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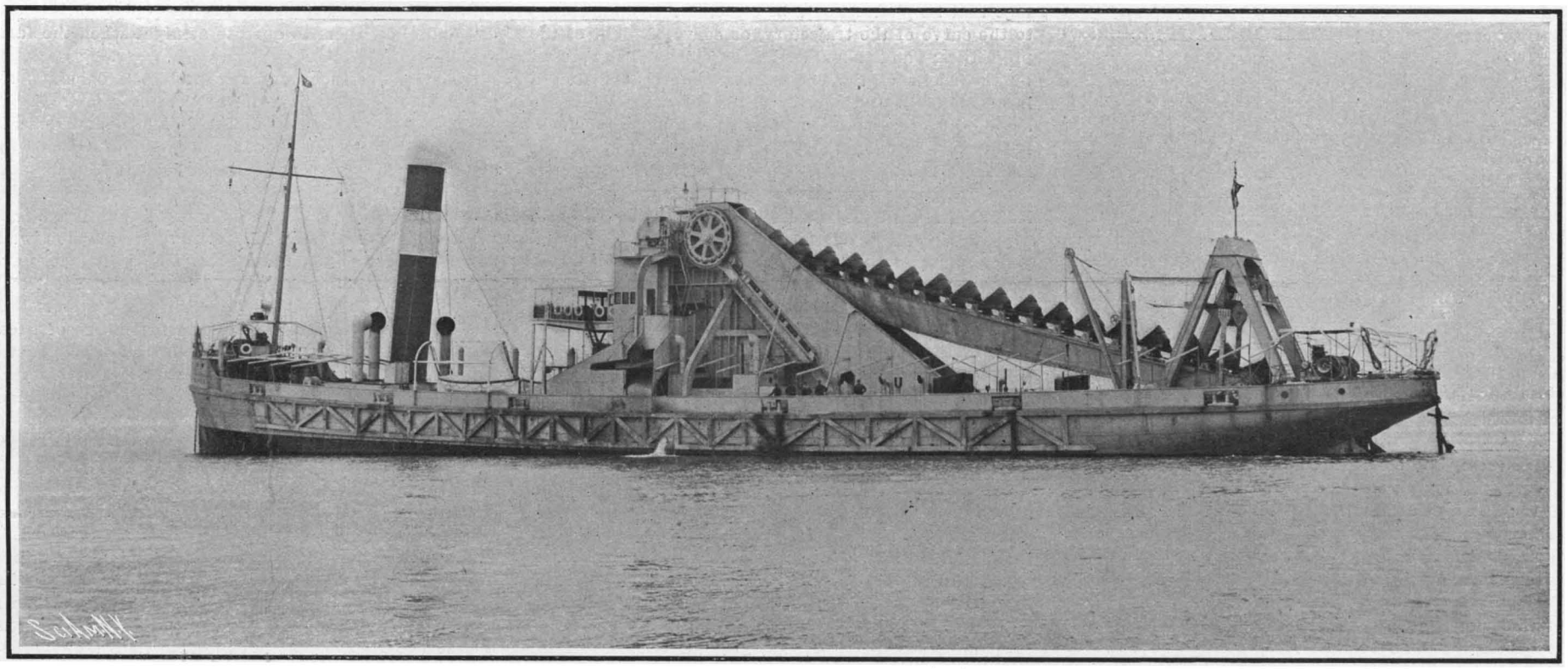
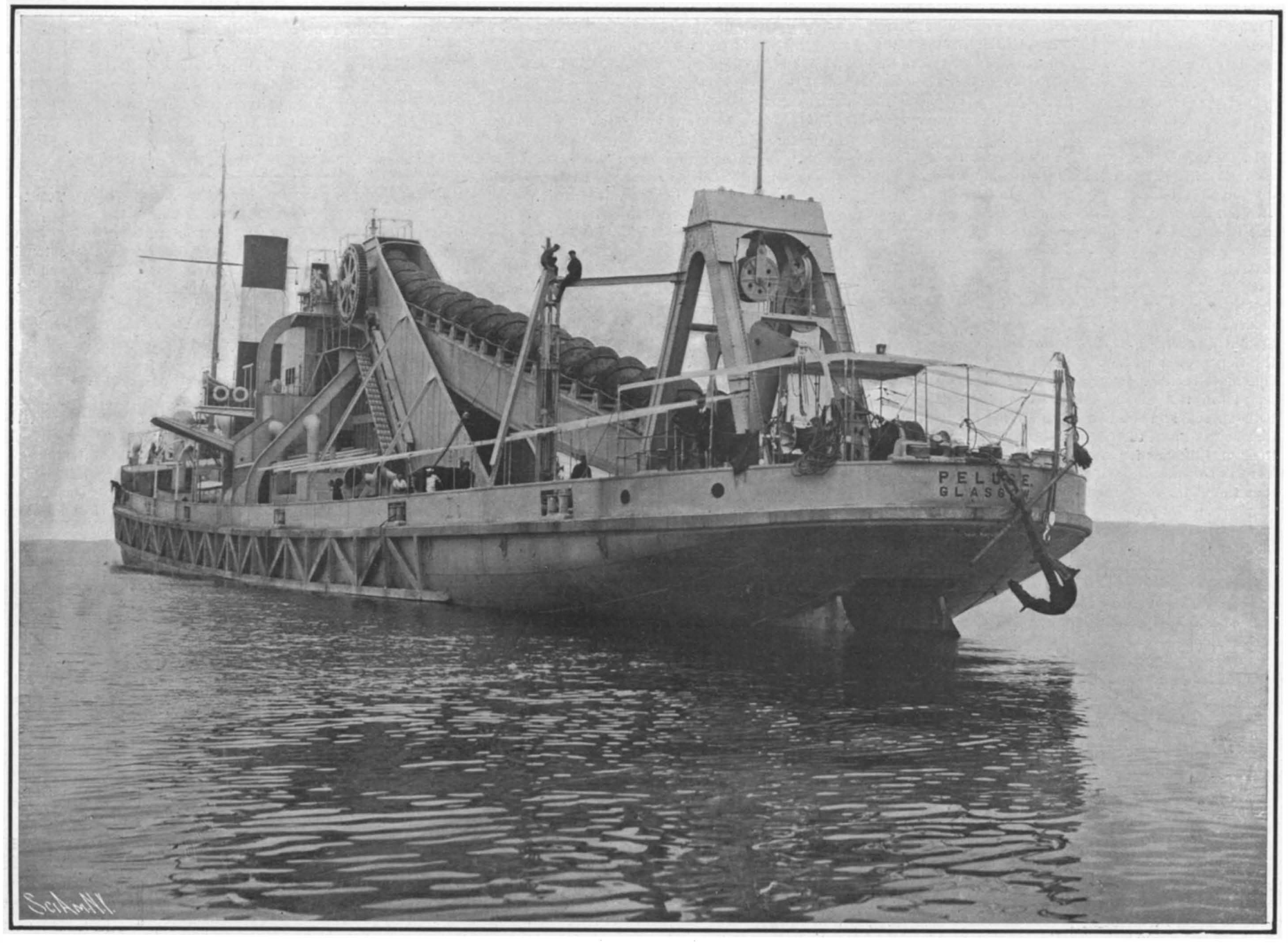


Broadside View of the "Péluse," the Largest Bucket Dredger Afloat.



Length, 305 feet. **Breadth,** 47 feet. **Depth,** 20 feet 2 inches. **Dredging depth,** 20 to 50 feet.

Stern View of the "Péluse," Showing Bucket Ladder and Well.

A HUGE BUCKET DREDGER.—[See page 171.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, SEPTEMBER 12, 1908.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

IS THE AEROPLANE PRACTICABLE FOR SCOUTING?

The army tests of aeroplanes at Fort Myer are naturally bringing the question of the military value of the airship into marked prominence. Our esteemed contemporary Engineering News, in the course of a thoughtful article upon this subject, is evidently less enthusiastic over the military possibilities of the airship as a future means of obtaining full information of an enemy's dispositions and movements than we are. It quotes, with an evident reservation of doubt, our statement that if the airship can only fulfill its present promise, the time is not far distant when the art of war as practised to-day will be stripped of its most important element of success (secrecy) and its prosecution, at least along modern lines, will be rendered well-nigh impossible. Our contemporary believes that we, in common with others who believe in the usefulness of the future aeroplane scout, have failed to realize how completely such a large object in the air will be at the mercy of the sharpshooters of the enemy. This is a point well worth consideration.

In the first place, then, let us state our conviction that an aeroplane in motion will be an extremely difficult object to hit. To "wing" it successfully (the dirigible because of its inflammable gas bag and great size is so obviously vulnerable as to be out of the discussion) it will be necessary to use a gun of considerable caliber; for the perforation of the canvas wings by the tiny, clean-cut holes of a modern rifle bullet, would amount to nothing at all. Now, for a modern field gun to do any accurate shooting, it is absolutely necessary to have the exact range. To get the range, even with the best range finders, is a difficult matter either ashore or afloat, and when the object is in motion the difficulties are increased; but both on sea and land the gunner has the advantage that he can mark the fall of his shots and make corrections until he has found the exact range. Moreover, he has the advantage, particularly on the sea, of knowing that the change of direction of the object takes place only in one, or approximately in one plane. Furthermore, the speed of the moving object is usually not more than 15 miles an hour at sea, and less than a fifth of that speed on land. But the perfected aeroplane, moving through the air at 40 to 60 miles an hour, at an elevation of, say, from 2,000 to 3,000 feet, will be a totally different proposition. At these high speeds it will change its position at the rate of from 60 to 80 feet a second. Unlike the army or navy target, instead of being confined to movement in one plane, it can move in as many planes as the operator may choose. It is certain that, if he finds himself under fire, he will follow an undulating or wave-line course, varying from a direct line both vertically and laterally. Nor could an object, sweeping through the air at high speed on a sinuous line of flight at the height named, be hit by point-blank fire with the heavy field guns, which alone would possess sufficient disabling power to bring it down. In spite of the great improvements that have been made in the training mechanism of field guns, it would be impossible to hold the piece on such an object a sufficient length of time to secure a point-blank hit. Perhaps something might be accomplished with time-fuse shells; but even with these, the firing, for the reasons stated above, would be largely of the "pot-luck" kind.

An important advantage in favor of the immunity of the aeroplane scout from hostile fire is that, in order to make a reconnoissance, it would not be by any means necessary to sail directly over the enemy's camp, fortifications, or line of march. Anyone who has done topographical work is well aware of the great advantage of observation afforded by each additional 50 or 100 feet of elevation. It would be possible to make a fairly good map of Manhattan Island and its environs, even from the 600 or 700 feet elevation of the Singer or Metropolitan tower, and to include in the map quite a wide radius of country. Hence the aeroplane, if subjected to hostile fire, could draw off to the outskirts of the locality to be observed and mapped, and still have a sufficiently detailed view of the country for all practical purposes. Now at this greater distance, the machine would have the advantage that its planes would be directed fairly tangential to the curve of the trajectory, or curve of flight of the projectiles; and should the aeroplane be reached by the shells of the enemy, the chances are that a large majority of them, even if they fell within the area of the cross section of the machine, would pass harmlessly between the planes, rudders, etc., without making a hit.

MANUFACTURING UNDER THE REQUIREMENTS OF THE BRITISH PATENT ACT.

For some months articles have been published in the leading American periodicals on the question of the necessity of manufacturing patented articles in Great Britain to preserve the validity of patent grants, but most of the information furnished is misleading, and most of the conclusions drawn show only too clearly that many of those who have undertaken to inform the public concerning the requirements are deficient in a knowledge of British or general patent practice, and in the rules of statutory construction.

The new law in Great Britain authorizes any person, after the fourth year of the term of a patent, to apply to the comptroller for the revocation of the patent if the patented article or process is manufactured or carried on exclusively or mainly outside of Great Britain. Under this provision, all British patentees have been advised to commence at once the manufacture of their patented articles in Great Britain, whether or not the patentee has any trade in that country or whether or not there is any real demand for the goods. Undoubtedly, it is true that when a British patent is dated more than four years ago, the articles which are sold under the patent in Great Britain should be manufactured in that country, or at least the manufacture should mainly be carried on there. Such a case comes directly within the wording of the statute; and while the comptroller has discretionary power to grant an extension of time, it would be foolhardy for a patentee to jeopardize his British trade by a failure to comply with the requirements. In other cases, such as when the patentee for one reason or another has not commenced the sale of the patented articles in Great Britain, no necessity can be seen for the taking of precautionary measures, although those interested should make certain that the goods are at least mainly manufactured in Great Britain when the industry is introduced there after the fourth year of the term of the patent.

There has been a great agitation in diplomatic fields in an effort to secure exemptions in favor of citizens of particular countries; but when it is understood that all the principal countries are either directly or indirectly accomplishing the purpose sought to be attained by the new British act, it will be realized that there is little prospect of Great Britain's relinquishing her rights. In many countries manufacture must be commenced within a stated time; and when the provisions of the laws are compared, Great Britain will be found to be much more lenient than some countries which take the matter as a personal grievance. In other countries, the manufacture at home of the patented as well as a great many other goods, is indirectly accomplished by tariff laws. Our high tariff, for example, accomplishes exactly the same purpose as the new British patent act; and our copyright law, exacting as it does the requirement that foreign books enjoying copyright privileges here, must be set and printed in the United States, places us much in the same self-protective position with regard to literary works.

When the whole matter is carefully considered, the growth of the underlying principle of the protection of home industries is perceived in the recent enactment.

PROPOSALS FOR COOLING THE SUBWAY.

The latest of the series of admirable reports made by Bion J. Arnold to the Public Service Commission deals with the question of cooling the New York Subway during the summer months. The expectations of the builders of the system that it would present a cellar-like coolness in hot weather were doomed, as the New York public realizes to its sorrow, to disappointment. The optimists forgot that each one of the thousands of motors on the cars would be constantly throwing off heat in such quantities as to more than offset the natural coolness of an underground chamber. It will be remembered that, as the result of the recommendations of Mr. George S. Rice, chief engineer of the Rapid Transit Board, made in March, 1906, grated openings were made in the Subway at the stations; twenty-five exhaust fans in conjunction with fourteen ventilating chambers were installed between 59th Street and Fulton Street; automatic shutters for the discharge of the heated air were placed in roof openings between Fifty-ninth and Ninety-sixth Streets; and an air-cooling plant was built at the Brooklyn Bridge station. Although this installation has tended to relieve the heated condition and improve the ventilation, the Subway is still too hot for comfortable travel.

The method of cooling recommended by Mr. Arnold is as follows:

First. Block the present louvres open during the day and allow them to operate at night when the fans are being run.

Second. Construct as many protected openings as practicable between the Subway and the street.

Third. At the Fourteenth Street and Grand Central stations install large disk fans located in such a way as to draw air from the street through the kiosks and force this air in large volumes down upon and among the persons waiting for trains upon the platforms.

Fourth. Construct a solid continuous division wall between the downtown and uptown express tracks extending from the north end of Ninety-sixth Street station to and including Brooklyn Bridge station. For the purpose of demonstrating the feasibility of such a wall it is suggested that the section extending south from the center wall now at Thirty-third Street station be constructed first far enough south to include the Fourteenth Street station. At stations the upper half of the wall to have vertically sliding counterweighted windows between columns.

The advantages of this scheme are that by constructing division walls between the tracks, the air can be made to travel in the same direction as the train. Each train, as it approached a free opening, would push out a large quantity of air and draw in by suction a considerable amount of air as it passed the opening, thus producing what might be called "piston" ventilation. It is estimated that at the present time there is a change of air in the Subway twice per hour. With the division walls in place it is estimated that the air would be changed at least six times per hour during the day. The deductions in Mr. Arnold's report as to the benefit to be secured seem to be conservative; and when it is learned that the cost of a division wall between Ninety-sixth Street and the Brooklyn Bridge would not be more than $76,000, if it were built of terra cotta, or more than $130,000 if it were built of concrete, the arguments in favor of making this change would seem to be strongly conclusive.

IMPROVEMENT OF NEW JERSEY-NEW YORK SUBURBAN SERVICE.—III.

PENNSYLVANIA RAILROAD.

In recent issues we have dealt with the extensive improvements which are being made in the suburban service between New York and New Jersey on the Lackawanna and the Erie railroads. The present article, the third of the series, describes the costly and important work done by the Pennsylvania Railroad in the improvement of its lines from Harrison, N. J., to the new terminal station at Thirty-third Street and Seventh and Ninth Avenues, New York, over a total distance of 8.6 miles, and in the construction of the vast terminal itself.

The commencement of this great work is found at Harrison, N. J., where a large yard and station is being constructed on a plot of land which measures approximately 3,500 feet in length by 2,500 feet in width. In addition to the commodious station, with separate express and local tracks, the yard will include extensive storage capacity for the rapid-transit cars and motors of the local service, and for the standard passenger cars and steam engines of the steam service. At this point the change of motive power will be made from steam to electric on all trains entering and leaving the zone of electric service. Immediately beyond the easterly end of the station the tracks rise on a 0.5 per cent grade to a level of 31.5 feet above the general ground surface, at which level they are carried on two skew bridges over the west-bound passenger and Newark freight tracks of the company and over the Morris & Essex Division of the D., L. & W. Railway. The whole of the new line, except at the various crossings of public roads, the Hackensack River, and the tracks of other railways, is carried on an embankment, which varies in height from 26 feet to 32½ feet above the surface of the Jersey meadows, the elevation of the latter being generally from 2 to 3 feet above mean tide level.

The bridging is exceptionally heavy and costly. In addition to the crossing of the Morris & Essex Division, which is over 600 feet in length, and the bridge over the west-bound passenger tracks and Newark freight tracks, over 400 feet in length, there are bridges over the N. & P. branch of the Erie Railroad;

the Greenwood Lake Railroad; the Boonton branch of the D., L. & W. Railway; and two bridges over the Erie Railroad track, the larger of which is about 500 feet in length; and, finally, near the western portal of the Bergen tunnel, the tracks of the New York, Susquehanna & Western, and the Northern Railroad of New Jersey have to be bridged. Bridges have also been constructed over several public roads. The most important structure of all is the bridge across the Hackensack River, over 1,000 feet in length, which includes a draw span some 300 feet in length. The whole of this work is of that solid and costly character which everywhere marks the engineering construction of this, America's greatest railroad. About 800 feet beyond the crossing of the Northern Railroad of New Jersey, the tracks enter the Bergen Hill tunnel on a 1.3 per cent down grade. They are carried in two separate tubes beneath the East River to the terminal station between Thirty-first and Thirty-third Streets and Seventh and Eighth Avenues, New York city. The length of the run from Harrison to the terminal station is 8.6 miles. From the station the tunnels are continued beneath Manhattan Island and the East River to a station near the Long Island shore, where connection is made with the present electric system of the Long Island Railroad.

