PANAMA CANAL—PLAN APPROVED BY PRES. ROOSEVELT

SCIENTIFIC AMERICAN

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An American Steam Shovel at Work on the Panama Canal. Practically the Whole of the Culebra Cut Will be Excavated by These Powerful Machines

THE PANAMA CANAL.—[See page 212.]

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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.

A CHANGE OF FRONT.

When it became evident in the spring of last year that there was a wide divergence of professional opinion as to whether it would be better to build a high-level or a sea-level canal at Panama, the President decided that in view of the great importance of the work, it would be advisable to place the matter before an international board of the most eminent hydraulic and canal engineers, not merely in America, but of the whole world. As finally constituted, this Board included the chief engineers of the most important canals in Europe, and engineers who have been responsible for some of the principal canals, river and harbor improvements, and reservoirs for city supply in this country. In his charge to the Board made at Oyster Bay last September, the President said: "I have named you because in my judgment you are especially fit to serve as advisers in planning the greatest engineering work the world has yet seen. . . . I hope that ultimately it will prove possible to build a sea-level canal. Such a canal would undoubtedly be best in the end, if feasible; and I feel that one of the chief advantages of the Panama route is that ultimately a sea-level canal will be a possibility." In spite of this strong indorsement of the value of their professional judgment, the President has deemed it best to reject the majority decision of the Board in favor of a sea-level canal, and recommend the adoption of the minority report in favor of a lock canal at high level.

At the time that the President was expressing his decided preference for a canal at sea level, the Scientific American shared in the general trend of opinion in those days in favor of the low-level type. We were largely influenced by the judgment of the Chief Engineer of the canal at that time, who, as the result of his personal experience at the Isthmus, had come to regard the construction of a lock canal as impracticable. His conviction was based on the belief that the deep alluvial deposits in the valley of the Chagres rendered the construction of a perfectly reliable dam impracticable. Furthermore, the sea-level plan was attractive, because we believed that it would present a more rapid means of transit from ocean to ocean, and one that would be attended with fewer risks. During the past twelvemonth, however, the more extensive borings which have been made at the site of the proposed dams have revealed more favorable conditions. Moreover, the dam which it is now proposed to build, and the vast inland lake which it will impound, invest the high-level project with such manifest advantages of deep-water navigation and security from collision and grounding of the ships that will pass through it, that the relative advantages of speed and security of transit, which we formerly supposed to belong to the sea-level route, have practically disappeared. With these two considerations removed from the question, there remains in favor of the high-level plan the fact that it can be built for fifty per cent less cost in money, and probably in from sixty to seventy per cent less time. It is undoubtedly considerations of the same character that have led the President to favor the minority report.

It would be a thousand pities if the impression should go abroad that in the division of opinion on the Consulting Board, and in the President's acceptance of what might be called the American point of view, any motives of national exclusiveness or prejudice have played a part. The parties concerned are too statesmanlike, too broad in their point of view, to be influenced in a matter of this kind by motives of a misnamed patriotism, and we consider it distinctly unfortunate that the suggestion of any such motive should have been even hinted at, much less alleged, in the dispatches that have been circulated so freely from Washington. We prefer to believe that in all the recent official deliberations of the government upon this momentous question, the final decision has been reached purely upon a consideration of the engineering, commercial, and military aspects of the case. The exhaustive investigation made by the Board of Consulting Engineers, as embodied in their report, is by far the most valuable contribution that has been made to the voluminous literature of the Panama Canal; and the fact that the five leading hydraulic experts of the Old World have lent their ripe experience to the final solution of the problem is an added guarantee that, when Congress shall have made its final decision, the type adopted will, all things considered, be the very best that could be built.

SOME LESSONS FROM THE PAST AT PANAMA.

To date, we have expended at Panama $60,000,000; and, comparatively speaking, we have as yet no more than scratched the surface of the ground. In the $60,000,000 is included, of course, the purchase price of $40,000,000 paid to the French company, the $10,000,000 paid for the ten-mile canal zone across the Isthmus, and the first appropriation of $10,000,000 for active construction. Although we have not yet by any means commenced "to make the dirt fly," the $10,000,000 has, no doubt, been well expended in preparatory work, including the sanitation of the canal zone, in the provision of suitable living quarters, in the purchase of excavating machinery, and in the thorough re-survey of the canal by a large force of engineers.

At the present juncture, when the nation, having formulated its plan, stands ready to launch its energies upon the colossal task confronting it, we shall do well to gather from the experience of the past few years some very obvious lessons, and lay them deeply to heart. In the first place, the brief incumbency and resignation of that distinguished and much-misrepresented engineer, Mr. Wallace (who by the way is a past president of the American Society of Civil Engineers, and, therefore, holds a professional reputation that is surely a sufficient guarantee of his integrity of purpose) served to impress upon the administration the necessity of giving the chief engineer at the Isthmus an absolutely untrammeled hand in the direction of the engineering and constructive elements of the work he has in charge. After a careful reading of the voluminous report of the inquiry that is now going on before the Senate, any impartial critic must feel that, if this work is to be done with the dispatch and reasonable economy which mark the great works of engineering carried out by the railroad systems of this country, it should be executed along those lines which half a century's experience has proved to be the most practicable. The well-intentioned, but slow and cumbersome methods which characterize the handling of government work can never be applied to good effect at Panama. The elaborate system by which, with the best intentions in the world, the government has hedged about the purchase of supplies and material and the general payment of accounts, while it is admirably adapted to prevent fraud, is equally well adapted to act as a veritable millstone about the neck of any engineer who attempts to apply its methods to a great work like that at Panama, which must be carried on two thousand miles from the seat of government in Washington.

Another lesson that we have learned is, that in the matter of providing the necessary material, plant, means of transportation, and labor force, the authorities should feel at liberty to buy in the cheapest market, and introduce that class of labor which is found to be most effective to the peculiar conditions on the Isthmus. It was brought out in the inquiry before the Senate that the progress of the engineering work has, at times, been subjected to intolerable delay, because there is a disposition to place requisitions in certain localities or States irrespective of the question of speedy delivery. Paternalism in an enterprise of this magnitude should have no place whatever. The speedy and economical completion of the work should be the paramount consideration. Malaria and the yellow fever itself would not prove more fatal to the speedy completion of the canal than would be the encroachment of "political pull" even in its mildest form.

Finally, the experience of the past indicates that the work should by all means be done under contract. Preferably, it should be let under a single contract, to a company capable of giving the strongest guarantees; or, at most, to two such companies, building the canal under two separate contracts, with the division line drawn at the deepest part of the Culebra cut.

GATUN DAM, THE KEY TO THE CANAL PROBLEM.

As a result of the long-drawn-out investigation and discussion of the Panama Canal problem, certain fundamental truths are beginning to emerge from the mass of contending theories, and stand out as well-established facts. Chief among these is the fact that a high-level canal built on the lines of the minority report is, all things considered, a better canal than one at sea level, provided, of course, that when it is completed it will be as permanent, in spite of its artificial dams and locks, as the simpler waterway cut at sea level from ocean to ocean. The most important feature in the high-level canal, the one, indeed, which renders it so attractive to shipping men, is the substitution for a narrow channel, 150 to 200 feet wide and over 40 miles long, of two large inland lakes, with over 30 miles of deep-water navigation free from risks of grounding and collision. But the creation of these lakes and their permanent security depends upon the erection of a number of dams, three on the Pacific side of moderate height, and one of much greater height and importance on the Atlantic side at Gatun. The nature of the foundations for the dams on the Pacific side is satisfactory, and there can be no serious doubt as to their future permanence should they be built. But around the colossal structure with which it is proposed to impound the waters of the River Chagres at Gatun, there has arisen a very spirited controversy, the majority report flatly declaring that no reliable dam can be put up in that locality, and the minority report declaring with equal emphasis that it can, and that it will be one of the safest structures of the kind ever erected.

The objections to the Gatun dam are based upon the fact that the depth to rock or its equivalent is so great, that it will be impossible, in building the dam, to include within it a core wall or diaphragm of impervious masonry, clay, or sheet piling, extending everywhere from high-water level to rock and shutting out any possibility of seepage through or beneath the dam. It has always been accepted as a fundamental axiom of dam construction among European engineers, and, indeed, until very lately among engineers in this country, that such an impermeable core wall must be included when the dam itself is built of earth or kindred material. Of late years, however, some very successful work has been done in this country in the erection of dikes, levees, and even high reservoir dams, that have been built of a homogeneous mass of earth upon an alluvial deposit that was itself impervious to water. The most notable instances of this are the great San Leandro dam in California, which is subject to a head of 120 feet of water, and also the long dyke which closes a gap in the natural basin that forms the great Wachusett reservoir for the water supply of Boston. There has been no trouble whatever with these two structures; and it is largely because of the good results obtained with them, that the minority board and the Canal Commission decided to pin their faith to the huge earth dam at Gatun.

By reference to the drawings shown on another page of this issue, the character of the Gatun dam and the bed of the valley underlying it will be clearly understood. The line of borings taken along the axis of the dam for a distance of about 10,000 feet shows that ages ago the Chagres River must have flowed through a deep gorge, the bottom of which at Gamboa was at the present sea level, at Bohio 165 feet below, and at Gatun 258 feet below that now obtaining. In this geological age the floods of the river have brought down bowlders, gravel, driftwood, sand, and fine silt, which have gradually filled up this gorge, raising the ground above sea level, and pushing the waters back to their present shore line on the Caribbean Sea. In the course of ages, as the ever-recurring floods poured through the gorge, they deposited first the heavy bowlders which occur between Gamboa and Bohio, then the gravel, and finally, as the water spread out and began to flow more sluggishly, the sand and fine silt. The result, as far as Gatun is concerned, is shown clearly in our sectional view of the borings. It will be noticed that the layer of gravel is buried 200 feet below the surface, and that above this is a mass of fine sand and clay, with occasional local pockets of shells and driftwood. It is the opinion of the minority report, based upon tests of the clay silt at Gatun, that if a sufficient mass or thickness of it is presented, it is practically impervious to water. Consequently, the plan of construction of the dam will be to utilize the sand and silt that will be dredged out of the channel leading from Limon Bay to Gatun, for the formation of a dam of Cyclopean proportions at Gatun. The structure is to be 135 feet in height, and over 2,600 feet in thickness at its base. Such a mass will be secure against displacement by the pressure of the water; and its density, coupled with the fact that the finest material will be built into it on the upstream side, will prevent the escape of the water by seepage. It is also contended that the great weight of the mass, added to the compact nature of the clay-sand formation upon which it is built, will similarly prevent the escape of water from the dam by seepage through the underlying material. It is expected that even if there should at first be a slight tendency to seepage, the fine silt brought into the lake will settle upon the surface of the dam and the bottom of the lake and ultimately completely seal it up, the action in this respect being similar to that which tends to seal up the sand-bed filters in municipal water works, and necessitate the periodical cleaning of the bed and breaking up of the sand to allow filtration to go on. The dam will be formed entirely by the sluicing process, the excavated material from the Limon channel being pumped onto the site of the dam, where the water will run off, leaving the solids compacted into a firm, impermeable mass. Moreover, before this pumping process commences, the surface of the valley over the area to be covered by the dam will be entirely cleared of its vegetation and top soil, until, at a depth of eight to twelve feet, the clean sand and silt is everywhere laid bare.

All things considered, while we fully appreciate the conservatism which led the majority of the consulting board to reject the Gatun dam proposal, we think that the success of the San Leandro dam, the Wachusett reservoir dyke, and of a dam of pure sand which has proved successful at Jeypore, India, coupled with the elaborate experiments made by the Commission to establish the impermeability of the material upon which the Gatun dam is to be built, to say nothing of the willingness of some of our foremost hydraulic engineers to stake their own reputation and the interests of the people of the United States upon the venture, fully justify the Canal Commission and the President in their acceptance of a high-level lock canal.

MIKKELSEN'S ARCTIC EXPEDITION.

In the Arctic Ocean there lies a group of islands which is known to geographers as the Parry Archipelago. The most extreme western lands of this group are the two large islands called Banks Land and Prince Patrick Island. Lying to the west of this archipelago, discovered over half a century ago by one of the Franklin search parties, lies the great unexplored Arctic Ocean, undoubtedly the largest unknown area in the frigid zone.

For the purpose of exploring Beaufort Sea, the most southern part of this ice-covered ocean, and for the purpose of mapping islands which are supposed to exist there, Capt. Ejnar Mikkelsen has left with an expedition fitted out by the Royal Geographical Society of England and the American Geographic Society.

There is reason for believing that Capt. Mikkelsen's expedition will be crowned, if not with complete success, at least with sufficient success to repay the time, trouble, and money which have been expended in his behalf. Although he may fail completely in exploring the entire region, he should at least succeed in plotting the formation of the continental shelf, in other words, that part of the sea floor extending from the edge of the continent at depths of from 600 to 1,000 feet before the bottom suddenly drops.

That such a shelf does exist most geographers are certain. They base their belief on the experiences of previous expeditions. Shallow waters caused the "Jeannette" to drift for two years in a course which took her far west and but little north. The "Fram" was also carried west but far to the north, simply because she floated over the ocean in regions where there were no lands to set up currents that prevented her from drifting in that direction.

Unknown lands probably arise from the continental shelf, and impede the free movement of the currents. Hence the drifting of the "Jeannette" and other vessels. If Capt. Mikkelsen succeeds in definitely fixing the outlines of this shelf and its position, his expedition will be considered eminently successful.

In the hope of discovering the lands which project from the shelf, Capt. Mikkelsen will make long sledge journeys westward from Banks Land over Beaufort Sea, skirting well within the continental shelf. Actual exploration, however, will not begin until the spring of 1908.

THE MOTH AND THE FLAME.

Why does a moth fly toward a flame? Because it is inquisitive, was the rather puerile answer given by the great Romanes. Because of some inexplicable inherited instinct, was the reason advanced by other naturalists. Because it is the nature of the insect, was a third and equally unsatisfactory reply. One reason was as good as another, but that of Romanes undoubtedly carried off the popular palm. Perhaps we owe it to him that the moth and the flame have pointed many a moral and adorned many a sad tale of curiosity tragically satisfied.

The investigations of Prof. Jacques Loeb bid fair to relieve the moth of the moral burden that has rested on his wings. Prof. Loeb has proved very conclusively that a moth, in common with many insects, flies toward a flame for the same reason that some plants turn their leaves toward the light. "Heliotropism" is the awesome name in which this tendency of plants and animals rejoices.

It happens that there are two kinds of heliotropism. If your moth or bug flies toward the light, it is positively heliotropic; if, like the earthworm, it shrinks from the glare, it is negatively heliotropic. Plants, too, may be classified into these divisions. Just as some flowers open only by day and others only by night, so some moths fly only by day and others only by night.

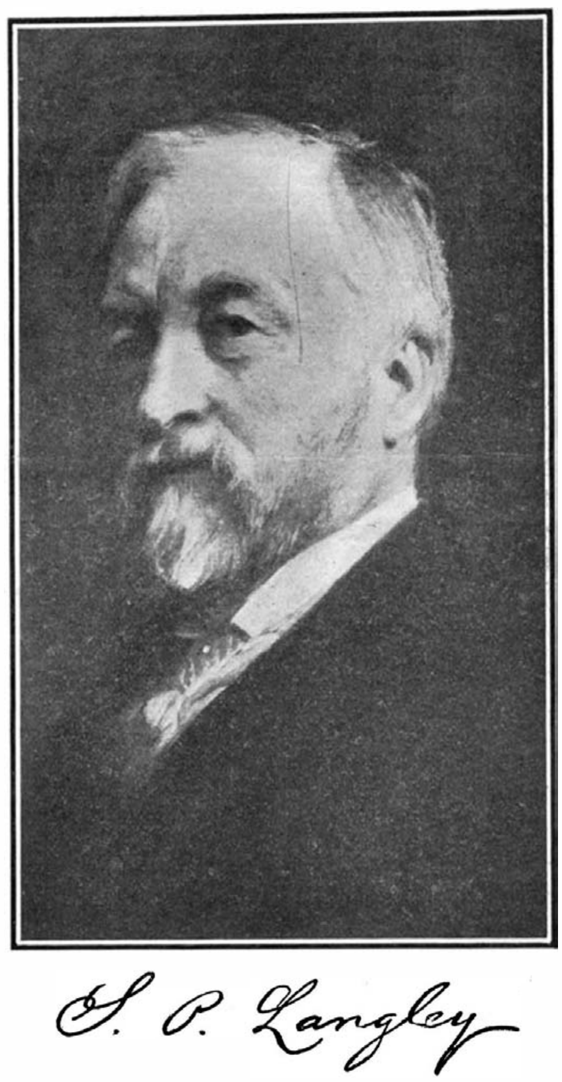
The results of Prof. Loeb's experiments explain with astonishing simplicity the causes of a June bug's merry antics as well as the apparently aimless movements of squirming, new-born vermin. Insects, it seems, move in the direction of the light rays that fall upon them. Change the position of the light, and the insect changes his course likewise. But the light must be of a certain intensity to produce a very marked effect. Suppose that in your experiments you exposed your bug to diffused light. He would move toward the light, to be sure; but he would creep toward it rather leisurely. Expose him to a bright glare, however, and he will hasten toward it with cheerful rapidity. That is why winged insects flutter gayly about in direct sunlight. Curiously enough, the influence of light is limited by atmospheric temperature.

From the circumstance that insects tend to arrange themselves and to move in the direction of light, it would almost follow that their structure must have something to do with their heliotropism. And such Prof. Loeb's experiments prove to be the case. The head of an insect is much more sensitive than the tail. Here the omnipresent skeptic will probably remark that an insect sees with his head and not with his tail, and that Romanes may be right after all. But such notoriously blind animals as the earthworm and other eyeless creatures are far more responsive to light at the head than at the tail. The mere possession of sight cannot, therefore, account for the earthworm's avoidance of light or for the moth's apparent liking for it.

Sometimes it happens that an insect is stimulated by light only at certain periods of its existence. In winged ants, for example, the period coincides with the time of the nuptial flight; in plant lice, with the appearance of wings; and in some larvæ, when full growth has been attained. Occasionally a caterpillar may crawl toward a flame, while the butterfly to which it gives rise may be repelled by light.

What is the cause of this curious effect? It must be confessed that science can give no satisfactory explanation. We might just as well ask, What is the cause of gravitation? The phenomenon is exactly the same as that which is produced in plant life. And that, in animals, it cannot be due to the nervous system is evident from the fact that leaves and branches have no nerves.

To be paralyzed by light, to be confined to a certain path, or to be incarcerated in an impalpable luminous prison would seem a serious limitation in the search for food. Yet it so happens that heliotropism may actually assist an insect in its struggle for existence. Certain caterpillars just after they are hatched, and when they are ravenously hungry, are compelled by the mechanical effect of light to crawl to the tips of branches, where they find their first nourishment in tender buds. After their first meal, the caterpillars lose much of their sensitiveness to light. Their heliotropism explains what has heretofore been vaguely attributed to instinct. Prof. Loeb even ventures the suggestion that the periodic migrations of many animals, such as those of birds of passage, may also be explained in part by heliotropic irritability.



SAMUEL PIERPONT LANGLEY.

With the death of Prof. Samuel P. Langley on February 27 there has passed away not only one of the most distinguished American workers in the field of pure science, but a physicist of world-wide reputation.

Prof. Langley was born in Roxbury, Mass., on August 22, 1834. Although astronomy was the study which most attracted him, even from his boyhood days, he drifted into the profession of civil engineering, where his mathematical taste found employment and likewise his manual dexterity. He soon gave up civil engineering for the allied profession of architecture. For seven years he worked patiently and then decided to abandon the profession. With no certain plans for the future he began to take up the study of astronomy in earnest. After a brief visit to European countries he obtained a position at the observatory at Cambridge, and was thus launched in his life work at the age of thirty. After a brief service at Cambridge, and at Annapolis, he became director of the Allegheny Observatory.

When Prof. Langley went to Pittsburg in 1867 he found there only an observatory in name. The equipment was inadequate, the endowment small. It was imperatively necessary that some means should be found whereby the work could be carried on. It was from the very poverty of the Allegheny Observatory that the greatest results came. In order to obtain money, Langley inaugurated "time-service systems" on a scale never before attempted. He first began by regulating the clocks of the Pennsylvania Central and other railroads associated with it, a system then comprising over 2,500 miles of railroad east and west of Pittsburg and along which 300 telegraph offices were located. Accurate time signals were communicated twice daily to each of these offices. Eventually some 8,000 miles of railway were run by this single Allegheny Observatory clock. The present system by which the railroad system of the whole continent is regulated may be said to be an outgrowth of that developed nearly forty years ago at Allegheny by Prof. Langley. The income thus derived was applied exclusively to the uses of the observatory.

In the course of two or three years the observatory affairs had prospered to such an extent that original work could be undertaken. Langley's first work was a laborious and minute study of the sun's disk, which study he completed in 1873. He revealed the true character of the "granules" upon its disk, discovered that the polarization of the corona is radial, and gave us the first complete account of the structure of a sun spot. A detailed study of the distribution of heat on the solar surface, begun in 1870, resulted in the previously unknown thermochroic action in the solar atmosphere, by reason of which, owing to the difference in wave length, it transmits heat more readily than light.

