth given to it, and must always be passed on its east side. Supposing it to bear South distant one mile, the course up the river to abreast Piney point is N.W. ½ W. 21 miles.

Piney point, 12 miles within point Lookout and on the same side of the Potomac, is distinguished by a white lighthouse 30 feet high, which shows a *fixed* light at 35 feet above the sea, visible 10 miles; the arc illuminated is 118° (N. 27° W. westward to S. 89° E.). Blackistone island 11 miles further up and also on the north side of the channel, has a *fixed* light upon it, 46 feet above the water, visible 12 miles; the arc illuminated is 322° (N. 2° W. westward to N. 36° E.). At Lower Cedar point (between the point and Yates point, above the Kettlebottoms), there is a screw-pile lighthouse standing in 3 feet water, which shows a *fixed* light at 35 feet above the water visible 11 miles; the arc illuminated is 267° (N. 55° W. eastward to S. 32° W.) and attached to the building there is a fog-bell. A screw-pile lighthouse has also been erected on the flats at Upper Cedar point, opposite the mouth of Tobacco river; it is in 8½ feet water, and shows a *fixed* light at 85 feet above the water, visible 11 miles,—the arc illuminated is 280° (N. 70° W. eastward to S. 30° W.), and there is a fog-bell. Lights *(fixed)* are also shown at fort Washington and at Jones point, near Alexandria.

The navigation of the river is not easy, especially above Blackistone island, for though, as a general rule, the fairway channel is in the middle of the river, several exceptions occur, caused by the projection of banks from the southern or western shore. Hence, only those having a local knowledge of these and of the various windings of the river, can take a vessel up in safety.

Cornfield Harbour, immediately within and westward of point Lookout, may be entered by rounding the lighthouse on that point at the distance of a mile (not nearer, because of the shoal extending from the point) and then hauling up north-eastward. Anchorage may be obtained in any convenient depth.

St. Mary River (in Potomac river), the mouth of which is 6½ miles north-westward of Point Lookout lighthouse, is sufficiently deep to admit large vessels, there being 36 to 17 feet water in mid-channel. Vessels may anchor at about 3 miles within the entrance, in front of Carthagena creek, in 3½ to 4 fathoms; or, further up the river in 4½ to 3 fathoms, and it should be borne in mind that the deepest water is always in the middle of the stream as the shore on each side is lined for a short distance out by a mud bank.

Patuxent River falls into Chesapeake bay at about 18 miles northward of the Potomac, and 8 miles southward of Cove Point light. The channel into it is reduced to little more than ½ mile in width by shoals extending from the shore on each side.

The course up the bay is N. by W. until Cedar point, the south point of the entrance to the river bears West distant 2 miles; steer now N.W. until Cove Point lighthouse bears N. by W. ½ W. when the course should be altered to W. ½ S. As soon as the river appears open, which it will do after following this course (W. ½ S.) about 1½ miles, steer in a S.W. by W. ½ W. direction. To ascend the river strangers should employ a pilot, although there is no difficulty if the mid-channel be maintained.

Approaching from northward, when Cove Point lighthouse bears West, distant 1½ miles, steer S. by W. for Cedar point until distant from it 1¾ miles, when the course should be altered to W. ½ S. as before.

Large vessels usually anchor in the entrance to the river, in 4 to 4½ fathoms, with Cove Point lighthouse bearing North; small vessels generally run about 2½ miles into the river and anchor under Drum point, the north point of the entrance.

On the foregoing courses the depths range from 4½ to 12 fathoms. The mean rise of spring tides is about 2 feet, and of neaps ¾ of a foot. On the days of full and change high water takes place at Drum point at 1h. 16m.; the mean duration of a rising tide is 5h. 48m., of a falling tide 6h. 45m., and of the intervening stand 25m.

Severn River.—Like the preceding rivers, the Severn falls into Chesapeake bay on its western side; it is distant about 88 miles northward of the Patuxent. Its entrance is between Tally point and Greenberry neck, which bear from each other N. ¾ W. and S. ¾ E. 2 miles, but the channel between the off-lying shallows, wherein is a depth of 8 fathoms and upwards, is only ⅛ mile broad. This channel is, we believe, marked by black buoys on the south-west and red buoys on the north-eastern side. Annapolis is built on the south bank of the river, at about 2 miles within its mouth. It is high water at 4h. 38m., on the days of full and change; springs rise 1, and neaps ¾ of a foot;—the flood continues 6h. 11m., ebb 6h. 15m., and the intervening still water 32m.

The roadstead is at the mouth of the river, and has a depth varying from 8½ to 7 fathoms. The best position for large vessels is in 7 or 8 fathoms, muddy bottom, with the State House in line with Horn point, N.W. by W. ½ W., and Thomas Point lighthouse S.W. by S.; this anchorage is 3½ miles from the city. Smaller vessels go further in, and bring-to in about 3½ fathoms, with the State House a little open southward of Horn point, and Thomas Point lighthouse open eastward of Tally point, S. by W. ½ W.

Vessels bound to Annapolis should steer up the bay as previously directed, preserving the middle of the channel as nearly as possible, and giving Thomas and Tally points a berth of 1½ miles to avoid the shallows running from them, the extremities of which are each marked by a buoy. When Thomas Point lighthouse bears W. by S. ½ S., the whole length of the river will be open, and the course should be directed into it, in a N.W. ½ N. direction. When running in, vessels will pass close to the south side of the red buoy off Greenberry point, and north of the black buoy off Horn point;—from this latter buoy haul towards fort Madison, and anchor in the middle of the river, in 19 feet water, muddy bottom. Vessels of under 12 feet draught can steer direct for fort Severn, and anchor in from 13 to 14 feet water. muddy bottom, abreast the city.

Patapsco River.—Patapsco river is 11 miles north of Severn river, and on the same side of Chesapeake bay. Baltimore, the chief city of Maryland, is on the north bank of the river, at about 9 miles from its mouth. The channel of the river has been deepened by dredging, and, although very narrow in the greater part of its length, has sufficient water in it at low tide to permit the passage of the largest vessels to the city. Its general direction is first W.N.W., and then N.W., it is well defined by black buoys on the south-western, and red or striped buoys on the north-eastern side. The principal portion of the harbour lies on the south-east side of the city, its entrance being between fort M'Henry and Lazaretto lighthouse; in this part there is a depth of 10 to 18 feet close to the wharves, but in Ridgley cove, on the south-west side of Baltimore, there is not, we believe, more water than 9 to 12 feet.

At Bodkin lighthouse, on the south side of the entrance to the Patapsco, it is high water on the days of full and change at 5h. 42m., and at Baltimore 50 minutes latter; at the former, springs rise 1¼, and neaps ¾ of a foot, and the mean duration of the flood is 5h. 28m., of the ebb 7h. 8m., and of the intervening still water 15m.; and at the latter place spring tides rise 1½, and neaps nearly 1 foot, upon the average, and the duration of the flood is 5h. 54m., of the ebb 6h. 38m., and of the intervening stand 44m.

Besides the fixed lights mentioned on pages 683-4, exhibited from the lighthouses on the Seven-foot knoll (off Bodkin point), and on the North point, there is a *fixed* light at fort Carroll, and another at Lazaretto point (opposite fort M'Henry). Fort Carroll is in the middle of the river, 3½ miles above North point, and near the edge of the shallow bank forming the north-eastern side of the channel, opposite Hawkins point; the light is 37 feet above the water, and visible 10 miles; attached to it is a fog-bell which is rung by machinery. Lazaretto point is 3¾ miles above fort Carroll, and forms the eastern side of the entrance to Baltimore harbour proper; the light on the extremity of this point is 35 feet above the water.

Having ascended the bay by the directions previously given, so soon as Sandy point lighthouse bears West, distant 1½ miles, steer N. by E. ¾ E. for the Lower and Upper Five-fathom buoys (striped), which may be passed on either side; it is, however, not advisable to decrease the depth below 4 fathoms, for between that depth and the western shore there are a number of small knolls, only 8 to 11 and 18 feet water. The banks at the entrance of Chester river are extensive and steep, so that considerable care should be taken to preserve the fairway. From the Upper Five-fathom buoy steer N.N.W. for the Entrance-buoy (striped), when up with which the lights on North point will be in range; if the lights are not visible, anchor in 4 fathoms water. If they can be seen, and having brought them in line, the course into the river, between the buoys, is about W.N.W., till abreast Sparrow point, and then N.W. ½ N., between fort Carroll and Hawkins point, as far as fort M'Henry; in the former part of the channel a steam-tug or pilot is very necessary, especially to a large vessel, on account of the narrowness of the channel. For smaller vessels, there is a much wider channel, as a depth of 15, 16 and 17 feet will be found in a good stretch on each tack.

Susquehanna River.—The town of Havre de Grace, at the mouth of this river, is generally considered to be the termination of the navigable part of Chesapeake bay. Its wharves can only be reached by vessels of 6 feet draught and under; those drawing more water must unload or load at Spesutie island, opposite Turkey point, as the intervening bay is shallow throughout, excepting that in its western part there is a narrow channel of 6 to 16 feet leading to Susquehanna river, and in its eastern another, 8 to 10 feet deep, leading into the North-east river. The light on Turkey point has been described on page 684; besides this there is a *fixed* light on Donoho battery (on the east side of the elbow of the channel, at 4½ miles N.W. ½ W. from Turkey point lighthouse) which is 36 feet high, and visible 10 miles. The *fixed* light on Concord point (2¾ miles N. ¾ W.

from Fishing battery) is 40 feet above the water, and may likewise be seen from the distance of 10 miles.

When bound into Susquehanna river, steer from the Upper Five-fathom buoy (off the mouth of Patapsco river) N. by E. ¾ E., until Swan point bears East distant 1¾ miles and Seven-foot knoll light bears W. by N. 4 miles, when steer N.E. by N. until the south point of Pool island bears N. ¾ W. 8½ miles, giving Mitchells bluff a berth of ⅝ mile; thence the course is N.N.E. ¼ E., passing 820 yards westward of Worton point buoy. With Worton point bearing S. by E. 1½ miles and the Walnut tree E. by S. ½ S. 1¼ miles, steer N.E. by E. ¼ E. giving Howells point a berth of ½ a mile. Having passed the mouth of the Sassafras river, Grove point (its north point of entrance) bearing S.E. by S., distant 1½ miles, and Turkey point light bearing N.W. distant 8½ miles, change the course to N.N.E. ¼ E. When Turkey point light bears East distant 1¼ miles, the course is N.N.W. ¾ W., until Locust point bears W. ¾ N. distant ⅝ mile, and Turkey Point light S.E. ¼ E. 2¾ miles, then make a N.W. ¾ W. course for nearly a mile until Locust point bears S. ¼ E. distant ⅜ mile, then steer W. ½ N. until the persimmon tree ranges with two poplar trees at Webster's house bearing S. by W. Stand to northward and eastward on this range until the Susquehanna river opens and Havre de Grace light on Concord point bears N.W. distant ¼ mile, when anchor or follow the buoys up the river. It is to be noted that the Devil's Island banks opposite point Concord, are nearly dry at low water. The channel leading towards Havre de Grace light is so narrow and crooked that strangers must be altogether guided by the lead and must not attempt to run in during night. The channel westward of Pool island should not be attempted by strangers; its least depth at low tide is 7 feet (1861).

Chester River is on the east side of Chesapeake bay, nearly opposite Patapsco river. Chestertown is on its west bank, 22 miles from the entrance following the windings of the river, and can be reached only by vessels of moderate draught, the least water in the channel-way being about 11 feet at low tide. The depth is 4 to 5 fathoms in the entrances between the banks extending from Swan point and Kent island, the extremities of which are marked by buoys, and this increases to 6, 7 and 10 fathoms as the river is ascended to a distance of 6 miles; it then gradually decreases to the town. The deepest water in the river is always in mid-channel.

Bound to Chester river from southward, follow the directions previously given until arrived at the Lower Five-fathom buoy, then steer E. by S. ½ S., and pass the red buoy on the north-east extremity of Kent Island spit on its north side; haul close round it, and steer S. by W. until the tall poplar tree on Love point, bears N.W. ¼ W., when the anchor may be cast in 5 fathoms, soft bottom, on the west side of the channel. When the wind blows from northward small vessels can run further in, and anchor eastward and northward of Hail point, the channel up the middle of the river being clear and deep.

Choptank River.—Choptank river discharges its waters into Chesapeake bay at Sharp island, and it can be entered either northward or southward of that island, although the southern channel is the deeper, there being but 12 and 15 feet water in the northern channel. Anchorage may be had under Sharp island which protects it from northerly and north-west winds, and pilots may thence be obtained to conduct a vessel up the river, or into Third Haven creek on the northern side of the river, 8 miles within Sharp island; the town of Easton, at the head of this creek, is 8 miles within its mouth, and can be reached only by small vessels under the guidance of local knowledge. Choptank river is deep enough throughout nearly its whole extent to receive vessels of considerable draught, there being in mid-channel 4 to 8, 7, and 10 fathoms water; the depth is frequently greatest where the channel is narrowest.

To enter Choptank river by the channel south of Sharp island, the channel usually followed, steer N. by W. ½ W. from Cove point until the light at Sharp island bears N. by E. ¾ E., and James point E. ¾ N., steer then into the river on a N.E. by N. course, and bring-to south-eastward of the island in any part that may be convenient.

CHESAPEAKE BAY TO CAPE HATTERAS.—From Chesapeake bay the coast of North Carolina is bordered by a chain of low sandy islands, which form with the main land numerous sounds, in general of an inferior depth. Some of these sounds are of great extent, of which Carrituck, Albemarle, and Pamplico are the principal. The latter, westward of cape Hatteras, extends 80 miles from N.E. to S.W., and is from 20 to 30 miles in width; it receives the Tar river and the Neuse at its western extremity, and communicates with the Atlantic by Ocracoke inlet, and with Albemarle sound by the channels on each side of Roanoke island. Albemarle sound is about 60 miles long from east to west, and from 5 to 15 miles wide; at its western extremity it receives the Chowan and Roanoak rivers, of which, indeed, it may almost be considered the continuation; and through Curritück sound and its inlets, which trend to the north, it communicates with the Atlantic. There is a succession of inlets between the long low, sandy islets, or reefs which skirt the coast, very few of which are sufficiently deep to receive sea vessels; some were formerly deep enough for this purpose, but have been closed by the silting up of the sand, in consequence of which the navigation of North Carolina is principally confined to small vessels.*

From cape Henry to cape Hatteras the distance is 34 leagues, and the course about S.S.E.; but the land near the latter bending to the south-westward, that direct course cannot be sailed upon. The land is all low, and as already noticed, bordered with narrow islets. At about 12 miles from cape Henry is the north end of a lake named Back bay, which we mention because of its remarkable topographical features: Mr. Mechan says of it "Back bay is divided from the

* The river Chowan is navigable to the town of Murpessbro' on the Meherrin, 10 miles above the confluence of the two rivers. The Roanoak is navigable for very small vessels to Weldon. The Tar or Pamplico is navigable to Washington, a distance of 30 miles, the depth being about 9 feet; and boats can go to Tarborough, 50 miles further. The Neuse is navigable for small vessels to Newbern, a distance of 40 miles. Newbern is the largest town in the State, and carries on an important trade in tar, pitch, turpentine, and grain.

ocean on the east by a sand beach, the southern extremity of which is dotted with high sand dunes, and oak, pine and cedar hummocks, containing the huts of numerous wreckers and fishermen, and known as the Wash woods. Further north are the Wash flats, a low smooth strand, so near the general level of the sea as to be submerged during strong easterly gales. When viewed from a vessel at sea, it seems a continuation of the ocean, and, with the high sand-hill range and trees of the Wash woods presents so near a resemblance to the entrance of the Chesapeake at cape Henry as to have been often taken for it, with disastrous effects; hence it is called False cape, or the False cape of the Chesapeake. The sand dunes at cape Henry are in some places 85 feet above the ocean level."