Although the terminal station building will cover only that part of the station ground extending from Seventh to Eighth Avenues, the area actually excavated extends from Tenth Avenue to beyond Seventh Avenue; and its whole area amounts to 28 acres. The total length of trackage of the station and yard is 16 miles, and in the station there will be a total of twenty-one standing tracks, and eleven passenger platforms. In clearing the ground for the terminal it was necessary to remove five hundred buildings, practically all of them dwelling houses. The 28 acres of ground was excavated to an average depth of from 45 to 50 feet, and the amount of material, mostly rock, taken out reached the huge total of 3,000,000 cubic yards. Around the whole of the space as thus excavated runs a massive concrete retaining wall 7,800 feet in length, and for this wall, the foundation, the street bridging, and sub-structures, 150,000 cubic yards of concrete was required.

The passenger station building will be 774 feet long, 433 feet wide, and its average height above the street will be 69 feet. It will contain a waiting room 277 feet long, 103 feet wide, and 150 feet in height. The fact that the whole of the station building must be supported above the tracks calls for no less than 650 massive supporting columns, the weight on the individual columns reaching as high as 1,658 tons. The total length of river tube tunnels under the Hudson and East Rivers is 6.8 miles, which is the total length, also, of the tunnels under the land. The total length of the tunnel from the Bergen portal to the Long Island portal is 5.3 miles, and the total length of track in tunnels, exclusive of yard tracks in the station, is 16.5 miles.

The service of this vast system, extending for 20 miles from Harrison in New Jersey to Jamaica on Long Island, will be entirely electrical. The express trains will be hauled by heavy electric motors, weighing over 100 tons each, and the suburban service will in all probability be operated on the multiple-unit system, with the motors applied directly on the axes of the passenger cars. It is estimated that the total cost of the whole system, by the time it is completed and put in operation, will reach $100,000,000.

ACETYLENE GAS FOR ISOLATED STREET LAMPS.

BY ALTON D. ADAMS.

A large demand exists for street lighting in villages and the suburbs of cities, where there are neither gas pipes nor electric wires, and this demand should be met by acetylene gas.

Street lighting beyond the limits of electric wires and gas pipes is now commonly done, either with kerosene oil lamps or with mantle burners using gasoline, but acetylene would be a welcome substitute in many cases.

As an example of kerosene street lighting, a small Massachusetts town lights about seven miles of streets in this way, until midnight, on a moon schedule, at a total annual cost of about $1,400, or $200 per mile, but the illumination leaves much to be desired.

A proposition has just been made to run an electric line into this town and light this same length of streets with 120 incandescent lamps of 40 nominal candle-power each, at a total annual rate of $2,160 per year, or $18 per lamp, this being the rate paid in a nearby town. These lamps are to operate a little less than 2,200 hours per year.

In one of the larger cities of Massachusetts, there are 792 gasoline mantle lamps that burned 1,857 hours, at a total cost of $17,476.17, or $22.32 per lamp, and there are also 491 gasoline mantles that burned 3,960 hours, at a total cost of $14,317.11, or $29.16 for each lamp, during 1907.

These figures amount to $31,793.28, paid by this city in one year for gasoline mantle burners, beyond the limits of the gas and electric systems.

In Boston, during a recent year, the number of gasoline or naphtha single-mantle burners in use on suburban streets was 1,943, burning 3,828 hours, and the total payment for this service was $56,735.60, or $29.20 per lamp.

Taking the country over, the sums annually paid for kerosene and gasoline street lighting must run well into the millions of dollars, and this volume of business, at the rates paid for the present service, warrants a strong effort to apply acetylene gas to the work.

As the above street lighting is much scattered, and along streets where there is little prospect of commercial business, to say nothing of the difficulty of securing franchises to lay pipes in the streets, it seems that acetylene gas can only be applied to it by means of a generator at each lamp, or else in compression cylinders.

If a small acetylene generator, or a cylinder of the compressed gas, can be located in each lamp-post, so as to give satisfactory results, at a practical expense, a wide field is open to street lighting with acetylene gas.

A small acetylene generator in the post of each street lamp corresponds, roughly, to the idea of the acetylene portable lamp now in use for house lighting, and there appears to be no serious technical objection to such an arrangement, except the freezing of the water in the generator.

With a 30 per cent solution of alcohol, water does not freeze until a temperature of more than two degrees F. below zero is reached, and a 50 per cent solution of glycerine carries the freezing temperature down to 24 deg. below zero. Some heat is developed when acetylene gas is generated, and it may be practicable to so insulate a small generator in a lamp-post that this heat will keep the water, with a moderate percentage of alcohol or glycerine, above the freezing point, even in very cold weather.

Compressed acetylene gas in a small cylinder at each lamp-post appears to offer a satisfactory plan for isolated street lighting, except perhaps as to the cost of installation—this being the method in general use on marine buoys.

Lighting in suburban districts and small villages permits only a very modest investment at each lamp, so that the cylinder used to contain the compressed gas must be small, and accessory connections must be avoided as much as possible.

A design on this line might locate the pressure regulator in one end of the gas cylinder, and attach the burner directly to this regulator, so as to avoid all piping. The size of the gas cylinder at each lamp-post would depend on the number of houses that the stored gas was required to operate, the burner, and on the rate of consumption.

It may be assumed that for general use in street lighting a burner without a mantle should consume one cubic foot of acetylene gas per hour, thus giving a light of more than 40 candle-power. For all-night lighting, from April 1 to September 30, on the basis of one cubic foot of gas per hour, a maximum of about 20.25 cubic feet of gas per night would be required. During the remaining six months of the year, the maximum requirement of gas per night would run up to about 13.5 cubic feet.

If a cylinder for compressed acetylene gas were given a capacity of 24 cubic feet of gas at normal air pressure, then on the system of one company that makes such cylinders and fills them with asbestos saturated with acetone, which latter absorbs the gas, the cylinder might be made 4 x 36 inches, at 150 pounds gas pressure.

This cylinder with 24 cubic feet of gas at normal air pressure would a little more than supply a one-foot burner during two nights, for six months of each year, and would have a surplus over the requirement for any one night, for the remaining six months. Such a cylinder is perhaps better suited to all-night lighting than a larger size because the investment at each lamp must be kept at a moderate figure.

For half-night lighting, the above cylinder would supply a one-foot burner during three lighting periods, in the shortest days of the year, and during five lighting periods, when the daylight hours are longest. If a capacity for only the longest half-night period is desired, a cylinder containing only eight cubic feet of gas at normal air pressure will be large enough.

There is an advantage in the use of cylinders during only a single night or lighting period, before they are recharged with gas, because in this way the pressure of the charge, and consequently the amount of gas, can be regulated according to the time of the year, so that all the gas will be consumed, and the burner will go out at the end of the lighting period. In this way the labor of turning out the burners may be saved.

When the small cylinders used at street lamps are to be recharged with gas, they may be taken to the generating station, and in such event it will sometimes be necessary to have a duplicate set of cylinders to replace those taken away.

Another plan is to carry several large charged cylinders about with a team, and recharge the lamp cylinders at their locations.

OFFICIAL METEOROLOGICAL SUMMARY, NEW YORK, N. Y., AUGUST, 1908.

Atmospheric pressure: Highest, 30.29; lowest, 29.70; mean, 30.01. Temperature: Highest, 91; date, 4th; lowest, 56; date, 27th; mean of warmest day, 82.5; date, 14th; coolest day, 58; date, 26th; mean of maximum for the month, 79.1; mean of minimum, 65.9; absolute mean, 72.5; normal, 72.7; deficiency compared with mean of 38 years, 0.2. Warmest mean temperature of August, 77, in 1900. Coolest mean, 69, in 1903. Absolute maximum and minimum for this month for 38 years, 96 and 51. Average daily excess since January 1, 1.4. Precipitation: 5.65; greatest in 24 hours, 3.25; date, 25th-26th; average of this month for 38 years, 4.56. Excess, 1.09. Accumulated excess since January 1, 3.56. Greatest August precipitation, 10.42, in 1875; least, 1.18, in 1886. Wind: Prevailing direction, south; total movement, 7,139 miles; average hourly velocity, 9.6 miles; maximum velocity, 37 miles per hour. Weather: Clear days, 12; partly cloudy, 10; cloudy, 9; on which 0.01 inch or more of precipitation occurred, 10. Thunderstorms, 5th, 6th, 7th, and 11th. Mean temperature of the past summer, 73.63; normal, 71.93. Precipitation of the past summer, 11.68; normal, 12.15.

THE CURRENT SUPPLEMENT.

A spirited illustration of the German battleship "Barbarossa" at full speed will be found on the front page of the current SUPPLEMENT, No. 1706. The many uses of zinc oxide are exhaustively given and formulas published. Spun glass is a French novelty which is described. A new type of gasoline-propelled railroad motor carriage, especially designed for the use of officials on inspection work, is in use on an English railroad. The car is very fully described and illustrated by our English correspondent. Marcel Deprez writes on his experiments in mechanically reproducing soaring flight. He designed a small model for the purpose of showing the existence of a horizontal component working in an opposite direction to the wind when the latter has obliquely ascending trajectory. That model he describes very thoroughly. Thomas L. White contributes a splendid discussion of the problem of rating an automobile engine. In a general way everyone knows that our so-called paper money is made at the Bureau of Engraving and Printing, but it is safe to say that very few outside of those directly connected with the industry know anything of the important machines used in banknote engraving. These machines are clearly and instructively described by Mr. Claude E. Holgate. A new and efficient method of room disinfection by means of formaldehyde gas mixed with vapor of carbolic acid is described by Dr. W. B. McLaughlin. The results of his experiments show that the penetration obtained by this method is much greater than with any other. The Paris correspondent describes a new automatic heat regulator. Prof. Florian Cajori contributes an illuminating article on the age of the sun and the earth. The usual science, engineering, and trade notes are also published.

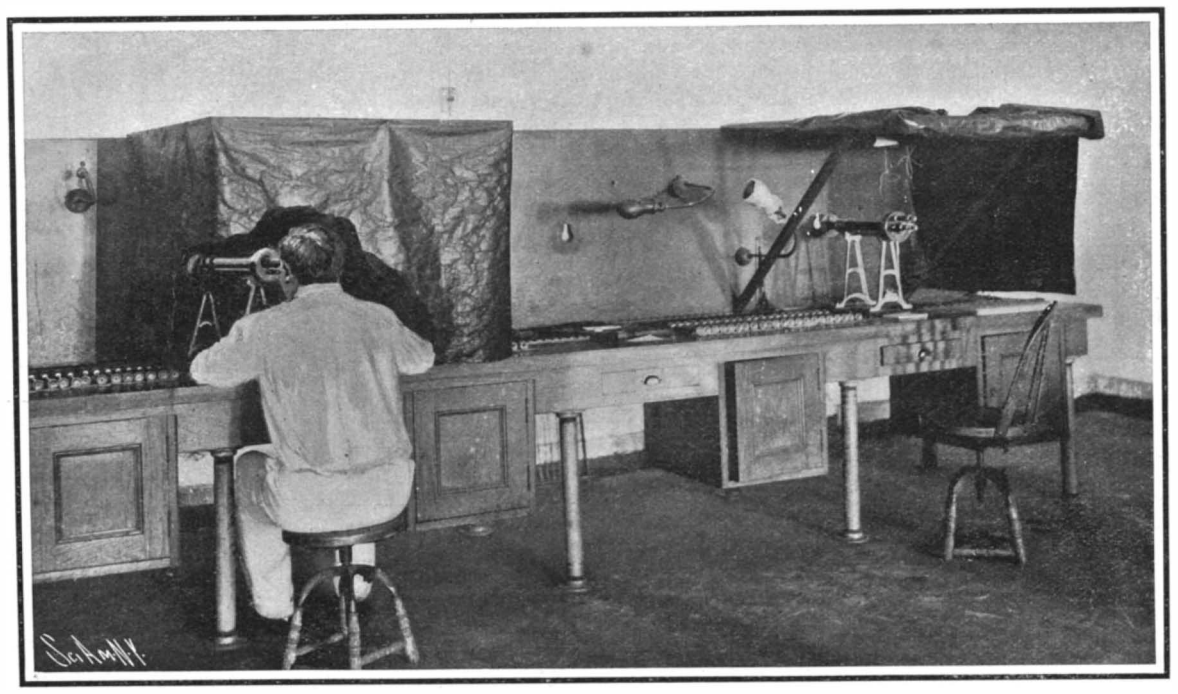
EXCAVATIONS AT ABYDOS.

Prof. J. Garstang, of the Institute of Archæology and the University of Liverpool, has recently returned from Upper Egypt, where he has been following up his previous excavations at the famous early burial ground at Abydos. This last season's work has been the most productive and valuable of his various expeditions. Among his relics he has secured an extensive collection of exquisite examples of pottery and carving, one unique find comprising a small ivory sphinx holding in its clutches the figure of a man which it is about to devour, the expression on the face of the sphinx being strikingly ferocious. The find is of great historical value, the figure of the sphinx, which is an emblem foreign to Egyptian civilization proper, being of a very early date. The professor's chief discovery, however, is that of the only tomb yet brought to light in Egypt of the "Hyskos" period, a temporary supremacy in Egypt of an invading race sometimes described as the Shepherds. The tomb yielded several beautiful specimens of pottery, the first of their kind ever discovered in the land of the Nile and in complete preservation. The ware is beautifully smooth, black in color, and when polished has a surface as brilliant as a mirror, while it is as thin as porcelain. This pottery is quite foreign to Egyptian workmanship and has evidently some connection with early civilization in Asia Minor, since Prof. Garstang found some similar specimens in that area during his excavations there some years ago. In his opinion the discovery of this tomb affords an interesting connecting link in the chain of evidence which he has collected identifying the Hyskos who invaded Egypt with the Hittites of Biblical history.

SUGAR TESTING IN THE UNITED STATES CUSTOMS SERVICE.

BY HERBERT T. WADE.

The largest and most important single item on which duties are collected in the United States Customs Service is sugar; and as the annual imports represent approximately some ninety million dollars, it is of interest to consider how this duty is collected, since it depends upon the exact and scientific determination of the quality of the sugar in each individual cargo. Raw sugar of commerce is graded according to its color, the cruder and coarser varieties on account of their various impurities being much darker than the pure or refined product. Accordingly, the sugar trade recognizes certain standards of color, to which arbitrary numbers have been assigned and which are known as the Dutch standard. These standards are available for use in the form of fifteen graded samples of raw sugars in sealed bottles of clear glass ranging from No. 6, a dark brown, to No. 20, almost white. They are prepared annually by a firm of chemists in Holland for sugar chemists and the trade generally.



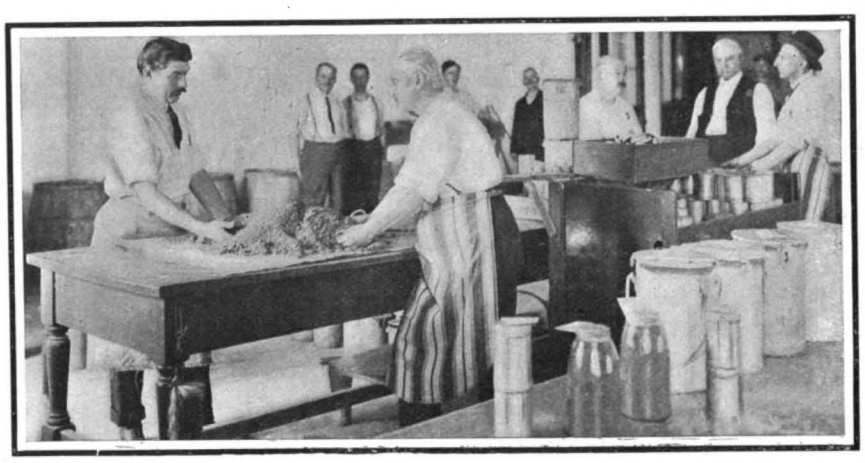
The Polariscope Bench Where Strength of Sugar Solutions Is Determined. At the Right the Curtains Have Been Rolled Back to Show the Instrument.

But to determine the actual amount of pure sugar or sucrose, $C_{12}H_{22}O_{11}$, in a sample of commercial sugar is a far more delicate matter, and not only at the custom house but at almost every stage in sugar manufacture requires the use of the polariscope. This instrument, which is made direct-reading, when once understood is remarkably simple in its use, and gives at once the percentage of pure sugar in the sample under examination.

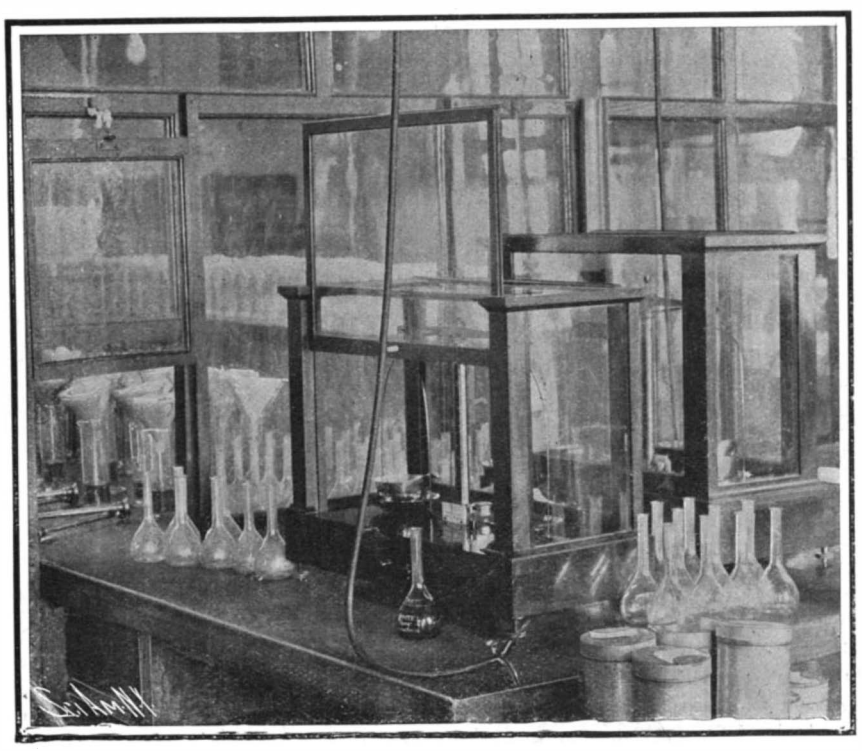
The underlying principle of the sugar-testing polariscope is that a solution of sugar in water is able to rotate a beam of plane-polarized light, the amount of rotation varying with the quantity of pure sugar in the unit volume of the solution. The apparatus consists essentially of a source of light, a Nicol or other polarizing prism, by which the light is polarized or caused to vibrate in a single plane; a plate of quartz or other device to divide the polarized beam into two parts, so that either there is an angle between the planes of polarization or one of the two beams is retarded by a half wave length; a closed tube containing the solution of sugar, through which the polarized beam passes and is rotated; a compensator consisting of two wedges of quartz, one having the power to rotate the beam in a right-hand direction and the other in a left-hand; an analyzing or Nicol prism to detect the plane of polarization of the beam; and finally, a telescope in order to render distinctly visible the field of vision. The position of the two quartz wedges with respect to each other can be varied so as to produce any desired thickness of quartz plate in order to neutralize the rotation of the sugar solution. Now, as the thickness of quartz equivalent to a standard sugar solution can be determined with high precision, it is possible to read off directly in terms of sugar degrees the strength of the sugar solution when made by dissolving 26 grammes of sugar in 100 cubic centimeters of water. If the 26 grammes of sugar were chemically pure, the quartz wedges when adjusted would be a direct reading for any lesser purity or strength of the sugar solution. Ordinarily, the tubes in which the sugar solution is contained, and through which the beam of polarized light passes, are 200 millimeters in length, with a second tube of 100 millimeters in length in case the solution is so dark from impurities as to prevent the passage of sufficient light. The adjustment of the polariscope, of which there are many forms, consists in making the two halves of the field similar in intensity, just as in the photometer. The most frequently used polariscopes employ white light, as from a small incandescent lamp or an incandescent gas burner, and are usually of what is termed the half-shade type. In this the light coming from the polarizing prism is plane-polarized in two planes with a small angle intervening, known as the polarization angle. Now, when this beam of light is examined with an analyzer, if the plane of polarization of the latter is placed at right angles to the line bisecting the angle of polarization, both halves of the field will appear equally illuminated, but any variation from this position causes the analyzer to transmit more of one beam than the other, and consequently to make that side of the field correspondingly brighter. Various devices are employed in polariscopes for securing

