SCIENTIFIC AMERICAN

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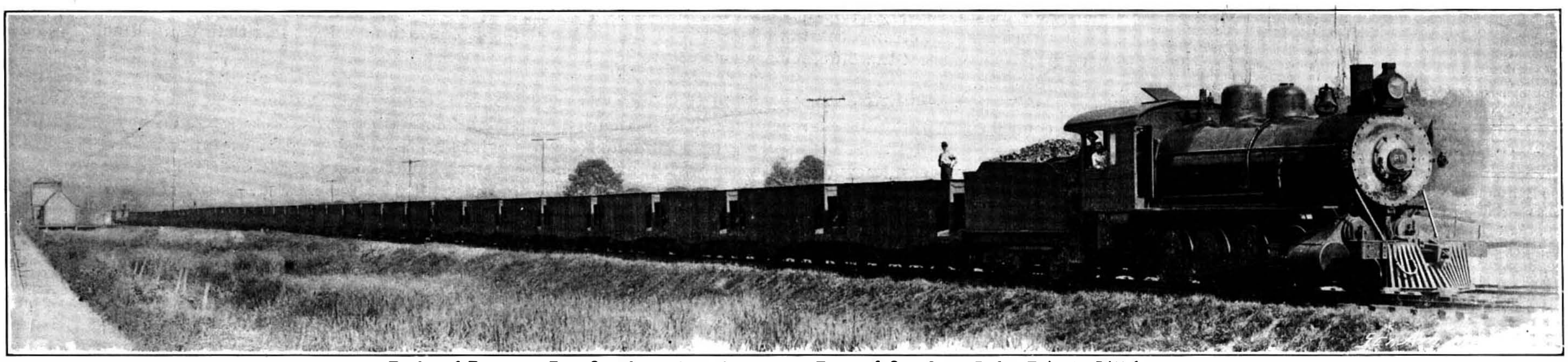
A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

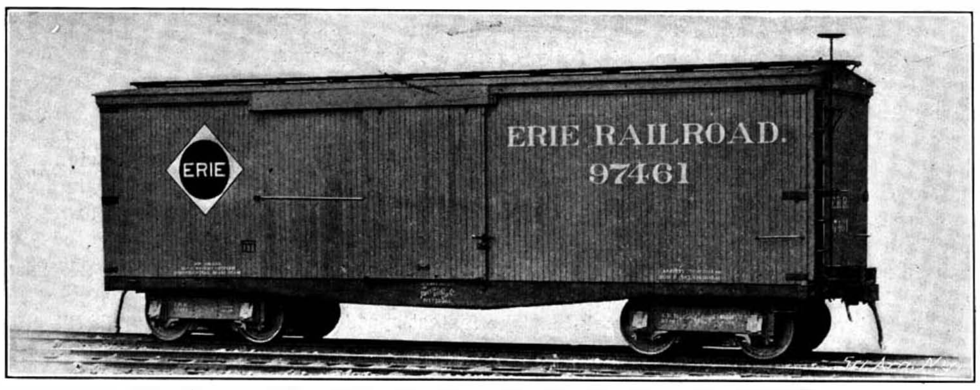
Vol. LXXXIV.—No. 25.
ESTABLISHED 1845.

NEW YORK, JUNE 22, 1901.

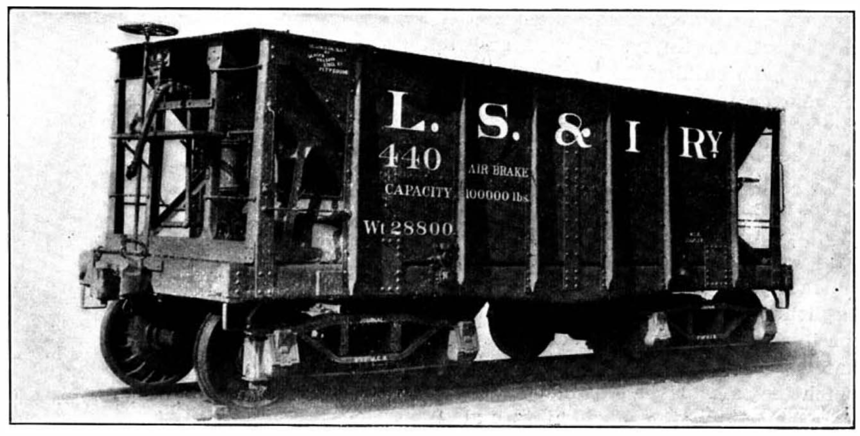
$3.00 A YEAR.
8 CENTS A COPY.



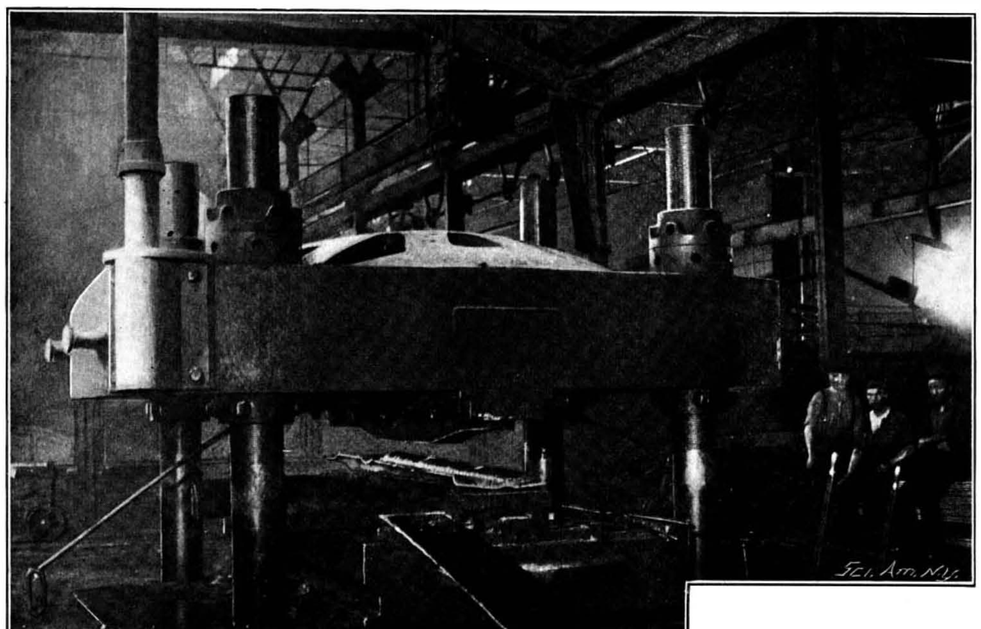
Train of Forty 50-Ton Ore Cars, Carrying 2,000 Tons of Ore from Lake Erie to Pittsburg.



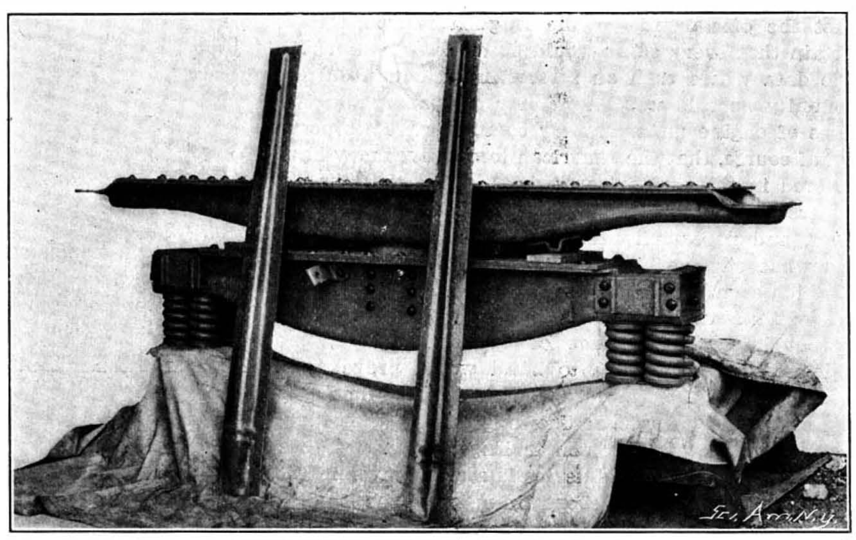
Box Car, 70,000 Pounds Capacity, with Pressed-Steel Underframing.



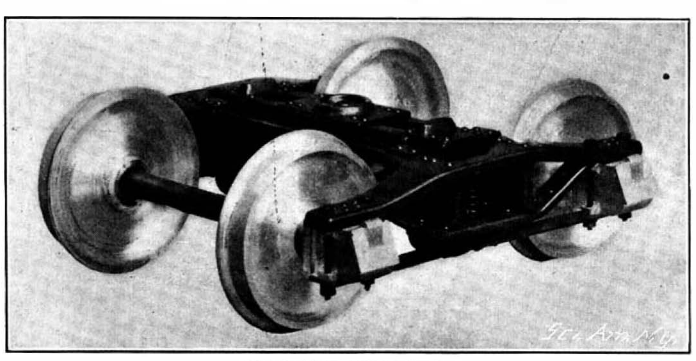
Ore Car—Capacity, 100,000 Pounds; Weight, 28,800 Pounds.



Hydraulic Press Forming Up Car Bolsters.

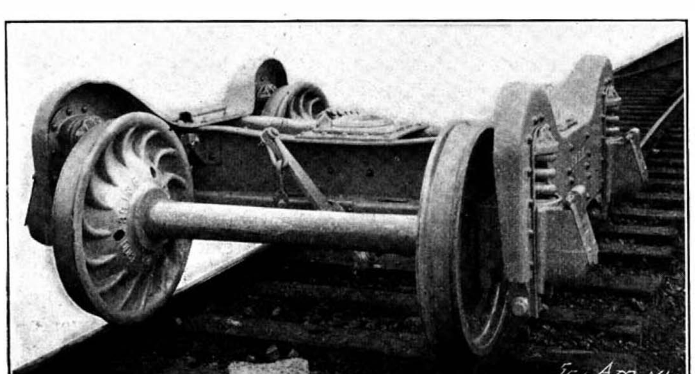


Pressed Steel Bolsters and Side Stakes.

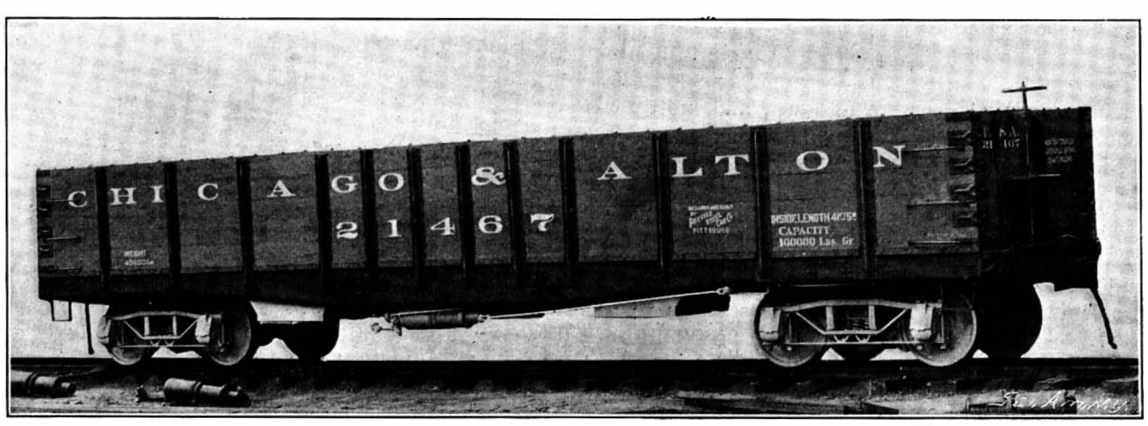


Diamond Type Truck.

Ballast Car—Capacity, 100,000 Pounds; Weight, 37,600 Pounds.



Fox Pedestal Truck.



Gondola Car with Pressed-Steel Underframing—100,000 Pounds Capacity.

THE PRESSED-STEEL CAR INDUSTRY.—[See page 391.]

Scientific American.

ESTABLISHED 1845

MUNN & CO., - - - EDITORS AND PROPRIETORS.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, - - NEW YORK.

TERMS TO SUBSCRIBERS

One copy, one year, for the United States, Canada, or Mexico $3.00
One copy, one year, to any foreign country, postage prepaid. £0 16s. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845)..........................$3.00 a year
Scientific American Supplement (Established 1876) .... 5.00 "
Scientific American Building Edition (Established 1885)........ 2.50 "
Scientific American Export Edition (Established 1878).......... 3.00 "

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

Remit by postal or express money order, or by bank draft or check.

MUNN & CO., 361 Broadway, corner Franklin Street, New York.

NEW YORK, SATURDAY, JUNE 22, 1901.

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.

AMERICAN LOCOMOTIVES ABROAD.

The American engines which were purchased by the Midland Railway Company of England in 1899 have at last been heard from officially. Mr. Johnson, Superintendent of Locomotives, states that the company put into operation thirty Baldwin and ten Schenectady engines, the builders having been given a free hand in the matter of design and pattern. The result of a six months' trial in 1900 showed, according to the report, that the cost of operation of the American locomotives exceeded that of the English engines by the following percentages: Repairs, 60 per cent; oil, 50 per cent; fuel, from 20 to 25 per cent. These figures are certainly surprising, and they are by no means offset by the fact that these engines cost each $2,000 less than English engines of the same size and power. It is impossible to draw any conclusions from this official statement until full details of the circumstances under which the comparison was made are known. Of course there have been the usual hints and suggestions that the imported engines were not given fair play; but to anyone who is acquainted with the working of at least the official side of the English railroads it is certain that every effort would be made to obtain reliable data where such an interesting and unusual opportunity as this was offered for comparing the two types of engine under similar conditions. It is possible, of course, that the American locomotives may have suffered in the comparison from the fact that the engineers and firemen were familiar with their own engines, and necessarily found the American machines somewhat strange. Ideal conditions would be those in which each type was operated by engineers and firemen of its own nationality, if we may so speak. It is reasonable to expect that of two locomotives, one which costs $2,000 more to build would prove more economical in operation. Part of this increased cost of operation might be due to the use of the copper fireboxes which are common in English practice; for it is not denied that this device is a great saver in the matter of repairs, the fireboxes in many of the English locomotives outlasting the engines. There is also a slight saving in fuel due to the superior conductivity of the copper over the steel—though this is so small as to be almost negligible.

After making all allowances of this kind, we fail to understand how such a great difference in repairs and oil could occur; and one is forced to the conclusion that the English engines must, as far as the engineers and firemen are concerned, have received more careful handling than the foreign-made locomotives. Possibly, also, the American locomotive may have suffered from the fact that it is built for harder service than its English competitor, and that it was hauling loads much below its maximum capacity. The American boiler is built to be forced, and the exhaust is harsher with a view to a fiercer draught. The exhaust is softer in the English locomotive and the boiler is not usually forced as it is in American service. It can readily be understood that if the American locomotives were not being worked up to their full capacity, they would show less fuel economy per load hauled than engines which were designed and built for the conditions of the test.

PROTECTION OF IRON STRUCTURES.

The complete revolution which has been effected in the field of industry by the introduction of iron and steel has brought the world face to face with a problem which, if it be not successfully solved, is likely to put a definite limit on the useful life of all structures that are built of these materials. Corrosion of such structures is a certainty if they be not absolutely protected from the oxidizing influences of the elements. They will lose steadily in weight and therefore in strength—a consideration which should modify somewhat our self-congratulations, when we point with pride to our towering, skeleton-steel, buildings and far-reaching bridges on shore, or to our fleets of giant steamships afloat. Although it has been understood from the very first that the life of iron and steel structures was, other things being equal, proportionate to the efficiency of the means used to prevent corrosion, it is nevertheless a fact that our knowledge of the best means to prevent their decay has by no means kept pace with our skill in the design and erection of metallic structures. This most vital subject is treated exhaustively in a paper presented by M. P. Wood, of New York, at the May meeting of the American Society of Mechanical Engineers, which contains a vast amount of data bearing upon the question of the relative value of the different systems of protection by painting.

The paper will be given in full in the SUPPLEMENT, commencing with the current issue, and without attempting to review it at any length, we would refer to three widely known structures, which are mentioned in the article as showing the destructive effects of corrosion, in spite of the fact that they are extensively painted at regular intervals. Thus, we learn that advices as to the condition of the great cantilever bridge over the Firth of Forth, Scotland, finished less than ten years ago, show that corrosion is widely established over the entire structure; and this in spite of the fact that a corps of painters is continuously employed upon it, and that the structure is practically repainted every three years, and in many places yearly. It seems that the lower sections, for 20 feet or more in height above the masonry piers, are particularly subject to attack by the salt spray which is blown from the Firth during the prevalence of high gales. Yet this structure received two coats of boiled oil at the shop before erection, and then two coats of iron oxide paint, the last two coats together calling for not less than 180 tons of paint. Another case in point is the tubular railway bridge over the St. Lawrence River at Montreal, where the destructive action of the elements was intensified by the hot gases and steam from the locomotives. The elevated railway system in this city is also quoted as affording an instance of the rapidity with which deterioration is taking place under our very eyes.

A valuable opportunity was offered to test the relative value of the various paints by an experiment which was carried out, or rather commenced and never completed, on the viaduct over the Harlem station of the New York Elevated Railway at 155th Street. Here the lattice work, floor beams and buckle plates are subject to attack by the gases of the elevated locomotives, and the structure is well suited to an investigation of this kind. The metal work was first carefully cleaned by the sand-blast, and then seventeen panels were painted with as many different grades of paint, some of the panels receiving two and some three coats. Every possible condition was brought to bear to make the test one of a practical, commercial nature, as well as to give it true scientific value. After an exposure of about nine months, a thorough examination of the condition of each panel was made by a prominent engineer, acting under orders of the Board of Public Works of New York city. The report was based upon a rating of 100 as representing a perfect condition of the coating. The freedom from rust varied from a maximum percentage of 99 to a minimum of 25. The 99 per cent of freedom from rust was shown by a paint known as Nobrac, and the 25 per cent freedom from rust was shown by a paint known as Red Lead Axtonide. A 97 per cent efficiency was shown by a lead graphite and lucol oil paint, and 92 per cent by a carbon paint. Then followed a carbon black paint with a record of 85 per cent and an amorphous graphite paint showed an efficiency of 80 per cent. It should be mentioned that the 99 and 97 per cent results were gained on panels which had received three coats of paint, while most of the other panels received only two coats; and it should further be noted that although there was little appearance of rust upon the panels securing a high percentage, the paints showed a tendency to crumble in places as though being rotten—a condition which would suggest inability to resist corrosion had the tests been continued for a greater length of time.

Unfortunately this important test was not continued. It is probable that the poor results obtained with many of the specimens offered were such that the makers were only too glad to have these telltale experiments brought to a speedy close. In view of the fact that New York has now under construction no less than three bridges which will rank among the largest in the world, and a rapid transit tunnel which will be framed from end to end with steel and will be associated with many miles of steel viaduct, we think the officials, both of the Tunnel and Bridge Commissions, should inaugurate a further series of tests, to ascertain what would be beyond question the most serviceable paint to use, in protecting metallic structures whose value will amount to not far short of a hundred million dollars.

OUR FASTEST BATTLESHIP.

The greatest credit is due to the builders of the new United States battleship "Illinois" for the brilliant success achieved by this vessel in her recent official trials over the Cape Ann course, when she showed an average speed during four hours of continuous steaming at full power, of 17.31 knots an hour. This gives to the "Illinois" the distinction of being not merely the fastest battleship of her official class—the other two of the same design being the "Alabama" and "Wisconsin"—but also for the time being the fastest battleship in the United States Navy. The "Alabama," built at the Cramp shipyard, has an official speed of 17.01 knots, and the "Wisconsin," built at the Union Iron Works, has an unofficial speed of 17.12 knots, or about one-fifth of a knot less than the "Illinois."

There are certain features which lend particular interest to this achievement. In the first place the contract requirement as to speed was that the vessel should maintain a speed of 16 knots an hour when the engines were being worked at full power. The contractors have, therefore, exceeded the requirements by a knot and a third. Moreover, the trial was to take place on a mean draft of 23 feet 6 inches and a displacement of 11,565 tons, and these conditions were fully realized; sufficient ballast being taken in to bring the vessel down to 23 feet 7¼ inches and sufficient coal and water being used up during the trial to decrease this draft by about an inch and a half. The trial, therefore, was a thoroughly practical test, and except, of course, for the fact that a good quality of coal and expert stokers were employed, the conditions represented those which will exist when the ship is fully equipped, ready for sea, with all stores on board, with a normal coal supply and with a clean bottom. The trial course on the New England coast, which is made use of by the government on these occasions, is 33 knots in length; and on this occasion it was marked off by means of buoys placed 6.6 knots apart, the "Illinois" covering the course twice during her four-hour trial. Near each buoy was anchored a naval vessel whose duty it was to take observations of the tide and of the time of the ship on passing these points. The fastest speed between any two buoys made by the vessel was 17.84 knots, and the slowest 16.97 knots. The engines were run at a mean speed of 118 revolutions per minute, and the boilers carried an average pressure of 180 pounds to the square inch.

