SCIENTIFIC AMERICAN

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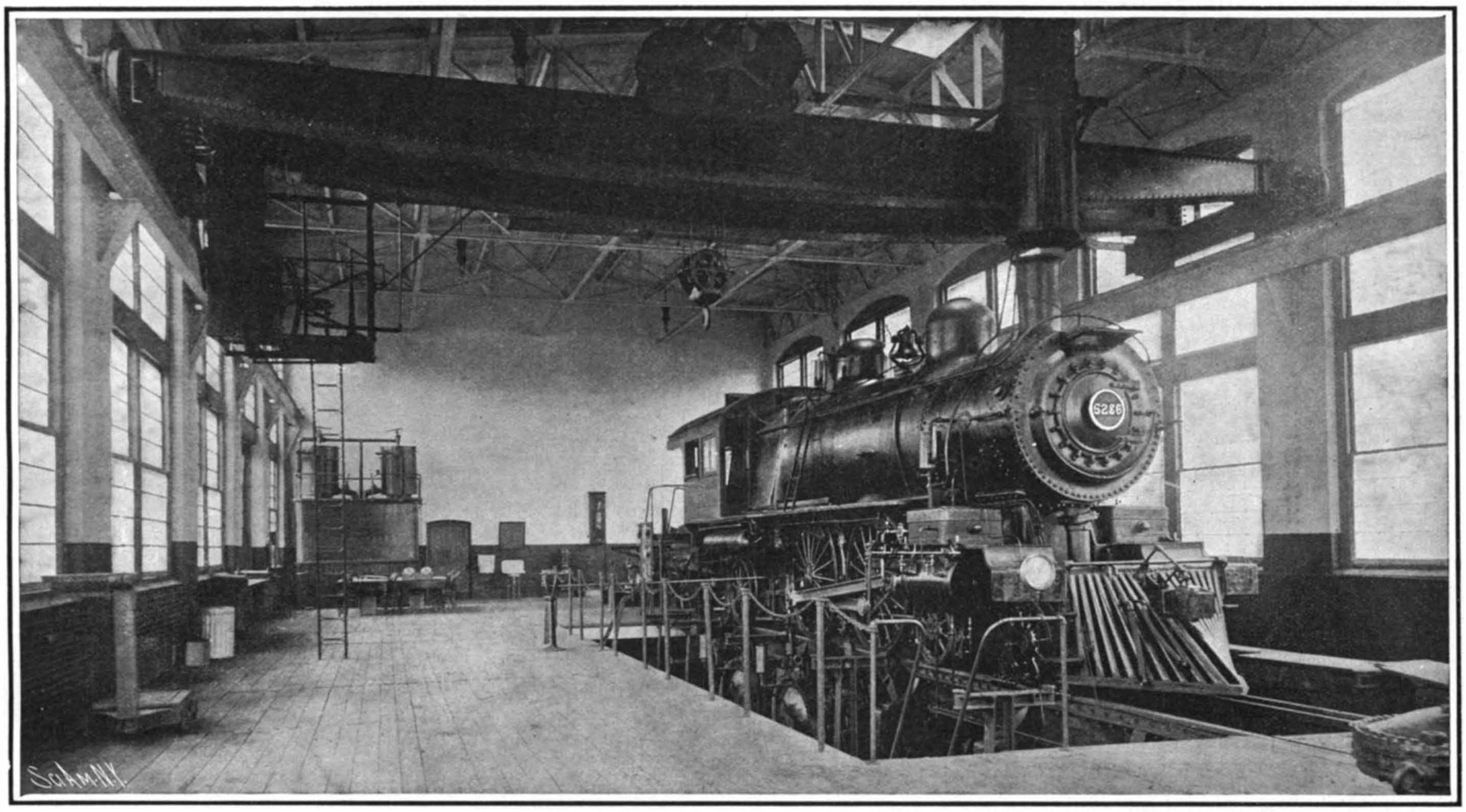
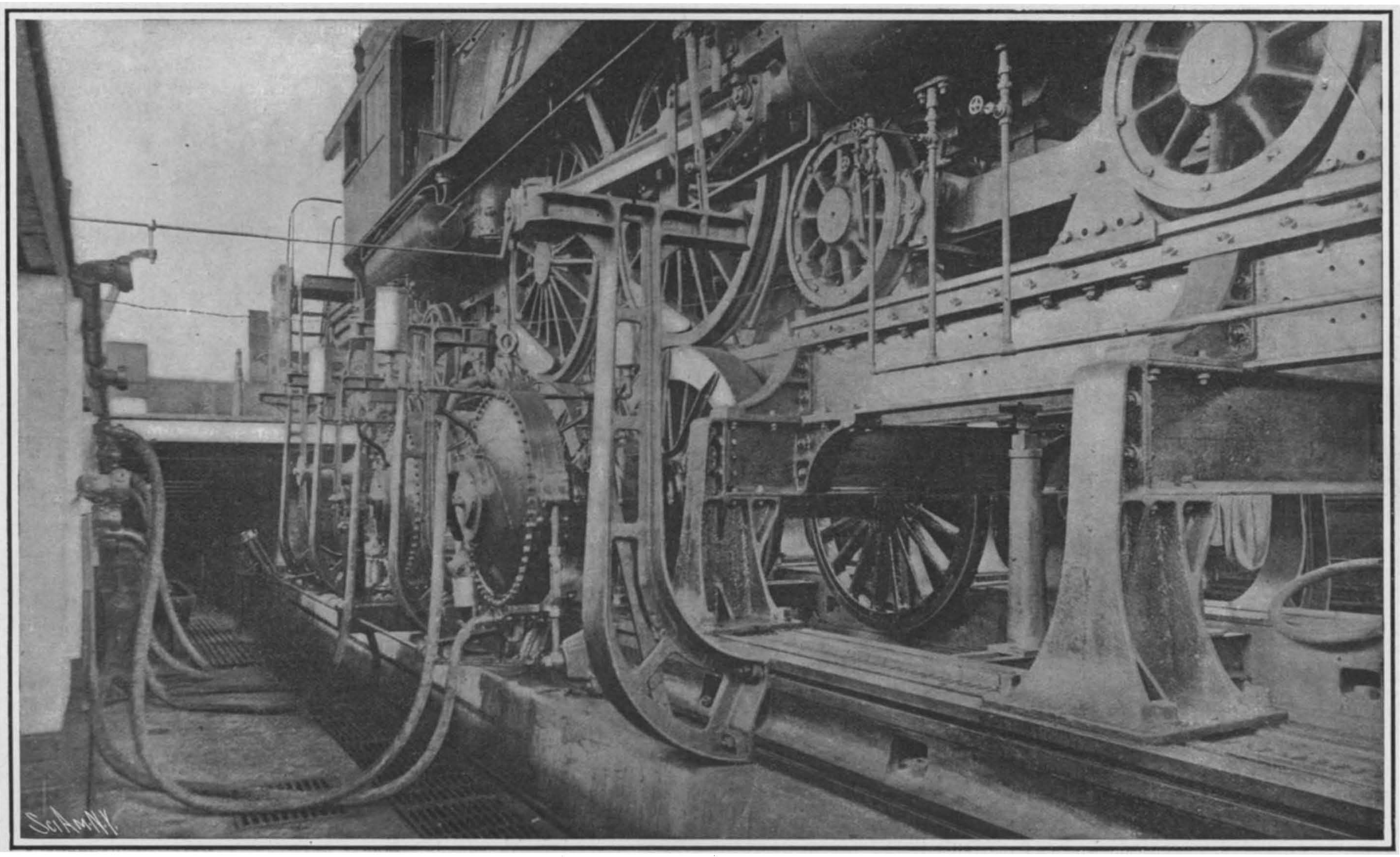
Vol. XCVIII.—No. 8. ESTABLISHED 1845. | NEW YORK, FEBRUARY 22, 1908. | 10 CENTS A COPY $3.00 A YEAR.



Interior of Main Laboratory of the Locomotive Testing Plant.



Pit Floor With Foundation Apparatus.

THE TESTING OF A LOCOMOTIVE.—[See page 126.]

SCIENTIFIC AMERICAN

ESTABLISHED 1845

MUNN & CO. - - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

CHARLES ALLEN MUNN, *President*
361 Broadway, New York

FREDERICK CONVERSE BEACH, *Sec'y and Treas.*
361 Broadway, New York

TERMS TO SUBSCRIBERS

One copy, one year, for the United States or Mexico $3.00
One copy, one year, for Canada 3.75
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THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (established 1845) .... $3.00 a year
Scientific American Supplement (established 1876) .... 5.00 "
American Homes and Gardens .... 3.00 "
Scientific American Export Edition (established 1878) .... 3.00 "

The combined subscription rates and rates to foreign countries, including Canada, will be furnished upon application.

Remit by postal or express money order, or by bank draft or check.
MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, FEBRUARY 22, 1908.

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

WHERE THE RECIPROCATING ENGINE DROVE OUT THE TURBINE.

A remarkable demonstration of the fact that the marine turbine does its best work when running at high speed, and that it ceases to be economical at low speed, occurred recently on the Great Lakes in connection with an attempt to capture the passenger traffic between two points, by placing upon the route a new and fast turbine steamer. The old-established service was operated by two boats, run by reciprocating engines at the very moderate speed of 16 miles an hour. The new company ordered a 21-knot turbine-driven boat from a British yard, placed her in service, and immediately began to secure the cream of the traffic. A representative of the old company, happening at this time to meet in England an engineer who had been prominently associated with the development of the turbine-driven steamship, told him of the conditions, and sought his advice as to the best way to meet the competition. The turbine engineer asked what was the speed of the boats of the competing lines, and on learning that it was respectively 16 and 21 knots, stated that it would be a very easy matter for the old company to drive the new fast boat off the route, by the very simple expedient of dropping the speed of their boats from 16 to 13 or 14 knots, and making the big reduction in fares which the reduced running expenses of the boats would render possible. He stated that the company owning the turbine steamer could never meet the cut in rates, for the reason that the reduction of the running speed of their vessel would not bring any corresponding reduction in the coal consumption. The company determined to make the experiment; and, after running their boats for a few months at a lower speed and a lower rate, they found that they not only recovered the passenger traffic which they had lost, but that the reduction in running expenses was so great, that they made more money than they had done under the old conditions. Furthermore, it was not many months before the turbine steamer was laid off the route and offered for sale.

It should be understood, however, that the conditions were peculiar at this point, and that the patrons of the line consisted largely of working people, to whom the reduction in fare, even if gained at the expense of time, was a decided consideration. Under average conditions the faster boat would have held the traffic, even at the high rates. We record the incident merely as showing in an interesting way the limitations imposed upon the marine turbine by its inability to run economically at low speed.

THE PENNSYLVANIA RAILROAD AND THE STEEL RAIL PROBLEM.

The Pennsylvania Railroad Company recently placed definite orders with steel manufacturers for 55,000 tons of rails, to be delivered during 1908. These rails will be rolled under entirely new specifications. In view of the increasing severity of road service, and the recognized necessity for developing an improved steel rail, the Pennsylvania Railroad has for some months been conducting an exhaustive examination of the entire art and practice of rail manufacture. A committee of experts—representing not only the railroad, but two of the important steel manufacturers—was appointed by the company last summer to make a special study of the subject. The series of experiments undertaken were probably unprecedented in their completeness, and in the importance of the scientific data which they supplied. The rail sections are believed to be a distinct improvement upon those hitherto in use on the Pennsylvania System. Most important of the features of the new specifications is the placing upon the manufacturer more of the responsibility for the character of the rail produced. The company recognizes that it is merely a purchaser—not a manufacturer. Considerable latitude is, therefore, to be allowed in the methods of manufacture adopted, so long as the result is a *sound rail.* The company has devised tests of a character so exacting, that it is made very much to the interest of the manufacturers to discard all material of the soundness of which there is any doubt. No specification, for example, is made as to the amount which shall be sheared from the end of the bloom formed from the top of the ingot. The problem of a proper discard has been discussed very freely by the different societies which have been considering rail specifications. Various percentages have been proposed—a discard of 25 per cent having the greatest number of advocates. The Pennsylvania Railroad feels, however, that in the present state of the art, at any rate, the responsibility for a proper discard should be left with the manufacturer.

The new specifications also provide that rails shall be free from "injurious" mechanical defects and flaws. This differs from the old specifications, in that no attempt has been made to describe the particular defects or flaws that will cause the rejection of rails. It is not considered wise to attempt to classify in the specifications the relative importance of defects, but it is specified that no rails will be accepted that contain defects or flaws which in any way impair their strength. The methods to be used in testing the new rails are very elaborate. To still further strengthen the practice of the company, and to insure that whatever future changes are made shall be based upon accurate data, a system has been devised whereby the history of all rails purchased shall be fully recorded. To insure that, for this purpose, it shall be possible to identify the part of the ingot from which particular rails were made, the new specifications require, in addition to the usual marking, that a letter shall be stamped on each rail to indicate its position in the ingot. To compile and consider the company's experience with rails, a special committee is to keep continually in thorough touch with the art, and is expected to supply the company with data that will enable it to secure the best rails which, at the time of any order, it is possible to manufacture. In placing its orders, the railroad invites the steel manufacturers to undertake to fill part of the allotment with rails made by the open-hearth process. It is desired to ascertain more clearly the actual differences in service as between the open-hearth and the Bessemer product.

"THE NAVY" AND NAVAL CRITICISM.

"The Navy," a monthly journal which is devoted largely to criticism of the navy, which criticism it feels to be laid upon it as "a duty to the public no less than to the personnel of the fleet," accuses the Scientific American of "bias," on the ground that the facts which were brought out in our recent reply to the Reuterdahl article were based upon official facts and figures. Now, if, in the discussion of a question of the first national importance, the quotation of the facts of the controversy as contained in the government files and records be an indication of bias, then we cheerfully plead guilty to the charge. "The Navy" objects to our first article because we made free use of one of the annual reports of the Navy Department. We used this matter because it most effectually and forever disproves the statement so often made, both directly and by implication, that seagoing officers have had nothing, or very little, to do with the designing of our ships. "The Navy," and all the miscellaneous crowd of detractors of our ships which has followed in its train, have made so much of this allegation, that we thought it was well once and forever to show its absolute baselessness.

In its reference to our second article our contemporary out-Herods Herod by telling us that when the "Connecticut" sailed for the Pacific, the top of her belt was submerged "to the extent of a full foot" below the water. If this be true, it can be shown by "The Navy's" own figures that the "Connecticut" must have displaced over 20,000 tons, or 2,750 tons more than the displacement of the British "Dreadnought," as given in this same issue of our contemporary; for the "Connecticut" at her normal draft of 24 feet 6 inches, and corresponding displacement of 16,000 tons, shows 4 feet 3 inches of her belt above the waterline. If, as "The Navy" states, when she "led the fleet out of Hampton Roads on December 16 last," her belt was "submerged to the extent of a full foot," it follows that she must have been 4 feet 3 inches plus 1 foot, or 5 feet 3 inches below her normal draft. Therefore, the "Connecticut" at the time of her sailing must have been loaded down until she had sunk 63 inches below the normal line, at which she displaces 16,000 tons. To sink the "Connecticut" 1 inch at normal draft requires an additional load of 63.14 tons; and when she has sunk four or five feet, because of the fuller waterlines, the displacement per inch of immersion would be somewhat greater. Therefore to bring her down 63 inches she must have taken on board something over 63.14 x 63 tons, or say 4,000 tons, and her displacement at that draft must have been at least 20,000 tons. Now, on page 4 of this same issue of "The Navy" it is stated that "the 'Dreadnought' has a displacement of 17,250 tons." Hence, according to our contemporary, our fleet started for the Pacific, headed by a ship whose displacement was at least 2,750 tons greater than that of the British "Dreadnought." And so it goes.

It is the desire of the Scientific American to get at facts, and we are willing to help our contemporary out of the ditch into which it has fallen in this matter of belts, by explaining that in the "Connecticut" and in all our later battleships, the top of the belt does not run at the same level from stem to stern. Throughout the wake of the vitals of the ship, that is, from 12-inch turret to 12-inch turret, the belt is raised 18 inches higher, in order to give just that very protection to the magazines, etc., which the detractors of our navy would have us believe our ships do not possess. This jog is distinctly shown in the engraving of the "Vermont" (one of the "Connecticut" class) published in our issue of January 25. It is evidently ignorance of this fact which has led "The Navy" into the curious belief that our 16,000-ton "Connecticut" is actually a 20,000-ton ship.

At the same time, we do not for a moment dispute the fact that the "Connecticut" and all the battleships of the Pacific fleet started out floating somewhat below their official full load draft. A battleship can be loaded down until she draws 30 or even 35 feet of water, if only the dead weight be put into her; and the ships of the Pacific fleet were literally crammed with coal, ammunition, extra fresh water, extra stores of every possible kind, and spare parts, many of which weighed several tons apiece. But their immersion under these abnormal conditions was expected to be greatly in excess of that "official full load" which will not be exceeded when the ships are setting out in search of an enemy. If the "Connecticut," or any other ship of the fleet, was loaded beyond the full load displacement, the fact proves nothing regarding the question as to whether the waterline belts are placed where they should be. It would have been quite possible to have sent that fleet to sea with the top of the belts 5 feet below the waterline, had Admiral Evans wished to carry more miscellaneous freight to the Pacific than he now has on board.

In our article of January 25 we showed that whereas the "Connecticut's" guns are 15 feet above the water at normal draft, the "King Edward" and many other first-class battleships, *at their respective normal drafts* carry their guns at an elevation from 2 to 4 feet lower. "The Navy," commenting on these figures with that delightful *naiveté* that has characterized so much its own and other recent criticisms of the navy, contends that since, at full load (which according to its own exaggerated estimate would give the "Connecticut" 4 feet more draft than normal) these guns will be but 11 feet above the water, they must be carried actually lower than the guns of the "King Edward," which were given in our article as 12 feet 9 inches above the water. The obvious answer to this is that, with equal increments of loading, the "King Edward," which is about the same size as the "Connecticut," would also sink 4 feet in the water, and that her broadside guns would then be only 8 feet 9 inches above the waterline; while those of the armored cruiser "Drake" would be not more than 6 feet 7 inches above water. Such comparisons, to be of any value, must be made upon a common basis, and it is the failure to observe this necessary condition, that renders so much of the criticism of our contemporary valueless.

DESIGNERS OF THE BROOKLYN BRIDGE TERMINAL.