(*Continued on page 170.*)

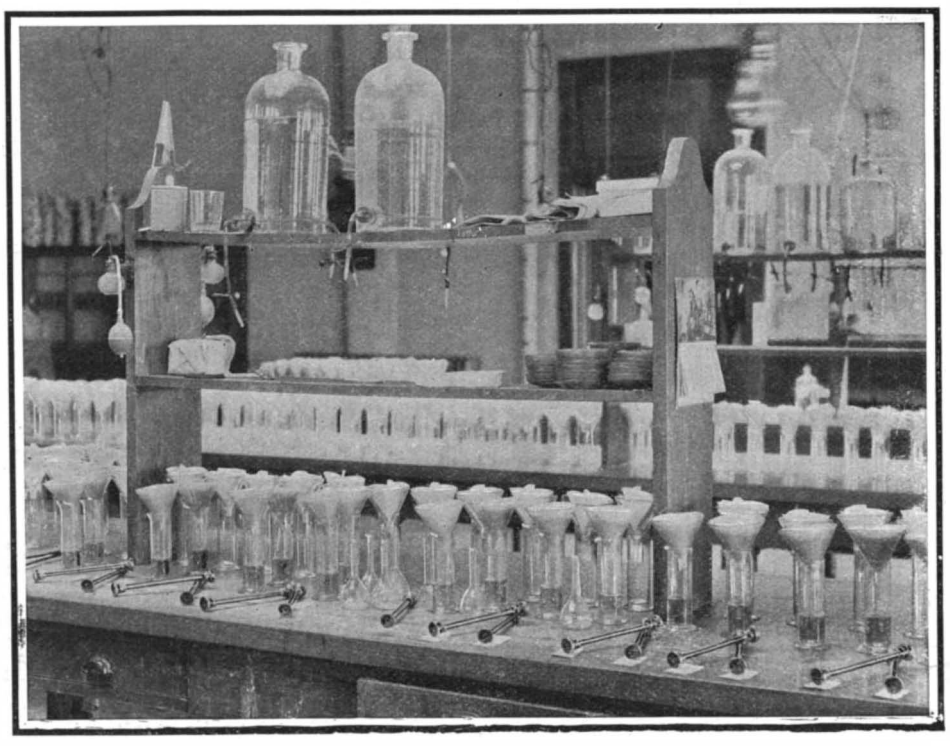
The Sugar Testing Laboratory at the Appraisers' Stores, New York. All Imported Sugar Is Here Tested.



Mixing Room. Samples Received from Docks Are Thoroughly Mixed and Small Samples for the Laboratory are Prepared.



One of the Balance Rooms Where 26 Grammes of Sample Are Weighed and Then Washed into a 100 Cubic Centimeter Flask.



Filtering the Sugar Solutions. Large Bottles Contain Clarifying Agent (Subacetate of Lead). Polariscope Tubes in the Foreground.

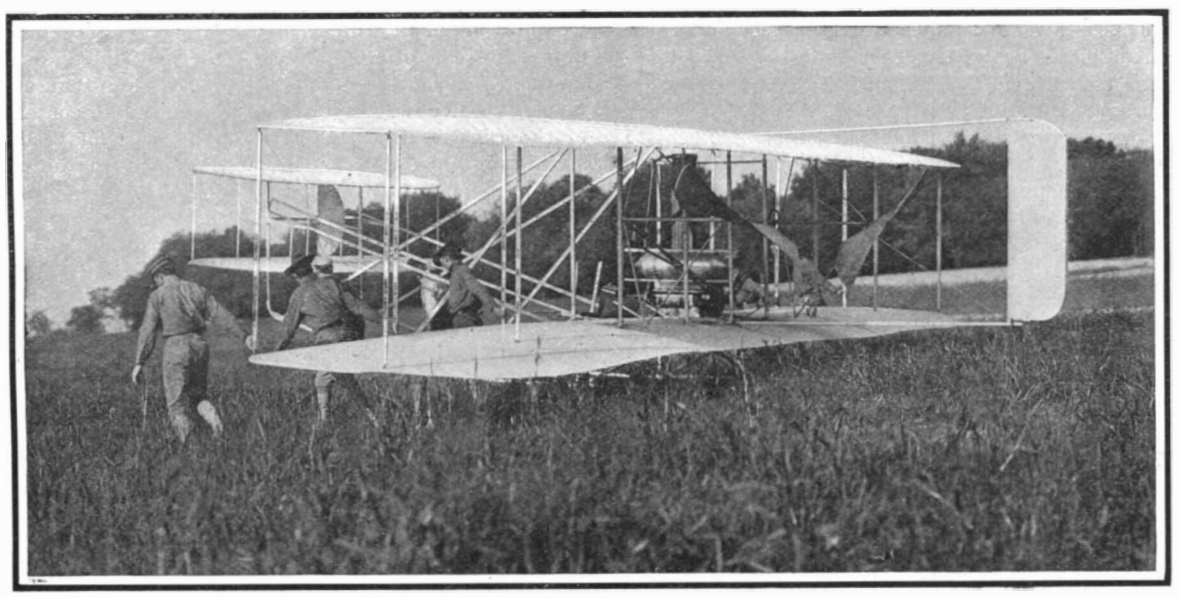
SUGAR TESTING IN THE UNITED STATES CUSTOMS SERVICE.

THE FIRST FLIGHT OF THE WRIGHT AEROPLANE AT FORT MYER.

BY OUR WASHINGTON CORRESPONDENT.

After several days of waiting, consumed in assembling and testing its various parts, Wilbur Wright's machine flew at its first attempt on the 3d instant, remaining in the air 1 minute and 10 seconds, and covering a distance of about a mile.

The aeroplane was launched from the starting rail shortly after 6 P. M., by the dropping of some heavy weights that were suspended from the tower and connected by a rope to the two-wheeled starting car.



Transporting the Machine to the Testing Grounds.

The aeroplane was placed upon this car, and as soon as it was jerked forward (the propellers having first been started) it left the car and ascended gracefully. The starting device is calculated to give the 1,000-pound machine a speed of 28 miles an hour in a distance of 50 feet. This speed is sufficient to cause it to rise readily in still air; but if there is a wind blowing from behind, no ascension can be made. This mode of starting, modeled somewhat after that devised by Langley, is peculiar to the Wright aeroplane, and while it enables the aeroplane to take the air in a short preliminary run, on the whole it does not appear to be so good a scheme as running on wheels on the ground. The use of runners or skids for alighting seems to be an excellent idea, however, and the combination of these with some arrangement of foldable wheels would seem to be a very good plan.

In its initial flight on September 3, the aeroplane went one and one-half times around the parade ground at Fort Myer, thereby covering a distance of approximately a mile. The speed varied somewhat, but it may be roughly averaged at 30 miles an hour. The flight was noticeable for its undulatory character in a vertical plane (which was occasioned by the aviator —Mr. Orville Wright—devoting himself chiefly to the side-steering lever), while the sharp turns that were made and the steep inward inclination of the planes in making them were other interesting points. In attempting to make the turn the second time at the opposite end of the field to that from which he started, Mr. Wright pulled his steering lever a little the wrong way, after which he made a quick descent to avoid hitting a new shed that was in process of construction. The machine was being turned quickly as it struck the ground, and one of the runners, owing to faulty assembling, was slightly broken. The demonstration convinced the spectators that the machine was capable of repeating the performance of the old machine.

A close scrutiny of the Wright aeroplane astonishes one by its great simplicity. The main planes are slightly arched downward at their ends. Their front edges are perfectly rigid, only their ends and rear edges being flexible. The outer ends of the lower plane, at the end and second uprights, are connected by a wire that runs through pulleys attached to the upper plane; while the corresponding ends of the upper plane are attached in a similar manner, with the exception that the connecting wire, in the form of a chain, is carried forward through pulleys and around the hub of one of the three vertical levers, so that a fore-and-aft movement of this lever causes the rear edges of the planes to dip down at one end and to rise a corresponding amount at the other. Close beside this lever, and in reality forming part of it, is another vertical lever that moves the twin vertical rudder. In making a turn, the angle of incidence of the outside end of the planes is at first increased, which causes the machine to rise at this end. The tendency which it has to turn in the opposite direction as a result of the increased resistance resulting from the greater angle, is overcome by means of the vertical rudder. As soon as the machine has tipped inward and started to make the curve the positions of the wing ends are reversed, the greater angle then being given to the inner end. If this procedure is not followed, the aviator cannot turn the aeroplane; and it is for this very reason that a wind fails to upset it. The horizontal rudder is operated by a straight inclined rod running directly from the lever to the two superposed surfaces in front. This rudder is used to maintain the longitudinal equilibrium and also for varying the height. It is operated by the left hand of the aviator, and until his hand becomes used to working it, the aeroplane is bound to do considerable bobbing up and down.

From this account one can see that the Wright brothers have followed closely the soaring birds in the method of steering and maintaining their transverse equilibrium; and that this method works well in practice goes without saying.

A South Pole Trip.

Upon his return from his present expedition in search of the north pole Commander Robert E. Peary plans to organize a national American antarctic expedition to explore the southern polar regions, a project which, he says, has the approval of President Roosevelt. Mr. Peary, however, does not intend to accompany the party. Herbert L. Bridgman, secretary of the Peary Arctic Club, was a delegate to the International Polar Congress held in Brussels in May. At that time Mr. Bridgman presented to the congress the following communication from Commander Peary, the text of which he has made public:

"I beg to state that on my return from my coming arctic expedition I shall endeavor in every possible way, consistent with my other duties, to promote and organize a national American antarctic expedition, to secure for this country its share of the honors and valuable scientific information still awaiting the explorer in that region.

"The project would include the building of another special ship on the same general lines and in the light of the experience gained in building and using the 'Roosevelt,' and the utilization of the methods and equipment evolved during my past seventeen years of arctic work. It would not contemplate my personal association with the expedition in the field.

"While it is too early now to make any definite statement, it is hoped that the Peary Arctic Club may lend its encouragement to the work. This project, I am happy to state, has the approval of President Roosevelt."

At a subsequent session of the commission it is hoped to offer a more detailed presentation of the matter for such action or suggestions as the commission may see fit.

Commander Peary has long had under consideration such an exploration as outlined in his letter.

Villages Situated at Great Altitudes.

The most elevated permanent human habitations in Europe are found in Switzerland. According to the census of 1900, nearly 12,000 persons live at altitudes exceeding 4,900 feet, and more than 4,000 at altitudes exceeding 5,900 feet.

The most elevated communities are found in Grisons. More than half the inhabitants of this canton live more than 3,300 feet, and two-fifths live more than 3,900 feet above the sea level. In the canton of Valais 66 per cent of the population are found at altitudes exceeding 3,300 feet, and 4 per cent at altitudes above 4,900 feet.

The highest Alpine villages are:

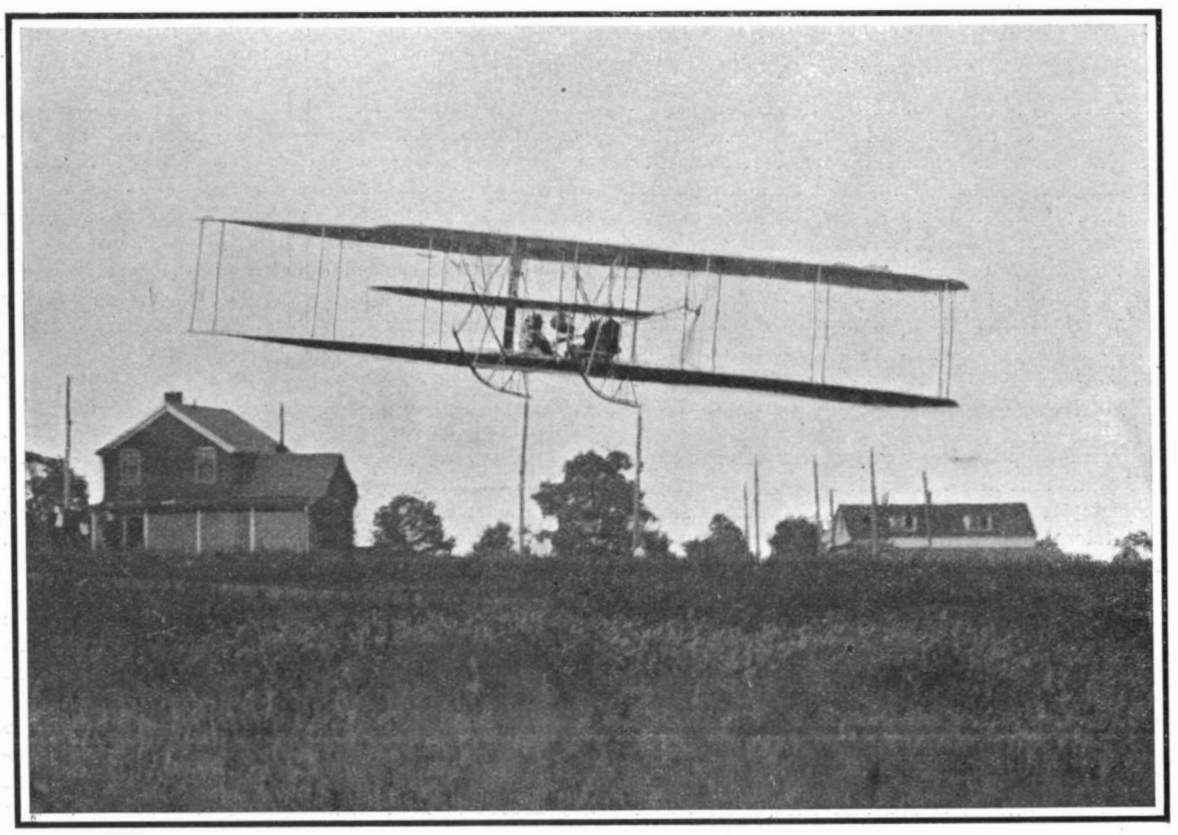
	Altitude.		Inhabitants.
	Meters.	Feet (Approx.).	
Cresta (Grisons)	1,949	6,500	33
Juif (*écart* of Cresta)	2,133	7,100	24
Findelen (Valais)	2,075	6,900	..
Chaudolin (Valais) ..	1,936	6,450	123
Lue (Grisons)	1,918	6,400	59
Arosa (Grisons)	1,892	6,300	1,071
St. Moritz (Grisons) ..	1,856	6,200	..
Pontresina (Grisons)..	1,803	6,000	488

Arosa, which contained only 88 inhabitants twenty years ago, owes its recent increase of population to the establishment of a health resort. All of these villages, with the exception of Findelen, which is inhabited only in summer, are occupied throughout the year. The most elevated shepherds' huts, used only in summer, are those of the Lona Alp in Eringerthal (altitude 2,665 meters or nearly 9,000 feet).

Wilbur Wright in France.

On the 2d instant Mr. Wilbur Wright, after over a week of enforced waiting due to bad weather, again got in the air in France and made a flight in a figure 8 lasting 10 minutes and 40 seconds. He covered a distance of 6 miles in this flight. In a second flight, something went wrong with the starting apparatus.

Manganese steel is now generally recognized as being the only suitable material for street railway track work where any large amount of traffic is to be dealt with, and, as is well known by street railway engineers, this material cannot be dealt with by the ordinary cutting tools, i. e., chisels, saws, files, etc., owing to the extreme hardness of the material.



The First Public Flight of the Wright Aeroplane in America.

THE FIRST FLIGHT OF THE WRIGHT AEROPLANE AT FORT MYER.

SUGAR TESTING IN THE UNITED STATES CUSTOMS SERVICE.

(*Concluded from page 168.*)

this end, and in the Lippich system used in the U. S. Customs Service, the two beams of polarized light are produced by two separate Nicols, the smaller of which covers but one-half the field of the larger. Recently, at the National Bureau of Standards, Mr. Frederick Bates, who is in charge of the work on polarimetry, has devised a polariscope where the angle between the polarizing and analyzing Nicols can be varied for different conditions of solution, thus acquiring the greatest sensitiveness and adaptability to various liquids. A polariscope constructed on this system has the analyzing Nicol and the large Nicol of the polarizing system mounted in bearings and joined by gears with a connecting rod. By rotating the rod with a milled head, the two Nicols are rotated, and the analyzing Nicol receives one-half the angular displacement of the large Nicol of the polarizing system. A circular scale shows the polarizing angle for any position of the Nicols. The apparatus in addition possesses the advantage of having a sensitive thermometer, graduated to one-fifth deg. C., placed between the quartz wedges, and the instrument has a high range of accuracy, enabling the better grades of sugar to be measured with correctness to 0.01 deg. S. This type of polariscope is now used in the control tests at the National Bureau of Standards, and doubtless will be supplied to the chemical laboratories at the Appraisers' Stores.

The duties on sugar are collected under the provisions of the tariff law of 1897, which provides a specific duty of 0.95 cent per pound for sugar under Dutch standard No. 16 in color, testing not above 75 deg. by the polariscope, with 0.035 cent additional for every additional degree, while for sugar above No. 16 Dutch standard and on all refined sugar there is a duty of 1.95 cents per pound. Thus the duty levied by the government essentially is based on the percentage of pure sugar contained in the raw sugar imported as determined by polarimetric examination. In collecting the duty, therefore, the problem is one of determining, first, the exact amount by weight of sugar in a given cargo, thus verifying the invoice; second, a proper sampling of the individual packages of the cargo, in order to afford a basis for subsequent classification and examination; third, the chemical and polariscopic determination of the quality of the sugar, in order to appraise the duty according to the tariff act.

In the United States imports of sugar come almost exclusively to the four great sugar ports, New York, Boston, Philadelphia, and New Orleans, and more recently, since the prominence of Hawaiian and Philippine sugar, to San Francisco. At each of these ports at the Appraisers' Stores are maintained sugar-testing laboratories. The weights, measures, and polariscopic apparatus are standardized and tested from time to time by the National Bureau of Standards at Washington, which institution also maintains a general supervision over the accuracy of the work by checking the measurements of the different samples tested at the various ports by independent measurements of its own.