At 20 miles south of cape Henry, a reef, having on its extremity 15 feet water, extends 1¼ miles from the shore, and is immediately succeeded by soundings of 7 fathoms.

Body Island Lighthouse.—At about 70 miles south of cape Henry is Oregon inlet, a narrow channel leading into Roanoke sound. On the south side of this inlet is Body island, on the northern end of which there is a white lighthouse, 86 feet high, which shows a light *revolving every 1½ minutes*, at 90 feet above the sea, visible 15 miles; its geographical position is Lat. 35° 47′ 17″ N., Long. 75° 31′ 43″ W.

Wimble Shoals.—These are a cluster of shoals situated about 15 miles southward of Body island lighthouse, following the line of coast. They consist of three ridges parallel to the shore, and their position is E.S.E. from the northern part of the woodlands on Chicomicomico, and distant 2 to 4 statute miles from the beach. The soundings are very irregular, changing sometimes 2½ fathoms in a cast of the lead, with coarse sand, gravel and shells on the shoals, and outside in 13 fathoms soft black mud. Lieut. Craven, U.S. Navy, in his report of the results of his survey of the shoals in 1854, which he refers to as not having been completed, says, "I have not in this season struck the shoalest water, as, in September, 1852, crossing in the *Corwin*, we had one cast of 3 fathoms, with 5 and 7 fathoms before and after it. Vessels of considerable draught should not approach the land here within 4 miles. There is generally a strong current setting towards the shore, and the water shoals very suddenly."

Fish Bank.—Southward of the Wimble shoals there is a large mussel bank of 5 fathoms water, intermixed with cockles, and small pebbles; this bank abounds with fish, such as sea-bass, sea-trout, flounders, skate, tusk, and dog-fish. The sea-bass here are remarkable for their size, as they generally weigh from 4 to 6 pounds.

A vessel has filled two barrels on this bank in the space of as many hours, with only three lines and three hooks; and there is no doubt that if two hooks had been applied to each line, double the quantity might have been caught. The water upon the bank differs very little in colour from that of the ocean; and, in the depth of winter, is very little colder. There is likewise to be caught, in the winter season, fish, by towing over this bank; that is, if suitable bait such as the ballabo be employed, which is usual in the West Indies. It is requisite to have good tackling, as the fish are remarkably strong, and usually weigh from 20 to 30 pounds each. Four or five lines have been lost in an hour, and at last it has been necessary to bend the deep sea-line to the inner end of the tow-line, and luff the vessel into the wind.

It may here be observed that northward of cape Henry the ground is generally composed of coarse sand with shells, but from cape Henry to cape Hatteras mostly of fine sand.

CAPE HATTERAS.—This cape is low,* and at 2 miles from its extremity is a lighthouse 140 feet high, coloured red, except the lower half (70 feet) which is painted white. It is placed on the south-eastern extremity of a long ridge of white naked sand, backed by woods, and the space between the building and the pitch of the cape is a low, flat, bare sand beach, very little above extreme high water. The light *flashes every 15 seconds*, is 150 feet above the sea, and can be seen from the distance of 20 miles from all parts of the horizon. Its geographical position is Lat. 35° 15′ 8″ N., Long. 75° 30′ 57″ W. The flash continues 5 seconds, and is followed by an eclipse of 10 seconds.

Beacon Light.—In addition to the flashing light on cape Hatteras there is a small *fixed* light, shown from a red coloured open frame-work structure, situated about ¼ mile from the extremity of the cape. This light is visible from a distance of about 6 miles.

From cape Hatteras a shoal runs out south-eastward about 1¼ miles, and has from 7 to 16 feet water upon it, bottom of hard sand. At a similar distance, and in the same direction from this shoal, but separated from it by a depth of 3¾ and 4 fathoms, is a small shoal, named the Diamond, on the centre of which are only 9 to 12 feet water: this shoal is distant from the cape about 2¼ miles, and is steep, so that it will require great caution when sailing in the vicinity, yet there

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* The coast in the vicinity of cape Hatteras appears to be undergoing some remarkable physical changes, for Mr. Mechan, the surveyor, thus wrote in 1860. "From Durant's point to within a mile or so of Hatteras inlet the beach averages 1¼ miles in width, and is thickly wooded and intersected by marshes, creeks, and ponds; it is also studded with small arable patches and vegetable gardens. The ground above Durant's point for a distance of about 2 miles is low in profile and only ¼ a mile wide. The winds have divested it of both trees and sand dunes, and it is thus rendered liable to inundation as well from the ocean as from the water of Pamplico sound. The beach on the side towards the sound is thickly settled, the houses being mostly the dwellings of pilots. The action of wind and sea is steadily diminishing the area of cape Hatteras, and in this vicinity, generally, the Atlantic and sound waters are gaining on the land. Since 1853 a breadth of about ¾ of a mile of the beach at cape Hatteras, abreast of the lighthouse has been washed away. The district, however, between the cape and the settlement below it, called Trent, presents a very considerable resistance to the waters. The average width of the peninsula there is 2 miles, and it is densely wooded with different kinds of oak, pine, maple, bay, beach, and dwarf palmetto. In contour the ground is comparatively bold, and although the soil is mostly of sand, except where the numerously interspersed sedge swamps occur, it is yet remarkably compact.

The small inlet which lay open immediately below Hatteras inlet in 1857 has lately closed up, but the main inlet remains almost unchanged."

is a good passage between it and the land for small vessels in moderate weather, or when the wind is off the shore. It is, however, considered safest not to approach cape Hatteras, at night or in thick weather, nearer than a depth of 15 fathoms, when approaching from northward and eastward, or 12 to 11 fathoms from southward and westward.

At the distance of 3¾ miles to the S.E. by S. of the Diamond shoal, and at 6¼ miles from cape Hatteras is the outermost of the cape Hatteras shoals, consisting of a series of shallow spots of 9 to 15 feet water; these are named the Outer shoals; from their western part the lighthouse bears N. by W. ½ W., distant 6¾ miles, and from their eastern edge, in 9 feet water, N. 87° W., about 8½ miles. The Outer shoals, like the Diamond, are steep, and require care when sailing round them; but there is a good passage, nearly 8 miles wide, of 4 to 6½ fathoms, fine grey sand and broken shells, between them and the Diamond, to pass through which from northward and eastward, bring the lighthouse to bear West, in 10 to 9 fathoms water, about 4½ miles from it, and run South until the water shoals to 7 or 8 fathoms, and the lighthouse bears N.W. ½ W., when you may run S.W., maintaining a depth of not less than 4 fathoms through the channel, and deepening gradually to the south-western edge of it, until in 7 or 8 fathoms, with the lighthouse bearing North.

When approaching the channel between the Outer shoals and the Diamond, from either southward or westward, bring the lighthouse to bear North, in a depth of 8 to 7 fathoms water, when you will be in about 4½ miles from it, and should run N.E., until you get into a depth of 8 to 9 fathoms water, with the lighthouse bearing N.W., when the shoals will be cleared.

To clear the Outer shoals, in approaching from the northward and eastward, bring the lighthouse to bear West, in 12 to 10 fathoms water, then run South, keeping in not less than 10 fathoms water, until the lighthouse bears N.W. ½ N., when any course south of West may be steered with safety. Coming from southward and westward, keep in not less than 10 fathoms water, until the lighthouse bears N.W., when any course eastward of North may be steered. In bad weather, and especially at night, do not approach the shoals nearer than the depth of 15 fathoms from northward and eastward, and 12 to 11 fathoms from southward and westward. It is necessary to watch the bearings of the lighthouse, and keep the lead going in beating round or between the shoals. Approaching the shoals at night, or in bad weather, if the lighthouse has not been seen before night, it will not be prudent to run for it. As the depth of 10 or 11 fathoms may be found westward of the shoals when going outside of them from the southward and westward, the land southward of the cape should not be approached nearer than 8½ to 10 miles.

If near the lighthouse and prevented from sailing round the Outer shoals, which at all times is most expedient, particularly with a large vessel, the channel between the Diamond shoal and the shoal spit extending from the cape may be run for. If from northward and eastward, bring the lighthouse to bear N.W. by W. ½ W., in 8 to 7 fathoms water, 2½ miles distant, and steer S.W., giving the end of the shoal-spit and breakers a berth of ½ a mile: on this course a depth of not less than 3 fathoms will be found. When the lighthouse bears North, in 5 to 6 fathoms water, the Diamond will be cleared, and when the lighthouse bears N.N.E. ½ E., in 6 to 7 fathoms water, the shoal-spit from the cape will be cleared, and the anchorage in Hatteras cove, immediately westward of the cape, will be opened, into which you may run, and obtain good anchorage in from 4½ to 5 fathoms water.

To pass betweeen the Diamond and the shoal-spit running from the cape, from either southward or westward, bring the lighthouse to bear North, in 5 fathoms water, when you will be about 2 miles from the breakers near the cape, and may steer N.E. through the channel, until the depth of 9 to 10 fathoms water be attained, when the shoals will be cleared.

*Buoys.**—As a security to vessels approaching cape Hatteras shoals, a large bell-beacon buoy, 40 feet long and 15 feet abeam, has been placed in 4 fathoms water inside the easternmost of the Outer shoals, the lighthouse on the cape bearing N.N.W. ¾ W. The bell weighs 1000 lbs., is fitted with four hammers, and is secured on the top of an iron mast, braced fore and aft and athwart-ship; there is a large iron cage below the bell, and as the buoy is of large size it ought to be seen at the distance of about 5 miles. When in the vicinity of this buoy, it ought not to be approached nearer than 2 miles to the eastward; 1½ miles to the southward; and 3½ miles to the westward.

A buoy is also placed in 3½ fathoms near the north-west spit of the northernmost of the Diamond shoals, at the northern entrance to the channel, from which the lighthouse bears N.N.W. ½ W. distant 3½ miles. Vessels of proper draught may pass within 100 yards to the north-westward of the buoy. The course through from the buoy is S.W. ¼ W. The channel opposite to the buoy is ¾ mile wide, and the shoals lie from S.S.W. to S.E. from it.

The currents over and in the vicinity of Cape Hatteras shoals, have a velocity of 3 to 5 knots per hour, and are greatly influenced in direction and force by the winds. The surface water of the Gulf Stream extends to within a short distance of the Outer shoals, for some time after a continuation of northerly and easterly winds.

It is high water here on the days of full and change of the moon at about 8 o'clock, and the tide rises from 4 to 5 feet; but with easterly winds several feet higher.

Hatteras Cove lies immediately westward of the cape, and is a good place to which a small coaster may run as a harbour of refuge, but the protection is only from northward and north-westward, it being exposed to all points between South and W.N.W. The anchorage is in 5 to 4½ fathoms, at about ¾ mile from the

* The shoals were made by the buoys in the manner described in the text, a few years ago. As the buoys are not mentioned in the official list of beacons on the coast of the United States, published at Washington in 1868, we are uncertain if they still exist.

north shore, with the point of the cape bearing about E.S.E., on a bottom of hard sand, with occasionally a little blue mud.

To enter Hatteras cove from southward and westward, bring the lighthouse to bear N.E. by N. ½ N., and run for it. If from northward and eastward, cross the shoals as previously directed. If from outside the shoals, keep in 12 fathoms water, until the light bears N.N.W., then steer N.W. until the light bears N.E. by N. ½ N., after which steer for the anchorage as before directed.

If obliged to beat into Hatteras cove, go about on approaching the western shore, or on standing in towards the shoal extending from the cape, or getting into less than 4 fathoms water.

CAPE LOOKOUT.—Cape Lookout is distant 66 miles from cape Hatteras in a S.W. by W. direction. It is the acute angle point of a narrow neck of land, behind which is Core sound, an extensive but shallow lake forming the south-western prolongation of Pamplico sound; westward from the cape the sound forms Beaufort harbour. The cape may be readily recognised by its lighthouse, a red tower 150 feet high standing near the extremity of the land, which shows a *fixed* light at 156 feet above the sea, visible 20 miles; its geographical position is Lat. 34° 37′ 16″ N., Long. 76° 31′ 7″ W. The old tower (formerly lighted) has been painted red and white in horizontal stripes.

In consequence of the little elevation of the land forming cape Lookout, and the shoals which extend from it 12 to 14 miles in a S.S.E. direction, the cape is a very dangerous headland to vessels running along the coast. During night the light (a first class one) is frequently hidden by haze: hence, the utmost attention should be paid to the soundings when there is reason to believe that the vessel is in the vicinity of the shoals, and the lead should be hove frequently. The broken ground of the shoals extends southward to about Lat. 34° 28′: in this parallel with this exception the depth is 14 to 12 fathoms, and thence to the Gulf Stream it gradually increases to 95 fathoms. The outer part of the shoals lies S.W. ½ W., 67 miles from Cape Hatteras lighthouse, and at the same distance S.W. ¾ W. from the outer part of Cape Hatteras shoals.

The following descriptions of the shoals are from the United States Coast Survey Reports of 1864 and 1865;—the first is by Lieutenant Commander T. S. Phelps, and the second by Mr. Charles Junken:—

"The breakers make S. by E. ½ E., 7½ miles from the lighthouse, and are constant with the exception of a space of about 2½ miles, where in moderate weather the sea does not break; and I was informed by the lighthouse heeper that this space was used by vessels drawing less than 9 feet.

From the south point of the constant breakers the shoal continues in the same direction 3 miles further, or 10½ miles S. by E. ½ E. from the lighthouse. This part of the shoal is indicated by light green water, varying to a yellow tinge on the shoalest lumps; and is also very 'lumpy,' the water over the lumps varying in depth from 9 to 18 feet, and it is on this point south of the constant breakers that the blockade vessels have recently touched. About 1½ miles to the southward and eastward of the above shoal is one on which there is 5½ fathoms water, and still further in the same direction, S.E. by S. ½ S., 18½ miles from the lighthouse, lies the outer shoal on which there is 5½ fathoms. Beyond this I discovered no indications of shoals. With the eye elevated 18 feet above the water, and 10½ miles from the lighthouse, just clear of the dangerous shoal, the ground on which the lighthouse stands is below, and the lower red stripe of the old lighthouse is half its width above the horizon; the constant breakers are plain in sight 8 miles distant.

The lower red strip, well on the horizon, will carry a vessel around the dangerous shoal in from 6 to 8 fathoms.

On the 5½-fathom shoal the breakers are in sight, with no horizon showing beyond, and when on the outer shoal, in 5½ fathoms, the lower edge of the upper red stripe of the old lighthouse is a little above the horizon, and there are no breakers in sight. With the top of the old lighthouse just discernible above the horizon, a vessel will be well clear of all shoals, and 15 miles from the lighthouse. In from 7 to 11 fathoms the colour of the water is dark green; in 5 fathoms a pale green; and in 3 fathoms and less a very light green, varying according to the depth."