We regret to find that in our recent article on the Brooklyn Bridge Terminal Station and Approaches, we accidentally omitted to give the names of the architect and engineer who were responsible for the design. The credit for the very successful architectural treatment of the work is due to Mr. Francis L. V. Hoppin, of this city, and the engineering features embody the results of a protracted study of the subject by the Chief Engineer of the Department of Bridges, Mr. C. M. Ingersoll.

In recent years, says a contemporary, researches have sufficiently established the position that meteoric irons may, in their essentials, be properly included in the category of steel; the fundamental difference being that, while artificially produced steels are mainly iron carbon alloys, meteoric iron steel is an iron nickel alloy with meteoric carbon.

AWARD OF THE ARMY AEROPLANE CONTRACTS.

By the award of three contracts for the construction of army aeroplanes, our government has suddenly leaped from the hindermost to the foremost place in aeronautics, and we may now reasonably consider ourselves several years in advance of other nations as regards mechanical flight. The proof of this is the now generally-admitted fact that the Wright brothers (whose bid of $25,000 for a two-man machine to be furnished within 200 days was one of the three accepted) flew over 24 miles in a circle at a speed of 38 miles an hour more than two years ago, while Henry Farman, the most successful foreign experimenter, was able to make a circular flight of barely a mile under favorable weather conditions just over a month ago. Moreover, Farman's machine required over twice as much power to propel it as did the Wrights' (38 as against 16 horse-power), and tests which he made showed that he could not carry more than 30 pounds extra weight, which is less than would be required to fit the machine with a radiator, and sufficient water to properly cool the engine. The Wright aeroplane, on the other hand, with an engine weighing 10 pounds per horse-power instead of 2½, and fitted with suitable arrangements for keeping the temperature of the cooling water below the boiling point, in its early crude state remained in the air 38 minutes, and, no doubt, could have been made to fly one hour, the length of time which the trial flight is to last in the case of the machine ordered by the War Department. In view of the performance of their 1905 machine with its crude and heavy motor, the brothers should have no difficulty in now building a two-man machine with fuel capacity for a three-hour flight at 40 miles an hour, according to the requirements.

Another successful bidder for a government aeroplane—Mr. A. M. Herring—is a man long identified with heavier-than-air aeronautics in this country, and one who has probably done more experimenting and original research in this line than any other American. Mr. Herring, when working with Mr. Octave Chanute in 1896, originated the two-surface machine afterward adopted by the Wright brothers, and the following year an English patent on a triple-surface motor-driven aeroplane was secured upon information furnished by Messrs. Herring and Chanute. A United States patent was applied for at this time also, but the Patent Office refused to grant this, even though the inventor offered to furnish a working model. In 1897 Mr. Herring claims to have made two short flights of 52 and 72 feet against a 25 to 28-mile-an-hour wind with a two-surface machine fitted with a 7½ to 9 horse-power compressed-air motor. These two short flights were accomplished after towing experiments with a glider had shown that the power required to fly a man-carrying aeroplane was much less than generally believed. After spending several years in the construction of light gasoline engines for motor bicycles, Mr. Herring in 1902 built a model aeroplane of from 7 to 10 pounds weight and fitted it with a single-cylinder, air-cooled gasoline motor, which weighed only 2 pounds and developed 0.47 horse-power. This model made over half a hundred flights of about a mile in length, its longest flight being 15 miles in a circle when attached to a pole with a string. The surfaces supported 10 or 11 ounces per square foot, and the pounds lifted per horse-power were about 125. This was not the only successful self-propelled model which Mr. Herring constructed, however, as in 1890 he built a monoplane having a tail and fitted with a 1-5 horse-power compound steam engine of 5 pounds weight, which flew 240 feet; while in 1897 another steam-propelled model made a flight of about a mile at Stevensville, Mich., and descended in the lake. From 1903 to 1906, while acting as editor of Gas Power, Mr. Herring continued his experiments with models and full-sized gliders during his spare time, while for the past year and a half he has devoted himself to the perfecting of an extremely light-weight gasoline motor of sufficient power, according to his tests, for a man-carrying aeroplane. He has also made an elaborate series of tests of air propellers, and has found it possible to construct propellers having an efficiency of as high as 94 per cent. From his more recent tests of full-sized aeroplanes, he has developed a new and more efficient type, which is in some respects a radical departure from the double-surface machine he has experimented with heretofore. The great point that he has been working for, and which he believes that he has attained, is *automatic equilibrium*. When once this is attained, and the surfaces are kept always at the proper angle, it will be possible to fly at the maximum speed with the minimum power. In the government aeroplane which he is building the proportion of useful load to the total weight carried per horse-power will be sixty per cent, while the machine will have a relatively high factor of safety as well. This machine is to be completed in 185 days. The price asked for it is $20,000.

A third contract was awarded to Mr. J. F. Scott, of Chicago, Ill., the price asked being only $1,000, and the time for delivery 180 days. Upon their completion, the machines will be tested at Fort Meyer, Va., and it is probable that, if they are successful, we shall soon have a complete aeroplane fleet.

WHEN WAS THE FIRST PENDULUM EXPERIMENT PERFORMED IN THIS COUNTRY?

A subscriber of long standing, Judge George Hillyer, of Atlanta, Ga., questions the claim of Columbia University to priority in the matter of having first performed the Foucault pendulum experiment in this country. Judge Hillyer states that the experiment was first performed during his student days at Penfield College (Mercer University), Georgia, in the year 1852 (a few months after Foucault's first demonstration) by Prof. Joseph E. Willett. Prof. Willett used the cupola of the old chapel at Penfield, with a pendulum very similar to that employed in the Columbia experiment, and the demonstration was a perfect success. As Judge Hillyer recalls it, Prof. Willett used an 80-pound leaden ball provided with a steel point and hung by a piano wire some 50 feet in length. The beat of the pendulum was about 10 feet. The pendulum swept back and forth across a graduated circle on the floor from sunrise to sunset, the bob moving along the arc of the circle precisely according to the time and spaces marked out by calculation before the experiment began. So it would seem that it was Prof. Willett who first performed this interesting experiment in America, and that he not only did it earlier, but did it as well as any other modern scientist.

LEMOINE AND HIS ARTIFICIAL DIAMONDS.

The Paris journals have been given material for sensational articles as the result of a law suit brought by Sir Julius Wernher, president of the De Beers Diamond Company, against an engineer, M. Lemoine. It appears that M. Lemoine claimed to have discovered a process for making diamonds of a large size in the electric furnace, and that by placing a crucible filled with charcoal powder and other ingredients in the furnace, he brought it to a high heat. After having been cooled, the crucible contained one or more fine diamonds. Lemoine had a varied career, having at one time been employed in the Transvaal mines, and subsequently served four years in prison for forgery. Not long since he entered into negotiations with Sir Julius and offered to give proof of his supposed discovery. He made a contract in which it was stipulated that the secret formula would be deposited at London in the Bank of England. Then began the experiments in a laboratory which Lemoine had fitted up in the Rue Lecourbe. Mr. Jackson, an English financier, was one of the witnesses of the experiments, and he states that Lemoine made the mixture of different ingredients and placed the crucible in the furnace. Then he withdrew it and plunged it into a vessel of cold water, after the fashion of Prof. Moissan's experiments. When cold, the crucible was sealed, and after some time the seal was broken, and upon opening it they found some twenty diamonds of somewhat small size. The tests were repeated with like results, but much larger diamonds were obtained. It was then decided to build a large plant for the purpose, and Lemoine commenced the erection of a turbine electric plant at Argeliers, in the south of France, where water-power was to be had. The plant was ostensibly built for light and power, but the current was in reality to be used for secret diamond fabrication. During this time Lemoine had secured sums from Sir Julius to the large amount of 1,671,000 francs ($322,503). But as the new plant had been running for a long time without any outcome, Sir Julius's suspicions were aroused. He pressed Lemoine to reveal his secret, but the latter kept putting him off. The result was a law suit between the parties. After the fashion of the celebrated alchemist Cagliostro, Lemoine is supposed to have used real diamonds and have placed them skillfully in the crucible. As to the secret papers deposited in London, it may be somewhat difficult to secure them. This would no doubt throw some light on the matter.

ASBESTOS SLATES—A GERMAN INVENTION.

According to a German publication, a firm in Munich has succeeded in artificially rendering asbestos waterproof, and has put upon the market this new kind of asbestos under the title of asbestos slates, which are thus described:

These asbestos slates, it is claimed, are as hard and as strong as the natural slate, and can therefore be laid on wall or roof constructions without any wooden laths being necessary. They are very easily worked, and can be bored, nailed, and cut just like wood, without any danger of splitting. They form a fireproof covering for inside and outside wooden walls, are valuable for insulation work of all kinds, even for electrical purposes; are of great use in building railway carriages as insulating material under the seat.; for use in postal telegraphic work for insulating the switches; for covering iron and wooden constructions; for use as fireproof doors for closing off single rooms in stores, warehouses, etc.; for lining wooden doors, and for covering walls and ceilings of all kinds so as to protect them from fire, heat, cold, dampness, disease, germs, and vermin.

EXTERMINATION OF FRUIT PESTS IN CALIFORNIA.

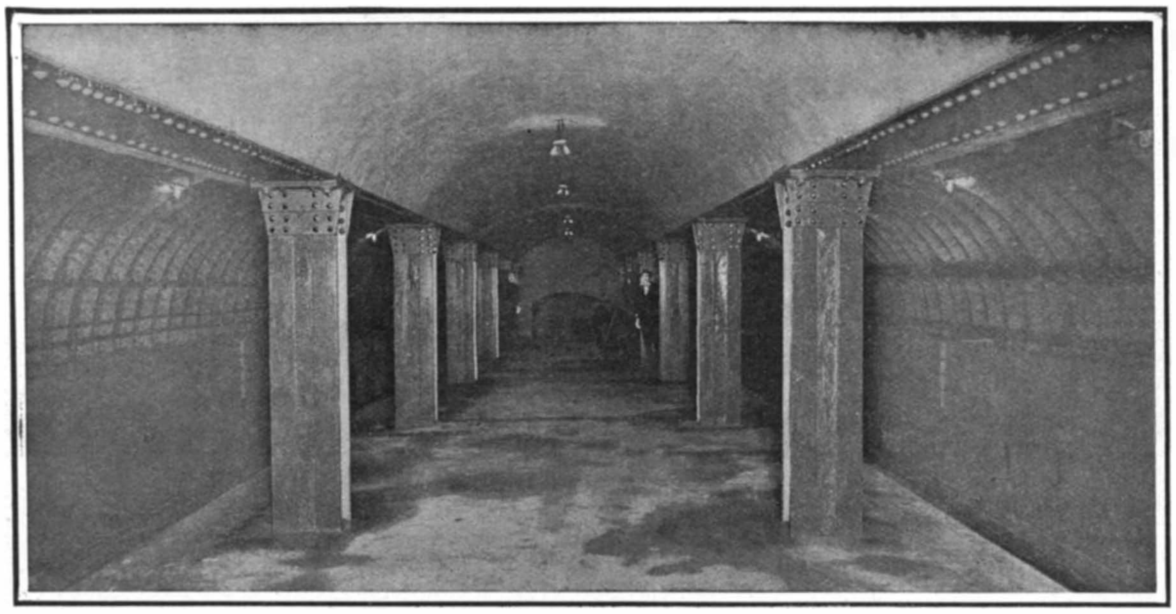
At the recent convention of fruit growers at Marysville, Cal., much attention was devoted to various methods of exterminating the pests that prey upon orchards. The horticulturists inspected the citrus orchards at Chico, and examined the work of destroying the white fly that has been accomplished by the State experts near Marysville. The principal pests are the white fly, the mealy bug, the red, black, yellow, and purple scales. Of these, the white fly is quite the most destructive. The mealy bug preys upon citrus orchards only. Chemical and artificial methods of destroying insect pests, while efficient in some cases, are generally unsatisfactory. The best plan is to introduce an army of parasitic bugs, that do not harm the trees, but destroy the predatory insects. The white fly, after doing millions of dollars' worth of damage in Florida, made its first appearance in California in the citrus orchards near Marysville. Prompt measures were taken to prevent the spread of this most destructive pest. Many experienced horticulturists and expert entomologists were consulted, and it was decided, after full discussion, to resort to defoliation, or cutting off the entire tops and leaves of the trees. The work was carried out under the direction of Edward K. Carnes, entomologist of the California State Commission of Horticulture. But even defoliation did not eradicate the pests, for the flies would lay their eggs in the leaves of the new shoots that grew out on the defoliated trees. It became necessary to keep a constant watch on the trees, and to pluck each shoot as it appeared. The struggle was a long and arduous one. Mr. Carnes says that while it cannot be stated positively that the white fly has been annihilated in the region around Marysville, it has at any rate been brought under control; and should it make its appearance again, the work of extermination can be carried on with comparatively little trouble and at small cost. Energetic efforts to destroy the white fly at Oroville, Cal., are being made.

The efforts to check the ravages of the mealy bug have not met with success. The experts say that, in spite of all that has been done, the mealy bug has increased in number and enlarged the area of its depredations during the last fifteen years. All ordinary means to check its progress have failed signally. By remarkably strenuous work, the pest has been eradicated in some sections by means of fumigation or treatment with pure alcohol or oil. The best hope lies in securing some parasitic insect that will wage a deadly warfare against the mealy bug. Indeed, it is said by some experts that, unless this is done, in a short time many of the citrus orchards will be completely infested.

All citrus-fruit trees are subject to red scale, but lemon and grape-fruit orchards are generally the centers of infection. At one time red scale threatened to ravage all the citrus trees in the region near Los Angeles. Spraying was tried repeatedly, but it was found that, when continued for several years, it results in a gradual increase and spread of the pest. There being no parasitic insect that is effective, it was necessary to resort to fumigation, which, being carried out thoroughly in all the orchards in the valley, proved successful in checking it. Red scale affects the fruit, leaves, and even the old wood of the tree; but yellow scale infests the fruit and leaves only. Yellow scale may be kept under fair control by the introduction of certain parasitic insects; but in aggravated cases treatment with hydrocyanic gas is recommended. Fumigation with this gas is the most valuable remedy against purple scale, which is confined entirely to citrus trees, poisoning them and causing death to the branches that are badly attacked. Large doses of hydrocyanic gas destroy the insects completely without hurting the trees. A continuous warfare has been waged in Southern California against black scale, the best means of combating which is also fumigation.

THE CURRENT SUPPLEMENT.

The current SUPPLEMENT, No. 1677, contains a number of most interesting articles. Of technological interest is the contribution on gums, resins, and their properties. The idea of making steel by electricity is not so very new, but still the reduction of ores by the electric current is a matter of commercial success only within our own day. An excellent article reviews the progress that has been made. F. H. Bryan computes the amount of air needed for ventilation. The formation of sand blasts and sand dunes along the Atlantic seacoast is so frequent that these eminences are common sights. Day Allen Willey writes entertainingly on this subject. The earth is a failing structure. Stresses are set up within it by many forces. How it is yielding to those forces and is being deformed beyond its elastic limit is set forth by John F. Hayforth.



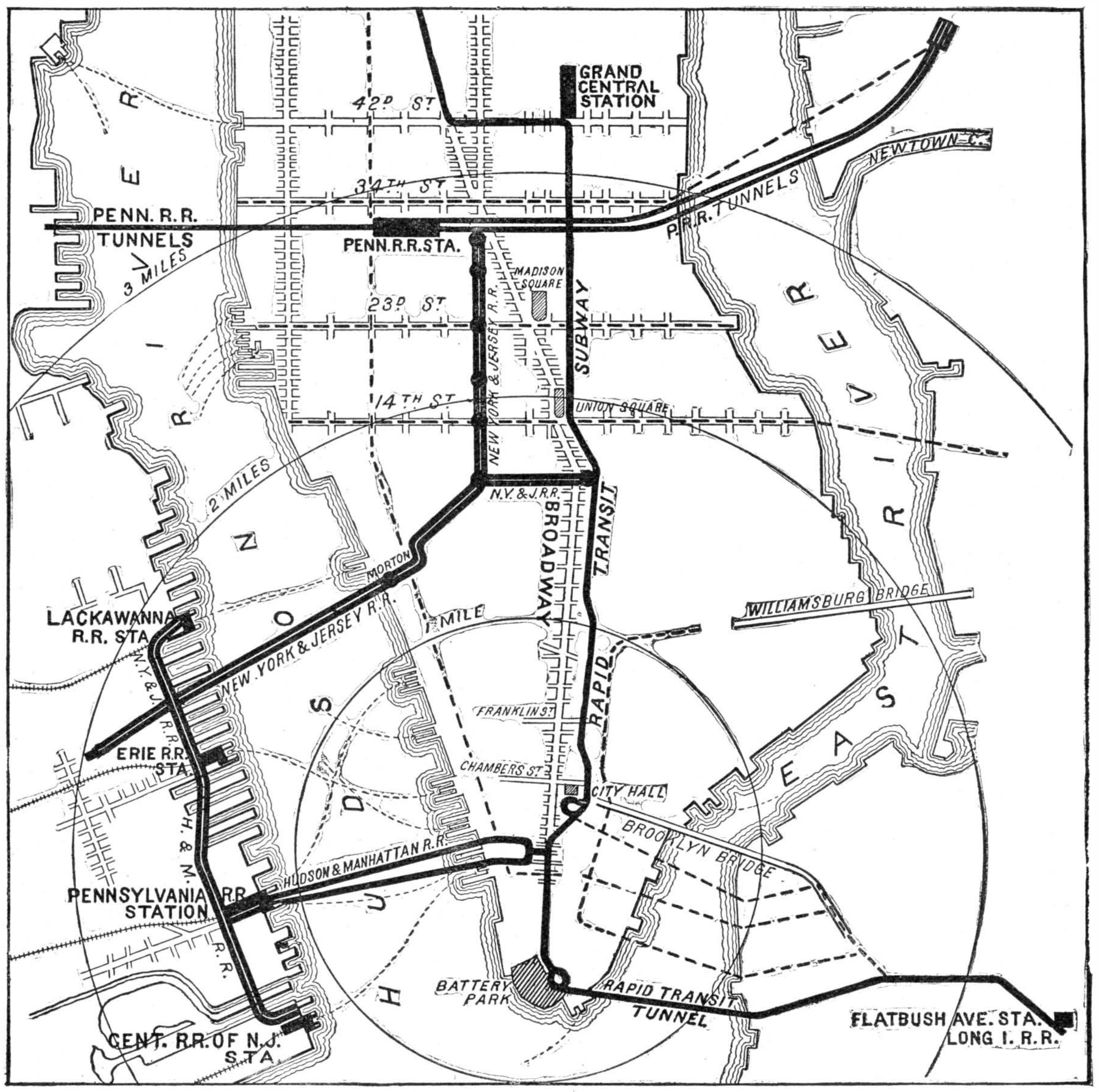
View in Christopher Street Station, Manhattan, Looking East.