When sugar is imported and is discharged from the hold of the ship under the direction of the custom inspectors, the first duty is to see that it is properly weighed, the government weighers recording for each half day the weight of all wet sugar, damaged sugar not wet, ship sweepings, dock sweepings, and other sugar, making proper returns to the examiner or sampler in charge. Next comes the taring, or deducting the weight of the containing packages. If the sugar is in tierces, hogsheads, or other irregular or wooden packages, the sugar is removed and the actual tare is taken; while if the sugar is in bags, baskets, or mats, a certain percentage is allowed by the government regulations, unless the weigher in charge may deem actual weighing essential. As this weighing can be done and is done at the wharves of the sugar refineries, where sugar cargoes usually are discharged directly, it is of course possible to do the taring with considerable accuracy when the original packages are emptied.

The government samplers are required to take samples of the different kinds of sugar making up a cargo, and also samples of each package, using various forms of sugar triers, and emptying the samples thus obtained into tin buckets of specified size and form, which as soon as labeled are locked and sent to the Appraisers' Stores. Great care is taken in this sampling that the samples taken shall represent the different packages as correctly as possible, and that the sugar buckets shall be locked and under official custody from the time the samples are taken until they reach the Appraisers' Stores. In weighing, inspection, and sampling, the different government officers are kept in rotation on the various docks, and the greatest care is manifested over the discharge of cargoes of sugar. The sugar samples must reach the Appraisers' Stores by the following day, and there they come under the direct control of the appraiser and his subordinates. Refined sugars too must be tested, and also molasses, adequate samples being taken just as in the case of raw sugars.

At the Appraisers' Stores the first test is to classify the sugars by color according to the Dutch standard as provided in the tariff act, and this is done by experts in the Appraisers' Office, especially if any of the portions are found to be close to No. 16 Dutch standard in color. In case the samples are found above No. 16, they are preserved and sealed, with full data of the shipment, including name of the importer, dates, etc. At the classification room the samples are mixed from not more than three buckets for testing in the laboratory. Two tin cans full of this sugar, with a third as a reserve sample, are prepared, and these without other identification mark than the serial number, are transmitted to the laboratory. The regulations provide that not less than two complete tests by different experts shall be made of each sample sent to the laboratory. If the polarization shown by the two tests is at 92 deg. S (sugar degrees) or above, and if the tests agree within 0.2 deg. S., the average of the two polarizations is accepted as the test of the sample. If the polarization is less than 92 deg. S. and the two tests agree within 0.3 deg. S., the average of the two is taken as the test of the sample. In case the agreement is not within the limits mentioned, the regulations provide for additional tests and also for retests. Once the sugar is tested, the importer is notified by the appraiser of the average test of the cargo, and also the quantity and test of each lot from which such average test is obtained. The importer has two days within which to claim an error and request a retest, which may be allowed by the appraiser for reasons deemed by him sufficient. The classification of the sugar in case of retest is based upon the average of the test and the retest, unless the appraiser is convinced that one or the other is in error. In determining the duty on imported molasses, groups of packages are sampled and classified, and if the molasses is imported in a tank vessel, an average is made of the test of samples taken during the discharge of the vessel. If the samples are thought to contain syrup of cane juice, they are subject to chemical analysis. In this event, if the polarization of the dry substance is above 75 deg. S., the sample is considered syrup of cane juice within the meaning of the tariff; but if the polarization of the dry substance is less than 75 deg. S., it is considered as molasses, which, according to the Treasury Department, is the liquid residuum drained or purged from raw sugar, while the syrup of cane juice is the juice of the cane highly concentrated, but not to the point of crystallization.

To assure perfect uniformity in the testing of imported sugars, it is provided that on each alternate day a sample of the sugar shall be tested at each of the ports of Boston, New York, Philadelphia, New Orleans, and at the same time, duplicate samples of the same sugars shall be exchanged between the appraisers of the said ports and the Bureau of Standards at Washington for duplicate tests. These tests are all reported to the Treasury Department, and thus guarantee the uniformity of the work of testing and the classification. On alternate days also, samples of sugars are tested as to dry substance at these ports, and duplicate samples are prepared and exchanged in the same manner, the tests indicating the direct polarization and the percentage of moisture in the original substance. As the tariff provides in part that sugars after being refined, when tinctured, colored, or in any way adulterated, shall pay special rates of duty, special examinations must be made at the five sugar ports, and also in the case of sugars which are subject to an additional duty where foreign countries impose an export bounty, and the same depends on the polariscopic tests of the sugar, although all other refined sugars, such as cut-loaf, crystals, crushed, or granulated sugar, are deemed to have tested at least 99.5 deg. S. when exported from the country of production.

It will be obvious from the foregoing that the polarization test is the most important part of the proceedings, and it is a quantitative, scientific examination which must be carried on with the greatest accuracy. In fact, several years ago there was considerable discontent on the part of importers with the polariscopic work of the customs officials, and the matter was carried into the United States courts, as the accuracy of the determinations was disputed. The Bureau of Standards on behalf of the national government was able to demonstrate the accuracy of the polariscopic apparatus by evidence of the most conclusive tests, so that the government won the suit, which involved at least several hundred thousand dollars.

The sugar-testing laboratory, where the polariscope is installed, usually is a room as far removed as possible from the vibration of machinery and away from any source of heat which cannot be controlled. The polariscopes are placed in the darkest corner of the room, and the top of the table on which they are set is surrounded on three sides by blackened partitions or walls not less than three feet in height, or suitable curtains of opaque material are hung around the polariscope to cut off interfering light. The instruments themselves must be exposed to the free circulation of the air from the remainder of the room, and the lamp must be 200 millimeters from the instrument and back of the partition, with a small opening for the beam to go through. The great point is to keep the polariscope away from such essential features of a chemical laboratory as ovens, assay furnaces, hot-water heaters, or other sources of heat, and also away from the direct rays of the sun. The standard temperature for sugar testing is 20 deg. C. or 68 deg. F. All apparatus, such as the measures of volume, polariscope tubes, quartz control plates, thermometers, and weights, previously must be tested and standardized at the Bureau of Standards. The thermometers are graduated to the Centigrade scale of not less than one-tenth of a degree. In testing the sugar, the contents of the can are thoroughly mixed by stirring with a spoon, and then 26 grammes are weighed on the balance in a German-silver dish, the operation being done as rapidly as possible, so that the sample does not suffer loss of moisture, as may happen, especially in a warm room. This weighed amount of sugar is then washed by means of a jet of water into a closed flask containing 100 cubic centimeters, in which all the sugar must be dissolved. If the solution thus obtained is clear and transparent, it can be filtered and the 200-millimeter polariscope tube is filled and the cover glasses and screw caps placed in position on the ends. In case the liquid is not clear and transparent, a clarifying solution, such as subacetate of lead, is added, and the solution filtered as before, while in the case of a very dark solution, such as dark-colored molasses, when it is too dark to polarize even in the 100-millimeter tube, boneblack may be used in the filter. Before any reading is made on the polariscope tube, a quartz control plate that has been standardized is placed on the polariscope and a careful adjustment made. It is known that quartz of a certain thickness will rotate a beam of polarized light a certain amount as compared with a normal sugar solution, so that with a test plate thus measured with precision and its equivalent in sugar degrees determined, the direct readings of the polariscope can be tested. Then the polariscope tube is placed in the polariscope, after the observing telescope has been adjusted so as to bring the dividing line between the two halves of the field into sharp focus and to secure an equality of tint. The wedges then are adjusted to secure the same equality of tint and a reading is made on the scale, which is graduated direct in sugar degrees. The regulations provide that the tube shall be read on two different instruments by the same observer, and not less than three careful readings of the tube shall be made on each instrument. The average of the readings is taken, and is corrected by the quartz control plate.

To determine the moisture in sugars, a small amount is dried at a temperature of 98 deg. C. for two hours in a small nickel dish about two inches in diameter and three-fifths of an inch high. Molasses syrups and *masse cuites* are similarly dried in a flat dish.

Once the quality of the sugar thus is determined, the matter passes into the ordinary routine channels of the appraisers' and collectors' offices, unless some appeal is made from the duty. The great uniformity that has been reached in sugar testing is characteristic of the appreciation of scientific methods in the work of the United States government and the co-operation of the different branches of the government toward this end.

Helium Gas Heavier Than Liquid.

We are used to thinking of gases as always less dense than liquids, and in fact we have never hitherto been able to increase the density of a gas, either by compressing or by cooling, down to the point where it becomes heavier than a liquid in contact with it. This could not take place, of course, if the gas became liquid or dissolved in the liquid. Dr. Kammerlingh Onnes has, nevertheless, accomplished this surprising feat by causing a bubble of compressed helium to descend by its own weight through liquid hydrogen, like a drop of water in oil. He compressed a mixture of hydrogen and helium in a capillary tube plunged into liquid hydrogen. The hydrogen becomes almost entirely liquefied and, if the pressure does not exceed 49 atmospheres, occupies the bottom of the tube. Beyond this pressure a bubble of almost pure helium, which is floating on the liquid, is seen to descend below it, and to rise again when the pressure is decreased to 32 atmospheres . . . . Besides its originality, this experiment will enable us to ascertain . . . the limit density of helium, which Van der Waals supposes to be that of the heavy metals.—Cosmos.

It is reported by Consul-General Robert J. Wynne that the ninth tunnel under the Thames, London, will shortly be opened. Of the tunnels under the Thames, five are used exclusively by subways and railroads, and the other four used for general traffic.

A HUGE BUCKET DREDGER.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

In connection with the widening and deepening of the Suez Canal at Port Said, the authorities have recently increased their dredging fleet by a new vessel, which ranks as the largest bucket dredger afloat. This vessel, which is named the "Péluse," was built by Messrs. Lobnitz & Co. at their Renfrew yards on the Clyde, and is of similar design to the "Ptolemée, which they supplied to the canal company some two years ago. The new vessel, however, has been acquired for service in the Port Said roads, which are being deepened.

The "Péluse" has a deck length of 305 feet, with a molded breadth of 47 feet, and molded depth of 20 feet 2 inches. The deck is steel throughout, sheathed with teak, and there is a raised forecastle and poop. Propulsion is effected by means of independent twin-screw engines indicating 1,800 horse-power, with a separate dredging engine of 600 horse-power. The latter machinery is of the three-crank type placed on the main framing. Steam is supplied from three boilers each of 15 feet diameter by 10 feet 7½ inches in length.

A feature of the vessel is that all gearing has machine-cut teeth. The auxiliary machinery throughout is operated by hydraulic power. Separate condensing plant is fitted for all machinery. The Lobnitz patent hopper-door arrangements are used.

The dredger has been designed to work between the limits of 20 feet and 50 feet below water level. Owing to her large size she navigated from the Clyde to Port Said in working condition, being of seagoing design in the widest sense of the term. The craft is classed by Bureau Veritas in their highest class with special mark, owing to the arrangement of watertight bulkheads rendering her practically unsinkable in the event of collision.

Washing Fabrics by Electrolysis.

In certain processes of cloth finishing the operations of scouring and washing, after the material has been filled and bleached, require a long time, careful handling and a large supply of water. Moreover, through lack of practical means for recovering them, the oil and fatty acids or soap pass away with the waste wash-liquor, involving considerable loss. Often there are found in cloth traces of fatty acids or soaps which produce spots and stains when the cloth is being dyed. The fact that the cloth is kept for a long time under a rolling action when in the bath also entails considerable wear and a very noticeable loss in weight.

The invention of a Frenchman, J. M. J. Baurot of the city of Roubaix, France, who was granted United States letters patent, provides for the treatment of the cloth by an electric current, which is used for penetrating, reducing, and extracting the soapy film formed. Additional to this is the recovery of the fatty semi-solid magma resulting from the soapy matters extracted from the cloth.

The cloth after entering passes over a roller and between a set of electrodes. Leaving the electrolyte, the material passes between squeezing rollers and then through a tension device over idle rollers to the large rubber-covered squeezing roll.

The electrolytic vat is kept filled with the proper amount of carbonate of soda or potash solution by replenishing as the electrolyte is consumed. By the action of the electric current passing between the electrodes, every fiber of the cloth is acted upon and there is produced a more complete saponification on the textile where before was only a coarse soapy film. Incidentally by the attraction of the freed salts with the elimination of gelatinous matters, waste fibers, dust and other small impurities which are kept in the yarn or material of the cloth and carried away with the salts thus formed, the action of scouring is completed, and when the cloth reaches the first pair of squeezing rollers their compressing action removes and throws back into the vat the soapy matter already solidified in a film on the cloth.

When the first compartment of the squeezing machine becomes filled with the soapy sludge the surplus sludge is led into the electrolytic recovery vat. The pieces of cloth thus successively pass from the first compartment in the squeezing machine and then are submitted to a second scouring which absolutely insures the completion of the action. In this method there is no danger of incomplete scouring which has been the cause of many difficulties and annoyances in dyeing. Moreover, method enables the time of scouring and washing to be shortened, for as a result of the facility with which the soapy matters are precipitated in the first compartment, the second compartment gets so little of such matters that the scouring of the cloth is effected well enough to allow the third compartment to be filled with a large supply of running water for washing. This is in most cases quite sufficient for the last rinsing of the cloth before being dyed.

The recovery of the fatty substances which compose most of the soapy wash-liquor led by the overflow from the first compartment of the squeezing machine is effected in the electrolytic vat connected to the dynamo. The alkaline salts are precipitated, the fatty acids depositing upon the surface of the electrode plates or rising to the surface of the liquor where they are easily removed. Such fatty acids still contain impurities which are removed by submitting them to the action of a press heated by steam, after which they come out clarified and pure enough to be either used again for making soap or sold to the trade. The treated magma gives out from 50 to 55 per cent in weight of fatty acids.

THE RECURRENCE OF ECLIPSES.

BY FREDERIC R. HONEY, TRINITY COLLEGE, HARTFORD, CONN.

The variations in the intervals of time between the dates of full moons and of new moons might convey the impression that the moon is a very poor time-

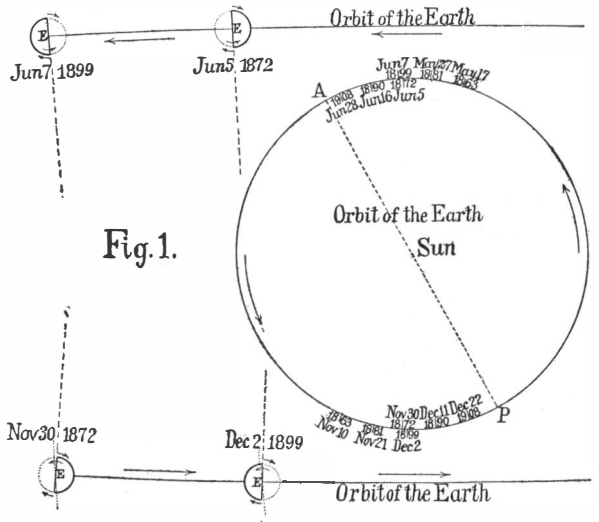


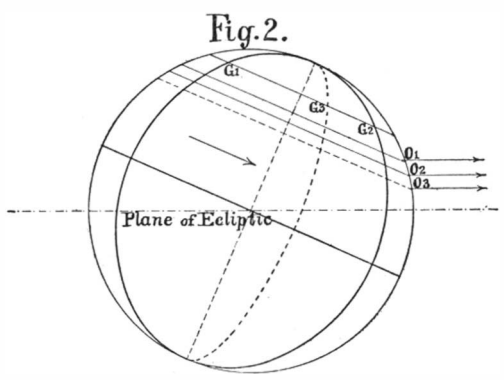
Fig. 1.

Diagram of Earth's Orbit, Illustrating Recurrence of Eclipses.

keeper. That the moon "comes to time" is demonstrated by the repetition of eclipses at intervals of eighteen years and eleven and a third days. It should be noted, however, that the circumstances of an eclipse are not the same as those of the eclipse of the previous date. On the repetition of an eclipse the earth occupies another position in its orbit. Each day it moves on the average nearly one degree $\left(=\frac{360}{365.25}\right)$ At aphelion, when the earth's velocity in its orbit is a minimum, eleven days represent less than 11 deg.; while at perihelion in the same number of days the earth moves a little more than 11 deg. During the additional fraction of a day the earth's rotation on its axis changes the longitude of the observer.

The yearly advance of the dates of eclipse seasons is due to a slow twisting of the plane of the moon's orbit in a direction contrary to her orbital motion. If this plane moved into parallel positions, the line of nodes, which is the intersection of the plane with that of the ecliptic, would come into line with the radius of the earth's orbit twice each year at opposite points. Thus the dates of eclipse seasons would not vary.

Fig. 1 represents the earth's orbit, whose axis is



Projection of Earth on a Plane Parallel to Its Axis and Perpendicular to Plane of Ecliptic.

THE RECURRENCE OF ECLIPSES.

AP; A and P being respectively aphelion and perihelion. A small part of the orbit for the months of June, November, and December is shown separately on a scale sufficiently enlarged to represent the moon's orbit, whose diameter is a little over one four-hundredth the diameter of the orbit of the earth. The position of the earth is shown for May 17, 1863, May 27, 1881, and June 7, 1899, the dates of solar eclipses when the moon was at the descending node. Nearly six months later in each year, when the moon was at the ascending node, the position of the earth is given for November 10, November 21, and December 2, the dates of solar eclipses. After an interval of nine years, when the line of nodes is turned about half way around and the moon is at the ascending node, there is an eclipse season. This is illustrated at the dates of solar eclipses June 5, 1872, June 16, 1890, and June 28, 1908; and also nearly six months later in each year, when the moon was at the descending node, and when the earth's position is indicated for November 30, December 11, and December 22. The limits of this page make it impossible to represent all the positions of the earth at these dates on the orbit drawn to the larger scale. The positions for June 5, 1872, and June 7, 1899, also those for November 30, 1872, and December 2, 1899, which are near together, have been selected in the illustration. The heavy full line represents that portion of the moon's orbit which is above, and the dotted line that which is below the plane of the ecliptic. The earth is at E; the moon's motion is in the direction of the arrow (within the orbit) and the direction of rotation of the line of nodes is indicated by the two arrows (without the orbit).

The table gives the dates of some eclipses of the sun between the years 1863 and 1908. It is divided into two parts, viz., those which occurred when the moon was at the ascending and descending nodes respectively. By this arrangement it is easy to see at a glance the effect of a complete rotation of a line of nodes, which occurs at intervals of eighteen years and eleven days, whether the date be that of an eclipse when the moon was at one node or the other.