This early work upon solar heat was accomplished with the aid of the thermopile, an instrument not sufficiently sensitive for the more minute work which it was his desire to undertake. He invented a new instrument which he called the bolometer—a thermometer of almost infinite tenuity, which measured radiant heat with an accuracy that has never been excelled. In its more recent forms the instrument can detect differences of temperature amounting to no more than the one-millionth part of a degree on an ordinary thermometer.

In the hands of Langley, the bolometer demonstrated experimentally that the maximum heat in the normal spectrum lies in the orange and not in the infra-red spectrum, as commonly supposed. Before the invention of the bolometer the distribution of heat in the spectrum was almost entirely unknown. In the course of three years' patient work, however, Langley completed a map of the principal lines of the heat spectrum and thereby furnished new material for a study of the interaction of solar heat and terrestrial atmosphere. What Kirchhoff did for the upper rays of the spectrum Langley accomplished for the lower spectrum.

One important result of all these bolometric investigations was the discovery that the earth's atmosphere acted with selective absorption to a remarkable degree, keeping back an immense proportion of blue and green, so that which was originally the strongest became, when it reached us, the weakest of all, and what was originally weak became relatively strong. The action of the atmosphere is just the converse of that of an ordinary sieve, or like that of a sieve which should keep back small particles analogous to the short wave lengths (blue and green) and allow freely to pass the larger ones (the dark heat rays). Langley, therefore, proved that white is not the sum of all radiations as we used to be taught, but that it resembles pure original sunlight less than the electric beam which has come to us through reddish-colored glasses resembles the original brightness.

An expedition to the top of Mount Whitney resulted in the discovery of an entirely unsuspected extension of the solar spectrum; in a calculation of the relative intensity of the different rays of the sun before they

(*Continued on page* 211.)

THE NEW BRITISH BATTLESHIP "DREADNOUGHT."

The recent launch of the battleship "Dreadnought" at Portsmouth, England, of which we present illustrations, was an event of more than common significance; for the ship is an entirely new type, and, as such, introduces a new era in the art of warship construction. It is true that in the "Lord Nelson" Sir Philip Watts, the designer of the "Dreadnought," had foreshadowed some of the prominent features of the latter ship, particularly as regards the abolition of the secondary armament. But the new ship is not merely superior in gun power; she embodies many other improvements, which render her a far more formidable vessel than the "Lord Nelson."

GENERAL DIMENSIONS.—The "Dreadnought" is the fastest and the most powerfully protected and heavily gunned warship yet constructed, and to accommodate her all-round increase in efficiency, it has been necessary to raise the displacement to 18,000 tons. The length has been increased to that of the largest modern cruisers, namely, about 500 feet. She has the enormous beam of 82 feet, and at 18,000 tons displacement will draw the moderate amount of 26 feet of water, which is 4 feet less than that of the "Royal Sovereign" class of battleships, of twelve years ago. Apart from her great length, the most noticeable changes are the practical abolition of the pointed ram, and the addition of a lofty forecastle deck—the latter an entirely new feature in British battleships. In this connection it should be mentioned that a startling innovation is to be made in the location of the officers' quarters, which will be no longer in the after part of the vessel, but forward in the bows, partly within the forecastle deck above mentioned, and also partly on the main deck below. This is the natural location for the executive officers, inasmuch as they will be near the bridge, chart room, etc., therefore more conveniently placed for their official duties. The change was made years ago in the merchant marine, and the continuance of the officers' quarters astern has been due to conservatism, and not to considerations of convenience. A striking novelty in the ship is the provision of two rudders, arranged parallel to the axis of the ship and 20 feet apart. The increased rudder area will give the ship rapid maneuvering ability.

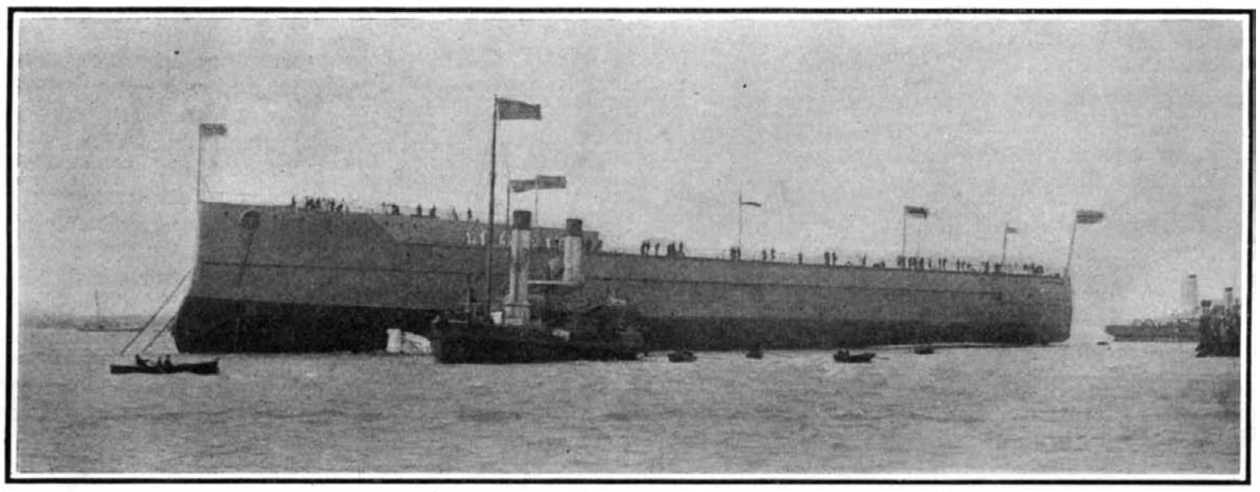
ARMOR.—The British navy, by arrangement with the Japanese government, was permitted to place several *attachés* on board the ships of the Japanese fleet throughout the operations of the late war, and the new battleship embodies valuable experience gained in this way. The armor distribution on the "Dreadnought" is carefully worked out, and it is not only heavy, but has been widely distributed. It includes the usual complete water-line belt, with the difference that it extends deeper below and higher above the water-line than has been usual, while the side armor above the belt is of extra thickness, and extends along the sides a much greater distance than in any previous ship, reaching from the wake of the aftermost to the wake of the foremost of the 12-inch gun barbettes. Associated with the side armor are armored decks, which serve to limit the destructive effect of high-explosive shell. The abolition of the customary secondary battery of 6-inch guns contributes to the completeness of the protection, inasmuch as the sides of the ship are not pierced by casemates, and a continuous wall of armor extends from below the water-line to the upper deck unbroken by any openings.

ARMAMENT.—It is in the armament of the "Dreadnought" that the most striking advance has been made. Hitherto, if we except the "Lord Nelson," the typical battleship has carried four 12-inch guns in two turrets, one forward and one aft, and a numerous battery of secondary guns, generally of 6-inch bore, and in some cases 7, 7½, or 8 inches. It was demonstrated, however, in the battles of the Japanese war, that the vital damage was done by shells of 10- and 12-inch caliber, smaller guns proving ineffective except upon the upper works and other unarmored portions—at least at the great ranges at which the battles were fought. Therefore, the 6-inch gun has been abolished altogether, and the "Dreadnought" carries ten 12-inch rifles, of a new and exceedingly powerful type, with a length of 45 calibers, a muzzle velocity of 2,850 foot-seconds, and an energy of 48,000 foot-tons. This gun is a great advance upon any previously installed in the British navy, the energy of the 40-caliber 12-inch gun mounted on ships as late as two years ago being 30 per cent less than that of the new piece. How greatly the power of a ship is augmented by increasing the number and efficiency of the guns of her main armament is shown by a comparison of the "Dreadnought" with the various classes of battleships built for the British navy since the Defense Act of fifteen years ago. Thus in the "Royal Sovereign" of 1892, the aggregate muzzle energy of all the guns carried by the ship was 160,000 foot-tons. In the "London" class, of a decade later, the total energy had risen to 195,000 foot-tons. With the introduction of 9.4-inch guns in the secondary battery, as in the "King Edward" class of 1903, the total energy rose to 270,000 foot-tons; while in the "Dreadnought" the total muzzle energy of all guns for one discharge is just under half a million foot-tons. These figures are rendered still more impressive when it is remembered that, because of their higher velocity, the 12-inch shells from the "Dreadnought" will be effective up to a range of six miles.

LOCATION OF THE GUNS.—In the location of the guns an effort has been made to give every piece a maximum arc of fire, so that on whatever point the enemy may range, the greatest number of pieces possible may be brought to bear upon him. In the ordinary method of distributing the armament along the broadside, a large number of the guns must, at any given time, be out of action, their fire being masked by the intervening superstructures or decks, as the case may be. In the "Dreadnought" this has been largely overcome by locating all the guns in two-gun turrets, and placing these turrets upon the upper deck, and most of them on the longitudinal axis of the ship, where they may fire on either broadside without interference. The disposition is as follows: Forward on the forecastle deck is a two-gun turret with its 12-inch pieces carried at an elevation of 34 feet above the water-line, and capable of an all-round fire except through a limited arc astern. On either broadside, and somewhat to the rear of this turret, is a two-gun turret firing from well abaft the beam to dead ahead, parallel with the axis of the ship. Astern on the upper deck, and well aft of the engine-room spaces, are two more two-gun turrets, placed one astern of the other on the axis of the ship, the aftermost gun having a wide arc of fire from well forward of the beam on either side to dead astern. The forward of the two turrets can train its guns throughout the same arc of fire except where it is masked by the aftermost turret. The maximum possible concentration of fire is six 12-inch guns ahead, eight on either beam, and two dead astern. To engage a pursuing enemy with both after turrets it would be necessary to swing the "Dreadnought" a little to port or starboard. The comparative weakness of the dead-astern fire is considered to be unimportant in view of the fact that the "Dreadnought," because of her great fighting power, will be pursuing rather than eluding the enemy. The high command of the 12-inch guns, which will vary from 25 to 34 feet, insures that at no time, even in rough weather, will the enemy's ships be shut out from the gunner's sight by intervening waves.

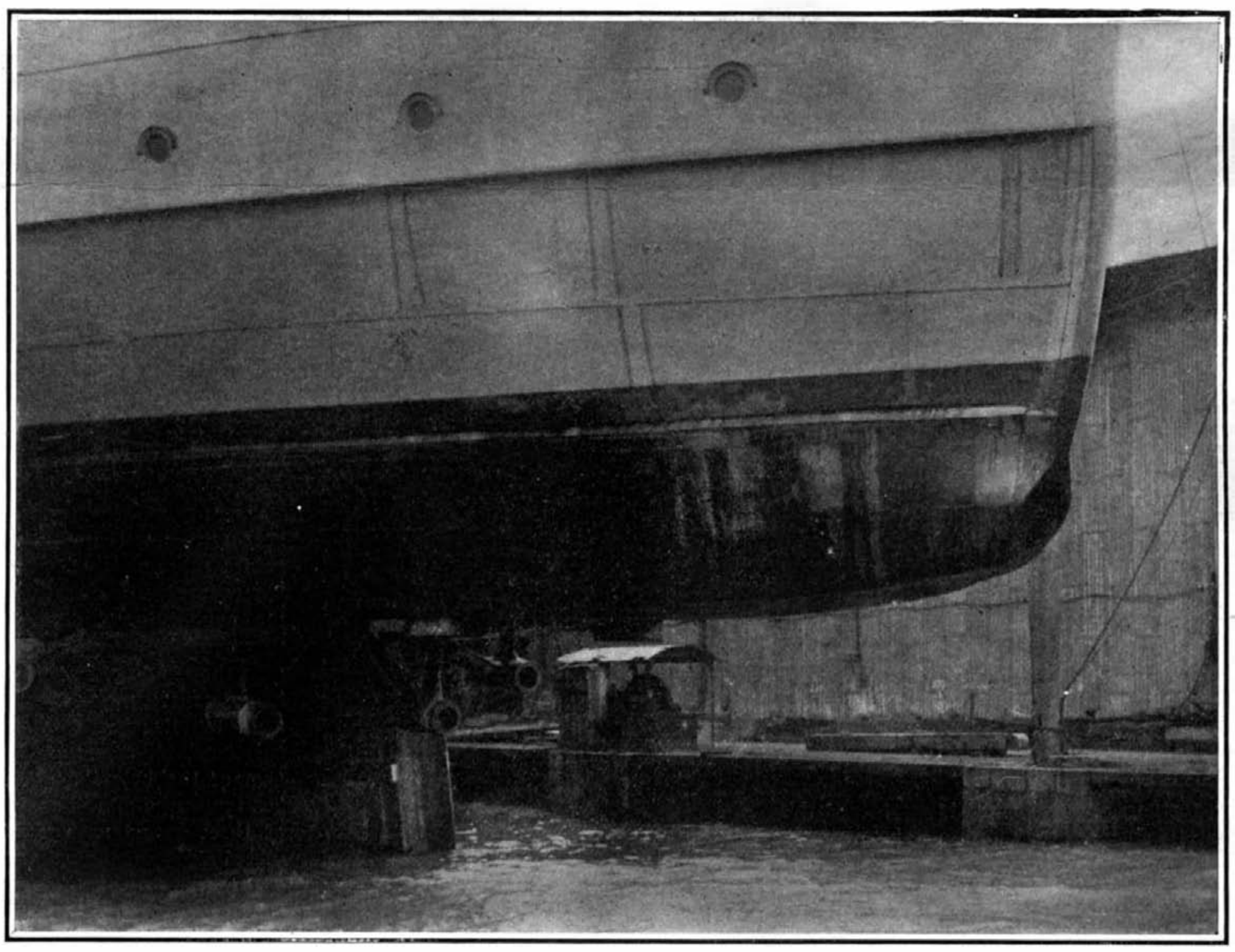
For repelling torpedo attack the "Dreadnought" will carry on her bridge and superstructure a numerous battery of a new type of 18-pounder rapid-fire guns, or better, a smaller number of 4.7-inch guns.

MOTIVE POWER AND SPEED.—The ship will be driven by an eight-cylinder turbine engine, driving four propellers on four shafts. The shafts, as will be seen from our engraving, are located abreast of each other. On each outer shaft will be a high-pressure main turbine and a high-pressure go-astern turbine; while on each inside shaft will be a low-pressure main, a low-pressure go-astern, and a small cruising turbine for



Length, 500 feet. **Beam,** 82 feet. **Draft,** 26 feet. **Displacement,** 18,000 tons. **Speed,** 21 knots. **Armament,** ten 12-inch guns in six turrets on the upper deck. **Motive power,** eight turbines developing 23,000 horse-power on four shafts.

THE LAUNCH OF THE BRITISH BATTLESHIP "DREADNOUGHT."



STERN VIEW OF THE "DREADNOUGHT," SHOWING THE BRACKETS FOR THE FOUR PROPELLER SHAFTS, AND THE STERN TORPEDO TUBE.

steaming ahead at low power. When the vessel is cruising, steam will be led directly to the small low-power cruising turbines on the inside shafts, whence it will pass to the high-pressure wing turbines, and from them to the low-pressure turbine on the inside shafts, whence it will pass to the condenser. With such a wide range of expansion it is anticipated that, even at the slower speeds, an economical coal consumption will be secured, thereby overcoming the one great objection that has hitherto been urged against the turbine as a drive for warships. The keel of the "Dreadnought" was laid in October of last year, and she was launched on February 10, or within a period of four months. It is expected that she will be in commission early in 1907, in which event she will have been constructed within the remarkably short time of eighteen months.

STANDARDS OF LENGTH.

BY HERBERT T. WADE.

The standards of length of the United States are two meter bars, which are kept in the custody of the National Bureau of Standards at Washington, and preserved most carefully in its strong vault. These standards are exact copies of the international prototype meter, and were constructed after years of investigation and labor by the International Bureau of Weights and Measures, being delivered to the United States government in 1890. Three years later the international meter as thus represented was adopted as the fundamental standard of length of the nation by executive order, and to these standard bars now all measures of length in the United States must be ultimately referred. This may seem somewhat strange in view of the fact that the metric measures are but rarely encountered in the United States outside of scientific work, but the yard and its subdivisions are defined in terms of the meter, one yard being equal to 3600/3937 meter. These standard meters are of X-section, a form now employed for all accurate standards, and are made of platinum-iridium alloy. It is of course essential that they should be preserved with the utmost care, and consequently they are only removed from the vault for use in making secondary standards, or for equally important investigations.

To illustrate one of the comparatively rare occasions on which the standard meter bars are employed for purposes of study and comparisons which involve their removal, reference can be made to the examination of the two standards in 1904, previous to sending one to Paris for comparison with the standards of the International Bureau. This study was made with a comparator arranged in the temporary quarters of the Bureau, and as shown in the accompanying illustration (Fig. 1). It was placed in a basement room, there being two masonry piers carrying a heavy steel I-beam, on which were mounted the comparison micrometer microscopes. The two standards to be compared were placed in a box of wood lined with copper and coated with brass, which was carried by rollers on rails laid on the upper surfaces of two smaller brick piers. This temporary instrument differed radically from the comparators of the International Bureau and the British Office of Standards,* where the micrometer microscopes are each mounted on separate piers, yet it proved satisfactory, and the Bureau now proposes to construct a permanent instrument, making the I-beam of invar, a nickel-steel alloy with a remarkably small coefficient of expansion.

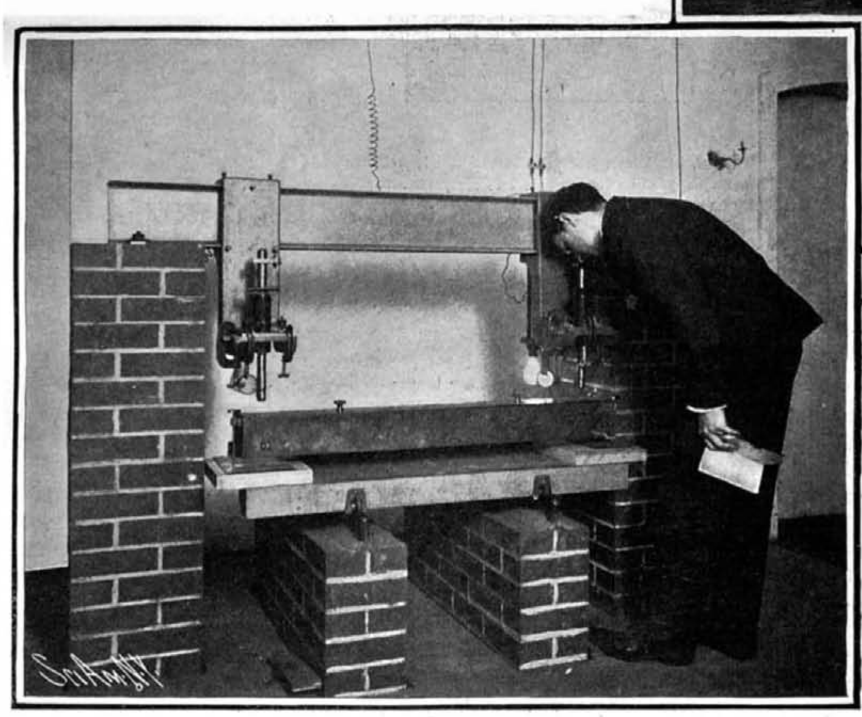


Fig. 1.—COMPARATOR FOR STUDYING STANDARD METER BARS.

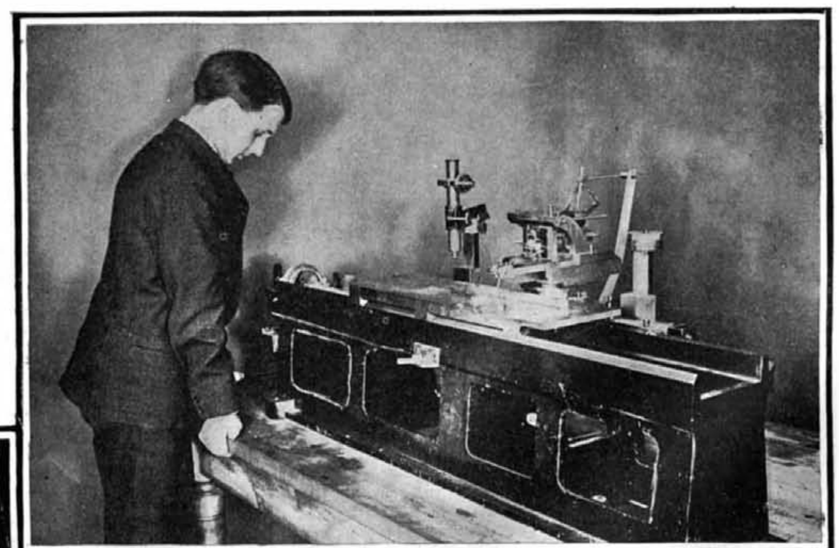


Fig. 2.—DIVIDING ENGINE FOR CONSTRUCTING LINEAR SCALES.