OPENING OF THE HUDSON RIVER TUNNEL SYSTEM.

On February 25 the first section of the Hudson and Manhattan Railroad Company's tunnels under the river will be opened for public service with the usual ceremonies. It consists of a twin-tube tunnel, extending from Hoboken, N. J., to the intersection of Sixth Avenue and 19th Street, New York, a distance of 2.85 miles. It is distinctively known as the Morton Street, or uptown tubes. In the coming celebration, New York and New Jersey, the respective States which are to be joined by the opening of the railroad, will be represented by Governor Hughes and Governor Fort; and President Roosevelt has consented to participate in the ceremonies, by touching a button in the White House, which will set the system in motion. Two official trains will start simultaneously from Hoboken and New York; and, as they come together exactly below the State line, which runs down the middle of the Hudson River, the two Governors will shake hands and extend greetings from the forward ends of the cars.

Before passing to a detailed description of the great work which is now being brought to a successful completion, it will be pertinent to review the history of the undertaking, which in its earlier stages was fraught with an unusual share of disaster and disappointments. For the beginnings of the present enterprise we must go back nearly thirty-four years to the year 1874, when the first attempt was made to excavate a tunnel below the Hudson River from the Jersey to the Manhattan shore. In that year Mr. Dewitt Clinton Haskin, one of the active spirits in the building of the Union Pacific Railway, commenced work on the Jersey side. A circular working shaft, 30 feet in diameter, was dug on Fifteenth Street, Jersey City, about 100 feet back from the bulkhead line of the river. The shaft terminated in an enlarged chamber, from which the headings of the two parallel tunnels were started on an easy down grade toward their deepest level, which lies in the proximity of the Manhattan shore. Another shaft was sunk on the New York side near the bulkhead line, at the foot of Morton Street, the distance between the two shafts being about 5,400 feet.

Mr. Haskin commenced the construction of the tunnel without the use of the customary shield and iron lining, believing that the silt through which the tunnel was to be driven would prove sufficiently compact, with the assistance of compressed air, to resist distortion, until the brick lining, 2½ feet thick, of the tunnel could be built in place. The plan of excavation was to dig out the material for a certain distance ahead of the completed brick tunnel; then line it with thin steel plates, 3/16 of an inch in thickness; and, as soon as 10 or 15 feet of the shell was in place, build up within it the brick lining, which was constructed of the best brick laid in hydraulic cement brick mortar. The original plan called for two separate tunnels with a single steam railroad track laid in each. As the work progressed, the difficulty of closing air leaks with sufficient speed led to the use of a pilot tunnel at the heading. This consisted of a 5-foot iron tube, which was carried forward on the line of the axis of the tunnel into the material ahead. This tube was used as a center from which struts were carried out radially, to support the surrounding wall of the tunnel and prevent distortion during the construction of the brick lining. On July 21, 1880, a shocking accident occurred, as the result of the shallowness of the overlying silt above the tunnel roof.

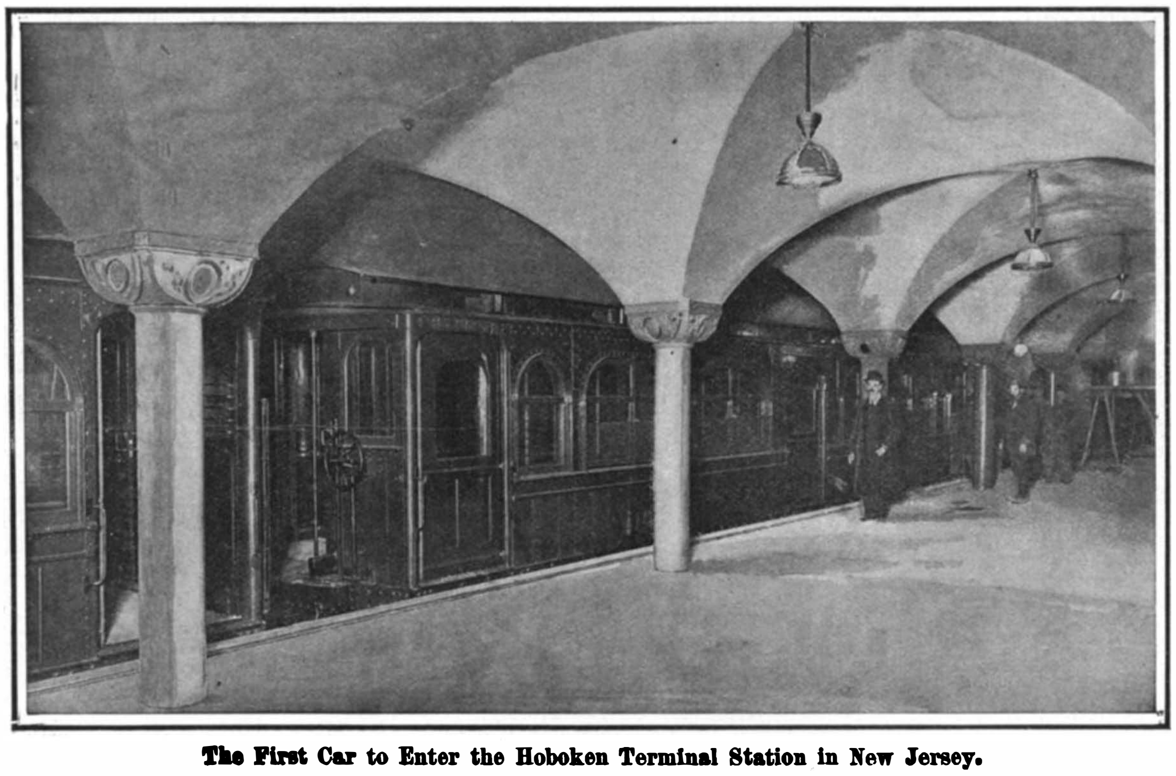


By this system a passenger, landing at any of the Jersey City railroad terminals, will be able to take a train direct to central points between Forty-second Street and the Battery.

Map Showing the New Jersey Tunnels and Subway and Their Relation to the Rapid Transit Subway.

There was a blowout, which resulted in such a sudden inrush of water, that the air lock, which was maintained a short distance back from the head of the tunnel, became jammed, and twenty of the workmen were caught before they could get through the lock, and perished. The work was carried on with more or less intermission until, with 2,000 feet of the north tunnel completed, the company, in 1882, suspended operations. Subsequently, in 1890, an English company was formed, with Sir John Fowler and Sir Benjamin Baker as consulting engineers, for the purpose of completing the tunnel; but after they had pushed the work forward until about 4,000 feet was completed, the work was again abandoned.

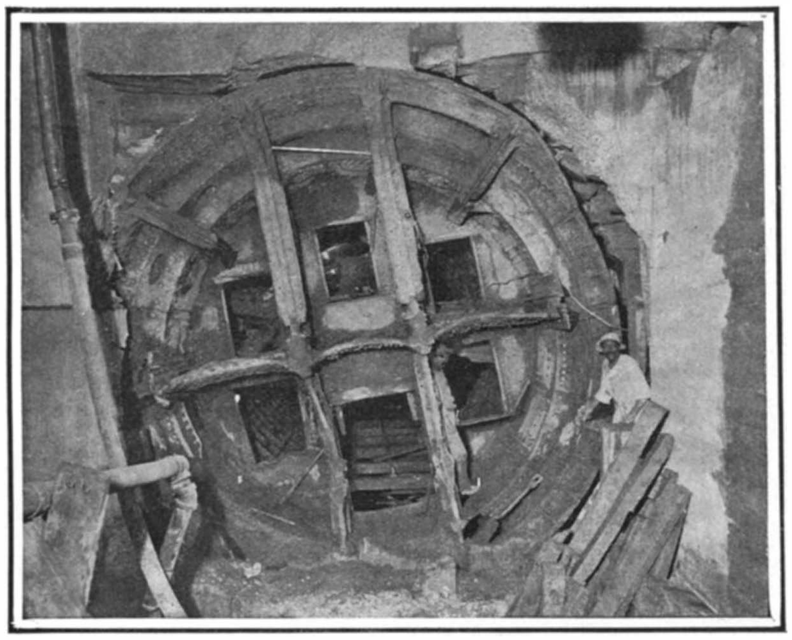
The scheme lay dormant until the year 1902, when Mr. W. C. McAdoo determined to take hold of the uncompleted tunnel and push it through to the Manhattan side. At that time public interest in the scheme was altogether dead; but Mr. McAdoo, realizing how great was the advantage that would be conferred by a direct rail connection between Jersey City and New York, and how certain would be the growth in popularity of a direct means of transit by rail in place of the ferry system, not only succeeded in pushing through the original scheme, but he and his associates have extended it on the ambitious scale shown in the accompanying plan of their system. The system, on the New Jersey side, consists of a two-track road placed in two separate 15-foot tubes which extend from the D. L. & W. Railroad terminal in New



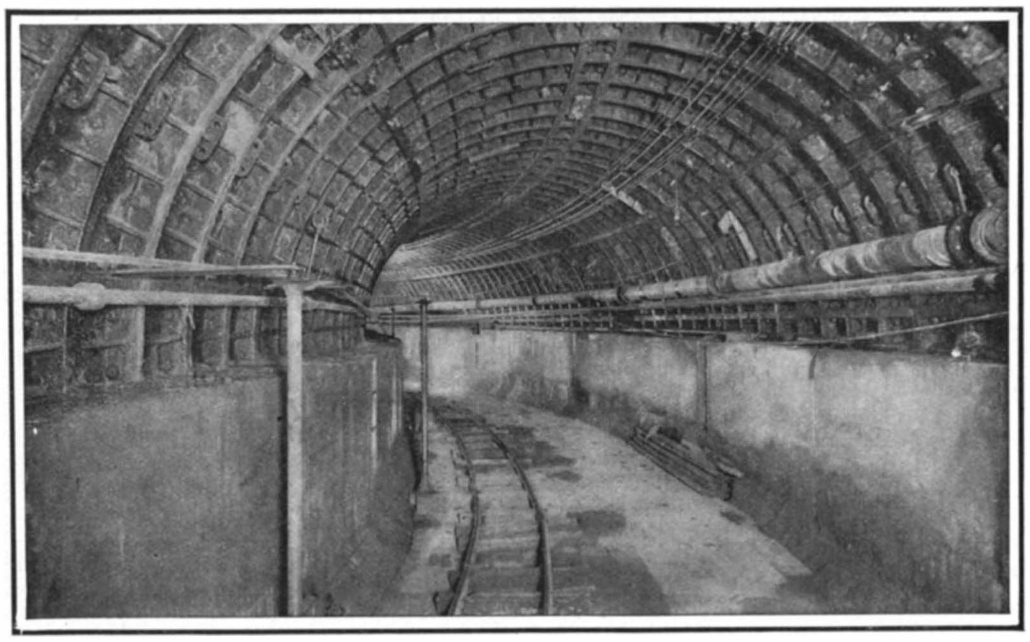
The First Car to Enter the Hoboken Terminal Station in New Jersey.

OPENING OF THE HUDSON RIVER TUNNEL SYSTEM

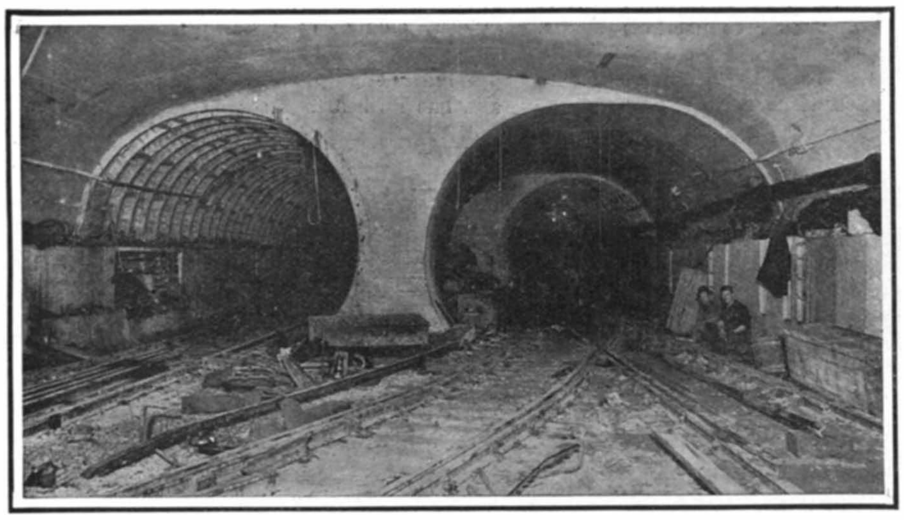
Jersey, parallel with the shore line to the terminal station of the Pennsylvania Railroad. Ultimately, it will be extended southerly from the Pennsylvania station to and beneath the terminal station of the Central Railroad of New Jersey. At the intersection of this Jersey City subway with Fifteenth Street, it is intersected by the twin tunnels across the Hudson River which are about to be opened. These two tunnels have been carried beneath Morton and Greenwich Streets on the Manhattan side, to Christopher Street,



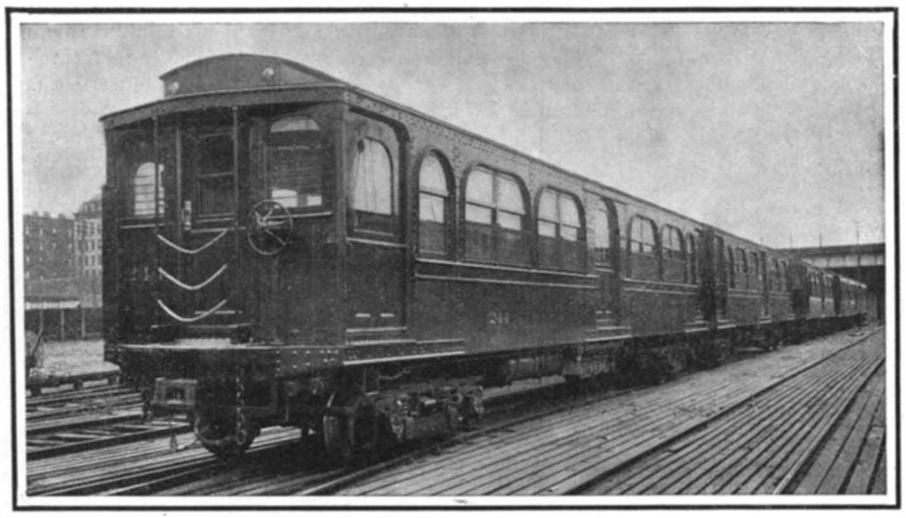
The Shield Cutting Edge Breaking Through Bulkhead at Sixth Avenue and Twelfth Street After Completing the Driving of One of the Tubes Under the River.



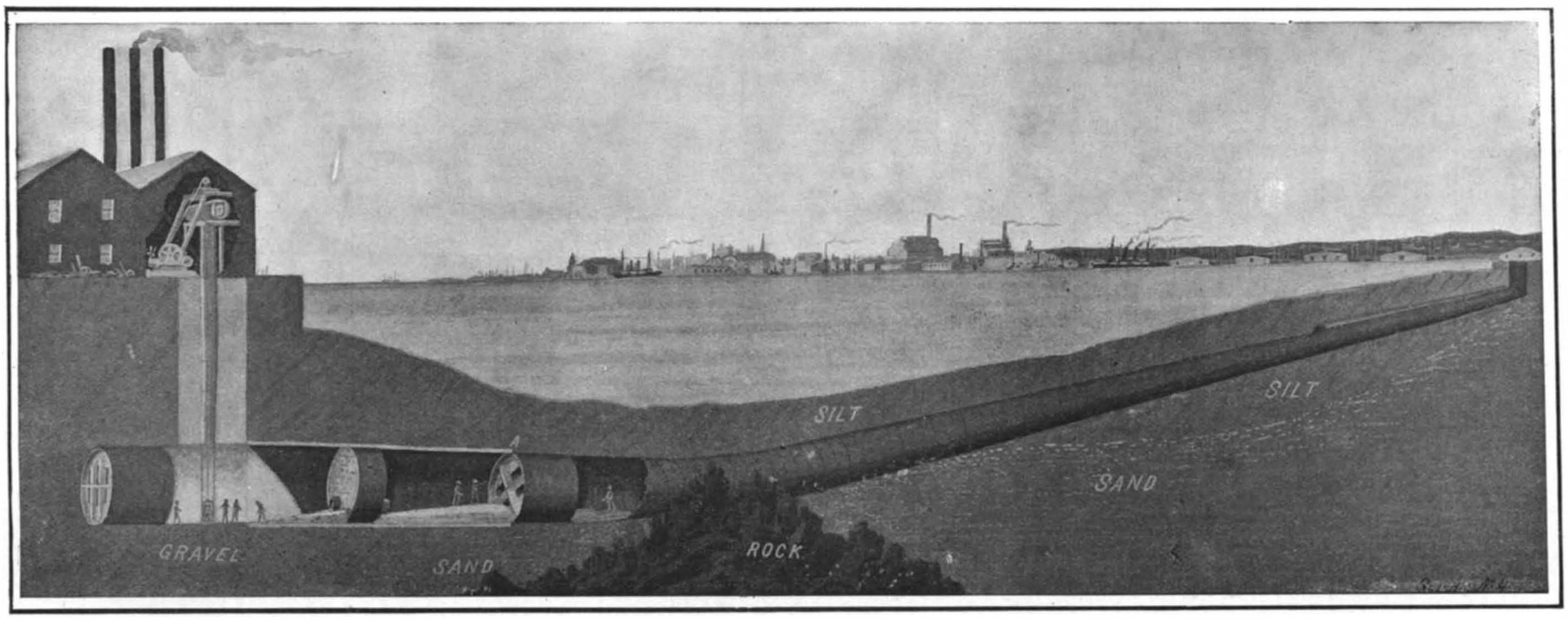
A Curve at Morton and Greenwich Streets With Vertical Side Walls. When Completed the System Will Comprise Eighteen Miles of Under-river and Underground Railroad.