An annular eclipse of the sun occurred on June 5, 1872, on June 16, 1890, and again on June 28, 1908, when the moon was at the ascending node. Fig. 2 is a projection of the earth on a plane which is parallel to its axis, and perpendicular to the plane of the ecliptic. In this projection the position of an observer to whom the central eclipse was visible at noon at a date prior to June 21 is on the visible hemisphere. Subsequent to that date the position is on the invisible hemisphere. The parallel and the position of the meridian of Greenwich are shown for each of the dates. G_1 and O_1 are the positions of Greenwich and the observer for June 5, 1872; G_2 and O_2 the positions for June 16, 1890. In both cases the observer was east of Greenwich and on the visible hemisphere. G_3 and O_3 show the positions on June 28, 1908, on the invisible hemisphere. At the latter date the observer was west of Greenwich. The path of this eclipse was illustrated in an article by the writer in the SCIENTIFIC AMERICAN for May 16, 1908. (The annular eclipse of the sun in June, 1908.) The latitude of the observer for each date is shown by the parallel; and the arrow indicates the direction in which the eclipse is seen. To avoid confusion, all unnecessary parallels and meridians are omitted. A dash line represents the meridian of Greenwich on the invisible hemisphere.

It should be noted that when five leap years are included in the cycle, the period is eighteen years and ten days; and that it is eighteen years and twelve days when only three leap years are included. The date is advanced one day when an eclipse and its repetition occur near the close and the beginning of a day. The length of the period expressed in days is 6,585.32.

ECLIPSES OF THE SUN.

	Moon at Ascending Node.					
Annular,	Nov.	10, 1863	Nov.	21, 1881	Dec.	2, 1899
Annular,	Oct.	30, 1864	Nov.	10, 1882	Nov.	21, 1900
Annular,	Oct.	19, 1865	Oct.	30, 1883	Nov.	10, 1901
Partial,	Oct.	8, 1866	Oct.	18, 1884	Oct.	30, 1902
Total,	Aug.	29, 1867	Sept.	8, 1885	Sept.	20, 1903
Total,	Aug.	17, 1868	Aug.	29, 1886	Sept.	9, 1904
Total,	Aug.	7, 1869	Aug.	18, 1887	Aug.	30, 1905
Partial,	July	27, 1870	Aug.	7, 1888	Aug.	19, 1906
Partial,	June	28, 1870	July	8, 1888	July	21, 1906
Annular,	June	17, 1871	June	27, 1889	July	10, 1907
Annular,	June	5, 1872	June	16, 1890	June	28, 1908
	Moon at Descending Node.					
Partial,	May	17, 1863	May	27, 1881	June	7, 1899
Total,	May	*5, 1864	May	16, 1882	May	28, 1900
Total,	Apr.	25, 1865	May	6, 1883	May	17, 1901
Partial,	Apr.	14, 1866	Apr.	25, 1884	May	7, 1902
Partial,	Mar.	16, 1866	Mar.	26, 1884	Apr.	8, 1902
Annular,	Mar.	5, 1867	Mar.	16, 1885	Mar.	28, 1903
Annular,	Feb.	23, 1868	Mar.	5, 1886	Mar.	16, 1904
Annular,	Feb.	11, 1869	Feb.	22, 1887	Mar.	5, 1905
Partial,	Jan.	31, 1870	Feb.	11, 1888	Feb.	22, 1906
Total,	Dec.	22, 1870	Jan.	1, 1889	Jan.	13, 1907
Total,	Dec.	11, 1871	Dec.	22, 1889	Jan.	3, 1908
Annular,	Nov.	30, 1872	Dec.	*11, 1890	Dec.	*22, 1908

* Central eclipse.

The Jones Airship Disaster.

Charles O. Jones's airship "Boomerang," familiar to New Yorkers by reason of its frequent ascensions from the Hudson River Palisades, dropped 500 feet to the ground at Portland, Me., on September 2. Jones was killed. In some inexplicable manner the outer varnished envelope of the gas bag was ignited. Realizing his danger, Jones opened the gas-valve in order to alight. The escaping gas caught fire; the cords by which the framework was suspended were severed, and the aeronaut plunged to his death.

The "Boomerang" was built by Jones at Hammondsport. Unskillfully designed, low-powered, and clumsy in its construction, it was often unmanageable even in comparatively light winds. The airship was 105 feet long, 21 feet in diameter, and had a gas-capacity of 25,000 cubic feet.

A POLICE ACADEMY AT ROME.

BY DR. ALFRED GRADENWITZ.

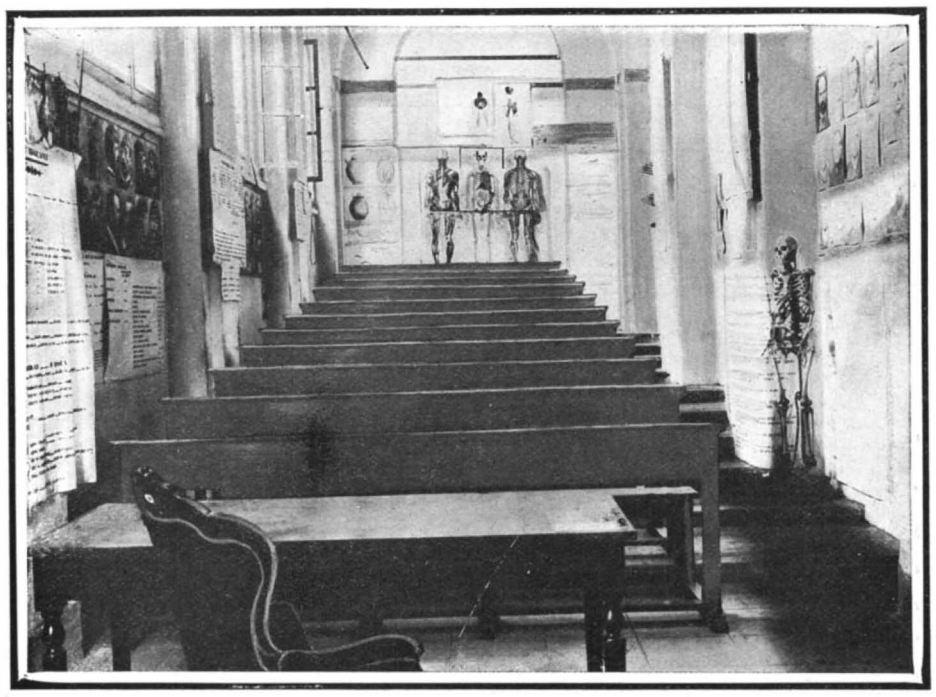
The day is far past when the application of torture was considered the safest means of wringing a confession out of a suspect. Scientific methods are now utilized in the police service to assist the ingenuity of detectives, and facilitate the apprehension and identification of criminals. Such methods are made the more necessary by the fact that the criminals themselves make use of science.

One of the most important branches of the police service is the identification of criminals, and the possibilities of science in this direction are especially striking. The anthropometric measuring method designed by Bertillon is the most valuable adjunct to the camera, and practically eliminates any possibility of mistake. Another far simpler and easier method is that of "dactyloscopy," according to which the imprints of the five fingers of each hand, with their characteristic curves, are used to ascertain the identity of the person.

Criminology has been especially developed in Italy, where many scientists have followed the tracks of Lombroso. This accounts for the fact that a police academy at which lectures and courses are delivered, not only by practical men, but by the foremost scientific experts, has been founded at Rome on the lines suggested by Prof. Salvatore Ottolenghi, to whose courtesy we are indebted for the accompanying photographs of that unique school.

In the following brief description of the programme of the school, a comprehensive view of the multifarious applications of science to "criminalistic" procedure is presented.

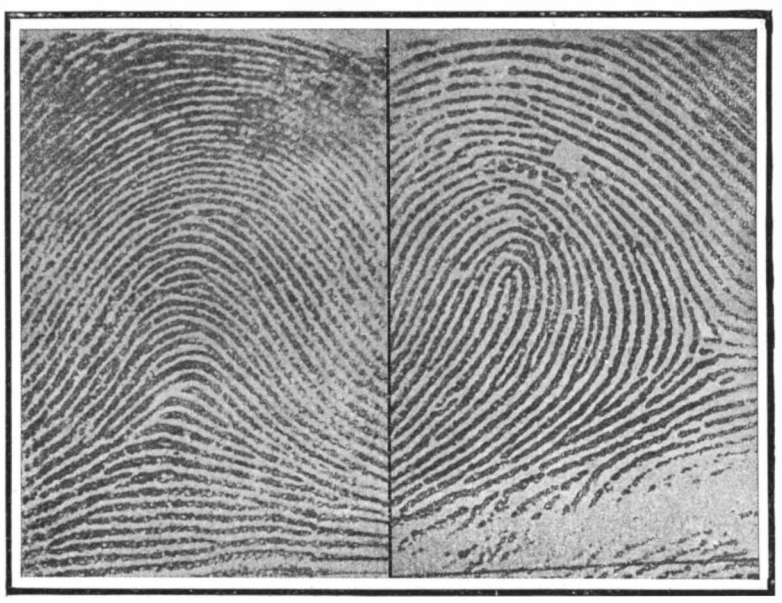
One of the illustrations represents Dr. G. Falco, an officer of the Italian identification service, in the act of taking the finger prints of a criminal. Printer's ink is first spread out uniformly over a zinc, glass, or marble plate. Then the finger tips of the individual are lightly pressed on the plate, producing upon the latter the characteristic lines shown in one of the cuts. A slight rolling or rocking of the finger endwise will



A Classroom in the Roman Police Academy.

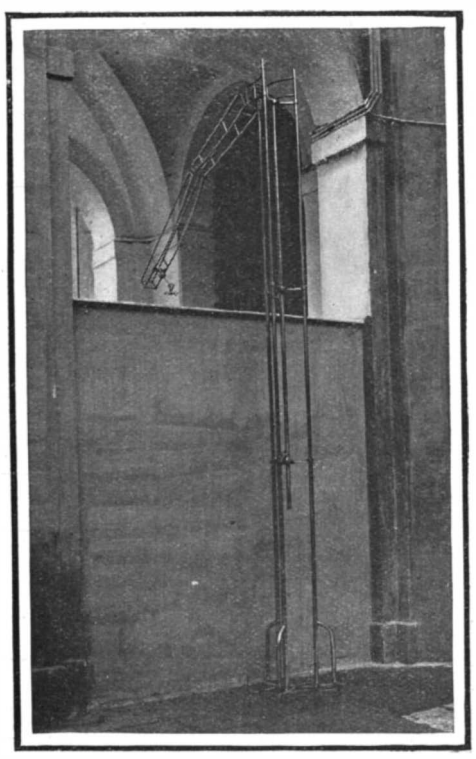
Dr. G. Falco Recording the Finger Prints of a Culprit.

Face of Card Showing a Double Photograph Taken with the Ellero Apparatus.

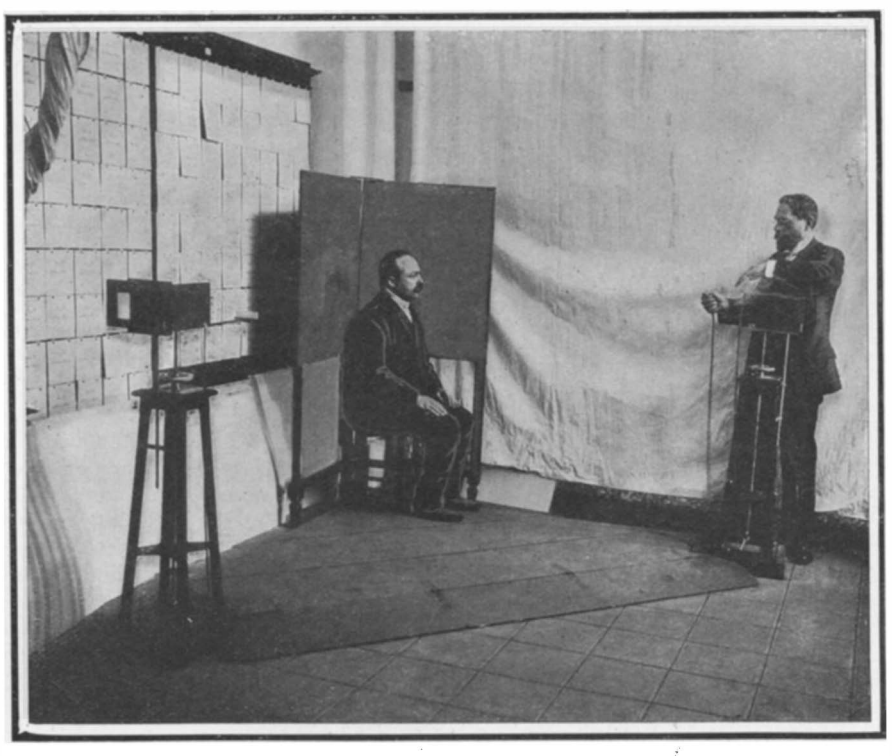


Finger Prints Greatly Magnified for the Purpose of Inspection.

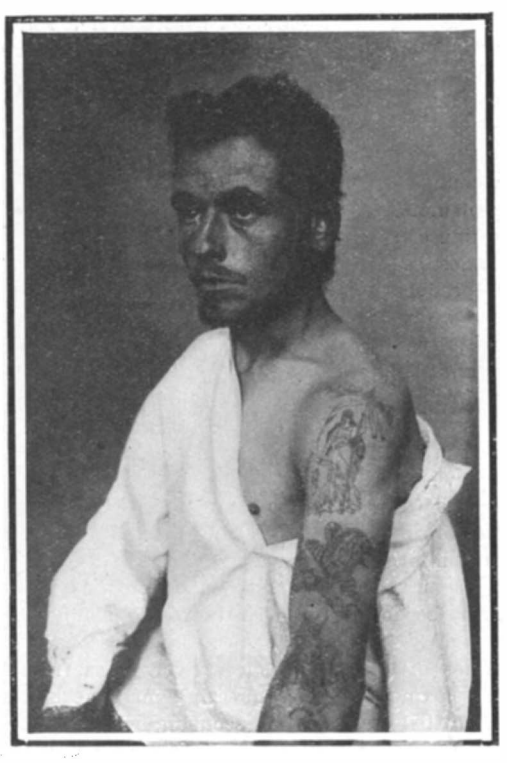
The Back of the Identifying Card With Bertillon Measurements and Other Data Filled In.



Ellero Apparatus for Photographing from One Room to the Other.



The Director of the Photographic Department Taking a Double Portrait of a Criminal for Preservation in the Records.



Photograph of an Individual with Tattooed Arm. The Tattooing Has Political Significance.

cause the extreme portions of the imprint to be as clearly produced as the more central regions. Imprints of the thumb should be upward of 2.5 centimeters (0.98 inch), those of the three following fingers about 2.5, and those of the little finger 2 centimeters (0.79 inch) in width, in order to take impression of certain intersections that are indispensable for classification. The imprints corresponding to each of the fingers are designated by a number, answering to a certain type, ten of which are distinguished, and the combination of figures thus obtained, in conjunction with photographic portraits, will afford sufficient data to completely identify a person. Photographic portraits, however, of the individuals themselves, are also of the highest importance.

The apparatus used in the Italian police service and at the academy was invented by Umberto Ellero, manager of the photographic police department, and allows two views, *en face* and in profile respectively, to be simultaneously taken. The apparatus comprises two cameras with fixed focus, any motion imparted to one of them being transmitted to the other camera, so that the individual is photographed simultaneously from the front and the side. This secures the advantage of higher speed and of less resistance on the part of the criminal, in addition to a perfect agreement in the expression of each of the two views. The police academy further possesses an apparatus, by means of which a photograph can be taken unseen from one room to another.

As photography is used most extensively in the search for a criminal (views taken on the spot, microphotographic records of blood traces, etc.) this art is receiving much attention at the school.

The Bertillon system of anthropometric measuring is also taught at the school. Though this method is somewhat lengthy, it in many cases affords the most valuable complement to ordinary data.

The results of modern psychology are likewise utilized, such characteristics as the motility, gait, handwriting, general sensitiveness and sensitiveness to pain of a person being used for his identification. Data relating to the intelligence, volition, temperament, feelings and character of the subject are also of the utmost importance. Recent experiments, according to which the associations most characteristic of a person can be utilized as an aid in ascertaining his guilt, strikingly illustrate the unexpected possibilities of psychology in that field.

Data relating to the functions of the most important organs are likewise useful, as inferred from the fact recently established by Prof. Einthoven, that the heart curves of a man of themselves suffice to characterize the person and fix his identity. Other data, the utilization of which is taught at the Roman academy, comprise the biography of an individual, his heredity, behavior at home and in business, his taste or dislike for work, past illnesses, or crimes committed.

Another study is the classification of the dangerous social sets from a scientific point of view (such as the difference between insane and non-insane criminals, established by Lombroso), or from a more practical standpoint, according to the characteristics of criminals and their crimes.

The relation of the dangerous classes of society to public safety is an important subject. Punishment can hardly be considered as a means of correcting the criminals, nor owing to the largely maladive disposition of the latter, is it a well-deserved expiation of personal guilt, so that we are forced in the majority of cases to regard punishment merely as an act of self-defense on the part of society against those that endanger its safety. It is therefore of the highest importance, in fixing the penalty, to take into account not only the crime but the personality of the convict and his conduct and degree of dangerousness.

In the case of crimes against life, intelligent investigation into the cause of death and its circumstances is obviously indispensable. The police officers should therefore have some scientific knowledge of the causes of death, and be in a position to utilize any blood stains or weapons found on the spot as useful evidence. In the search for the criminal a distinction should be made, according as he is known or unknown, or else has left any traces. The procedure of criminal officers in these various cases is taught both theoretically and practically. Of much importance, therefore, is the management and internal arrangement of public safety offices, comprising the archives, with their biographical files, local topography, calendars of criminality, and books on criminal geography.

The instruction imparted at the school comprises daily practical exercises, theoretical and practical lectures delivered three times per week, according to the above programme, and daily demonstrations.

As in medical clinics, demonstration on the individual is the basis of instruction at this police school. The police officer derives his knowledge from the inspection of criminals, and in this connection the Roman police academy may be considered unique in the world. In addition to the exhibition of culprits, photographic records, corpses, tangible evidences of crime, and handwriting and other productions of the criminal, are used as means of instruction.

What skill may be acquired after some training in the identification of persons is inferred from the fact that the pupils after a short time's practice can select from hundreds of photographs any one characterized by means of some salient data. Instruction in practical criminal psychology is mainly based upon the memoirs of prominent criminalists, and the cross-examination of all kinds of criminals.

With the school is connected a laboratory, in which not only a complete apparatus for the Bertillon measuring method, but all kinds of instruments for the investigation of organic and psychic functions are found. Instruments for gaging the working of the senses and recording any unconscious motion are likewise contained in this laboratory in addition to the handwriting and similar productions of criminals, as well as any documents liable to give an insight into their minds. Photographic apparatus of precision for the recording of handwriting and figures, as well as for taking views of the scene of the crime, and microscopes for the investigation of traces and imprints are other valuable aids to instruction.