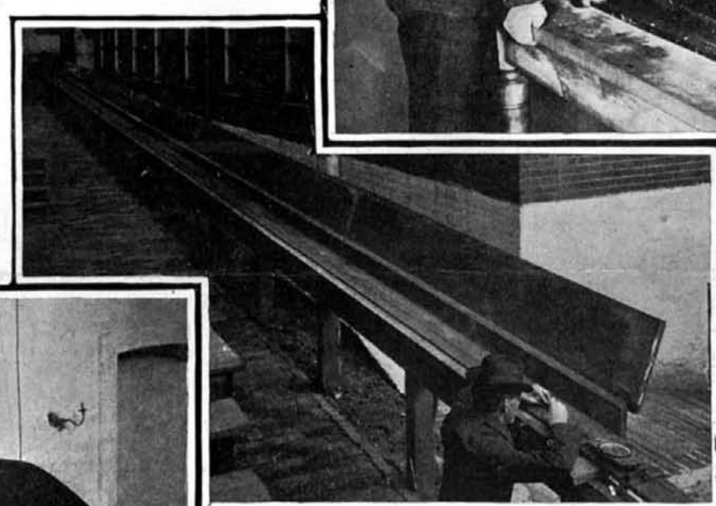


Fig. 3.—TESTING SURVEYORS' STEEL TAPES ON TEMPORARY BENCH.

With such a comparator it is believed that results almost, if not quite, as accurate as those secured at the laboratories named will be secured, and it possesses the further advantages of permitting the microscopes to be clamped at any point on the bar, thus allowing standards of any length to be studied, instead of those of just a meter, as is the case where the microscopes are mounted on the masonry piers. In such an instrument a secondary standard could be compared directly with the national standard.

It is often desirable to construct secondary standards, and for this purpose what is known as a dividing engine is employed, as is shown in Fig. 2, where a tracing tool can make a series of linear marks as the bar to be graduated is pushed along on its carriage, which is moved by an accurately-cut screw revolving in a nut attached to or pushing against the carriage. Or the standard bar can be placed so that the microscope of the dividing engine is over one of its lines, and a mark is then traced on the new scale. Then both scales are moved along until the microscope is over the desired mark on the standard, when a second line is traced. The instrument can be arranged to work automatically, and a scale with a series of divisions can be engraved speedily. It is able to divide linear scales of different lengths and with different divisions; and when once the characteristics of the screw are determined and various corrections made, considerable accuracy can be attained. Secondary standards prepared in this way are available for many purposes, and with them the standards of instrument makers and mechanical engineers are compared.

In regard to measures of length, one of the most important duties of the Bureau is to standardize and certify surveyors' steel tapes. This is a matter of much practical importance, as the variation of the standards used in laying out the cities of the United States has caused much confusion, and has at times resulted in producing litigation. Thus in Philadelphia, owing to an error in the length of the measure used in early surveys, 100 feet as then measured correspond now to 100 feet 3 inches, and tapes divided on such a basis are actually made and sold for use in this part of the city, while elsewhere a standard foot is employed. In the early surveys of New York and Brooklyn measuring rods, chains, or tapes were used whose errors in some cases amounted to as much as $1\frac{1}{2}$ inches in a hundred feet. Consequently, in laying out a city or large tract, it can be seen how such errors of the standard used to measure distances would soon increase, and occasion discrepancies in surveys and descriptions of property.

While of course there has been a marked improvement from the early days of the nineteenth century referred to, yet to-day it is no less important to have means to accurately standardize tapes, and thus guarantee their true values. At the beginning of the Bureau's work this was done, as is shown in the illustration, Fig. 3, which represents a temporary bench or accurately measured distance, where tapes were tested under a proper and standard strain, due allowance being made for temperature by using carefully tested thermometers. In the new laboratory of the Bureau a special provision has been made for this work, and a standard bench 50 meters—164.04 feet—in length, made of bars of steel welded together by means of thermite, has been constructed, so as to form a continuous strip on which the tapes to be tested can be laid. This is mounted on one of the walls of the tunnel connecting the physical and the mechanical buildings of the Bureau, and on it the standard distances will be laid off most carefully. This tunnel is susceptible of temperature regulation, and here geodetic base bars and other linear standards can be tested and standardized.

The testing of gages and various standards of length, such as test pieces used in mechanical engineering, represents another side of the work of this division of the Bureau. This is of importance, as in manufacturing, especially when carried on on a large scale, it is essential that all standard sizes should not only be interchangeable, but should be defined in terms of a national standard rather than that of a single shop or one arrived at in some arbitrary way. This section of the Bureau is planning to take up quite extensively the testing of watches and chronometers, and for that purpose receives daily from the Naval Observatory noon signals by wireless telegraphy from the standard clock of that institution. The Bureau has a self-regulating clock in its laboratory, which is installed in a vacuum case, and is provided with a pendulum of invar, whose coefficient of expansion at ordinary temperatures is so small as to be practically negligible.

As accuracy in the measurement of linear distances underlies all mechanical as well as scientific work, the importance of preserving and maintaining proper standards and attending to the accuracy of the measures in use can readily be appreciated, and the Bureau is frequently consulted in such matters by various manufacturers. Should at any time within a few years the metric system be adopted, as is being urged by large and influential interests, the work of the Bureau would be to provide for the issue of proper standards and to certify to the correctness of new measures, a task that in Germany was carried on by a similar organization (Normal Aichungs-Kommission) with great success when the metric system was adopted some thirty years ago.

One of the latest methods of preserving wood has been patented by Montravel, in France. It has been recognized that one of the best means of preservation is to keep the wood at a high temperature in closed vessels (about 250 deg. C.) and at the same time at a high pressure, some 250 pounds per square inch. This method has been perfected by the inventor. The object of the improvements is to provide means of heating as efficacious as usual, but more practical and economical. Another aim is to utilize a part of the air pressure which has served for one operation, thus saving work in compressing. In the new process the pieces of wood are put in compression cylinders and the air is sent direct from the compressors into the cylinders. To heat the air, each cylinder is surrounded by a masonry envelope not in contact with it, thus leaving a free space. The hot gases from a furnace are circulated in this. Cooling is effected by introducing cold air in the space. To obtain a specially good and cheap heating, a series of gas jets is placed in the lower part of the air-jacket and fed by a gas-tube, and having an air tube to aid in combustion. When the plant uses several cylinders side by side, there is a saving in the work of air compression by utilizing a part of the compressed air in a cylinder at the end of the operation to send it into the next cylinder in commencing the compression here. Piping is arranged between the cylinders for this purpose.

* See Scientific American, July 22, 1905, p. 65.

A METHOD OF BURNING SLACK COAL IN A COMMON SOFT-COAL FURNACE.

BY THALEON BLAKE, C.E.

Several years ago I began a series of experiments to determine the value, if any, of water added to coal previous to burning in stationary engines. Shortly afterward I met the owner of several bituminous coal mines, who directed my attention to the desirability of a practical method of burning slack coal in stoves. Such coal being cheaper would appeal to the householder, provided he could burn it in the common style of soft-coal stove known as the "oak"; while a wider market for such coal would be welcomed by miners. Acting on this hint, I made numerous experiments, and have found that with care in firing, slack coal may be easily and completely consumed in the oak coal stove.

The data are as follows: Slack coal, being the waste of lump, and formed in the process of mining, by attrition in handling, shipping, and delivering, is largely composed of "dust" with an intermingling of small pieces, ranging from the size of a pea to a hickory-nut or walnut, according to the size of the meshes of the screen used to separate the more salable and higher-priced lumps. The dust, of great fineness, makes it difficult to consume under the conditions which usually obtain for burning large lumps. A stove which will burn a lump the size of a man's head, with closed damper, will not retain fire long when charged with slack coal thrown in haphazard fashion, even though the drafts are open. The dust-coal extinguishes fire almost as well as water, if dumped onto the ignited coals, because it excludes air.

The successful burning of slack coal, therefore, depends wholly on building up the fire until it forms an arched crust at some elevation above the bottom of the firepot. This crust, composed of incandescent coal, prevents the firepot holes from getting choked up, and supports the fresh coal, admits air beneath the fire, and, as it cracks and consumes, opens air channels to the coal above. It glows and throws off carbon monoxide, which burns above to carbon dioxide, as does anthracite coal. Damp, not wet, coal, if the draft is strong, makes a porous crust, as the particles stand off from each other, whereas very dry slack has a tendency to condense to a mass impenetrable by air. The method of building this crust is illustrated in Fig. 3. Care must be exercised, first, to remove all ashes from the firepot of the stove; second, to lay several sheets of paper on the bottom; third, to place on the paper two to four inches of shavings, or mixed paper scraps and kindling wood; fourth, to sprinkle a very thin layer of slack coal over the whole. The mass is now ready to be lighted. As it burns, add, little by little, small quantities of coal, dropping it mostly in the center. As soon as the charge burns out, the shavings and paper gone, the few pieces of blazing coal will be seen in the bottom. If fresh slack were put in now in any except the smallest amount, the fire would be extinguished immediately. It is better to add several more inches of shavings or more sheets of paper before the coal, which as before should be mostly deposited in the center. It takes from fifteen to thirty minutes to get a crust formation strong enough to support an ordinary stove shovel full of coal.

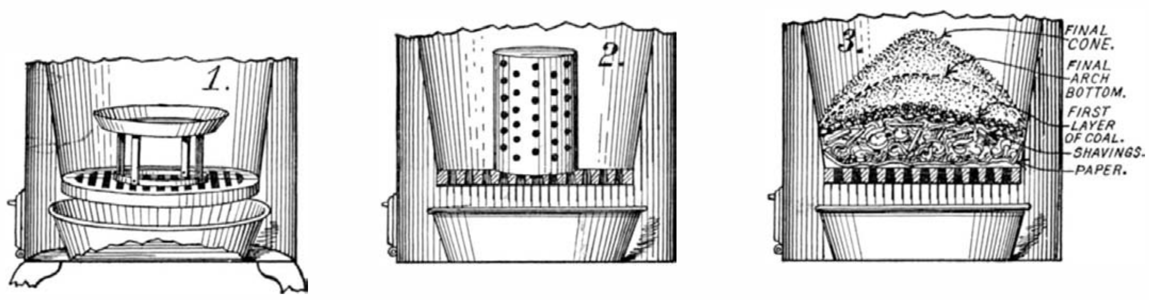


Fig. 1 shows a pan, such as used in baking, supported by four legs. This upholds the coal. A band around the bottom of the legs keeps them from slipping into the firepot holes. Fig. 2 illustrates a cylinder, perforated and with open bottom. This lets air pass into the surrounding coal. Fig. 3 shows method of building fire on common grate.

DIAGRAMS SHOWING METHOD OF BURNING SLACK COAL IN A COMMON SOFT-COAL FURNACE.

The reason for depositing the coal in the center is that a cone is built up which, when it gets afire and burns on its under side, retains the arch shape, and supports itself and load of fresh coal as it is added; besides, when the coal is slowly slid onto the top of the cone from the shovel, the larger pieces of little lumps roll to the base, where the coal should never be allowed to cover up the bottom holes, so as to obstruct the free passage of air. Burning on the sides, in a ring, they greatly assist to create and maintain the crust. The larger the space between the bottom of the firepot and the under side of the fire, the more apt is the fire to burn well and hot. The drafts must be open, mostly, or the fire dies quickly away. Poking the ashes from the bottom with poker is preferable to shaking down the ashes, as the latter sometimes breaks down the crust.

As aids to burning slack, two contrivances may be applied to any oak stove.

Slack may be obtained at much reduced prices, varying in locality, of course, but always for one-fourth to one-half the price of the same kind of coal in large lumps. It burns with an intense heat, and its fire is not troublesome either to build or tend.

The Japanese cruiser "Tsukuba" failed to leave the slip on the day of her launch.

A Chinatown in China.

A journey was recently made to the interior of Kiangsi by Mr. Walter Clennell, the British consul at Kiu Kiang, an interesting report of which has been published by the government. In the course of this expedition the consul visited the Chinese manufacturing town of Ching-te Chen, the staple industry of which is pottery. According to the consul everything in Ching-te Chen either belongs, or is subordinate, to the porcelain and earthenware industry. The houses are for the most part built of fragments of fire-clay known as lop'ing-t'u that were at one time part either of old kilns or of the fire-clay covers in which the porcelain is stacked during firing. The river bank is for miles covered with a deep stratum of broken chinaware and chips of fire-clay, and as far as could be judged, the greater part of the town and several square miles of the surrounding country are built over, or composed of, a similar deposit. A great industry employing hundreds of thousands of hands does not remain localized in a single spot for 900 years without giving to that spot a character of its own.

The consul states that this town is unlike anything else in China. The forms, the color, the materials used in the buildings, the atmosphere, are somewhat reminiscent of the poorer parts of a civilized industrial center. At present there are 104 large pottery kilns in the town. The greater part only work for a short season in the summer. During this busy season, when every kiln is employing on the average from 100 to 200 men, the population of Ching-te Chen rises to about 400,000 souls, but of this total nearly, if not quite, half are laborers drawn from a wide area of country—chiefly from Tuch-ang district—who only come for the season, live in rows of barrack-like sheds, and do not bring their families with them.

But apart from the kilns one passes along street after street where every shop is occupied by men, women, and children all engaged in the designing, molding, painting, or distributing of pottery. Potters' sheds, where the clay is mixed and molded on the wheel, are innumerable. The river bank is crowded for three miles by junks either landing material and fuel, or shipping the finished product. Shops for the retail of the ware, though numerous, are less in evidence than might be expected, and the wholesale trade, which is in the hands of the guilds, makes very little display. Apart from the meeting halls of these guilds there are scarcely any buildings with any architectural pretensions, but the guild halls are elaborate structures.

Plating on Paper.

A new electric process for covering paper with a metallic surface is given by Paper and Pulp. It consists in placing the bath in a porcelain tank in which are immersed two metal plates. One of the plates is formed of the metal which is used to cover the paper. A rather weak current is used for the bath. A thin layer of metal is deposited on the second plate, as is usual in the galvanoplastic process. When the deposit has reached a thickness of about 1-250 inch, the plate is placed against a sheet of paper which is previously coated with the proper kind of glue. After drying, the metallic layer adheres to the paper so strongly that it remains upon the latter when it is pulled off the metal plate. A variation of the process consists in ornamenting the foundation plate with any kind of designs or letters, and these are reproduced on the metallic deposit. The solutions which are recommended in the above process are as follows: For silver paper, a bath is made of cyanide of silver 210 parts, cyanide of potassium 13 parts, water 980 parts. For gold paper, cyanide of gold 4 parts, cyanide of potassium 9 parts, water 900 parts. For copper, sulphate of copper 18 parts, sulphuric acid 6 parts, water 40 parts.

Erratum.

In last week's Scientific American we published a picture entitled "A Turnout on the Mürren Alpine Railway." We have been informed by a correspondent that the picture really represents the railway up the Saleve between Veyrier and Monnetier, near Geneva, Switzerland.

Air Surface Hydroplanes for Motor Boats.

Apropos of the description of hydroplane motor boats published in our last issue, it may be of interest to our readers to know that a French inventor, M. Ader, has drawn up a scheme for fitting a motor boat with wings, or air hydroplanes, for the purpose of causing it to glide over the surface of the water.

M. Ader's proposed boat has a hull very similar to that of the usual motor-boat hull, save that the bottom is absolutely flat. The hull contains a gasoline motor, and has a propeller placed some distance below it. At its forward part there are two large lateral wings, which are much longer than they are wide, and a horizontal tail formed in two movable parts arranged in the shape of a cross, and which is much wider than it is long. The wings can be folded up against the side of the boat when not in use, and the tail can be folded upon the stern.

The wings and tail are stretched over the water as described below. The under side of the wing is hollow, and the concavity of the upper part forms a water-sealed air chamber for its entire area. Air compressed by a motor-driven pump within the boat is forced under the wings, it being led to their under surface through a flexible pipe. A regulator regulates at will the flow of the compressed air, and a safety valve regulates the maximum pressure. When the boat is at rest, and the compressed air is forced under the wings, after they have been fully extended, the air bubbles around their edges, both front and back, and escapes into the atmosphere. When the boat is under way, the air is compressed sufficiently strongly to be capable of supporting the entire weight of the boat and its contents; any excess of air escapes at the rear of the wings. The compression necessary is not very great. This may reach the twentieth of an atmosphere, or perhaps a little less, according to the load and the surface of the wings. It should be understood that the metallic edge of the wing should contact but slightly with the surface of the water, and that as the elastic layer of compressed air serves as the supporting medium, the effects of cohesion will consequently disappear. The tail has an arrangement similar to the wings, which separates it as much as possible from the water.

The motor is placed horizontally inside of the boat. It has steel cylinders with cast jackets. It drives the air pump, and is connected to the propeller shaft through a suitable change-speed and reverse gear. The propeller has blades which can be varied in pitch and in diameter, so as to make it sufficiently responsive to the changes of power and of speed. When the wings and tail are folded up, the boat will move as does an ordinary one; but for the purpose of gliding over the water, the wings and tail are extended, and the motor is set driving the boat on low speed. Under the impulse of the propeller, the inclination of the wings tends to cause the boat to rise toward the surface. The second speed is then thrown in, and the inclination of the wings is diminished. Finally, the motor and propeller are run at their highest speed, and the wings are given their normal inclination. The body of the boat will at this moment be completely raised out of the water and supported by its three elastic, pneumatic pads. The effects of cohesion will disappear to a great extent and, according to the inventor, on calm water very great speed can be obtained. Although it is only possible to use this arrangement on still water, it is interesting to note that it is one of the most original propositions for a gliding boat which has thus far been advanced.

Official Meteorological Summary, New York, N. Y., February, 1906.

Atmospheric pressure: Mean, 30.20; highest, 30.92; lowest, 29.62. Temperature: Highest, 59; date, 21st; lowest, 5; date, 6th; mean of warmest day, 52; date, 21st; coldest day, 12; date, 6th; mean of maximum for the month, 38.4; mean of minimum, 24.1; absolute mean 31.2; normal, 30.8; average daily excess compared with mean of 36 years, +0.4. Warmest mean temperature for February, 40, in 1890; coldest mean, 23, in 1875 and 1885. Absolute maximum and minimum for this month for 36 years, 69, and —6. Precipitation: 2.57; greatest in 24 hours, 1.22; date, 8th and 9th; average for this month for 36 years, 3.78; deficiency, —1.21; greatest precipitation 7.81, in 1893; least, 0.82, in 1895. Snow: 5.0. Wind: Prevailing direction, northwest; total movement, 9,664 miles; average hourly velocity, 14.4 miles; maximum velocity, 59 miles per hour. Weather: Clear days, 14; partly cloudy, 3; cloudy, 11. Sleet: 9th.

SAMUEL PIERPONT LANGLEY.

(*Continued from page 207.*)

have entered the earth's atmosphere; in the indication that scarcely sixty per cent of the solar rays penetrate to the earth's surface because of the atmosphere's selective absorption; and finally in a new and important estimate of the solar constant.

In later years Langley occupied much of his time with the problem of artificial flight. He took up the subject not so much from the standpoint of the ordinary inventor, but as a branch of atmospheric physics. In his papers "Experiments in Aero-dynamics" and "The Internal Work of the Wind" he laid down for the first time a really sound and trustworthy scientific basis for the study of aerial locomotion.

The result of his investigations was the construction of a small aeroplane model, an aerodrome, which demonstrated the correctness of his theoretical principles. His models made successful flights of about three-quarters of a mile. This was the first time in the history of aerial navigation that an aeroplane was driven by its own power through the air. The success of these smaller models prompted him to construct a larger machine to carry a man. In 1904, experiments with this contrivance were made on the Potomac River. They failed, unfortunately, not because of any inherent defect of the aeroplane itself, but because of faulty launching devices.

As the secretary of the Smithsonian Institution. Prof. Langley will be chiefly remembered as the founder of the Smithsonian Astrophysical Observatory and the founder of the National Zoological Park.

Prof. Langley possessed a cultivated literary taste, ripened by an acquaintance with the art of the old world, the effect of which was at once evident when he began to write for publication. He had skill in the manipulation of tools, machinery, and instruments of precision. He was a practical engineer, familiar with the computations and the applications of mechanics and physics. He was a skillful mechanical draftsman and a trained man of business, thrifty, alert, and progressive. His thoughts were almost prophetic in regard to the probable results of experiments which he was about to begin.

His written work is characterized by a charm of style and lucidity of presentation that would do credit to a finished essayist. His "New Astronomy" will ever stand as a splendid example of what can be done in the way of popular scientific writing. His more technical publications have that hardly definable quality by which we become aware that they are written from a full mind. Every statement of fact or expression of opinion is based upon a hundred single instances, or upon a hundred concurring judgments.

The Current Supplement.

The current SUPPLEMENT, No. 1575, opens with a biographical sketch of the late Samuel Pierpont Langley, accompanied by an excellent full-page portrait. Mr. G. T. Beilby writes on Gold and its Chemistry. Recent investigations of polonium by Mme. Curie are reviewed. Some notes on steam turbines by Capt. H. Riall Sankey are published. These deal with the production of motion energy in steam turbines of various types and the conversion of this energy into mechanical work. The Manufacture of Hydraulic Cements is excellently discussed by L. L. Stone. Mr. Philip L. Wormley, Jr., writes on "Cement Mortar and Concrete: Their Preparation and Use for Farm Purposes." Mr. William B. Strang has perfected a system that is destined perhaps to meet all the requirements of an independent electric car. This system is a combination of a gasoline engine, a dynamo, and storage battery. A thorough description of the car is given in the SUPPLEMENT. Dr. W. A. Cascari gives some notes on gutta-percha and balata. An excellent article on a convenient camera, by the late George M. Hopkins, is published. To those who wish a good review of the recent progress in radio-activity a paper by Mr. Frederick Soddy may be recommended. The Science Notes, Engineering Notes, and Trade Notes and Formulæ will be found in their accustomed places.