"The most prominent of the shoals is Lookout breaker, (Cape Lookout light bearing N. by W. 7 miles distant), with only 4 feet of water on it; and although very heavy breakers, they are no great obstacle to the cautious mariner, their continuous foaming and roar serving to warn in the approach to them. They serve to define the slue, or channel, of 2½ miles in width, between the Lookout breaker and the Shore breaker. This channel is used by coasting vessels drawing less than 9 feet. In coming from eastward they head on a west course for the south-east end of Lookout breaker, approach it to within a ¼ of a mile, and then steer N.N.W. along the breaker until they reach a depth of 6 fathoms. The Shore breaker also can be followed as a guide through the slue, but no channel available for larger vessels than the class named exists at present, by reason of the many shoal lumps found in the slue.

That part of the shoals which is continuous with the spit extends 3 miles outside of Lookout breaker, cape Lookout light then bearing N. by W. ½ W., and distant 10½ miles. Here the three narrow ridges connecting with Lookout breaker end, with a depth on them varying between 12½ and 20 feet. These ridges are the most dangerous part of the shoals, as there is no indication of their existence in moderate weather.

Beyond the ridges there are three detached lumps, each covering an area of less than ½ a square mile. The least depths on them are 4¾ and 5½ fathoms, and from the outer one cape Lookout light bears N.W. by W. ½ W., distant 18½ miles."

The following is from the chart of the shoals, the result of the survey made in 1866 by the United States Coast surveyors.

To clear the outer shoals.—Approaching from northward and eastward, bring the lighthouse to bear N.W. in from 18 to 14 fathoms water; run S.W. by W., keeping in not less than 12 fathoms water, until the lighthouse bears N. by W. ½ W. when any course to the southward of West may be steered.

Approaching from southward and westward, bring the lighthouse to bear North distant about 15 miles in 11 or 12 fathoms water; run E. by N. keeping in not less than 8 fathoms water, until the lighthouse bears N.W. ¾ N. when any course to the eastward of North may be steered.

With the eye elevated 18 feet above the water, and 15 miles from the lighthouse, the top of the old lighthouse is just discernible above the horizon.

In thick weather the outer shoals should not be approached; from northward and eastward into a less depth than 15 fathoms from southward and westward, into less than 11 fathoms.

At 8½ miles from Lookout breakers (10½ miles from the lighthouse) a depth of 6 fathoms can be carried through, as follows:—*Approaching from northward and eastward*, bring the lighthouse to bear N.W. by N. ¾ N. distant 10½ miles, in 10 to 11 fathoms water, run S.W. by W. (keeping in a depth of not less than 6 fathoms) until the lighthouse bears N. ½ W. in 7 fathoms, when all the dangers will have been passed.

Lookout breaker is visible at a distance of 8 miles in clear weather. There is a channel of 18 feet water at ¾ mile inside this breaker, which runs N.W. by W. and S.E. by E. The slue, about a mile from the spit of the cape, carries 8 feet through the shoals. Neither of these channels should be attempted by strangers.

Lookout Bight.—In Lookout bight, the small bay immediately on the west side of the cape, vessels occasionally anchor and find protection from northerly and easterly winds. To run in; when in 8 fathoms water, bring the lighthouse to bear E. by N. and steer for it. The best position is at ½ a mile from the beach, in 5 to 6 fathoms, with the point of the cape bearing South, and the lighthouse E. by N. distant about a mile. Care must be taken to sail directly the wind shifts, as should it blow strongly from westward or southward the vessel would be driven on shore.

Cape Lookout to Cape Fear.—From cape Lookout to cape Fear, the bearing and distance are S.W. by W.. 84 miles. Between the capes there are islands along shore, divided only by shallow inlets; of these latter the principal is Bogue inlet, lying westward of cape Lookout, at the distance of 27 miles from Beaufort harbour, and having over its bar never less than 8 and 9 feet of water; within is a river having on its western bank the town of Swansborough. New River inlet is 4½ leagues westward of Bogue inlet, and has 8 feet water in it, and, therefore, must only be used by small craft; off the entrance to this inlet there is said to be a shoal at a short distance from the shore. New inlet is the last of these, and is situated between Smith island and Federal point.

CAPE FEAR is the south-east extremity of Smith island, which forms the two entrances of cape Fear river and the port of Wilmington. At Bald head, the western extremity of the island, distant about 4 miles from the pitch of the cape, there is a tower 92 feet high, which is a useful land-mark. This tower was formerly a lighthouse; its geographical position is Lat. 33° 52′ 19″ N., Long. 77° 59′ 49″ W.

On the shore of Oak island, at the western side of Cape Fear river, there are two small lights, used for crossing the bar. And, on Federal point, a little north of Smith island and on the north side of New inlet, there is a lighthouse 45 feet high, which shows a *fixed* light at 50 feet above the sea, visible 12 miles;—the arc illuminated is 325° (N. 35° E. eastward and southward to North). In addition to these lights there are others for the local navigation.

The shoals from Cape Fear extend out 10 miles in a S. by E. ¾ E. direction from the pitch of the cape; but off their extremity, there are several patches of 10 to 18 feet, which make their entire length from the cape about 15 miles, or 18½ miles from Bald Head tower. The shoal spot at their extremity (2½ fathoms) is distant 18 miles S.S.E. ¾ E. from the tower. The outermost have hitherto been called the Frying Pan shoals, but this term is now applied to the whole of the shoals from the cape. When passing them, vessels of heavy draught ought to keep in 15 to 18 fathoms, especially in threatening weather, and under no circumstances run into a less depth than 12 fathoms.

The Frying Pan Shoals have a width of about 2 miles, and a depth over them of 6 to 11 and 17 feet:—as the depth close to their edge is 4 to 5 fathoms, the sea generally breaks heavily upon them in strong gales. Near the cape there is a part which dries at low water, and here for some distance are breakers; there are also breakers at the end of the shoals. Small vessels sometimes cross the shoals, but strangers ought never to attempt it in vessels drawing more than 7 feet. If drawing not more than 9 to 10 feet, it is possible to cross the shoals at high tide, at the distance of 4 miles from cape Fear, steering from East to E.N.E., or West to W.S.W.; or drawing 10½ to 11 feet at the distance of 5½ to 8 miles from the cape, steering N.E. to E.N.E., or S.W. to W.S.W. There is also a channel of not less than 18 feet, running N.E. by E. and S.W. by W., at the distance of 18 miles S. by E. ¾ E. from Bald head lighthouse. The south extremity of the shoals is very steep, as the lead will drop from 7 or 12½ feet into a depth of about 8 fathoms.

At about a mile from the south end of the shoals extending from the cape, there is a small shoal of a mile in extent, lying 14½ miles S.S.E. ½ E. from Bald Head tower. It has a depth of 10 to 16 feet upon it, and 3½ to 8½ fathoms will be found between it and the shoals from the cape. Upon this shoal the sea breaks in moderate weather. There are also, at 2 or 2½ miles southward of this shoal, two small patches of 16 to 18 feet water, lying S.S.E. ½ E. to S.E. by S., 16 to 17½ miles from Bald Head tower; close to them is a depth of 8½ to 7 fathoms. These various shoals may be considered as a prolongation of the dangerous shoals from the cape, and in approaching them great caution is necessary, particularly in a large ship. At 2 miles eastward from them, the depth is

6 fathoms; at the same distance southward 10 fathoms; and westward 9 fathoms.

Lightvessel.—The lightvessel off the south end of the Frying Pan shoals is moored in 10 fathoms at about a mile outside the outer 18-foot shoal. It is distant 19 miles S.S.E. ¼ E. from Bald Head tower; 28 miles S. by E. from Federal Point lighthouse; and, its geographical position is considered to be Lat. 33° 35′ N., Long. 77° 50′ W. It is schooner rigged;—the hull is painted yellow, with the words "Frying Pan Shoals" painted in large black letters on each side; lower masts painted yellow, top-masts black; the day-marks are black, one on each mast. It shows two *fixed* lights at 40 feet above the sea, visible 10 miles, and carries a fog-bell and horn. This lightvessel should always be passed on its south side.

Buoys.—In addition to the lightvessel just mentioned, the Frying Pan shoals were marked in 1866 by four buoys, each side of it being guarded by two buoys. Strangers should be very careful that they keep to seaward of these buoys.*

From the lightvessel to the centre of the outer breakers, the bearing is N.N.W. ¼ W. The southern extremity of the breakers, with only 10 feet of water upon them, is about 4 miles inside the position of the vessel. A shoal spot with 16 feet water on it, bears about N.W. ¼ N. nearly 2¼ miles; and another shoal spot, with 18 feet water upon it, bears about N. ¼ E., 1½ miles from the vessel.

The soundings eastward of the lightvessel are, in general, gradual and uniform from 10 fathoms to about 6 fathoms before deepening, after crossing the outer extremity of the shoal in the vicinity of the lightvessel; and the soundings westward gradually deepen, from the vicinity of the vessel, from 9 and 10 to 15 and 17 fathoms.

Sailing vessels of heavy draught should not run in bad weather into less than 15 to 18 fathoms water when passing these shoals. Steamers and small vessels may run with safety, under ordinary circumstances of weather, on the line East and West, upon which the lightvessel is placed.

If from eastward, and bound to Cape Fear river, vessels may clear the west side of the Frying Pan shoals by not bringing Bald Head tower to bear westward of N. by W. If bound eastward from the river, steer S. by E. to the distance of 15 miles from the bar, when the depth of 8 to 10 fathoms will be attained, and the lightvessel will bear East; steer now for the lightvessel and pass it on its south side. Strangers should at all times avoid getting among the shoals, and are strongly recommended, at night or in thick weather, to keep southward of Lat. 33° 35′ N.

CAPE FEAR RIVER, immediately westward of cape Fear, is the largest and most important river in North Carolina, and has a north-west course for about 300 miles. Its depth to Wilmington, a distance of 34 miles, is 9 to 11 feet,

* The Frying Pan shoals may not now be buoyed, as the buoys are not mentioned in the "List of Buoys, Beacons and Day-marks on the coast of the United States" published by the Lighthouse Board, Washington, in 1868.

and there is boat navigation to Fayetteville, 95 miles farther. The principal channel into the river lies between Smith island on the east, and Oak island on the west side, and is about a mile wide, with soundings of 3½ to 5 and 6 fathoms; but this depth is not continued outside the river as there is a bar of 7 to 9 feet water. New inlet, north of Smith island, between it and Federal point, has also a bar of less than 9 feet at low tide. As these inlets are subject to frequent changes, instructions for entering them are useless, the assistance of a pilot is therefore indispensable.

It is high water at Smithville on the days of full and change of the moon at 7h. 17m., with a rise of tide of 4½ feet. The mean duration of flood tide is 6h. 1m., and of ebb 6h. 26m. At the 10-foot shoal, 14 miles from the tower on Bald head, the tide makes an hour sooner, and on the outer edge of the shoals 1½h. sooner than on the bar of Cape Fear river. At the cape the variation of the compass is at present only 22′ E.

When approaching the coast in the vicinity of Cape Fear, it is prudent to keep nearly a degree southward of the latitude of the place intended to be made, until there is reason to believe that the vessel is on the edge of the Gulf Stream, when a course must be directed according to circumstances. If possible, avoid sailing northward of Lat. 33° 20′ N., or, at the highest, Lat. 33° 25′ N., until the depth of 10 fathoms is attained, which will be near the south or outer end of the Frying Pan shoals. Approaching the coast in Lat. 33° 20′ N. the first soundings will be from 30 to 35 fathoms, very near the inner edge of the Gulf Stream. When in 17 fathoms, the bottom will be fine gray sand with black spots; these soundings are maintained for a considerable distance. When steering westward the depth will decrease very little for the first 5 or 6 leagues; in 14 fathoms it decreases gradually but with greater rapidity;—in clear weather the land can be seen from the depth of 10 fathoms, which is within the Frying Pan shoals. From an offing off the outermost of the shoals no land can be seen on a bearing westward of N.W.

Between cape Fear and Winyah harbour the coast forms Long bay, in which are several inlets: Lockwood's Folly inlet at about 11 miles westward of Bald Head tower; Little River inlet (dividing North from South Carolina), still farther westward; and North inlet northward of North island, and about 9 miles from Georgetown lighthouse. All these are too shallow to be visited by any but coasters.

WINYAH or GEORGETOWN.—This town, on the west bank of the Peedee river, is distant about 75 miles from cape Fear. The entrance is barred by shifting sands, hence *the assistance of a pilot is always necessary.* Buoys mark the navigable channels. The bar has usually a depth of about 7 feet upon it at low tide; the depths outside it are irregular.

All the coast about Winyah harbour is low and unmarked by any distinctive scenery; the lighthouse on the south end of North island is, therefore, a very conspicuous object to vessels approaching. This building is 82 feet high, coloured white, and shows a *fixed* light at 85 feet above the sea, visible from all parts of the sea horizon at the distance of 15 miles; its geographical position is Lat. 33° 13′ 21″ N., Long. 79° 10′ 58″ W.

At about 8 miles northward of the entrance to Georgetown harbour there is a narrow channel into the harbour named North inlet, which is not navigable by vessels.

CAPE ROMAN.—Cape Roman and the shore in its vicinity is very low, and the cape itself when seen from a distance appears to be a sand left dry by the tide. Cape Roman, is, properly speaking, the southern extremity of a narrow islet, named from that circumstance Cape island, which is separated from the shore by a narrow channel of 14 to 21 feet water. Into this channel small vessels drawing less than 7 feet, the depth on the bar, may run for shelter and anchor between the lighthouse and the island: it should, however, only be entered by coasting vessels the masters of which are thoroughly acquainted with the navigation.

On the east end of Racoon cay, within or westward of Cape island, there is a tower 150 feet high, which shows a light *revolving every minute* at 154 feet above the sea, visible from all parts of the sea horizon at the distance of 19 miles.*

Cape Roman Shoals.—These very dangerous shoals extend out from cape Roman 4 miles in a S.E. ¾ E. direction, or nearly 6 miles from the lighthouse on the same line of bearing. The flat upon which they rest has a gradually decreasing depth of from 18 to 5 and 2 feet, the latter being close to the shore of Cape island. The outermost shoal is on the extreme edge of this flat; it has but 7 feet on it at low tide, and is extremely steep, for on its south-eastern side the lead from 7 feet drops almost at once into 30 feet, and this rapidly increases seaward to 37 and 40 feet. On account of these shoals great care is requisite when running down the coast from cape Fear to Charleston; it is recommended not to get into a less depth hereabout than 8 fathoms, and to make a frequent use of the lead.

When approaching the shoals of cape Roman, from northward, it will be advisable not to get into a less depth than 8 fathoms, because there is a 15-foot shoal outside the flat bordering the coast between Winyah harbour and cape Roman. This shoal is 5 miles from the shore, opposite the entrance to the North Santee river; from it Winyah lighthouse bears N. by W. ¼ W. 7 miles, and that on cape Roman S.W. by W. ¾ W. 12 miles.

BULL BAY.—This is an excellent harbour of refuge for vessels unable to enter Charleston harbour, by reason of strong N.E. or S.W. gales. It is about 5 miles

* This lighthouse is about 6 miles from the extremity of the shoals off the cape, and 10 miles south-westward from the entrance to Santee river; its geographical position is Lat. 33° 1′ 8″ N., Long. 79° 22′ 12″ W., and its light should be seen at the distance of 17 miles outside the shoals. Near it is an old tower 65 feet high, which is painted with red and white horizontal stripes.

in extent, and nearly its whole surface is occupied by a shallow flat, but there is a good channel in the western part of the bay, close round the east end of Bull island, into which vessels of not too great a draught to cross the bar (13 feet at mean low water) may run. The rise and fall of the tide are about 4½ feet. The instructions in 1857 were, "When in 6½ fathoms water bring Bull Bay lighthouse to bear N.W. by W. ½ W., and steer for it on that bearing, leaving the bar buoy 250 yards on the starboard hand, until in 3½ fathoms water, then follow the beach around until off the mouth of the creek, and anchor in 3½ fathoms, muddy bottom. This is a safe anchorage and the channel is clearly marked by the breakers on either hand."