The next fastest first-class battleship in the navy to the "Illinois" and her sisters is the "Iowa," which has an official speed of 17.09 knots. Then follow the sister ships "Kentucky," of 16.89 knots, and "Kearsarge," of 16.81 knots speed. Next in point of speed are the three vessels of the "Oregon" type, the fastest of which is the "Oregon," of 16.79 knots, while the "Massachusetts" has a speed of 16.21 knots and the "Indiana" one of 15.55 knots. Although the "Illinois" has exceeded her contract speed by 1.31 knots, this is not the greatest amount by which any battleship in our navy has shown herself superior to contract stipulations, the credit for this being due to the "Oregon," which exceeded her contract speed of 15 knots by 1.79 knots per hour. Against this, however, must be put the fact that it takes proportionately more engine power to make a gain in speed above 16 knots than it does above 15 knots, and this on account of the well-known rule that the necessary horse power to drive a vessel increases as the cube of the speed.

The "Illinois" and her sisters may be called the prototypes of the form of battleship which is destined to become permanent in the United States Navy. They are marked by a high freeboard and generous accommodation for officers and crew, being in this respect a decided improvement on our first battleships of the "Oregon" class. She is 368 feet on the water line; 72 feet 2½ inches in beam, and displaces 11,565 tons on a draft of 23 feet 6 inches; the normal coal supply is 800 tons and her full bunker capacity 1,440 tons. She carries a complement of 40 officers and 453 men. The main battery consists of four 13-inch rifles in balanced turrets, carrying armor 17 to 15 inches in thickness, and fourteen 6-inch rapid-fire guns, of which ten are on the main deck within a casement of 5½-inch armor, and four are on the upper deck with similar protection. There are sixteen 6-pounder rapid-fire guns in the secondary battery and four 1-pounders, besides two Colts and two field guns. The "Illinois" is also provided with four torpedo tubes. The armor belt, which extends from abaft the after turret to the stem, is 16½ inches in thickness at the top edge and 9½ inches at the bottom. It tapers in thickness toward the stem, where it is reduced to 4 inches. Diagonal 12-inch armor connects this belt armor with the barbettes, which are themselves protected by 15 inches of steel armor. Forward the vessel has a freeboard of 20 feet and aft of 13 feet. Altogether we must confess to a liking for the "Illinois" and her sisters. Her speed, it is true, is not up to the latest standard of 19 knots which has been accepted by our own and most foreign navies as sufficient; but she is an exceedingly powerful vessel for attack, and would stand the hardest kind of hammering in a sea fight without risk of serious disablement.

GAS ENGINES.*

BY PROF. AIME WITZ.

Among the merits of gas motors there is one which should be specially mentioned, and that is that they will accommodate themselves to all kinds of gas and may be fed by the richest as well as the poorest products, whose scale extends from acetylene down to the blast-furnace gases. For this it is only necessary to modify the proportions of the explosive mixture, and to regulate properly the degree of compression and the ignition period. When an appropriate carburetor is used it is possible to use hydrocarbon liquids whose density and volatility are quite different, comprised between gasolines and ordinary petroleum. It is owing to this great elasticity that the gas motor has reached such a wide development and has been put to such varied uses, its power ranging from one or two up to a thousand horse power.

The gas engine of 1,000 horse power was a brilliant dream whose realization haunted the minds of many workers, and the foremost among these; it has now a tangible realization, for it suffices to couple in tandem or otherwise two cylinders like that of the great motor shown at the Exposition by the John Cockerill Company to obtain this result. This engine is of the single cylinder type, measuring 52 inches diameter with 56-inch stroke. It has developed, under the inspection of a commission of prominent engineers, 560 to 670 effective horse power, consuming blast-furnace gas of but 27 calories per cubic foot. It absorbed about 88,440 cubic feet of gas per hour while developing 670 horse power. According to the remark of an eminent engineer, the cast iron is henceforth only a secondary product of the blast furnace, which assumes the rôle of a powerful gas generator, furnishing, on the one hand, 150 tons of cast iron per day and on the other 21 million cubic feet of gas. Even discounting one-half of this volume for heating the air-blast of the furnace and for other uses, there remains a quantity of gas sufficient to produce 3,500 effective horse power by the use of gas engines. If the same gases were used to heat the boilers of steam engines not more than 1,000 horse power could be obtained. The gas engine has thus found a new sphere of action, and a like success is in store for the engineers who will utilize the gases of coke furnaces.

The gas generators of Dowson, Gardie, Deutz, Bénier and others have been essential in the progress of the gas motor. At first they required choice coal, anthracite of the best quality, carefully separated from dust and otherwise possessing exceptional qualities which corresponded to a high price, but at present ordinary anthracite is used of a relatively low price, and this has multiplied the applications of the gas generators; among these may be mentioned electric light plants, tramway stations, pumping works, mills, printing establishments, and even in the spinning and weaving industries gas engines have been used with successful results. A motor of 100 horse power working 3,000 hours per year, whose generator is fed by anthracite at $5 per ton, gives the effective horse power hour at less than $0.008 (allowing for interest, etc.), with a gain of $0.001 over a good steam engine burning coal at $4 per ton, and the first cost of the plant is somewhat less. These results are certain at present. The energy of the generator gas ranges from 30 to 40 calories per cubic foot. The generators accommodate themselves to the use of coke, but the high price of this combustible is an obstacle to its use. Mr. Mond has put in service in the chemical works of Brunner, Mond & Company, in England, a remarkable form of generator which permits the use of fine bituminous coal, with the formation of sub-products which are quite remunerative. The ensemble of the apparatus resembles a small gas works, but the cost per kilowatt hour is only $0.008, with Crossley engines of 25 horse power, and this figure has justified a complete installation of this kind. The Riché generator, in which wood is used, gives gas of a relatively high quality at 80 calories per cubic foot, which has been used with Charon engines quite successfully. This process may find useful applications in localities where wood is plentiful, and thus the domain of the gas motor will be increased.

The use of water gas for motors has not been attended with the results which were hoped for; this may cause some surprise, but the necessity of using coke and the alternative phases of working may perhaps explain the fact. The Delwick generators, which furnish a gas of 70 calories per cubic foot, have had a certain success in Germany, and in America the Lowe generators, transformed by Merrifield, are used. But few experiments have been made as to the supply of motors by water gas, but these have been sufficient to give new proof of the great adaptability of the motor, which works as well with water gas as with mixed or with Siemens gases. Biedermann and Harvey have proposed a novel process, this being to supply the generators with carbonic oxide gas which would be reduced to carbon monoxide by contact with incandescent carbon. If this idea becomes practicable it would give rise to an interesting regeneration of the burned gases of the motors. In fact, the cycle could be closed by reviving these gases by causing them to pass through a layer of carbon at a red heat. The high temperature of the exhaust would no doubt suffice to keep up the reaction and the heat would thus be recuperated. Unfortunately, there would be an accumulation of nitrogen on account of the introduction of air into the motor cylinder to form the explosive mixture.

The gases of distillation may now be considered, these constituting the gases of high quality. Their energy varies from 100 calories per foot (gas from dry wood) to 140 from coal and 200 from schist. These are average figures, and we find 130 to 160 calories for the gas of the city gas-works. This latter has been the first gas used for the motors, and for which they were invented and built, from the time of Philippe Lebon to Lenoir and Otto. With gas at $0.54, $0.81, $1.08 and $1.35 per 1,000 feet, and for motors of 4, 10 and 30 horse power, working 3,000 hours per year, the price per horse power hour is shown in the following table:

COST PER HORSE POWER HOUR.

Motor.	Gas at $0.54	Gas at $0.81	Gas $1.08	Gas at $1.35
4 horse power	$0.022	$0.028	$0.034	$0.040
10 " "	.019	.025	.031	.037
30 " "	.017	.023	.029	.035

These figures, which, of course, are subject to variations, show at least that up to 10 horse power the gas engine need not fear the competition of any motor, even with city gas at $1.08 per thousand, but for 30 horse power the price should not exceed $0.81. It is true that the gas engine, fed from the city mains, has such great practical advantages that it will be used even if the price per unit of work is somewhat higher. It needs no accessory apparatus, no grate nor supply of combustible; it can be set working instantly by operating a valve and consumes nothing during the hours of rest.

The application of gas engines in cities has not received the development which might be expected by reason of the great improvements made during the last ten years. Now that an effective horse power hour can be guaranteed by the consumption of 18 cubic feet of gas of 135 calories (city gas) the use of these motors should be advantageous and economical in many industries. In Paris, the gas company supplies only 3 per cent of its output for gas engines; however, in Germany some of the gas-works supply as high as 17 per cent for this purpose.

* Paper read before the International Congress of Gas Industries. Reported by Paris Correspondent of the SCIENTIFIC AMERICAN.

THE CLOTHING OF THE ANCIENT ROMANS.

At the December meeting of the Archæological Institute of America, Prof. Myron R. Sanford, of Middlebury College, read a most interesting paper upon "The Material of the Tunica and Toga," and we extract the following from the Journal of the Institute:

With the passing of the simple toga and tunica of the early years to the more ornate and complicated forms of dress there came to Rome many new fabrics to vie with wool. Many Latin writers tell of the use of linen, cotton, silk and various mixed stuffs. The idea students gain from the perusal of classical literature is that rarely did the newer materials actually supplant wool in making up the various articles of cloth. No one seems to have undertaken the formidable task of an elaborate study of the existing paintings and statuary representing the Roman dress, to determine how far the artists intended to suggest various materials in their drapery. In some of the portrait statues in Pompeii it is unreasonable to believe that the clumsy, thick folds do not represent some form of wool, and the lighter and sometimes diaphanous folds the finer fabrics. Frequently in painting, and not rarely in statuary, different materials are to be seen in the clothing belonging to the same figure. The Latin department at Middlebury College has been interested in experimenting with a considerable variety of materials in imitation of some of the well-known figures. Besides coming to certain conclusions regarding the graceful and stiff folding of different cloths, the students had realized a fact insufficiently emphasized in the manuals, namely, that no material from the heaviest wool to the most delicate silk will of itself take the beautiful folding shown in the ordinary statue or painting. The drapery in the latter is always one of two results; it is either taken from the plaits and foldings of the clothing of the model draped beforehand with the most painstaking care, or it is the conventionalizing of the artist. Not until a trial is made will one realize how elaborate the process must have been to produce the appearance of the toga of Hortensius, for the accidental disarrangement of which on the crowded street he sent a challenge to his friend. Often the simplicity of certain effects is, after all, an elaborate effort. For example, the Commodus of the Vatican collection seems to have the drapery hanging from the body in the most natural manner, while an attempt to imitate it will show that it is a case of art concealing art. The simplicity is only apparent, and occasionally no imitation with material of any part whatsoever can follow the contortions in the drapery of certain classic figures.

SCIENCE NOTES.

A comet which was first seen in South America about the first part of May has reappeared, according to a dispatch from Lima, Peru, dated May 12, says The New York Tribune. It apparently has two tails, one of which is longer than when it was first seen.

At Carracross, on the west coast of Ireland, the only building in the place is the residence of the priest. Seventeen old fishing boats, one of which is said to have been built between 1740 and 1750, form the rest of the quaint little village. There is not a tree of sufficient size to furnish timber within eight miles.

A new process now used in Germany of imitating wood carvings, etc., in plaster, bronze and other materials, is said to supersede the old way of painting and lacquering, in so far as it reproduces perfectly the fibers and pores of the wood models. The model, which is best made from porous oak, is covered pretty thickly with a solution of two per cent collodion, and when this is dried up it leaves the usual dull and porous appearance of the wood unaltered, but the model is perfectly oil proof, and the casting is proceeded with in the usual way.

The approaching millenary of Alfred the Great lends special interest to the estate of Winklebury, in Hampshire, now in the market. It contains the well-known circular camp of that name, said to have formed a stronghold of Alfred. Excavations just made by Reginald Smith, of the British Museum, have brought to light fragments of ancient British pottery. An examination was also made in the autumn of last year, and on both occasions bones of extinct animals have been discovered, showing traces of fire, probably sacrificial. The camp is believed to have existed before the Roman invasion. It was occupied as late as the seventeenth century by the Parliamentary forces when besieging Basing House.

The London Lancet in an article on nicotine inverts the order of injuriousness usually associated with cigarettes, cigars and pipes. It states that nicotine itself has been proved to be practically guiltless of evil effects in smoking, but pyridine and its derivatives are responsible for headaches, trembling and giddiness. The degree of toxicity in smoke depends largely upon the completeness of combustion. The combustion of a cigarette is more complete than that of a pipe or cigar. A pipe acts as a condenser, but the condensed products do not reach the mouth, while considerable condensation must occur in a cigar, the products reaching the mouth and being absorbed. Therefore The Lancet places the cigar first in the order of injuriousness, then the pipe and lastly the cigarette.

John D. Rockefeller has given $200,000 to found "The Rockefeller Institution for Medical Research." The gift is not intended for an endowment fund, but is for immediate expenditure. Mr. Rockefeller has for some time been consulting with eminent medical men as to the need of such an institution, and he has had the best advice. Facilities for original investigation are to be provided, especially in such problems in medicine and hygiene as have a practical bearing on the prevention and treatment of disease. The first work of those connected with the institution will be that of co-operating with the New York Board of Health in studying its work and the problems confronting it, and particularly that of milk supply. Researches of a more ambitious nature will be begun in the fall under the guidance of experienced investigators.

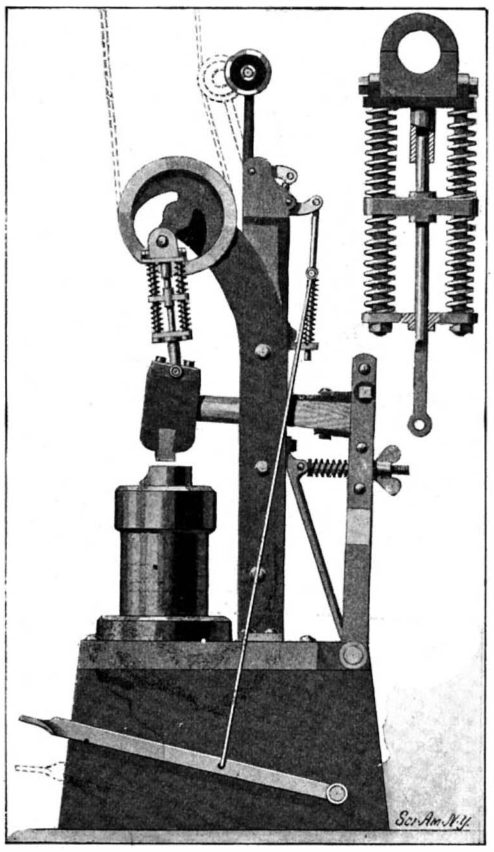
There is a movement in Great Britain to secure a photographic record of historic events, and homes in the country which are rapidly disappearing before the advance of progress. The work is being carried out by the National Photographic Record Association. It was founded in 1897 by several well-known gentlemen, anxious to preserve photographic records of objects of interest, scenery, life, customs, and history of the time. Such a faithful picture as that secured by means of the camera conveys a much more comprehensive idea of the subject than columns of written description can convey. The pictures are being preserved in the British Museum as they are collected, and they will constitute a valuable work of reference to the chroniclers of future generations. Several members of the association are enthusiastic photographers, and many valuable pictures have been secured by this means. The society also commissions pictures of important events or historic spots to be secured in all parts of the country. The work is of exceptional value in connection with London, since many of the old, historic and interesting landmarks are rapidly vanishing, so that within a few years there will be very little of ancient London in preservation, with the exception of the national buildings and monuments.

AN ADJUSTABLE POWER-HAMMER.

The inventions which have recently been patented in the United States include an adjustable power-hammer devised by Mr. Abel Sack, of Ashton, Neb.

The handle of the hammer, as our illustration shows, is hung on centers carried by a link, the lower end of which is fulcrumed on the base. By means of a screw-rod surrounded by a spring which presses on the link and on an inclined brace extending from the base to a central upright, the link is caused to swing forward or backward so as to shift the hammer and its die according to the nature of the work in hand.

The hammer-head is pivotally connected by a yielding pitman with the wrist-pin of two counterbalanced crank-wheels driven by a belt. Our smaller illustration shows that the pitman consists of a head from which a tubular portion depends, designed to receive the upper end of a shank pivoted to the hammer. The shank carries a cross-head through which guide-rods extend. Springs are coiled around the guide-rods, and press against the cross-head on opposite sides. The pitman yields in the direction of its length; for an upward pressure of the hammer on the pitman causes the cross-head to press the springs.



SIDE ELEVATION AND DETAIL OF POWER-HAMMER.

By hanging the hammer on a link pressed outward by a spring, and by connecting the hammer with a yielding pitman to the crank-wheels, it is evident that the desired blow to be given can be struck with any pressure. Objects of any kind can be readily fashioned by this trip-hammer, owing to the yielding pitman and to the transverse adjustability of the hammer relatively to the anvil.

In order to tighten or loosen the belts and simultaneously to actuate and stop the hammer, tightening pulleys are employed which are operated by a treadle through the medium of a system of levers and links. When the hammer is idle the belts run loosely around the crank-wheels. By pressing the treadle the tightening-pulleys are thrown forward against the belts to tighten them. When the pressure on the treadle is released, a spring automatically withdraws the tightening-pulleys from the belts.

The hammer delivers a drawing stroke, since it is supported so that it can move longitudinally.

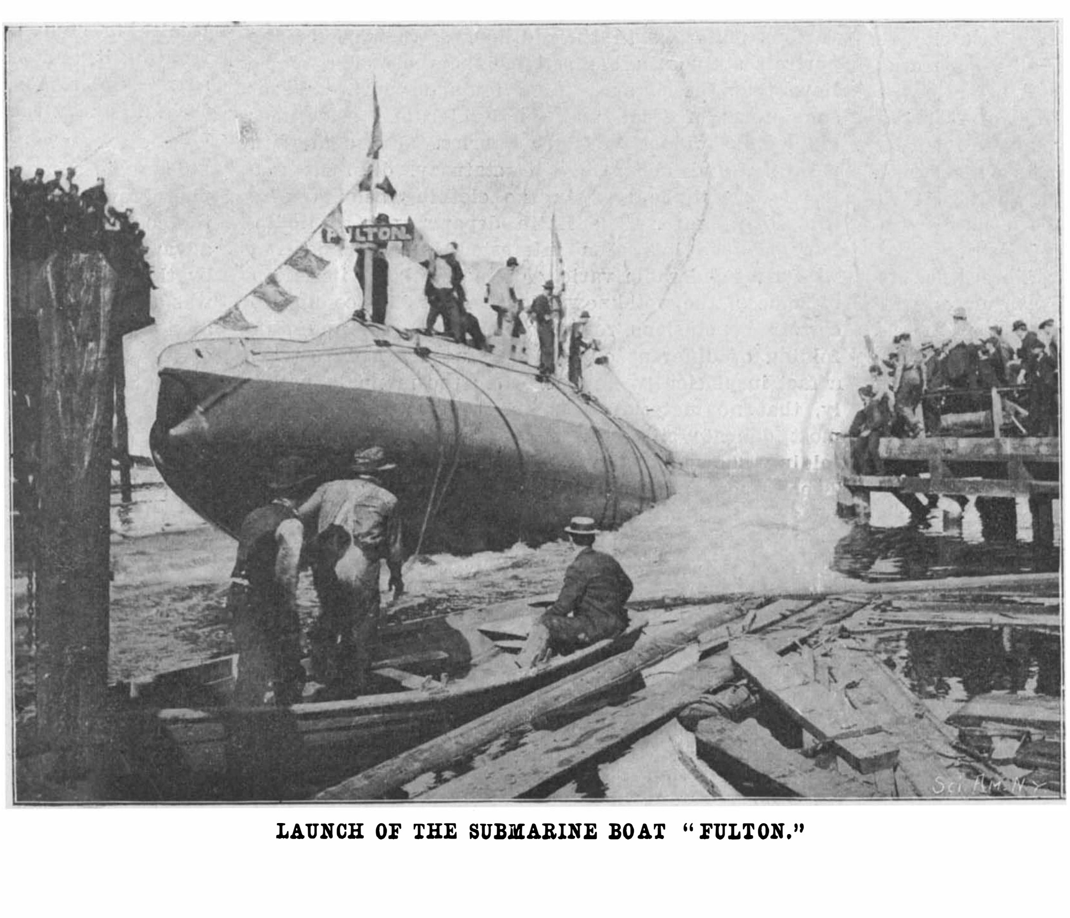
LAUNCH OF THE SUBMARINE TORPEDO BOAT "FULTON."