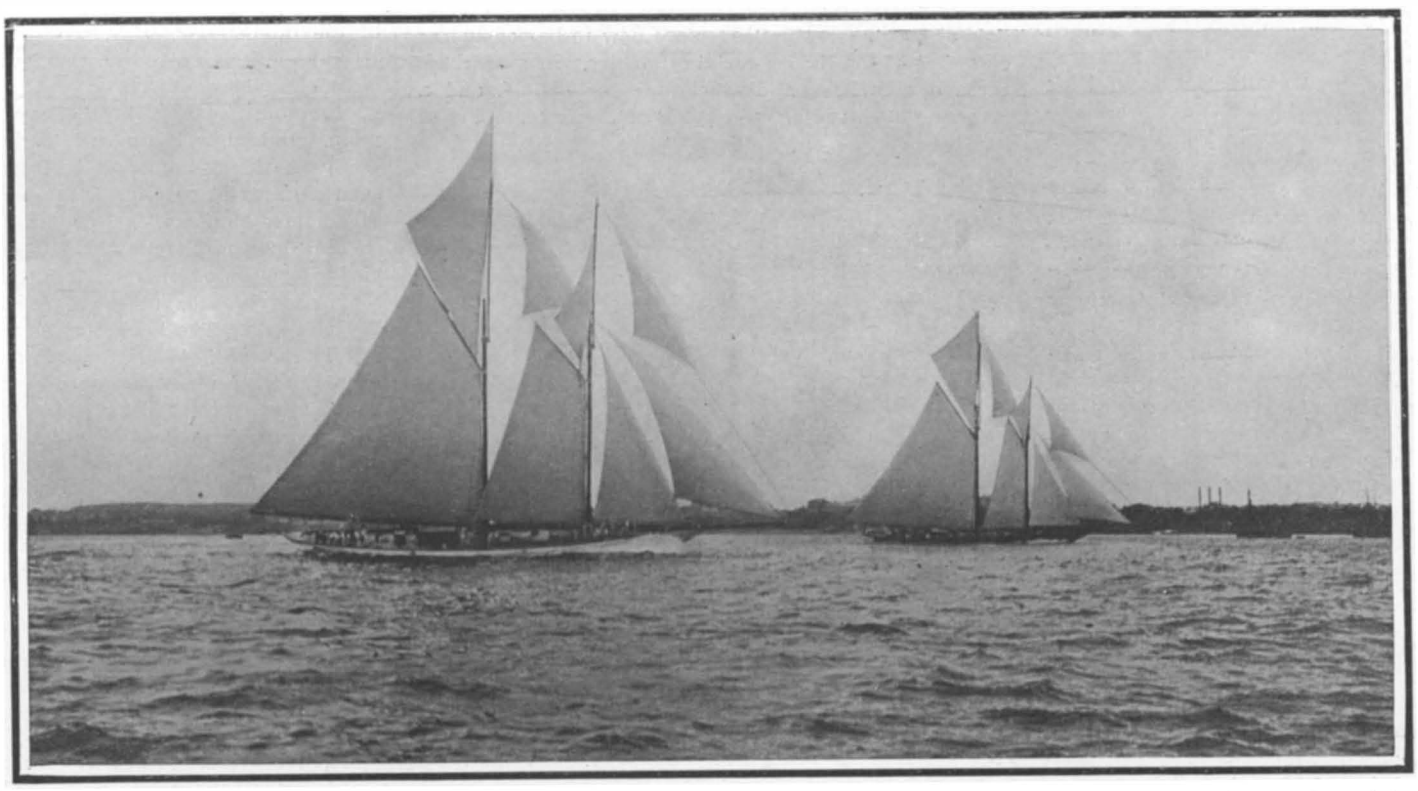
The scientific training of officers, carried out for some time, has obviously revolutionized the whole of the Italian police service. In the place of the identifying cards filled out with more or less indefinite data, which were formerly used, cards are now used containing detailed information, which perfectly suffices to insure the identification of any individual. The two sides of such a card are herewith illustrated comprising on the front side the double portrait of the man, as obtained by the Ellero apparatus, and the five finger imprints of the left hand, while those of the right hand are recorded on the back. On the latter will be found also a special section reserved for the signature of the criminal, which, however, has not been filled in in the present case, the man pretending to be unable to write. Above this section are the Bertillon data, and finally, these are supplemented with particulars of the character and biography of the individual.

THE NEW GERMAN RACING SCHOONER "GERMANIA."

The recent brilliant victories of the German-designed and constructed schooner yacht "Germania" in British waters was one of the most significant facts that have occurred of recent years in the yachting world; for it places the German yacht designers in the very front rank of the naval architects of the world.

The entrance of Germany into the sport of yachting is of comparatively recent date; and it is due mainly to the efforts of that all-round sportsman Kaiser Wilhelm II; for during the decade and a half in which the Germans have begun to figure in this the noblest of all sports, they have been content, at least in the class of large ships, to purchase their yachts from foreign owners or place their orders with foreign yards. The German Emperor's cutter yacht "Meteor" was designed by Watson, and his present "Meteor" by A. Cary Smith. The fine fleet of schooner yachts, which forms the most notable portion of the German fleet, is composed mainly of American- or English-built yachts. The efforts of the German naval designers have hitherto been confined mainly to boats of the smaller classes; and the notable successes in little fellows of the "Sonderklasse" type, two or three years ago, were indicative of the good work the Germans would probably do, if they ever turned their attention to the larger boats.

For this season's racing, Krupp von Bohlen Halbach, of the Kieler Yacht Club, placed an order with the naval architect Max Oertz for a large keel schooner, which was built by Krupp at the Germania yards. The dimensions of the yacht are: Length over all, 155 feet; waterline length, 108 feet; beam, 27 feet; and total sail area, 14,135 square feet. The "Germania" is built of steel, and in the course of the racing in the Solent this year, she proved herself to be the fastest racing two-masted schooner at present afloat. In the match for the Kaiser's cup she sailed the old Queen's course of 47 miles in 3 hours, 35 minutes, and 11 seconds, at an average speed of 13.1 knots. Commenting on her performance, the English yachting journal The Yachtsman said: "We have no schooner in England which can compare with the 'Germania' for speed, and if report is true, we shall be left further in the lurch by our German friends next year." This report is to the effect that the German Emperor is so pleased with the performance of "Germania," that it is his intention to order a large schooner from the same designer for next season's racing.



Length Over All, 155 Feet. Waterline Length, 108 Feet. Beam, 27 Feet. Sail Area, 14,135 Square Feet.

The "Germania" is the first large racing schooner yacht to be designed and built in Germany. She has proved to be the fastest schooner in the present British racing season.

THE NEW SCHOONER "GERMANIA" RACING AGAINST "HAMBURG" IN THE BALTIC.

The first races of "Germania" were sailed on the Baltic, where she decisively defeated both "Meteor" and "Hamburg." "Hamburg" is the large Watson-designed schooner, now owned in Germany, which won second place in the ocean race a few years ago from Sandy Hook to Land's End. The accompanying photograph, for which we are indebted to Major A. E. Piorkowski of the German Imperial Army, was taken during the course of one of these races.

At the Heroult electric iron smelter on the Pitt River in Shasta County, California, a number of new types of electric furnaces are being tested on a small scale, instead of working with one large furnace alone, as has been heretofore the plan. A bank of transformers will be ready by the time the new Lyon furnace under construction is completed. The new furnace, of a capacity of 25 tons of pig iron per day, is on the same plan as the original experimental one. It is claimed that it will remove the objections found to the Heroult furnaces first erected.

THE FACULTIES OF PLANTS.

BY DR. D. T. MACDOUGAL, DIRECTOR OF THE DEPARTMENT OF BOTANICAL RESEARCH OF THE CARNEGIE INSTITUTION OF WASHINGTON.

That plants are really alive is but grudgingly conceded by even the well-informed, and when this concession is made, it is always with the mental reservation that while they may be alive after a fashion, yet their "aliveness" is not of the sort that characterizes animals. This prejudiced view finds its expression in various ways, among which may be included the habit of writing and thinking of plants as "lower" organisms, or perhaps as degenerates.

In order to appreciate the real place of plants in the world it is necessary to recall that they are composed of protoplasm, the common essential substance of plants and animals alike. Now, protoplasm has certain general primitive properties, which it exhibits no matter whether it be found in the leaf of a fern, the tip of a root, the trunk of an oak, the body of a horse, or the brain of a man. In each of these cases, however, it has taken on other specialized powers which enable it to perform the complicated work of the organism of which it forms a part.

Some time within the last hundred million years, or to be exact, about sixty million years ago, protoplasm came into existence on the surface of the earth, in a manner wholly unknown. It was probably in the form of small specks or masses of a jelly-like substance of complicated structure, although not so complex as the protoplasm of to-day, and was extremely liable to injury by almost any force. By reason of its great fragility and complexity it was necessary that it make constant adjustments to the forces (such as heat, light, chemical activity, mechanical shock, and contact) that impinged upon it. That it was capable of making adjustments made possible its continued existence until to-day.

It is impossible for us to retrace the long way back to this original stage of living matter and to ascertain all of the things it may have done in that day-before-yesterday of science. It may have started to solve the problems of existence in a score of ways not easily imaginable for us, but its forgotten failures have left no trace of their existence. Not that this primitive living matter consciously tried to find a distinct way of doing things, but in the very nature of its activity it must have done many things foredoomed to failure. Of the things that it did do, however, those that followed two general methods of procedure were successful, and by them the two main groups of organisms have been produced, which are no more to be compared than a telescope and an automobile, or an automobile and a warship, so different are they.

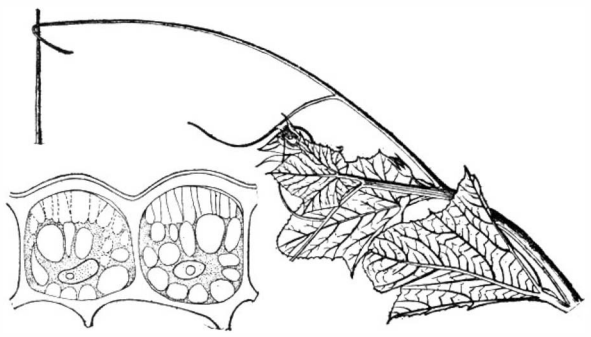
The adjustments by which protoplasm fits itself more perfectly to its surroundings are guided by its primitive property of irritability, the power of perceiving changes in the intensity of the light rays playing upon it, in the degree of heat of the air around it, of the soil on which it rests, of distinguishing between dry and moist objects, and of reacting differently to hard and soft bodies in a way that generally adapts the living substance to endure, and make use of these factors.

Having this primal capacity, the long-continued play of evolutionary forces led gradually to its development into forms which would serve the organism better and better. Irritability has been developed in the animal into the senses, and with this development there has been a constant tendency to localize and seat the different phases of it in the specialized sense-organs, which deal chiefly with one class of forces. A moment's reflection will show that it is the specialized irritability of our sense-organs that guides us, as highly differentiated masses of protoplasm, in making the thousands of adjustments that enter into our daily activities.

Light is, perhaps, the most important factor in the existence of plants, since energy is absorbed directly from its rays and is used in building up complex foods from simple substances obtained from the soil and air. If the plant is to obtain energy from light, the supposition would lie near that it must present its surfaces to the rays in such manner as to enable it to do this advantageously, for the amount of benefit to be derived from the rays would depend directly upon their intensity, and upon the angle at which they strike the surfaces. With this fact in hand one would at once suspect that the plant might have developed some power of measuring the intensity and direction of the rays.

If each of us were as large as a mountain and had the tiny organism, man, in an experimental laboratory for the purpose of testing his power of distinguishing light and darkness, we might go about getting at the facts in several ways. The readiest method would be to blindfold him. Not knowing anything about eyes we might suspect that the five-digitate antennæ he used so vigorously and so variously might be able to perceive light. To test this supposition we would perhaps tie a cloth impervious to light around one arm, and seeing that he still could tell light from darkness we might swathe both arms. This test being a failure—and both the test and the failure are highly reminiscent of the ways of scientific work—we would remove the bandages from his arms and perhaps wrap them around his head, with the result that we would presently ascertain by what means this peculiar biped knew night from day.

The same method applied to a plant will lead to similar knowledge. Any group of window-plants may be seen bending toward the glass in such manner as to present the broad upper surfaces of the leaves at right angles to the strongest illumination. The whole shoot appears to be concerned in the reaction, and we must



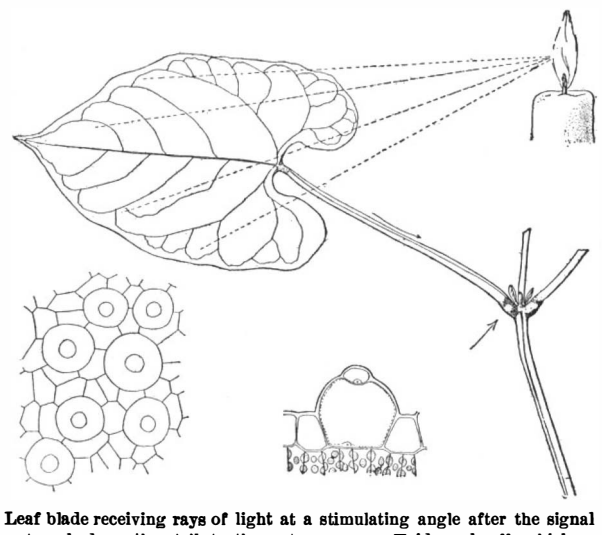
A tendril curving around a rod. Percipient cells from the surface of the tendril sensitive to the touch of an object weighing no more than the fiftieth of a grain.

use the blindfolding method to ascertain what parts are sensitive to light. If sheets of tinfoil are bound around the stem, and it is turned away from the window, the next day it will be found to have curved back toward the window. This shows at once that the individual under treatment perceives light without the aid of the stems, although the swathed stems curve in the reaction. Next turn attention to the flowers if present, and when these are black-capped the plant still turns unerringly to the proper quarter to receive its daily dole of sunshine. The leaves are now to be considered as a seat of the light-perceiving faculty. In most cases these organs have a distinct stalk or petiole, and a broader blade, the chief purpose of the latter being to

A grass stem prostrated by wind and raised by the action of its motor organs.

spread out an expanse of green tissue which entraps the rays and makes their energy available for the chlorophyl processes. Inclose the stalk of the leaf in tinfoil or black cloth, and the plant still turns its faces to the light, but sheathe the broad surfaces of the blade and it is truly blindfolded, and now does not turn toward the window when removed from it. Some plants, however, are capable of perceiving light in a feeble but much less accurate manner on portions of the stem and petioles.

If prepared sections of the blades of some of the more delicately reacting plants are placed under the microscope it will be found that the outer walls of the



Leaf blade receiving rays of light at a stimulating angle after the signal travels down the stalk to the motor organs. Epidermal cells which converge the rays and are sensitive to oblique rays.

THE FACULTIES OF PLANTS.

epidermal cells are curved outward, making lenses which converge the rays upon the inner walls, and allowing them to be transmitted to the cells beneath where they play upon the green color-bodies in which the construction of food-material takes place. Imagine one of these epidermal cells to be a room with a convex skylight roof and a glass floor. When the rays come through and fall upon the floor they pass through to the room below, and drive the chlorophyl-mills making sugar and other substances. The lateral walls of the skylighted room are lined with a living layer sensitive to light, and if the leaf or the building is moved so that the rays strike the sensitive layer a signal is sent to a distant shifting mechanism. Slowly, but with unerring precision, this gets in motion and brings the leaf to a position where the rays once more come through the condensing skylight and pass through the floor to the food-making cells below. In accordance with this action the plant moves all of its leaves into fixed positions, in which they receive the daily illumination most advantageously. In certain cases the leaf-blade performs delicately gaged movements, by which it receives the rays until they become so intense as to be harmful and then the surfaces are turned away from the source of the rays. The management of the leaf-screen in either of these cases demands an automatic mechanism capable of detecting very minute variations in the intensity of light, and one which may also accomplish rapid and accurate movements.

The exactness with which the plant can measure intensity of illumination is not to be easily realized, but the following test will serve as an exemplification: A small, rapidly growing shoot, such as that of a young mustard plant, is placed in a dark room for a few hours until it has lost all effects of stimulation from light. Then two standard candles are placed at distances of three yards on opposite sides and the sensitive leaves will receive stimulation of equal intensity on both sides and may remain stark upright. If one of the candles is moved an inch closer the shoot will begin to curve toward it as toward a window. The intensity of light varies as the square of the distance from its source, and it has been found that some plants can appreciate a difference so small as one three-hundred-thousandth of the intensity of a candle at a distance of a yard. It may be seen, therefore, that but a slight movement of one candle would be necessary to disturb the equilibrium of the shoot in the experiment in the dark room. Indeed it is difficult to place the candles correctly in the first place. It is needless to say that such delicacy of reaction is far beyond the capacity of the unaided human eye. Nor is the sensitiveness of the shoot confined to an appreciation of intensity, for a marked power of distinguishing colors is shown, and the plant responds differently to various portions of the spectrum. The blue and the red do not excite the plant alike, as it bends toward the source of the first and is indifferent to the second.

The tests described above indicate that the blades of the leaves chiefly receive stimulation from light, but an examination of almost any species shows that the curvature does not take place in the blades but at the bases of the leaf-stalks, or in the stems, in portions which may be a few inches or a foot away from the blades. In almost all cases the movement takes place in tissues more or less widely separated from the part which is sensitive to illumination. This may be proven conclusively if all of a plant except the blade of a single leaf be blindfolded and then subjected to illumination from one side. The curvature will take place in parts of the plant kept in darkness, and we are justified in concluding that the light-receiving or light-perceiving organs send some kind of an impulse or signal to the distant motor tissues which cause the movement.

Some species have upright leafy shoots, while others are creeping or decumbent. In either case the machinery of the organism is exactly adapted to return and hold the root and shoot in the characteristic position. The perception of position is not one of the keenest activities of the animal, but it is of very great importance to the plant, and the mechanism by which it perceives its relation to the vertical is one of the most delicate of all vegetable structures. The essential part of the apparatus consists of cells containing numbers of freely moving granules, which rest against the delicate layers of protoplasm which line the walls. When they are in contact with the wall of the cell which is normally lowermost the organ remains at rest. If the wind lays the shoot prostrate, or if a root is diverted from its course, the granules in hundreds of cells are thrown against the lateral walls and countless signals are sent to the motor zones, and curvatures ensue which bring the tips of the organs to their proper positions. This action begins within a few minutes after a stem or root has been displaced and effectually maintains the positions of the various organs.

A large number of species of plants has become sensitive to the touch or blow of a solid object in a manner broadly analogous to the touch reactions of animals. One form of this reaction is exhibited by plants which climb by the aid or tendrils. Tendrils are generally long, slender organs sensitive on one surface only, although in some species the percipient cells cover the entire surface. When one of these organs comes into contact with a solid object the outer sensitive cells are stimulated and communicate an impulse to cells not far distant and curvature ensues within a second, or a few seconds at most, which generally results in curling the organ around the object. Singularly enough these

organs distinguish between a touch and a blow. The rudest shock or jar does not set the tendril in action, so long as the sensitive cells do not receive a pressure of some continuity, but the most delicate contact of the smallest object will cause stimulation. Thus a bit of spider's thread or the finest silk fiber weighing no more than the fiftieth of a grain will serve to excite curvature. Water, or even as heavy a liquid as mercury, will not cause curvature when poured over a tendril, but if minute particles of chalk are suspended in the water the repeated contact of these bodies will set up a reaction. This is in fact an appreciation of the difference between pure and muddy water, which is probably beyond the capacity of any organ of touch of the human body. After a tendril has grasped a support by means of the above mechanism, the free portion of the organ is thrown into a corkscrew which has the effect of pulling up the stem and anchoring it by an elastic spring.