The lighthouse on the north end of Bull island is a brick building 35 feet high, which shows a *fixed* light at 49 feet above the sea, visible from, we believe, all parts of the sea horizon at the distance of 12 miles. Its geographical position is Lat. 32° 55′ 20″ N., Long. 79° 33′ 44″ W.

When leaving Bull bay for the southward the dangerous shallow ground on the south side of Bull island must be carefully avoided. The outer edge of this ground, upon which is a depth of not more than 15 feet, is distant 5 miles from the lighthouse on a S. ½ E. bearing; close to it is not less than 6 fathoms water.

Rattlesnake Shoal.—The low coast between Bull bay and Charleston is fronted by a shallow flat, which extends out, more or less, 2½ miles. On the outer edge of this shallow flat is the dangerous Rattlesnake shoal, upon which is a depth of not more than 7 to 10 feet. It is 1½ miles long, from E. by N. to W. by S., and ½ of a mile wide, and lies 8 miles from the nearest shore. It was marked in 1868 by two nun buoys, coloured black and red in horizontal stripes;—the *outer* buoy is moored in 8½ fathoms on the north-east point of the shoals, and from it, fort Johnson bears W. ½ N.; the north-east point of Long island North; and Charleston bar lightvessel S.W. ½ W.,—it can be passed on either hand;—the *inner* buoy is moored in 8 fathoms on the inner end of the shoals, and from it, the south-west point of Dewees island bears N.N.E. ½ E.; fort Sumter tower West; and Charleston bar lightvessel S.S.W.

In the channel north of Rattlesnake shoal there is sufficient water for small vessels, but it will be always advisable to go south of it. In the event of the buoys being adrift, the shoal should not be approached nearer than to have fort Moultrie bearing W. ¾ N.

CHARLESTON is the principal harbour in South Carolina. It is barred by shifting sands, hence instructions for entering it are useless and the *employment of a pilot by strangers imperative.* The channel is buoyed. In 1866 the depth over the bar of the channel was 11 feet at low water. The average time of high water after the moon's meridian passage is 7h. 24m. Spring tides rise 5½ feet; neaps 4¾ feet,—the mean duration of rise is 6h. 16m., of fall 6h. 9m.

Lights.—The lighthouse on Morris island, situated 3½ miles southward of fort Sumter on the south side of Charleston harbour, is coloured white, 110 feet high, and shows a *fixed* light at 133 feet above the sea, visible 17 miles; its geographical position is Lat. 32° 41′ 56″ N., Long. 79° 52′ 29″ W.. There is also a small beacon light visible 12 miles, at ½ mile south-eastward from this light.*

A small *fixed* light on Sullivan island, north side of the entrance, is visible 12 miles. A *fixed* light is also shown at fort Sumter, another at castle Pinckney, and one at the east end of Charleston battery.

The lightvessel outside Charleston bar is moored in 6 fathoms at about a mile E. ½ N. from it. It shows two *fixed* lights at 44 feet above the sea, visible 12 miles, and carries a fog-bell and horn. Its geographical position is Lat. 32° 40′ 34″ N., Long. 79° 48′ 0″ W.; from it the shoal spot of the Rattlesnake shoal bears N.N.E. ¾ E. distant 5 miles. (1866).

A lightvessel bearing a *red* light is moored in the main ship channel over the wreck of the Weehawken monitor. (1866).

PORT ROYAL.—The harbour of Port Royal is formed by the outlet of the extensive Broad river, and is an excellent anchorage, with an ample depth of water for the largest vessels. In its northern part, just within the entrance is Beaufort river, upon the western bank of which, at 12 miles from the sea, is the town of Beaufort; this river has sufficient water for ordinary ships, as the depth decreases gradually from 30 to 11 feet, the latter being at about half-way up the stream, and again off the town.

As the sands fronting the entrance to Port Royal are subject to change especially after strong easterly gales, *strangers must employ a pilot.* The bar has usually about 20 feet water on it.

The lightvessel outside the entrance to Port Royal, named *Martin's Industry*, is moored in about 7 fathoms. It shows two *fixed* lights at 44 feet above the sea, visible about 12 miles, and carries a fog-bell and horn. Its geographical position is about Lat. 32° 5′ 31″ N., Long. 80° 35′ 18″ W.

SAVANNAH RIVER forms the boundary between South Carolina and Georgia, and is sufficiently deep at its entrance to admit large vessels. The channel in is buoyed, and there are several lights and beacons for the purpose of indicating a change in the direction of the navigable channel. *Strangers must employ a pilot.*

The lighthouse on the south side of the mouth of the river stands on the north-east end of Tybee island. It is coloured white, is 134 feet high, and shows a *fixed* light at 150 feet above the sea, visible 19 miles. In addition, there is a small *fixed* (beacon) light at about ½ a mile in front of it, which can be seen at the distance of 13 miles.

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* We are uncertain if these lights are now shown. They are noted in the U.S. Lighthouse List for 1869 as extinguished, and the buildings are not inserted in the U.S. Coast Survey chart of 1866. Many of the lighthouses on the coast of the southern states were destroyed during the civil war—these are gradually being re-established.

At the commencement of the war in the United States the Federals destroyed the harbour of Charleston by sinking barges laden with stones in the navigable channels. There are reasons for indulging the hope that in this instance good may spring out of evil, for it is believed by engineers that the effect of the obstructions will be the scoping out of a permanent channel in the bar by reason of the outward current from the river not being suffered to spend its force over the whole of the flats forming the bar.

Vessels bound to Port Royal are recommended to make the land about Tybee island, as the lighthouse just mentioned makes that part of the coast more distinguishable than any other. Ships drawing 14 or 15 feet water may go in at Tybee, and proceed through land to Beaufort, in Port Royal island; thence, such as draw 8 or 9 feet water, may go through land to Charleston;—from Charleston, vessels of 7 or 8 feet water, may go through land to the river Medway, in Georgia.*

Tides and Winds.—It has been observed that on this coast N.E., Easterly, and S.E. winds cause higher tides than other winds, and also somewhat alter their course. Off Port Royal entrance at about 6 leagues from the land, in 12 fathoms water, the flood sets strongly southward, and the ebb northward; at a greater distance from the shore there is no tide at all. Near the entrance to the harbour there is a strong indraught during the flood tide, and an outset with the ebb tide.

If the wind blows hard from the N.E. quarter, without rain, it commonly continues so for some time, perhaps three or four days; but if such winds are attended with rain, they generally shift to the East, E.S.E., and S.E. Southeast winds blow right in on the coast, but they seldom blow dry, or continue long; in 6, 8, or 10 hours after their commencement, the sky begins to look dirty, which soon produces rain. When it comes to blow and rain very hard, there may be some certainty that the wind will fly round to the N.W. quarter, and blow hard for 20 or 30 hours, with a clear sky.

N.W. winds are always attended with clear weather; they somtimes blow very hard, but seldom for longer than 30 hours. The most lasting winds are those which blow from the S.S.W. and W.N.W., and from the North to the E.N.E. The weather is most settled when the wind is in any of these quarters.

During summer, thunder-gusts are very common on this coast. They always come from the N.W. quarter, and are sometimes so heavy that canvas cannot withstand their fury. They come on so suddenly that the greatest precaution is necessary to guard against the effects of their violence.

BAHAMA BANKS.

These, consisting of the Great and Little Banks, are generally composed of coral, and are of great extent. They are remarkable for being very steep, as the lead from 10 fathoms or less will frequently drop into 100 fathoms. Scattered

* None of the rivers on the coast of Carolina, Georgia and Florida should be entered by strangers without the assistance of a pilot. They are all barred, and the channels in are subject to frequent change. A survey of the whole coast is now in progress.

over them are many ledges, awash or nearly so at low tide; as these are in general easily seen in clear weather, there is but little difficulty in avoiding them.

On the Great Bank lie the island of New Providence, the Current isles, Berry isles, Andros, Eleuthera, Harbour island, Exuma, Yuma or Long island, the Jumentos, cay Verde, and San Domingo cay; to the north and west lie the Isaacs, Bemini isles, Cat cays, Orange cays, &c.

On the Little Bank are the Abaco isles, Great Bahama, Memory rock, &c., and between Abaco and the N.W. point of the bank there is an extensive chain of small low cays on the edge of the bank whereon many vessels have been wrecked, being carried thence by the strong westerly swell which generally sets upon them.

The islands are in general low, flat, and interspersed with broken porous rocks: the soil is usually light and sandy, and produces an abundance of trees, among which will be found mahogany, brasiletto, lignum-vitæ, wild cinnamon, pimento, satin-wood, cedars, &c.; there are, moreover, many spots of good soil used for the cultivation of cotton and the rearing of cattle. In the islands there is but a scanty supply of fresh water; that which they have is very brackish, and is generally obtained by digging a hole in the sand about 6 feet deep, and inserting a cask without a bottom. The climate is temperate; the northern isles being refreshed in the winter months by the cool north-westerly winds, and the southern isles almost constantly enjoying the Trade-wind of the ocean.

The winds on the East, S.E. and southern parts of the Great Bahama bank, from the months of November to April, veer from the N.E. and eastward, these being the regular Trade-winds in these months: but when the wind is in the S.E. quarter, it generally rains, and is boisterous; veering to the southward and gradually to the northward about every 10 days, and on the northern parts of the bank about every 7 days during the months above-mentioned; veering round with rain, and blowing fresh from the south-eastward, southward, and south-westward, and very frequently come in a heavy squall of wind, rain, lightning, and thunder, from the northward, with a gradual increase to a gale during the winter season. When the wind is in the S.E. quarter you may prepare for a N.W. gale ere 20 hours have elapsed. The thermometer during these months averages from 70° to 78°. The gales are most severe and of greater duration in the latter part of the season. The easterly breeze sets in very light in May, and there is, at times, heavy rain. The winds, from June till August, are strong from the eastward, and squally. August to October is considered as the hurricane season, when the weather is variable; sometimes hot and sultry, with little wind,—and sometimes squally, with variable winds. Thermometer 84° to 90°. There is, frequently, from the latter end of October to the middle of November, unsettled and squally weather, with variable winds and showers. A general description of the winds of the region will be found on p. 108.

In completion of the series of directions in this work it will be sufficient to describe New Providence and Nassau.

NEW PROVIDENCE, the principal island of the Bahamas, is 17 miles long from east to west, and 7 miles broad: on its north side is the harbour and town of Nassau, which is also the seat of government.

Nassau.—The harbour is sheltered on the north side by Hog island. At the usual anchorage for vessels of moderate draught the depth is from 13 to 15 feet at low water springs; large vessels, however, bring up outside the port near the north shore of Hog island. Nassau may be recognised from a distance by forts Fincastle and Charlotte, between which is Government house (a large white building on the top of a hill, which will be seen over Hog island); or by the lighthouse (near the west point of Hog island, in Lat. 25° 5′ 37″ N., Long. 77° 22′ 22″ W.), on the east side of the entrance to the harbour. The light, *fixed*, is 68 feet above the sea, and visible from an offing of 10 miles; it is shown over an arc of 90° (N.W. northward to N.E.). At 100 feet westward from the lighthouse there is a flagstaff used by the pilots for signalling.

The west end of Hog island, composed of white sand hills, 20 feet high, terminates, in a point of low rocks, beyond which is the barred entrance to the port. On the bar the least depth at low water springs is 15 or 16 feet, and on it are frequently heavy breakers with North and N.W. winds, on which account the harbour may sometimes be inaccessible for several days; in general, ships drawing more than 14 or 15 feet cannot pass over it without danger, for the rise at springs is only 4 feet, at neaps 3 feet: it is high water at full and change at 7h. 30m.

The *outer anchorage*, northward of Hog island, is with Government House open east of Christ church S. by W. ¾ W. in 8 fathoms, $\frac{4}{10}$ of a mile from the shore of the island, and with the lighthouse bearing W. by S. ¾ S.;—nearer than this to Hog island the water shoals very rapidly.

The navigable channel of the harbour is well marked by buoys and beacons,—thus, there are four *red* buoys to be kept on the port side on entering, and three *black* buoys on the starboard side. The first red buoy marks the extremity of the spit extending from the west end of Hog island, and the first black buoy is placed on the north-east projection of a shoal named Hogfish. Besides these buoys there are the Tony beacon, on a conspicuous rock of that name, and an obelisk eastward of Charlotte fort; these are readily recognised from the offing.

A pilot can in general be procured within 2 or 3 miles of Hog island, or perhaps at a greater distance, and when intending to enter the harbour it is always advisable to have one on board if possible.

To *cross the bar* in a good position, bring the Ordnance Wharf bathing-house in one with the spire of the Presbyterian chapel, bearing S.E.; this course also leads well up the harbour; or bring the obelisk and Tony beacon in one, bearing S. by W., and proceed until the flagstaff on Hog island and the lighthouse are in one, then haul up S.E. Frequent reference must be had to the chart,* and bear

* See the Admiralty chart No. 1452.

in mind the remark above respecting the buoys. The anchorage off the town is oppposite the Navy and Ordnance yards and the barracks, with the Tony beacon and the Cocoa-nut tree on North Cay in one.

The following instructions for vessels bound to Nassau are from the *West India Pilot*, 1866:—"The entrance to Nassau harbour lies between Hog island and Silver cay; but between them a rocky bar runs right across, which breaks heavily with strong N.W. and North winds, and is sometimes impassable for several days. The greatest depth at low-water springs is 17 feet, but this is only in a space not 50 yards wide, and vessels drawing over 15 feet cannot cross it with safety.

When bound to Nassau from the North or N.E. a wide berth should be given to the north-east elbow of the Little Bahama bank, until the parallel of 26° 30′ N. is reached. Approaching from eastward the latitude of 25° 45′ N. should be most carefully maintained until either the north end of Eleuthera, which may be seen about 12 miles off, is sighted, or the Abaco lighthouse, which is visible in clear weather 16 miles.

The current, as the Bahama islands are approached from these points and also from the East and S.E., generally runs to the N.W., but not strong. To the northward of Eleuthera, however, a strong set in the opposite direction will sometimes be found after N.W. and North winds, and probably after fine weather, on the increase of the moon, but it will be safer not to depend upon this. Should the land of Eleuthera be made, haul round Egg Island reef at the distance of 3 or 4 miles; and when Great Egg island bears East, the course will be about S.W. by S., and the distance nearly 32 miles to Nassau lighthouse.

The first objects seen when approaching Nassau harbour, will be forts Fincastle and Charlotte, and soon after the Government house (a remarkable large square building on the top of the ridge), between them. When near the entrance a stone obelisk will be observed on the hill, a short distance to the eastward of fort Charlotte—which is the westernmost fort; and when the lighthouse bears South distant about ½ a mile, a small low rock will be opened out close under the land, called Tony rock, on which is a pole beacon with a triangular frame on the top. The obelisk and beacon in one bearing S. by W., will lead over the deepest part of the bar westward of a red buoy on the extremity of the spit from Hog island, and eastward of a black buoy on the Hogfish bank; when the flagstaff on the west end of Hog island comes in line with the windows of the lighthouse, haul sharp up to the S.E., with the Bathing house on the end of the Ordnance wharf in one with the Presbyterian chapel, bearing in mind that the flood will set the vessel strong towards the sand ridges on the east side of the channel.