A Crossover West of Greenwich Avenue Station, Showing the Separate Twin Tunnels.



A Train of the New Steel Cars for the Hudson Companies' Tunnels. Large Sliding Side Doors are Features of the Cars.



Sectional View, Showing the Course of the Tunnel Under the Hudson River.

OPENING OF THE HUDSON RIVER TUNNEL SYSTEM.

and the junction of Ninth Street and Sixth Avenue. Here they branch into two separate pairs of tunnels, one of which extends beneath Ninth Street to Fourth Avenue, to a connection with the present Fourth Avenue Rapid Transit Subway. The other branch extends north below Sixth Avenue to 19th Street, which point will constitute, for the present, the terminus of that portion of the tunnels which is about to be opened to the public. Ultimately, as fast as the work can be done, the Sixth Avenue tunnels will be extended to Thirty-third Street, where a station, of ample size to accommodate the large amount of traffic which will seek this route, will be built. At Thirty-third Street the new system will be in touch with the Pennsylvania Railroad tunnels across Manhattan Island and the great terminal station between Thirty-first and Thirty-third Streets and Seventh and Ninth Avenues. At this point, therefore, passengers from New Jersey using the Hudson Companies' tunnels will be able to change to the cars of the Long Island Railroad system. The Jersey shore line subway, south of the intersection with the Morton Street tunnels, will tap the Erie Railroad terminal, the Pennsylvania Railroad terminal, and ultimately the terminal of the Central Railroad of New Jersey.

The downtown tunnels, extending from the Pennsylvania Railroad terminus in Jersey City to the Manhattan shore, will consist, like the rest of this system, of two single tubes with a single track in each. The station which has been excavated below the Pennsylvania Railroad terminal station has been blasted out of the solid rock at a depth of 85 feet below street level. It is 150 feet in width, and with its approaches is nearly 1,000 feet in length. It provides for four, and in some cases, five parallel tracks, two for through trains, and two for local trains. Access to the station is had either directly from street level, by a subway below the floor of the upper station, or from the station floor itself by means of six passenger elevators. Two elevators lead directly to the street, and four of exceptional size, each capable of holding over a carload of passengers, lead directly from the platforms of the tunnel station to the platforms of the Pennsylvania station overhead. The southerly tube of the downtown tunnels passes below Cortlandt Street until the big terminal building of the company is reached, where it swings in to a large terminal station below this building, having five separate tracks and separate loading and unloading platforms for the passengers. The trains on leaving the station pass into the return tunnel, which is built below Fulton Street and returns underneath the Hudson River to the tunnel station below the Pennsylvania depot in Jersey City. A subway leads from the Cortlandt Street terminal station to the Rapid Transit Subway below Broadway.

The cars are built entirely of steel. They are absolutely fireproof, and are constructed upon a plan differing materially from any others now used in the Metropolitan district. They have large, sliding side doors in the middle, as well as at either end, and the platforms are so arranged at the terminal stations that passengers enter and leave the cars at the same time. Those leaving go out on one side, and those entering the cars come in on the opposite side. This will do away with the congestion and crowding experienced at terminal stations on other Metropolitan railroads. All station platforms throughout the system are built on a tangent, or straight line, so that there is no dangerous space between the cars and the platform, such as is seen where stations are built on a curve. The doors of the cars are operated by compressed air, and no signal bells are used. When the last door in the train is securely closed, the motorman receives an electric flash signal, and starts the train. The automatic adjustment is such that the signal to start cannot be given so long as any door in the train remains open the fraction of an inch. The cars are brilliantly lighted and very comfortable. They have only side seats, and are equipped with steel rods set vertically at frequent intervals, to aid passengers in steadying themselves when trains are crowded.

Throughout the system, which, when completed, will comprise eighteen miles of under-river and underground railroad, the stations are designed with a view to comfort, permanency, and beauty. They are made large enough, not merely to accommodate the Metropolitan traffic of to-day, but to receive comfortably the greatly increased multitudes sure to travel by subsurface routes in the decades to come. Every part of the stations is constructed either of concrete or metal, so that, like the cars and the tunnel, they are thoroughly fireproof.

To the passengers who descend into the tunnel for the first time, the architecture of the stations is the most striking feature, and particularly so if they have an eye to the general fitness of things. The roof is formed of vaulted arches, which show a pleasant effect of light and shadow produced by the glow of incandescent globes.

The engineering features of the Hudson Companies' tunnels are full of special interest. We have already referred to the early attempts to complete the Morton Street tunnels. The original shaft constructed at the westerly end of the tunnels, is 30 feet in diameter and 65 feet in depth. It is brick-lined and opens into the power house in which the new operating plant is installed. The external diameter of the northern tunnel is 19 feet 5¼ inches and its internal diameter 18 feet 1¼ inches. The southern tunnel is 15 feet 3 inches in internal diameter, and 16 feet 7 inches in external diameter.

Both tunnels were built by the Greathead shield system and lined with a cast-iron shell which is made in segments provided with internal flanges by which the shell is bolted in place.

After the English company abandoned the construction of the northern tunnel in 1891, it was allowed to fill with water. When the work was taken in hand by the present company the tunnel was pumped out, and it was found that with the exception of some 470 feet, the work already done was in good condition. This was in the latter part of 1896, and from that time until 1902, when orders were given to proceed with construction, the tunnel was regularly pumped out and maintained in good condition. A new building was erected at the Jersey shaft, equipped with a very complete power plant, including hydraulic pumps, air compressors, etc. The shield which was used by the English company was overhauled and was used in completing the north tunnel. It was designed for use only in silt, and when the tunnel reached a point where rock and boulders were encountered in the lower half of the excavation, it was found necessary to build a heavy apron, extending 6 feet in advance of the upper half of the cutting edge, and reaching from side to side of the shield. This apron was built of 12-inch I-beams and ¾-inch steel plates, and was strongly braced. Under the shelter of this apron, which was heavily shored up, the workmen were able to pass forward of the shield and drill and blast out the rock below it. This work is unique in horizontal shield excavation, and it was carried forward with complete success.

The method of operating the hydraulic shield is so well known as to need no detailed description here. It was forced forward into the silt by means of hydraulic rams set up between the front edge of the completed iron lining of the tunnel and the rear edge of the shield. As it moved forward, the silt was squeezed through open inlets into the interior of the shield, where it was broken off, loaded into trucks, and drawn away from the heading by a cable.

On the south tunnel new air-locks were installed, and the necessary machinery built. The shield for this work, which was designed by Jacobs & Davies, engineers of the company, is shown in the accompanying engraving. It will be seen that it is divided by one horizontal and two vertical frames and by transverse diaphragms. The shell is double and the whole construction is calculated to give great stiffness and resistance to distortion. It is provided in front with a movable working platform which, if necessary, may be carried forward of the cutting edge. In the rear it is provided with the necessary hydraulic jacks, valves, etc., for carrying forward the shield and for swinging the erector—a massive arm which moves something like the hands of a clock, and is used for picking up the cast-iron plates and placing them in position ready for bolting up. It is interesting to know that in spite of the difficult nature of the material through which the tunnel was driven, there being, in some places, rock below and soft silt in the upper half of the tunnel, progress was made at the rate of between 4 and 5 feet a day. The work was rendered particularly hazardous by the fact that there was at times a hydraulic head due to 65 feet of water, and that there was only 10 feet of soft silt between this hydraulic pressure and the roof of the tunnel. In driving the Cortlandt Street tunnels the shield was driven bodily forward, forcing the material to give way by displacement. Great credit is due to the chief engineer, Charles M. Jacobs, and his staff for the speed and accuracy with which they have brought this great work to its successful conclusion.

In closing the present article, it is gratifying to be able to state that by the time this issue is in the hands of our readers, the first of the four tubes of the Pennsylvania Railroad below the East River will have been put through, and that all four connections will, judging from present progress, be opened through within three months.

THE TESTING OF A LOCOMOTIVE.

BY FREDERIC BLOUNT WARREN.

Powerful locomotives, no matter how costly, do not matriculate from the builders' shops into the class that draws the sixteen-hour trains to Chicago, or pulls the Lake Shore flyers, without first having demonstrated their capacity by a series of most exacting tests.

Railroad officials must have some better proof of an engine's capacity than the mere indorsement of the men who make the mechanism. So, when locomotives come newly painted and polished from the big Baldwin shops, for instance, the owners send them into testing plants, mount them upon a delicate and compact series of registering instruments, and run them at all speeds, until their weaknesses have been detected and their strong points emphasized almost to a fractional degree of an atom. The testing machinery is, in reality, nothing more than a treadmill, in principle. In outward appearance it seems to be just so many large wheels revolving on axles, so arranged that each wheel of the engine under test meets a corresponding wheel in the tester.

Once in position, an engineer climbs into the locomotive cab, opens the throttle until it has reached its widest point; the steam shoots into her tubes and chests, the great wheels begin to revolve, gain speed and finally become a circling blur, in which the eye is unable to detect the interstices. Deriving the full power from its fuel, the forward or backward movement of the locomotive is nevertheless barely a fraction of an inch.

This is an unromantic testing beside that which Kipling described with characteristic vigor. The "tryout" which he depicted consisted of taking an engine, hitching it on to heavy freight cars and sending it out on the line, on levels and tangents, on curves and grades, until the machinery demonstrated its worthiness to take the speedy runs of its owners. Railroad men to-day are more exacting. Figuratively, their testing plants ask questions of a mass of wonderfully-constructed iron and steel, and the metal answers them in their entirety.

The chief plant of this kind is located in Altoona, Pa., being a part of the extensive shop system of the Pennsylvania Railroad. With a force of sixteen men, it has been in constant operation since November 19, 1906, and, on an average, about three complete tests are made each week.

A separate building of steel and brick has been erected for housing the apparatus. The driving wheels of a locomotive under test rest upon supporting wheels with rims shaped to correspond with the head of a rail. The axles of these supporting wheels carry absorption brakes. The turning of the driving wheels causes the supporting wheels to revolve, but these are retarded to any extent desired. The work actually done by the locomotive consists in overcoming the friction resistance of the supporting wheels and brakes, the resulting force exerted at the drawbar being measured by a traction dynamometer. The axles of the supporting wheels run in heavy pedestals secured to cast-iron bedplates resting upon a concrete foundation. There are two bedplates running parallel to the track, and in order that the supporting wheels may be directly beneath the locomotive drivers, these bedplates are provided with T-slots, so that the pedestals may be moved along parallel to the track, and secured in any position to suit the particular engine under test. The only wheels of the locomotive which move during a test are the drivers. The wheels of the leading truck rest upon rails secured to I-beams and supported upon the same bed-plates that carry the pedestals. The wheels of the trailing truck rest upon supporting wheels—which remain stationary during the test—and are carried by pedestals secured to longitudinal bedplates.

Preparation of the testing plant to receive a locomotive consists of bolting the pedestals to the bedplates, so spacing them that there will be a pair of supporting wheels directly beneath each pair of drivers of the locomotive. A section of special rail is bolted to the inside faces of the supporting wheels. This rail is composed of a heavy I-beam, to the top of which is secured a grooved head in which the flanges of the drivers run. The top of the supporting wheels are in line with the track entering the testing plant building, so that a locomotive can be backed in and the drivers will run on their flanges until in position directly over their supporting wheels. After a locomotive has been secured in place and its drawbar attached to a dynamometer, these grooved rails upon which it ran in are removed, leaving the drivers resting upon the supporting wheels.

The axle for each pair of supporting wheels carries upon each of its overhung ends an Alden absorption brake. Each of these brakes consists of two smooth circular cast-iron disks, keyed to the supporting-wheel axle. On each side of each one of these disks is a thin copper diaphragm secured at its periphery, and also at its inner edge to a housing which does not revolve and has its bearings upon the hubs of circular revolving disks. The stationary housing is so designed that when it is filled with water under pressure the copper disks are forced against the revolving disks, creating friction. Provision is made for securing continuous and uniform lubrication of the surfaces of these revolving disks, and the water is caused to flow through the housing in order to carry away the heat generated. Thus the water performs two functions: it supplies pressure to cause the friction, and it carries away the heat generated by the friction.

Connection between each brake and the source of water supply is made by a flexible hose. Discharge pipes for all the brakes empty into an iron trough, and each pipe is provided with a valve located adjacent to the valve in the supply pipe for the same brake. When placing a load upon the locomotive under test, these valves are adjusted until the individual brakes each absorb their share of the work. When this preliminary adjustment has been made, the power absorbed by all of the brakes may be increased or decreased by operating a large valve in the supply main.

A special system has been installed for the purpose of supplying water under uniform pressure for use in the brakes.

An adjustable drawbar is used to connect the locomotive with a dynamometer and, in addition, the dynamometer housing is provided with a means for raising and lowering the dynamometer proper to bring this drawbar truly horizontal. Two safety bars are provided between the locomotive and the dynamometer frame, to decrease the vibration transmitted to the dynamometer through the drawbar. At their ends these bars have universal joints to insure perfect freedom of adjustment, and each bar is provided with an oil dashpot near the dynamometer end.

The Pennsylvania Railroad's traction dynamometer, which measures the drawbar pull of the locomotive, is of the lever type. The weighing mechanism is supported by a frame, which slides up and down in ways formed by the housings. These housings are very massive, rigidly secured together, and anchored to a heavy foundation. The lever system is constructed upon the Emery principle, in which flexible steel fulcrum plates take the place of knife edges used in ordinary scales. As the levers are vertical instead of horizontal, their weight would not come upon the flexible fulcrum plates in the direction in which they transmit pressure. In certain cases it has therefore been necessary to supply two fulcrum plates with their axles at right angles, one for carrying the weight of the levers, and the other for transmitting the thrust.

The mechanical and mathematical detail entering into this phase of locomotive testing is so delicate and complicated that it would be, in an article of this kind, almost wholly unintelligible to the lay machinist, though of course easily understood by trained engineering minds.

Of very great interest, however, are the records obtained on a recording table, over which an endless strip of paper eighteen inches wide is mechanically drawn, and upon which a continuous story of the test and its results is told. The paper is driven by direct connection with one of the supporting wheels of the testing mechanism, upon which the locomotive drivers rest. The speed reduction is so arranged that when the locomotive under test travels one mile on the supporting wheels, the paper moves 52.8 inches, giving a scale of 100 feet to the inch upon the diagram. In order to obtain an accurate movement of the paper, it passes between a finely corrugated brass roller and another roller covered with rubber. The winding drum to which the paper is finally delivered is arranged to slip upon its shaft, in order to accommodate its constantly increasing diameter as the test progresses.

A datum pen marks a continuous straight line upon this paper. A traction recording pen moves across the paper perpendicular to the datum line, being dependent upon the force transmitted by the drawbar from the locomotive. The maximum travel of this pen away from the datum line is eight inches. Two sets of springs are provided. With the heaviest set the eight-inch movement of the traction pen corresponds to a load of 80,000 pounds upon the drawbar, which represents the maximum capacity of the dynamometer. With the other set of springs the eight-inch motion of the traction pen corresponds to a pull of 40,000 pounds upon the drawbar, and with all the flat springs removed the eight-inch motion corresponds to a 16,000-pound load. The total motion of the drawbar to give the eight-inch movement to the recording mechanism is about 0.04 of an inch. The multiplication of the recording and weighing mechanism is therefore 200 to 1.

An integrator is provided and attached to the traction recording mechanism, so that the foot-pounds of work performed by the locomotive is automatically summed up. Five additional electrically-operated pens are provided. They normally draw continuous straight lines. One of them is electrically connected to a clock, so that each second is indicated by a jog in the straight line which the pen normally draws. Another pen is electrically connected to a roller, which is rotated by the recording paper, causing the pen to make a jog in the line for every thousand feet which the locomotive travels. Another pen is electrically connected to the integrator, and makes a jog in its line every time the integrator measures one square inch. The remaining electrically-operated pens are used for recording such features of the test as taking indicator cards.

For handling coal used by the locomotives under test, a very complete plant has been installed. Bottom-dumping railroad coal cars are run in on a track beside the test building. They are dumped into a large hopper, and from this the coal is carried by a bucket conveyer to two elevated reinforced concrete pockets, each of which has a capacity of about fifty tons. Each coal pocket is provided with a hopper cut-off gate at a convenient height above the main floor of the test building. Coal from the bins, as needed, is discharged through the gates into wagons holding about 1,000 pounds each, which are run over weighing scales, pushed out to the locomotive, raised by hydraulic elevator to the firing platform, and then dumped.

Ashes from the locomotive are discharged at the pit level, placed in wagons, and removed.

A supply tank located in the corner of the laboratory supplies the water used in the locomotive boiler. This water first passes through a meter, the reading of which is used as a check upon the weighing tanks. A small motor-driven centrifugal pump returns to the supply tank the overflow from the injectors used on the locomotive.

So unique and complete is this big testing plant of the Pennsylvania Railroad, that rarely is there a week that passes when engines of other railroads are not tested because the owners of the locomotives lack the facilities in their shops to determine the road value and capacity of their own transportation haulers.

For the completeness of this plant and the highly-maintained state of perfection the Pennsylvania officials attribute much credit to Mr. Theodore N. Ely, Chief of Motive Power of the Lines East.

According to L'Eclairage Electrique, traction by steam locomotives fitted with smoke consuming apparatus is to be temporarily re-established in the Simplon Tunnel, owing to the fact that the locomotives lent by the Valtellina Railway have given rise to difficulties in working. Their dimensions cause them to act as pistons, and thereby a great deal of energy is absorbed. Further, on account of the condensation, arising from the difference of temperature inside and outside the tunnel, the insulators deteriorate, and several motors have been damaged. Modifications which have been introduced in the motor insulation will, it is hoped, satisfy these special operating conditions.

Correspondence.

Energy of Recoil of Guns.

To the Editor of the SCIENTIFIC AMERICAN:

In looking through an article on "Guns and Armor" in your issue of December 7, 1907, I happened to notice an erroneous statement which seems worth correction. The author of that article says: "At the instant that a 12-inch projectile is driven from the muzzle of the gun with an energy of over 44,000 foot-tons, the gun itself is driven in the opposite direction, backwardly, with exactly the same energy."

It is lucky for the designers of our gun carriages that this is not true. Of course it is the *momentum* of the parts moving backward which exactly equals the momentum of the parts moving forward. The *energy* of the projectile is vastly greater than the energy of the gun, for the simple reason that the former moves very much farther than the latter under the action of the effective force, the powder pressure.