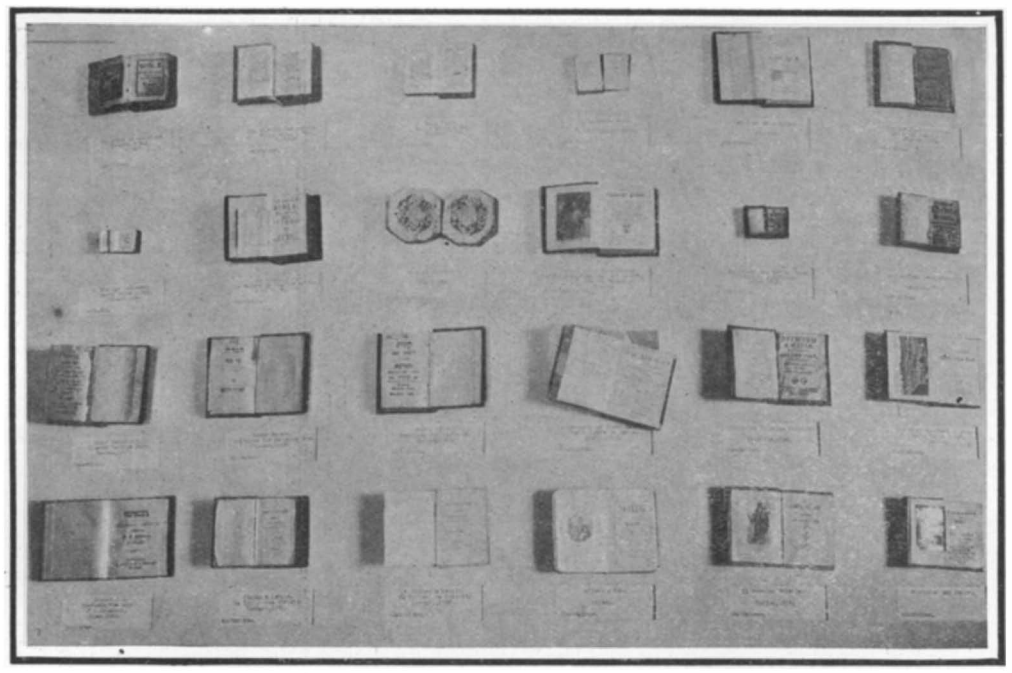
The "sensitive plant" (Mimosa), a small decumbent shrub native to the tropics, offers a striking illustration of another form of sensitiveness to mechanical stimuli, by which shocks and blows, but not contact are appreciated. The base of the leaf-stalk is attached to the stem by a highly developed pulvinus, or motor organ. The slightest shock or jar will cause this motor organ to act, and the leaf is quickly dropped through an arc of ninety degrees. If a stronger stimulus is given, an impression is conveyed up and down the stem to other leaves, and the effect of a single snip of the scissors on a leaflet may be transmitted through a stem a yard in length at a rate of a third of an inch per second, in a manner highly reminiscent of the action of nerves.

The space at command does not allow even a simple description of all of the capacities for adjustment to the external world displayed by plants. In addition to making external responses, or reactions to external forces, a perfect correlation exists between the different organs by which efficient co-operation is secured. Nowhere is this better illustrated than in the common poppy. During the growth of the flower stalk and bud, they are held in the form of a shepherd's crook with the bud pendulous from the tip. When the innumerable divisions and the complicated quadrille of the chromosomes in the ovary of the flower have finally brought the precious egg-cells to a stage where they are ready to receive the chromosomes from the elongating pollen-tubes, the completion or attainment of this stage results in a signal being sent to the curved stalk a few inches away, and it quickly straightens: as the bud expands simultaneously the saucer-shaped flower opens and faces the sky ready to receive the fertilizing pollen. Once this is received the changes ensuing result in sending off a second signal to the motor zone of the stalk and the curvature reforms the shepherd's crook, which holds the capsule pendulous to drop the seeds when mature.

In no instance, however, does the activity of the plant involve choice or decision, or anything except the most generalized form of consciousness. The sensory functions are purely reflexive, and there is no central organ where impressions are received, and from whence signals are sent out, but the percipient organs themselves send impulses direct to the motor tracts.

It is to be seen, therefore, that plants are not degenerates, nor are they lower than animals in any sense: no matter what development they may achieve, or what progress they may make in improvement, they become more widely separated from the animal. Instead of being a lower branch of the phylogenetic tree which has produced animals, they form a separate phylum arising from the common substratum of primitive protoplasm. They constitute a distinct group following a path widely divergent from that of animals, and make the numberless adjustments necessary to their continued existence by a set of sensory faculties wholly characteristic.

During the six hundred thousand centuries that plants have been in existence they have moved unconsciously toward the perfection of a mechanism which receives stimuli, gains impressions, and transmts impulses with a delicacy and accuracy superior to that of the animal in some instances, and fairly commensurate with their needs in all cases.



A COLLECTION OF MINIATURE BOOKS. THE LARGEST IS BUT TWO INCHES IN HEIGHT.

A LIBRARY IN MINIATURE.

Pictured in the accompanying engraving is one of the most important divisions of the Congressional Library at Washington, yet all of the books it contains could be put into a good-sized overcoat pocket. The collection is indeed a library in miniature. The largest book is but two inches in height, while the smallest can actually be placed on a man's thumbnail with room to spare. The piece of cardboard on which the books are fastened is only three feet in length and it contains twenty-four of the tiny volumes. A comparison of the tiniest with the largest book in the collection will give a better idea of the minute size of these works, yet everyone is a complete book in printing and binding. The smallest contains about fifty pages of printed matter, although the characters are so fine that a microscope is required to read them.

MODERN IMPROVEMENTS IN DRYDOCK CONSTRUCTION.

BY H. A. CRAFTS.

Numerous and quite important technical improvements are to be observed in the construction of the modern graving drydock, and these improvements are especially in evidence on the Pacific coast. One of the more difficult problems of operating a drydock is the handling of the bilge blocks, which have to be very nicely adjusted in order to receive any vessel that may be let down upon them. In fact, the master of every vessel that is about to be drydocked is required to furnish the manager of the dock with exact drawings of the outward contour of his hull, in order that the drydock people may be able to adjust both their keelson blocks and bilge blocks so that the vessel may be settled upon them with exactitude in all parts.

Of course, the adjustment of the keelson blocks is a comparatively easy task; because they are all set upon a right line, and only need to be regulated as to their elevations. But it is quite a different thing when it comes to placing a long individual bilge block so that it will receive the weight assigned to it simultaneously and with the same pressure as every other block. There must be both horizontal and vertical adjustment in order that the hull may not be subjected to any degree of wrenching in any of its parts.

But it is in the mode of constructing the bilge ways that the improvements introduced by Mr. Holmes, the chief engineer of the San Francisco Dry Dock Company, are most apparent. The old-fashioned bilgeway, and one still in quite common use, especially in the government drydocks, is raised above the level of the dock floor, and the blocks are confined to the trackage by a system of steel clamps, falling on both sides and catching a piece of armor running along the edge of the way.

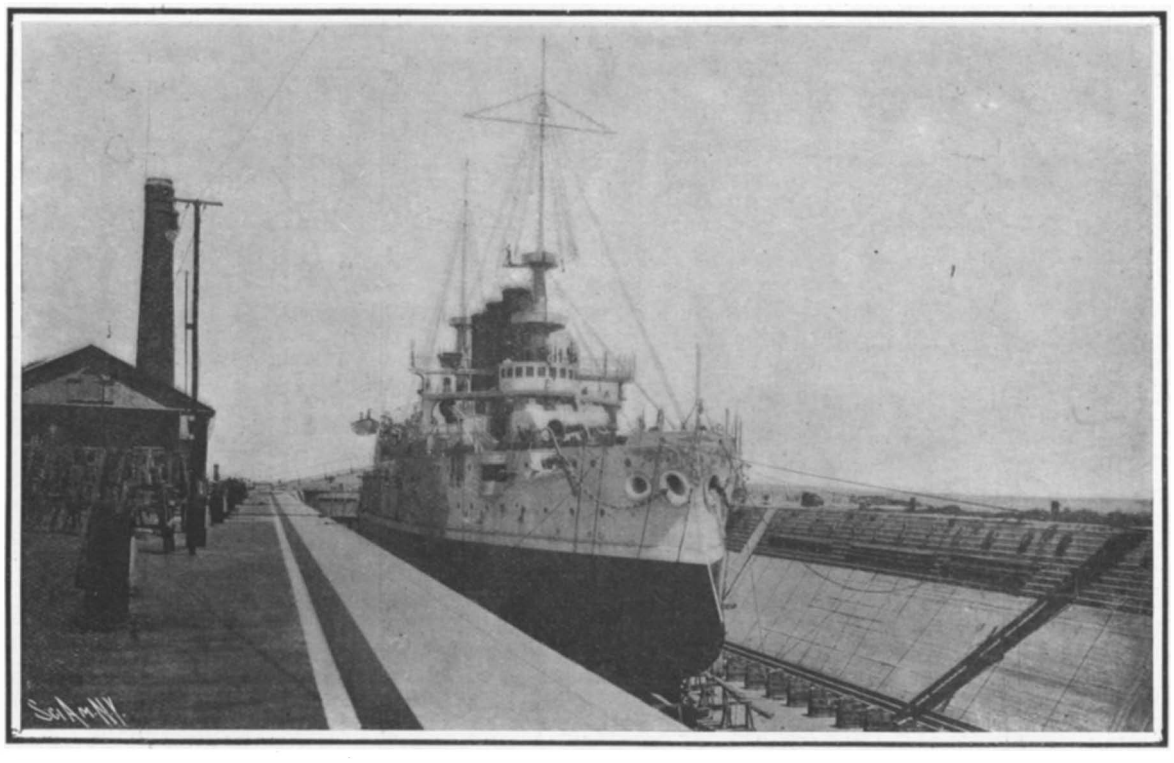
These raised bilgeways are always much in the way in operating a dock; and with a view to doing away with these incumbrances, Mr. Holmes has abolished the raised ways or tracks entirely, and has arranged the bilge blocks to run on a level with the dock floor, being at the same time guided by clamps that drop down into slots let into the dock floor and clutch strips of metal armor with which the slot is edged, very much after the fashion of the slot in the cable street railroad.

Thus the dock floor is left perfectly free and open, while at the same time the bilge blocks may be run back and forth just as well as if they were operated upon raised ways.

Both lines of bilge blocks are arranged so that they can be operated from one side of the dock, whereas it used to be the custom, and the custom is to some degree extant to-day, to operate each line of blocks independently from its own side of the dock. By the new plan, a pair of companion blocks, that is, a block and its opposite, may be operated by one man and from one side of the dock, and the thing is done by means of a combination of lead lines and hoist blocks. By pulling one pair of lead lines the bilge blocks are made to approach each other, and by pulling another pair they are made to recede from each other. An improvement has also been made in the method of drainage. The floors of the government drydocks are drained by a system of small sewers, and much trouble is experienced by these sewers becoming clogged. The new method does away with sewers entirely, and drains the dock floor from the surface. Drainage is effected from each end of the dock to the center, and into the main sump or pump pit, by a system of open gutters, the gutters being 2½ inches wide and 6 inches deep. By this means the floors can be cleaned by the use of a common "squeegee," or rubber-armed scraper, into the gutters and then flushed with a hose. Likewise the gutters, being open, may be easily cleaned out should they become clogged or foul.

Another innovation concerns the method of cleaning the gate seat. Of course, it will be understood that it is necessary for the caisson of a drydock to fit into the gate seat perfectly, otherwise there will be a leakage so soon as the dock is pumped out.

In order to clean the gate seat, Mr. Holmes has devised a new method. A system of water pipes built into the masonry of the gate seat discharges upon the seat. These pipes are connected with the donkey engine of the dock, and powerful jets of water are projected through them upon the gate seat.



U. S. S. "OHIO" IN THE SAN FRANCISCO DOCK.

RECENTLY PATENTED INVENTIONS.

Of Interest to Farmers.

STALK-CUTTER ATTACHMENT FOR PLOWS.—R. B. HUMAN, Chickasha, Okla. The improvement pertains to a stalk cutter attachment for plows, and the object is to produce a device which is simple in construction and which can be conveniently attached to plows of ordinary construction. The construction enables the level of the device to be adjusted with respect to the plowshare.

HAY-COCKING MACHINE AND HAY-LOADER.—G. L. HOLLIDAY and I. S. HAWKS, Curtis, Wis. The object of the invention is to produce a machine which will operate in a simple manner to form cocks from the hay, and which can be used as a loading device for placing the hay in wagons. It relates to harvesters and especially to hay-making machines.

COTTON SEPARATOR AND CLEANER.—R. H. PURNELL, Rosedale, Miss. The present apparatus is designed primarily as an improvement on the previously patented invention of the same inventor. The improvements now patented are devised with a view to more effectually separate the stalks and trash from the cotton and expeditiously deliver the cotton to receiving sacks. The compact arrangement of devices serves to effect two distinct separating operations before the cotton is delivered to the sacks.

CHURN.—P. B. CUPP and K. N. EVERETT, Van Wert, Ohio. More especially the invention relates to churns having a plurality of dashes movable in different directions, and arranged to be manually operated. It is simple and durable and inexpensive to manufacture. An object is to provide common means for operating the dashers in different directions. Still further to provide manual means operable in a substantially horizontal plane for driving the dashers, these being so constructed that they may be operated either in the same or in opposite directions to one another.

Of General Interest.

RUBBER-DAM HOLDER AND CUTTER.—A. B. PRENTIS, Bandon, Ore. In operating the dam, when it is desired to remove a portion from the roll, a rod is turned to loosen the swinging yoke, to permit the dam to be drawn thereunder, until a suitable length has been withdrawn. The rod is now turned to clamp the dam, and a block is moved, thus cutting off the withdrawn portion of the dam.

COLLAPSIBLE CRATE.—ILA V. HOLLOWAY, Monument, Col. When empty this improved crate can be knocked down and folded together, thus occupying small space for shipment. It is easily set up and when set up forms a strong and substantial crate. The undercut portions when used, permit of dispensing with certain nails or screws, since the overhanging portion of the ends retains the slats in place.

PERFUME-VAPORIZER.—E. J. KEEFER, North Manchester, Ind. The object of the invention is the provision of a vaporizer, more especially designed for use in stores and other places, and arranged to enable a customer or other person to test the odor of the fluid, and thus be in a position to make a selection of the goods with the greatest accuracy.

METALLIC DOOR.—A. H. BOBB, New York, N. Y. The purpose here is to provide a construction of metallic doors, one wherein comparatively few parts are employed, which parts are capable of being quickly and conveniently assembled, and wherein also the metal composing the door can expand and contract to a proper extent.

APPARATUS FOR MIXING GAS AND AIR.—E. DANKELMANN, 6 Helgoländer Ufer, Berlin, Germany. The inventor employs separate suction and forcing dampers for the gas and air respectively to make provision against excessive pressure in the service pipe for causing the flow of the admixture through a circulation conduit, thus remedying evils which might arise from fluctuations in pressure. In employing back suction or return conduits their efficiency may be increased by providing them with special suction valves so that upon each stroke of the suction apparatus two inlets of gas or air on one hand and for admixture of gas and air on the other are opened, but are closed during forcing operation.

APPARATUS FOR MASSAGING THE VAGINAL WALLS, ETC.—J. E. AMENT, Indiana, Pa. One purpose of the invention is to provide a device especially adapted to replace a prolapsed uterus without touching the organ with either hands or instruments, to medicate the afflicted parts, to exercise the walls and broad ligaments, and to assist in breaking up adhesions.

PLASTER-BOARD.—J. J. RYAN, New York, N. Y. A purpose here is to provide a plaster board, the outer face whereof is fire-proof and semi-plastic, enabling a nail to be driven through the same to a point below or within the fire-proof semi-plastic material, so that the semi-plastic material may be troweled hard and smooth when desired.

NON-REFILLABLE BOTTLE.—M. ECKER, New York, N. Y. In this patent the invention relates to non-refillable bottles and its object is to provide a bottle of this class which cannot be refilled, and which is constructed without employing metallic parts or valves. Extreme simplicity and effectiveness in operation are the principal objects.

HOLDER FOR THERMOMETERS.—LUCY R. EDWARDS, Jacksonville, Fla. This holder for a clinical thermometer is such as used by doctors and trained nurses in taking temperature. In hospital wards it is frequently necessary that the thermometer used for taking temperature should be used exclusively by a patient, and that the implement should be kept in an antiseptic condition. The object is to provide a holder having means for holding thermometers in a disinfected or antiseptic condition.

UTERINE SUPPORTER.—G. BECK, Jersey City, N. J. The purpose of the invention is to provide means for introducing the device in an expeditious and painless manner, which means can be conveniently manipulated by the patient; and also to provide means for preventing loss of the device should it possibly slip from the parts, which latter means are also employed for removing the device when so desired.

STEP-LADDER.—E. ROWE, Indiana, Pa. This improvement pertains to step ladders, and the object is to produce a ladder having the rungs or steps thereof braced in such a way that their strength is materially increased, and to produce an arrangement whereby the side pieces of the ladder are relieved of strain in the vicinity of the steps or rungs.

Hardware.

THREAD-CUTTER.—N. ZOGG, New York, N. Y. In the present patent the invention is designed to provide thread cutting taps and dies with lead cutters, adapted to readily start a thread in a nut, bolt, or similar object, without the friction and effort incidental to thread cutters of ordinary construction.

FLOOR-JACK.—H. T. SPEDDEN and E. M. SPEDDEN, Chewelah, Wash. The invention pertains to jacks used for forcing the tongues and grooves of floor boards together while laying and securing them upon joists, studding or ceiling timbers, and the object is to provide details of construction for a jack, that adapt it for service as a means for forcing together and holding flooring in place, before nailing such boards on the frame of a building or other structure.

CLEVIS.—T. J. DAVIS, Harding, S. D. The invention relates more particularly to clevises used in connection with plow beams, whiffletrees, drags, and the like. The object is to provide a clevis having a removable clevis pin, which can be easily detached or placed in position, and in which the pin is resiliently held in position to lock it against accidental displacement.

SLIDING-DOOR FASTENER.—G. M. INGEBO, Veblen, S. D. An object of this invention is to provide a fastener for use with sliding or rolling doors and the like, which is extensible to permit its adjustment for use with doors of different thicknesses, and which is operable from both the outside and inside of the wall in which the door-way is located. Means provide for preventing entrance of cold air, and the door from warping.

Heating and Lighting.

DIRT-RETAINER FOR GAS-NOZZLES.—H. SÜSSMANN, 144 Alte Jacobstrasse, Berlin, Germany. The invention has for its object a dirt retainer for gas nozzles, which more especially in the case of inverted gas burners, prevents dirt or impurities contained in the gas pipes from reaching the nozzle and stopping this latter. Among several advantages the retainer is readily interchangeable or dismountable so that all the parts may be cleaned without difficulty.