The latter mark will lead eastward of Tony Rock ledge, at the north end of which there is a small black spar beacon, and westward of the red buoy marking the west edge of the sand ridges. When the cupola of the jail, a conspicuous building in the centre of the town, comes in one with a small look-out house on the ridge, a little to the eastward of fort Fincastle, haul up on this line, and anchor with Tony rock beacon in line with a cocoa-nut tree on North cay W. ¾ N. abreast the Navy yard, Ordnance wharf, or barracks, as most convenient. *In entering, the red buoys and beacons will be left on the port hand, and the black buoys on the starboard.*

Should the wind be scant a vessel may sail in or out of the harbour, with the Bathing house on the Ordnance wharf in one with the Presbyterian chapel, provided there is no swell on the bar, and she crosses it at the last quarter flood, which is the best time for that purpose. It is clear, however, that these directions can only be of use to those fully acquainted with the place, except in a case of the greatest emergency. Handy vessels that can insure staying may beat in, but this must be done entirely by the eye. Every confidence may be placed in the pilots, who are always at hand. Vessels of 14 or 15 feet draught had better moor head and stern with their head to the westward, and the best bower to the eastward, and be careful in swinging not to tail on the anchor. In the summer season, after the period of north-westers, it will perhaps be more convenient to have the vessel's head to the eastward.

If the harbour is approached with a northerly wind, and there is an uncertainty as to the state of the bar, should it be dangerous to cross, a red flag will be hoisted on the signal-staff near the lighthouse. In this case it will be more prudent to proceed to the Douglas channel, or to the anchorage at the south-west end of the island. Should it be passable, but too dangerous for a boat to get out, a white flag will be hoisted, and the pilot boat will be seen in waiting just within the breakers showing a flag (red and white horizontally). In this case, cross the bar upon the first leading mark, the beacon and obelisk in line, and when the flagstaff comes on with the lighthouse, steer for the boat and receive the pilot. This, however, is a dangerous experiment for a vessel of heavy draught; and, except in a case of great urgency, it will be far more prudent to act as above stated.

Should a strong north-wester overtake a vessel at the entrance of either of the Providence channels, it will perhaps be better to remain under the lee of the south end of Abaco, or anchor under the west side of the Hole in the Wall, and wait until the wind moderates and the sea goes down. It may still continue to blow hard as the wind draws round to the N.E., but when it reaches this quarter the sea generally subsides on the bar in a short time. A good sheltered berth will be found under Abaco in 11 fathoms water, with the lighthouse E. by N. ¼ N. about ¾ of a mile from the shore.

Outer Anchorage.—With the wind to the southward, or, merely wishing to communicate with Nassau, a temporary anchorage will be found off the north side of Hog island, in about 8 fathoms, on the very edge of soundings, with Government house just open to the eastward of Christ church S.S.W. This anchorage must, however, be approached under easy sail, and care must be taken not to shoot too far in; in the winter months be prepared to quit, the moment the wind threatens a change.

Eastern Channel.—Vessels drawing under 11 feet draught may enter Nassau harbour from Douglas road or Cochrane anchorage, but this is only to be done by the eye. A depth of 9 feet may be carried at low water over the eastern flats off fort Montague, and the channel lies close under the south sides of Athol and Hog islands."

The Coast.—The western extremity of New Providence is a low sandy point, having off it a cay named Goulding. Off the southernmost point of the island there is good shelter in 5 fathoms with Clifton house (near its western point) bearing N.W., at ¾ of a mile from the shore. A shoal spot of 12 feet lies close to the edge of the bank at ¾ of a mile southward of the anchorage. Vessels proceed hither during strong N.W. or North winds, when they cannot enter the harbour of Nassau; but, as the wind moderates, it invariably draws to the eastward, and this then becomes a leeward position. The Douglas and Fleeming channels, hereafter described, are therefore preferable.

From New Providence the bank runs to the north-eastward about 35 miles to Eleuthera, and has on its edge a number of small islands and rocky reefs, separated by narrow channels, the principal of which are the Douglas and Fleeming channels.

Douglas Channel.—This channel is 15 miles north-eastward from Nassau lighthouse. It is distinguished by two pole beacons on small black rocks, in the centre of the opening, which is about 1¼ miles wide, between Booby island and the east end of Rose island. It is navigable for vessels of 20 feet draught, but is so narrow and tortuous, and the tides in it are so rapid, that *a pilot is absolutely necessary*. In the event of a vessel being forced to run in without this assistance, the following directions may be useful.

Wait for the flood tide, and strike the edge of soundings with the beacons in one S.E. ¾ E., which will lead close to the westward of Booby Island ledge, and when the small pile of stones on the west end of that island bears E. ½ N. haul up about E. by S. ½ S., so as to pass to windward of the black buoy on the north-east edge of the shoal ground of the Douglas rocks. It is seldom, however, that the wind will allow a vessel to do this; but the tide is so strong under the lee, that by proper attention she may shoot through the narrows, which is only about 1½ cables wide. Should she be forced to make a board, it had better be done under the west side of the Douglas rocks, where they are steep-to. If under 14 feet draught she may shoot in to the southward of the beacons, but there is a very dangerous small rock, with 4 fathoms around it, right in the middle of the opening between the Douglas and South Channel rocks, which, on account of the strong ripplings over the dark bar that runs across, is not seen.

If it be determined to take the latter channel, a boat had better be placed over this rock, for the tide runs here so strong that without a good commanding breeze the vessel will be scarcely under control. Having passed the buoy, a S.E. course will lead between the Turtle head and the black buoy off the north end of the Hook sand, whence the course may be gradually shaped to the S.W. for Douglas road or Cochrane anchorage, guided by the eye and the chart.

A convenient berth will be found in about 4 fathoms water, sand and marl, with the block-house on Potter cay nearly in one with Montague fort on New Providence W. by N., and the house on Rose island N. ½ W., about 8 miles from the town of Nassau. An anchorage may also be taken up a short distance within the Douglas channel in Shoe Hole road in 4 or 4½ fathoms, but it is not good holding ground, and in a strong Norther vessels are liable to drag. The sea in these winds seldom breaks across, and they may, therefore, run in here when the bar at Nassau is impassable.

There are wells of excellent water near the house on Rose island, but difficult and inconvenient to get at.

It is high water, full and change, in Douglas channel at 8h. 30m.; springs rise 4 feet, and neaps 2½ feet.

Fleeming Channel.—This channel is 25 miles N.E. by E. ½ E. from Nassau lighthouse. The opening between the Six Shilling cays and the Samphire cays, S.W. of them, is 6 miles wide, but the channel is only about 1½ miles in breadth, and lies about a mile south-westward of the former islets. It is capable of admitting vessels of 20 feet draught without much difficulty, but some little knowledge of the locality is required.

On the south-westernmost of the Six Shilling cays is the outer or Shannon beacon, triangular shaped, 60 feet high, and visible 7 or 8 miles. The inner beacons on the Quintus rocks are two pole beacons on the southern rock; they bear N. by E. ¾ E. and S. by W. ¾ W. from each other, and the southernmost lies E. by S. 1½ miles from the Shannon beacon.

When approaching Fleeming channel from northward, run down close to the edge of the bank, which is about a mile from the cays, and enter upon soundings with the Shannon beacon bearing E. ¾ S., when the Quintus beacon will be just open south of it, and then steer S.E. This course should lead about a mile south-westward of the Shannon, and when it bears N. ¾ W. bear up S.S.W., which will lead into Douglas road or New anchorage. There are many small heads in the way, but they may be easily seen from aloft.

As the tides run right across the inner part of the channel, the flood to the S.E., the ebb to the N.W., at the rate of 2 or 3 knots, steer accordingly, so as to pass 2 cables to the eastward of a black buoy (with *vane*) moored S.E. by E. ½ E. 2 miles from the Upper or N.E. Samphire cay, and S.W. by S. 6½ miles from the Quintus poles; these latter, therefore, will be a good guide. The buoy lies in 2 fathoms water, at the inner and narrowest part of the channel, which is little more than a mile wide. A short distance to the north-east of the buoy there is a small ledge of 14 feet, called the Middle Ground, with 21 feet on either side, but it had better be left to the eastward.

In beating out, when the buoy eastward of the Samphire cay bears southward of S.W. by W., do not stand farther eastward than to bring the Quintus beacons in line, and to the westward keep the Pimlico islands open eastward of the Six Shilling cays. The edge of the shoal ground on either side of the channel, however, may be seen from aloft. A vessel may anchor in the channel, or take up a convenient berth for quitting, about a mile to the S.W. of the Quintus rocks, but she will be exposed to the westward. The shoal ground extending southward from the Shannon beacon cay should be carefully avoided.

It is high water, full and change, in the Fleeming channel at 9h. 0m.; springs rise 3½ feet, and neaps 1½ feet.

From Fleeming channel the bank runs north-eastward to the Current isles off the north end of Eleuthera; these are also named Russell, Royal, and Egg islands. They are very low, but well-wooded, and are separated from Eleuthera by a narrow channel sufficiently deep for small vessels. There are numerous reefs about the Current islands, a knowledge of which can be best gained by reference to the chart.

*** Navigators bound to the West Indies, the Gulf of Mexico, and the Caribbean sea, must refer to the special Sailing Directions for those parts, as they are too extensive to be inserted here, and could not be condensed with sufficient accuracy to ensure safety.

DOUBTFUL ISLANDS, ROCKS, SHOALS, AND VIGIAS.

The following Table contains the list of the various Rocks, Shoals, &c., that have, from time to time, been reported as existing in the North Atlantic—*exclusive* of those, which bordering the mainland, will be found described in special Sailing Directions for the particular part of the coast near to which they are found. It is well known to the navigator that the chart of this part of the ocean has long been disfigured by the insertion of *dangers*, many of which are still pertinaciously believed in; this Catalogue of such doubtful and supposititious dangers is given that, when he approaches the neighbourhood, he may be on the alert, and should he see what *appears to be a rock*, make some small effort in the cause of hydrography to satisfy himself and his brother seamen, whether it may not be a wreck, a whale, or some floating substance, such as, when viewed from a distance, has been frequently mistaken for a rock or shoal until closely examined; not to multiply instances, it may suffice to extract the following observations from

WILKES' "Narrative of the United States Exploring Expedition" (1838—1842); when in the vicinity of St. Anne's shoal, Lat. 38° 8′ N., Long. 34° 8′ W., he resolved to sail over its assigned position. "We passed over it, the sea was smooth, the horizon clear, and the day beautiful. At 8h. A.M. the lookout cried out, 'Rocks or a wreck on the starboard bow!' which at once created an excitement on board. We stood for it. It had at first every appearance of a rock, then that of a wreck with the masts gone. It proved, however, to be a large tree of cotton wood, 120 feet in length, and 14 feet in circumference at the height of 5 feet above the roots. It had been a long time in the water, was full of barnacles, and much eaten by the teredo navalis. Great quantities of fish were about it, consisting of dolphins, sharks, &c., we did not, however, succeed in taking any. In rough weather it might easily have been mistaken for a rock, particularly if passed in twilight, or at night."

Captain WILKES also sought for the following rocks and shoals—Tulloch, Maria, Bom Felix, Bonetta, Patty, Warley and French—but saw not the slightest signs of their existence.

More recently (1851—1852) Lieut. LEE, of the U.S. surveying brig *Dolphin*, while engaged in sounding operations, examined the assigned positions of the Potomac, Field, Anfitrite, Dyet, Gandaria, Gombaud, Emily, French, Blaesdale, Voette, Galleon, Galissioniere, Martin Tulloch, Livingstone, and Mourand rocks and shoals, as well as the Vigia of 1827, without finding any traces of them.

The existence of the Eight Stones is disproved by the routes of H.M. ships *Southampton*, *Chanticleer*, *Blossom*, *Beagle*, *Ætna*, *Raven*, *Emulous*, and *Sulphur*, as well as by soundings taken in the U.S. brig *Dolphin*.

The soundings made by Capt. PULLEN, R.N. and by Commander DAYMAN, R.N., tend to disprove the existence of the Devil rock.

So, also, the deep sea soundings made in the vicinity of the assigned positions of the following—Breton, Chaderton, Cleveland, Betsey, Aitkin, Chaucer, Henderson, and Beaufort vigias—show that their existence is very improbable.

Texeiro may be rejected, since Maury has plotted over its assigned position the tracks of a large number of vessels, none of which made any mention of it.

It may not be amiss however to quote in this place the remarks of the late Hydrographer, Admiral WASHINGTON, on *Vigias*, in his "Instructions to Surveyors."—

The constant endeavour to pass over the places of all the Vigias which are marked near her track in the charts, should be considered as one of the prominent duties of a surveying vessel. Multitudes of these imaginary dangers are circumstantially described, and are traditionally inserted in all our ocean charts, and from which they ought not to be expunged without the most satisfactory evidence of their non-existence, within wide limits of their alleged positions. It is true that pieces of wreck, sleeping whales, shoals of fish, and sundry other floating substances, may account for a large proportion of these pretended rocks; yet, on the other hand, the mighty operations which are perpetually and silently going on in nature's great laboratory, and which are occasionally manifested by the protrusion of a real rock above water—and again by its withdrawal—should teach us not to be too sceptical as to the former existence or future confirmation of some of them.

"A full day, will, therefore, be well employed in every such search; and as it is incredible that in very deep water any rock should rise like a column perpendicularly from the bottom, the search must be accompanied by some deep sea casts, say to 1000 fathoms at least, in order to strike some part of the slope.

"With the like object in view, the observant seaman will keep his eyes open to every unusual appearance in the sea—such as partial ripplings and, when out of the reach of rivers, to all discoloured water, whether white, brown, or green, flocks of birds, or shoals of fish, as they may possibly be an indication of some change in the nature or depth of the bottom; and in all such cases a deep-sea cast of the lead should be obtained."

The following observations by Captain WINGATE of the iron ship *Sarah and Emma*, on the facility there exists for mistaking floating wrecks, &c.—*when viewed from a distance*—for rocks, deserve the consideration of ship masters who it is to be feared have too often needlessly reported a rock or other danger in the open ocean, when putting the vessel out of her course for 5 or 10 miles, would in the majority of cases have settled the point definitely.

"While I am writing to you I may as well mention two other circumstances that occurred on the same passage.

In the Java Sea, 21st November, 1863—at 10h. 30m. A.M. officer of the watch reported 'sail on starboard bow,' which on a nearer approach I took for an island, having trees on it distinctly visible; of course I thought it a new discovery, as, in my then position, nothing appeared on my chart 'latest and best'.

At 2h. 30m. P.M. wind being light I sent second officer in a boat to ascertain the nature of it,—then about 1¼ miles off. According to his *description* it was—a solid mass of roots of trees entwined together; eighteen trees on it averaging 24 feet high, the largest being 1 foot in circumference—cabbage or palm trees—left on it ship's name: Lat. 4° 54′ S., Long. 106° 36′ E.

Again,—28th February 1864, at 8h.30m. A.M. saw something on starboard beam about 1¼ miles off, bore down to it, and found it to be about 40 feet of the after end of a vessel, bottom up; and from appearance should think it about half the original; by the way the broken part of the timbers and planks were worn, as well as by the large amount of barnacles and weed on it, think it had been a long time in the water; no copper or sign of any having been on,—Lat. at noon 40° 11′ N., Long. 32° 11′ W.; difference from 8h. 30m. A.M. 3′ N., 11′ E.—position of wreck, 40° 8′ N. and 32° 22′ W.