Human Motive Force.

According to the researches of Fischer, the latent calorific energy stored in the food absorbed by an adult man a day is 3,000 to 3,500 calories of heat. A notable part of this energy is used within the body for determining animal activity, respiration, digestion, elimination, etc. The excess may be expended in mechanical work. A day of eight hours and average and continuous work is equivalent to a work of 127,000 kilogramme-meters, or 300 calories, or a little less than one-half horse-power. Under these conditions the cost price of 100 horse-power may be thus calculated: Man, 250 workmen at 3 francs per day, 750 francs; horse-power, 10 horse-power, all expenses included, 60 francs; engine, steam, 6 francs; engine, gas, 3.50 francs. Human motive force is, therefore, one hundred times dearer than mechanical motive force.

Correspondence.

A Standard of Light.

To the Editor of the SCIENTIFIC AMERICAN:

The idea of establishing a standard for light, as suggested by Mr. Butzing in your issue of January 27, is a good one. This we have long needed, and I hope he will take it in good part if, in furtherance of our object, I somewhat severely criticise his plan.

Though the sun is our great source of light, its intensity upon the earth is subject to so many variations that it is inconvenient for a standard, and difficult to connect with any standard already in use. It seems to me that some simple, exact connection with an established standard is essential for a new standard.

Photo salts are too unstable to satisfactorily serve as means of measurement.

Consider the following suggestions: Many elements and substances, upon being heated to certain temperatures, are seen to emit light without chemical change, and the light increases with increase of temperature. Being only an amateur scientist, I will not suggest the proper material for a standard, but a metal or alloy which begins to glow at a comparatively low heat, and reaches a high intensity of light before inconvenient softness appears, would seem to offer most suitability. The emitted light should resemble sunlight as closely as possible in those characteristic qualities by the effect of which it is to be measured.

By any good device adapted to the chosen way of heating, suspend a standard ball of the alloy, say of 1 decimeter diameter, within a tube of 2 decimeters diameter, made of non-heat-conducting material, and having directly in front of the ball a circular opening of 1 decimeter diameter. At a distance of 1 meter directly in front of the ball place the light-measuring medium. At a prescribed place within the ball, perhaps best at the center, place the bulb of such a standard self-registering thermometer as shall be capable of effectively resisting the high temperatures, and the scale of which can be conveniently read by the light of the glowing ball. I suggest an electric furnace method of heating the ball. The experiments must be conducted in a light-tight room.

By such a method, exact ratios of Centigrade degrees to adopted light units can be determined. At once difficulties occur to me and, no doubt, some of your readers will see many more. Reliable thermometers for high temperatures have hardly yet been made, but by many experiments with a number of instruments, a working approximation of accuracy can be wrought out, which researches with the better instruments of the future can correct.

How would selenium answer as a measuring medium? I am not acquainted with the element, only that, by report, its electrical conductivity changes in relation to the intensity of the light to which it is exposed. To what particular rays of light it is sensitive, I am not informed. If to the actinic rays only, it will be suitable for measuring photo rays and sunlight, but not so well for other illuminants. If selenium be used, the measuring instruments can be made of a standard selenium cell, a small and simple dynamo run by clockwork and a weight, and a good galvanometer. If, as is not likely, selenium is sensitive to polychromatic light, then by making the ball of an alloy whose rays will fairly well cover the solar spectrum, we will have the elements for the making of a good all-around instrument. It is, of course, evident that the light of the glowing ball must be adapted to the measuring medium.

I hope the many readers of the SCIENTIFIC AMERICAN will give us full criticisms and further information.

IRVING G. CHATFIELD.

Forestville, Conn., February 10, 1906.

[Greenish-yellow rays of light produce the greatest effect on selenium.—ED.]

Lubrication of the Under-Water Surface of Ships.

To the Editor of the SCIENTIFIC AMERICAN:

Being a subscriber to your periodical, I read certain letters in your issues of January 6 and 27 concerning the lubrication of the under-water surface of ships; but it was only a few days ago that my attention was called to a letter on the same subject, published December 23, 1905, signed D. B. I have read these letters with the utmost interest, particularly because I have busied myself with the discussion of this question for the last two years.

Some twenty years ago, it occurred to me that it would be possible to lessen the friction between a ship's skin and the surrounding water by means of air bubbles; but as I had at that time no leisure for experiments, I was unable to attempt the exploitation of my idea. However, since I have retired from business I have again taken up the question, and have carried out some experiments with the model of a vessel on nearly the same lines as mentioned in the letter of T. W. H. in your issue of January 27. These experiments were not at all satisfying, and there was no apparent diminution of the friction observable, even when the under-water part of the model was wholly surrounded by air bubbles.

Notwithstanding these unsatisfactory results, I am still convinced that the idea is of value. As I did not have the opportunity nor the means to experiment on a large scale I used a small model, and it appears to be possible that the air bubbles in this case reached the surface of the water before coming in full contact with the under-water surface of the model, or that there were other circumstances which gave rise to these poor results. I thought it best to solve this question by experimenting on a large scale, but before undertaking this it appeared wise to study the motion, size, shape, etc., of air bubbles containing different quantities of air at different depths, rising along different planes of different structures, at different inclines, and so on.

If the idea were correct, it would undoubtedly be of the utmost economical value, and worthy of thorough investigation. From these considerations I began early last year to project and construct a series of physical instruments for the purposes of this investigation, and have already obtained some remarkable results. It will take a considerable time, however, before my researches are completed. At all events, the idea of lessening the friction between a ship's skin and the surrounding water is not new, nor is it as simple as it appears at first glance to be. Possibly it was not even novel twenty years ago, when it first occurred to me.

J. K. E. TRIEBART.

Nymegen, Holland, February 14, 1906.

Wrought Iron for Pipes.

About 1890 several cast-iron conduits at Berlin, from 3.5 to 10 centimeters in diameter, were ruptured, which led the authorities to replace the cast-iron pipes with those of wrought iron, covered with the following composition for protection: 65 kilogrammes of tar, 3 kilogrammes of rosin, 15 liters of sand, 7 liters of loamy clay, and 4 liters of powdered lime. A coating of this mixture, 3 or 4 millimeters thick, was applied. In more than a dozen years of service, these pipes have been preserved from rust and have undergone no change.—Rev. des Eclairages.

There has been recently completed in New York city the largest strictly private electrical plant in the world. This plant, situated in the basement of the Mutual Life building, is designed to furnish light and power to an entire city square and its tenants. The plant consists of four 600-horse-power Watts-Campbell Corliss engines and four 350-kilowatt 110-volt generators. The engines are of the Tangye or heavy "rolling-mill frame" type, supplied with Corliss valve gear. The generators are provided with a special feature in the form of an automatic brush-shifting device, which moves the brushes back and forth across the face of the commutator, thus eliminating the possibility of wearing ridges.

This plant is designed to replace the old equipment of four 100-kilowatt Siemens & Halske generators, direct coupled to straight-line engines. The work of installation began about two years ago with the removal of the old boilers originally supplying steam to the Mutual Life building. The present boilers are designed to furnish steam at 300 pounds pressure if necessary.

The foundation for the plant had to be specially constructed, the location of the new units being limited to the space occupied as a court between the various buildings. The difficulty of constructing the foundations was enhanced by the fact that the concrete slabs supporting the structural steel columns of the building's framework rested on sand, which had to be excavated from between the columns with the greatest care. A sufficient space having been cleared out, beams were laid in such a manner as to form a closely bolted network, concrete was poured on and about them to fill in the entire excavation, and the various units of the plant were bolted securely to this firmly-knit mass. The plant is designed to operate 20,000 incandescent lamps, 10 or 12 electric elevators, 8 motors of from 2 to 6 horse-power, including an electric pump, and 6 blowers, with fans ranging from 36 to 60 inches diameter.

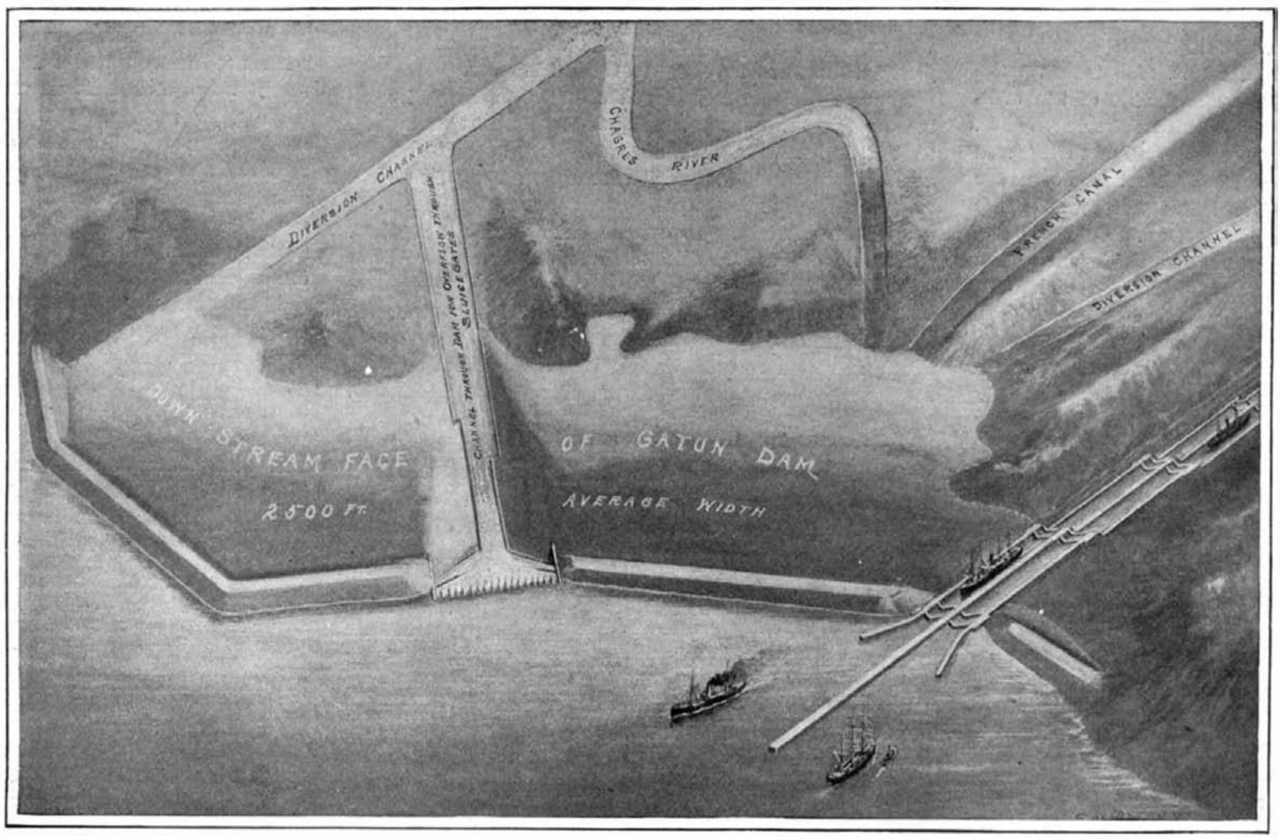
Tomato growers in the English county of Kent are perplexed by a strange bacterial disease which appears among the fruit every five years. The disease first made its appearance in 1888, defied all efforts that were made to eradicate it, and ruined the crop. The following year, however, there was no trace of it. In 1892 and 1897 it appeared again, though with diminishing prevalence, while its last attack was in 1901-02. From the careful studies that have been made, the disease appears regularly in five-year cycles. Every possible effort to exterminate the pest has been made, but without success. The disease is of a most virulent and epidemical character. The crops are entirely ruined, and serious losses have resulted.

A TRIP THROUGH THE PANAMA CANAL IN 1915.

When the Isthmian Canal Commission received the report of the consulting board of thirteen distinguished engineers, appointed by the President to decide which was the best type of canal to build at Panama, it found that, by a vote of eight to five, the Board recommended the construction of a canal at sea level. Because of its distinguished ability, the findings of such a Board should have possessed, it would almost seem, something of a mandatory and final authority. Nevertheless, the Isthmian Canal Commission of six members, four only of which are engineers, felt compelled to decide against the finding of this International Board of thirteen engineers, and recommend a high-level canal with locks. That this momentous decision was given purely on the merits of the case, and was prompted simply by considerations of construction and subsequent operation, goes without saying. It is the purpose of the present issue of the Scientific American to give a concise description of the canal that is recommended, and present the leading arguments which led the Commission to decide against a canal at sea level and in favor of one with locks and high-level lakes.

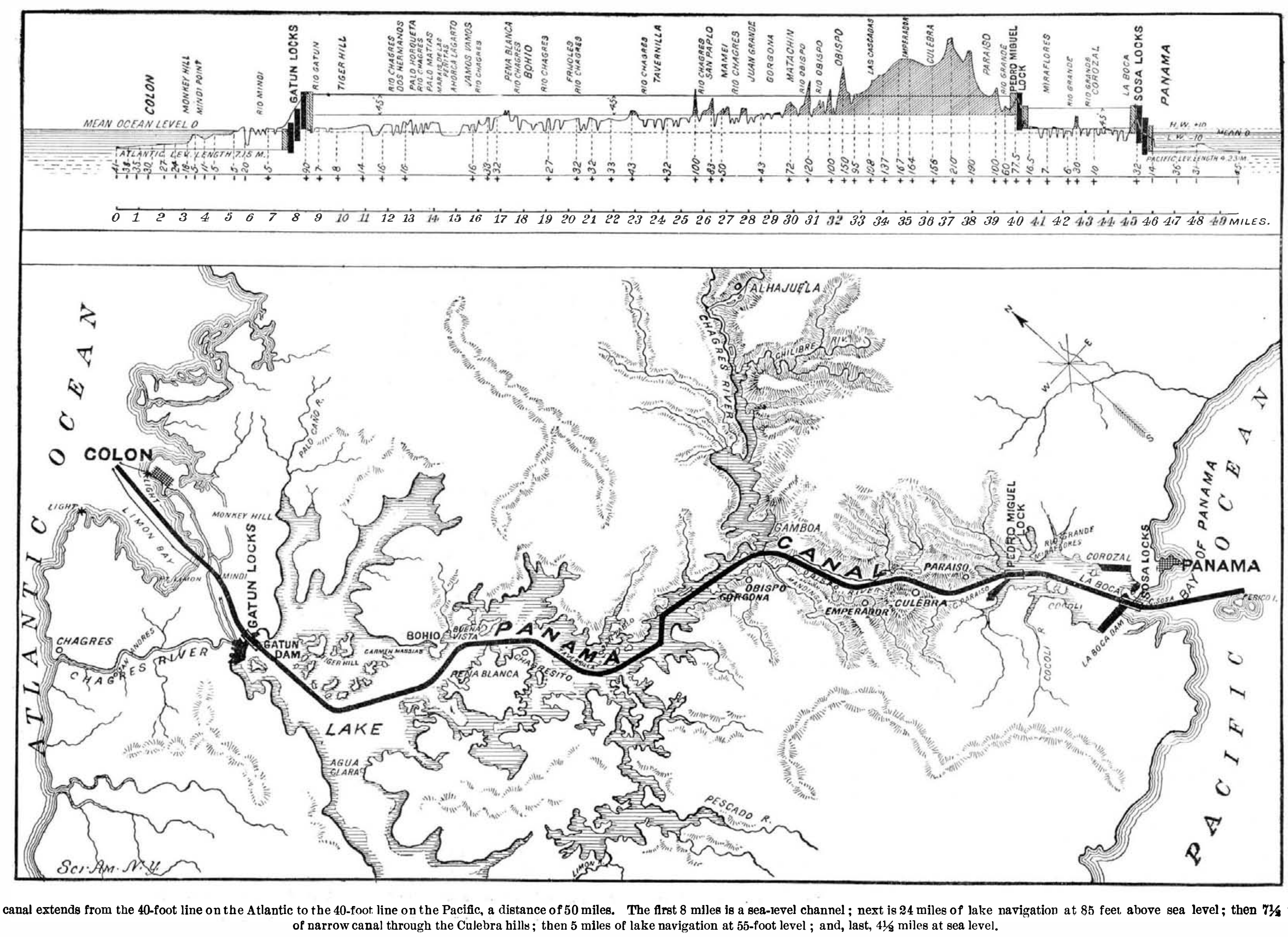
The Terminus, Limon Bay.—By way of gaining a general impression of the lake-and-lock canal as it will appear when completed, let us suppose that the sanguine expectations of the Commission have been realized; that the work has been completed by the year 1915; and that we are approaching the canal from the Atlantic on one of a line of 40,000-ton freight and passenger steamships that are trading between New York and the Orient. Our ship is 700 feet long by 75 feet broad, and draws 35 feet of water. The first indication that we have reached the canal entrance is the sight of two long, low jetties extending seaward, one reaching out for the distance of a mile from the city of Colon, the other extending in a far line across Limon Bay from the low-lying shore, 4½ miles distant. These two jetties, the captain tells us, were built out on converging lines, until they reached deep water at the 40-foot contour line, where they terminate in two lighthouses distant from each other about 1,000 feet. The Panama Canal steam pilotboat now places one of its pilots aboard, who at once shapes his course straight for the center of the 1,000-foot entrance.

In the Sea-Level Channel.—As we pass through, leaving the terminal lighthouses on either hand, we find ourselves passing between a double line of buoys, and the pilot tells us that these mark the delimitation of a broad channel, 500 feet wide, which has been dredged through the mud and silt of Limon Bay. There is a northwesterly wind blowing, which is kicking up quite a sea on the outside; but we notice that as soon as we have passed in between the breakwaters, we are in quiet water. This is due to the long rock jetty, which extends parallel with our course and about 800 feet to the west of it, and serves to break the force of the sea that is running, and prevent the natural tendency of the waves to set us over toward the easterly side of the channel. We are steering a course due south, and moving along at a comfortable speed of 12 knots an hour. In about twenty minutes time we approach the shore line near the mouth of the Mindi River, and here the canal proper commences. We steam straight in between the low-lying alluvial shores for a distance of one mile, until the pilot is able to sight the range marks, which tell him that it is time to make a 25-degree turn, and head for the great locks at Gatun dam. To give room for this turn, the canal has been widened out to 800 feet. We head straight for the easterly bank, until, at the command of the pilot, a few turns are given to the wheel, and the



The great earth dam, 9,000 feet long on the crest, 2,500 feet through, and 135 feet high, will create a lake 85 feet deep and 120 square miles in area, in the valley of the Chagres. It will control the Chagres floods and afford twenty miles of deep-water navigation. The surplus water of the Chagres will pass out through the regulating gates shown in the center of the dam. These will be built of massive concrete and masonry.

BIRD'S-EYE VIEW OF THE GATUN DAM AND LOCKS.



The canal extends from the 40-foot line on the Atlantic to the 40-foot line on the Pacific, a distance of 50 miles. The first 8 miles is a sea-level channel; next is 24 miles of lake navigation at 85 feet above sea level; then 7¼ miles of narrow canal through the Culebra hills; then 5 miles of lake navigation at 55-foot level; and, last, 4¼ miles at sea level.

PROFILE AND MAP OF THE PANAMA LOCK CANAL.