The launch of the submarine torpedo boat which is herewith illustrated affords practical evidence of the fact that the possibilities of submarine warfare are being fully recognized and tested by the great naval powers of the world. It is to the French navy that we owe the present awakening of interest in this subject, and their elaborate course of experiments in the Mediterranean are fresh in the public mind. Antedating these French experiments were those of the British government with the "Nordenfeldt;" but for the past decade and a half the English navy have done practically nothing in this direction. It is but just to say that the present interest in the question of submarine warfare is largely due to the indomitable energy and confidence of Mr. Holland, the inventor of the type of submarine recently adopted by both the British and American navies.

At present there are six boats of the Holland type under construction for the United States navy. Four of these, the "Adder," "Moccasin," "Tortoise" and "Shark," are under construction by Lewis Nixon at Elizabethport, N. J., and two, the "Grampus" and "Pike," are being built at the Union Iron Works, San Francisco. The vessel shown in our illustration, which was launched on June 13 at the Nixon shipyard, is identical with these vessels in every particular. She was built for the Holland company to be used as an experimental vessel, and in a few weeks' time she will make a series of trial runs in Peconic Bay. In these trials every part of the equipment and motive power is to be subjected to thorough test, and the experience thus gained will be incorporated in the six boats which are now in frame and plated at the two yards where they are under construction. The vessels are similar in general design to the "Holland," which has been illustrated at different times in the Scientific American. The length over all is 63.33 feet, the diameter 11.75 feet, and the displacement when submerged 120 tons. The vessel is driven by a single screw, and motive power is furnished by four-cylinder Otto gasoline engines of 160 indicated horse power, and by electrical motors of 70 horse power. The gasoline engine will be used for propulsion on the surface, and also for charging the batteries, which will be drawn upon by the 70-horse power motor when the vessel is submerged. When the gas engines are charging the batteries, the electric motor is used as a dynamo. The armament consists of a torpedo tube, which is provided with five Whitehead torpedoes. The conning tower is 21 inches in diameter and is protected by 4 inches of armor. The speed is to be about 7 knots an hour.

There are separate engines for operating the vertical rudder, and the two horizontal diving rudders. These engines are worked by air at a pressure of 50 pounds, supplied from six storage flasks which carry air at a pressure of 2,000 pounds to the square inch. The necessary reduction of pressure is secured by means of a reducing valve.

In recent government trials between Annapolis and the Norfolk Navy Yard, the "Holland" (the precursor of the improved boats, of which the "Fulton" is the first) ran a total distance of 145 miles. The trip was a surface run, and the actual speed, after corrections, was 5 2-3 knots. The temperature did not rise above 60° F. For surface propulsion the ventilation arrangements were good, and under submarine conditions, although the commanding officer detected an odor from the gas, the crew appeared to suffer no discomfort. The report states "the behavior of the boat and of all mechanisms was excellent" with a few minor exceptions.

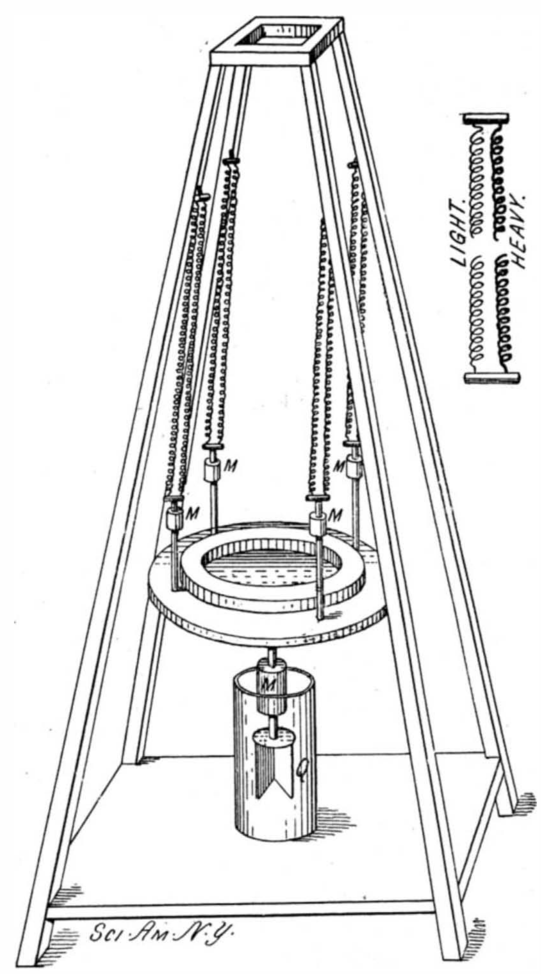


LAUNCH OF THE SUBMARINE BOAT "FULTON."

THE FORM OF MERCURY BATH—EXPERIMENTS AT THE OBSERVATORY OF PARIS.

BY J. GUENAIRE.

The mercury bath is an indispensable adjunct to the telescope used to observe the passage of a star at the meridian of observation. As the angles are counted from the vertical, it is essential that the latter should be accurately determined; this is carried out by the use of the mercury bath. The telescope is directed perpendicularly over the bath, and in consequence two images of the cross hairs near the eye piece are formed. One of these is formed directly and the other by reflection from the mercury; if the telescope is exactly vertical the two images coincide.



MERCURY BATH, HAMY SYSTEM

It is then observed whether the zero of the graduated circle at the side of the telescope corresponds with the zero of the vernier, or if not, what correction is to be added or subtracted. At the Observatory of Paris the question of mercury baths has been carefully studied of late, owing to the fact that the Observatory is located in the center of the city and the surface of the mercury is troubled by the vibrations of the soil. Among the different forms of mercury baths in use may be mentioned, first, the bath formed of a material which is wet by the mercury; it has certain advantages, the reflected image being fixed, but diffused. This want of sharpness may come from vibrations which are very rapid, but of small amplitude. Second, grooved baths; in these the vessel has grooves on the bottom 0.12 inch wide by 0.12 inch deep. This form was studied by Leverrier in 1869, and its introduction was considered as improving notably the observations of the vertical, and was thought to have entirely suppressed the influence of vibrations. In fact, the image is improved, but to a degree quite insufficient for permitting the observation of the nadir during the day. Third, floating baths; a floating bath with a thin layer of mercury, proposed by P. Gautier, was tried with success at Paris and Melbourne, but it was afterward shown by Perigaud that its advantages had been wrongly attributed to the floating, and his experiments show that it is the thickness of the mercury which comes into play. The images are sharper as the layer is thinner. It is on this principle that are established the baths which are at present in use at the Paris Observatory for meridian observations. Fourth, suspended baths; this type of bath appears to have been proposed by Seguin and Mauvais in 1852. After placing the bath upon rubber plates or cushions they found that the best results were obtained by suspending it from rubber bands, and concluded that elasticity by traction is preferable. At Melbourne, Mr. Ellery, in 1888, found that the rubber band system overcame the large trepidations, but not the smaller ones, and that the problem was not yet solved. It is only recently that M. Hamy, of the Paris Observatory, established theoretically the conditions which the bath should fill, and he has obtained with his new bath an image which is practically motionless. This apparatus was shown at the Paris Exposition, and is at present undergoing some modifications in detail. M. Hamy wished to find by calculation whether it was possible to realize a method of suspension which would give a perfect surface to the mercury. The two main problems may be briefly mentioned. The study of small movements of a solid swinging in a liquid when the vessel is submitted to vertical vibrations shows that after a time the solid takes a vibratory movement, synchronous with that of the vessel, but of different amplitude; the latter is much smaller than that of the vessel, if, with a sufficient immersion, the resistance to movement due to viscosity is not too great. Then, remarking that the action of a liquid upon the solid in movement is comparable with the elastic action of a spring, M. Hamy was led to solve the second problem, this time not making the restriction that the vibrations should be vertical. A rigid support, having a vibratory movement, acts upon a heavy solid, M, which is suspended from it by coiled springs of negligible mass and attached at the points of a regular polygon. The question is to determine the absolute movement of the mass, M, knowing that the speed of a point, Q, of the solid with relation to the support is opposed by resistances proportional to this speed. The consideration of the problem shows that the effect of the trepidations of the soil upon the surface of the mercury may be nearly annuled by the proper suspension of the vessel. In the present apparatus the vessel is suspended from a framework by four long double springs. The vessel is very heavy, and arranged so that the center of gravity is near the surface of the liquid. The springs are arranged in pairs, two springs of different thicknesses being placed side by side so as to oppose their vibrations. Below the vessel is a vane which plunges into a viscous mixture of tar and oil. Above the vane is a weight for regulating the center of gravity and bringing it near the surface of the liquid. The experiments made with the new system at the Paris Observatory have completely confirmed the previsions of theory. During two consecutive days the images given by the new bath have been observable at all hours of the day and in satisfactory conditions of sharpness.

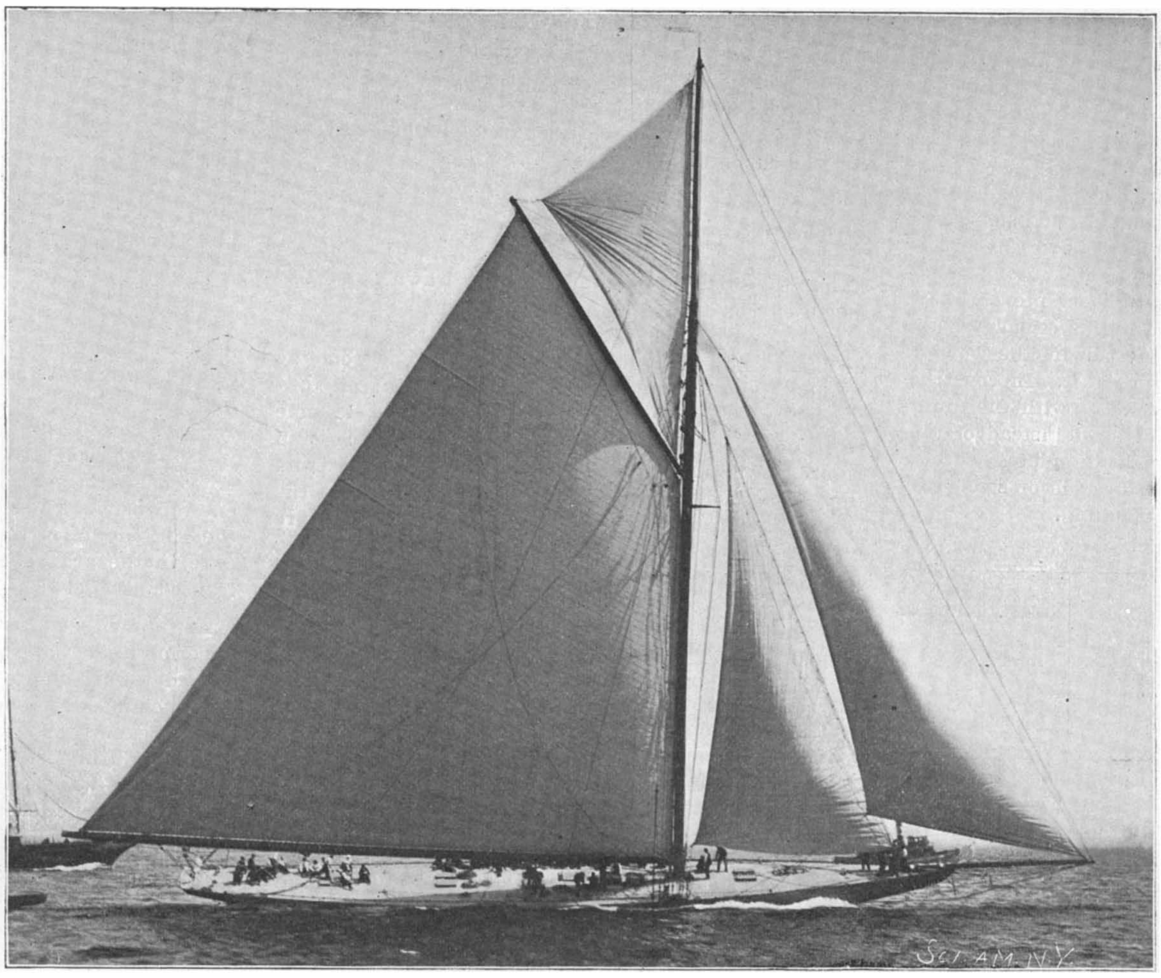


Photo. by N. L. Stebbins, Boston.

"INDEPENDENCE."

Length over all, 140 feet 10½ inches. **Beam,** 23 feet 11½ inches. **Draft,** 20 feet. **Ballast,** 75 tons. **Sail Area,** 14,300 square feet.

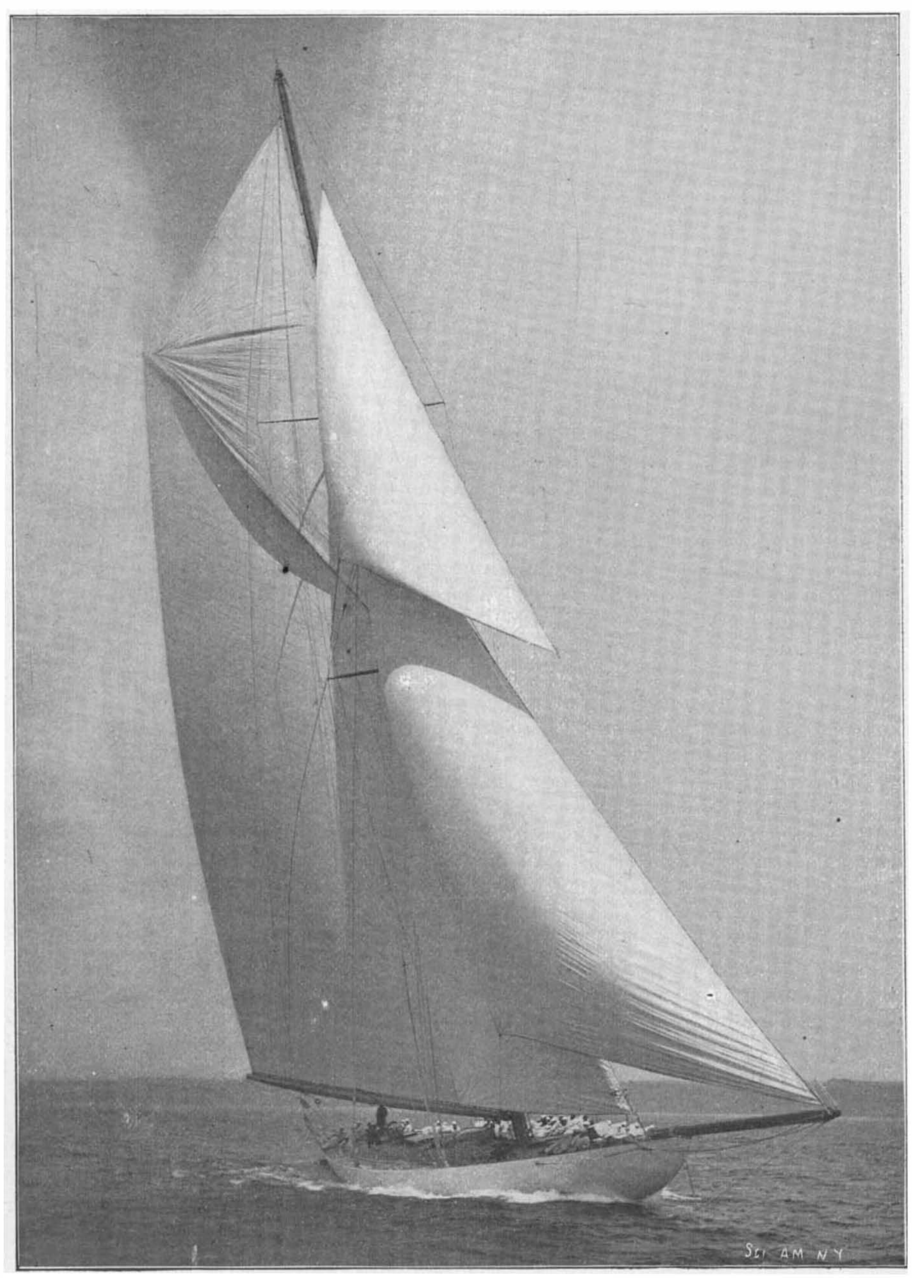
THE THREE CUP-YACHTS OF 1901.

It takes but a glance at the three photographic views of the cup yachts of the present season, and the accompanying table of their measurements, to be convinced that in the effort to produce, on a given water-line length, the fastest possible sail-driven racing yacht, our present-day designers have arrived at a common type from which they vary only in minor particulars. Admitting the existence of a type-yacht, it must be confessed that the palm for originality, as far as the modeling of the hull is concerned, belongs to Crowninshield, the young designer at Boston, who, in the modeling of his first 90-foot cutter, has not hesitated to branch out on new and hitherto untried lines. Judged on the basis of construction, however, the most original boat of the three is the "Constitution," which differs so

Photo. by Symonds & Co., Portsmouth, England.

"SHAMROCK II."

Length over all, 135 feet. **Beam,** 25 feet. **Draft,** 19 feet. **Ballast,** 95 tons. **Sail Area,** 14,200 square feet.



Copyright, 1901, by Frank H. Child, Newport, R. I.

"CONSTITUTION."

Length over all, 132 feet 6 inches. **Beam,** 25 feet 2½ inches. **Draft,** 19 feet 10 inches. **Ballast,** 93 tons. **Sail Area,** 14,400 square feet.

widely in this respect from her competitors and, indeed, from all other 90-foot racing yachts that have preceded her, that she stands in a class entirely by herself. Of the Watson yacht it must be confessed that she presents less novelty than the other two boats. She reminds the writer strongly of the yawl "Sybarita," also built from Mr. Watson's designs, which has hitherto proved the fastest 90-foot yacht in British waters. The "Shamrock" differs from that boat chiefly in her bow sections, the overhang being much longer and the beam being carried much further into the bow, with a substitution of flat and full sections for the sharper V-sections which are found in the bow of the "Sybarita" and other Watson craft. In construction she is not unlike "Shamrock I.," with the difference that her sheer strake is of steel instead of aluminium. The body of the yacht is plated with a special make of bronze, and the deck is of steel, covered with a thin layer of pine planking.

DIMENSIONS OF 90-FOOT CUP-YACHTS.

	Length over all.	Beam.	Draft.	Ballast.	Sail Area.
	Ft. In.	Ft. In.	Ft. In.	Tons.	Sq. Ft.
Shamrock II........	135 0	25 0	19 0	95	14,200
Constitution........	132 6	25 2½	19 10	93	14,400
Independence... ...	140 10½	23 11½	20 0	75	14,300

As to the performance of the three competing yachts under sail, it may be described as truly sensational. Both "Shamrock" and "Constitution" have been dismasted, and "Independence," as the result of a jamming of her steering gear, came very near being so. As far as can be judged from these sailing trials, "Shamrock II.," after her defeat by "Shamrock I.," appears to have very little prospect of winning the cup. The only element of uncertainty, as far as she is concerned, hinges on the possibility that "Shamrock I." is sailing faster than she was when over here in 1899; but inasmuch as orders were given that, to render her a medium of comparison, the older vessel should not be changed, we see no reason to suppose that she is a faster boat now than then. As to the speed of "Constitution" and "Independence" there has been no scale by which to judge of it, other than the perfervid imagination of the spectators who have followed these vessels in their canvas-stretching trials. Nevertheless, we should be greatly surprised if both of these boats are not faster than "Columbia," and this for two reasons. In the first place, "Constitution" is several tons lighter in construction than "Columbia," and by transferring the weight so saved from the hull to the keel, and adding 12 inches to her beam, it has been possible to increase her sail-plan at least 10 per cent over that of "Columbia," without giving her more displacement than that boat. "Independence," on the other hand, has achieved the same result by the peculiarity of her model. Although her hull is probably no lighter than that of "Columbia," she gains power through the flattening of the floor and hardening of the bilges, and the carrying of the floor out into overhangs of exceptional length. As originally designed she was to carry a sail-spread of 14,611 square feet, with a total amount of ballast of 75 tons. Mr. Crowninshield, the designer, gave her an excessive sail-spread and a moderate amount of ballast, with the idea of decreasing the first and increasing the second, should the sailing trials prove it to be necessary, until the proper balance between the two had been established. The unprecedented character of her model—unprecedented, that is, for a 90-footer—rendered this tentative method of proportioning the spars almost a necessity; and, very wisely, care was taken to have the sail-spread over rather than under the capacity of the boat. It is easier to cut down a sail-plan than to increase it, and the Boston boat is now having 5 feet cut from her mast and as much from the topmast, with the result that 300 square feet of canvas, and a corresponding weight in spars and gear, will be removed from an altitude of from 100 to 173 feet above the deck. The reduction of weight aloft will fully compensate for the reduced sail-power. Another change is the substitution of a rudder of the normal type for the experimental balanced rudder with which the preliminary trials have been carried out. Altogether, the coming races promise to be, to say the least, exciting. The enormous sail-plans, the fact that the designers have kept down the factor of safety to the vanishing point, and the possibility of piping breezes during the month of September, when the races will be held, introduce elements of uncertainty which may yet land the cup in the lockers of the boat which carries the stoutest spars and gear.