LAMP-SHADE HOLDER.—J. CRUIKSHANK, Shamokin, Pa. The holder is especially adapted for use in connection with an incandescent electric light. In the common form it is customary to provide a plurality of radially-disposed screws movable into and out of engagement with the shades, but in this all screws are eliminated, all hooks which take their place are moved simultaneously, and a single movement of a single operating member serves for the operation of all of the gripping members.

Household Utilities.

EGG-STRAINER.—H. J. WALZ, Buffalo, and J. W. BUTLER, Hermitage, N. Y. One object in this instance is the production of an inexpensive and effective egg-separator in which provision is made to discharge bad eggs from the device, and also eggs having their yolks broken previous to reaching the point where the white of the egg is strained or separated from the yolk.

Machines and Mechanical Devices.

FEEDER.—F. M. MOTT, Douglas, Ariz. Ter. The feeder is more especially designed for feeding ore and other materials to stamp mills and other machinery or devices, and arranged to permit of governing the amount of the material fed according to the capacity and working of the stamps, to insure proper reduction of the material without danger of choking the mill by overfeeding.

COVER-FASTENING MEANS FOR USE ON WASHING-MACHINES.—P. A. FOLK, Spokane, Wash. In operation the machine will wash any fabric from the finest lace to the heaviest clothing without tangling, tearing, or otherwise injuring them. When the clothing and water are placed in the machine and the latter is revolved the water and clothing will not revolve with the machine but will remain at the bottom of the drum, where it will be thoroughly rubbed and agitated.

FEEDING DEVICE FOR NAIL-MACHINES.—J. S. PYPER, Keeseville, N. Y. The device is intended especially to be used in connection with machines for pointing horseshoe nails. The inventor's object is to produce a device which will operate effectively to present the nails to the pointing mechanism in the proper position.

STENCIL-PRINTING MACHINE.—L. W. VON BEHREN, Evansville, Ill. This invention relates to machines for reproducing, which are employed for the purpose of making fac-simile duplicates of typewritten or other autographic matter from paper or other stencils which have been coated with substances impervious to ink, and from which portions of the substances have been removed by the impact of a type face as in writing upon a sheet in a typewriter, or by traversing the surface of the sheet with the point of a stylus or the like.

THREAD-HOLDER.—J. ROSENBERG, New York, N. Y. The invention is an improvement in thread holders more particularly adapted for factory sewing rooms. The object primarily is to provide a device, in which the thread is conveniently accessible for sewing purposes but which cannot be unauthorizedly displaced from the holder or stolen.

TIRE-UPSETTER, PUNCH, AND SHEAR MACHINE.—J. F. BADGER, St. Louis, Mo. The object here is to provide a powerful and efficient tire upsetter for upsetting or shrinking tires on the wheels of vehicles, either hot or cold, and which also shall be capable of performing the work of shearing, punching, etc. The machine is a very economical one for the wheelwright, since it embodies the functions of several machines in one and takes but little floor space.

SLICING AND CORING ATTACHMENT FOR PARING-MACHINES.—J. F. KOHLER, New York, N. Y. A purpose here is to so construct the attachment that it can be readily applied to certain machines in a manner to constitute a fixed part thereof, and further to so construct and apply it that it will operate in perfect harmony with operative parts of said machines, to produce in one continuous operation the paring, coring, and slicing of an apple, and the discharge of the core from the fork of the machines upon which the apple is supported during the paring.

SAUSAGE-MACHINES.—F. MATHEYER, New York, N. Y. The machine fills or stuffs the meat into casings, and is provided with a plunger reciprocating in a cylinder containing the meat, the plunger after starting the machine completing a full stroke for discharging the meat and then returning it to starting position to permit refilling of the cylinder, the movement of the plunger being positive, thus requiring no attention, and enabling the attendant to devote his time to the application of the empty casings and the removal of the filled casings.

SODA-WATER FOUNTAIN.—B. SPINELLI, New York, N. Y. The objects of the improvement are to provide a working arrangement for drawing syrup or other liquid from a container and pouring it in a glass or other vessel, without opening the refrigerating chamber or other compartment in which the container may be inclosed; and, to provide an accurate measuring device.

Prime Movers and Their Accessories.

MOTOR.—O. PEPPER, San Francisco, Cal. The object of the inventor is to provide a device whereby the movement of water can be utilized for generating power. Further, to provide a motor serving for the utilization of wave or other movements of bodies of water to produce power, and having means for directing the waves to augment their effect upon the motor. It automatically adjusts itself to varying tide levels.

Railways and Their Accessories.

RAIL-FASTENING.—A. NEWELL, Guadalajara, Mexico. The intention in this case is to produce a device which, if subjected to jars or vibrations, will operate to clamp a member such as a rail, and maintain the clamping force with the same or greater intensity by the vibration or jar to which the parts are subjected. It is adapted more particularly for use in connection with metal ties for holding railway rails thereon.

Pertaining to Vehicles.

TRANSMISSION-GEAR.—P. HAYWARD, Hanging Rock, Ohio. The invention relates to transmission gears, Mr. Hayward's more particular aim being to provide a construction for general use. The improvement further relates to a form of transmission gear especially suitable for road vehicles, and comprising means for reversing the motion of a revoluble driven member.

DOUBLETREE AND LINE-HOLDER.—W. A. WILLIAMS, Lexington, Okla. The invention provides a line holder for use in connection with draft trees, so the line will not become entangled in the trees. A bar is provided which ranges longitudinally above the trees, the ends of the bars having base members which are secured in place by the bolts that secure and pivot the single-tree to the ends of the double-tree; an additional support for the bar is provided by a central upright, the foot of which is secured by the belt that secures and pivots the double-tree to the tongue.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

HINTS TO CORRESPONDENTS.

Full hints to correspondents were printed at the head of this column in the issue of August 8th, or will be sent by mail on request.

(10845) H. H. says: Kindly tell me whether a Wimshurst machine can be used for wireless transmission. A. A static machine such as a Wimshurst machine can be used for wireless telegraphy to a degree, by attaching one terminal to the aerial and grounding the other terminal. Of course, a condenser, Leyden jars or plate, must be used with the machine to develop any power at all in the spark.

(10846) C. W. F. says: Will you please solve through the Notes and Queries the following problem: A man wishes to plant 19 trees in his garden and to have them in 9 straight rows and have 9 trees in each row. A. We confess that we do not know how to get 19 trees in 9 straight rows so as to have 9 trees in each row, and in this hot season we cannot draw on our small reserve of gray matter to try to solve the puzzle.

(10847) R. Y. A. says: Can you tell me how to build an inexpensive septic tank to take care of all the drainage of a house in the country that will work perfectly? There is a blue clay soil with gravel streaks in it. A. The septic tank system of sewage disposal involves a process the suggestion of which was revolutionary only a few years ago, making use for the purifying of sewage of the very putrefying agents which in previous systems were as far as possible avoided. An effective use of the system equally involves careful study in the design, so that the anaerobic or putrefactive and aerobic or nitrifying chambers are properly balanced and separated, so that it is rather a "large order" to give you offhand and by letter full instructions how to build such a system "that will work perfectly" and with no particulars as to the quantity of sewage to be treated. We can confidently recommend the Cameron Septic Tank Company of Monadnock Block, Chicago, who have made a special study of this system, or if you desire something simpler in the way of sewage disposal, special articles in our SUPPLEMENT Nos. 387, 469, 1121, and 1450 give some valuable information on methods of sewage disposal for farms and isolated houses. We shall be glad to advise you further as to *details* upon which any of the above information is insufficient, but the subject as a whole is too large for treatment by letter.

(10848) C. M. K. says: If a horseshoe magnet is held close to but not touching a soft iron wheel, will it act as a break or check on the motion of the wheel? Would the effect be the same on a hard steel wheel? If the magnet acts as a check, would the effect increase or decrease with increased speed of wheel? A. If a horseshoe magnet is placed so that a disk of metal revolves between its poles, the magnet acts as a brake upon the rotating disk. This is the method employed to regulate the rotation of the works of a recording wattmeter. The rotating disk has a current of electricity produced in it by the lines of force of the magnet, and this current flows in such a sense as to oppose the rotation. The more rapid the rotation of the disk, the stronger is the action of the magnetic brake. There would be no difference in his respect between the metals excepting what their electrical resistance would produce. The effect upon copper would be the greatest. The result is not due to magnetic attraction, but the Foucault current set up in the disk.

(10849) J. T. S. says: I have experienced a peculiar phenomenon, which I do not quite understand, and which I am curious to know would be experienced by any one. I was looking at the sun with my naked eyes for a few seconds; then I closed my eyes and put my hand over them, when gradually a luminous spot would appear before them. In the center and at its inception this spot is a glowing yellow, gradually spreading out into magnificent purple, red, deep blue, and sometimes terminating in a large field of green. I am unable to make out whether this is seen objectively or subjectively. The phenomenon sometimes varies in the order of the colors and their distinctness. Will you kindly explain this experience? A. The colors you have seen after exposing your eyes to a very bright light are due to the shock given to the retina by the light. They are wholly subjective, since you see them with the eyes closed, and are more or less persistent or enduring according to the length of time the eye is exposed to the bright light. It is easily possible to injure the eyes very seriously by such exposure to the direct rays of the sun, if it is to any degree prolonged. After such a shock to the retina, one may see images of the sun upon any surface or wall at which the eye is directed. It was by gazing long and repeatedly at the bright image of the sun's light seen through a prism that Sir Isaac Newton saw these colors moving about after his eyes as he looked from one object to another, and he gave the name "spectrum" or ghost to the appearance. We have since known the color of the rainbow as a spectrum of the sun's light.

NEW BOOKS, ETC.

THE MANUAL OF STATISTICS. Stock Exchange Hand-Book, 1908. Thirtieth Annual Issue. Railroad and Industrial Securities, Government Securities, Stock Exchange Quotations, Mining, Grain and Provisions, Cotton, Money, Banks and Trust Companies. New York: The Manual of Statistics Company. 12mo.; cloth; 1080 pages. Price, $5.

The thirtieth issue will add to the high standing of the manual as a repository of those data which give information on securities, quotations, provisions, banks, trusts, etc. The railroad department comprises the railway companies of the United States, Canada and Mexico, with details of their organization, mileage, capital stock, funded debt and earnings. That of the industrials is a record of manufacturing, street railway, electrical, gas, mining, land, coal, iron and steel, telegraph and telephone and miscellaneous corporations. Such important features as those of government securities of the United States, Cuba, the United Kingdom of Great Britain, and Japan, and all the great municipal securities of the United States and Canada are printed in full. In fact, this is the plan adopted throughout, and the arrangement of the details is so clear that investors and investigators will have the advantage of a complete service down to date that is easy and expeditious to acquire. Eighteen large maps of railroad systems and mining and other industrial districts add to the value of the work.

GEOLOGY OF COAL AND COAL MINING. By Walcot Gibson, D.Sc., F.G.S. London: Edwin Arnold, 1908. 16mo.; pp. 341. Price, $2.50.

The author has produced an excellent volume on the geology of coal and coal mining. The subject of fossils is admirably treated. Prospecting and boring are taken, and studies on an exposed and on a concealed coal field are given. Then follow chapters on the coal fields of Great Britain, continental Europe, North America, Africa, India, Australia, China, Japan, New Zealand, and the Dutch East Indies, not forgetting the comparatively small fields of South America. The book is well illustrated and printed.

THE FALLS OF NIAGARA. Their Evolution and Varying Relations to the Great Lakes; Characteristics of the Power, and the Effects of Its Diversion. By Joseph William Winthrop Spencer, M.A., Ph.D., F.G.S. 1905-6. Ottawa: Geol. Surv. Canada, 1907.

The latest and most elaborate study of the physical history of Niagara deals primarily with the history of the recession of the cataract from end to end and describes with much detail the local physical features, the contemporaneous distribution and discharge of waters in the region of the Upper Lakes, as well as the sequence of water levels in the Ontario basin. The author has computed the time which it probably took for the river and cataract to reach their present stage.

THE WIFE AS A FAMILY PHYSICIAN. By Anna Fischer-Dueckelmann, M.D. Milwaukee: International Medical Book Company, 1908. Large 8vo.; pp. 870; 27 full-page color plates and prints; 440 original text illustrations. Price, $5.

This portly volume is a practical book of reference to the family in health and in sickness. It is written by a graduate of the University of Zurich, and has been translated and adapted with the collaboration of a staff of eminent physicians. The publishers inform us that the book has had an extraordinary success in Europe, having been published in eleven different languages, and several million copies having been sold. It would seem that this, in itself, is sufficient evidence of its merit. From the scientific point of view we do not, of course, recommend everyone to be his own physician, because in that case he is apt to have a bad patient. But the present book recommends the natural healing art and does not, as a rule, prescribe drugs. It does not tend to make the service of a physician unnecessary; but its aim is to teach people a hygienic mode of life and to take sensible precaution against disaster. The book is profusely illustrated and is well printed and bound.

PRACTICAL IRRIGATION: ITS VALUE AND COST. By August J. Bowie, Jr., S. B. New York: McGraw Publishing Company, 1908. 8vo.; pp. 232. Price, $3.

The prospect of converting desert land into flourishing country lends the most attractive aspect to irrigation. Some people, carried away with the possibilities of irrigation, lose sight of the all-important financial end of the question, and make extensive investments in plant which is unnecessary or unsuited to the work to be done. Others, with ill-advised ideas of economy, endeavor to irrigate their land without properly laying it out, and spend for labor many times the cost of a suitable installation. To speak intelligently about irrigation we must know the cause and the value, not only of the plant as a whole, but of the individual parts thereof. The author has written a very carefully balanced book, which should be indispensable to all engineers and others who are interested in irrigation work. We are particularly impressed with the common-sense methods which the author suggests. For instance, he states that where the cost of obtaining water is high, expensive means of preventing seepage may be justified. When the fuel is high, and the plant is operating under a high level of efficiency, a high-grade plant should be installed. Where fuel is cheap and cheap low-grade labor is available, it may be folly to install a high-grade plant with its added expenses and complication. It has been the endeavor of the writer to furnish data for determining the cost and value of irrigation and of the apparatus and machinery which may be used therein.

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COMPLETE LISTS of manufacturers in all lines supplied at short notice at moderate rates. Small and special lists compiled to order at various prices. Estimates should be obtained in advance. Address Munn & Co., List Department, Box 773, New York.

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Inquiry No. 8759.—For a firm to do porcelain enameling of ventilator tops, such as used on the outside of arc lamps.

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Inquiry No. 8806.—For manufacturers of drawing materials.

Inquiry No. 8807.—For dealers in second-hand cotton machinery.

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Sash fastener, R. Daubaignan	897,719
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Wrench, V. Carlson 897,584
Wrench, J. Minett 897,640
Wrench, H. R. & R. J. Munce 897,767

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Bottle, P. O. E. Friedrich 39,477
Bottle, J. J. Greene 39,478
Bottle, P. W. Schofield 39,479
Bottle, G. B. Van Wye 39,480
Bottle casing, G. P. Altenberg 39,481
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Curtain, lace, W. Hardy 39,494, 39,495
Curtain, open work, W. M. Maser 39,496
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Lamp, P. Krastin 39,484
Lunch board, lap, L. Van Putten 39,490
Motorcycle horn, L. Rubes 39,486
Note sheet, shorthand, W. J. Guy 39,492
Ruching, A. Boehm 39,498
Sideboard, O. Hebestreit 39,491
Spoon, bonbon, W. W. Brown 39,468
Spoon, fork, or similar article, J. Clulee 39,469
Spoons, forks, or similar articles, handle for, W. C. Codman 39,470
Spoons, forks, or similar articles, handle for, G. P. Ittig 39,471
Spoons or similar articles, handle for, J. E. Straker, Jr. 39,472
Type, font of, S. C. Gaunt 39,493
Vehicle body, R. Huff 39,488
Vending machine casing, A. Stewart 39,487
Water heater, W. J. Finn 39,489

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Antiseptic preparation for the skin, Sharp & Dohme 70,452
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Boots and shoes, leather, H. B. Reed & Co. 70,469
Boots and shoes, leather, Regal Shoe Co. 70,470
Boots, shoes, and slippers, leather, Paul Brothers 70,468
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Bread, G. E. Rentz 70,437
Brushes, shaving, Gillette Safety Razor Co. 70,428
Cement, Portland, Alpha Portland Cement Co. 70,422
Cement, Portland, J. & A. Pavin de Lafarge 70,432
Chains, Diamond Chain and Manufacturing Co. 70,445
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Detergent compound, Imperial Car Cleaner Co. 70,431
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Pen, pencil, and paper clips, W. F. Oakley 70,436
Perfumes, Sterling Supply Co. 70,453
Precious metal and plated ware, certain, Acker, Merrall & Condit Co. 70,456
Remedy for diseases of the stomach or bowels, M. Feierstein 70,446
Rubber boots and shoes, Roberts, Johnson & Rand Shoe Co. 70,471
Sash and hair-bow sets and hair-bow sets, Smith & Kaufmann 70,473, 70,474
Saws, Henry Disston & Sons 70,449
Saws, jewelers', Hammel, Riglander & Co. 70,448
Shirts, dress and negligee, C. M. Flora 70,460
Soaps, M. P. Binkley 70,423
Sorghum molasses and corn syrup, compound of, Schnull & Co. 70,439
Spelling blanks, J. C. Blair Co. 70,433
Surgical apparatus, certain, Dragerwerk, Heinr. u. Bernh. Drager 70,427
Suspenders, garment supporters, garters, and arm elastics, American Narrow Fabric Co. 70,458
Syrup, maple, St. Paul Syrup Refining Co. 70,441
Thread and yarn, John V. Farwell Co. 70,465
Tooth paste, W. A. Wood 70,455
Valves, Lunkenheimer Co. 70,450
Vehicle wheels and gears, Muncie Wheel and Jobbing Co. 70,435
Whisky, straight bourbon, A. J. Henseler 70,430

LABELS.

"Columbia," for liquid fish glue, Columbia Glue Co. 14,339
"Goitrene," for a medicinal preparation, Goitrene Co. 14,337
"Keepudry," for rain coats, L. G. Titus 14,340
"Raven Rocks Straight Bourbon Whiskey," for straight bourbon whisky, J. Wandstrat 14,334
"Richmond Fancy Patent Flour," for wheat flour, City Mills Co. 14,336
"Royal Stewart," for cigars, American Lithographic Co. 14,331
"School Artgum," for a cleaning composition, A. Sommer 14,338
"Stone Plover," for cigars, Hansfeld & Huennekens Cigar Co. 14,332
"Tobacco Finos," for cigars, Schmidt & Co. 14,333
"Wall Street Bourbon Whiskey," for straight bourbon whisky, J. Wandstrat 14,335

PRINTS.

"French Auto Oils," for lubricating oil, Marshall Oil Co. 2,328
"No. 72. Astrological Fate Cards," for playing cards, United States Playing Card Co. 2,329
"The Bennett Company's Line of Pianos," for pianos, W. M. Robinson 2,330

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., 361 Broadway, New York.

Canadian patents may now be obtained by the inventors for any of the inventions named in the foregoing list. For terms and further particulars address Munn & Co., 361 Broadway, New York.