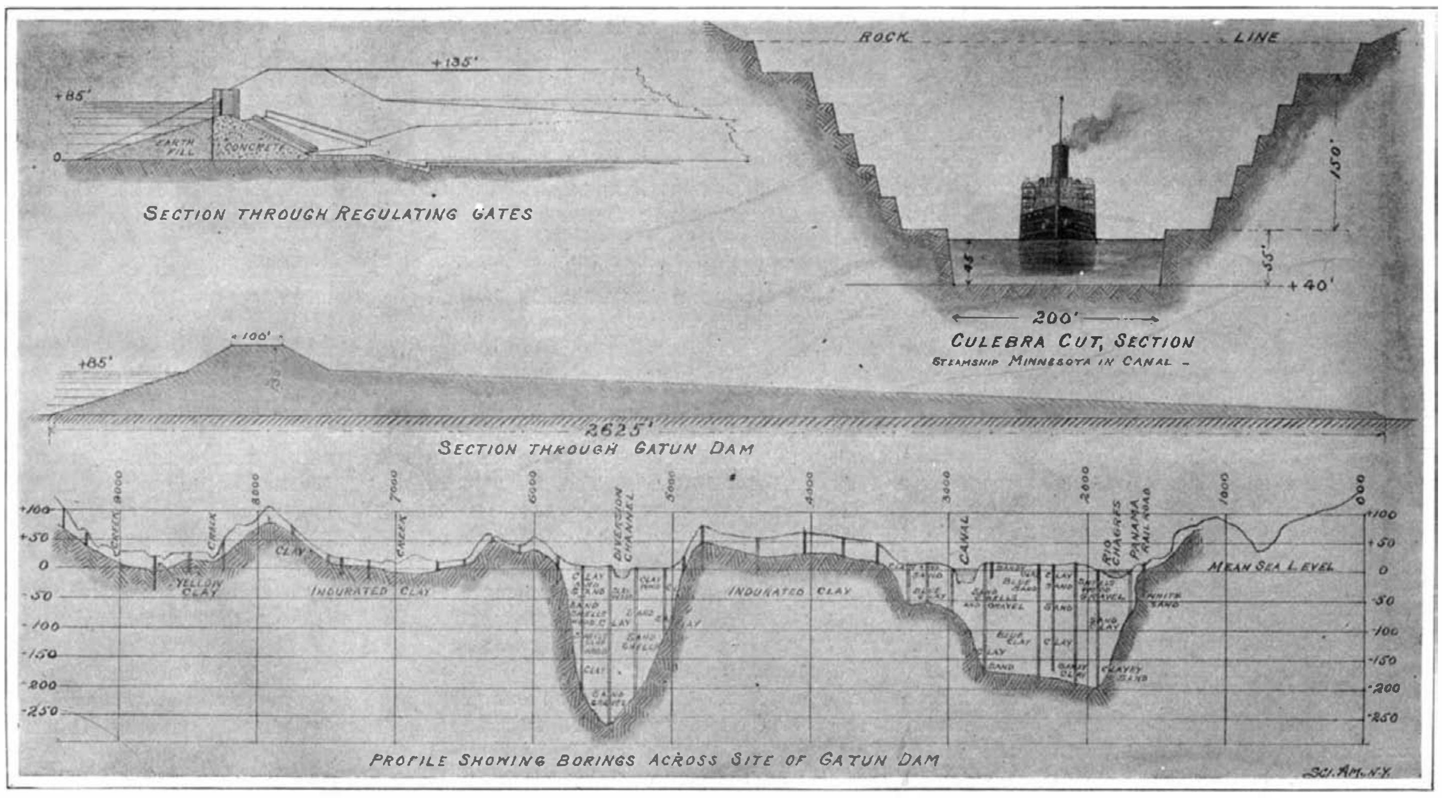
great ship, now running at a reduced speed, swings easily around onto her new course. The pilot explains to us that this method of making the turns by a sharp angle, in a widened channel, is greatly preferable to making the same turn on a long, easy curve, where it would be difficult to keep the helm set at the exact point to guide a large vessel on a true center line between two curving banks.

THE GATUN DAM.—On straightening out on our course, we notice that the country on the port side of the ship is changing in its topographical character, and lifting into what appear to be the foothills of a distant range of mountains. These low foothills appear to stretch directly across our course, and they terminate opposite a similar ridge on the opposite side of the valley, through which formerly flowed the far-famed Chagres River. Running straight across the valley between these converging hills, there extends the downstream slope of a vast artificial mound, by which the gap between the hills has been filled in, the valley of the Chagres closed, and the vast interior basin of the Chagres artificial lake formed. This huge dam, on the upstream side, slopes at an easy angle up to its crest 135 feet above the valley, and 50 feet above the surface of the lake, the latter being held at 85 feet above sea level. At the water level the dam is everywhere 375 feet through, measured on a horizontal line, and from its crest it slopes down the valley with a gentle fall of 1 foot in 25, until it meets the natural surface of the ground. Measured on its base on the surface of the ground it is 2,500 feet through, and its cubical contents reach the enormous figure of 21,200,000 cubic yards. Looked at from the downstream side, it has exactly the appearance of the clean-cut parapet and long sloping glacis of a gigantic modern fortress.

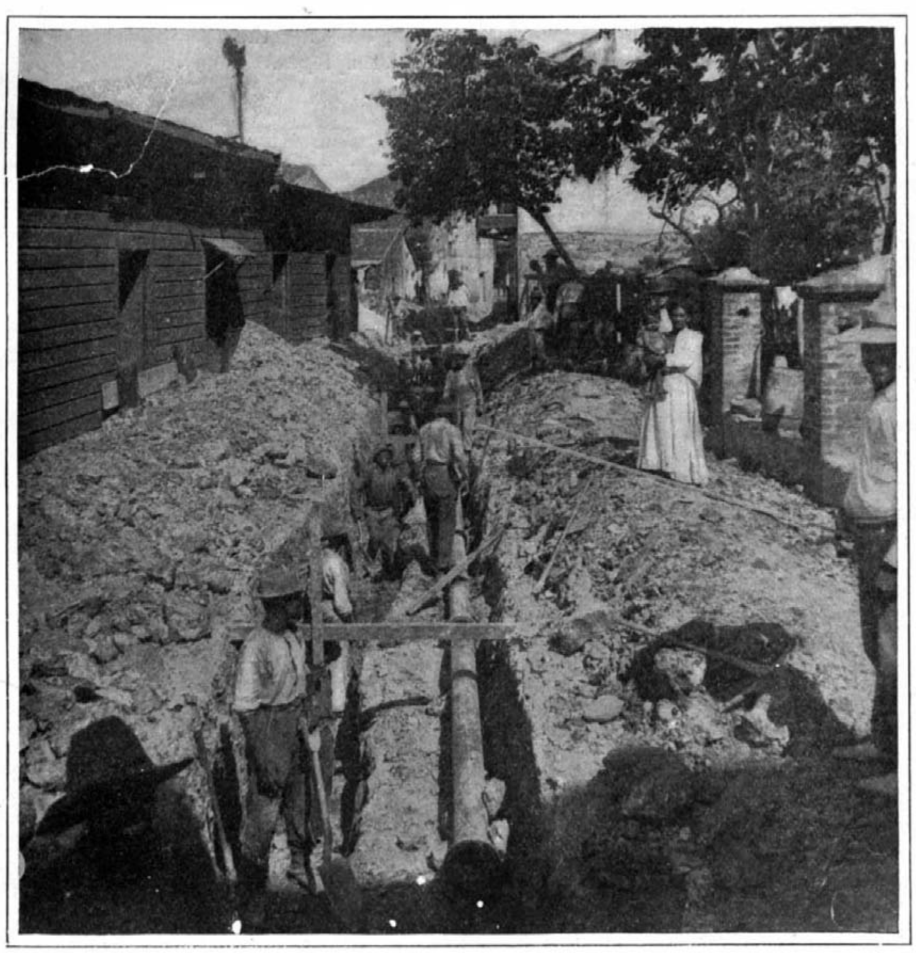
GATUN LOCKS.—The pilot now signals for dead slow speed, and as we make a slight turn to port of a few degrees, we see before us, a quarter of a mile distant, and standing out white and clear against the sky, the long 3,000-foot stairway of the famous Gatun locks. They consist of six great chambers, each 100 feet wide, 90 feet deep, and 1,000 feet long, arranged side by side in pairs, and rising in three steps, of 28 feet, from the level of the sea to the surface of Gatun Lake, 85 feet above sea level. These locks are the greatest of their kind in the world, and by the time they were completed had cost over $15,000,000. As we enter the first lock, into which we are warped by means of powerful electric winches, operated, we are told, by hydraulic-electric power from a reservoir located far up the Chagres River, there steams out of the adjoining lock at the same level a famous old freighter, the "Minnesota," the pioneer of a fleet of similar and even larger ships that is now plying between Atlantic and Pacific ports by way of the new canal.

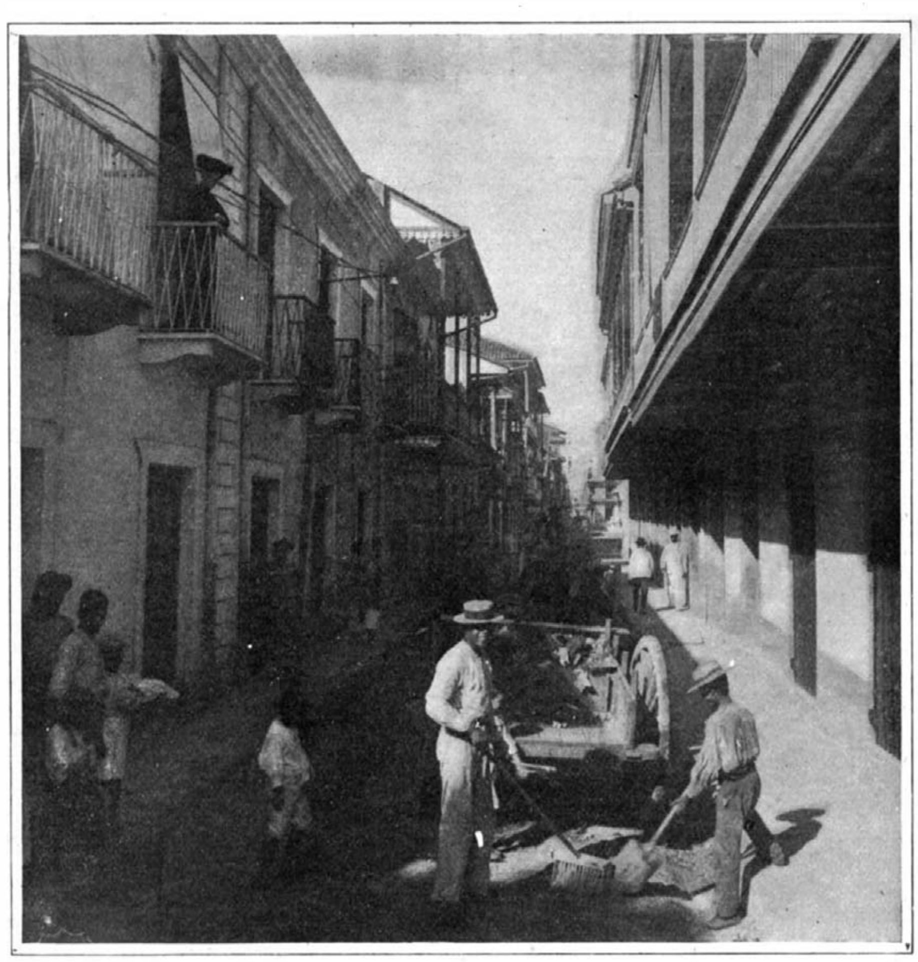
CHAGRES LAKE.—On entering the third lock we catch our first glimpse of the great artificial lake which at once served to solve Panama's greatest problem, the control of the Chagres, and provided twenty miles of broad deep waterway, through which shipping might travel with almost the freedom of ocean navigation. The transformation effected by Gatun Lake is something that can only be appreciated by those who have crossed the Isthmus when the old Panama Railroad was the one means of transit. The marshy swamps and poverty-stricken villages are gone. We see in their place a broad expanse of water, which stretches on the right hand, past the foothills of Agua Clara to a shore line 15 miles in the distance. To the left the lake extends between the ranges of the mountains in two long estuaries five and eight miles in length; while directly to the southeast, the pilot informs us that the lake backs up through the old valley of the Chagres for a distance of between thirty and forty miles. It is as fair a picture of lake and mountain scenery as one could wish to look upon, and the pleasing impression was heightened by recollection of the fact that this great inland sea, 120 square miles in extent, is the key to the successful execution of the greatest and most useful engineering work of modern times.

As soon as our ship is clear of the last lock, the pilot calls for full speed ahead. With from 70 to 45 feet depth of water, and never less than a clear width of 800 feet of channel, for the next twenty miles we are able to steam with something of the freedom of ocean navigation. For the first four miles our course lies due south, in order to enable us to round a group of islands of which Tiger Hill is the loftiest point. Then another five miles brings us to Bohio, where the hills on either side close in on the Chagres valley until the lake is only about half a mile in width. Here, during the earlier studies of the problem, it was proposed to place the famous Bohio dam, the site having been abandoned because of the impossibility of finding a suitable foundation. After passing Bohio the lake broadens out again, and for the next seven miles to San Pablo it is from two to three miles wide. Here, for the first time, the water of the lake adjacent to the line of the canal begins to have a less depth than that of the canal itself, which, throughout this summit level, is never less than 45 feet. From San Pablo



THE FOUNDATIONS, DAM, AND REGULATING WORKS AT GATUN.





Laborers Excavating for New Water and Sewer Service. Work Done Under Department of Municipal Engineering of Canal Zone.

Street Cleaning Department at Work on One of the Streets of Panama. This Street Has Been Graded and Covered with Top Dressing of Gravel.

SANITATION OF THE CANAL ZONE.

we steam for the next four miles through a channel 45 feet deep and 800 feet wide, to Juan Grande, where the channel reduces in width to 500 feet, at which width it continues for the next 4¾ miles to Obispo. By this time the lake has narrowed to an average width of about three-fourths of a mile, and the valley of the Chagres turns from an easterly to a northerly direction, the lake backing up through the valley for a further distance of six or seven miles.

Control of Chagres Floods.—At this point is Gamboa, which was selected for the construction of a dam 180 feet high, should it have been determined to build a canal at sea level. At the surface of the water the distance between the abutting hills on either side of the lake is about 1,500 feet, and the depth of the lake through the outlet is about 35 feet. To such a high level has the great dam at Gatun raised the Chagres waters, that the rushing floods of the river have been entirely shorn of their peril. The backing of the lake seven miles up the valley, beyond the point at which the original course of the river intersects the canal, entirely relieves the canal authorities from any anxiety on account of the enormous floods which pour down the valley of the Chagres in the sudden and heavy rain storms. The rushing river spreads out quickly into the ever-widening area of the lake, and long before the gorge at Gamboa is reached, the flood waters have spent their force.

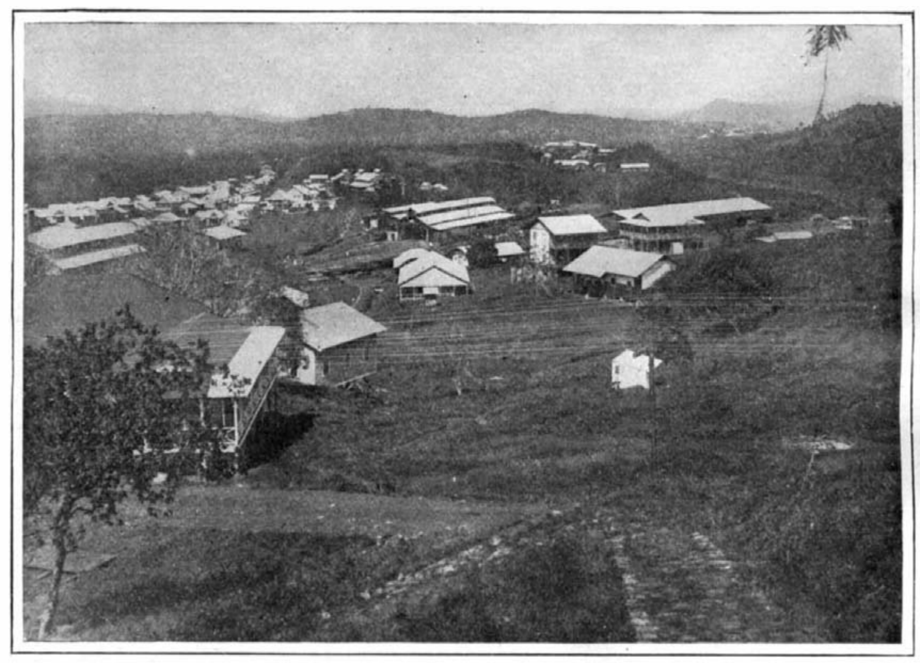
The Great Culebra Cut.—Thanks to the height of the Gatun dam, the waters of the lake were raised to such a high level that in the distance we have traveled from Gatun to Obispo the 45 feet of depth in the channel was obtained, we are told, with practically no excavation whatever in the first 17 miles of its length, and with but a very moderate amount of excavation in the next 5 miles. At Obispo, however, the canal swings rather sharply to the right, and we are confronted at once by the Culebra range of mountains through which, like a gigantic railroad cut, we see the canal excavation. For the next mile and a half the canal (we have left the lake channel and are now in the canal proper) is cut with a bottom width of 300 feet to Las Cascadas, where we enter the only stretch of the canal, 4¾ miles in length, in which the bottom width is brought down to 200 feet. The walls of the canal immediately abutting on the water are approximately vertical for a height of five feet above the canal surface. Then there is on either side a broad bench, upon the easterly one of which are the tracks of the Panama Railroad. From this bench the sides of the cut are carried up in a series of parallel steps. The distance up the sides of the cut, in the deepest portion, is between 300 and 400 feet. In passing through this section, our speed is reduced to five or six miles an hour, for the reason that if, in the restricted channel, we were to steam any faster, the ship might take a sudden veer and strike the banks before she could be brought on her course again. As we finally emerge from the Culebra hills, we see before us the gates of Pedro Miguel lock, and beyond them we catch our first glimpse of the Pacific Ocean, now only a matter of some seven miles distant. There is but one lock at Pedro Miguel, with a fall of 31 feet, but so vast are its proportions, that it cost the sum of $7,000,000 to make the huge excavation in the rock bottom and put in the concrete and cut-stone walls and the massive electrically-operated gates.

Rio Grande Lake.—We now find ourselves at the head of another great freshwater lake, formed by damming up the river Rio Grande, which heads in the Culebra Mountains and flows to the Pacific. For the first two miles from the lock to Miraflores the channel is dredged through the bottom of the lake to a width of 500 feet, and our pilot at once takes advantage of this fact by raising the speed from 5 to 12 knots an hour. At Miraflores we enter again upon unobstructed navigation, the channel broadening out to more than 1,000 feet in bottom width. Still farther increasing our speed, in a quarter of an hour we have crossed the last stretch of the lake, and are confronted by the great dam and double flight of locks at La Boca, on the Bay of Panama.

While we are being warped into the first of the double flight of locks at Sosa we learn that the Rio Grande lake required three separate dams for its formation; one about 3,500 feet long to the west of Sosa Hill, another 1,200 feet long to the east of the hill (these two serving to close the natural outlet of the Rio Grande River) while a third dam, about a mile in length, but of comparatively shallow height, being in fact more in the nature of a dyke, was built across a stretch of lowland about 1¼ miles to the northeast of the locks. The main dam adjoining the locks, which is known as La Boca dam, cost over a million and a half dollars, and the same amount was spent on the other two structures, known as the Ancon-Sosa and Ancon-Corozal dams. The Sosa locks cost $13,000,000. The descent from the Rio Grande lake to Panama Bay is made by two flights, each of 27 feet.

The Pacific Terminus.—We are now once more at sea level, and we steam at reduced speed through a dredged channel 300 feet in width until we reach deep water at the 40-foot contour line, at a distance of 4¼ miles from the Sosa locks. Here we drop our pilot, and start at full speed on our 5,000-mile trip across the Pacific. From the time when we passed between the inclosing jetties off the city of Colon to the time of entering deep water on the Pacific, a period of 11 hours has elapsed, and this in spite of the fact that we met and passed several ships on the way. The meeting of ships, however, occasioned no such delay as it does in the narrow Suez canal at sea level; for the canal superintendent dispatched the ships in such order that they met only in the broader channels or on the broad surface of the freshwater lakes. Throughout the whole of the trip, although we draw 35 feet of water, we have never had less than five feet of water below our keel; for 23 miles out of the whole distance of 49 miles, we have been able to steam at full speed in practically unrestricted navigation; for 12 miles we have steamed at three-quarter speed; and only during our passage through the 200-foot wide section of the canal at Culebra have we been obliged to come down as low as five or six miles per hour.

The Main Street of Culebra—a Typical Village on the Route of the Canal.



View of Camp at Empire on the Canal, Showing the Type of Houses Built for the Canal Employes.

SANITATION OF THE CANAL ZONE.

SANITATION OF THE PANAMA CANAL ZONE.

Towering in importance high above all the many important problems that demand solution if the United States is to build a canal at Panama, is that of sanitation. The 25,000 laborers that will be needed, must be housed, fed, supplied with pure water, and safeguarded by a thorough system of sanitation. Furthermore, the two great scourges of the country, yellow fever and malaria, must be stamped out or kept under control, and measures taken to prevent any outbreak from becoming epidemic.

Housing.—The present commission found on the Isthmus a few large hotels for the engineering and clerical force, and 2,100 small houses for the laborers, which had been built by the French. About 1,200 of these houses have already been repaired, a large number of others built, and the hotels have been greatly enlarged. There is to-day accommodation for the 15,000 men employed on the work. The houses for the laborers are of wood, and built five feet above the ground. Each contains two or three bunks, with galvanized iron frames and removable wire or canvas bottoms; a stout table, and chairs. They are of a size that provides the 500 cubic feet of space to the man required by sanitary authorities. The camps are built on high ground, and as soon as they are established, drains are dug, sewerage put in, and the vegetation is cut down from a large contiguous area.

Water Supply.—An abundant supply of good drinking water is found in the hills that border the canal. Water is piped from reservoirs near the terminal cities of Panama and Colon, and the work of enlarging these, and putting in pipe lines to convey water to the various camps along the line from the nearest natural source of supply, is being vigorously pushed. An analysis, recently made, of the water at Culebra cut showed it to be as pure as the water from Croton reservoir. The laborers are at present being fed by the government at the rate of 30 cents a day; but it is probable that ultimately a contract will be let for the running of the mess-houses for the whole force.

Cleaning the Cities.—The system of cleaning up of the cities, which accomplished such wonders for Havana, is being vigorously carried out in the canal zone. Yards are being thoroughly cleaned, sewers put in, cesspools abolished, the garbage is regularly collected, the streets swept, and as fast as possible they are being graded and drainage of surface water established. In Colon the grade of the streets is being raised well above the marsh level, and from one end of the zone to the other, every possible precaution is being taken to render the district cleanly and wholesome.