Copyright Business in 1900.

From January 1 to December 31, 1900, the United States copyright fees amounted to $66,630.50, distributed as follows: Filing 8,478 titles foreign productions, $8,478; filing 89,489 titles United States productions, $44,744.50; 23,832 copyright certificates, $11,916; for copies of record, $662; for recording assignments, $801; search fees, etc., $29.

Automobile News.

Electric cab service in Paris has proved very unprofitable, and it is said that the loss represents $900,000. The failure of the enterprise is considered to be the high cost of maintaining the accumulators and the consequent high charge for the service.

The Northwich Union Fire Brigade had a startling experience recently, and the attendant circumstances were of a serious nature, says The Mechanical Engineer. Lately the steam fire engine, hitherto drawn by horses, has been converted so that steam propulsion is now used. The trials have not been wholly satisfactory owing to the continuous emission of sparks from the funnel. One evening the brigade received a call to a fire about three miles from the city. The brigade turned out with their steam-motor fire engine, and before they reached the city boundary the sparks from the engine had ignited a load of straw standing in the roadway, and the hedges in two places. The city fire brigade were called out to extinguish the blazing straw, but the whole was consumed and the wagon damaged. Other hedge fires, as well as two large straw ricks, were ignited by the engine before it reached its destination, while on arriving there a pipe in the engine burst and rendered it useless for all practical purposes.

When the out-of-town use of electric automobiles is discussed the question is often raised in a dubious way as to the existence of proper facilities for charging and storage of vehicles. The Electrical World gives an interesting list of the charging plants between New York city and Greenwich, Conn., a distance of possibly thirty miles. It will be seen that there are ten plants, averaging one to every three miles: No. 1. West Chester Village, near Morris Park; No. 2. Union Port, electric power house—both convenient to Westchester Country Club and Century Golf Club. No. 3. Pelham Manor, near station of N. Y., N. H. & H. RR., Harlem River branch; convenient to N. Y. Athletic Club, Pelham Country and Golf clubs; at the laboratory of Mr. E. T. Gilliland. No. 4. New Rochelle, Rose and Huguenot Streets, one block from N. Y., N. H. & H. RR. station, at livery establishment of Mr. Charles H. Coe; vehicles cared for and batteries recharged. No. 5. New Rochelle, electric power house, Webster Avenue. No. 6. Larchmont, Boston Post Road and Chatsworth Avenue, opposite golf links, and convenient to Larchmont Yacht Club; J. Maddox & Sons. This will be a model station for the care of vehicles and recharging of batteries; also the Central office of the company. No. 7. Rye, "Rye School for Riding and Driving," at N. Y., N. H. & H. RR. station, and the entrance to Apawamis Golf Club; care of vehicles and recharging of batteries. No. 8. Portchester, Portchester Electric power house, after June 1. No. 9. Portchester, directly opposite N. Y., N. H. & H. RR. station, at livery establishment of Charles H. Benedict; care of vehicles and recharging of batteries. No. 10. Greenwich, after June 1, 1901, near entrance to Fairfield Country Golf Club and at station of N. Y., N. H. & H. RR., or other locations convenient for residents of Belle Haven.

The annual race known as the "Course du Catalogue" presents a rather unique feature, as the machines, instead of being classed as usual in regard to weight or capacity, are classed according to the catalogue price, making five series, with a sixth for electric vehicles. The race was run this year on the 28th of April from Melun to Nangis, Valence and back; this route forms a quadrilateral of 46 miles, and the distance was covered once by the light machines of the first class and the electric vehicles, and twice by the others, or 92 miles. The race was one of the most successful of the season, and attracted a great crowd of prominent chauffeurs. In the first class, machines valued up to $800, the best record was made by Demester on a Gladiator machine, who covered the 46 miles in 1h. 19m. 22 2-5 sec., or an average of 35.1 miles an hour. The second series (machines valued at $800 to $1,600) was won by Edmond (Darracq machine), making 92 miles in 2h. 32m. 55 sec., or 36.5 miles an hour. Third series, $1,600 to $2,400, Cuenod (Geo. Richard machine), 92 miles in 3h. 47m. 53 sec., or 25.1 miles an hour. Fourth series, $2,400 to $3,200, none. Fifth, value above $3,200, De Champrobert (Bolide machine), 92 miles in 2h. 27m. 27 1-5 sec., or 38.4 miles an hour. Electric series, Garcin (Bouquet, Garcin & Schiore), 46 miles in 3h. 16m. 20 2-5 sec., or 14.4 miles an hour. The record made by De Champrobert is the best which has been made for two tours over this route; M. De Rothschild made the best record for one tour, but this was run outside of the official race. This was the result of a wager laid between MM. De Rothschild and René de Knyff at the time of last year's race; the former gentleman had bet that he could make an average of 36 miles an hour with his 28 horse power Daimler machine, but did not succeed. This year he raised this figure to 42 miles an hour, and won the bet with a very small margin, using a Mercedes (German) machine, which carried three persons.

Engineering Notes.

According to the report issued by the Minister of Railways in Austria for 1899, there were 18,738 kilometers in existence; 2,015 accidents occurred, of which 318 were due to collisions, and trains left the rails in 308 cases. The number of passengers injured through accidents and neglect on their own part was 215, with 15 fatal injuries. The proportion of personal injuries was 1.51 per million passengers, and 0.04 per million passenger-kilometers.

Consul Donaldson, of Managua, says that the Nicaraguan government has placed an order with its agent in New York for 2,400 tons of steel rails for the new central branch of the National Railroad, which is being constructed by a German engineer, Mr. Julio Wiest. Considering the fact that Nicaragua has always purchased rails in Germany and England, says Mr. Donaldson, and that the contractor for the present railroad is a German, the placing of this order in the United States is an item of considerable importance in the growth of our trade with Central American countries.

As a consequence of the increasing demand for superior grades of sugar in Japan, attention is being turned toward improving the very primitive methods of crushing now employed at Tainan, and turning out a cleaner and higher grade sugar, says The Engineer. As a first step in this direction four iron mills —crushers—were introduced during the year to replace old stone crushers, but as the same motive power—bullocks—is used as before, this improvement is limited only to the extraction of a larger percentage of juice, and the quality of the sugar produced remains much the same.

According to statistics issued by Lloyd's Register, during 1900, exclusive of warships, 692 vessels of 1,442,471 tons gross—viz., 664 steamers of 1,432,600 tons, and 28 sailing vessels of 9,871 tons—have been launched in the United Kingdom. The warships launched at both government and private yards amount to 29, of 68,364 tons displacement. The total output of the United Kingdom for the year has, there fore, been 721 vessels, of 1,510,835 tons. The tonnage launched in 1898 and 1899 was less by 75,000 tons and 26,000 tons respectively than that launched in 1900. As regards war vessels, the figures for 1900 are less than those for 1899 by 100,000 tons.

A committee of the Canadian Roadmasters' Association reported that the best method to prevent the creeping of rails on a soft or swampy road-bed is to put on 18 inches of cinders—to lay ties 10 to 12 feet long, and 7 to 8 inches thick, and not more than 8 inches from bearing to bearing; also to block four ties on each side of joint, under each rail, with angle bars of 4 inches by 4 inches scantling. In the discussion, an official of the Canadian Pacific Railway said that several years ago he had some experience with badly creeping rails, and had adopted the practice of putting in ties of 12 feet length, and 8 inches thick, with a bed of cinders, using a long angle bar. He found that it prevented the rails from creeping, but thinks that with heavy trains and engines it is almost impossible to prevent it altogether. Another railway man laid stress upon the importance of keeping the bolts tight in track over swampy land. He has had experience of track which will creep 8 to 9 inches both ways the same day in hot weather, but this is believed to be an extraordinary experience.

The Nilgiri Railway is notable as being the first Abt-rack railway constructed in India, and, at present, the longest of its class in the world. It is, moreover, the first for which all the plant and material was manufactured in England. An account of the permanent way and rolling stock was given at the meeting of the Institution of Civil Engineers, on February 12, by Mr. W. J. Weightman, says Nature. The railway was chiefly designed to serve the important towns of Ootacamund, the summer headquarters of the Madras government, Coonoor, Kotageri and Wellington, the latter being the military sanatorium for South India and Burma. It is 16¾ miles long, and from its starting point at Mettapollium on the Madras Railway, ascends nearly 5,000 feet to the plateau on the Nilgiri Hills. The first 4¾ miles are adhesion-line with gradients not exceeding 1 in 40; the remaining 12 miles are built on the Abt-rack system, and have a ruling gradient of 1 in 12½. The formation-width is everywhere 16 feet, and as the rainfall is frequently 6 inches in as many hours, the greatest possible care has had to be taken to see that it is effectually drained. The locomotives are of the type known as "combined" Abt engines, that is, they can run either on rack or on ordinary line. Before the line was opened for traffic a series of brake experiments was made with a fully loaded train of 100 tons gross weight. With an ascending train at speeds of 6, 8 and 10 miles per hour on a 1 in 12½ gradient, stops were made in 24, 36 and 60 feet respectively; with a descending train at various speeds ranging from 4 to 12 miles per hour, relative stops were made in 54 feet, increasing to 425 feet.

PRESSED-STEEL SYSTEM OF CAR CONSTRUCTION.

In the early days of railroads in the East, wood was used almost exclusively as the material of framed structures. Not merely the trestle viaducts, but even the important long-span bridges were constructed of timber. Half a century ago this was a matter of necessity, and to-day, on western roads, it is still one of economy. With the growth of the steel industry and the great cheapening of iron and steel structural shapes, it was only a question of time before these wooden bridges would be replaced by more serviceable and safe metal structures, and as the country opened up by the pioneer railroads in the West is being settled and its resources developed, the same substitution of steel for wood is taking place.

Strange to say, although the use of iron and steel in the construction of the rolling stock of the railroads was advocated and experimentally attempted nearly half a century ago, it is only within the last three or four years that the steel car has been able to assert its superiority over wooden railroad cars, and thereby bring within measurable distance the time when, at least for the transportation of freight, all-steel rolling stock will be exclusively used. The same arguments which favored the introduction of steel bridges, steel ships, and skeleton-steel buildings, are now operating to produce a revolution in the freight car business, which is one of the most remarkable economic facts in the field of transportation. Briefly stated, the argument from a structural standpoint is based upon the fact that, although a cubic foot of southern yellow pine or Oregon pine when built into the car will average about 50 pounds in weight as against a weight per cubic foot of steel of 490 pounds, the maximum strain allowed in calculating the necessary section of the various members of a wooden freight car is only 1,100 pounds to the square inch, as against a unit of stress allowed in the case of steel of 13,000 pounds per square inch; figures which show a theoretical superiority weight for weight of steel over wood, say of about 20 per cent. This saving would apply only to such parts of a car as were subjected to direct tension or compression. Seventy-five per cent of the material in the car acts as a beam, however, and is subjected to transverse strains; and here the saving of weight, strength for strength, will amount to about 9 per cent. Hence it is estimated that the theoretical saving of weight on the whole car is about 11 per cent. In making the connections and joints of the steel parts, however, there is not so much sacrifice of materials as in a wooden car; and this 11 per cent advantage must, therefore, be increased proportionately. Moreover, it is safe to say that, in a comparison of two cars of the same carrying capacity and strength, the "factor of safety" will be found to be larger in the steel car than in the earlier type.

What is suggested by theory is proved by actual facts; for in a wooden car of 30,000 pounds weight empty, and 60,000 pounds carrying-capacity, the ratio of the load to the total weight of car when loaded is 66.67 per cent; whereas in a pressed-steel car of 80,000 pounds capacity, weighing 28,500 pounds, the ratio of load to total weight when loaded is 73.75 per cent; while in the case of a pressed-steel ore car of 100,000 pounds capacity, weighing 28,000 pounds, the ratio of load to total weight when loaded is about 78.1 per cent. Another and valuable advantage of the pressed-steel car is that its life is probably double that of the wooden car. It was officially reported by the Western Railway of France, in the year 1897, that steel cars built in 1869 had lost only 6 per cent of their weight by corrosion in an interval of twenty-eight years.

As a result of the reduction of the dead-weight of the car there are many numerous advantages to which the roads that have adopted the new system refer in justification of their policy. Thus, the capacity of the individual car being increased, a reduced number of cars is required to haul a given amount of freight. From this it follows that there is a reduced amount of empty-car hauling to be done, and a reduced amount of switching service. The train-length is shorter, and hence it is easier to back trains into sidings and otherwise handle them in the various yards of the roads. There is also a reduced payment for car mileage and cost of inspection; and, lastly, there is a decrease in the cost of repairs from an average of say $35 to $40 per annum for the wooden car to an average, as proved by reports received from the railroad companies, of from $10 to $15 for the steel car. We have before us an interesting comparison given by Mr. Von Z. Loss in a paper read before the International Railroad Congress, Paris, last year, showing the comparative earnings of wooden and pressed-steel cars operating under average conditions of service in the United States. The figures are worked out on a basis of costs and earnings per ton per mile on an assumed yearly mileage of 5,000 miles loaded and 5,000 miles empty. The cost per ton per mile of both live and dead weights is assumed at 3 mills, and the gross earnings per ton per mile of freight in the Eastern States of America at 6 mills. Of 1,000 pressed-steel gondola cars, recently figured on against specifications for wooden gondolas of 80,000 pounds capacity, the wooden car weighed 18.2 tons and was of 82,000 pounds of coal capacity. The steel car weighed 16.1 tons, and had a capacity of 86,200 pounds of coal. In the case of the wooden car the yearly income from lading hauled 5,000 miles at the given rate amounted to $1,230. The cost of hauling the lading was $615, and the cost of hauling the dead weight $546; so the net earnings for the year of the wooden car amounted to $69. In the case of the pressed-steel car the yearly income from lading amounted to $1,293. The cost of hauling the lading amounted to $646.50; the cost of hauling the dead-weight amounted to $483, the net earnings of the steel car per year working out as $163.50, or $94.50 in excess of those of the wooden car. Hence, it was shown, the increased earning capacity of the car during its life of thirty years would be $2,835, and the increased earning capacity of 1,000 steel cars over 1,000 wooden cars during a life of thirty years would be $2,835,000. It is estimated, in the paper above referred to, that the average capacity of the existing wooden cars in the United States is about 25 tons, and that the total capacity of all wooden cars in the United States is 37,500,000 tons. From this it is figured that on the basis of an average annual mileage per car of 3,500 miles, and an average cost per ton per mile of 3 mills and average gross earnings of 8 mills, the total yearly profit from all wooden cars is $215,000,000. If the above-mentioned lading of 37,500,000 tons were to be concentrated in large capacity, pressed-steel cars, the total dead-weight would be cut down from 21,000-000 tons to 14,000,000 tons, which would represent a hauling expense saving of 147,000,000 tons. Of course the above figures are given merely in a general way for comparison, and must not be applied too literally, for the reason that there must be certain localities where the conditions of railroad service, and the nature of the freight to be carried, would not favor the use of large-capacity cars; but even if the statement be largely modified by this consideration, the argument is still enormously strong in favor of the new system of construction.

That the above estimate of the economies realized by the use of steel cars is not exaggerated is rendered likely by the remarkable popularity which they have achieved with the railroad companies. Although the first pressed-steel car was built as late as 1897, the industry has grown at such a rate that at the beginning of the present year there were 46,000 pressed-steel cars in use, and at the present time about 10,000 men are employed at the four different works of the Pressed-Steel Car Company in turning out new cars at the rate of over a hundred per day. The two largest factories are located at McKee's Rocks and at Allegheny, at each of which works over 4,000 men are employed. There are also two smaller works at Joliet and Pittsburg, each employing about 600 men. Of the two larger concerns, the one at Allegheny is the older. In spite of the frequent enlargement of the latter establishment during the past three years, it was found necessary to purchase new ground at McKee's Rocks and erect an entirely new plant to accommodate the rapidly increasing business.

The steel used in the manufacture of the cars is what is known as medium-soft Carnegie, with an ultimate strength of 60,000 pounds to the square inch, and an elongation of 25 per cent in 8 inches, with a reduction of area of 50 per cent. The buildings are laid out with a view to a minimum amount of handling of the material, which moves from shop to shop in a regular sequence of operations, until it is hauled out on the tracks from the paint shop in trains of finished cars, to be taken to the various railroads of the country. At the date of our visit to these works in March, 1901, cars were being finished at the rate of 106 per day.

The stock, in the shape of plate steel, is first marked out with templates and sheared to the finished size. It then undergoes either Heavy Pressing or Light Pressing. The larger pieces, such as longitudinal car sills for the under-framing, and also such pieces as require but slight forming in the presses, are pressed cold; and one realizes what an economy in labor there is in the manufacture of these cars in seeing how rapidly the side sills, many of them 40 feet in length, are pressed into shape, the work being done in three strokes of the hydraulic press. The first stroke brings up the center of the sill where its section is deepest, and two more strokes serve to bring up the shallower ends. As a matter of fact, the whole operation of forming side sills of the largest dimensions occupied only one and a quarter minutes. The smaller and more complicated pieces, which are more difficult to bring up to shape, are first heated in the furnace to a bright cherry red, and then subjected to light pressing in a smaller hydraulic press.

After pressing, the parts are taken to the construction department, where the work is almost entirely one of drilling and riveting, the work of the presses being of such accuracy as to involve a minimum amount of fitting. As much of the machine-riveting as possible is done in the Construction Department, and the material is then passed on to the Erecting Department, where the cars are put together, and such hand-riveting done upon them as is necessary. Here the draft-gear and brakes are put in as ordered, each Road having its own special preference as to type and pattern. In the erecting shop there are four aisles with series of parallel tracks extending down them. Upon these the cars are erected. The axles come to the tracks rough-turned, where they are finished and put upon the wheels by hydraulic pressure.

One of the first items undertaken in the direction of pressed-steel car construction was the pressed-steel bolsters for trucks. As shown in our engraving, these are built as box girders, in a form which offers great resistance to vertical and lateral distortion. Then followed the pressed-steel truck, of which we show two types; one, the Fox Pedestal Truck, which is specially suited to first class roadbeds, and the other the Pressed-Steel Diamond Truck, which affords greater horizontal flexibility and is suited to roads with less carefully aligned and surfaced track. Our other illustrations show some of the types of car which are to-day in successful operation.

Electrical Notes.

A company has been formed to manufacture the new storage battery invented by Thomas A. Edison, which will be known as the Edison Storage Battery Company. The new company will proceed at once to enlarge the factory of Mr. Edison at Glen Ridge.

It is said that negotiations are in progress with the Western Union Telegraph Company for the adoption of the Rowland multiplex-telegraph printing invention. The machine has been brought to a high state of efficiency, and the heirs of Prof. Rowland and business men of Baltimore have organized what is known as the Rowland Company.

A correspondent of The Electrical World writes that while in the Western Union office at Reno, Nev., recently, he noticed a very pronounced hum above the noise of the instruments. Upon inquiry he was informed that the Blue Lakes Power Company was testing its line and that this inductive effect was the result. It was also stated that the line was at the time being experimentally tested at 85,000 volts, the line being about 170 miles distant from Reno. The noise, which was most disagreeable, would rise to a certain pitch and then fall to a lower pitch as if the generator was racing.

The first installation of Marconi's wireless telegraph system upon an Atlantic liner has been placed upon the Beaver steamship "Lake Champlain." When the vessel left Liverpool, owing to the great interest that was manifested in the innovation, arrangements were made at several parts of the coast for receiving messages from the vessel as she proceeded on her journey. Communication was first opened with the wireless telegraph station at Holyhead when the steamer was thirteen miles distant, and was maintained until thirty-seven miles separated the vessel from the station. Several of the passengers availed themselves of the opportunity to telegraph to their friends in all parts of the United Kingdom, each message being acknowledged from the receiving station and then dispatched to its destination over the government wires. The experiments were highly satisfactory, and the other vessels of this line will be similarly equipped with the apparatus as soon as possible. When the various steamships of the other transatlantic companies are fitted with the apparatus, it will be possible for the passengers to be kept posted in the progress of the world, even in mid-ocean, since the news will be telegraphed from ship to ship.

A new underground rapid transit electric railway is being projected in London. It will stretch from Piccadilly along the Strand, Fleet Street, Ludgate Hill, to the City. By this means travel through the busiest artery of the metropolis will be considerably facilitated. It is proposed to take the line beneath a narrow street in the immediate vicinity of St. Paul's Cathedral, and great apprehension is felt that the excavations will seriously impair the foundations upon which the sacred edifice stands. The soil beneath Ludgate Hill and the surrounding neighborhood is composed for the most part of loose gravel and sand. The Dean and Chapter of the cathedral fear that any excavation would tend to drain off the underground water. The cathedral itself rests upon a tremendous bed of concrete. Should the underground water be tapped there is a liability of this concrete bed cracking in all directions, in which event the safety of the edifice would be severely menaced. A settlement of the building, it is considered, would be inevitable. The Central London Railway in its passage through Cheapside passes beneath the church of St. Mary le Bow—another of Wren's buildings—and through the settlement of the building the spire has been thrown 23 inches out of the perpendicular.