PHILIP B. ALGER, Professor U. S. N.

Annapolis, Md., January 3, 1908.

Effect of the Manhattan Terminal on the Manhattan and Williamsburg Bridges.

To the Editor of the SCIENTIFIC AMERICAN:

In the issue of the 8th instant you published a very interesting article on the permanent Manhattan terminal of the Brooklyn Bridge, and I would like to call your attention to the effect of this improvement, not only on the Brooklyn Bridge, but on the Manhattan and Williamsburg bridges.

In the first place, the plans of the Bridge Department for this permanent double-deck Manhattan elevated terminal at the Brooklyn Bridge will cut off any possibility of an elevated connection between the Brooklyn, the Manhattan, and the Williamsburg bridges, and, further than this, elevated trains are to operate through the Center Street subway, interfering seriously with future extensions of the several Brooklyn subways, which must connect with and depend for efficiency throughout upon quick transit through this Center Street subway as the main objective of all Brooklyn subway service.

At the present time, construction is being carried on by which the elevated railroad tracks at the Manhattan end of the Brooklyn Bridge may be spread, allowing two central tracks to descend at a sharp grade, which terminates on a curve at a station to be located under and north of the old Staats-Zeitung building, while plans are rapidly progressing by which a great municipal building will occupy the site above, shutting off any possibility of extending the elevated tracks from either of the two upper-deck terminals, which are to be built under the plans of the Bridge Department.

At the Manhattan Bridge the four tracks on the upper level are to be at such an elevation that no feasible approach can be arranged at the New York end; and while notification was sent by the Board of Estimate some time ago to all transportation companies, inviting applications for the right to operate over the Manhattan Bridge, no use of these four upper tracks is to-day physically possible, except by constructing an unsightly elevated incline on the newly-acquired Flatbush Avenue extension, so as to allow the Brooklyn trolley lines to get to the upper tracks and then run to New York, and terminate at such an elevation above the street as would seem to preclude any chance of the tracks extending to the street surface there.

Without any elevated railroad connection from the upper tracks of the Manhattan Bridge at the New York end, it has appeared necessary to the authorities to turn over two of the lower tracks on the bridge for the Brooklyn elevated railroad, which is now designed to run through Flatbush Avenue from Fulton Street, and to descend near the bridge approach to the street level, so as to connect with these lower tracks of the Manhattan Bridge.

Even with this peculiar arrangement proposed, by which the trolley lines in Flatbush Avenue extension pass up an inclined plane, and the elevated lines there are to run down an inclined plane on the Bridge Plaza in going to New York, the grade for the elevated trains from the lower deck of the bridge to the Center Street subway is so steep as to be considered by the Brooklyn Rapid Transit Company prohibitive, requiring the equipment of every car with high-power motors, and the proposed grades for the elevated tracks into the Center Street subway at all three of the bridges are practically the same.

Such arrangements on the Manhattan Bridge are inconsistent with its design and purposes, with its four upper-level tracks originally intended for elevated service by an elevated connection in Manhattan.

At the Williamsburg Bridge a long-delayed contract, providing for elevated connection with the Broadway line, has been carried out, and nearly a year ago the Department of Bridges made a contract providing for tearing down about half a mile of the elevated structure at the Manhattan end of the Williamsburg Bridge, by which these Brooklyn elevated trains will now run down to a station in Delancey Street, and ultimately through the Center Street subway to the other two bridges.

Looking for a moment at our Brooklyn Subway Loop Line, which is being built by the city as a part of the Broadway-Lafayette Avenue subway, of the Fourth Avenue subway, with the Coney Island extension, and properly of the Flatbush extension, which it could also serve, it must be admitted that the four tracks in the Center Street subway will be necessary for these lines extending over the three bridges and for the Pineapple Street tunnels, which are now proposed by the Public Service Commission as connections of the Center Street subway. To load this Center Street subway with all the through elevated service as well, in the short Manhattan run, where stations are at short intervals, must result in congestion, which will reduce the capacity of both systems, and especially prevent efficiency throughout the subway extensi-- in Brooklyn. This Center Street subway was to be the nucleus of future subway *extensions*, as provided in the resolution of the Board of Estimate providing for spurs and further connections from the Broadway-Lafayette Avenue line, and it seems evident that the Center Street subway will be fully loaded, and that independent provision should be made for the elevated service of Brooklyn.

The history of the Stevenson elevated loop scheme through the Bowery line and the older proposition of Engineer Martin for the Center Street elevated loop is all pertinent to the question to-day, and immediate action should be taken leading to a rational treatment of this elevated service connection in Manhattan for the Brooklyn lines. Objections to the double-deck elevated line proposed through the Bowery were principally in the great distance off Broadway, through which a large part of the traffic would reach the bridges, and from the fact that the proposition was so tied up with demands of the Interborough Company, that the Brooklyn interests could not be separated and treated on their merits. A Center Street elevated road seems to be out of the question, and it is for this reason that we have for the past year urged the construction of the Baxter Street Elevated Bridge Loop, which was incorporated at our suggestion in the amended Dowling Bill last year. It is a plan which is thoroughly practical as to line and grade, and running through a street where the improvements are generally unimportant, and where the grade of the elevated structure through Baxter Street and private property may readily be carried through to the subway on Delancey Street or to an elevated structure through this very wide bridge approach, provided for this purpose by the city.

There is no more important Brooklyn proposition to-day than this elevated connection in Manhattan, from the fact that it affects the utility of both the present elevated service and the future subway service for Brooklyn. The Brooklyn Rapid Transit Company were ready a year ago to pay a fair rental on the cost of this Baxter Street elevated loop, with its favorable grades and alignment, and proposed furthermore to utilize the available space under the structure for trolley connection between the bridges. Without the elevated loop in Manhattan the city cannot use the upper tracks of the Manhattan Bridge for elevated service, and the utility of the Brooklyn subways is reduced to such an extent as to delight the opponents of city control of city utilities. Opposed to us are the Interborough and other private interests working for the crippling and permanent defeat of what is being attempted by the city at this critical time in transit extensions for the city, and the public should understand these definite issues.

R. WALTER CREUZBAUR,
Consulting Engineer of Public Works,
Borough of Brooklyn.

Brooklyn, February 13, 1908.

The Growth of Modern Steamships.

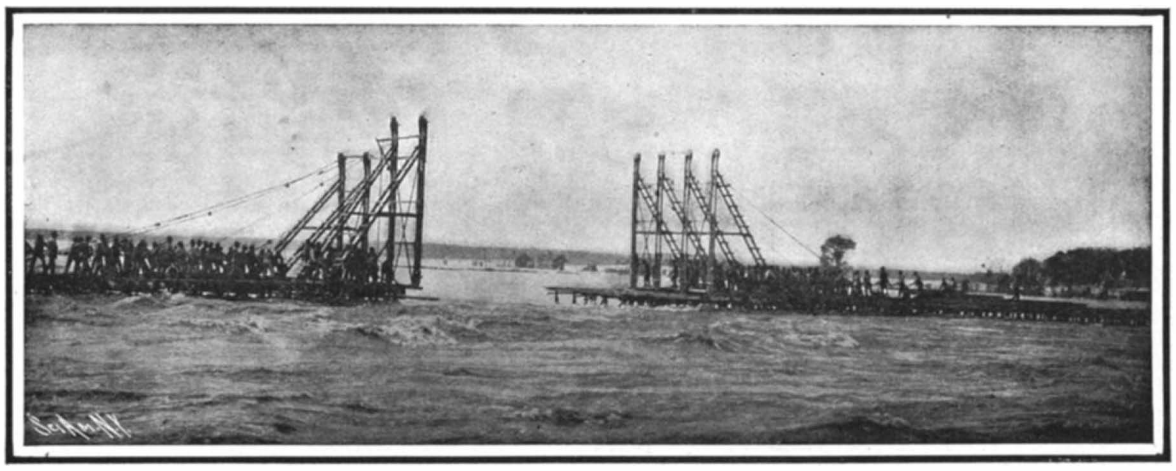
The maximum size of ocean-going steamships has doubled within the last ten years, and prophecies are frequently heard of continuous growth, alike in size and speed. It seems probable, however, that in the immediate future there will be little increase in the size or speed of steamships. Speed does not pay, and some regard must be paid to the depth of harbor channels and the capacity of drydocks. Before vessels larger than the "Lusitania" are designed, there must be some assurance that they can get in and out of the ports which they are likely to visit. Any demands created by expanding commerce can easily be met by increasing the number of vessels to be devoted to it and by increasing the frequency of sailing dates.

Every knot of speed added beyond a certain point means a more than proportionate expense. And speed is not everything. More than one of the transatlantic lines are noted for the roomy comfort of their steady, slow-traveling boats, which neither pitch unduly in rough seas nor transmit a constant vibration from the engines.

CLOSING A 700-FOOT BREAK IN THE MISSISSIPPI LEVEES.

BY PAUL J. BRAND.

While the freshets of 1907 set no new record for high water in the lower Mississippi, yet they were of tremendous importance as showing that the great Father of Waters may be curbed and controlled by the skill of American engineering, and that, though the swollen waters may, through the circumstances of some local defect, break through the long-winding levee system, they can be turned back into their channel and, with no great delay, agriculture may be resumed in these most fertile fields in the world.



Bridging Over the Deepest Part of the Torrent.

In other words, the high water of 1907 served to demonstrate that the levee system can be maintained in its integrity, and that if a crevasse should occur, it can be closed, no matter what its width or depth, at an expense which appears small, indeed, if we consider the benefit derived by the affected area.

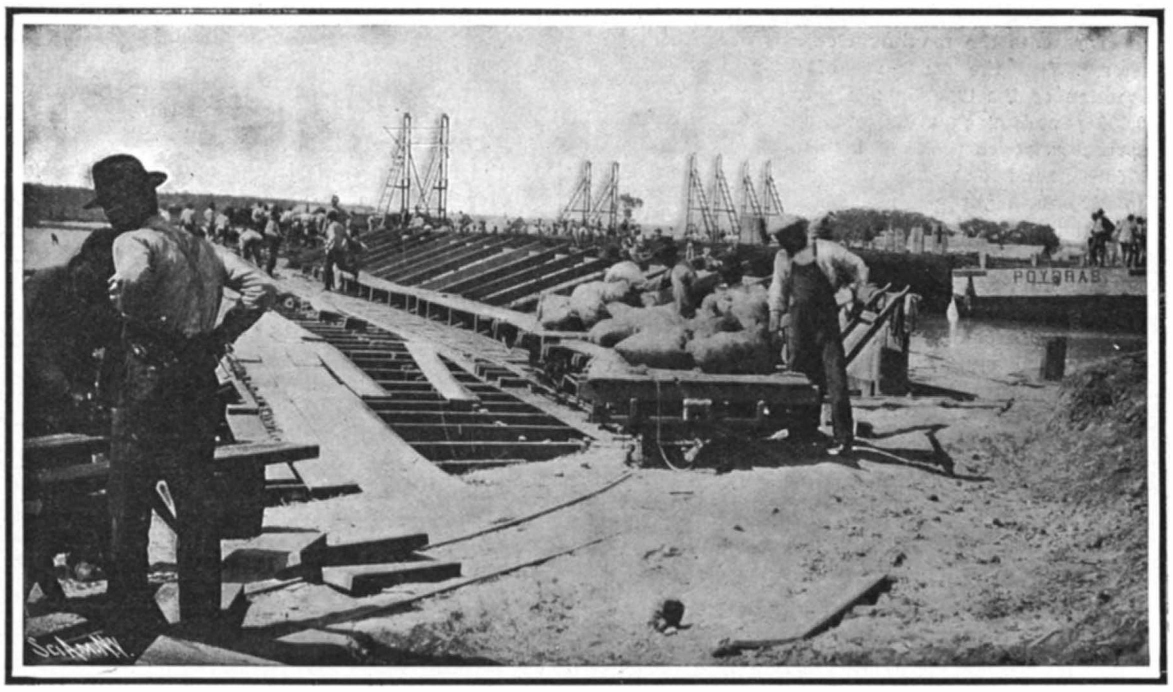
To make the subject plain, it is necessary to state that an immense section of the United States in the lower Mississippi Valley, along the Mississippi, as well as other streams, is of alluvial formation, either entirely or in part. For its protection during seasons of high water, when the melting snows and ice and rain water from the upper country come pouring down, swelling the Mississippi and all its tributaries, and rivers rise to stages varying from five to ten feet or more above the country through which they run, high embankments of earth are built along the shores of the streams.

A break in this line of embankments, or levee system, is locally known as a "crevasse." Crevasses, as the levee system has been perfected and strengthened, have been occurring more and more rarely, but it still sometimes happens that a muskrat or crayfish will bore a hole through the base of the levee during the night, and the water, washing through the opening, will enlarge it with incredible rapidity and tear a breach through the levee, which, if not checked in its incipiency, will flood hundreds of square miles of farm lands.

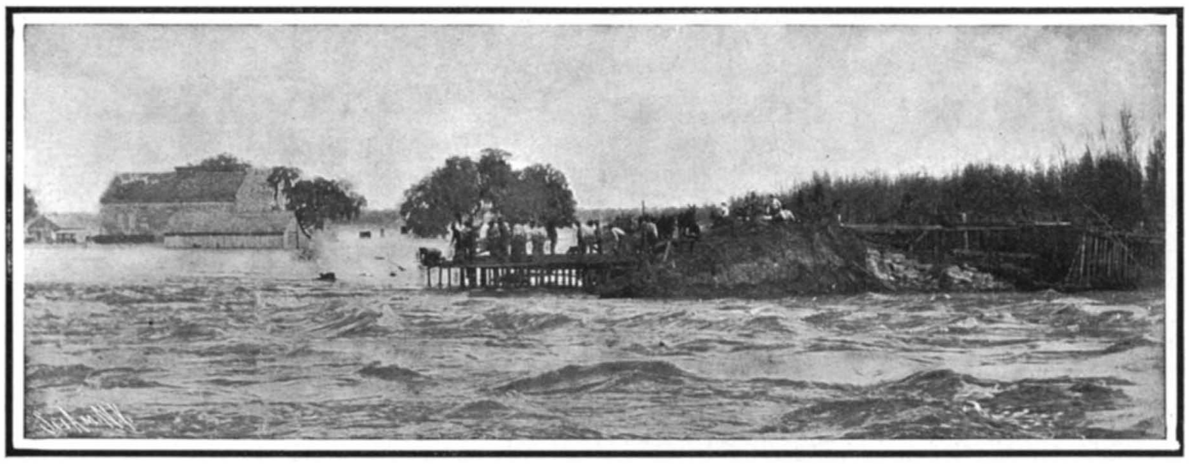
From Memphis down to the end of the levee system below New Orleans, there was in 1907 but one break throughout the long period of flood—the Live Oak crevasse, caused by a muskrat hole in a bank 15 feet high. This was closed at a cost, covering all expenditures, of $24,599.36, according to the vouchers and reports submitted upon the completion of the work by the Hon. Theodore S. Wilkinson, a former member of Congress and manager of an important group of plantations, who undertook the closure of the breach at the urgent request of the residents of the locality.

Before the work of closure was finished in every detail, the river had begun to rise again, and within a few days had returned to a 17-foot stage, but behind the closed crevasse, cane had been replanted and was growing, other crops had been set out, and all indications pointed to an exceedingly good agricultural season.

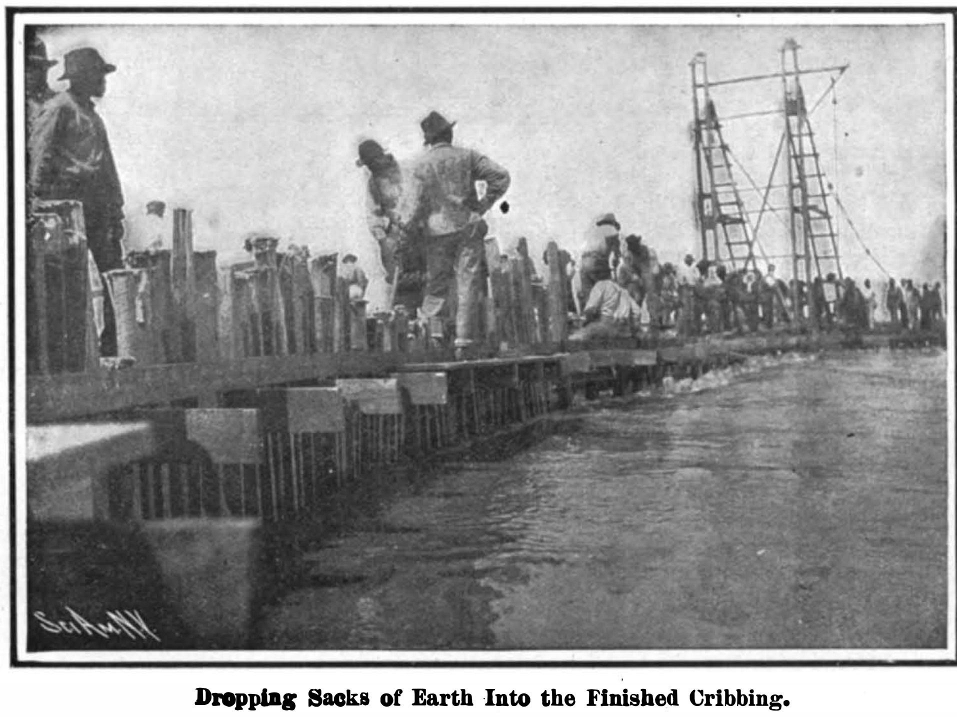
Besides the great gain in redeeming a vast stretch of country from the spreading waters, and independently of its interesting feature as the first break of such magnitude successfully closed, the Live Oak crevasse was a matter of national importance, or, at least, of prime importance to the entire Mississippi Valley, for it served to prove the correctness of the theory of the engineers that the only way to adjust the slope of the river, to prevent the formation of bars and the consequent banking of waters and abnormally high levels, is to keep all of the waters of the stream confined within the levee system. A crevasse naturally causes a more or less pronounced sluggishness of the river, permits the sand and detritus to deposit, and there follows a bar across the channel a mile or so below the break. Last year there was but one crevasse, and it was closed. The river above, between Memphis and New Orleans, showed the effects of scouring. In spite of the inordinate volume of the flood at Memphis, New Orleans was below her high-water record. The next high water will be still lower.