I have mentioned this from my attention having been drawn to a notice in your 1863 magazine, p. 125, concerning the defined position of Gough's rock.

Now I do not dispute the existence of said rock, and in that particular locality, but I do positively say that my floating mass was seen and passed within

20 feet, and most assuredly had there been any sea on at the time I should have taken it for *a fixture at least*, because I believe it would have caused a heavy break around it; for although there was little wind at the time, the water comparatively smooth, still, with the hollow part down, there was quite a break caused by the sea running up both sides of the *run or quarters*, and there meeting the splash from the wide open part as it rose and fell, and the water rushing into it and the rebound. Any one knows what a ripple a boat bottom-up will cause by its motion on the surface of the water.

By appearance I should think it part of a vessel of about 150 tons or so. Now a rock most certainly would not shift, but may not my floating mass have been more to the eastward twelve months before, and I think there is a deflection of a part of the Gulf Stream somewhere in this locality—but that I leave to your calculation."

If shipmasters would only take a little trouble in order to verify their questionable *new discoveries* we should then see more frequently than we do reports such as the following, which justify the remarks of Captain Wingate:—

"Schooner *William Inglis*, Captain Smith, September 6th 1855: Lat. 37° 48′ N., Long. 35° 11′ W., at 2 P.M. saw what we took to be breakers on the starboard bow; luffed up and ran close to: found it to be a large ship (800 tons) bottom up, copper bottom, copper quite fresh and bright."

Capt. Thomson of the *Eclipse* says "On my passage from Figueira for St. John's, on the 25th of June, in Lat. 45° 40′ N., Long. 29° W., I saw something to leeward, which I took to be a rock, standing about 8½ feet out of water. Put the vessel about to make sure. Coming near to it, found it to be an iron buoy. From the water to the top it very much resembled a flat top sugar-loaf. Thinking it might be seen again in hard blowing weather, and be taken for a rock, as I could have believed it was had it been blowing strong at the time, I was resolved to get it on board, which I did, but not without getting my boat out, and with great difficulty, the lower part being very much covered with barnacles, some as long as nine inches. Dimensions of the buoy about 5 feet long,—8½ feet out of the water; 10 feet round the base, 4½ feet round the top, quite tight from leakage, no mark of any kind upon it; apparently had been coal tarred. I believe it has been a fairway buoy of some gatway, or a warning buoy of some rock; apparently been in the water some time.

The wreck of a barque was passed in the channel, September 19th, in Lat. 49° 21′ N., Long. 6° 18′ W., colour similar to that of submarine rocks, covered with seaweed."

Lat. N.	Long. W.	Name.	Date.
0° 30′	29° 35′	Coral shoal...	1822
0 54	26 50	Prince shoal	1854
0 57	41 6	Blaesdale's reef...	1819

Lat. N.		Long. W.		Name.	Date.
0°	59′	28°	4′	A Shoal	1860
2	0	22	18	Cæsar breakers	1880
3	7	24	14	Pryce or Mary shoal	1846
4	5	19	20	French shoal	——
4	5	20	34	French shoal	1796
5	4	21	25	Warley's shoal	1813
9	47	30	0	Longchamp's rock or Solis island	——
10	7	27	32	Hannah's Coral shoal	1824
10	37	60	8	Delaware shoal...	1839
11	0	24	30	Patty's Overfalls	——
12	0	27	20	Five Palms Vigia or Hinman's shoal... ...	——
12	0	33	28	Texeiro's shoal...	1810
12	20	54	49	Galissioniere's rock or Fonseca island ...	——
12	30	28	56	Garcas, Baxo das	1848
13	0	29	50	Garcas, Baxo das	——
14	29	26	30	Tregarthen rock...	1856
14	37	58	59	St. Esprit reef	1817
14	50	29	40	Dubreuil's Vigia...	1753
15	0	48	58	Voette bank	——
15	45	21	15	Webb's rock	——
15	45	27	20	India shoal...	——
15	48	23	13	Leton rock...	——
15	56	49	40	Galleon's bank	1780
16	0	37	0	Maalstrom	——
16	32	20	37	Bonetta rock	——
16	42	59	6	Martin's reef	1842
16	44	58	50	Martin's reef	1828
16	44	26	49	India shoal...	1863
16	59	21	30	Emily rock...	1845
17	0	20	3	Birkenhead or Porgas bank	1850
18	7	50	0	Betsey's rock	1808
19	17	65	50½	Clowes reef...	1817
19	20	20	37	Bom Felix shoal...	——
19	45	20	50	Maria's rock	1818
20	0	68	50	Hannah's breakers	1791
20	50	66	45	Guigou's bank	1733
23	15	32	25	Gombaud's rock...	1764
24	10	61	40	Livingston's Overfalls	1819
24	20	64	50	Staminca rock	——
24	34	65	10	Mourand's bank...	1778
25	30	37	45	Gandaria rock	1842
27	31	60	3	Chaucer bank	1850
27	51	78	31	Courier rock	1849
29	42	30	17	Inglefield bank	1810
30	45	10	20	Cleveland reef	1765
30	49	78	27½	Huntley's rock	1833
30	52	27	12	Vigia	——
31	17	53	22	Vigia	1827
31	30	34	48	Neva rocks...	1856
31	30	36	50	Vankeulen's rock	——
31	40	23	45	Josyna rock	1697
31	48	40	28½	Westenenk shoal	1840

Lat. N.		Long W.		Name.	Date.
32°	0′	24°	48′	Gilchrist rock	1848
32	10	58	10	False Bermudas...	——
32	20	20	50	Steenground rocks	——
32	46	60	6	Dyet rocks	1845
33	45	55	25	Bell rocks	——
33	49	71	41	Ashton rock	1824
34	37	16	40	Eight Stones	1732
34	51	72	28	Orion rock	1845
35	0	28	30	Kutusoff bank	1816
35	25	49	1	Columbine shoal...	1844
35	50	66	4	Anfitrite shoal	1846
35	58	27	19	St. Mary's bank, discol. water	1819
36	30	9	16	Daedalus rock	1813
36	31	32	24	Atila rock	1856
36	54	19	49	Jean Hamon's rock	1783
37	27	24	45	Tulloch reef	1808
37	31	66	0	Field's Vigia	1853
37	42	32	57	Martyr's, or Açore's reef	1845
37	50	34	18	Vigia...	——
37	56½	33	4	Constante reef	1840
38	10	67	26	Potomac soundings	1833
38	15	22	14	Keus rock	1853
38	16	38	49	Chantereau's shoal	1828
38	24	39	25	Chantereau's shoal	1721
38	26¾	30	25	Ferreira's reef	1840
38	27	37	57	Chantereau's shoal	1846
38	32	33	16	Pronk rock...	1844
38	40	29	8	Falconer rock	1847
38	46	24	47	Whale rock...	1809
39	0	64	20	Munn's reef	1827
39	18¾	46	19½	Supposed Banks...	——
39	18	35	50	Hilton rocks, awash	1845
39	30	50	30	Anna rocks...	1841
39	32	50	50	Carmlick	——
39	40	41	40	Breton's rock	1816
39	45	41	25	Breton's rock	——
39	47	34	29	Candler's rock	——
40	5	58	45	Akest	——
40	16	33	0	Gough's rocks	1830
40	18	58	40	Watson's rock	1824
40	20	63	50	America rock	1846
40	22	42	40	Shoal	1803
40	25	54	28	Hamilton	1851
40	26	36	5	Spanish shoal	1769
40	26	36	10	Wahlstein breakers	1857
40	27	49	56	Hervagault breakers	1855
40	28	30	0	Gough's rocks	1778
40	38	30	3	Gough rock	1861
40	38	30	3	Gough rock	1863
40	45	36	47	Beazley shoal	1841
40	50	54	53	Daraith's rock	1700
40	53	52	0	Vigia	1750

Lat. N.		Long W.		Name.	Date.
41°	2′	49°	23′	Hervagault breakers	1723
41	8	22	30	Perseus shoal	1813
41	6½	49	57	Hervagault breakers	1816
41	18	41	33	Druid's reef	1859
41	19	41	25	Druid's reef	1831
41	24	41	20	Druid's reef	1803
42	0	41	10	Desmaires' rocks	1683
42	30	24	5	Amplimont rocks, 30 feet high	1735
42	30	24	5	Amplimont rocks	1829
42	37	41	45	Beaufort Bank	1832
42	42	37	30	Ramigeau's Vigia	——
42	45	29	0	Henderson bank...	1850
42	51	24	15	Amplimont rocks, 8 feet high	1842
42	56	24	30	Amplimont rocks, awash	1846
43	20	25	10	Woodall's rock	1829
43	30	37	35	Vigia	1788
43	41	26	25	Kenny	——
43	41	28	51	Mossman rock	1854
44	9½	22	57¾	Midgley shoal	1838
44	15	19	25	Five Heads...	1757
44	15	25	5	Greeve's ledge	1745
44	43	6	37	Dvina rock...	1853
44	52	26	25	Green rock, or Is. Verte	1742
44	56	23	51	Chaderton rock	1858
45	10	20	19	Mayda rock...	1863
45	13	14	27	Catharina rock	1864
45	13	16	48	Esmaralda rock	1856
45	32	11	57	Lean shoal...	1854
45	33	37	25	Barencthy rock	——
45	33	22	20	Terpsichore rock	——
45	34	29	36	Empress rock	1862
45	40	19	17	Mayda rock	1842
46	0	26	0	Laidmain rock or shoal	——
46	0	30	0	Mariner rock	1288
46	9	12	50	Devil's rock	1831
46	10	19	40	Mayda rock	1736
46	12	15	3	Sprigg rock	1842
46	14	37	20	Barencthy's rocks	1862
46	24	13	10½	Devil's rock	1764
46	25	35	40	Christubel shoal, in three heads...	1863
46	30	49	35	Ryder shoal	1845
46	33	13	2	Devil's rock	1829
46	35	13	7	Devil's rock	1818
46	35	13	8	Devil's rock	1829
46	35	18	24	Watkin's rock, 8 feet below surface	1865
46	36	19	30	Mayda rock	1840
46	48	19	50	Mayda rock	1705
46	49	28	48	Read rock	——
46	55	13	0	Devil's rock	1737
46	55	39	30	Jaquet island	1836
47	5	24	28	Waban rock, in two heads...	——
47	24	7	12	Chapelle rock	1764

Lat. N.	Long. W.	Name.	Date.
47° 30′	8° 5′	Chapelle rock	1857
47 37	8 2	Chapelle rock	1822
47 37	28 51	Three Chimnies...	1842
47 43	8 4⅓	Chapelle rock	1842
47 54	29 40	Three Chimnies...	1729
47 55½	29 40	Three Chimnies...	1863
48 7	21 21	Negre's rocks	——
48 8	20 30	Negre's rocks	1722
49 36	16 17	Smith or Wallace bank	1856
50 15	16 26	Midas, broken water	1865
51 0	19 10	Brasil rock...	1742
51 10	16 0	Brasil rock...	1791
55 15	9 56	Aitkin's rock	1852
55 15	10 40	Aitkin's rock	——
55 17	... ...	Aitkin's rock	1826
55 18	11 14	Aitkin's rock	1740
55 19	9 53	Aitkin's rock	1793
55 24	24 40	Vigia	1746
58 0	33 0	Bus, sunken land of	——
58 45	13 30	Solon rock, 10 feet below surface	1860
56 40	17 45	Lion's bank	1776
60 57	16 40	Alof Kramers's bank	——

We do not say that the *whole* of the foregoing are fictitious; but the large majority certainly have no existence, especially those reported to lie in the well beaten tracks of outward and homeward bound vessels.

NOTES ON MAKING PASSAGES.

Is the Eastern, Middle, or Western Route across the Equator the most advantageous, so as to be in the best position when the Southern Tropic is reached?—An analysis of log books will give the best answer* :—

TO THE EQUATOR.—the *time* taken by ships from the English Channel to the Equator can at once be illustrated by a table,—from which it appears that those making the route *west* of the cape Verde islands have a slight advantage at the beginning of the year,—those going *east* of the cape Verde islands having a similar advantage towards the end of the year:—

* N.B.—In these *Notes*, when the tracks of vessels are spoken of, the authorities are as follows:—1. The abstract voyages of upwards of 1000 English vessels in the possession of the author, and made during the last 20 years; 2. H. WISE's 100 voyages to and from India and China of the E.I. Co's ships; 3. MAURY's "Sailing Directions" for American ships; and 4. Maandelijksche Zeelanwijzingen Java naar het Kanaal, and Maandelijzingen Zeelanwijzingen van het Kanaal naar Java, which refer to Dutch ships.

Period of the Year.	English Ships.				Dutch Ships.				American Ships.				Average of the Three Nations.			
	West of C. Verdes.		East of C. Verdes.		West of C. Verdes.		East of C. Verdes.		West of C. Verdes.		East of C. Verdes.		West of C. Verdes.		East of C. Verdes.	
	No. of Ships.	No. of Days.	No. of Ships.	No. of Days.	No. of Ships.	No. of Days.	No. of Ships.	No. of Days.	No. of Ships.	No. of Days.	No. of Ships.	No. of Days.	Total Ships.	No. of Days.	Total Ships.	No. of Days.
Jan., February, March......	33	29·0	48	30·3	43	31·5	31	34·5	23	30·3	8	28·7	99	30·3	87	31·2
April, May, June	78	29·0	33	29·8	110	31·3	36	32·5	37	29·2	8	31·0	225	29·8	77	31·1
July, August, September ...	204	33·6	30	30·5	122	34·6	17	35·7	34	32·8	7	35·7	360	33·7	54	34·0
Oct., November, December	99	34·8	51	33·0	66	34·4	30	33·8	17	30·3	11	30·8	182	33·2	92	32·5
Average Days from March to October.	282	31·3	63	30·2	232	32·9	53	34·1	71	31·0	15	33·3	585	31·8	179	32·6
Average Days from October to March.	132	31·9	99	31·6	109	32·9	61	34·1	40	30·3	19	29·7	281	31·8	131	31·9
Average days..................	414	31·6	162	30·9	341	32·9	114	34·1	111	30·6	34	31·5	866	31·8	310	32·2

For the English vessels on the *Western route* we have the following details:—

January, February, and *March*;—from the log-books of 33 vessels:—

The *mean* position of the vessels north of the Line was 26° 10′ W. in 16° 15′ N.: they were occupied 7¾ days sailing from 10° N. to the Equator, which they crossed in 23½° W.;—making the passage from the Channel to the Line in 29 days.

April, May, and *June*;—from the log-books of 78 vessels:—

The *mean* position of the vessels north of the Line was 26° 35′ W. in 14° 5′ N.: they were occupied 8½ days sailing from 10° N. to the Equator, which they crossed in 24° 36′ W.:—making the passage from the Channel to the Line in 29 days.

July, August, and *September*;—from the log-books of 204 vessels:—

The *mean* position of the vessels north of the Line was 26° 50′ W. in 14½° N.: they were occupied 10¾ days sailing from 10° N. to the Equator, which they crossed in 22° 25′ W.:—making the passage from the Channel to the Line in 33½ days.