Stamping Out Yellow Fever and Malaria at Panama.—Thanks to the splendid work of Col. W. C. Gorgas, U. S. A., the chief sanitary officer of the canal zone, it has already been proved that yellow fever and malaria, the two prevailing diseases, can be successfully combated and practically stamped out. Yellow fever is conveyed from man to man only by the female Stegomyia, who must have previously bitten some human being suffering from yellow fever. Therefore, yellow fever cannot originate in a place where there are no infected Stegomyia, until a yellow fever patient has been introduced and has infected the local pest; or until the mosquito, infected at some distant point, has been introduced. Practically, the introduction of a yellow fever patient is the only method by which the locality can be infected.

The immediate object of the sanitary measures is to get rid of all infected Stegomyia. This can be accomplished with great certainty by establishing a system whereby the health authorities are certain to be informed of every case of yellow fever; and then fumigating the house in which this case occurred, so as to destroy all the mosquitoes within its borders. The same thing must be done with all contiguous houses. It has been found by experience that this kills all the infected mosquitoes at that particular focus. By doing the same thing at every other focus as yellow fever occurs, all the foci in the community are gradually destroyed, and when the last focus has been got rid of, yellow fever is at an end. A more expeditious method is to systematically fumigate every house in the town.

The Stegomyia is a house mosquito, and being cleanly in her habits seeks principally the clean rain-water barrels and water containers, and never travels far from her birthplace. Therefore, as an additional sanitary safeguard, every receptacle for water should be so screened that mosquitoes cannot have access to it.

The safest precaution is to pipe the water supply in from a distance, so that the people will not need to keep a supply of water in vessels.

How well the government has succeeded in stamping out yellow fever, is proved by the statement of Governor Magoon, made during his recent testimony at the Senate investigation at Washington, that January 26, 1906, was the seventy-fourth day since there had been a case of yellow fever at Panama, and the ninetieth day since there had been a clearly established case at Colon.

An even more important problem than that presented by yellow fever is the control of malaria throughout the Canal Zone. The ten thousand natives of the district are distributed in about twenty small villages along the route of the canal, and these people are very generally affected with malaria. A microscopic examination of the blood of these people, taken at random at various points along the line, showed that out of several hundred cases, fifty per cent contained mosquito parasites in the blood. Four times out of five, if the female Anopheles bites a native she becomes infected, and when she bites one of our nearby laborers, he in turn becomes infected. Hence, if our laboring force is not to be completely used up, as was that of the French government, preventive sanitary measures must be taken.

There are two ways of approaching this problem; either by doing away with the infected human being, or by doing away with the mosquito. Since it is out of the question to do away with the infected natives, the remedy must be sought in the extinction of the mosquito. If some substance could be introduced into the circulation of the infected man and kill the parasite, and at the same time not be injurious to the man, the desired object would be effected, and in quinine has been discovered the suitable poison. This vegetable substance is harmless to man and fatal to the malarial parasite. Most of the effective tropical sanitarians, the Germans and the Italians conspicuously, have achieved a great success by inducing as large a proportion of the population as possible to take regularly small quantities of quinine, and they have succeeded, without adopting any other measures, in doing away with malaria in the several localities.

The disease may also be successfully attacked from the side of the mosquito, and the Anopheles may be as effectively exterminated as the Stegomyia by covering up water containers, clearing up the yards, preserving the surface of the road so there will be no puddles, instituting a regular system in all towns for the collection of garbage, and by the use of oil. Asked in regard to the prevalence of malaria, Governor Magoon stated that the percentage of malaria on the Canal Zone today is no greater than it was in any of our frontier States while they were new countries in process of being settled. Col. Gorgas confidently expects to get malaria as completely under control as yellow fever is now known to be.

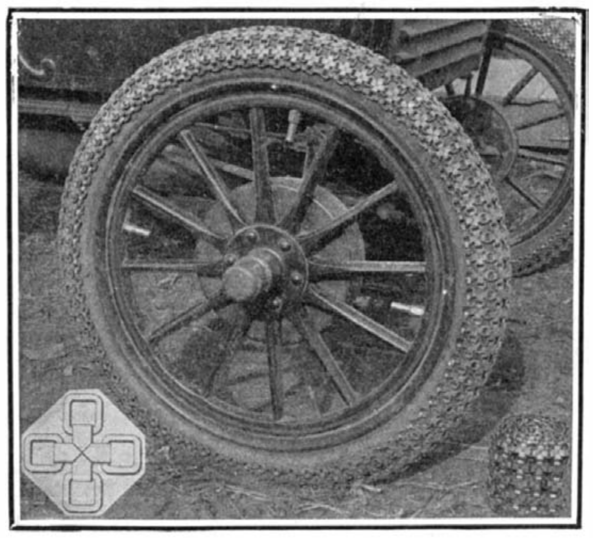
Price of Carrier Pigeons.

The cost of valuable pigeons, even at auction sales, is higher than generally supposed. Within a few weeks, 92 pigeons of the Coucke variety produced a total of 3,772 francs, or 41 francs per head on the average. More recently, according to M. Thauzies, 196 pigeons belonging to M. Hausenne, of Veviers, sold for 14,000 francs, or 71 francs each on the average. Certain subjects, where the competition was lively, brought 240, 300, 400, and even 550 francs. A single amateur paid the sum of 1,485 francs for three pigeons. After having read these facts, hunters who so far forget themselves as to fire at carrier pigeons will be doubly criminal.—La Nature.

Treatment of Pyrites Containing Gold.—Several geologists, notably Signor Mors, have expressed the opinion that wherever traces of free gold exist, there is in the neighborhood a still richer source in the form of combined gold. This theory has been confirmed by the process of a Belgian chemist, M. Body, who, experimenting in Italy, has actually effected the geological synthesis of the formation of alluvions and, according to Italian journals, has confirmed the theory attributing the formation of placers to volcanic action. The process is based, not on the elimination of the sulphur, but on its addition. The yields of gold resulting exceed those obtained by means of leading and cupellation. Founded on the polysulphuration obtained by a chemical disaggregation of the ore in presence of special salts under the influence of a temperature not exceeding that of the cherry red for a comparatively short duration, the action of this disaggregation disengages gold from its most stable combinations. In the Piedmont factory, where the process was carried out, the expense, it is said, did not exceed 10 or 15 francs per ton of ore treated. In fine, obstinate pyrites was converted into a product which could be treated by ordinary methods. As gold-bearing pyrites occur in large quantities in nature, it is evident that the new method has a wide field for development.

A NEW DETACHABLE NON-SKID TIRE PROTECTOR.

A patent has just been granted to Mr. Lewis Slama, of Humboldt, Neb., on a new tire guard for automobiles, to prevent skidding on wet pavements or slipping on snow or ice. The construction of the guard is clearly illustrated in the accompanying engraving, which



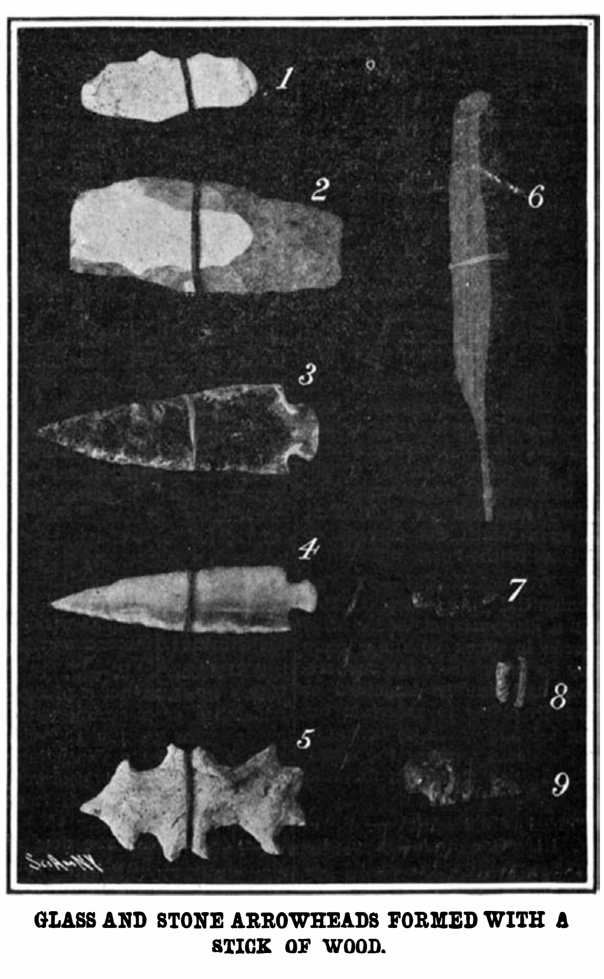
IMPROVED TIRE PROTECTOR.

shows the device in position on an automobile wheel. The guard, it will be observed, is made up of cruciform links and ring-like links alternately connected together to form a broad chain or heavy netting, which is mounted on the tire. The cruciform links are very simply made out of sheet metal cut to the shape of a cross, the four arms being passed through ring links and bent in toward the center, as shown in the detail view. The links along the edges of the guard are made a little smaller, so that the guard will shape itself to the form of the tire. For this reason, when the guard is applied to the wheel and the ends are joined, it will keep its position, even when quite slack. The only parts of the guard that bear against the tire are the flat cruciform links, the edges of which are turned up, so that there is no danger of wear. We are informed that the guards shown in the photograph were in constant use on the same tires for several months, and that although the tires were old when the guards were applied, no tire troubles were experienced in the hundreds of miles run. Aside from its non-skidding advantages, the guard serves to prevent destructive side wear, due to running in ruts, and also affords a protection against puncture. When not in use the band may be conveniently rolled up, as shown in the foreground of the illustration.

ARROWHEADS SHAPED WITH A WOODEN IMPLEMENT.

BY F. C. MASON.

Pictured in the accompanying engraving is a remarkable set of glass and flint arrowheads, which were chipped out of the rough material with an ordinary stick of oak as a tool. The wooden tool is shown in the photograph, and its worn end indicates the use to which it has been put. The work is that of Ernest Baurman, a young lad living near Berlin, Mich., who without instruction learned the trick after three years



GLASS AND STONE ARROWHEADS FORMED WITH A STICK OF WOOD.

of experiment. The boy became interested in the arrowheads which were turned up on his father's farm, and became curious to learn how the Indians could have made them without metal tools. His curiosity led to a careful study, not only of the arrowheads themselves, but also of the chips which had been split off in making the arrowheads. This, he says, taught him in what direction the pieces were flaked off, and gave him the clew which led him to the solution of the mystery. Before deciding on a wooden stick as a proper implement for fashioning arrowheads, he first tried many different materials, but eventually came to the conclusion that a stick of oak was the most suitable. The arrowheads shown in the illustration were made in the presence of Mr. Kendal, a friend of the writer's. Fig. 1 is a chip removed from the piece of flint illustrated in Fig. 2, and shows how large a bit can be removed when necessary. Young Baurman, who had previously operated on glass, was given a piece of French mirror plate, and out of this he formed the beautiful arrowhead shown in Fig. 3. The work was executed in about an hour, and is superior in style and finish to any prehistoric specimen of flint ever seen. Fig. 4 is an arrowhead chipped out of opalescent glass, and Fig. 5 is a specimen of work on a piece of white flint, which shows how intricate a design the boy can follow. A flint arrowhead is shown in Fig. 9. Among Mr. Kendal's specimens was a small piece of volcanic glass or obsidian. The piece was ½ x ⅛ x 1½ inches long. He handed it to the boy, requesting him to make an arrowhead out of it. The boy replied that with his permission he would break off a piece to see the texture of the material. Permission was granted, and about half an inch was broken off. Then out of the larger piece the boy fashioned the arrowhead represented in Fig. 7. The remainder is shown in Fig. 8. This arrowhead is almost perfect in its symmetry, the point being as sharp as a needle and the edge keen, but not jagged. The thickness, at the thickest part, measures about 3/32 of an inch, and the tang for fastening to the arrow is not over 3/64 of an inch thick.

But most remarkable is the instrument used in making the arrowheads. This is shown in Fig. 6. It is a simple piece of oak about 5 inches long and slightly pointed. The exact movement of operation Mr. Kendal has not mastered, but it seems to be a twisting action which flakes off the chips. I made some experiments for myself on a piece of flint, and succeeded in removing flakes with a small piece of hard maple. The largest chip measured about ¼ x ¼ inch. The boy removed flakes as large as ½ x 1¾ inches. The secret lies in a knowledge of the composition of the texture of the stone. You must start the flake at the right place each time. For many years scientists were puzzled by the same problem that presented itself to young Baurman, namely, how arrowheads of flint could be fashioned without metal implements. The solution of the problem was found in Tierra del Fuego, where the natives fashioned implements of flint and glass with tools of walrus bone in much the same way as the Michigan lad performs his work. To the latter, however, belongs the credit of being the first white man to master this art.

New Microphone Transmitter.

A new form of microphone transmitter has lately been invented by the Italian engineer Quintana Majorana, of the government telegraph department. It differs entirely from the ordinary carbon microphone which is in common use, and is based upon the capillary contractions which the sound vibrations are made to produce upon a liquid jet. The principle upon which this action is based was observed by Chichester Belt some twenty years ago. The contractions of the liquid vein rise to corresponding variations in the electrical resistance of the circuit. Using an induction coil we are able to obtain telephonic currents which under favorable conditions may reach, for sounds whose vibration is 500 periods per second, an intensity of 100 milliamperes. This is a much more powerful effect than can be produced in the telephone at present. Besides the loud-speaking telephones, we may remark the Bailleux microphones which are used on the government lines in Italy and give only a current of 20 or 25 milliamperes, which is among the highest figures. In the new instrument it is claimed that the sound is clear and sharp. The construction is not as simple as a carbon microphone, but there is a great gain in power which will give it the advantage.

Concentrated Lye.—By combining different salts contained in wood ashes in the following proportions, though they are not absolute, a good lye is produced: 16 per cent of sulphate of potash, 2 per cent of potassium chloride, 76 per cent of carbonate of potash, and 6 per cent of carbonate of soda. The compound can be made up in small tablets, weighing about 0.0130 of a gramme, for bleacheries and for household use. Each tablet is sufficient for 40 liters of water; it will clean the linen, giving a perfect white and leaving a good odor.—Revue des Produits Chimiques.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

ELECTRICAL ROSETTE.—J. A. Mebane, South Boston, Va. The invention is an improvement in that class of devices commonly designated as "rosettes" or "ceiling-blocks," the same being provided with ears for connecting electrical circuits and also with safety-fuse wires extending between the respective attachments with which the line-wires and the lamp-wires are duly connected.

OVERHEAD LINE.—E. Giraud, 18 Rue Royale, Paris, France. In Mr. Giraud's present patent the invention has reference to divers improvements in overhead lines, and more particularly to the high-tension lines, the fall of which, brought about by the breaking of a conductor, is liable to cause serious accidents.

ELECTRIC-TRACTION SYSTEM. — J. P. Gorman, Jr., New York, N. Y. This invention relates to systems of electrical traction, and more especially to those receiving current from series of separated contact devices. It presents all advantages of separated contact conduction, there being no two live points so readily accessible that a person is liable to touch both at the same time. The arrangement of the poles renders construction comparatively inexpensive and secure against leakage and allows a single line of poles to serve two tracks.

Of Interest to Farmers.

THRESHING - MACHINE. — W. Brenton, Carlisle, Ind. The straw or grain is passed by the cylinder onto an endless apron and is moved toward the rear of the machine, a toothed cylinder agitating the straw and dislodging the grain during its passage. At the end of the conveyer the dislodged grain falls between the aprons upon the riddle, while the straw passes upon the upper surface of a rotating cylinder and between cylinders supported by shafts to an endless apron, where it is agitated a second time. Threshed grain falls from this apron onto the grain-board and from thence through the riddle and into the shoe.

CHURN-COVER.—J. C. Hogue, Winfield, Texas. The improvement pertains to earthenware churns, and its object is to provide a cover arranged to prevent undue splashing of milk through the dasher-stem opening and to allow convenient periodical removal of the cover for examining the progress of churning and to permit of stacking the covers during the process of burning the same in a kiln or the like.

CORN-PLANTER.—C. W. Lanham, Stanford, Ky. The planter is driven over the ground to be planted with the power-wheel in contact therewith. The wheel imparts rotation to a shaft, which in turn rotates the dropping-wheels. Each of the openings in the dropping-wheel receives corn from the hopper during its passage thereunder and drops same into the shoe when the wheel is rotated. When the end of the row is reached, the power-wheel is elevated out of contact with the ground, thus restraining operation of dropping mechanism while the turn is being made.

BUTTER-PRESS.—F. Murphy, Lisbon, N. Y. One of the principal objects of the invention is to provide means by which butter or like substance may be molded into a plurality of prints, each possessing any desired shape, dimensions, and weight, and also to simplify the construction of presses of this character, as well as to greatly reduce the labor attending the manipulations or operations thereof.

GATE FOR WIRE FENCES.—R. H. Singer, Uniontown, Md. It is the common practice to provide passageways in wire fences with closures comprising a swinging bar-gate or a series of detachable wire bars or rails adapted to slide in holes provided in opposite posts. The cost of the gate, and many other important objections have led to Mr. Singer's present invention, which embodies an improved closure consisting of connected and attached wires, lever-clamps, and screw-eyes.

Of General Interest.

MOISTENING DEVICE.—P. A. Peterson, New York, N. Y. The purpose of the invention is to provide a moistening device adapted for home or for office use and which can be carried in the pocket and so to construct the device that it will be simple, durable, and economic in construction and which will be effective in operation, being ready for use as long as there is any supply of moisture at hand.

BUTTER-CUTTER.—R. J. Woolley, Portland, Ore. In use a block to be divided is placed upon the support in contact with the wall. To permit introduction of the block an upright may be removed, and then may or may not be returned to furnish a stop at this side of the support. Means are provided to pass the wire through the material to divide it horizontally. If the upright is in its socket, it is removed and the standard-frame allowed to travel to and remain at extremity of the base. The upright is then inserted in its socket and frame applied, two uprights entering its openings. It is now drawn downwardly, dividing the two sections of the block into two series of cakes, which may be removed and operation repeated.

ATTACHMENT FOR BOAT-DAVITS.—N. Murchison, New York, N. Y. The principal objects of the invention are to provide means for lifting both ends of a boat by a very efficient hand-operated device and freeing it from the chocks, to deposit both ends simultaneously and at the same speed in the water, and to provide for steadying the boat in the chocks without employing additional mechanism. The present invention is designed as an improvement on or attachment for a form of boat-davit previously patented by Mr. Murchison, yet capable of use with many other forms of davits.

POSTAGE-STAMP-BOOK CABINET.—J. P. McDonald, Philadelphia, Pa. This inventor provides an improved portable stamp-cabinet adapted to preserve stamps in good order and easily accessible for counting or removal. The cabinet is particularly adapted for the use of postal clerks, stamp-clerks, and others who preserve, handle, or sell stamps.

VACUUM-TRAP.—G. M. Hilger, Chicago, Ill. The object in this case is to provide a trap designed for use in connection with vacuum-separators, vacuum oil-separators, and other apparatus requiring removal of the liquid while the latter is under a vacuum, the trap being automatic in operation, and arranged to allow the condensating liquid of the apparatus to flow under gravity-pressure into the trap and to be forced out of the latter under pressure to a suitable place of discharge.

BRIDLE-BIT.—A. B. Campbell, Coraopolis, Pa. This improvement pertains to bridle-bits used for the control of a horse when riding or driving the animal, and has for its object to provide novel details of construction for a bit that adapt it either for the control of vicious hard-mouthed animals or those that are easily controlled.

EMBALMING-CATHETER.—H. M. Crippen, Ballston Spa., N. Y. The catheter comprises a tube and flexible member, combined with which is a slidable member, performing the function of stiffener for the flexible member and of a shield for preventing the operator's hands from becoming soiled. The slidable member is provided with means by which it is held in any position adjusted on the catheter, said means constituting a grip to be taken hold of to operate the slidable member and also a packing for preventing leakage of blood and other matter between the slidable member and catheter tube.

MUSICAL INSTRUMENT.—A. M. Krueger, Belleville, Texas. The invention relates to stringed musical instruments of the lyre type; and its object is to provide a new and improved musical instrument which is very light, of high resonant qualities, and arranged to permit convenient manipulation of the strings without the player touching the soundboard with the fingers.

ATTACHMENT FOR FAUCETS. — G. A. Ollsen, Providence, R. I. In this instance one of the principal objects of the inventor is the provision of a device by which a pail, pan, or other vessel may be conveniently suspended on a faucet or spigot to be filled with water or other liquid drawn from the discharge-spout thereof.

TRANSFER APPARATUS FOR WIRE HEDDLES.—E. Neumann, Crefeld, Rhenish Prussia, Germany. This is an automatic apparatus for receiving and holding in position and also for discharging the pieces of wire in the manufacture of wire heddles, and for use in combination with heddle-making machines, especially for that kind in which the several steps of forming the central eye and the end eyes of the heddles are carried on automatically, but in separate stages. Also for use in combination with almost any kind of automatic heddle-making machines for receiving wire heddles when formed and subsequently discharging these heddles into an automatic soldering-machine, which smooths and makes durable the central eye and ends of the wire-heddles.