THE STRALAU-TREPTOW TUNNEL UNDER THE RIVER SPREE.

The first submarine tunnel ever constructed in Germany extends beneath the River Spree, between Stralau and Treptow, and has been in active use since its formal opening, in 1899. Although the tunnel is but 453 meters (493.77 yards) long, its construction was no simple task, for the quicksand of which the soil beneath the Spree is largely composed was removed with some difficulty.

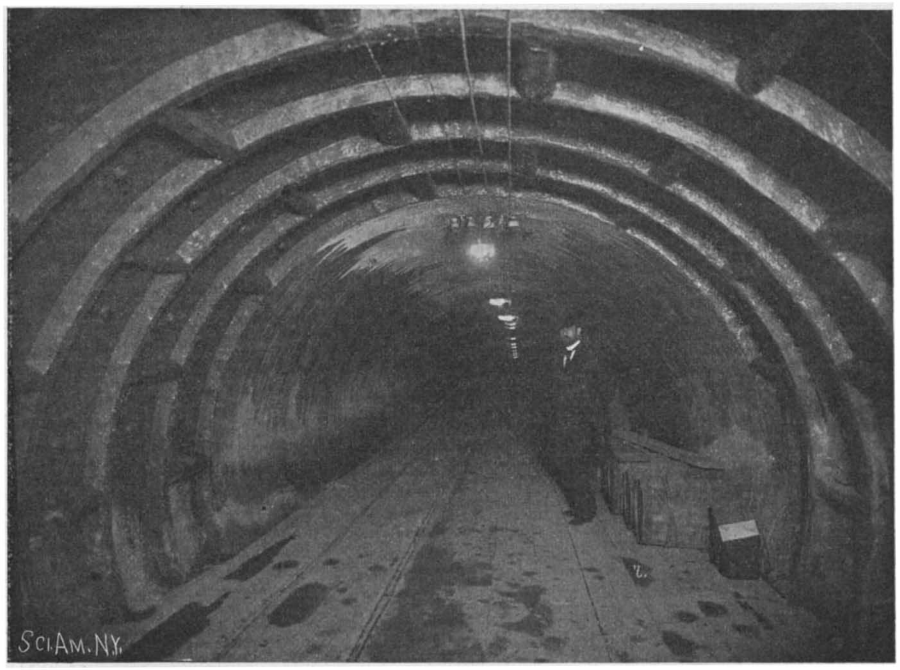
The preliminary work was begun in the summer of 1895. But the actual work of removing the soil in the line of the tunnel was not commenced until the end of February, 1896, because the tunneling-shield was delivered too late. Despite this delay, 160 meters (524.8 feet) of soil had been excavated by the end of autumn of that year. A second interruption of the work was caused by the deliberations of the authorities as to whether the street railway should be extended so as to pass through the tunnel under the river. Finally work was again resumed in September, 1897; and in February, 1899, the last shovelful of soil was removed and the last rivet driven.

The tunnel crosses the line of the river approximately at right angles, the width of the stream at that point being 195 meters (212.55 yards). So deep is the tunnel that between its roof and the river-bed there is still a layer of sand some 3 meters (9.8 feet) in thickness. The lowest point of the tunnel lies 12 meters (39.36 feet) below the mean water level of the Spree. In the direction of Treptow to Stralau the tunnel is built on a downward inclination (1:20), but becomes more level as it passes under the river (1:600).

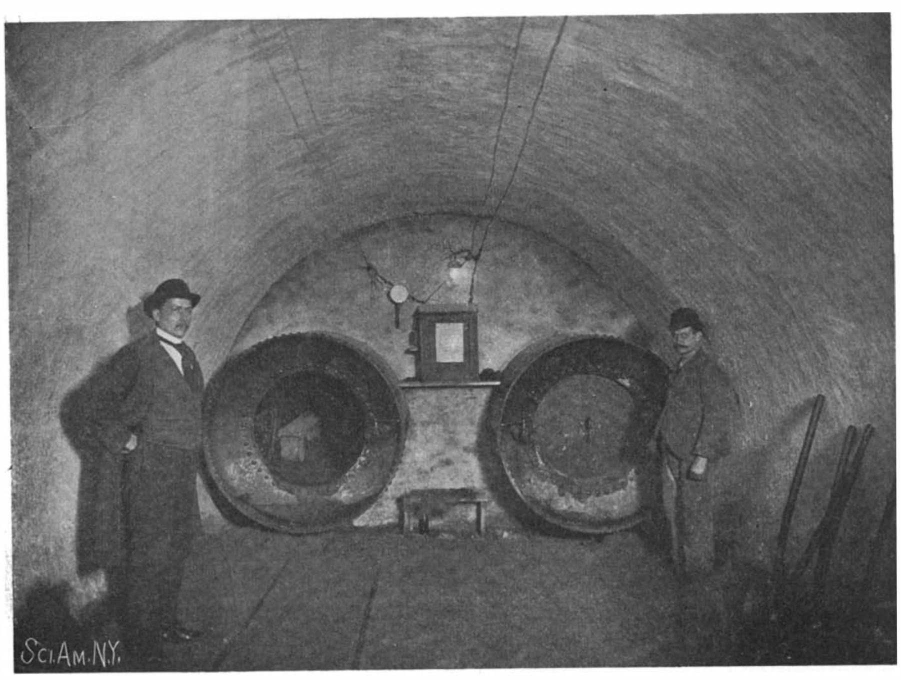
The tunnel tube is composed of cast-iron annular segments varying in width from 500 to 650 millimeters (20 to 26 inches), and having flanges which are connected by screw-bolts. Between the rings or annular segments flat, iron straps are laid, which appear externally as corrugations and serve as reinforcing and stiffening members. Externally the tube is covered with an 8-centimeter (3.2-inch) layer of cement, and internally with a 12-centimeter (4.8-inch) layer. The clear breadth of the tunnel is, therefore, reduced to 3.75 meters (12.3 feet), and barely leaves room for a narrow passageway along the tracks. The rails are embedded in the cement of the tunnel-bottom.

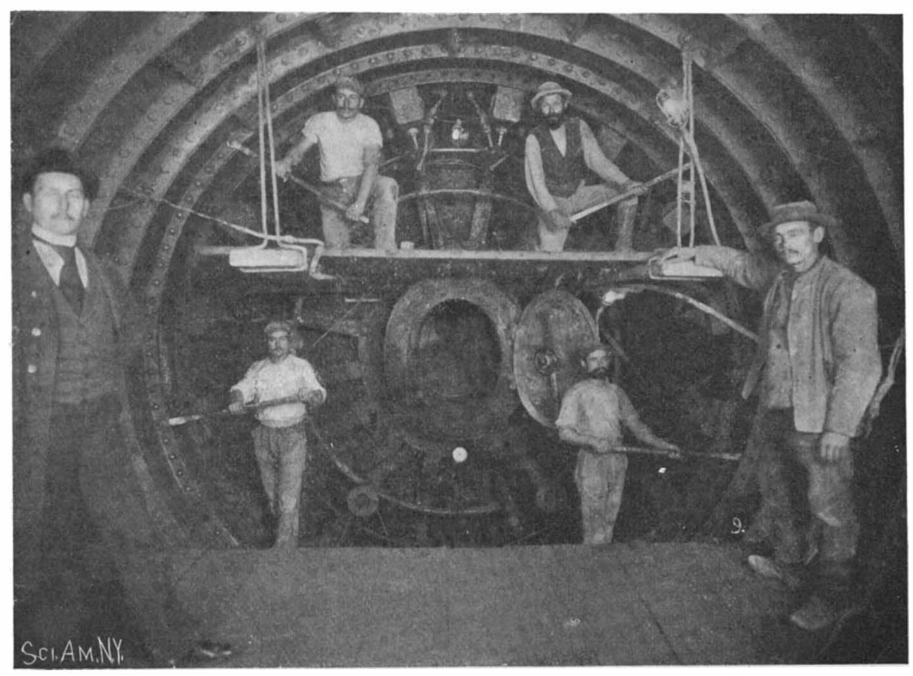
The tunnel was built in the usual way, the shield having been pressed forward as the work advanced. The completed portion was divided from the working-chamber by a partition provided with two air-locks for the entrance of laborers. Compressed air was used for ventilation. In front of the working-chamber the shield was placed, forming a second chamber between its inclined front wall and its vertical rear wall. Through openings in the front wall, which could be closed by slide valves, the sand was excavated and thrown back into the chamber. When sufficient sand had thus been removed to leave a small and clear space, the shield was pushed forward by sixteen hydraulic jacks. In the new tunnel space which had thus been formed an additional ring was built after the pistons of the hydraulic rams had been withdrawn. In the narrow annular space between the tunnel and shield, cement was packed. Thus 374 meters (407.66 yards) were cleared beneath the Treptow shore and the river-bed. The 80 meters left on the Stralau shore were built on the subway plan; that is, a trench was dug, the walls of which were lined with piles or planks shored in the usual manner, and cement laid along the bottom of the trench. For a length of 30 meters (98.4 feet) it was found that the plank walls could not resist the action of the quicksands. The section was, therefore, divided by partitions into three compartments, which were separately completed.

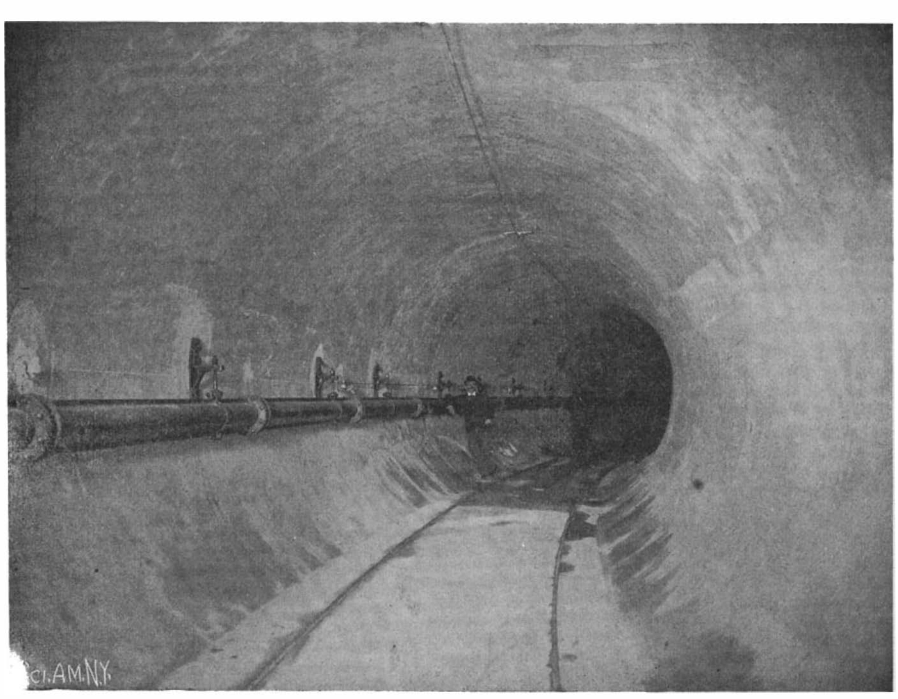
During the work of constructing the tunnel telephone wires were carried along the line so that those at work could communicate with the power house. Aside from minor mishaps, which were unavoidable owing to the imperfect working of new machinery, and lack of experience on the part of the laborers, no serious accident occurred during the progress of the work. The cost of the tunnel is about $425,000, or $850 per yard.

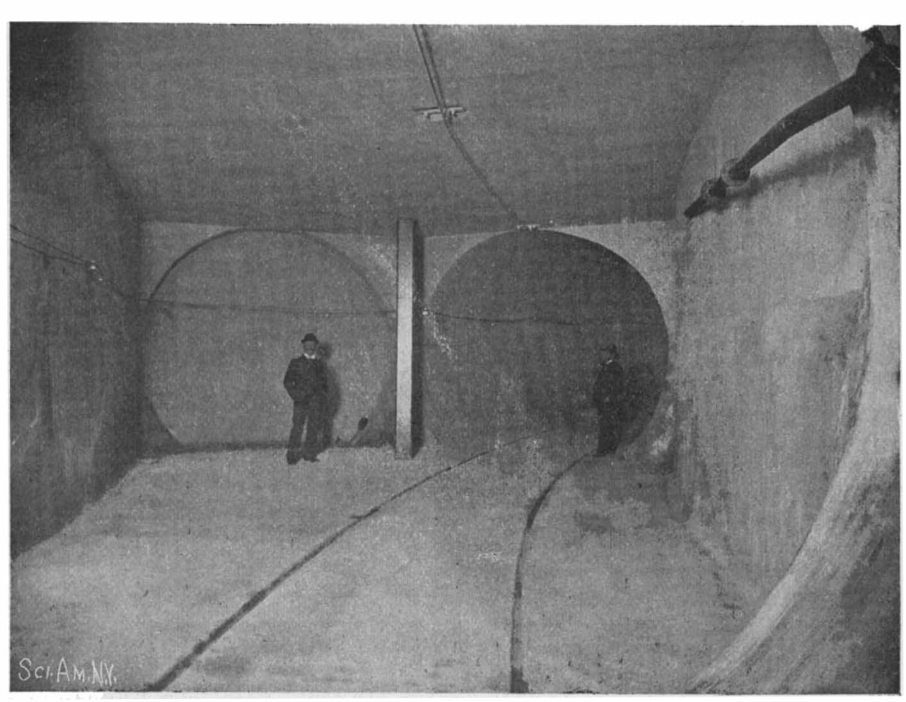

Section of Completed Tunnel.

Turpentine mixed with wax is known to give very good floor wax. A cloth squeezed out in turpentine restores the luster to oilcloth.


Entrance to the Lock-Chamber.


Rear Face of Shield.


A Bend in the Tunnel.


Commencement of a Double-Tube Section.

THE STRALAU-TREPTOW TUNNEL BENEATH THE RIVER SPREE.

METHOD OF TESTING SPECIMENS OF MARBLE.

BY PROF. FRANK D ADAMS.

In the SCIENTIFIC AMERICAN for April 23, 1898, an account was given of some researches on the Flow of Rocks, which were being carried on by Prof. Adams and Prof. Nicholson, at McGill University, in Montreal. The rock employed for purposes of experiment was Carrara marble, small columns of which were inclosed in stout tubes of wrought iron, constructed after the manner of ordnance by wrapping long strips of Lowmoor iron around a bar of soft iron and welding the strips to the bar as they were rolled around it. The core of soft iron composing the bar is then bored out, leaving the iron tube, into which the marble column was very accurately fitted. The pressure was applied through heavy steel pistons fitted into either end of the tube, making use of a hydraulic accumulator by which the ordinary pressure of the water mains—namely, 130 pounds to the square inch—could be increased to any desired extent, pressures up to 13,000 atmospheres, for instance, being frequently applied. Making use of this machine, it was shown that columns of marble, when inclosed in the iron tubes as above described, might, at the ordinary temperature, be deformed, the marble column being squeezed down and the inclosing iron tube bulged out; the marble remaining throughout the process compact and solid.

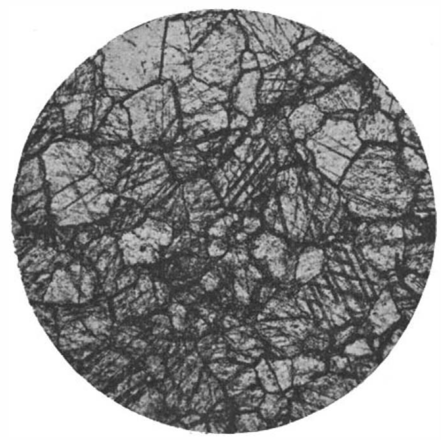
Since the appearance of the article in question, experimental work along this line has been continued, additional presses have been constructed, new apparatus installed, and many new and important results obtained.

The machines, as at present arranged, are shown in our engraving. The three presses are set up side by side, but at different levels, to allow free play to the long screws which afford an accessory means of increasing the hydraulic pressure in the cylinders. The cylinders and additional intensifiers, with all their complicated system of pipes and valves—by which the water pressure from the main is transferred to the oil which fills the whole system, and through it to the machine, and by which the pressure may be maintained constant at any value for any desired time—are shown on the right of the photograph. The apparatus is also arranged so that water under any desired pressure may be passed through the rock itself while it is being squeezed. The rock may be heated to any desired temperature by means of a gas flame, or a gasoline blast, while undergoing compression. The hydraulic pump in front is capable of developing a pressure of 10,000 pounds to the square inch, and may be used either in connection with the machine or for forcing water through the rock itself.

In the machine on the left a marble column, inclosed in its iron tube, is in position ready for the application of the pressure to deform it at the ordinary temperature ("cold dry squeeze"). The machine in the center is arranged for a "hot dry squeeze," that is, for an experiment in which the rock shall be deformed while heated to 300 degrees C. or 400 degrees C. The heat is supplied by the Bunsen burner shown in the photograph, the heated gases circling about within a massive iron casting which incloses the iron tube containing the marble, without coming in contact with the latter except at the ends—space being left within the casting to allow for the bulging of the iron tube when the pressure is applied. The wires of the platinum thermometer for measuring the temperature pass into the casting on the left side, through the fire-clay tube shown in the photograph, and are brought out almost in contact with the iron tube inclosing the marble. Before the experiment is commenced the whole apparatus is, of course, covered with asbestos to prevent loss of heat. This, however, was removed before the photograph was taken, in order that the arrangement of the parts might be clearly shown.

Another appliance is employed for producing a "hot wet squeeze," in which the rock, while heated, is strongly compressed, water at the same time being forced through it at a pressure of several hundred

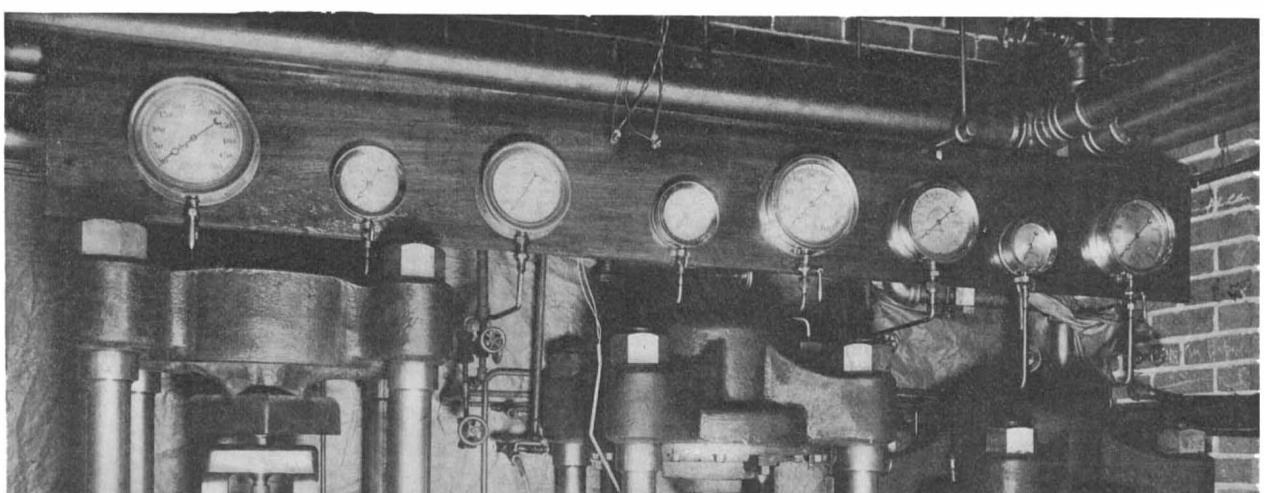
Micro-Photograph of Carrara Marble Before Compression.



Micro-Photograph of Carrara Marble after Deformation at 300° C., Showing the Flattening of the Calcite Grains.

pounds to the square inch. By means of the machines fitted with these accessories, Carrara marble has been deformed, not only when cold and dry, but when heated to 300 degrees C. and to 400 degrees C. when dry, and heated to 300 degrees C. while water was being forced through it, the time occupied by the experiments being from 10 minutes to 64 days.

On the completion of the experiment, the bulged tube containing the marble was slit through longitudinally along lines opposite to one another. The marble within was found to be still firm and compact, holding the respective sides of the tube, now completely severed from one another, so firmly together that it was found impossible, without mechanical aids, to tear them apart. By means of a steel wedge driven in between them, however, they could be separated, but only at the cost of splitting the marble through longitudinally. The half-columns of the marble, now deformed, generally adhered so firmly to the tube that it was necessary to spread the latter in a vise in order to set them free.