Putting on Finishing Touches to the Closed Crevasse.



Rush of Water Through the Crevasse Flooding Farm Buildings.



Dropping Sacks of Earth Into the Finished Cribbing.

Driving Four Piles Simultaneously with Negro Labor.

CLOSING A 700-FOOT BREAK IN THE MISSISSIPPI LEVEES.

Navigation will continue improving all along the river as the slope is adjusted and bars disappear, and if there should be any crevasses, they will be closed.

Early in January of last year, the weather bureau began to send out warnings of coming high water. Hurried preparations were made in the various river districts by the United States and State boards of engineers, for much levee work had been undertaken. New Orleans, with its entire river front absolutely protected against the highest possible water, and with protection levees on all sides, was not in the least danger; but the city was full of Carnival visitors, and the natives feared the moral effect of a crevasse far more than the pecuniary loss, which they knew must be comparatively small. But during the night of February 21, 1907, the news reached the city that the levee at Live Oak plantation, about twenty-five miles down the river, had given away suddenly. So small an agency as a muskrat hole had done the work. The river, then showing 19 feet 8 inches on the weather bureau gage at New Orleans, or about 10 feet above the country at Live Oak plantation, poured through the break with a mighty rush. A watchman had passed the spot but a few hours before, but the muskrat hole underfoot was being steadily washed out, and within four hours after the levee gave way, the crevasse was fully 50 feet wide. Desperate efforts were made to hold the ends with cribbing, built outstream to break the force of the current on the broken levee, but to no purpose. The spot was at the end of a long reach in the river, where the current came with all the impetus of about five miles of straight headway. After several days of fruitless work, the crevasse was abandoned, and the water spread over a vast region, reaching as far up country as Algiers, opposite New Orleans, and over to the Gulf, where much damage was done to the extensive oyster beds of the State.

Then came the consoling forecast of the weather bureau, predicting that by March 5 the river would temporarily fall to a 16-foot level at New Orleans. The weather bureau had never yet missed a forecast on the river, and the news acted as a wonderful stimulant. Mr. Wilkinson was importuned to undertake the task of closing the break. He finally agreed, after obtaining the authority of the levee board in whose district the break had occurred, and preparations were made to begin the work when the river would be down at the lowest and most advantageous stage, to which it was rapidly falling.

It was found that the break had by then attained a width of 250 feet. Even at the lowered stage, the river was still some 6 or 7 feet higher than the country, and there were channels washed through the crevasse from 12 to 19 feet deep. Never in the history of the river had such a torrent been turned as that which poured through here, but Mr. Wilkinson, assisted by Colonel Sidney J. Lewis of the State board of engineers of Louisiana, and Superintendent J. S. Landry of the New Orleans, Fort Jackson & Ship Island Railroad, commenced the work on March 6, with the river at 5 feet 1 inch.

In the absence of batture, it was found necessary to build the cribbing, or framework destined to hold sacks of earth against the current, on the inner or land side of the broken levee, the depth in river, a short distance beyond the break, being as much as 75 feet. On lines furnished by the engineers, a structure in the form of a bridge, with four rows of light piling, was begun in a semicircle, both ends resting on the levee, on each side of the break, and the cribbing curving landward, so as to form a crescent, 700 feet in length.

So far, the proceedings presented nothing novel, but it was the method of driving the piles, and the bracing given them against the swift current, which alone made the closing of the break possible. In order to obviate the difficulty of driving piles symmetrically so that they might be solidly attached to each other, Mr. Wilkinson conceived the idea of building four pile drivers, connected with each other, and with hammers moved by hand-drawn ropes. By this means, four piles were suspended at the same time, let go simultaneously with the weight of the hammers, and fastened into the bottom before the current could have swerved them, a work which would have been well-nigh impossible by any other means. Once driven into the ground, the outer pile was braced by means of three pieces of wood, or scantling, loosely fastened together at one end with a bolt. The bolted pieces were pushed into the water along one pile, the bolted end down, the center piece fastened to the top of the pile, whose lower end was embraced by the projecting ends of the two side pieces, and these side pieces bent out to the top of the pile in the next row, to which they were securely spiked.

This method, used for the first time in crevasse work, assured success. On several occasions enormous drift logs floated in through the break and struck the cribbing with great force; but the bracing proved to be so strong that, although a few of the piles were broken, the main part of the cribbing remained intact and the damage could easily and quickly be repaired.

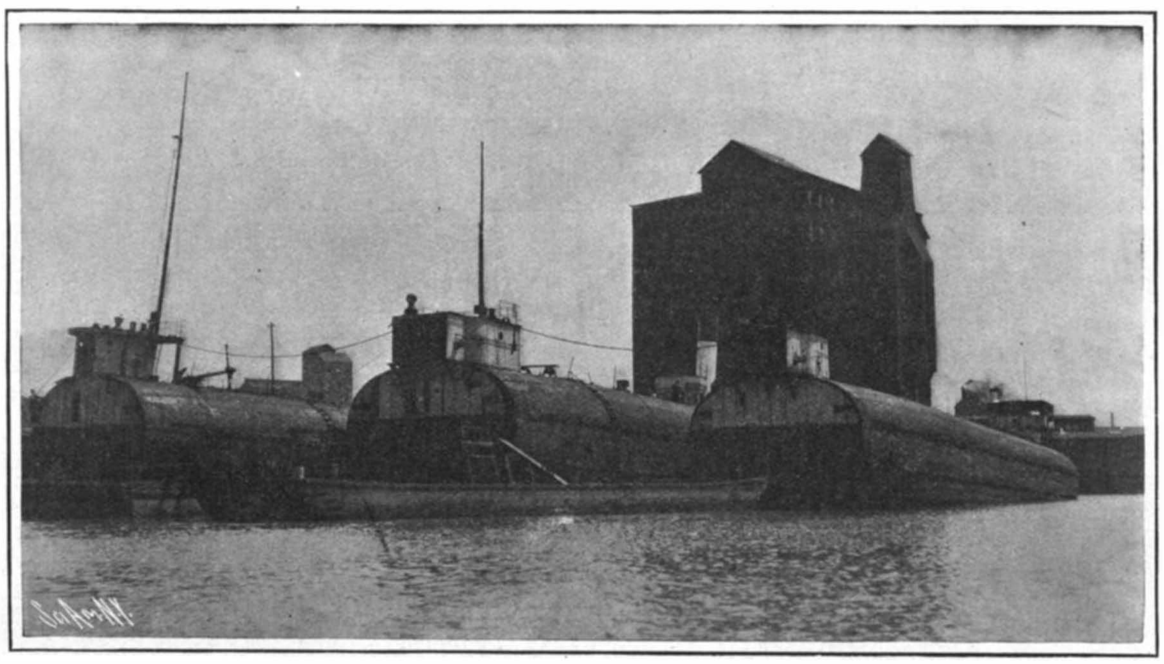
Another entirely new feature in the closing of this crevasse was the employment of a tramway for the distribution of material, and especially for the carrying of the heavy sacks of earth, which were filled with the material of the top of the existing levee, the only available dry earth. Owing to the lack of solidity of cribbings constructed on previous occasions at other places, the employment of trams had been out of the question, and all of the material had to be carried by laborers on their shoulders.

Another interesting detail is that it took some 60,000 sacks of earth to fill the finished cribbing, showing how necessary were the tramway and mule-drawn cars. Fully 20,000 sacks had to be replaced, that quantity having been found so defective that the rushing water washed the sandy earth out of them before they could get fairly settled on the bottom.

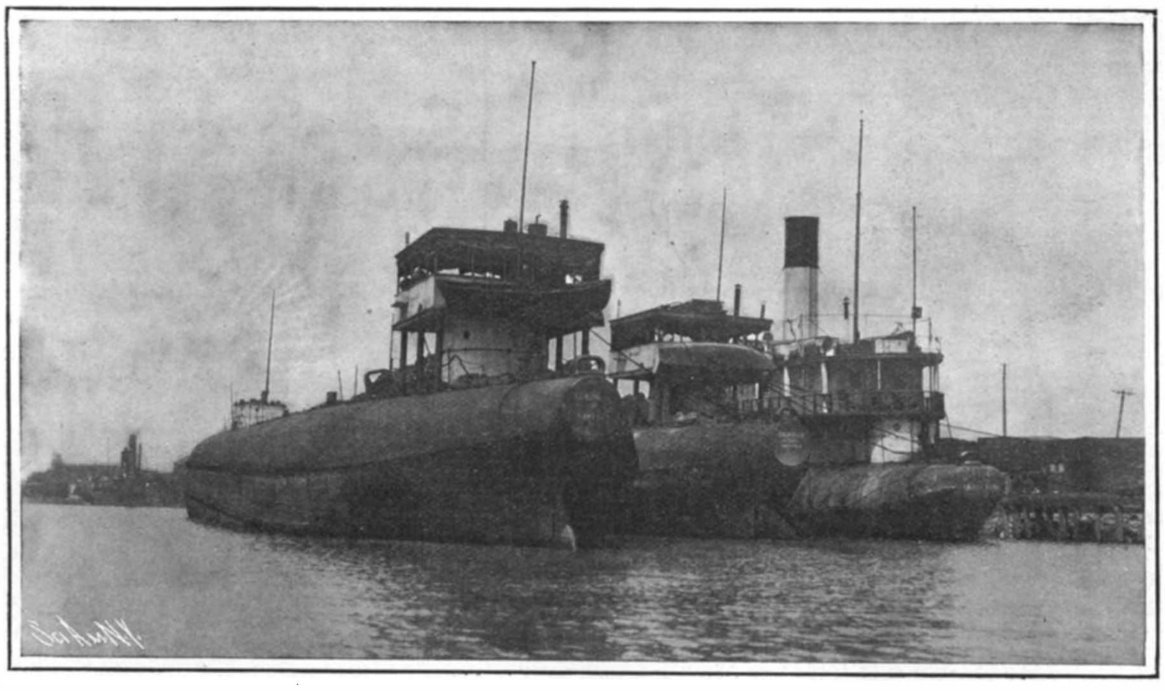
When the cribbing was finished, large quantities of rice straw were dropped in front of the break from a barge outstream, and this proved very serviceable in assisting the sacking to seal up the break.

All of this being finished, a row of sheet piling, making a waterproof fence, was driven immediately in front of the cribbing, and the water was completely shut out of the Live Oak plantation and adjacent country by March 17, the whole work being done in eleven days.

On March 21, when the work was formally accepted by the Lafourche Basin Levee Board and Mr. Wilkinson was presented with a gold medal, in recognition of his timely services, there was not a trace of flood water anywhere behind the closed crevasse, and the planter and the farmer were again working their fields.



Bow View of the Whalebacks After They Had Been Cut.



Stern View of the Whalebacks. The Bows Before Being Shortened Were Similar to the Sterns.

SENDING THE WHALEBACKS OUT TO SEA.

SENDING THE WHALEBACKS OUT TO SEA.

BY L. E. MOSS.

The Empire Shipbuilding Company, of Buffalo, recently had the contract for preparing three whalebacks—a steamer and two barges—for the trip through the Welland Canal.

The vessels, which had been bought by a Boston firm for the seacoast coal carrying trade, were sent down to Buffalo from the upper lakes. They were tied up in Buffalo and the work of cutting the vessels in two was begun. The photographs show the whalebacks after they were ready. The vessels measured 285 feet in length; and it was found that eighteen feet would have to be cut from each to make it short enough to pass through the Canadian waterway. It was no haphazard job. The forepart of each whaleback was carefully removed and the sections carefully numbered. Then the pieces were stored in the after hold. The odd appearance of the ships, as thus cut down, attracted no little attention, for the pilot houses projected over the bulkheads at which the hulls were cut in two.

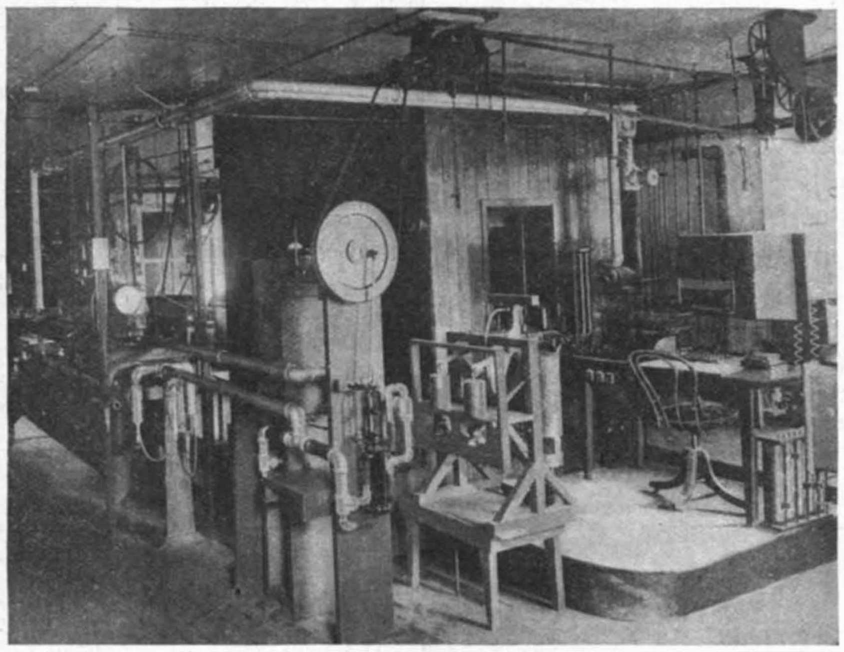
The three ships, the "Bombay," the "Bay City," and the "Baron," as thus shortened, left Buffalo, passed Port Colborne and down Lake Ontario and the St. Lawrence to the shipyards at Levis, opposite Quebec. Here they were docked again, and the hull sections that had been removed were taken from the hold and rebuilt in place. Thence the ships sailed out through the gulf and down to their destination at Boston. The whaleback, about eighteen years ago, was heralded as a revolutionizer in lake freight traffic. It was in 1891 that the first one crossed the ocean. That was the "Charles W. Wetmore," of 3,000 tons. It was at first thought that they would prove to be excellent vessels for carrying ore and other heavy freight. But the quarters for the crew are uncomfortable, and uncomfortable also is the motion of a whaleback, for it rolls like a log in heavy weather. The great lake steamers that are now plying the upper waters, of enormous capacities and economical to operate, have done much to crowd out the whaleback. Hence there are few of these odd craft to be seen in these days, and those that remain are gradually being transferred to the seacoast, where they can be used for short runs, mostly in the coasting coal traffic.

THE EFFICIENCY OF THE HUMAN MACHINE.

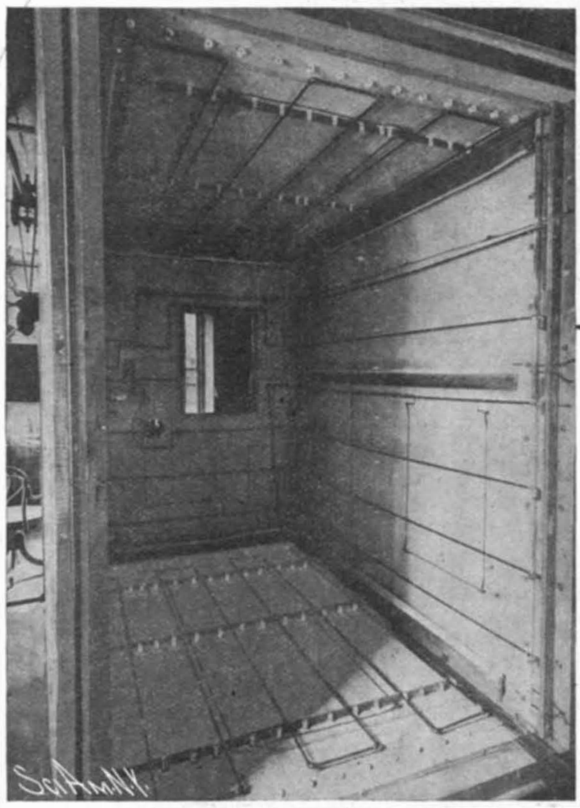
BY RENÉ BACHE.

When, not long ago, it occurred to Profs. Atwater and Rosa, of Wesleyan University, to test the efficiency of the human machine—that is to say, the human body, considered as an engine—through the medium of a stationary bicycle rider, it seemed necessary that, in order to obtain exact results, the man and his wheel should be placed inside of a huge box, specially constructed for such purposes, and kept there night and day for a considerable time, measuring meanwhile all of the food and drink supplied, and even, as one small detail, analyzing the air expired by the subject of the experiment in breathing. The man was mounted on a bicycle, which was fastened to the floor of the box, the front wheel being removed, while the rear wheel was so adjusted that its rim passed between two electro-magnets. Inasmuch as the machine, with its rider, was elevated a few inches above the floor, no locomotion was accomplished, of course, the performance being merely meant to counterfeit ordinary bicycle exercise. Thanks to the above-mentioned contrivance, the magnets being connected with a dynamo, the energy developed was transformed into electricity, and in that shape measured.

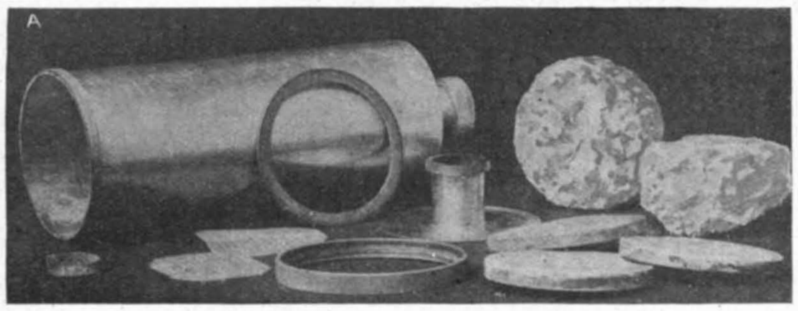
The "Ergometer" Measuring Work by Electricity.