RESPIRATOR.—J. Warbasse, Newton, N. J. It is intended that this device will be very light, and therefore adapted to be conveniently worn over a nose to supply out-of-door air to invalids or other persons requiring pure air during waking or sleeping hours, the device being also adapted for use in laboratories, shops, and places where noxious fumes, filings, and dust floating in the air are liable to be inhaled. It is useful for the administration of oxygen, gas, anesthetics, medicated air, and vapors.

HOSE AND HYDRANT CONNECTION.—L. A. Weston, Adams, Mass. The object of the invention is to provide a simple, inexpensive, and thoroughly effective device whereby a hose having a coupling provided with a thread adapted to the connecting device may be quickly and securely attached to a hydrant having a thimble upon which the threads do not correspond to those of the hose.

ATTACHMENT FOR LADDERS.—F. Van Alstine, Sacramento, Cal. An object in this case is to provide a store-service ladder with means whereby goods in stock within a store or other space may be taken from the supporting-shelves therefor and readily examined or handled at any height, either to ascertain the amount of stock on hand or make up orders or sort or rearrange the goods without the operator having to descend with the goods for that purpose.

BACK-PROTECTION GARMENT. — S. F. Swantees, Itasca, Ill. One intention of the improvement is the provision of means for presenting a soft surface to certain parts of the body, so that garments otherwise of a rough and irritating nature can be worn with comfort; and further to provide means for forming an air-space between the soft material forming the inside surface and the main part of the garment.

TIME-INDICATOR FOR LETTER-BOXES. —J. C. Smith and J. S. Davis, Montgomery, Ala. This invention pertains to means on a letter-box for indicating the time at which the letters are collected, and has for its object an indicator of the character stated which will be automatically operated, displaying the next time of collection upon simple closure of the letter-box door.

MARINE VESSEL.—J. J. Sitzler, New York, N. Y. This improvement refers especially to propulsion of marine vessels, the object being to reduce the displacement of the vessel to a minimum, so as to reduce the resistance to propulsion, and to produce a more efficient propeller than that commonly employed.

CUFF-FASTENING. — H. C. Shepherd, Crete, Neb. In this case the invention relates to improvements in fastening devices for shirt-cuffs, an object being to provide a fastening to take the place of the ordinary buttons or links that will have a neat appearance and that will hold the cuff in proper position without danger of breaking or bending the cuff.

FORK.—W. A. Reddick, Niles, Mich. This fork is of simple construction, yet possesses great strength and durability. The ring, while providing a simple and inexpensive means for securing the grip in place, possesses the additional utility of being a convenient means for suspending the fork and as a suspending means the rigid ring integral with the fork is much superior to the ring as ordinarily constructed.

SAW-GAGE.—J. S. Linton, New York, N. Y. The inventor provides a gage for the tables of machine-saws, which can be set so as to guide the cutting operation of two boards in such manner that their mitered edges will be cut to accurately fit together, and, further, provides a gage of simple, durable, and economic construction adaptable to any saw-table and which can be quickly and conveniently adjusted to produce cuts of any desired angle or bevel.

TRIP CASING-SPEAR.—W. H. Kesselman, Parkersburg, W. Va. This trip casing-spear is for use in oil-wells and the like. The inventor provides means whereby the jaws can be forced into engagement with the inner walls of the casing in a very simple manner, and in such a way that no accumulation of dirt or other obstacles will prevent their operation, and, furthermore, provides for loosening the device from the walls of the casing when it appears to be impossible to raise the casing with the spear.

BINDER.—C. L. Donohoe, Santa Barbara, Cal. In this patent the invention relates to a binder for leaves or papers of various sorts, but is especially adapted for use in what is known as the "perpetual" ledger system of bookkeeping. The object of the invention is primarily to produce an efficient, easily-operated, and practically-indestructible or all-metal binder.

ROLLING DOOR OR SHUTTER AND MEANS FOR OPERATING THE SAME.—J. Cahill, Norfolk, Va. The invention pertains to improvements in "rolling" doors or shutters and means for operating them, its main object being to provide a rolling door or shutter which shall be simple in construction and noiseless in operation. Another, is to close the opening or space at the top of the doorway usually caused by the unwinding of the door or shutter.

NON-REFILLABLE BOTTLE.—C. E. Carroll, Newport, Ark. When this bottle is empty, it is impossible to fill it, since it is impossible to remove the casing pushed down over the neck and impossible to pour liquid into the bottle without so removing it. The valve or cork or other suitable material prevents any ingress of liquid into the bottle. A small opening through the valve allows the inward passage of air to release the vacuum created by the outrush of the liquid.

LABEL-HOLDER.—De Witt G. Brown, American Falls, Idaho. This device for holding labels is particularly for gummed labels, used for example by druggists. The object is to provide a device in which the labels may be effectually held in such a way as to permit of their convenient removal and also to avoid curling or rolling of the labels due to the application of the gum to one surface thereof.

ETHER MIXTURE FOR DISINFECTING.—T. Bargiela, J. P. Mislowsky, A. Caricchia, and L. E. Odio, Buenos Ayres, Argentina. The invention refers to a new compound which possesses special properties for deodorizing and aromatizing petroleum and other hydrocarbons. Oil treated loses some greasiness, its illuminating power is greater, while the flashing point is higher. It may be used in the preparation of varnishes, the aromatization of animal fats and oils, and candle-wicks impregnated with the substance increases brilliancy of light.

ANIMAL-TRAP. — J. H. Tharp, Cherokee, Kan. In operation a plunger is lifted against resistance of a spring until the eyes thereon engage pins on the rock-shaft. The shaft is then rocked by a depending arm to bring the pins in horizontal position, and a swinging platform is lifted until it engages a notch in the arm, the tension of spring providing resistance between the arm and pins to retain the platform in elevated position. Slight addition to weight of platform, however, will overcome the friction, causing the platform to descend and release the arm. Rocking of shaft allows the eyes to slip from the pins and the plunger to descend.

SELF-LOCKING SEAL. — F. Laporte, St. Louis, Mo. Mr. Laporte provides a sealing-strip, provided at one end with a plurality of transverse slots and having the opposite end laterally extended. A single transverse slot is formed adjacent to junction of the laterally-extended end with the strip, and beyond this slot is a projecting embossed surface. A tongue of large extent is formed upwardly from substance of strip near commencement of lateral extensions and having its attached end adjacent thereto, and a second tongue of small extent is formed downwardly from substance of the first tongue and having its attached end adjacent to the free end of said tongue.

Hardware.

MECHANIC'S SQUARE.—J. M. Realing, Daytona, Fla. In this patent the invention has reference to squares such as used by artisans in many classes of work. The object of the improvement is the provision of a tool of this kind which will combine the utility of a try-square, bevel-gage, and a level. It is adapted for inside and outside position on all work.

NUT-LOCK.—J. Peters, Bothwell, Ontario, Canada. In this instance the aim of the inventor is the provision of novel features of construction for a nut-lock that adapt it for general use to detachably secure a nut in a reliable manner on the threaded end of a bolt and permit the reuse of the nut-lock as often as may be desired.

Heating and Lighting.

STOVE.—C. T. Taylor and G. L. Clark, Mount Sterling, Ill. In this case the invention pertains to stoves; and the object of the inventor is to produce a stove in which the combustion will be improved and equalized at all parts and to provide the stove with improved means for heating air for the purpose of warming living apartments or rooms.

CUT-OFF VALVE FOR GAS OR OIL BURNERS.—A. Ashcraft, Fort Smith, Ark. The improvement relates to valves more particularly designed for cutting off the fuel or illuminating supply from gas or oil burners. The object is to provide a valve of the character stated which shall not only be simple in construction and adapted for ready attachment, but after being set or opened for supply of gas or oil the burner operates to automatically close the valve, cutting off the fuel-supply should the gas or oil cease to burn.

Household Utilities.

RECLINING-CHAIR.—L. Kipp, Waterbury, Conn. The invention has reference to chairs, and especially to that class adapted to be used as steamer-chairs or reclining-chairs. The object of the improvement is the production of a chair of this type which is of simple construction and which may be quickly adjusted so as to support a person in an upright position or in different reclining positions.

BOOK-HOLDER.—J. N. Miller, Ashland, Ore. The holder is simple in construction, light, and occupies but little space on a desk. It may be cheaply constructed of any suitable material, and when folded up the holders may rest together. The edges of the book are supported out of contact with the desk or table, and the arrangement of the front supports directly beneath the edges of the book insures a very stable position of the holder.

ALARM.—W. L. Monroe, Omaha, Neb. Although this device furnishes an effective alarm in which the hammer is operated by ample force under comparatively slight pressure by the door or window which is to actuate it, it may be very cheaply manufactured, the base, holder, shield, and guiding and retaining projections being stamped from a single sheet of metal, while the other elements are simple to produce. The holder may be varied in diameter to receive cartridges of any suitable caliber or may support any other device which by contact of the hammer will sound an alarm.

Machines and Mechanical Devices.

APPARATUS FOR FORMING AND SOLDERING CAN-BODIES.—L. C. Sharp, Omaha, Neb. In the present invention the carrier moves continuously and without reversal throughout the entire operation of the machine, and the various steps performed by it do not involve the interruption of the movement of the carrier, thus making a fast machine. Peculiar means are also involved for automatically feeding the sheets or blanks of tin to the machine, thus dispensing with an operator to stand by the machine and steadily feed the blanks thereinto.

INVOICING MACHINE.—J. Q. Wimer, Joplin, Mo. The invention relates to an apparatus for measuring the number of yards in a piece of cloth while it is being unwound from the board upon which the bolt is formed and rewound upon a similar board. Pressure is sufficient to kill any insect, such as a moth, which may be within the folds, and rewound upon a second board.

SPEED-INDICATOR. — B. Volkmar, New York, N. Y. The purpose of the invention is to provide an indicator capable of indicating a greater number of miles than any other indicator of which the inventor has knowledge of the same size and type. A further purpose is to provide an indicator in which a governor-ring has sliding motion upon the shaft, and is connected with a long tapered cone that slides upon the shaft, which cone operates a chain of gearing for moving a hand or pointer over the dial.

STEAM HYDRAULIC INTENSIFIER. — T. E. HOLMES, 63 Sheldon road, Nether Edge, Sheffield, England. The design of the invention is to obviate defects without in any way interfering with the ordinary mode of working a press. It provides (for the purpose of effecting the automatic cut-off of the steam-supply) mechanism in the nature of a "hunting-gear," which on one hand, is connected to the main controlling-valve and its actuating-lever and, on the other, is adapted to be controlled automatically by the main steam-piston, said lever being controlled directly by hand or steam or other power relay, which in turn is manually controlled through medium of hunting-gear.

LIQUID-WEIGHING MACHINE. — C. J. HEDEMANN, Honolulu, Hawaii. This invention relates to improvements in machines for weighing liquids, such as cane-juice or other material capable of running or discharging from a supply-pipe; and the inventor's object is to increase the accuracy of the weighing and the efficiency of the machine. The present invention resides in means or additional features to the machine shown and described in a former patent granted to Mr. Hedemann.

CORE-CUTTER FOR CEMENT-BLOCK MACHINES.—J. W. STUART, Paris, Ill. This improved machine is used for forming building-blocks of cement or other plastic material, and especially for cutting out or coring the blocks when being molded, whereby they are produced with a central hole or passage of any desired shape, thus economizing material, reducing the weight of blocks, and adapting them when duly laid in a wall to form continuous vertical air-passages.

TUCK-GUIDE FOR SEWING-MACHINES.—S. FRIEDMAN, New York, N. Y. The invention has reference to such sewing-machine attachments as tuckers, and has for its principal objects the provision of a device by which work of different widths may be operated upon with a minimum amount of attention and in which the relation of the elements to one another may be changed to meet varying conditions.

Prime Movers and Their Accessories.

INTERNAL-COMBUSTION ENGINE.—C. M. STEELE, Statesville, N. C. The object in this case is to eliminate or neutralize shock resulting from the explosion of the charge and its effect upon the engine and to provide means for more effectually air-cooling the parts. The piston and cylinder are mounted respectively upon separate parallel crank-shafts, so that the explosion of the charge causes the cylinder to yield in one direction and the piston in the other, the cylinder turning one crank-shaft and the piston the other, both shafts being connected by toothed wheels running in opposite directions.

GOVERNOR MECHANISM.—H. T. BALLARD, Youngstown, Ohio. In the present patent the invention has reference particularly to a governor mechanism for Corliss engines; and the object of the inventor is the provision of an efficient mechanism applied to the fly-wheel or shaft of the engine by which to regulate the valve mechanism.

STARTING MECHANISM FOR GAS-ENGINES.—V. B. MILLER, Philadelphia, Pa. The invention relates to starting mechanism for explosion-engines. In starting engines of this class in the usual manner by means of a crank it frequently happens that the crank will be given a violent jerk or "back-kick." The object of the invention is to produce a mechanism of simple construction which will enable explosive-engines to be started without danger to one turning the crank. It is especially applicable in connection with gas-engines of the type usually found on automobiles.

ELECTRICAL IGNITER FOR INTERNAL-COMBUSTION ENGINES.—W. H. WALTER, New York, N. Y. The aim of this inventor is to provide a simple and efficient construction of igniters of that class which employ stationary terminals or electrodes and which may be advantageously used on internal-combustion engines in which oil is liable to be pumped up from the crank-pit past the packing-ring and into the combustion-chambers. The object is to provide an improved igniter which insures the passage of an electric spark or sparks under any and all conditions of service and in which the deposit of carbonaceous matter on the terminals (one or both) is overcome.

ROTARY ENGINE.—R. C. MCLEAN, Cleveland, Ohio. The object of the inventor is to provide an engine which is simple in construction and which will operate efficiently with little waste. Further, to provide such an engine with an improved arrangement for the exhaust-ports. Its use is by no means confined to steam, and it may be operated by any other gas, such as compressed air. Indeed, it could be operated by water.

Railways and Their Accessories.

NUT-LOCK.—M. OMALIA, Scranton, Pa. Mr. Omalia employs a main washer or ring-plate to be placed over the bolt employed and flatly against the surface of a portion of the structure to be bolted, and in conjunction therewith employs a supplementary washer or ring-plate also adapted to be placed over the bolt used. Said washer is also so adapted to a part of the structure to be bolted as to be incapable of turning about the bolt in either direction, while the two said washers are so adapted to each other as to effectually resist any tendency to reverse turning of the nut on the bolt.

CAR-FENDER.—J. LANDAU, JR., New York, N. Y. The object of the present invention is to provide a fender arranged to safely land and retain any object struck by the fender-basket, to permit of conveniently folding the fender when not in use, and to allow quick and convenient transfer of the basket from one end of the car to the other. It relates to fenders such as shown and described in the Letters Patent of the United States formerly granted to this inventor.

NUT-LOCK.—H. SEEGER, Morley, Iowa. The nut-lock is designed especially for railway-work, but useful in various other connections. It comprises the arrangement with a bolt and a shouldered nut of a washer or collar adapted to surround the bolt inside of the nut and carrying a peculiar dog coacting with the shoulder or shoulders of the nut securely to lock the same.

RAILROAD-TIE. — C. E. SHANNON, Marble City, Indian Ter. The aim of this inventor is to produce a tie which will have the strength and durability of a metal tie, combined with the resiliency and advantages of a wooden tie. It can be laid upon the usual road-bed where wooden ties are used, and does not require a specially-prepared road-bed of asphalt or concrete, such as is often required with metal ties. When the wooden blocks wear out, they may be readily removed without removing the body of the tie, and new ones may be easily inserted.

CROSS-TIE AND MEANS FOR HOLDING TRACK-RAILS THEREON.—E. A. GILLCHRIST, McKeesport, Pa. The purpose in this improvement is to provide novel details of construction for a railroad cross-tie of the class formed of concrete or a similar composition of matter and for means embodied therewith, that enable the convenient, stable, and secure clamping connection of track-rails that are mounted upon the tie and permit speedy release of the rails and removal from the tie.

Pertaining to Recreation.

AMUSEMENT APPARATUS.—O. ROBERTS, Winfield, Kan. Mr. Roberts employs a frame associated with which is an ascending section of trackway, said section merging at the upper end thereof into another which is descending then ascending, but in a different plane from that of the first mentioned section, the second mentioned then merging into a corresponding section terminating in an under or return section between which and a receiving-section used there is a gap over which the vehicle and occupants are carried along a trajectory, there being also a second gap between lower terminal of the receiving section and upper terminal of a final section of trackway, over which final section the vehicle reaches the ground from whence it started.

TARGET.—T. J. MCNELLY, New York, N. Y. Principal objects of the invention are to provide a target with an indicating device and a movable bull's-eye which when hit by a bullet will release the indicating device, so as to show that the eye has been hit; also, to provide a bell which will be rung at the same time and to provide the target with a series of removable sheets each representing a target and each designed to be removed from the main target after each person's shooting has ended in order that a record may be kept by each one of his own score.

Pertaining to Vehicles.

LOG-CARRIER.—W. E. SINCLAIR, Mobile, Ala. This improvement is in that class of carriers in which the draft animals attached to a tongue and wheeled axle are utilized for lifting and handling logs, the tongue being adapted to slide in suitable guides and connected with a pivoted lifting-lever which in turn operates chains and grapples attached to the log. The chief objects are to reduce the draft heretofore required for raising the logs by the lift-lever and chains and also to enable operation of loading and unloading to be more quickly effected.

VEHICLE-WHEEL.—M. G. BABIO, New York, N. Y. Mr. Babio's invention refers to an improvement in wheels, and particularly to an improvement in the construction of the wheel for which he formerly made and filed an application for patent, and the purpose is to avoid friction between the flanges of the primary hub and the sides of the secondary hub, so as to adapt the above-named construction to light and high-grade vehicles, which adaptation will give more comfort to occupants than attained in those now in use.

Designs.

DESIGN FOR A TOILET-POWDER RECEPTACLE.—W. A. BRADLEY, New York, N. Y. Mr. Bradley has invented a new, original and ornamental design for a toilet-powder receptacle of very neat and graceful proportions. The width of the receptacle is double the thickness, the height double the width, the body is nicely rounded. The screw-threaded neck and perforated top are attractively designed.

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.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Inquiry No. 7930.—For manufacturers of machinery for making a dry condensed milk by spraying same upon a revolving cylinder which is heated by steam.

Inquiry No. 7931.—For manufacturers of Chapman metal aspirator which can be screwed on water tap to exhaust air from tubes.

Inquiry No. 7932.—For manufacturers of rubber cloth specialties.

Inquiry No. 7933.—Wanted, address of firm making preparation called "Ascage."

Inquiry No. 7934.—For manufacturers of machinery for the manufacture of powder.

Inquiry No. 7935.—For manufacturers of machine and mold for making concrete drain tiles, also for powdered sand and stone screens.

Inquiry No. 7936.—For firm who can supply the tobacco-cutting machine, roasting and preparing cigarettes.

Inquiry No. 7937.—For the manufacturers, dealers or jobbers in novelties and office or store equipment.

Inquiry No. 7938.—For manufacturers of raw hide pins, 1/8 inch to 3-16 inch diameter by 12 inches long.

Inquiry No. 7939.—For manufacturers of ceiling fans run by steam and gasoline power.

Inquiry No. 7940.—For manufacturers of gasoline engines.

Inquiry No. 7941.—For manufacturers of nut-shelling machinery.

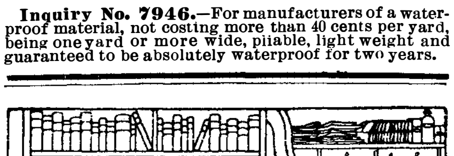
Inquiry No. 7942.—For the manufacturers of stone mills and handle and spoke machinery.

Inquiry No. 7943.—For manufacturers of brass balls and rods suitable for static machines.

Inquiry No. 7944.—For manufacturer that makes small dove-tail or lock-cornered odorless wood boxes.

Inquiry No. 7945.—For manufacturers of saw machines for squaring small timber from one inch up.

Inquiry No. 7946.—For manufacturers of a waterproof material, not costing more than 40 cents per yard, being one yard or more wide, pliable, light weight and guaranteed to be absolutely waterproof for two years.



HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(9899) F. Q. B. calls attention to a misstatement in one portion of a note upon projectiles, which we gladly amplify and correct. The theoretical path of a projectile in a vacuum would be a parabola, and in textbooks of physics the subject is ordinarily treated from the theoretical standpoint only. The results of the resistance and motion of the air are such as to render the theoretical result of little practical value in gunnery. In a case cited by Wood, a ball was shot with a velocity of 1,000 feet per second and at a range which should have carried it by the law of projectiles to a distance of 31,250 feet. Its actual range was 5,000 feet. A projectile rises highest when shot vertically upward, or at an angle of 90 deg. with the horizontal. For other angles its rise varies as the square of the sine of the angle of elevation. As the sine of 30 deg. is 1/2, it follows that a bullet shot at this angle would rise 1/4 as high as if shot vertically; if shot at 45 deg. elevation, it would rise 1/2 as high as at 90 deg. elevation. The greatest range is found at 45 deg., and for equal angles above and below 45 deg. the range is the same.