PRESSES FOR MAKING RESEARCHES ON THE FLOW OF ROCKS.

The deformed marble was then tested in compression by means of an Emery testing machine, and its strength compared with that of half columns of uncrushed marble cut to the same form. Thin sections were also cut from the deformed marble, and their microscopic character compared with that of the uncrushed rock.

It was found that when the marble was deformed in the cold, after deformation it would bear a load of as much as 5,350 pounds per square inch. This, however, was only about one-half the crushing weight of the original rock, which is about 12,000 pounds per square inch. The predominant structure of the deformed rock, under the microscope, was found to be what is known as a cataclastic structure—that is to say, the calcite crystals composing the marble had been broken and the fragments had passed over one another, but had remained so firmly pressed together that the rock still retained its solidity. The strength of the rock when deformed at a temperature of 300 degrees C., however, rose to 10,652 pounds per square inch; that is to say, it was nearly as strong as the original rock, and under the microscope it was seen to have moved, not by the breaking of the individual crystals composing the rock, but by a flattening of each crystal, owing to movements on twinning and gliding planes. This is precisely the nature of the movement in the case of iron or any other metal when it is hammered or rolled, as has been shown by the recent investigations of Ewing and Rosenhain. The marble "flows" under these conditions just as a billet of iron does when heated and rolled.

Our engravings show microphotographs of a section of the marble before squeezing, and the same marble after it has been deformed at 300 degrees C. The flattening of the grains can be distinctly seen.

When the heated marble was deformed, while at the same time water was being forced through it, the movement was of the same character as that just described, but the marble was found to be actually stronger than the original rock.

These experiments have an important bearing on the nature of the movements which take place in rocks when they are folded up into mountain ranges, and they are now being continued with granites and other harder rocks.

Areas of Future Cities.

Writing in the Fortnightly Review, H. G. Wells observes that we are "on the eve of a great development of centrifugal possibilities. And since it has been shown that a city of pedestrians is inexorably limited by a radius of about four miles, and that a horse-using city may grow out to seven or eight, it follows that the available area of a city which can offer a cheap suburban journey of thirty miles an hour is a circle with a radius of thirty miles. And is it too much to expect that the available area for even the common daily toilers of the great city of the year 2000, or earlier, will have a radius very much larger even than that?

Now, a circle with a radius of thirty miles gives an area of over 2,800 square miles, which is almost a quarter that of Belgium. But thirty miles is only a very moderate estimate of speed, and the reader will probably agree that the available area for the commuter of to-day will have a radius of over 100 miles and be almost equal to the area of Ireland. The radius that will sweep the area available for such as now live in the outer suburbs will include a still vaster area. Indeed, it is not too much to say that the London citizen of the year 2000 A. D. may have a choice of nearly all England and Wales south of Nottingham and east of Exeter as his suburb, and that the vast stretch of country from Washington to Albany will be all of it 'available' to the active citizen of New York and Philadelphia before that date."

Stonehenge has been cut off from Salisbury Plain by a wire fence and a charge of a shilling is made to visitors who desire to pass the barrier in order to get a near view of the monument.

THE LIFE HISTORY OF AN INSECT PARASITE.

BY S. FRANK AARON.

The parasites of the insect world, like those of other animal kinds, including the human, are wonderfully intelligent and absolutely remorseless; they must be so to successfully carry on their affairs. But the insect kinds, being little things and preying upon little things, do not at once impress us with a feeling of repugnance, and indeed they are so generally found to be beneficial to mankind that we must call them friends. I think that it can be safely stated that the majority of the insects attacked by parasites are noxious species.

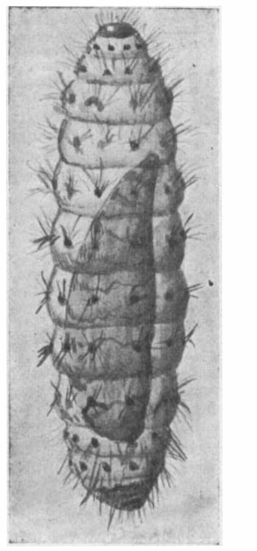
Insect parasites are of many kinds, even the mild-mannered lepidoptera including among its numbers a few species, while the diptera, coleoptera and hemiptera possess many. It is to the hymenoptera that we turn, however, when the word parasite is used, for here are hundreds of species—the true insect parasites of insects. To this order belong the ichneumon, brachonid, chalcid and proctotryped flies, stingless relatives of the wasps, all the species of which live by their wits. For the most part these most typical parasites attack the larvæ only of their victims, for by this they will most easily derive nutriment and have the time to reach development; and, too, the larvæ of the insects attacked are far more easily victimized than the hard-coated, more active and short-lived imagoes. Of the insects attacked, the lepidoptera furnish the greater number of species; indeed, it is probable that no moth or butterfly larva is without its parasitic enemy, while the coleoptera, hemiptera, diptera, and even other hymenoptera, are quite as commonly parasitized. To the insect thus preyed upon naturalists have applied the term "host," and the manner in which these unfortunate larvæ become tenanted by living, squirming, voracious bloodsuckers, that sap upon their vital organs and eventually kill them, is very interesting. With the parasite fly it becomes, of course, a matter of expediency, a question of room; supply and demand the chief factors. Thus we see a large, bulky larva either infested by a parasite of considerable size, or by many tiny grubs of a small species. A medium-sized ichneumon will choose for its host a larva that grows just large enough to serve the purpose of nourishing *its* larva, and thus, generation succeeding generation, the parasite will remain true to its host, though no doubt, if the host could be consulted, it would wish its admirers should prove more fickle.

One of the daintiest of our common insects is the pretty little collared grapevine moth, *Harrisina Americana*, formerly included in the genus *Procris*. This moth is deep bluish-black, the only touch of bright color an orange or vermilion band or collar surmounting the thorax, and it is a surprise to discover that its caterpillar is bright yellow, with only small brown or black spots distributed, ring-like, on each segment. Grapevines are its most common habitat, and feeding in small colonies, each being the hatching of one batch of eggs, and each caterpillar being possessed with the usual caterpillar appetite, it is very natural to find some portion of the vine with its leaves rapidly disappearing, one by one. Indeed, were it not for our friends the wren and the parasite, our grapevines would soon practically cease to exist. And as efficient as the admirable little wren is, I believe the parasite plays the more important part. So successfully warred upon are these pretty little pests that it is doubtful if any large vine supports an average of more than half a dozen caterpillars of Procris that reach maturity.

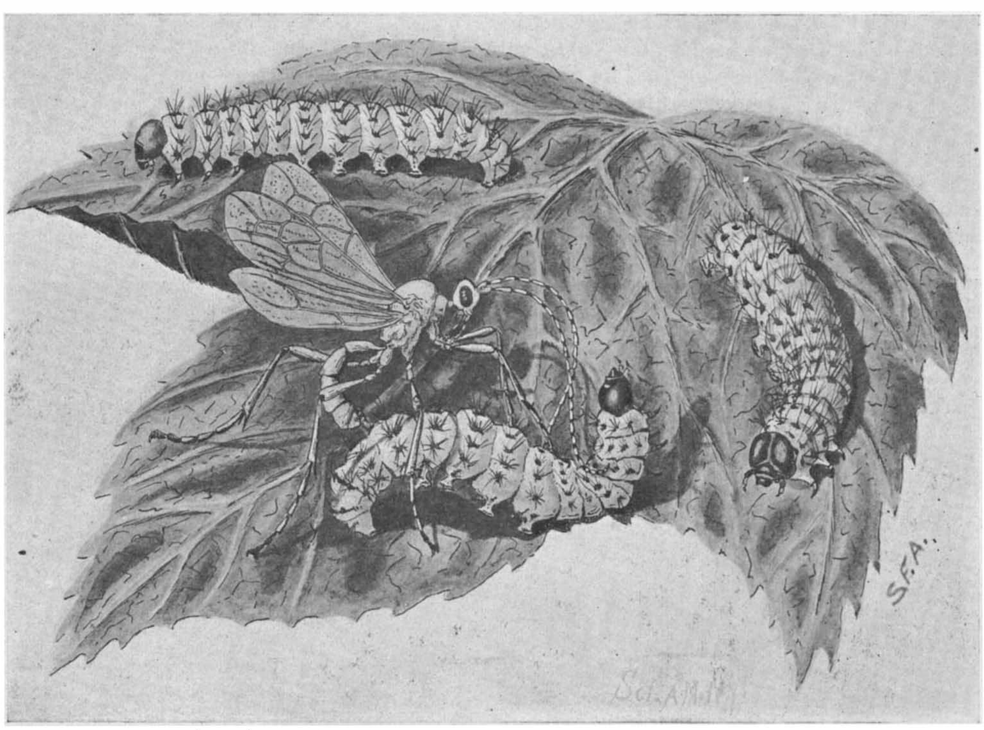
Naturalists have many ways of naming species. Here they have called a parasitic insect after the later generic name of its host. Thus a small brachonid fly, pale yellow in color, with large black eyes, the individual parasite of the grapevine moth, has been given specifically the later generic name of its host, *Rhogas harrisinæ*. It seems almost like benefits forgot to load the brief existence of this most useful insect with such a name, and, as with most insects, there has been no common name supplied with which to more familiarly label it. So the generic name must serve, as with Procris.

Decidedly the most interesting part of the tragedy between Rhogas and Procris is the beginning of it, when, after the female of the former, with unerring instinct, has hunted diligently for the larva of the latter, she happens upon a colony of her victims. Back and forth she has searched, under and above each leaf, walking excitedly as if on springs, her long antennæ incessantly twitching and touching the leaves; flying from leaf to leaf and exploring with a thoroughness that would do a trained bird dog credit. She makes straight for her game when found and proceeds at once to business. To prove she has come upon those of the right breed, her powerful scent organs, the antennæ, with seemingly caressing touches, inspect the caterpillars, which in turn at once show alarm, swinging their heads from side to side, as a means of repelling attack. But such means are vain. Straddling the first lowly caterpillar, with her stilt-like legs reaching too far out on each side for interference, Rhogas curls her flexible, segmented abdomen downward and forward and thrusts her keen sword-like ovipositor deep into the squirming victim, and upon the instant a minute egg is forced through the ovipositor and under the skin of the caterpillar. The ovipositor is then withdrawn and the fly seeks another victim close by, repeating the operation till her egg supply is exhausted, having perhaps parasitized a dozen or twenty worms, in one or more colonies. But these sword thrusts of the ovipositor do not kill the caterpillar outright, nor of themselves result in death. Nature's little plan would here miscarry if such were the case. The victims go right on living healthfully for a time. But when the eggs are hatched, each caterpillar becomes the host of a tiny white grub with a truly terrible appetite. This is the larva of the Rhogas. The grub feeds and rapidly grows upon the vital juices of its host. The caterpillar continues to feed also, furnishing its tenant with food. But as the parasite grows the poor host loses its activity, soon scarcely moves, and finally, its insides having been almost entirely devoured, it perishes miserably. By this time the larva of Rhogas is full grown and is ready to pass into the next, or pupa, stage of its existence, intermediate between the grub and the perfect insect, and finding the hollow skin of the caterpillar a fit habitation it remains in its place, the stiff dry skin becoming its cocoon. In addition, before changing, it spins a thin silken lining that serves to strengthen the walls of its domicile. This pupal life, analogous to the chrysalis stage that the poor caterpillar host would have passed into before becoming a moth, had it lived, is with the hymenoptera of short duration, and in six or ten days, the weather being warm, another perfect Rhogas, transformed from the grub, cuts open a little flap in the dried caterpillar skin, emerges, and presently flies away to find and parasitize other Procris caterpillars.

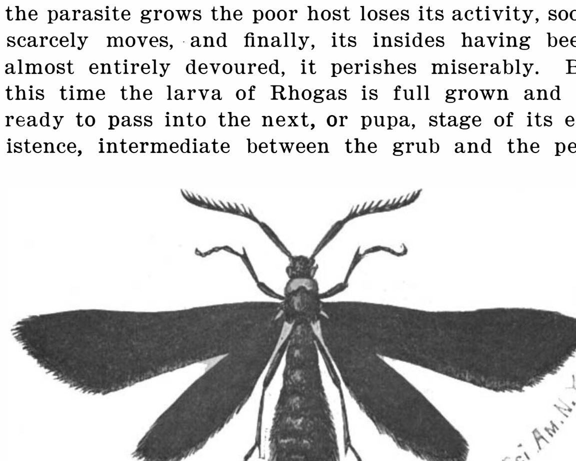
Thus we have observed one of the most wonderful acts in nature, a life endowed with the very extravagance of cruelty, that seems at first almost uncompensating, for the mother parasite never sees her offspring, indeed it is reasonably certain that she knows nothing about their existence, but with an instinct resulting from a very high development she goes about preparing for their welfare.



PARASITIZED CATERPILLAR OF PROCRIS, SHOWING LARVA OF RHOGAS WITHIN. (Enlarged.)



RHOGAS ATTACKING CATERPILLAR OF PROCRIS. (Enlarged.)



COLLARED GRAPEVINE MOTH. (Enlarged.)

The Chemistry of Soil.

"Undoubtedly one of the most wonderful discoveries of modern chemistry has to do with the soil," says The Saturday Evening Post. "It has been ascertained that the most barren land can be made rich simply by adding to it certain mineral elements which cost but little. On this basis it is estimated that the United States will be able eventually to maintain 500,000,000 people—more than one-third of the present population of the world. It is merely a question of supplying the requisite quantities of nitrogen, phosphoric acid and potash. The last two are readily obtainable at small expense, whereas the first may be supplied either by furnishing to the soil condensed nitrogen in the shape of slaughter waste or nitrate of soda or by planting clover, beans or peas, which have an affinity for nitrogen and absorb it from the atmosphere. It is now known that nitrogen is the most important plant food, and, inasmuch as this element composes four-fifths of the atmosphere, the question is merely to absorb it into the soil. It has also come to be understood that only 2 per cent of the material of plants is derived from the soil, the remaining 98 per cent being drawn from the air and from water."

Improvements in the Holy Land.

It has often been stated that if one of the Prophets had returned to the field of his labors, he would have had little difficulty in recognizing the old scenes, but now matters are decidedly changed. The railway from Joppa to Jerusalem is now on a paying basis, and other lines which will connect it with points of interest up and down the valley of the Jordan have been projected or are actually in course of building. In Jerusalem there are electric lights, telephones, phonographs, modern stores and sanitary plumbing; in fact, all the comforts of civilized life can now be obtained. Trolley lines are projected to connect Jerusalem with Bethany, Bethlehem, the Lake of Galilee, Samaria, Jericho, Nazareth and other places. Recently an American salesman went to Jerusalem and Beirut and sold modern merchandise to the amount of $3,800. It is thought that in a few years the Holy Land will be a good consumer of flour. More than two hundred phonographs were recently sent to Jerusalem, Damascus and nearby places, the Moslems buying them largely for their harems. There seems to be a considerable opening for windmills and irrigating machinery in the East. The Sultan appears to be favorably disposed toward the modernizing of this part of his dominions.

The Current Supplement.

The current SUPPLEMENT No. 1329 is filled with most interesting subjects, the first article being "Science and Agricultural Experiments," which describes the remarkable work which our experiment stations are doing. "Kondeland in German East Africa" is accompanied by a number of engravings. "Syntonic Wireless Telegraphy" is by Signor Marconi. "Protection of Ferric Structures," by M. P. Wood, is a most valuable paper, and is referred to elsewhere.

Contents.

(Illustrated articles are marked with an asterisk.)

RECENTLY PATENTED INVENTIONS.

Electrical Apparatus.

CONTACT-PLUG.—CHARLES WAGNER, Manhattan, New York city. The inventor has devised an improved contact-plug for attachment to walls and other supports. The plug is arranged to insure a perfect contact when in the socket, to be readily removed in order to break the contact, or to be inserted in order positively to make the circuit. Porcelain is used for the socket and plug.

BATTERY-TRAY. — JAMES R. BLACKWELL, Manhattan, New York city. It sometimes happens that the working of the apparatus connected with a battery is deranged by the breaking of one of the cells. The object of this invention is to provide a tray to hold a number of cells and to indicate when a cell is broken. The battery elements are connected with an alarm, so that should a cell be broken its liquid, flowing into the tray, will cause a current to pass through the alarm, thus indicating that there is a break.

COMBINATED WATER-TIGHT JUNCTION-BOX, RECEPTACLE, AND FIXTURE.—ANNA E. JAHL, Manhattan, New York city. The invention provides an improved combination water-tight junction-box, receptacle, and fixture, which is especially designed for use in places subject to considerable moisture, as along the shore of a river, in ships, and in subterranean and submarine work. The device is arranged to insure at all times proper connection, and, in case of an overload in the main current, to prevent breakage of the electric lamp by burning out a fuse.

Mechanical Devices.

ELEVATOR FOR BINDERS.—ALBERT M. ALLEN, Pauls Valley, Indian Territory. Mr. Allen has dispensed with the top elevator-apron by providing a single apron having slats carrying teeth, and has thus materially reduced the draft of the machine. The apron of the elevator is passed over two wheels, the slats at the inner face being adapted to enter the spaces between the teeth of the wheels. Hence the apron is given a positive and uniform movement, and will not be shifted as heretofore, by frictional contact with a smooth surface.

CLUTCH AND REVERSING MECHANISM. —JOHN BLUM, West Hoboken, N. J. The mechanism comprises a shaft to be driven: an internal gear-wheel: and an external gear-wheel, both gear-wheels being loose on the shaft. With the gear-wheels a driven pinion meshes. For each gear-wheel an independent clutch-mechanism is provided to lock either of the gear-wheels to the shaft to be driven. The device permits the operator readily to drive the shaft in either direction or to stop whenever he may desire.

STOP-MOTION FOR MECHANICAL TOYS. —ATHERTON D. CONVERSE, Winchendon, Mass. The purpose of the invention is to provide a means for automatically preventing the wheels or axles of a motor-controlled vehicle from turning until the vehicle is placed upon the support on which it is to travel. The driving-axle is provided with a projection. A second axle is employed, which is mounted to turn and slide and to operate a check-device which is arranged for contact with the projection from the driving-axle. The moment the vehicle is placed upon a support the wheels begin to turn.

SHOE - TURNING DEVICE. — GEORGE B. GARDNER, Haverhill, Mass. This invention relates to devices for facilitating the work of turning shoes, which work is necessary in the manufacture of certain kinds of shoes. The turner comprises two essentially parallel arms movable relatively toward and from each other. One of the arms has its end portion turned laterally approximately parallel with the line of relative movement of the arms.

CONCENTRATOR.—EDWIN A. SPERRY, Biwabik, Minn. The material treated is to be mixed with water and delivered on the surface of the table from the distributing-box. By adjusting the conical pitch of the table-top the ore-pulp is allowed to flow down toward the edge of the table, while the vanning or agitating motion, together with the action of the water mixed with the pulp, gives the particles an opportunity to separate according to their respective specific gravities. The heavier particles settle on the table, while the lighter particles remain on top of the heavier. The revolution of the tables moves the material so deposited, and a spray from a pipe washes off the upper and lighter portions of the material deposited and leaves the heavier values on the surface of the table. The values are in turn washed off into suitable receptacles.

DISINTEGRATING - MACHINE. — BRUNO MOUSTIER, Roquevaire (Bouches du Rhône), France. The machine is a powdering or disintegrating machine which breaks up, crushes, granulates, and pulverizes by inter-reciprocating shock of the material, and is characterized by a special construction which is exceedingly efficient and which reduces the wear of the working parts to a minimum.

MOTOR. — CHARLES W. STEELE, Detroit, Mich. The motor is designed to be employed in connection with boiler-tube cleaners, and comprises a casing which can be connected at one end with a motive-agent supply-pipe. A cap is secured to the opposite end of the casing, and is provided with exhaust-ports. In the casing is a series of deflectors. A shaft has bearing at one end in the deflector at the inlet end of the casing and at the other end in the cap. Propeller-wheels are secured to the shaft and alternate with the deflectors, the wheels having peripheral angularly-disposed blades. The scoring-off process is materially assisted by the exhaust motive agent.

CLOTHES-WRINGER. — ALBERT G. CARLING, Hackensack, N. J. By means of the improvements devised by Mr. Carling the clothes-wringer can be actuated speedily for light work and can be adapted, by a quick change of working parts, for slow movement with great increase of power when heavy work is to be performed.

PROPELLER.—KIRK G. JOHNSTON, Piqua, Ohio. The object of the invention is to provide simple means for shifting the angle of the blades and locking them in order to propel the vessel forward or backward without reversing the direction of rotation of the propeller-shaft. The device is particularly serviceable in naphtha and gasoline launches.

ACETYLENE-GAS GENERATOR.—TYRRELL H. DUNCOMBE, 300 Talbot Street, St. Thomas, Ontario, Canada. The water-reservoir, gas-receiver, and generating-chamber are arranged side by side. The water is allowed to gravitate from the reservoir to the carbid in the generator in order to produce gas, and is forced back and away from the carbid by the gas so produced, to cause the generation of gas to proceed or to be discontinued automatically in accordance with the consumption.