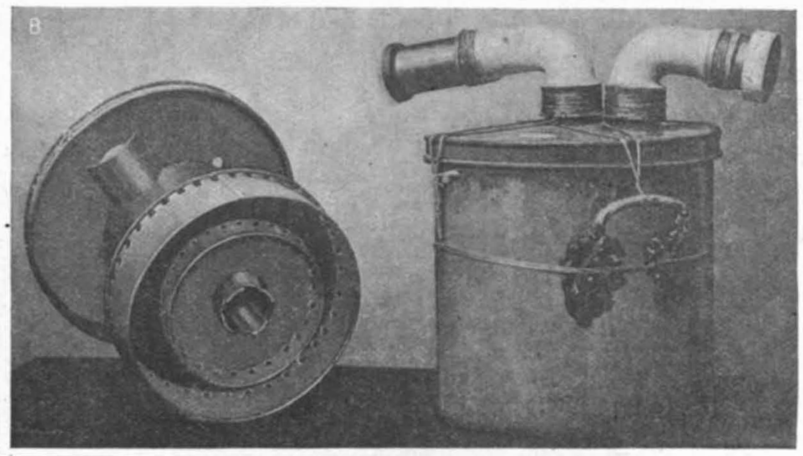


The Calorimeter Box Occupied by the Rider and the Recording Disk Outside.



Interior of the Calorimeter Box. Temperature and Moisture are Accurately Regulated.





A. Container for Soda Lime Which Absorbed the Carbonic Acid Expired.
B. Container for Sulphuric Acid Which Took up the Moisture Exhaled.

THE EFFICIENCY OF THE HUMAN MACHINE.

The box was lined with metal and, in addition, with a network of wires, through the medium of which it was practicable for an expert observer, seated outside at a desk, to regulate, with the help of apparatus specially arranged for the purpose, the temperature and degree of moisture of the air inside. Furthermore, the interior was illuminated by electricity, so as to render the prison of the solitary rider as cheerful as possible under the circumstances. The power which he himself generated ran one incandescent lamp attached to his machine.

By an ingenious method of ventilation, the box was kept continually supplied with fresh air, while the used air was drawn out of it, and made to pass through silver cylinders containing lumps of soda lime. The soda lime absorbed all of the carbonic acid that came from the rider's lungs, which was afterward separated out and measured. As already stated, all foods and drink were carefully weighed, and, with tables at hand showing just how much energy is contained in a pound of beefsteak, a pound of eggs, a pound of potatoes, and so on, it was a simple matter to calculate the amount of utilizable fuel that went into the man.

In other words, it was readily ascertained just how much power went into the human machine in the shape of food consumed. The power that came out, represented by the energy developed, was converted into electricity and measured by a dynamometer. As a result, it was found that the rider actually delivered 21 per cent of the energy contained in the fuel supplied—a very remarkable showing, when it is considered that an economical steam engine delivers in actual horse-power only about 13 per cent of the total heat value of the fuel expended!

It must be considered, however, that a good deal of energy was necessarily utilized by the rider in keeping his own internal mechanism in operation. There was his heart pump, which had to do its regular work; the processes of digestion drew, of course, upon the fuel supply, and so likewise with other functions of the body. In all likelihood, according to Prof. Atwater, an additional 20 per cent of energy was expended in this way. But taking into consideration merely the energy developed through the bicycle, the experiment gave convincing proof that a man is a more efficient machine than any engine yet devised—that he will yield more power, for a given amount of fuel, than the best steam engine or oil engine.

An athlete, says Prof. Atwater, may be regarded as a human machine of exceptional efficiency. Such an individual, engaged in a prolonged contest like a walking match, will deliver 36 per cent of the energy contained in the food he consumes, or sometimes even more. Conclusions on this subject were reached through systematic observations of a six-day bicycle race, the experts engaged in the study being present from the beginning to the end of the struggle, by turns night and day, and weighing every morsel of food given to the riders. All of the food was liquid or semi-liquid, and samples were analyzed.

It was estimated that the winner of this race, in the first twenty-four hours, did work that was equivalent to lifting twenty million pounds one foot—or, to state it otherwise, what was equal to lifting 3,825 pounds (nearly two tons) to a height of one mile. An ordinary laborer, doing average toil, develops in that length of time an amount of energy sufficient to raise two million pounds one foot. Whence it appears that this human machine, who led in the bicycle contest, delivered as much power as ten such laborers put together.

This may be regarded as representing the utmost possible achievement of the human engine. One-fourth of the total energy developed, according to Prof. Atwater, was expended in overcoming the resistance of the air through which the rider passed. Crouching in a semi-upright posture, he exposed just about three square feet of surface to the opposing atmosphere, and during the first twenty-four hours he was obliged to overcome an air-resistance equal to 5,000,000 foot-pounds — in other words, to exert as much power as would be required to lift half a ton to a height of one mile.

Two thousand and seven miles were covered by the winner of the race in six days and six nights, during which period he lost only four pounds in weight. This loss doubtless represented body tissue which was turned to account as fuel, saving the digestive system just that much work. One fact particularly noticed, by the way, was that the foods which agreed best with the men who took part in the contest were not the typical fuel foods, such as starch, but foods which furnished large percentages of the stuff that goes ordinarily to make muscle and blood. Under these peculiar circumstances the "protein" was burned in the body as fuel, supplying energy.

It appears, then, that the human body runs with less waste than any other engine. No other machine is nearly so economical, or will continue in operation for so long a time without wearing out, with so small an expenditure for repairs. The human machine will outlast five of the most improved locomotives; it will keep in running order three times as long as a first-class printing press, and its "life" is twelve times as long as that of the newest type of automobile. For a given amount of fuel, it yields twice the work of a locomotive engine. In short, it stands to-day unapproached by any energy-producing contrivance known.

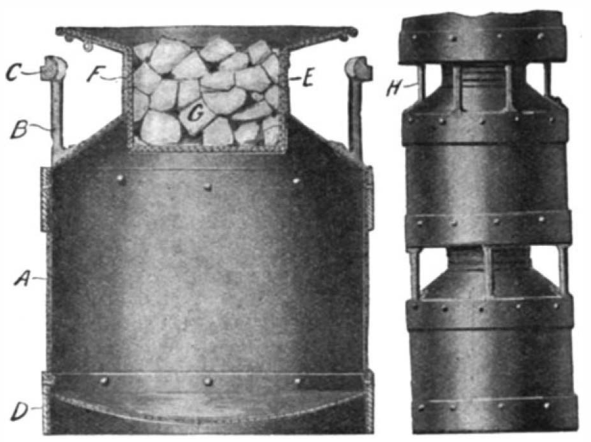
Tire Filler.

A preparation particularly suitable for filling pneumatic tires so as to make them puncture-proof or for molding, is obtained by heating together 1 pound of glue, 1 pound of molasses, 4 fluid ounces of glycerine, and ¼ teaspoonful of tar.

Patent Department

SHIPPING CAN FOR TRANSPORTING MILK.

A recent invention furnishes an improved can for use in transporting milk. The can is arranged to provide ventilation of the milk, and has means for

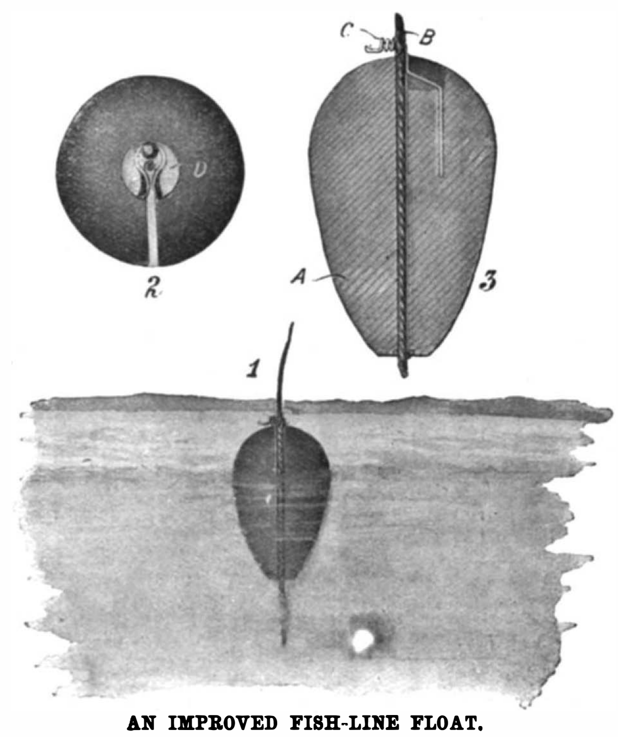


SHIPPING CAN FOR TRANSPORTING MILK.

keeping the milk cool. Each can is so formed that it will support a similar can above it, and thus the cars may be packed with tiers of cans without necessitating the provision of shelves or scaffolding to support each row. The details of the construction are best shown in the cross-sectional view. The body of the can is indicated at *A*. Riveted to the breast of the can are a pair of handles *B*; these handles are formed of two upright posts terminating at their upper ends in cross bars *C*. The lower end of the can is provided with a band *D*, and this is adapted to rest on shoulders on the cross bars *C* of the can below. Fitted into the neck *E* of the can is a cover *G*, which is of such form as to provide a receptacle for ice. Between this cover and the neck at one side, a channel *F* is formed to provide ventilation for the milk in the can. At its upper end this channel opens into a slot in the lip of the can. A catch on the cover is adapted to enter the slot, and when the cover is partially rotated, the lug enters a transverse slot in the lip and securely locks the cover to the can. It will be observed that the bottom of the can is curved to clear the cover of the can below it. The lip of the can is braced by means of supports *H*. One of the illustrations shows how the cans are supported one above the other. A patent on this improved shipping can is owned by Messrs. Joseph B. Whitehead and Timothy M. Farrell, of Pocatello, Idaho.

AN IMPROVED FISH-LINE FLOAT.

An improved fish-line float has just been invented, which is arranged to allow the line to be reeled up to the sinker without removing the float. The line is held to the float by means of a spring catch with sufficient friction to support the hook at the desired depth. In the accompanying engraving the float or bob is shown at *A*. The bob is of the usual egg form. In one side a slot is cut the full length of the bob to receive the line *B*. In the upper end of the slot a recess is formed, in which the spring catch *C* is secured. This spring is formed with coils which overhang the slot. The coil is drawn to one side to admit the line *B*, and then the latter is caught between the coils. At the bottom of the float, as shown in Fig. 2, an auxiliary line holder *D* is provided. This consists of a bow-shaped spring, the arms of which approach each other to form a contracted throat near the bottom of the slot. The line is merely forced through this throat, and is thus retained in place. It will be apparent that the spring *C* will grip the line and press it against the rear of the slot, thus preventing it from slipping freely through the bob. If it is desired to increase the hold on the line, the spring *C* may be squeezed so that the coils will be permanently compressed, and its individual coils will lie more closely together. If it be desired to attach the line to the bob so that it will not slip through, even under tension, a hitch may be taken around the vertical shank of the spring. Mr. James S. Denning, of 41 Spruce Street, Burlington, Vt., has procured a patent on this improved float.



AN IMPROVED FISH-LINE FLOAT.

A New Material for Static Electric Machines.

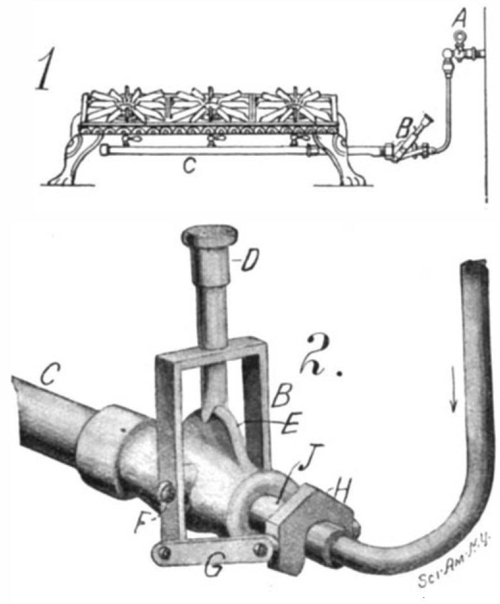
A recent invention provides a new material to be used as a substitute for glass or hard rubber in static induction generators. It is claimed for this material that it will not collect moisture, that it will revolve at high speed without danger of breakage, and that it is much cheaper than either glass or rubber. The material is formed as follows: A non-conducting fibrous mass is roughly formed into the shape and size required for the machine, and it is then immersed in a bath of melted sulphur until thoroughly saturated; after that the material is placed in a mold of proper shape and pressed until cool, in order to make a smooth, true, and compact plate. The quantity of the electric force produced by a static machine depends largely on the speed of the revolving plates, hence the advantage of this new material, which will withstand a strong centrifugal force. All the insulated parts of a static machine may also be made of this material. A patent on the improved material has been granted to Mr. Henry B. Todd, of Meriden, Conn.

Bridge Testing in Egypt.

After being for three years under construction, the largest bridge across the Nile has been completed. It connects Cairo with the island of Rodah, where, according to tradition, Pharaoh's daughter found Moses in his cot among the rushes. The Rodah Bridge, or, as it is sometimes named, the Ghizeh Bridge (taking the name from the district it will serve on the west bank), has a length of 1,740 feet and a width of 65 feet. There are fourteen spans and a swing span of 209 feet, which is turned by an electric motor. When open, this swing gives a clear span of 70 feet on either side of its pivot for the passage of vessels. The official testing of the bridge took place on October 9, 1907, the whole of the bridge, span by span, being subjected to a weight equal to 400 pounds to the square yard. To make the test the footpaths on either side were piled up with sand, and over them a couple of locomotives and a score of wagons ran on an improvised railway. The roadway was occupied by twenty tramcars, each loaded with large bags of cement; twenty-four water carts, twenty dust carts filled with sand, and eight steam rollers. These were on the bridge for the whole of the day, and were left stationary over each span, while the records of deflection were made by Egyptian government officials. The test was concluded by a sort of "gallop past" by the whole mass of tramcars, water carts, sand carts, and steam rollers, moving as one body at the full speed of, and led by, the steam rollers. This is the third bridge to be constructed over the Nile at Cairo.

SAFETY CONNECTION FOR GAS STOVES

The customary method of connecting a gas stove with the gas supply pipe by means of a flexible tube is open to serious objections. The connections are apt to work loose, or the rubber deteriorates, causing a leak, and when the gas is turned off at the stove the pressure in the tube is liable to force one or the other of the connections off its nipple, allowing the gas to pour into the room. Furthermore, the flexible tube is liable to come into contact with the hot stove and be burned. To obviate these difficulties, it is proposed to use a metallic connecting tube, and a recent invention provides a simple means for connecting this tube at one end to the service pipe and at the other to the stove. In the accompanying engraving the connecting pipe is shown attached to the gas supply pipe by means of a swivel coupling *A* of well-known type. At the opposite end the pipe is coupled to the supply pipe *C* of the gas stove by means of a simple mechanism *B*. A nipple formed with a tapered opening is threaded on to the pipe *C*. Pivoted to this nipple is a bifurcated lever, provided with a central pin which is adapted to engage a cam *E* formed on the nipple. The lower ends *F* of the lever are connected by links *G* to a yoke *H*. The latter bears against a shoulder on the tapered head *J* of the connecting pipe. By swinging the lever *B* toward the right, as shown in the engraving, the crosshead *H* draws the head *J* into firm contact with the nipple, thus coupling the connecting pipe to the stove supply pipe. The pin which bears on the cam *E* is pressed

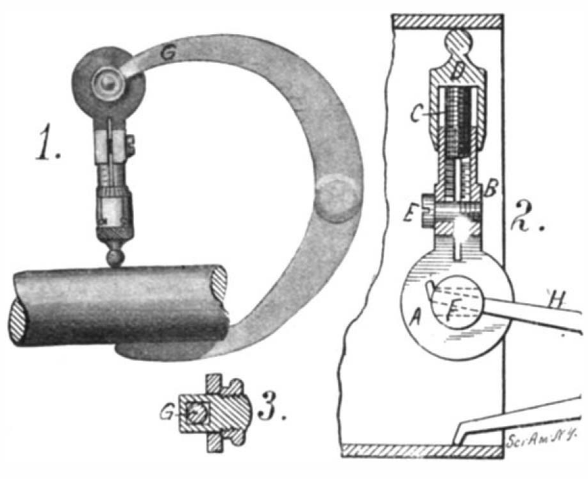


SAFETY CONNECTION FOR GAS STOVES.

into engagement therewith by means of a spring in the cap *D*. The cap is threaded to the shank of the lever, so that it may be adjusted to regulate the tension of the spring. It will be evident that this method of coupling prevents the parts from working loose, and to avoid tampering with the coupling the cap *D* may be firmly screwed down, so as to exert a strong tension upon the pin and make it difficult to throw the lever to the release position. The inventor of this gas connection is Mr. Herman E. Loebe, 49 Greenville Avenue, Jersey City, N. J.

MICROMETER ATTACHMENT FOR CALIPERS AND THE LIKE.

Pictured in the accompanying engraving is a micrometer device adapted to be used with outside and inside calipers, measuring rods, and the like, to enable the user to accurately set his tool to a desired dimension. The device consists of a head *A* formed with a split hub *B*. The hub is internally threaded and is adapted to receive a screw rod *C*, which carries a thimble *D*. The thimble *D* and the hub *B* are provided with the usual graduation to indicate the desired measurement. A clamping screw *E* engages the split hub *B*, so as to securely clamp the hub onto the screw *C* after the thimble has been adjusted. The outer end of the thimble is formed with a knob adapted to be used to contact with the article which is to be measured. The head *A* is provided with a central opening adapted to receive a clamping bolt *F*, as shown in the sectional view, Fig. 3. The bolt *F* is provided with a transverse opening, into which one arm *G* of the caliper may be inserted, then by tightening the nut on the bolt the arm will be clamped against the head. Fig. 1 shows the method of using the device on an outside caliper. The micrometer device is clamped to one arm of the caliper, and the article to be measured is held between the contacting knob of the thimble *D* and the other arm of the caliper. The caliper can then be set to the exact dimension required by turning the thimble, and in comparing two articles the difference in size may readily be determined. In Fig. 2 the method of applying the attachment to an inside caliper is shown, and it will be apparent that the device can with equal facility be applied to a measuring rod for use in making certain measurements. The inventor of this device is Mr. George Koffskey, of 3421 Dauphine Street, New Orleans, La.



MICROMETER ATTACHMENT FOR CALIPERS AND THE LIKE.

RECENTLY PATENTED INVENTIONS.

Of General Interest.

RECEPTACLE.—C. Uhden, Spokane, Wash. An object in this instance is to provide a receptacle adapted for use with or without a cover, and having two bails constituting a handle and arranged to be secured one to the other to obviate the danger of permitting one end of the receptacle to fall in case one of the bails slips from the hands to the holder.