October, November, and *December*;—from the log-books of 99 vessels:—

The *mean* position of the vessels north of the Line was 26° 40′ W. in 13° 5′ N.: they were occupied 11¾ days sailing from 10° N. to the Equator, which they crossed in 25° 50′ W.;—making the passage from the Channel to the Line in 34¾ days.

For the English vessels on the *Eastern route* the details are as follows:—

January, February, and *March*;—from the log-books of 48 vessels:—

The *mean* position of the vessels north of the Line was 22° 36′ W. in 4° 48′ N.: they were occupied 8½ days sailing from 10° N. to the Equator, which they crossed in 22° 48′ W.;—making the passage from the Channel to the Line in 30½ days.

April, May, and *June*;—from the log-books of 33 vessels:—

The *mean* position of the vessels north of the Line was 22½° W. in 7° N.: they were occupied 10½ days sailing from 10° N. to the Equator, which they crossed in 23° 6′ W.;—making the passage from the Channel to the Line in 29¾ days.

July, August, and *September*;—from the log-books of 30 vessels:—

The *mean* position of the vessels north of the Line was 23° W. in 9° N.: they were occupied 9½ days sailing from 10° to the Equator, which they crossed in 21° 36′ W.;—making the passage from the Channel to the Line in 30½ days.

October, November, and *December*;—from the log-books of 51 vessels:—

The *mean* position of the vessels north of the Line was 22½° W. in 12° 6′ N.: they were occupied 12½ days sailing from 10° N. to the Equator, which they crossed in 24° 18′ W.;—making the passage from the Channel to the Line in 33 days.

Of the English ships,—taking the *western* route, the shortest period was 19 days; the longest, 46 days. For the *eastern* route, shortest period, 19 days; longest, 43½ days.

Of Dutch ships that crossed the Equator east and west of Long. 25° W. we have the following results :—

105 vessels W. of Long. 25° W.—

	Crossed Equator in	Mean.
Jan., Feb., March,	26° W.	25·2 days.
April, May, June,	28° W.	30·4 ,,
July, August, Sept.,	27° W.	34·0 ,,
Oct., Nov., Dec.	28° W.	27·3 ,,

588 vessels crossing E. of Long. 25° W.

	Crossed Equator in	Mean.
Jan., Feb., March,	22° W.	30·1 days.
April, May, June,	23° W.	31·6 ,,
July, August, Sept.,	21° W.	33·1 ,,
Oct., Nov., Dec.	24° W.	30·7 ,,

Thus the Dutch ships show a gain of 4 days by crossing the Equator west of Long. 25° W., from October to March, the difference between 30·4 and 26·3 days; while all alike average 32·3 days from April to September. On the *westerly route* the shortest passages are in February, 22 days: the longest in August and September, 37 days. On the *easterly route* the shortest passages are made in December and January, 27 days; the longest in September, 34·7 days.

The late Admiral FitzRoy in Meteorological Papers, No. II, says—"when bound southward across the Atlantic Equator, under sail only, it is advisable to make the *eastern* or in-shore passage, near Africa, from November to May; and to take the *western* crossing, between 23° and 32° W. from June to October."

The Dutch on the other hand say, that while the winds are always more or less favourable on the *western* route, vessels can with greater advantage take the *eastern* route during June, July, August, September, and October, when the S.W. Monsoon in the North Atlantic will place them in good position for crossing the Equator to the eastward.

A Hydrographic Notice from which an extract has already been made on p. 213-214, says;—"as the *best meridian for crossing the Equator by outward bound ships*, still appears to be an unsettled question among navigators, and as it is connected with the subject of the Equatorial currents referred to above, it may be of interest to seamen to append the following tabular statement, showing where each of the 930 ships (the registers of which are with the Meteorological Department of the Board of Trade) made their crossings; it being observed that all these ships were bound from British ports either to or round the Cape of Good Hope, round Cape Horn, or to some port of South America, southward of Bahia, between 1855 and 1865:—

Meridians of crossing the Equator.

	East of 20° W.	20° to 22° W.	22° to 24° W.	24° to 26° W.	26° to 28° W.	28° to 30° W.	30° W. and Westward.
Jan.	3	5	9	21	15	22	10
Feb.	5	6	7	12	13	4	2
March	7	8	11	21	17	8	2
April	7	12	25	12	11	2	2
May	1	8	12	19	16	15	4
June	0	2	8	11	24	22	10
July	3	12	8	18	23	9	26
August	17	10	11	15	19	5	11
September	15	10	7	12	20	8	7
October	2	9	6	11	22	17	16
November	0	3	1	10	17	32	29
December	2	1	3	9	21	12	10
930 ships	62	86	108	171	218	156	129

It is impossible, without a more rigid analysis than has yet been bestowed on this question of crossing the Equator, to determine with precision the best meridian. It is certain that it must vary according to the seasons, and perhaps the months; and as will be seen by a few examples appended, the evidences of the advantages of the more Easterly route contrast favourably with the extreme Westerly route.

Until, however, the various conditions attending the size, class, and speed of the ships, the favouring circumstances or otherwise of veins of wind, or calms, and other local conditions are duly allowed for and include a large number of ships extending over several years, it appears reasonable to assign weight to the practical results afforded in the preceding tabular statement.

One fact is observable in compiling this statement, viz., that of the 930 ships 803 passed 100 miles or more to the eastward of the Roccas, and thus to the eastward of Fernando Noronha.

Examples of the number of days occupied by *Sailing* ships in reaching the Equator in different meridians and at different months of the year from among the 930 ships quoted :—

In January and February, 3 ships of 609, 614, and 1126 tons respectively, crossed the Equator in 21°, 24¾°, and 32½° W., and are respectively 21 days from Greenock, 22 days from the Start, and 23 days from Liverpool.

In March, April, and June, 4 ships of 964, 898, 1041 (deeply laden), and 477 tons respectively, crossed the Equator in 21½°, 28¾°, 24½°, and 28°, and are respectively 21½, 26, 31, and 34 days from Deal, Plymouth, Gravesend, and Liverpool.

In July and September, 3 ships of 1160, 1202, and 765 tons respectively, crossed the Equator in 30¾°, 32½°, and 32½° W., and are 20½, 33, and 42 days respectively from Scilly, the Downs, and Liverpool.

In November, 1855, and 1856, 2 ships of 1050 and 300 tons respectively crossed the Equator in 31¼° and 31° W., and are 45 and 21⅜ days in crossing the Equator from Liverpool; the ship making the longest passage leaves Liverpool with a fair but light wind, which lasted with slight intermission to the N.E. Trades, which were also light; this ship was 14 days from 6° N. to the Equator."

To the foregoing we add the following illustrations to the same effect:—

In May, 4 ships crossed the Equator in 23°, 25°, 27°, and 30½° W., and were respectively 25, 21, 21, and 23 days from off the Eddystone.

In June, 4 ships crossed the Equator in 22°, 24°, 27½°, and 31° W., and were respectively 31, 25, 25, and 34 days from off the Eddystone.

In July, 6 ships crossed the Equator in 19°, 22½°, 24°, 26½°, 29½°, and 31° W., and were respectively 29, 26, 24, 29, 28, and 24 days from off the Eddystone.

In 1854, 5 ships were in Lat. 10° N. in the middle of July; they crossed the Equator in 20°, 22½°, 23°, 24¼°, and 25¾° W., and were respectively 30, 26¼, 25½, 36, and 30 days from off the Eddystone.

In August, 4 ships crossed the Equator in 18½°, 21°, 25° and 27° W., and were respectively 29, 26, 29, and 29 days from off the Eddystone.

In 1854, 4 ships were in Lat. 10° N. on August 18th and 19th; they crossed the Equator in 17½°, 19°, 23°, and 24½° W., and were respectively 34½, 22, 34½, and 43½ days from off the Eddystone.

In September, 4 ships crossed the Equator in 19°, 22°, 24½, and 28° W., and were respectively 22, 26, 27, and 27 days from off the Eddystone.

In 1856, 5 ships were in Lat. 10° N. at the end of September; they crossed the Equator in 19¾°, 24½°, 24½°, 25°, and 27° W., and were respectively 38, 29½, 39½, 39, and 39½ days from off the Eddystone.

In November, 4 ships crossed the Equator in 24°, 30°, 30°, and 31° W., and were respectively 23¾, 19, 22¾, and 24 days from off the Eddystone.

In December, 5 ships crossed the Equator in 23°, 24°, 25°, 26°, and 29° W., and were respectively 32¾, 36½, 24, 21, and 32 days from off the Eddystone.

Maury recommends the *western* crossing of the Equator in all seasons, which of course is very advantageous for vessels bound round the Cape from American ports; but the policy of going so far west as Las Roccas is very questionable, and it is quite certain that in *many* instances as much as 10 or 14 days have been lost in clearing the Brazilian coast. (*See* also p. 731, "From New York across the Equator and to Rio)."

In crossing the zone between 10° N. and the Equator, experience will most probably prove that neither the extreme easterly nor the extreme westerly route should be adopted—though much depends on the month; nor is it ever advisable, under any circumstances, when bound from the Channel, to cross the Equator to the westward of 30½° W.

Any attempt to take the route *through* the cape Verde group inevitably results in making a long passage to the Equator.

Not to multiply instances in which a far westward route has resulted in failure —and of which we could furnish many—we give the following:—

An Aberdeen clipper bound to Australia crossed the Equator, 1857, June 27th in Long. 32° 20′ W.; on 30th in Lat. 4° 46′ S. sighted the land and tacked; July 2nd in Lat. 6° 5′ S. sighted the land again and tacked; July 5th at 8 A.M. sighted San Augustin distant 8 miles at noon in Lat. 8° 9′ S.,—when she made a fair start.

Bound from the **Channel to Pernambuco and Rio** the westerly route may be adopted with advantage, but keep clear of the shoals on the Brazilian coast.

Most Westerly Position South of the Equator.—Of 162 vessels that made the passage East of the Cape Verde Is., the mean westerly point was Long. 30° 36′ W., in Lat. 17° 36′ S.; of 414 vessels passing West of that group, the mean westerly position was Long 33° W. in Lat. 19° S.

It may be here remarked that in some years—as, for example, in 1856—it is possible to make southing with very little westing; in that year many vessels that crossed the Equator in 27°, 28°, and 29° W., did not subsequently make a degree of westing, and in fact, within 10° of the Line, some of them commenced to make easting.

Position of Crossing the Meridian of Greenwich.—The mean position of 200 vessels bound to India or China was Lat. 37° 11′ S.; lowest, Lat. 31° 2′ S.; highest, Lat. 42° 15′ S.

The mean position of 376 vessels bound to the Australian Colonies, Lat. 38° 36′ S.; lowest, Lat. 31° 33′ S.; highest, Lat. 47° 3′ S.

Of Dutch vessels bound for the east, taking the *eastern* route, 574 crossed the Meridian of Greenwich in Lat. 36° 15′ S.; 135 vessels by the *western* route crossed the Meridian of Greenwich in Lat. 40° 40′ S.

Time from Equator to Meridian of Greenwich.—Of the vessels taking the eastern route the mean number of days was 23; shortest, 12 days; longest, 32½ days. Of the vessels by the western route, the mean number of days, 24; shortest, 17½ days; longest, 36 days.

Of 709 Dutch vessels the average is 24 days by each route.

It may be set down as an axiom, that any attempt to make *easting* at too early a period on the voyage must result in loss of time. In one instance, in 1850, when the meridian of Greenwich was first crossed in Lat. 33° S., it was subsequently crossed and recrossed no less than *three* times, the last being in

Lat. 40° S., in another instance, in 1856, it was crossed twice on the same voyage, the first time in Lat. 29° S.; so that it may generally be recommended to take the mean position given above—viz., Lat. 37° to 38¾° S.

From New York across the Equator and to Rio:—Vessels from the United States used formerly to cross the Atlantic towards the cape Verde islands, and there they fell into the track from Europe to the Equator. MAURY has shown them that there is no occasion to make so much easting; a mean E.S.E.-ly course (true) carries them to Lat. 30° N., in Long. 43° W. thence a S.S.E.-ly course (true) takes them across the Equator in 30° to 33° W.: he says "I have not yet found a single case, in which there has been, after crossing the Line as far as 32°, the least difficulty in clearing cape San Roque. Navigators should not hesitate, if they are pinched, to go inside of Fernando Noronha, but in doing that they should take care not to run foul of the Roccas, Lat. 3° 51′ S., Long. 33° 47′ 7″ W. I have the track of one vessel that dashed on, crossed the Line in 41° on the 19th day out, and on the 32nd day was south of the parallel of Rio. This, though, was in the winter and spring, when vessels can afford to keep to the westward, but it was going farther west than I should advise.

"Suppose a vessel to cross in 32° or 33°, and to get the S.E. Trades at S.E.; by standing on S.S.W., she keeps herself in a position in which any change of wind is favourable. If it haul to the eastward, she can lay up and clear the land; if it haul to the southward, she can go about and make easting, and get along rapidly by stretches upon long and short legs.

"For the guidance of navigators who follow the new route, and are pinched in clearing cape San Roque, as they no doubt will occasionally be, I repeat the following suggestions:—From the Line, in Long. 33°, cape San Roque bears S.S.W. From this crossing place, in a smart ship, that will fetch where she looks, a S.E. wind all the way from the Line would just prevent the vessel from clearing. But the chances are more than a hundred to one that the wind will not hang steadily at S.E. all the way from the line to cape San Roque. If it haul to E.S.E. you can lay up and clear; if it haul to S.S.E. you can put about and make easting. But suppose the wind holds steadily at S.E. or at any other point which will prevent you from clearing the cape; draw a line from your place on the chart to the cape, and avoid falling to the west of that line, by taking advantage of slants, or by beating accordingly as you may have the wind, and making long and short stretches."

But probably the raciest bit of "Sailing Directions" ever written is that where referring to the passage of the *Flying Cloud* across the Equator in 34° W., on which occasion the Captain laments having had to cross the Equator too far west, Maury says "it is true, no vessel should willingly cross so far to leeward, but cases are not unfrequent of vessels, after crossing in 34°, and even in 37°, having no difficulty in clearing San Roque. They do this by following the 'Sailing Directions,' which advise them in such cases *to stand on and trust to chance (!) for a change of wind, and to luck (!!) for favourable slants (!!!)*"

Homeward, round the Cape of Good Hope to the Equator:—From Lat. 35° S. to the Equator, there are two routes,—on which those that take the more westerly lose two or three days from May to October. The most advantageous position in which to cross the different parallels is given in the following Table for every month in the year; and it will be seen that, as regards time, vessels are longer on this part of their voyage from April to August (both inclusive) than during the rest of the year;—this being in a great measure due to the smaller breadth of the S.E. Trade-wind zone at that time, as well as to the winds being more variable:—

Months.	Cross the parallel of 30° S. in Long.	20° S. in Long.	10° S. in Long.	Cross Equator in Long.	Days.
	E.	E.	W.	W.	
	°	°	°	°	
January	12·5	0·7	11·5	23·0	23·5
February	12·5	1·5	12·0	24·0	23·4
March	12·0	1·5	12·0	24·0	23·2
April	11·5	1·0	12·0	24·0	23·3
May	11·0	0·7	12·0	24·0	26·4
June	11·0	0·0	11·5	23·0	25·6
July	11·0	0·0	11·0	21·0	26·2
August	10·5	0·0	11·0	20·5	25·4
September	10·5	0·0	11·0	20·5	23·1
October	11·0	0·7	11·5	22·0	21·4
November	12·0	0·7	11·5	22·5	22·8
December	12·5	1·0	11·5	23·0	22·6

Homeward-bound—from the Equator to the Channel:—From the Equator, tor, the routes of homeward-bound vessels may be classed under three heads from November to May,—the *westerly*, *middle* and *easterly*. On the westerly route the winds appear to be fresher and generally more favourable, so that though the distance is longer the time is shorter than by the other routes,—to the extent of 2 or 3 days. But during June, July, August, September, and October—in fact from the time the sun is approaching the northern tropic until he has crossed the Equator—there are but two routes (the westerly and easterly) in respect to which there is little choice—the mean for each being 41 days; they are distant from each other 2½ degrees of longitude on the 15th parallel, and the westerly route at this season is never so far to the westward as the westerly route from November to May; the following are the details:—

From November to May.