COAL-MINING MACHINE.—OTIS JACOBY, Sandrum, Ohio. The chief features of the invention are a strong main frame and a carriage which supports the cutting devices and the engine or motor mechanism and which moves back and forth in the main frame, so that the cutting devices can be properly projected to cut into the bank of coal when the machine is operated. In this machine the main frame possesses great strength to resist the vibration and lateral strain when the cutters meet an unyielding obstruction.

MACHINE FOR OPERATING UPON PITHY STALKS.—GEORGE R. SHERWOOD, 971 Warren Avenue, Chicago, Ill. The shell from one side of the stalk is severed by a cutter which is reciprocated longitudinally. To this cutter the stalk is fed by rollers which extend parallel with the cutter. The roller on the side from which the shell is cut is practically unyielding during operation and under the control of adjusting devices: while the other roller is yieldingly supported. Both of these cutters discharge on a carrier which can be coupled to other carriers to deliver the shell at any desired point. The pith is discharged by a screw-conveyer at one side of the machine.

STREET-SWEEPER.—JESSE M. HARR, Ninth and H Streets, Washington, S. E., D. C. This machine is designed to be propelled by one laborer and automatically to sweep up the dirt and deposit it in a receptacle by the machine. The dirt-receptacle rests on the bottom of the machine. A rotary brush and a bucket are provided, the bucket being adapted to be opened on the side adjacent to the brush and to be automatically raised and dumped into the dirt-receptacle.

Vehicles and Their Accessories.

BICYCLE-LOCK.—EARL F. L. RUSSELL and CHARLES M. BROWN, Denver, Colo. The purpose of this invention is to provide a simple device for rendering bicycles inoperative and thereby preventing them from being stolen. This device comprises a bolt adapted to be forced against the tire of the bicycle-wheel so that the wheel cannot be turned.

ELASTIC TIRE.—WILLIAM F. WILLIAMS, 17 and 18 Great Pultney Street, London, W., England. The invention relates to the manufacture of hollow rubber tires of D section adapted to be secured to the wheel-rim by a band passing through the bore of the tire. The inventor produces a tire having embedded in the rubber (in immediate proximity to the bore) helical springs conforming with the transversely-arched shape of the tire, in combination with cords adapted to form a core to fill up the interior of the springs. Cords and springs co-act to strengthen the tire.

MEANS FOR SECURING ELASTIC TIRES TO WHEELS.—WILLIAM F. WILLIAMS, 17 and 18 Great Pultney Street, London, W., England. The invention relates to tires which are clasped about the wheel-rim by a metal band binding the base of the tire, or by inwardly-turned marginal flanges on the margin of the tire. The novel feature of the invention is to be found in a means for adjustably tightening and securing the tire.

Miscellaneous.

PIPE-STOPPER.—GEORGE B. SIDELINGER, Danville, Ill. Mr. Sidelinger has devised a means for hermetically sealing the ends of pipes in a most secure manner and yet so as to permit him to remove the plug quickly and easily whenever necessary.

WATER-REGULATING DEVICE. —THOMAS J. SANFORD, Chicago, Ill. The device is designed to regulate the water fed into an elevated tank on a building, is automatic in operation, is adapted to supply water to water fixtures for use as required and likewise to supply water to a heating-tank which is connected with the system of water-distribution.

POCKET-BOOK, HAND-BAG OR THE LIKE. —MAX VOGELGESANG, Brooklyn, New York city. By means of the improvements invented by the patentee a convenient change-pocket is provided entirely separate from the other compartments of the article. Hence it is possible more readily to store change, bills, cards, handkerchiefs and the like separately.

GAS-METER SUPPORT.—HENRY T. HOLLAND, Manhattan, New York city. The inventor has devised a support which is cheap, strong, and simple, which permits ready access to the meter from all sides, which is capable of being used in different positions, and which is compact, permitting the gas-meter to be set where but little space is available.

TUNING - BUTTON. — ARTHUR J. LANG, Brooklyn, New York city. The tuning-button is of the kind used at the neck sections of stringed musical instruments. The purpose of the invention is to provide such a tuning-button with a light, yet durable head, and firmly to secure this head on the stem or shank.

PRESERVE-TIN.—EMILE BESSE and LOUIS LUBIN, Paris, France. These two inventors have devised a tin which can be soldered with or without pressure, in such a manner as to prevent the melted solder (which is interposed between the tin and its cover or its bottom plate) from running during the soldering into the interior or down the outside of the tin.

TOOL-HANDLE.—JOHN C. LAMBERT, Tonica, Ill. The handle comprises a shell in which two jaws are fitted. The jaws are tapered and the inner walls of the shell are correspondingly formed. One of the jaws has a threaded shank at its upper end over which is passed an eye formed on the under jaw so that the jaws may be connected with each other. The threaded shank of the first-named jaw screws into the upper end of the shell.

WORKMAN'S TIME-RECORDER.—JOHN A. DEMUTH, Oberlin, Ohio. The workman who is late is provided with a special time-card which he perforates by a register. When the workman leaves at night he repeats the operation so that the card bears two perforations. If the workman goes out and returns at noon the card bears four perforations. In order to verify the record of a late man a special device is employed by which the card is perforated. If this perforated record tallies with the workman's account, the workman's record will be accepted as correct.

SAFETY-CHECK.—WILLIAM H. BLACK, 100 Broadway, Manhattan, New York city. The invention is an improvement in checks, drafts, and other papers representing value, including foreign exchanges, letters of credit, etc., and is specially designed for use as a traveler's check without necessitating a personal identification. The paper is good anywhere in the hands of the purchaser or his indorsee, but is good nowhere in the hands of a wrongful holder. The check can be cashed in by the purchaser at the issuing office without the necessity of giving bond or securing identification further than that afforded by the counter-signature.

BADGE-BAR.—BENJAMIN HARRIS, Manhattan, New York city. By means of the badge-bar a ribbon is fastened to the coat. The device comprises a bar the front face of which is ornamented and the rear face of which is provided with peculiarly-arranged pins, one being adapted to pierce the coat and the other to engage and suspend the ribbon.

BADGE-BAR.—BENJAMIN HARRIS, Manhattan, New York city. This badge-bar comprises a back-plate, a front binding-rim, a panel-bearing insignia or ornamentation, and pins at the back for securing the bar and the badge ribbon. The various parts are held together in a novel way.

PROCESS OF TREATING BLAST-FURNACE SLAG IN ITS MOLTEN STATE.—ALEXANDER D. ELBERS, Hoboken, N. J. The molten slag is gathered in a kiln having non-conducting walls and having an air-space above the surface of the slag. This space has restricted communication with the atmosphere. Communication between the air of this space and the atmosphere is regulated so that the air above the slag is intensely heated by radiation and the cooling of the slag is retarded while the slag is in a state of transition to the solid form.

MUSIC-RACK AND LIGHT-SUPPORTING ATTACHMENT FOR STOOLS OR CHAIRS.—CHARLES H. BACON, Danielson, Conn. The invention provides means for adjustably securing a music-rack and a support for a lantern to a stool, thus accommodating each musician of a band with a support for music and with a light.

CIGAR.—FREDERICK E. ARNOLD, Ann Arbor, Mich. The cigar is arranged to prevent the ashes from falling off while smoking and at the same time to preserve all the flavor in the cigar and insure a free draft.

DESK-TOP.—ROBERT M. SMITH, Chicago, Ill. By means of Mr. Smith's invention an ordinary school-desk can be transformed into a desk fitted both for academic work and for manual training. This end is obtained by fitting the desk with a reversible top, one side of which can be used for academic work, and one side of which is arranged for manual work.

WATER-INDICATOR.—WILHELM VOLTZOW and HENRY JÜRGENS, Brooklyn, New York city. By means of this machine the depth of water in a receptacle is accurately indicated in feet and inches at any desired point above or below the receptacle or at any point within the receptacle. The device is particularly applicable for automatically indicating to the watch or officer of the deck of a vessel the depth of water in the hold in feet and inches.

DOOR SPRING AND STOP.—HENRY MCCURRY, Evanston, Ill. This invention is an improved closing spring for stop devices for swinging doors of carriages to prevent the doors from swinging too far outwardly and striking the carriage-wheels. The device is entirely hidden from view when the door is closed.

CAN-SPOUT.—VIRGINIE A. HENRY, Manhattan, New York city. The invention provides a spout which is readily attachable to a can and which protects the contents of the can against dust and other foreign matter, and which excludes the outside air from all but a small portion of the surface of these contents.

DESK.—ROBERT M. SMITH, Chicago, Ill. The desk is a combined study and manual-working desk adapted for use in schools which combine both manual and academic studies. A reversible top is pivotally connected with slides mounted in slideways of a framing. Upon the movement of the slides from one end of the desk to the other the top is reversed. It is to be understood that the one side of the top is designed to be used for manual training, and the other side in the ordinary manner.

Designs.

BADGE. — FREDERICK KOCH, Manhattan, New York city. The design shows the new Pan-American Exposition badge which has recently gained such wide popularity. The badge consists of two heart-shaped elements arranged one beneath the other.

CANDY-MOLD.—CHARLES REPETTI, Manhattan, New York city. The mold produces a candy which bears a design consisting of two crossed flags upon which a pan is superposed, the dish of the pan bearing the head of a buffalo. The purpose is obvious.

GRASS-HOOK.—HENRY B. BARDEN, Wallingford, Vt. The shank of the hook is near the heel of the blade and slightly elevated at that point. The blade hangs at an angle to the cutting edge lower than the back, giving free play for a broad swath, and preventing the hand from coming in contact with the ground.

PARING-KNIFE.—CORNELIUS T. DEMAREST, Hackensack, N. J. The leading feature of the design consists of a blade having two points extending therefrom which are dished.

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.

NEW BOOKS, ETC.

THE VICTORIA JUBILEE BRIDGE. Complimentary Souvenir Booklet, issued by the Grand Trunk Railway System.

This artistic little souvenir book is bound in silvered metal covers and well illustrated with fine engravings, showing both the original Victoria tubular bridge across the St. Lawrence at Montreal and the new Jubilee bridge, which was finished in 1899. Considerable interest attaches to the original bridge, especially as it was opened in 1860 by the Prince of Wales. A photograph of the Prince and party, as well as the various commemorative medals, are all reproduced in the book, which contains a complete description of this great engineering feat and its accomplishment.

PLAIN FACTS ABOUT THE AUTOMOBILE. By Albert S. Clough, S.B. Manchester, N. H.: The Nature Study Press. 1901. 36 pp.

This pamphlet contains a popular description of the three systems now in use in this country, viz., steam, electric and gasoline. A comparison of them is made and the prospective purchaser is enlightened as to the advantages and disadvantages, and also given some valuable points as to their care.

SNAP SHOTS. Photographic Paper. J. W. Williard, Editor. New York: Snap Shot Publishing Company. 20 pp.

This breezy little photographic paper is now in the midst of its ninth annual volume, and continues to be the purveyor of interesting notes and short articles on practical photographic methods.

THE LOCOMOTIVE. Hartford Steam Boiler Inspection and Insurance Company. Vol. XXI. 1900. 191 pp., 40 ill.

The bound volume for 1900 of this little paper contains many articles of value to engineers and others having the care of steam engines and boilers. A number of photographs of curious boiler explosions are reproduced, and the causes gone into and described. In each number a monthly list of boiler explosions is given, as well as a list of boilers found defective upon inspection.

BIBLIOTICS, OR THE STUDY OF DOCUMENTS. By Persifor Frazer. Third Edition, greatly enlarged, rearranged and in part rewritten. Philadelphia: J. B. Lippincott Company. 1901. 266 pp., 45 ill.

This little volume is a complete handbook for those interested in the determination of the individual character of handwriting for exposing forgery and fraud. The author uses scientific methods throughout, employing composite and micro photography for obtaining a standard of comparison and for investigating tremors in the pen stroke respectively. His book describes (1) physical considerations, (2) grammapheny, or the study of the individual characteristics of the writing, (3) plassopheny, or the means to be employed for the detection of forgeries, (4) chemical considerations, including a statement of the constitution of common inks and chemical tests applicable to documents by means of which the nature of an ink may be ascertained. The author describes no less than seven methods of investigation of which he is the originator. The book also has an appendix containing valuable notes on the scientific aspect and legal status of the subject.

ELECTRIC LIGHTING. By Francis B. Crocker, E.M., Ph. D. New York: The D. Van Nostrand Company. 1901. 500 pp., 391 ill. Price $3.

This book, which is the second of two volumes dealing with the subject, describes the distributing system and lamps, and covers all parts of electric lighting systems excepting the generating plants. In treating each branch of the subject the principles are first stated with considerable fullness and are then followed by practical examples of prominent methods and apparatus employed in actual practice. Both volumes are intended as textbooks for engineering schools and as handbooks for practising engineers, and thus all abstruse and detailed matter has been omitted as far as possible. The National Electrical Code and the Report of the Committee on Standardization of the American Institute of Electrical Engineers are added as appendices.

THE TRUSTS. By William Miller Collier. New York: The Baker & Taylor Company. 1900. 336 pp.

Mr. Collier should receive the thanks of every business man for such a fair-minded and able discussion of this great problem of the new century in America. He approaches the trust question from the economic standpoint and views it in the light of past experience. He shows the causes that have led to the giant corporations of to-day, as well as the dangers that lie in the monopolistic tendencies of these corporations; and also indicates what appears to be the proper legislation to hold such tendencies in check. The conclusion he reaches is that the trust is a natural outcome of modern competition; that it is the most economical form of conducting industries, and that its only danger is in its power to become temporarily a monopoly and raise prices if it so desires. That such a course is in the end self-destructive he very clearly demonstrates. A chapter on trusts and expansion offers some good suggestions as to one unappreciated aid in remedying the evil, while another chapter is devoted to all the various remedies. A number of appendices give the various acts that have been passed, both State and Federal, thus far to regulate trusts. The book is a fair-minded discussion of both sides of this burning question by an able student of political economy.

UNTERSUCHUNGEN UEBER HETEROGENESE. Von Dr. A. P. Fokker in Gronigen. IV. Die Granula der Milch. Three plates. Gronigen: P. Noordhoff. 1901. Octavo. Pp. 102. Price, paper, $1.

The work before us is an ingenious demonstration of a new hypothesis that bacteria are not individual living creatures, but only partial bions, proliferative forms of diseased protoplasm from which they have sprung by heterogenesis.

SUR LE SYSTÈME GLANDULAIRE DES FOURMIS. Par Charles Janet.

SUR LA VESPA CRABRO L., Ponte. Conservation de la chaleur dans le nid. Par Charles Janet.

VORSCHLAG ZU EINER NEUEN EINFACHEN METHODE DER VIELFACHTELEGRAPHIE. Von J. W. Giltay, in Delft. Sonderabdruck aus der Electrotechnischen Zeitschrift. Berlin: Verlag von Julius Springer. 1901.

ETUDES SUR LES FOURMIS, LES GUEPES ET LES ABEILLES. Note 18, Aiguillon de la Myrmica rubra, Appareil de fermenture de la glande à venin. Par Charles Janet. Paris: Georges Carré et C. Naud. 1898. Pp. 27.

THE PRACTICAL HOTEL STEWARD. By John Tellman, Chicago, Ill. The Hotel Monthly. 1900. Price, $1.

A most excellent book which will be welcomed by all hotel and club stewards. It gives precisely the information which stewards need to conduct the affairs of a house with economy. The steward is very much in the position of a general of an army, and in order to make a success it requires unremitting attention to the smallest detail. The book before us gives samples of menus for various grades of hotels, samples of requisition blanks, etc., and takes up the question of wines with rare intelligence. It is written by a thoroughly practical hotel steward.

The American School of Correspondence of Boston has just published a Reference Library of Engineering Practice, Steam, Electrical and Mechanical, which comprises a set of five large and extremely handsome volumes. The editors have been led to prepare this library as a result of success obtained in teaching engineering subjects to mechanics and others who are not deeply versed in mathematical science; and in the preparation of the library the use of clear and simple language has been adhered to throughout. The illustrations, which have been carefully chosen, number some 2,000. The volumes are handsomely bound.

Business and Personal Wants.

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Inquiry No. 877.—For manufacturers of sugar machinery.

Inquiry No. 878.—For manufacturers of screw-top, round tin cans for liquids in quart and smaller sizes.

Inquiry No. 879.—For manufacturers of small malleable iron castings, near Canon City, Col.

Inquiry No. 880.—For manufacturers of aluminium and brass novelties by contract.

Inquiry No. 881.—For manufacturers of glass.

Inquiry No. 882.—For manufacturers of cigarette making machines.

Inquiry No. 883.—For manufacturers of copper pails.

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Inquiry No. 885.—For dealers in dishes, lamps, silver ware, dress suit cases, watches mandolins and guitars, rocking chairs and jewelry; western houses, if possible.

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Inquiry No. 893.—For tobacco dryers.

Inquiry No. 894.—For tobacco grinding mills.

Inquiry No. 895.—For glue machinery.

Inquiry No. 896.—For vacuum pans for glue.

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Inquiry No. 898.—For manufacturers of steam river boats of the stern-wheel pattern.

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Inquiry No. 903.—For manufacturers of diving bells, supplies, etc.

Notes & Queries

HINTS TO CORRESPONDENTS.

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

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

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

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

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

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

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(8215) C. J. K. asks: What horse power electric motor, connected to axle by double reduction gearing, would be necessary to draw a train of cars weighing five to six pounds, track perfectly level? How many cells of acid battery would be required? A. A very small motor should pull a couple of pounds on the drawbar, which is all that is required to draw a weight of 6 pounds on a level track. SUPPLEMENT Nos. 783 or 1210, price ten cents each, may contain plans which will meet the case. Two cells will drive the first, and four to six the second of these motors.

(8216) U. M. writes: 1. I would like to ask a few questions in regard to voltmeters described in SUPPLEMENT No. 1215, page 19480. 1. What necessary changes are required to make the voltmeter register from 0 to 12? That is, divide the full length of scale into 12 divisions in place of 125 divisions. A. To cause the needle to swing the whole length of the scale for a voltage one-tenth as great, or for 12.5 volts, you should use one-tenth as much wire. 2. Would it be advisable to use copper plate of ⅛ inch (which I have) in place of brass, for the back of voltmeter? A. There would seem to be no reason why copper may not be used in place of brass, except that copper is harder to work than brass.

(8217) C. G. asks: Is nickel plate acted upon by photographic chemicals? A. All acids dissolve nickel with more or less rapidity, hence these dishes are not suitable for use in photographic work. Use hard rubber, celluloid, glass or porcelain. The use of nickel-plated dishes is unsafe in the kitchen for the reason that the acids of the foods will form with the nickel compounds which are poisonous.

(8218) J. L. M. writes: All wiring tables are figured mostly in algebra. I am not up in this study, and wish you would give me some table that can be worked out in plain multiplication and division for getting sizes of wire for carrying different amounts of current at different voltages any given distance and with different percentages of loss. A. Cushing's "Standard Wiring," price $1 by mail, contains the rules expressed in initial letters, with the signs of multiplication and division. These can be easily learned and are the simplest form for expressing the rules.

(8219) C. H. asks: 1. Can glass be made by sand and potash falling between two arcs or is it necessary that it should be held in place before it will form into a liquid, and would it then interfere with the carbons or current? A. We do not think sand could be melted in the time it would occupy in falling through between the carbons, and if it were it would turn solid in the same time after it passed into a colder place below. You will find a furnace to be the cheapest way for melting sand and making the glass. 2. If glass were held in an arc would it break the current? A. Yes, if the heat did not crack it too soon. 3. Would a blowpipe have any effect on an arc the same as with gas to direct the heat? A. No. The blowpipe does not direct the heat of a gas jet. It produces the heat. The heat of a blowpipe is due to the fiercer combustion of the gas in the greater supply of oxygen furnished by the blast. It is a blast furnace on a small scale. The arc would be cooled by a blast of air, since its heat is not due to combustion, as in the ordinary flame. An arc can be blown out to a point and act as a blowpipe by using an electro-magnet to repel the arc.

(8220) J. J. D. writes: In the SCIENTIFIC AMERICAN of March 23, page 178, I saw the expression, "a current of three thousand volts at the motors." Is the expression correct? A few weeks ago in your inquiry column, in answer to a correspondent, you said, "We get the expression very frequently, 'A current of so many volts.' The statement is entirely wrong. A current is measured in amperes, not in volts." A. The voltage of a current is its pressure. The current is measured in "amperes." The expression so often heard, "A current of 110 volts," is not correct. It should not be used, even if it does occasionally find its way into our columns. We confess that we do not always use entirely correct language; that does not prevent our pointing out incorrect language when it comes in our way to do so.