(9900) H. M. K. asks: What is the chemical composition of wood, bituminous and anthracite coal, and natural and artificial gas? Is the composition of natural gas the same in the various gas-producing rocks and fields? How and in what proportion should natural gas and air be combined in order to create the most heat? Please explain this combination, and also the formation of the new compounds (and elements, if any) giving also the proportionate amounts. Is it possible for the air mixer to allow too much air to mix with the gas? How and in what way in the process of burning is heat made? Most stoves are made so that the gas and air mix before combustion, but in some stoves they do not. Is it possible to get the same amount of heat from 1,000 feet of gas in each case? Does the draft of the stove or the pressure of the gas burnt affect in any way the proper mixture of the gas and air by the mixer? What is the color of the flame in perfect combustion, and why should the color be different in imperfect combustion? What are the evil effects produced by burning gas without a flue connection? A. We may state that the chemical composition of anthracite coal is as follows: Carbon, 86; volatile hydrocarbons, 4; ash and moisture, 10. The composition of bituminous coal varies very greatly, but as a general average we would give the following: Fixed carbon, 65 to 45; volatile hydrocarbons, 25 to 45; ash and moisture, about 10. Wood kiln dry: Carbon, 50; hydrogen, 6; oxygen, 41 1/2; nitrogen, 1; ash, 1 1/2. Natural gas: Marsh gas, 93; hydrogen, 1 8/10; nitrogen, 3 2/10; other gases, 2. Coal gas: Marsh gas, 40; hydrogen, 46; carbon monoxide, 6; small quantities of other gases, 8. The chemical composition of all of these varies in different localities, but the above figures may be regarded as giving an approximate average. Natural gas and artificial gas both burn with the best results when they are both mixed with air in just the right proportion to give perfect combustion. The best mixture of air and coal gas is one part of gas to about five to seven parts of air measured by volume. The proportion with natural gas is about the same. It is possible for the air mixture in a burner to admit too much air. In the combustion of gas or solid fuel the hydrogen combines with the oxygen of the air to form H_2O, and carbon in the fuel combines with the oxygen of the air to form CO_2. This union of hydrogen or carbon with the oxygen of the air is what produces the heat. It is better to mix the gas and air before combustion, but it is possible to get perfect combustion if this is not done. It is also possible to get perfect combustion regardless of the pressure of the gas or draft on the stove, and so long as the combustion is perfect the same amount of heat is produced. Where the gas and air are mixed before combustion the flame is apt to be nearly colorless, and when they are not so mixed the flame is apt to have considerable color, especially if there is much carbon present in the gas. Where there is no flue connection, the products of combustion escape into the room and vitiate the air.

(9901) H. A. W. says: I would be pleased to have you inform me of the process of coloring incandescent electric light globes, and the necessary ingredients used in producing the following colors, i. e., ruby, green and blue. A. Aniline dyes are used for coloring the bulbs of incandescent lamps. These may be dissolved in amyl acetate or in photographer's collodion. The bulbs should be cleaned thoroughly and dried, coated with the white of egg and dried. The dye will then adhere firmly to the glass. The details of the process may be found in the Notes and Queries of the SCIENTIFIC AMERICAN, No. 10, vol. 74; and in SCIENTIFIC AMERICAN SUPPLEMENT, No. 948, price 10 cents each.

(9902) J. M. C. asks: In all articles I ever read I have gotten the idea that a dynamo of a given current (say 10 amperes) could be run at any voltage, say 14, 25, 52, 75, or 110, and give out 10 amperes, provided lamps in circuit called for that amount. In fact, my idea has been that I could use eight 14-volt, eight 25's, eight 52's, ten 75's, or sixteen 110's, voltage varying with speed, but amperes still the same if lamps call for it. You see I figure eight amperes in circuit (about) in all the voltages, leaving 2 amperes for variation of excitation. Am I right or wrong, yes or no? A. The voltage of a dynamo depends upon the speed of the armature, which determines the number of lines cut per second. The amperes depend upon the resistance of the circuit, internal and external. If you have a resistance which allows 10 amperes to pass without overheating, you can within the limits of safety vary the speed and so the voltage, and the same 10 amperes will flow. But it is not possible to have such a range of voltage as you mention. To change from 14 to 110 volts requires eight times the speed of the armature. No armature could stand the centrifugal force of such a speed. The proposition as you make it is not practicable.

NEW BOOKS, ETC.

Wireless Telegraphy. Its History, Theory, and Practice. A. Frederick Collins. New York: McGraw Publishing Company, 1905. 12mo.; pp. 299; 332 illustrations. Price, $3.

This is an excellent and very complete work on wireless telegraphy. All phases of the subject are treated with a definite, logical sequence, which brings the state of the art down to the present time. Each subdivision is approached with a brief historical introduction, which is followed by a theoretical discussion, after which the various experiments are outlined, and finally the practical workings are described. This logical method of dealing with the subject renders the work valuable to the student as well as to the trained specialist.

Modern Lightning Conductors. An Illustrated Supplement to the Report of the Lightning Research Committee of 1905. With Notes as to the Method of Protection and Specifications. By Killingsworth Hedges, M.I.C.E. and M.I.E.E., Hon. Sec. to the Lightning Research Committee. London: Crosby Lockwood & Son, 1905. New York: D. Van Nostrand Company. 8vo.; pp. 119. Price, $3.

The chief basis for confidence that the theory of protection from lightning is to be made fairly clear, and the matter of control soon come into an existing practice, lies in the conferences, reports, and numerous other researches on modern lightning conductors, a great deal of which matter has been used for the purposes of this volume. The author deals materially with the Report of the Lightning Research Committee and information supplied by the Observer's Reports of this scientific body, in fact, as the title states, it is their illustrated supplement. Mr. Hedges throws signal ability into the work of facilitating the opening up of a new field of inquiry, made possible by the efforts of Sir Oliver Lodge and other scientists. In a comprehensive manner the methods most suitable are explained, illustrations of the necessary accessories are given, also a description of arrangements in use on the Continent. He includes the introduction to the L. R. C. report, 1905, by Sir Oliver Lodge, wherein this eminent authority claims, that "it is not so much quality of electricity that has to be attended to, as electrical energy; that this electrical energy is stored between clouds and earth in dangerous amount, and that the object should be to dissipate it, not as quickly, but as quietly as possible." The work is rich in notes on the latest American and Continental practice, specifying that of Holland, Belgium, France, Germany, Hungary, and Italy. A chapter on examples of lightning stroke on protected buildings confirms the meaninglessness of the familiar term, "area of protection." It is full of quotable facts; its seventy-four engravings are an efficient contribution to diagram and pictorial accuracy needed in such cases, and notwithstanding it is somewhat discouraging to be told that the present system of lightning rods, which will protect from one class of flash, may not be able to shield a building from injury by the other class; still the student will find that it sets out clearly the theory of lightning, and the way one can, to a great extent, protect a structure by suitable conductors, and thus dissipate its energy.

Practical Engineer Pocketbook for 1906. Manchester, England: Technical Publishing Company, Ltd. No date. 24mo.; pp. 598. Price, 60 cents.

Like the Practical Engineer Electrical Pocketbook the Practical Engineer Pocketbook is always a welcome visitor. We can well remember seeing the first edition some eighteen years ago. Now the work has waxed fat and improved both in accuracy and in scope. It is one of the best pocketbooks which we have ever seen, and is unquestionably the most economical as regards its purchase price. It is a book which we can heartily recommend to mechanical engineers.

The Investigation of Mine Air. Edited by Sir Clement Le Neve Foster, D.Sc., F.R.S., and J. S. Haldane, M.D., F.R.S. London: Charles Griffin & Co., Ltd. Philadelphia: J. B. Lippincott Company, 1905. 12mo.; pp. 191. Price, $2.

The present book is an account by several authors of the nature, significance, and practical methods of measurement of the impurities met with in the air of collieries and metalliferous mines. No questions receive closer attention from mining engineers at the present time than those relating to the health and safety of the men under their charge, and among all the dangers which threaten the miner or impede his work, none are more real and urgent than those due to impure air. A knowledge of the impurities in mine air, their sources and their effects, has thus become almost a necessity to mining engineers. A number of English and foreign authors collaborated in the production of the present volume, which is unusually complete and is also adequately illustrated.

Die Hemmungen der Uhren. Ihre Entwicklung, Konstruktion, Reparatur und Behandlung vor der Reglage. By C. Dietzschold. Krems a. Donau, Nied.-Osterr, 1905. 8vo.; pp. 234.

The author has presented here a most thorough treatise on watch and clock escapements, from both the mechanical and mathematical standpoints.

School Chemistry. A New Textbook for High Schools and Academies. By Elroy M. Avery, Ph.D., LL.D. New York: American Book Company, n.d. 16mo.; pp. 243. Price, $1.20.

Clearness and accuracy of statement mark the definitions, directions, and explanations. The experiments are simple and instructive, easily performed, and adapted to the use of inexpensive and easily obtainable apparatus. Unusual space is devoted to chemistry as applied to important industrial processes. In fact, every modern topic pertaining to the science that is worthy of consideration receives its proper treatment; the practical applications of chemistry to the affairs of everyday life, such as the contamination of water, bread making, the fertilization of soils by the action of nitrifying bacteria, etc., are given a great amount of attention.

Practical Pattern Making. By Paul N. Hasluck. Philadelphia: David McKay, 1905. 16mo.; pp. 160. Price, $1.

"Practical Pattern Making" contains in a form convenient for everyday use a comprehensive digest of information contributed by experienced craftsmen. The author is too well known as a versatile amateur mechanic to need any introduction to the readers of the Scientific American. The illustrations, which number 300, are excellent.

Appreciation of Pictures. A Handbook. By Russell Sturgis, A.M., Ph.D. New York: The Baker-Taylor Company, 1905. 8vo.; pp. 308. Price, $1.50 net.

The author is a very well-known writer on art topics, and was editor of an important dictionary of architecture. Mr. Sturgis's long experience in art matters gives him an authority in dealing with painting. The present volume, which is handsomely illustrated, has seventy-three well-executed engravings and takes up the Epoch of Primitive Charm; the Epoch of Early Triumph; the Epoch of Achievement; the Epoch of Splendor; the Beginnings of Modern Gloom; Recent Art, Color and Light and Shade; Recent Art, Sentiment and Record; Recent Art, Monumental Effect. The book is one which we can heartily recommend.

Elements of Descriptive Geometry. By Charles E. Ferris. New York: American Book Company. No date. 8vo.; pp. 127. Price, $1.25.

Inquiry among the leading draftsmen shows that nearly all their work is done in the third quadrant or angle. It seems reasonable, therefore, to teach the subject of geometry in technical schools as it will be used by graduates. Many years of experience in teaching this subject proves to the author that the student may learn to think with this problem below the horizontal and behind the vertical and perpendicular planes, just as well as above and in front of these planes. A large number of practical examples given in the past were assigned to cadets at the United States Naval Academy, and the author considers that they will serve well to illustrate the principles of descriptive geometry.

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Wheels to axles, mechanism for connecting vehicle, H. Hill 813,423
Wheels, toe or grouter attachment for traction, J. McDonald 813,571
Whip operating device, A. Burrows.... 813,401
Wicking in lengths and bundling the same, machine for cutting cotton, H. Marsh.. 813,441
Window, R. O. Scheel 813,455
Window, W. J. Klemm 813,716
Window cleaner, Johnson & Rowe.... 813,800
Window screen, rolling, H. E. & W. H. Gilland 813,642
Window ventilator, W. A. Ralston 813,737
Wire basket, M. E. Johnson 813,499
Wire goods making machine, J. C. Perry.. 813,823
Wire stretcher, W. McNames 813,574
Wire stretcher, J. S. & R. A. Snyder.... 813,837
Wire stretcher, F. H. Carter 813,859
Wood grinder, T. H. Savery.... 813,834
Wrench, E. Axford 813,686
Wrench, J. A. Barton 813,850
Wrench, Hielscher & Standley 813,892
Yarn and making the same, C. B. Potter.. 813,583

DESIGNS.

Brushes, mirrors, or similar articles, back for, H. J. Straker 37,849
Card mount, H. H. Collins, Jr....37,860, 37,861
Clock case, A. T. Fischer....37,852, 37,853
Collar, F. J. Novak 37,863
Forks, spoons, and similar articles, handle for, S. Smith 37,850
Glass receptacle, G. R. West.... 37,851
Lantern, J. Losli 37,856
Music indicator, J. MacMaster 37,854
Paper box, P. B. Myers 37,862
Pencil, E. Faber 37,855
Ring, G. E. Burns 37,848
Vending machine case, H. C. Traute.37,857 to 37,859

TRADE MARKS

Alloys, non-ferrous, Lumen Bearing Co.... 49,950
Aseptic preparation, H. K. Mulford Co.... 50,043
Automobiles, St. Louis Motor Carriage Co.. 49,959
Balls, base, A. J. Reach Co.... 49,987
Beer, J. Ruppert ....49,956 to 49,958
Beer, Pabst Brewing Co. 49,975
Beer, lager, S. S. Pierce Co.... 49,978
Beer, lager, J. Chr. G. Hupfel Brewing Co.. 50,022
Bookbinding cloth, C. Chivers 50,039

Boots, shoes, and slippers and soles therefor, Morse & Rogers 49,954, 49,955
Boots, shoes, and slippers, leather, Clark-Hutchinson Co. ....49,999 to 50,001
Brushes for painters and decorators, Hanlon & Goodman 50,006
Calicoes, American Printing Co.....50,032 to 50,034
Canned oysters, fish, clams, crabs, shrimp, and lobster, A. Booth & Co.... 50,030
Canned salmon, J. G. Megler.......50,050 to 50,052
Candy, G. B. Hazard 50,044
Cards, playing, New York Consolidated Card Co. .....49,936 to 49,939, 50,024, 50,025, 50,061
Carriages, wagons, and carts, Studebaker Brothers Manufacturing Co. 49,979
Cigars, R. & W. Jenkinson Co.... 50,016
Cleaning preparations, India Alkali Works... 49,968
Coal tar product, synthetic, Mellier Drug Co. 50,012
Coffee, Levering Coffee Co. 50,048
Coffee, Stewart Brothers Co. 50,057
Confections and bonbons, chocolate, H. D. Foss & Co. 50,042
Corsets, Marshall Field & Co. 50,049
Corsets, Warner Brothers Co. 50,062, 50,063
Corsets, Weingarten Bros. 50,064
Cotton duck, Mount Vernon-Woodberry Cotton Duck Co. 50,013
Dyestuff, Cassella Color Co. 49,997
Embroidery, Atlantic Novelty Co. 49,990
Explosives, Masurite Explosive Co. 49,973
Fabrics, silk, Stewart Silk Co.... 50,058
Fabrics, waterproof textile, A. Berel.... 49,991
Flour, wheat, J. B. Camors & Co.... 50,046
Foods, prepared cereal, American Cereal Co. 50,059
Game boards, Carrom-Archarena Co. 49,996
Gas mantles, incandescent, Flash Self Lighting Mantle Co. 49,932
Gloves, boxing, A. J. Reach Co.... 49,988
Governors for pumping engines, C. P. McMullen 50,011
Hair restorers and dandruff destroyers, W. J. Foree 50,003
Herring, smoked, Slade Gorton & Co.... 50,056
Hoof dressing, W. F. Young.... 50,029
Horse blankets, W. B. Riley & Co.... 50,055
Hose pipes, nozzles, gates, and couplings, Eureka Fire Hose Co. 49,948
Hosiery, R. J. Fisher 50,002
Insect powder, Caroh Chemical Co.... 50,037
Jams and jellies, Wilkinson, Gaddis & Co... 50,065
Jelly preparation, Michigan Carbon Works.. 50,053
Jewelers' pendant bows, Swartchild & Co... 49,980
Journal, trade, M. T. Richardson Co.... 50,010
Kid, glazed and dull or "mat," Keystone Leather Co. 50,008
Knives, pocket, Challenge Cutlery Corporation 49,998
Leather, lace, New York Leather Belting Co. 49,934
Leather, patent, A. C. Lawrence Leather Co. 49,986
Liniment, F. G. Boynton 49,993
Malt extract, Paragon Malt Extract Co..... 49,981
Medicinal cordial, Kirk-Geary & Co.... 49,971
Medicine, proprietary, Salo-Sedatus Chemical Co. 50,017
Medicine, purgative, F. G. Boynton 49,994
Medicines for diseases of the liver, Peacock Chemical Co. 50,054
Metal polish, American Metal Polish Co..... 49,942
Milk, condensed, Borden's Condensed Milk Co. 50,036
Mirrors and mirror frames or supports, J. P. Eustis Manufacturing Co. 50,007
Mowers, lawn, A. B. Case.... 50,038
Nails, horse, Union Horse Nail Co....49,941, 49,964
Oil, succedaneum for cod liver, Norwich Pharmacal Co. 50,026
Paint for metallic roofs, liquid, L. C. Brown 49,944
Paints and enamels, Gerstendorfer Bros..... 50,005
Paints, enamel, Peerless Enamel Paint Works 49,976
Paste goods, cereal, John B. Canepa Co.... 50,060
Periodical, W. A. Marsh 49,972
Pickers and burring machines and attachments and parts thereof, Curtis & Marble Machine Co. 49,945, 49,967
Pills, Lamont, Corliss & Co.... 50,047
Printing apparatus, hectographic, F. F. Daus 49,946
Quebracho extract, A. Klipstein & Co.... 50,031
Reamers, Standard Tool Co. 49,982
Remedies for asthma, J. K. Brater.... 49,995
Remedy for throat affections, Glessner Medicine Co. 50,020
Rings, finger, W. Loeb & Co.... 50,009
Rubber erasers, Eagle Pencil Co.... 49,951
Rubber substitutes, Dermatine Co. 50,018
Rubber water bags and water bottles, Seamless Rubber Co. 50,027
Scissors and shears, Challenge Cutlery Corporation 49,965
Sewing machines and sewing machine parts, Household Sewing Machine Co. 49,933
Shade cloth, oil, Hulse Bradford Co.... 50,045
Shoe polishes and blackings, F. E. Fennessy. 50,040
Shoes and slippers, leather and canvas, McRae & Bevill 49,953, 49,974
Show cases, John Phillips & Co.... 49,969
Steel, high speed tool, Fuller Brothers & Co. 50,004
Stogies, R. & W. Jenkinson Co.... 50,015
Suppositories, Eli Lilly & Co.... 50,019
Switchboard cords, J. E. Crawford.... 49,966
Talking machine records, Victor Talking Machine Co. 49,985
Talking machine sound boxes, Victor Talking Machine Co. 49,984
Taps, Standard Tool Co. 49,983
Tonics and remedies for dyspepsia and stomach troubles, V. E. Beck.... 50,035
Undershirts and underdrawers, Erlanger Bros. 49,931
Varnishes, American Varnish Co. 49,960, 49,961
Varnishes, John W. Masury & Son.... 49,970
Ventilators, chimney cowls and ventilating caps, and ridging, Globe Ventilator Co.. 49,949
Watches and watch parts, Hampden Watch Co. 50,021
Waters, distilled and carbonated, F. M. Finley 50,041
Whisky, D. Kelly Co. 49,935
Whisky, Ullman Einstein Co. 49,940
Whisky, Back & Griewe 49,943
Whisky, Many, Blanc & Co. 49,952
Whisky, Standard Distilling Co. 49,962, 49,963
Whisky, C. F. Riordan 49,977
Whisky, A. Guckenheimer & Bros. 49,989
Whisky, E. Block & Sons 49,992
Whisky, P. J. Bowlin Liquor Co.... 50,014
Whisky, J. W. Evenden Co. 50,023
Whisky, Star Distillery Co. 50,028
Wire rope, Durable Wire Rope Co.... 49,947

LABELS.

"Ale of Ginger," for ginger ale, Chattanooga Bottling Co. 12,687
"Alexander Hamilton," for cigars, G. B. Samuel 12,690
"Alka-Dent," for dentifrice, C. M. Griswold. 12,691
"Eagle Brand," for hair restorative, E. Reynolds 12,692
"Ferro-China-Bascal," for bitters, Basilea & Calandra 12,686
"Handelsman's Munificent Mutual Benefit Trading System," for pass books, I. Handelsman 12,685
"Macaroni Bread," for bread, J. S. Norman. 12,688
"Patrician Friction Polish," for shoe dressing, Faunce & Spinney 12,684
"Pride Crown Bread Meats," for meats, A. R. Worm 12,689

PRINTS.

"A Stormy Day at the Flat Iron Building," for rubbers, Stahl & Jaeger.... 1,582
"Mandolin," for playing cards, Willis W. Russell Card Co. 1,584
"Oak," for playing cards, Willis W. Russell Card Co. 1,586
"Pain King," for liniments, F. B. Clark & Co. 1,583
"Sabre," for playing cards, Willis W. Russell Card Co. 1,585

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.

PROPOSALS will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until **10 o'clock A. M.,** March 20, 1906, and publicly opened immediately thereafter, to furnish at the naval station, New Orleans, La., 1 single-screw gasoline launch, length over all about 79 feet, extreme beam about 14 feet 6 inches, draft when fully laden not to exceed 4 feet 6 inches. Applications for proposals should refer to **Schedule 394.** Blank proposals will be furnished upon application to the navy pay offices, New York, N. Y., and New Orleans, La., or to the Bureau.
H. T. B. HARRIS, *Paymaster-General, U. S. N.* 2-21-06