The parallel of 15° N. is crossed—
On the western route in Long. 36° 20′ W.—in 10 days, from the Equator.
,, middle ,, ,, 33° 15′ W.— 11½ ,, ,,
,, eastern ,, ,, 30° 25′ W.— 13 ,, ,,
The parallel of 30° N. is crossed—
On the western route in Long. 40° 45′ W.—in 5¼ days, from Lat. 15° N.
,, middle ,, ,, 36° 25′ W.— 5½ ,, ,,
,, eastern ,, ,, 32° 5′ W.— 5¾ ,, ,,
The parallel of 40° N. is crossed—
On the western route in Long. 39° 30′ W.
,, middle ,, ,, 35° 25′ W.
,, eastern ,, ,, 30° 25′ W.
The parallel of 45° N. is crossed—
On the western route in Long. 34° 35′ W.—in 9½ days, from Lat. 30° N.
,, middle ,, ,, 28° 55′ W.— 10¾ ,, ,,
,, eastern ,, ,, 24° 40′ W.— 12 ,, ,,

Thence to the Channel the times are 13¼, 12¼, and 10 days respectively; making a total, from the Equator to the Channel—for the westerly route 38 days,—for the middle route 40 days,—and for the easterly route 40¾ days;—the gain by the westerly route being made between the Equator and 40° N., and is equivalent to 6 days as compared with the easterly route.

The *Aerolite* in March, by the western route made this part of the voyage in 22¼ days.

The easterly route cannot be recommended at this season; indeed, in some instances, vessels having been compelled to make more westing after crossing the parallel of 25° N.,—especially in March, April, and May.

The best route is W. of the Azores.

From June to October.

The parallel of 15° N. is crossed—
On the western route in Long. 30° 0′ W.—in 11½ days from the Equator.
,, eastern ,, ,, 27° 20′ W.— 11¼ ,, ,,
The parallel of 30° N. is crossed—
On the western route in Long. 38° 0′ W.—in 5 days, from Lat. 15° N.
,, eastern ,, ,, 34° 30′ W.— 5¾ ,, ,,
The parallel of 35° N. is crossed—
On the westerly route in Long. 37° 55′ W.
,, easterly ,, ,, 33° 55′ W.
The parallel of 40° N. is crossed—
On the western route in Long. 32° 40′ W.—in 11¼ days, from Lat. 30° N.
,, eastern ,, ,, 27° 20′ W.— 12¼ ,, ,,

Thence to the Channel the times are 14 and 12 days respectively making a total, from the Equator to the Channel—for the western route 41¾ days,—and for the eastern route 41¼ days.

Some good passages have been made East of the Azores at this season.

Bound to Guayana, at all seasons enter the N.E. Trade as speedily as possible;—then, from *December to April*, steer to cross the parallel of 10° N., between 37° to 42° W., thence on a S.S.W.-ly course make for the parallel of 8° N.; when soundings have been got in 45 to 50 fathoms, a N.W. course may be adopted until the depth is reduced to 6 or 7 fathoms. During *May* and *June*, the parallel of 10° N. may be crossed on the meridian of 37° to 40° W., thence steer for the parallel of 3° N. about 350 miles off the coast, and when approaching the land do not come under 5 to 7 fathoms. From *July to November*, passing 150 leagues west of the cape Verde islands, steer to enter the northern part of the S.E. Trade which may possibly be found in 8° to 5° N., then make a westerly course in about 3½° N., after which on approaching the coast proceed as before.

During the rainy season, observations cannot be relied on when approaching Guayana. At all seasons avoid the mouth of the river Amazon. The land should always be made to the eastward of the port owing to the strong N.W.-ly current; also when making the land keep the lead constantly going—the shoals that fringe the coast are avoided by not shoaling under from 6½ to 8 fathoms.

M. Tardy de Montravel says—"the parallel of 10° N. should be crossed, at all seasons, between 43° and 45° W., so as to pass the variable zone to the westward of its most difficult part, and at the same time sufficiently far to the eastward to be able when gaining the regular winds, to make the land well to windward. Bound to Cayenne the course should be shaped, allowing 1½ points for a N.W. current, so as to strike soundings in Lat. 3½° N. in 9 or 10 fathoms. Having reached a depth of 5 or 6 fathoms, the course should be shaped parallel to the land,—N. ½ W. on the ebb, and N. ½ E. on the flood, so as to preserve this depth until to the northward of cape Orange.

Bound to the West Indies, the Less Antilles, and the Gulf of Mexico, enter the N.E. Trade as speedily as possible,—then make to the westward and pass between Antigua and Guadaloupe for the larger islands and for the Gulf. From *April to September*, when the N.E. Trade is well to the northward, the larger islands may, however, be made by passing north of the Virgin islands. For the ports of Venezuela take the channel between St. Lucia and St. Vincent, or that between Grenada and Tobago.

From the northern ports of the United States and from the Bermudas to the West Indies the course is direct, but on making the islands and the channels be well to the eastward. The current runs to the westward among the Less Antilles.

From Jamaica or Cuba to the Less Antilles, pass out of the Caribbean sea and make to the eastward.

From the West Indies, Guayana, and Venezuela, to the Channel, make to the northward and then, passing south of the Bermudas, shape a direct course.

From Cumana steer for the Mona passage; from the western ports take the Windward passage.

From Cuba and the Mexican Ports enter the Atlantic by the Bahama channel, thence steer to pass out of the Gulf stream and to the south of the Bermudas.

Bound to the Gulf of Guinea, and the Bight of Benin, having passed cape Verde make for cape Palmas; from October to May the winds are especially favourable; but during June, July, August, and September, when the S.W. Monsoon is prevalent, do not approach the land nearer than 100 leagues.

Having arrived within 20 leagues of cape Palmas, great assistance will be derived from the Guinea current in making any port to the eastward; and if with adverse winds the vessel is obliged to keep off the land do not go south of 2° N., for there she gets into the Equatorial current which runs to the westward: when nearing the port of destination, you must not get eastward of it.

Bound to Fernando Po or any of the other islands, keep in the Guinea current as long as possible, and then stretch across it,—and make your port from the southward; the same remarks apply to the Gaboon and ports north and south of it; for the current runs N.E. and E.N.E. in the offing, but N.N.E. near the coast.

Leaving the Gulf of Guinea, stretch to the southward into the Equatorial current: the most favourable season is from May to December when there will be no necessity to cross the Equator, as the S.E. Trade-wind is at that period well to the northward; from December to May westing must be made on the parallel of 1° or 1¼° S., as far as the meridian of 17° or 23° W.—when by falling into the usual track of homeward bound vessels, the route is similar to what has been discussed on p.p. 782-783. From May to September a vessel may possibly, by taking advantage of the westerly monsoon, make the cape Verde islands; to the northward of these she will get the N.E. Trade-wind when she must stand to the N.W., and by passing eastward of the Azores, considerably shorten the passage.

NOTES ON SOME OUTLYING ISLANDS, BANKS, &c.

MILNE BANK:—Milne bank was reported by Admiral Sir ALEX. MILNE, K.C.B.:—"On the 28th March, 1864, in Lat. 43° 35′ N., Long. 38° 50′ W., during the passage from Bermuda to England, the sea assumed a dark, dull, lead colour, and soundings were obtained in 92 and 81 fathoms, and 12 miles E.N.E., 100 fathoms, fine sand and ooze.

I am inclined to think that a bank of some considerable extent exists in this locality, as the water for many hours previous to sounding was of the same peculiar tint, indicating soundings, and this appearance continued to the E.N.E. until the night of the 29th inst. This morning we regained blue water, and with reference to notices on the chart of 100 fathoms water, reported in 1859 by Lieut. SAINTHILL, and of 35 fathoms reported in 1851, it strikes me as probable that this bank extends from Long. 42° to 35° W., and between the parallels of 42 and 45° N."

VIRGIN ROCKS:—The position of the Virgin rocks was ascertained by Captain BISHOP, H.M.S. *Manley*, and Mr. ROSE, R.N., in 1829, who give the following account of them.—"The bank on which the shoal is situated, extends E. by N., and W. by S., 4½ miles, its broadest part 2¾ miles; the soundings are regular, from 28 to 30 fathoms deepening suddenly on the outer edge to 39 and 42 fathoms, the rocks are in Lat. 46° 26′ 33″ N., Long. 50° 56′ 20″ W. extending in an irregular chain S.W. by W. and N.E. by E., 800 yards, varying from 200 to 300 in breadth; the least depth of water is on a white rock, in 4½ fathoms, with 5 to 6½ fathoms all round it, the bottom distinctly visible. Towards the extremities of the shoal are several detached rocks, of from 7 to 9 fathoms, with deep water between, and a current setting over them, W.S.W., one mile an hour, with a confused heavy swell."

RYDER SHOAL.—In 1845, a shoal with only 21 feet water on it and having a surface of 100 to 200 feet, was reported by Mr. JESSE RYDER, the master of the fishing schooner *Bethel*. He estimated it to be about 50 miles east of the Virgin rocks, and (by observation) found the Lat. to be 46° 30′ N.

ROCKAL AND ROCKAL BANK:—To the westward of the Hebrides and to the N.N.W. of Ireland lies a long and narrow bank extending 160 miles in a N.E. and S.W. direction,—this is known as the Rockal bank. It was surveyed by Captain VIDAL, R.N. The edge of the bank of soundings having a less depth than 100 fathoms is 20 miles to the northward of the rock known as Rockal, and 45 miles to the southward of the same rock, with an average width of 35 miles; over the remaining area the soundings are from 100 to 200 fathoms. The north end of the bank is in Lat. 58° 20′ N., Long. 18° 40′ W., where there is 163 fathoms of water; the S.W. end, with 190 fathoms, is in Lat. 55° 50′ N., Long. 15° 35′ W.

Rockal bank has recently (1862) been examined by Mr. R. Hoskyn, Master R.N., from whose survey the following particulars are taken :—

Rockal is in Lat. 57° 35′ 58″ N. by meridian altitude of sun; Long. 13° 42′ 21″ W., mean of A.M. and P.M. sights, four chronometers, sea horizon. The rock has an elevation of 70 feet above the sea, is about 250 feet in circumference at its base, and is composed of a coarse granite.

The summit of the rock, sharp pointed and whitened by birds, can only be gained from its N.E. side, and landing is at all times difficult, for it is steep on all sides. On the N.E. side, however, is a small detached rock called Haslewood rock, uncovered at half tide, with 30 fathoms of water between it and Rockal, from which it bears N.E. by N. 1½ cables distant.

Helen Reef, bearing S. 79° E. 2 miles from Rockal, has about 6 feet water over it at low water. It is so called from a vessel of that name that was wrecked on it, and is very dangerous. The situation of it is generally shown by its breakers, but towards high water, and in very fine weather, it only breaks at long intervals. From being small and steep-to, there is then nothing to indicate the approach to it. To avoid it keep Rockal clear of a W. by N. bearing. There is a safe passage between it and the rock.

The lowest estimate that was formed of the range of the tide (judging from the appearance of the rock) was 6 feet; but this seems large for a tide wave in mid ocean.

From Rockal we steered for the Irish coast, when, nearly midway between it and the Irish bank, we obtained one sounding of 1660 fathoms, and found the current here, from a boat moored to the bottom, S.E. by E. ½ E., 1 knot.

FÆROE ISLANDS:—A group of 20 islands, with numerous small islets and outlying rocks, between Norway and Iceland, and W.N.W. from Shetland, is known as the Færoe islands. They are too far north and too rugged to be very productive; but they are well inhabited for their size and situation. They are generally lofty and the coasts are very precipitous. Thorshavn in Stromoe is the principal town. The following positions are given by Lieut. Raper, R.N. :—

Monk rock, Lat. 61° 20′ N., Long. 6° 41′ W.;—Suderoe island, south point, Lat. 61° 25′ N., Long. 6° 41′ W.;—Great Diamond, Lat. 61° 43′ N., Long. 6° 40′ W.;—Myggenoes island, west extreme, Lat. 62° 6′ N., Long. 7° 37′ W.; —Waderoe island, north point, Lat. 62° 24′ N., Long. 6° 31′ W.;—Fugloe island, east point, Lat. 62° 20′ N., Long. 6° 13′ W.;—Nalsoe island, south point, Lat. 61° 57′ N., Long. 6° 39′ W.;—Nalsoe island, north point, Lat. 62° 3′ N., Long. 6° 39′ W.;—Thorshavn hill, north of fort, Lat. 62° 1′ N., Long. 6° 45′ W.

By Sir L. M'Clintock's observations in 1860 the longitudes of the Færoe islands should be about 2′ more to the west.

ICELAND, on the verge of the Arctic circle, has always been celebrated for its numerous volcanoes and boiling springs. It consists of two parallel table-lands from which rise lofty snow-clad mountains,—while the coast is torn in every direction by *fiords* penetrating into the interior and splitting into endless branches; in these fiords the sea is generally still, dark, and deep between steep walls of rock from 800 to 1000 feet high. The principal town is Reikiavig on the west side of the island. Iceland has in its vicinity numerous small islands, islets, and rocks. The following positions are taken from Lieut. Raper, R.N.

Portland island, Lat. 63° 23′ N., Long. 19° 8′ W.;—Hvalsbak rock, Lat. 64° 36′ N., Long. 13° 24′ W.;—East extreme, or point Gepirhuk, Lat. 65° 5′ N., Long. 13° 30′ W.;—Cape Langanaes, Lat. 66° 23′ N., Long. 14° 31′ W.;—Cape Revsnig, Lat. 66° 33′ N., Long. 16° 12′ W.;—Siglenaes, Lat. 66° 12′ N., Long. 18° 50′ W.;—Grimsey island, north point, Lat. 66° 34′ N., Long. 18° 4′ W.;—Mevenklint, Lat. 67° 10′ N., Long. 18° 30′ W.;—North cape, Lat. 66° 28′ N., Long. 22° 26′ W.;—West point, or Staalburghuk, Lat. 65° 30′ N., Long. 24° 32′ W.;—Sneefeldsyokel, Lat. 64° 48′ N., Long. 23° 46′ W.;—Outer rock, or Grenadeer Huen, Lat. 63° 40′ N., Long. 23° 10′ W.;—Reikiavig, Lat. 64° 8′ N., Long. 21° 55′ W.;—Cape Reikianes, Lat. 63° 48′ N., Long. 22° 42′ W.;—Mount Hecla, 5364 feet, Lat. 63° 58′ N., Long. 19° 41′ W.;—Oster Yokel, 5964 feet, Lat. 63° 36′ N., Long. 19° 39′ W.;—Westmanna island, south point, Lat. 63° 20′ N., Long. 20° 23′ W.

By Sir L. M'Clintock's observations in 1860, the longitudes of Iceland should be about 3′ more to the west.

THE END.

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