(8221) C. G. asks: Will you please publish in the SCIENTIFIC AMERICAN a description how to make a Wehnelt interrupter for a direct current of 125 volts? A. The SUPPLEMENT, pages 19602 and 19811, price ten cents each, contains illustrated articles upon the Wehnelt interrupter. The interrupter is adjusted to the voltage of the current by varying the length of the platinum wire which is in the acid.

(8222) R. H. C. asks: 1. In a copying camera or enlarging camera, how far from the source of light (incandescent gas burner) should the condensing lens (ground glass) be? A. A condensing lens is not found necessary. Place the ground glass one or two inches in front of the negative. It will then diffuse the light of the lamp so as to give an even illumination over the negative. 2. At what distance from the condensing lens should the negative be placed? A. If a lens is used the negative should be quite near it, so that the negative shall be covered by the cone of light from the lens. 3. What size should the condensing lens or ground glass substitute be for a 4 x 5 or 2¼ x 3¼ negative? A. Anything larger than the negative. 4. What kind of lens or lenses should be used in enlarging to obtain the best results? And what size (diameter) should the lens be? A. The same lens that was used in making the negative will work to enlarge it to any size. If the lens will cover the plate, it will serve to enlarge it.

(8223) W. T. M. writes: In answer 8111, for specific heat of hydrogen and constant volume for 0.2419 read 2.419. The ratio of the specific heats at constant volume and pressure is 1.41 for hydrogen and 3.4062 divided by 1.41 equals 2.419. A. We confess the error. And yet we quoted the best authorities accessible. Our error arose from not verifying the calculation and making sure that the reference was correctly made. Since our correspondent has called our attention to the matter, we have been through a large number of authors on this subject with interesting results.

	Specific Heats.	
Authority.	Constant Pressure.	Constant Volume.
Smithsonian Tables	3.4062	0.2419
Barker's Physics...........	3.4090	0.2359
Ganot's Physics...........	3.4090	0.2359
Pickering, Phys. Manip.....	3.409	0.236
Kohlrausch, Phys. Exp.....	0.409	......
Hastings and Beach Physics..	......	2.402
Ames and Bliss' Manual....	3.406	2.419
Whiting, Phys. Meas.......	3.40	2.40

It is of course known by every student of thermodynamics that the ratio of the specific heat at constant pressure to that at constant volume, for a perfect gas, is constant, and is 1.41. Our table makes it plain that at some time a typographical error occurred in giving the specific heat at constant volume, giving it as 0.24 instead of 2.41, and that this error once started has been transmitted from text to text. The oldest book quoted above was printed in 1876, and contains the error, which is thus shown to be venerable. Another more glaring error of the same sort is seen in the number given by Kohlrausch, 0.409, an obvious error, if one is informed on the subject; but a reference book is for the learner and the uninformed. These cannot detect such a misprint unless by a comparison of authorities, which may not be at hand, and for which there may not be time. Very few would think of verifying the statements of so eminent an authority as Kohlrausch. We think we have shown that we were in good company when we committed the error. This is not a solitary instance of errors traveling for a long time in textbooks without detection. Many an experiment has been printed without being performed by the author, which was an impossibility. A laboratory book in chemistry recently published by a professor in a university directs the student to collect chlorine by the displacement of water! He will get some after the water is saturated, but meanwhile the back pressure may interrupt the complete success of the operation, and even break things.

(8224) R. A. S. asks: 1. What is the voltage of six cells of the Edison-Lalande battery, type "Q," as is used in the Otto gas engines, when connected in series? What is the amperage? A. A cell of this type is given 2-3 volt in the catalogue of the company. Six cells in series would have 4 volts. The safe working current is given as 2.5 amperes. The internal resistance of these cells is very low, 0.07 ohm. In order that the current may be 2.5 amperes the coil should have a resistance of 1.2 ohms, with the battery in series. 2. What difference would there be in the voltage and amperage if they were connected in multiple? A. When the battery is in multiple the voltage is 0.667 and the internal resistance is 0.01 ohm. With the same external resistance the current given would be about one-half an ampere. 3. I have a small toy motor which will run on two cells of the battery, if connected directly with the battery, but will not run on all six cells after it has passed through the resistance coil used for making the sparks for the engine. Can you tell me why this is? A. This is because the resistance of the coil is large as compared with that of the battery.

(8225) L. E. Dare asks: Is there an electric light which can be used successfully at any depth of water and about at what depth? A. Any incandescent electric light will burn under water at any depth if the wires and the lamp are protected from getting wet.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending June 11, 1901, AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Advertisement displaying device, W. J. Jackson ... 676,235
Advertising device, movable, J. W. Fawkes, Jr. ... 676,126
Advertising displaying card, G. P. Duncan. 675,885
Agricultural implement, L. A. Aspinwall.. 676,248
Air brake, Wisner & Ely ... 676,019
Air brake mechanism, Mallinckrodt & Sauvage ... 676,398
Air compression apparatus, K. O. B. Textorius ... 676,401
Air compressor and explosive motor, combined, F. H. Biasse ... 676,349
Air compressor, hydraulic, L. E. Mitchell. 676,266
Air compressors, separator for hydraulic, W. O. Webber ... 676,016
Air separator, C. H. Lane ... 676,041
Animal trap, A. R. Hamilton ... 676,036
Automatic lubricator, P. J. Harleman.. 675,948
Automobile, I. Kitsee ... 676,263
Automobile vehicle, L. H. Dyer ... 676,223
Axle bending machine, Parry & Byers ... 676,007
Bag filling and weighing macine, A. & L. Smith ... 676,100
Bags or packets, machine for filling seed, C. T. Price ... 676,048
Bailing press, P. K. Dederick ... 675,937
Bank bill cutter, W. J. Arney ... 675,877
Barometer, mercurial, A. S. Davis ... 676,178
Barrel machine, C. A. Rafter ... 676,203
Bearing, axle, A. Riebe ... 675,975
Bed, folding, A. Haberman ... 676,384
Bicycle, L. S. Kallajian ... 676,003
Bicycle handle, Boehm & Waldron ... 675,927
Bicycle saddle support, A. R. Anthony et al 676,021
Bills, posters, etc., to walls, device for attaching, J. C. Patterson ... 676,150
Blasting device, Bryant & Brown ... 676,219
Blind holder, W. D. H. Nichols ... 676,337
Blower, rotary fan, H. B. Keiper ... 676,322
Boiler stay bolt, steam, J. H. Davenport... 675,935
Bolt, S. D. Latty ... 676,240
Bolt clamping device, N. W. McCourt ... 676,367
Books, detachable group of leaves for sectional, A. O. Kittredge ... 676,138
Boot or shoe, J. J. Pelucha ... 676,047
Bottle cork block, J. L. Wilson ... 676,018
Bottle corking device, J. P. Raiche ... 675,906
Bottle filling machine, W. P. Truden ... 676,402
Bottle, non-refillable, A. A. Freckman ... 675,942
Box cover brace and support, E. Kubias ... 676,325
Box trimming machine, J. E. Erickson ... 675,940
Brake, T. Edgington ... 675,939
Bricks, apparatus for the manufacture of, J. P. B. Fiske ... 676,249
Brush holder, A. F. Batchelder ... 676,298
Brush holder, H. Geisenhoner ... 676,308
Bucket, clam shell, J. C. Hoshor ... 676,189
Buckle, sheet metal, J. F. Molloy ... 676,198
Bung and means for drawing same, H. Bauer ... 675,921
Burial casket lowering apparatus, Breed & Warther ... 675,928
Burner, A. W. Straight ... 676,374
Burner for glowing lights, O. Reitz ... 676,153
Buttons, hangers, etc., fastening device for, J. E. Platon ... 676,273
Cabinet or paper case, J. T. Hoyt...676,315, 676,317
Cable splicing tool, C. Wigtel ... 676,292
Can closing apparatus, R. A. Hall ... 676,229
Can cooling machine, E. Manula ... 676,070
Cane stripper, J. Hester ... 676,252
Car coupling, M. A. Brown ... 676,218
Car, dumping, J. J. Souder......676,102 to 676,104
Car, dumping, A. Roesgen ... 676,278
Car, dumping railway, J. J. Souder ... 676,101
Car, grain, M. Sorlie ... 676,052
Car seat, H. Witte...676,169, 676,170
Car side bearing, W. S. Rogers ... 675,977
Car step, extension, H. E. Youtsey ... 675,916
Car step, extension, R. C. Smith ... 675,983
Car track cleaning attachment, hand, A. Hagg ... 676,385
Car wheels to their tracks, device for anchoring, J. C. Wands ... 676,167
Carbonated water holders, apparatus for filling, Koch & Hall ... 676,366
Carbureter, R. Y. Thomas ... 676,054
Cartridge, H. Henneberg ... 676,000
Cartridge charging machine, L. Chambon ... 675,932
Cartridge clip, R. W. Scott ... 676,371
Cartridge shell crimping tool, N. D. Holbrook ... 676,255
Cash indicator, J. H. Snow ... 675,984
Cash or parcel carrier or distributer, W. H. Sheppard ... 676.050
Cash register, T. H. Blair ... 676,216
Cash register, E. H. Jahnz ... 676,386
Cask, H. A. Cohn ... 675,882
Chain links, machine for imparting uniform dimensions to, G. Paul ... 676,078
Channel opening machine, L. Goddu ... 676,362
Checkrein holder, E. Hagberg ... 675,997
Chimney cowl, D. Keller ... 675,952
Chisel, M. Sporleder ... 676,053
Chute for wagons, etc., I. L. Vansant ... 676,212
Cigar package, C. Johann ... 676,136
Cigar tip cutter and lighter, G. Weiss ... 676,404
Circuits, regulating device for alternating current, E. Thomson ... 676,344
Clock signal, electric, H. B. Vaughan ... 676,346
Clock striking mechanism, J. Gutekunst ... 675,890
Clod crusher and land leveler, G. E. Blaine. 675,924
Clothing, etc., holding device for, C. V. D. Blair ... 675,925
Coin controlled apparatus, H. S. Mills ... 676,146
Coin controlled machines, bogus-coin detector for, P. E. Berger ... 676,114
Color sample, R. J. Simpson ... 676,373
Combing machines, idler-pulley for wool, F. W. Nims ... 676,046
Composition of matter, N. B. Mayer ... 676,095
Concentrator, J. Mellein ... 676,388
Container, flexible, B. E. D. Stafford ... 676,012
Cork extractor, J. Rogginger ... 676,205
Cork puller, E. Walker ... 676,013
Corset stiffeners, etc., spring for, H. Torley 676,210
Cotton chopper and cultivator, combined, J. E. B. Ogden ... 675,968
Couch, box, I. Karpen ... 676,004
Couch, box, G. E. Bedell ... 676,215
Curb, cistern, W. B. Dorward ... 676,355
Currycomb, C. Fockens ... 676,358
Curtain fixture, A. B. Smith ... 675,982
Cut off, rain water, W. T. Mills ... 675,963
Cutting table, bias, F. B. Granger ... 676,228
Damper regulator, furnace, J. Bruss ... 676,120
Dispensing apparatus, C. S. Goodfellow ... 676,130
Display and stock cabinet, combined merchant's, C. Sparks ... 676,157
Distribution system, H. F. Parshall ... 676,339
Door, Twiss & Cook ... 676,284
Door check, pneumatic, S. W. Peregrine ... 675,903
Door operating mechanism, M. J. McDonnell 676,149
Dovetail joint, A. Pfeil ... 676,079
Drapery hanger, J. Langlois ... 676,397
Drier, C. Wacker ... 676,165
Drying apparatus dust removing device, M. Konig ... 676,140
Drill. See Electric drill.
Dump and elevator, portable, P. E. Erickson ... 675,941
Dyeing apparatus, E. E. Plantrou ... 676,151
Dyeing, etc., machine for, C. E. Drew ... 676,222
Educational appliance, J. A. Healey ... 676,313
Egg carrying case, W. Craine ... 676,354
Ejector, duplex steam, W. D. Labadie ... 676,239
Electric drill, J. C. Lincoln ... 676,043
Electric meter, L. E. G. Cauro ... 675,931
Electric meter, L. Gutmann ... 675,996
Electric propulsion system, H. Halberstadt.. 676,035
Electric switch, E. Schulz ... 676,280
Electrical apparatus coils, protecting device for, P. H. Thomas ... 676,105
Electrical contact making device, P. R. Papin ... 676,098
Electrical distribution system, E. J. Berg.. 676,300
Electrical impulses, reception and retransmission of, A. Muirhead ... 676,006
Electrically lighting light ships, etc., means for, J. H. Junge ... 676,365
Electrode, primary battery, W. T. Seddon.. 676,281
Electrodes, apparatus for making, G. J. Miller ... 676,333
Electrodes for storage batteries, etc., making, G. J. Miller ... 676,334
Electrograph, M. Beck ... 675,878
Elevator safety appliance, Gracey & Gfeller 675,888
Elevator safety catch, H. Jewell ... 676,258
Elevator safety device, C. R. Pratt ... 676,152
Engine attachment, traction, C. E. Anderson ... 675,994
Engine eccentric, steam, O. P. Holt ... 676,038
Engine oil feed, explosive, G. J. Weber ... 676,403
Engine starting device, explosive, Z. S. Taylor ... 676,247
Engines, device for preventing racing of marine, J. T. Parry ... 675,969
Engines, electric igniter for explosive, J. V. Rice, Jr. ... 676,099
Engines, spraying and vaporizing device for crude oil explosive, F. Van Duzen ... 676,285
Eye cups, F. E. Young ... 676,379
Eyeglasses or spectacles, lens mount for rimless, A. Leo ... 675,957
Farm gate, H. P. Wellman ... 676,107
Feeder and band cutter, self, W. Brandon. 676,301
Fence, wire, G. S. Bartholomew ... 676,023
Fertilizer grinder and separator, D. Z. Clay 676,175
Fire alarm, automatic electric, W. J. Brewster ... 676,085
Firearm, magazine, Linville & Endicott ... 676,094
Fire extinguisher, J. H. McConnell ... 676,148
Fire extinguisher and alarm, combined, J. G. J. Davis ... 676,221
Fire pot, C. F. Schenk ... 675,908
Fireproof blind, W. R. Kinnear...675,953 to 675,955
Fireproofing and preserving fabrics, etc., A. Nieske ... 675,901
Fish cleaning apparatus, Munn & Lotz ... 676,073
Flask, siphon, I. Ripper ... 676,009
Floor, sidewalk, or window cleaner, F. W. Richter ... 675,907
Fluid meter, H. H. Frost ... 675,943
Fluids, apparatus for compressing or exhausting elastic, W. Reavell ... 676,080
Fluids of different densities, apparatus for separating, D. H. Haywood....675,891, 675,949
Folding box, Z. B. Webb ... 676,015
Folding box, D. Drawbaugh ... 676,393
Forge, H. B. Keiper ... 676,323
Fountain, F. W. Darlington ... 675,883
Furnaces, condenser for fumes of metallurgical, E. Balbach, Jr. ... 676,380
Fuse for projectiles or torpedoes, distance, G. Klumak ... 676,139
Fuse, safety, L. Abendroth ... 675,993
Game apparatus, H. Barghausen ... 675,920
Garment, F. H. Sprague ... 675,985
Garment, W. P. McGuire ... 676,336
Garment fastener, K. Zuber ... 676,294
Gas and air heater for burners, C. M. Seifert 675,981
Gas and steam generator, combined, S. D. Mott ... 676,199
Gas, apparatus for making water, H. Strache ... 676,245
Gas burner, oil, P. B. Spaulding ... 676,011
Gas burner regulator, R. Beese ... 676,173
Gas burner self-igniting attachment, R. Beese ... 676,174
Gas generator, acetylene, J. W. Tallmadge. 675,987
Gas heater, G. White ... 676,017
Gas lines, automatic drip for, J. W. Hough. 676,065
Gas meter, prepayment, Hawkyard & Braddock ... 676,231
Gas meters, coin freed prepayment mechanism for, A. Stansfield ... 676,206
Gas producer, A. Laughlin ... 676,329
Gas producer, W. Garrett ... 676,394
Gas, purifying water, H. Strache ... 676,209
Gas retort charging apparatus, G. A. Bronder ... 676,025
Gate. See farm gate.
Gate, L. W. Seckler ... 675,980
Gear generating cutter, E. R. Fellows ... 676,226
Gear generating machine, E. R. Fellows ... 676,227
Gear, power transmission, R. Jackson ... 676,040
Gearing, toothed, Humpage & Jacques 676,233, 676,234
Glass and making same, ornamental, C. Byrnes ... 676,122
Globe guard, Lepel & Schultze ... 676,331
Glue applying machine, M. D. Knowlton ... 676,237
Grain drill, F. J. Noechel ... 676,076
Grinding and polishing apparatus, C. W. Nystrom ... 675,967
Grinding machine, roll, J. Dawson ... 675,936
Grinding mill, ball, C. Hofmann ... 676,254
Gun, shot, C. S. Evans ... 676,181
Gun, spring air, A. Schoenhut ... 676,279
Halter for horses or cattle, B. S. Thomas. 675,910
Handle, G. S. Allen ... 675,917
Harvester, potato, H. H. Higdon ... 676,188
Hat box, B. F. Porter ... 676,274
Hat mark and guard, combined, J. S. Wright ... 676,293
Hay cocking machine, D. W. Valleau ... 676,058
Hay fork, F. J. Vessely ... 676,287

Hay loader rake, J. Dain, Jr. ... 676,304
Hay rake and loader wheel, G. A. Johnson. 676,320
Heater, J. J. Herbrecht ... 676,037
Heaters, means for controlling electric, E. E. Gold ... 676,309
Heating and circulating apparatus, water, J. D. Lafreniere ...676,093, 676,192
Heating apparatus, I. V. Arvonen ... 675,919
Heating apparatus, Conway & McCarthy.. 676,176
Heating apparatus, liquid fuel, P. J. E. E. Chambost ... 676,063
Heating device, A. Elmendorf ... 676,180
Hitching fetter, animal, Rommel & Owen.. 676,243
Hod, W. G. Avery ... 676,022
Hod, J. W. Guerin ... 676,250
Hoops upon jacketed cans or other vessels, machine for tightening wire, J. G. Hodgson ... 676,232
Horseshoe, rubber tread, E. F. Culbertson. 676,086
Hot air cabinet, H. A. Dygert ... 676,124
Hot air furnace, J. P. Schaffer ... 675,978
Hub, vehicle, G. C. Lewis ... 676,042
Hydraulic machines, means for varying areas of plungers of, W. J. Hagman ... 676,251
Ice making apparatus, W. B. McCrosky ... 675,965
Incandescent lighting device, J. P. Keating. 675,951
Index for ledgers, etc., G. C. Sheperd ... 675,909
Inhaler, J. Y. McFarland ... 675,966
Insect destroyer, L. Ricard ... 676,341
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Joint. See Dovetail joint.
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Lamp, incandescent electric, J. McCullough. 676,074
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Level, spirit, J. Lemle ... 676,330
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Motion, mechanism for converting rotary into reciprocating, B. H. Locke ... 676,044
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Rein holder, W. E. Hill ... 676,133

(Continued on page 398)

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Telegraph transmitting apparatus, printing, K. Himrod et al........ 676,091
Telegraphy apparatus, wireless, G. Marconi 676,332
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Valve, H. J. Schmitt........ 675,979
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(Continued on page 399)

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Spoons, forks, etc., handle for, S. A. Keller	34,647, 34,648
Tile, vitreous floor, A. Plant	34,661
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Confectionery and chocolate, W. F. Schrafft & Sons	36,574, 36,575
Drugs and medicines, certain named, H. A. Blair	36,555
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Flour, corn, Mattie Mitchell Co	36,565
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Furniture, certain named household, Hoosier Mfg. Co	36,584
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Lard, lard compounds, and lard substitutes, Cudahy Packing Co	36,567, 36,568
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Soaps and perfumes, Colgate & Co	36,560
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"Pure Old Diamond Rye Whiskey," for whisky, B. M. Sweeney	8,446
"Purista," for cigars, Norwood Cigar Co	8,448
"Rausch's Nut-Oel," for a nut-oil, G. Rausch	8,442
"Reliance Brand," for canned sugar-corn, Waterloo Canning Co	8,440
"Royal Garden Iced Tea," for teas, J. M. Bour Co	8,443
"Sign Writers' Union Label," for signs, C. W. Smith	8,452
"Suchagood," for coffee, J. Wirscheck	8,444
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"Horlick's Malted Milk Hot," for malted milk, Horlick's Food Co	357
"Horlick's Malted Milk With Egg," for malted milk, Horlick's Food Co	358
"Noah's Ark," for wall paper, Lawrence & Bullen	356
"'One of the 57,' Heinz's Baked Beans With Tomato Sauce," for baked beans with tomato sauce, H. J. Heinz Co	360
"'One of the 57,' Heinz's Tomato Soup," for tomato soup, H. J. Heinz Co	361
"The 'Colossal' Vest Suit," for clothing, L. Morse & Co	354
"The Siamese Curtain," for curtains, Cohen Bros. & Co	355

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