CLOSURE.—C. B. Stillwell, Jacksonville, Fla. One object of this invention is to provide a simple closure for vessels, such as bottles and the like, which has means permanently attached thereto for withdrawing the closure from the mouth of the vessel without the aid of a corkscrew or other device for a like purpose.

DEVICE FOR SUPPORTING UMBRELLAS AND THE LIKE.—A. E. Shuster, North Bend, Ore. The patentee's object, primarily, is the provision of a device which when in use will be comfortable to the wearer, and to permit the umbrella or like article to be thrown in various angular positions and positively retained or displaced with ease and facility and without the use of hands or arms of the wearer.

POLLEN-COLLECTING DEVICE. — E. Moulie, Jacksonville, Fla. An object of the invention is to provide a device by means of which pollen from flowers or other blossoms can be collected for use in the manufacture of perfumes, medicines, and the like, and in flower and plant breeding, and in which the flowers, twigs, or branches bearing blossoms from which pollen is to be collected are held with their stems immersed in water or other liquid contained in a vessel. It embodies improvement over the construction of the device shown in Letters Patent formerly issued to Mr. Moulie.

DRUM.—A. D. Converse, Winchendon, Mass. The purpose of the invention is to provide a means for effectively maintaining the rim of a drum upon the flesh tuck hoop, no matter what character of head is employed, or whether the cords at one point be tightened more than at other points, and means serving under all conditions of use to prevent the rim from shifting from its true position relative to the head.

CABINET FOR HOLDING PHONOGRAPH DISK-RECORDS.—X. Cukier, New York, N. Y. The object of the improvement is to produce a cabinet which can be used conveniently for the purpose of holding records that have the form of disks and which will enable the records to be arranged in alphabetic order. Further, to construct the cabinet in such a way as to enable its alphabetic divisions to be readily changed so as to allow of an extension or enlargement of a particular division.

NEEDLE.—R. B. Bach, New York, N. Y. Instead of having two strands of thread passing along the sides of a needle and enlarging the opening formed by it, a single thread will pass from the center of the butt of the needle, and smaller than the needle itself, so that a clean opening will be made and there will be no tendency to tear fabric, flesh, or other material upon which the needle is employed.

GRATE FOR BRICK-KILNS.—P. E. Bennett, Roseton, N. Y. The intention of Mr. Bennett is to provide a grate for brick kilns, arranged to insure proper burning of the fuel in the fire-box, to permit of conveniently placing the grate in position, and to allow quick removal of the grate from the fire-box of one kiln for reuse of the fire-box of another.

Hardware.

PLANING-SAW.—C. E. Rider, Myrtle Point, Ore. The end to be attained in this invention is the provision of a saw which will make a smooth clean cut on both soft and hard woods, and which will expel the saw-dust as it is produced, whereby the planing-blades or bits will not be choked and thus cause the saw to heat and run hard.

Machines and Mechanical Devices.

GEARING.—T. J. Westerman, Olalla, Wash. The invention refers to reversible friction clutches, and more particularly to means whereby the area of the friction faces may be materially increased to more effectively hold the parts in engagement with each other; the object is to provide maximum gripping power for the minimum area of friction surface, and to provide a device positive in its operation.

SAWMILL SET-WORKS.—N. E. Rice, Zenia, Cal. The principal object here is to provide means for enabling the sawyer or person controlling the movement of the carriage in a sawmill also to control the set works so that the sawyer may, unassisted by anyone, set the knees so that the mill will make a cut of any thickness. To this end a peculiar adjustable mechanism is employed for advancing the knees any extent, which is combined with an operating device and indicator located so as to be readily actuated by the sawyer without interfering with his other duties.

PAPER-MAKING MACHINE.—J. A. Dupont, 142 Boulevard Pereire, Paris, France. Machines of the type called plate machines or web machines, are well known and in these the web of damp paper coming from the wire cloth is transferred to a second wire cloth which is endless and by which it is carried through the drying chamber. The invention relates to a special arrangement of this second wire cloth with regard to the principal wire cloth, for the purpose of insuring the transfer of the sheet of paper to the above cloth under such conditions as reduce to a minimum the pressures upon the damp sheet and obviate crushing and distortions.

Prime Movers and Their Accessories.

INTERNAL-COMBUSTION ENGINE. — H. W. Adams, Fargo, N. D. Means are provided whereby after the main body of exhaust gases have been permitted to escape from the working cylinder, a further portion of said gases is forced out by the admission of a blast of compressed air, and after the exhaust port is closed, the gases still remaining in the cylinder are removed by communication between the cylinder and the chamber in which a more or less perfect vacuum exists. The flow of fresh charge into the cylinder is produced by previous compression of air going to make up said charge, and by rarefied condition within the cylinder after communication with the vacuum chamber has been closed.

FLUID-PRESSURE TURBINE. — B. E. Lewis, Palouse, Wash. A fluid pressure turbine is provided which is simple and durable in construction, and arranged to use steam or other gaseous fluid motive agent economically and to the fullest advantage, by causing the motive agent to act both by impact and by pressure, and to expand during its passage through the turbine.

FLUID-PRESSURE ENGINE. — H. Lentz, 123 Kurfürstendamm, Halensee, near Berlin, Germany, and C. Bellens, 43 Rue de Chézy, Neuilly-sur-Seine, France. A method of and the means for obtaining in elastic fluid machines simple or multiple expansion running by rendering the cylinders solid one with the other in groups of two, is the object of these inventors. It consists in establishing between these combined cylinders communications such that the concordant phases of admission or exhaust may be controlled by a single valve member and that consequently the two cylinders rendered solid, instead of expanding from one to the other as in compound engines, work at the same pressure.

MUFFLER.—W. L. Gee, Saratoga Springs, N. Y. The muffler is intended particularly for use in connection with internal combustion engines to reduce the noise in the exhaust. The inventor's purpose is to provide an efficient device of the lightest construction and involving the minimum degree of back pressure in the engine, thus fitting it especially for use in automobile work.

INTERNAL-COMBUSTION ENGINE. — P. Daniel, New York, N. Y. The invention refers more particularly to means for forming the explosive charge and delivering it to the engine cylinder; the object being to utilize the pressure generated in the cylinder at time of explosion for delivering the desired quantity of fuel to the air supply and to compress this supply within the crank case of the gas engine.

Railways and Their Accessories.

MAIL-BAG CATCHER AND DELIVERER. —E. Roberts, Ishpeming, Mich. Any number of bags are secured to a ring and the ring may be applied to crane when the latter is within the car and the latter moving rapidly toward the point for delivering bags. The crane is swung and secured by a latch and an abutment within the ring strikes the arm of the catcher nearest the car. As the car approaches the catcher, means provide that the ring will drop upon the arm and be prevented by a hook from slipping off. Bags may be delivered from express trains at points where desired to subsequently deliver such bags to accommodation trains and dropped at different stations.

CAR-DOOR.—A. J. Munson, Garretson, S. D. The invention contemplates the production of that class of door employed in box-cars when hauling grain and the like, which can be easily operated and locked in position and elevated to be removed entirely out of way when not in use. A novel locking means holds the door in engagement with the frame when lowered to its operative position.

CROSS-TIE.—J. F. Grandy and C. F. Grandy, Greenville, S. C. The ties are arranged in ordinary manner, and rails laid thereon. The rails in position, spikes are inserted in the tubes and arranged with a lip engaging the base of the rail and with a lug engaging a pocket remote from the face of the tie upon which the rail rests. A locking pin is inserted and driven into the tubes a sufficient distance to lock the spike in place. Means aid in drawing the rail base down firmly upon the tie; and also to adapt the spike for insertion from either end of the tube. Removing the pin disengages the rail from the tie when desired.

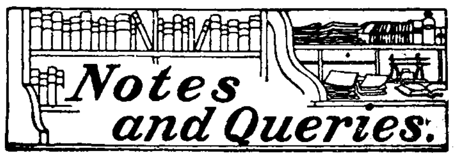
Pertaining to Vehicles.

BRAKE-HANDLE. — F. W. Lechner, Wenona, Ill. The invention relates to a handle especially adapted for use in the operation of a plurality of different mechanisms. More particularly it relates to a handle adapted to be used in connection with vehicles for operating the brakes and other mechanism which may be used in connection with the vehicles.

COMBINED STEERING AND DRIVING AXLE.—P. Daniel, New York, N. Y. In this patent the invention has reference to certain improvements in motor vehicles, and relates more particularly to means whereby the same axle upon which the steering wheels are mounted may also receive power to propel or aid in the propelling of the vehicle.

BICYCLE ATTACHMENT.—B. M. Badger, Dillon, S. C. This improvement is in the nature of a pantaloons' guard for the drive sprocket. In applying it, no portion of the bicycle will be disturbed, the guard being simply passed over the pedal and crank, brought up to its place against the outer face of the sprocket wheel and the fastenings applied, requiring but little time and even less skill and labor.

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



HINTS TO CORRESPONDENTS.

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.

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Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(10672) L. S. C. B. asks: A number of times I have had occasion to see a vehicle passing on the far side of a picket fence. When looking through the spaces at an angle, the wheels of the vehicle appear to revolve in the opposite direction to that in which vehicle is moving. Can you explain this? A. The effect of looking through the pickets of a fence at the spokes of a wheel of a moving carriage is called in science a stroboscopic effect. You will find examples of it given in Hopkins's "Experimental Science," which we send for $5.00. In the exhibitions of moving pictures this may often be observed. A vehicle will be seen to drive along over the screen at a rapid rate with the wheels seeming to be either at rest or perhaps turning backward. A very curious appearance is presented to the eye if you watch for such manifestations. The effect is due to the interruptions of the view of the moving vehicle by the pickets of the fence, so that the eye sees only a series of its positions following each other in rapid succession, and these blending into a continuous motion, or perhaps destroying all appearance of motion, thus giving the impression of rest.

(10673) W. L. asks: We have always noticed with interest the answers to correspondents, and thought that perhaps we would not be asking too much of your time in order to obtain an explanation of the following: By taking a "dustless" feather duster (which consists of feathers so arranged that they form a mat, and used for wiping desks, etc., rather than dusting) and rubbing it rapidly upon one's trousers or other cloth and then placing it near a lighted incandescent electric lamp, the filaments in the lamp will swing toward it. If held underneath the filaments will vibrate rapidly, and if held at one side for a few moments the filament will act as if magnetized and remain bent toward that side of the lamp. On turning out the lamp the filament returns to its original position. We of course understand that by rubbing the duster some kind of magnetism is produced, but do not understand how it could affect the filaments with the glass of the lamp between. A. The action of a filament of an incandescent lamp, when the duster is placed as you describe, is caused by the electricity generated in the feathers by friction on the woolen cloth. Rubbing it upon silk would answer the same purpose and produce the same effect. The electricity of the duster attracts the filament when the current of electricity is flowing through the lamp. Electricity and magnetism act through glass as easily as if the glass were not there. There is no magnetism in the case of the duster and lamp.

(10674) S. A. asks how to bleach sponges. A. Sponges should be soaked in warm water, and well-cleaned. To two gallons warm water add 1 ounce permanganate of potash, 3 grammes Epsom salts. Soak sponges in bath about 30 minutes, then wring and rinse out. Add 7 per cent hydrochloric acid to 2 gallons water, add also 4 ounces hyposulphate soda. Soak sponges until bleached, and rinse. Raw sponges vary in yielding to the bleaching operation, and the bleacher must use his judgment in adjusting the strength of the baths.

NEW BOOKS, ETC.

The Metric and British Systems of Weights, Measures, and Coinage. By F. Mollwo Perkin. With 17 diagrams. New York: The Macmillan Company. 83 pages; 8vo.; cloth. Price, 50 cents.

A discussion of the disadvantages of the British system of weights and measures, and a comparison of it with the metric system. Values are given of the units of each in terms of the other, as well as the manner of transferring the various thermometric scales from one system to another.

Mosquito Life. The Habits and Life Cycles of the Known Mosquitoes of the United States; Methods for Their Control; and Keys for Easy Identification of the Species in their Various Stages. An Account Based on the Investigations of the Late James William Dupree, M. D., Surgeon-General of Louisiana, and Upon General Observations by the Writer. By Evelyn Groesbeeck Mitchell. New York: G. P. Putnam's Sons. Illustrated; 12mo.; cloth; 281 pages. Price, $2.

At this time of year the mosquito is so nearly forgotten that a book describing the universal little pest does not arouse the interest that it would awaken during the height of the summer. It is quite possible, however, to destroy these blood-thirsty plagues in certain localities, if the requisite knowledge is possessed, and as a good general always plans his campaign in advance, a short mention of "Mosquito Life," by Evelyn Grosbeeck Mitchell, may not be out of place. In it is told how they breed, how they bite (although, with this point, most of us are only too familiar), how they transmit disease, how long and on what they live, how they may be identified in their various stages, and finally, how they may be locally controlled.

Electrical Installations of the United States Navy. A Manual of the Latest Approved Material, Including Its Use, Operation, Inspection, Care, and Management and Method of Installation Aboard Ship. By Commander Burns T. Walling, U.S.N., and Julius Martin, E.E. Annapolis, Md.; The United States Naval Institute. 8vo.; cloth; 648 pages; 300 illustrations.

The title sufficiently describes the scope of this book. The authors have done their work thoroughly, giving us a volume which is as interesting as it is valuable.

First Report of the Wellcome Research Laboratories at the Gordon Memorial College, Khartoum. Quarto; cloth; 86 pages.

"The First Report of the Wellcome Research Laboratories at the Gordon Memorial College, Khartoum," has recently come to our hands through the courtesy of the director. This research laboratory, the gift to the Soudan government of Mr. Henry S. Wellcome, is incorporated with Gordon College, and has for its object the study of tropical diseases and the investigation of the conditions and natural resources of the country in general.

Electric Railways. Theoretically and Practically Treated. By Sydney W. Ashe. Vol. II. Engineering Preliminaries and Direct-Current Substations. New York: D. Van Nostrand Company. 12mo.; cloth; 282 pages, illustrated. Price, $2.50.

This volume, the second of a series of three which the author has projected, deals with engineering preliminaries, and direct-current sub-station operation. Much valuable information is compressed into small space, and the result is a compact reference book which will be useful to all who are interested in the problems it deals with.

Le Détroit de Panama. Documents relatifs à la solution parfaite du problème de Panama (détroit libre, large et profond). Par Philippe Bunau-Varilla, ancien ingénieur en chef des ponts et chaussées, ancien ingenieur en chef du canal de Panama (1885-86), ancien ministre plénipotentiaire de la République de Panama à Washington (1903-1904). Paper; 8vo.; 305 pages. Numerous figures and a map. Price, $2.50.

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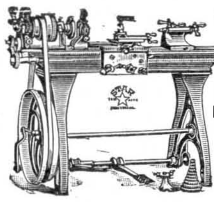

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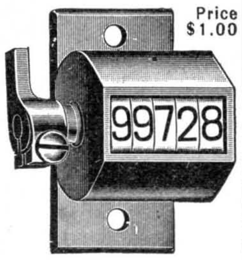

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Soap, J. S. Harris 67,631
Stenciling machines and stencil sheets, Underwood Typewriter Co. 67,655
Stoves and ranges, Orbon Stove and Range Co. 67,651
Syrup for carbonated beverages, H. Wheaton & Sons 67,659
Tablets, headache, Deimar Drug Co. 67,614
Talking machine records, Hawthorne & Sheble Manufacturing Co. 67,632
Talking machines, Hawthorne & Sheble Manufacturing Co. 67,633
Tire punctures, preparation for stopping, New Miraculum Corporation 67,584
Tonic, uterine, Davis Chemical Co. 67,540
Trousers, G. Sichert 67,571
Truck bolsters, car, Pressed Steel Car Co. 67,604
Undergarments, muslin, Rice-Stix Dry Goods Co. 67,570
Vessel closures, Chellis-Hillman Co. 67,594
Wagons, farm and truck, Turnbull Wagon Co. 67,606
Waters, laxative mineral, Igmandi Import Co. 67,673
Whisky, E. Block & Sons 67,626
Whisky, Jacob Dudenhoefer Co. 67,636
Whisky, Thos. Moore Distilling Co. 67,640
Whisky, brandy, gin, and cordials, J. Cartun 67,627

LABELS.

"Almond Whitener," for ointment for use after washing, H. H. Lepper 14,041
"Flor Fina," for cigars, Schmidt & Co. 14,037
"Genco," for cigars, M. Gaffner 14,036
"Highland Chief Rheumatic Remedy," for a rheumatic remedy, J. E. Dunlap 14,040
"Princess Cold Cream," for a salve for cleansing the face and removing impurities from the skin, H. H. Lepper 14,044
"Pura Semola," for macaroni, F. Ricciardelli 14,039
"Skin-Clean-O," for a toilet powder to be used in place of soap, H. H. Lepper 14,042
"Skin Nourisher," for a pharmaceutical preparation for building depleted physical tissues, etc., H. H. Lepper 14,043
"Uncle Sam's Crown," for a game, A. C. Howes 14,045
"Whittle Epsom Lithia," for mineral water beverages, Whittle Springs Co. 14,038

PRINTS.

"'Best' Damp Proof Shoes," for shoes, Best & Co. 2,218
"Colgate's Collapsible Tube for Toilet Creams and Pastes," for toilet creams and pastes, Colgate & Co. .... 2,212 to 2,214
"Men's and Boys' Apparel," for men's and boys' apparel, H. C. Lytton 2,215
"Men's Apparel," for men's apparel, L. Adler, Bros. & Co. 2,216
"Men's Apparel, for men's apparel, Rosenwald & Weil Co. 2,217
"Parisian Tree Cake Known in Germany as 'Baumkuchen,'" for tree cakes, P. Fulleborn 2,211

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.

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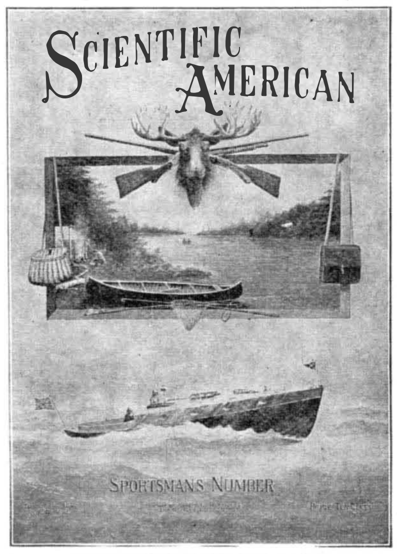

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