SCIENTIFIC AMERICAN

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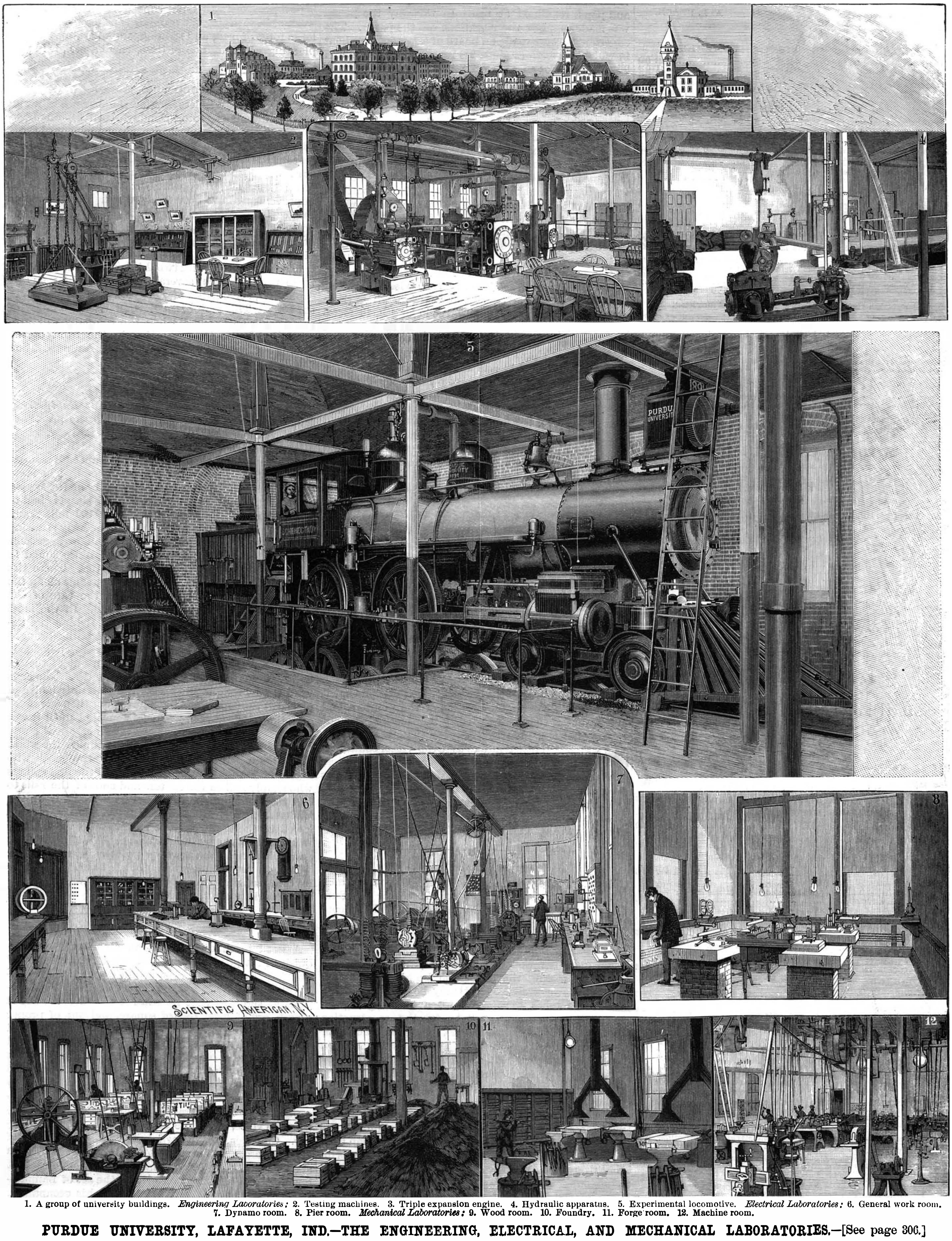

1. A group of university buildings. *Engineering Laboratories;* 2. Testing machines. 3. Triple expansion engine. 4. Hydraulic apparatus. 5. Experimental locomotive. *Electrical Laboratories;* 6. General work room. 7. Dynamo room. 8. Pier room. *Mechanical Laboratories;* 9. Wood room. 10. Foundry. 11. Forge room. 12. Machine room.

PURDUE UNIVERSITY, LAFAYETTE, IND.—THE ENGINEERING, ELECTRICAL, AND MECHANICAL LABORATORIES.—[See page 306.]

Scientific American.

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Contents.

(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 854.

For the Week Ending May 14, 1892.

Price 10 cents. For sale by all newsdealers.

VIBRATIONS OF STEAM VESSELS.

Mr. A. F. Yarrow presented recently, before the Institute of Naval Architects, a very able paper, descriptive of a series of practical experiments which he has lately conducted, relating to the causes of vibration in screw-propelled vessels. The paper is illustrated with a number of diagrams. One of the instruments employed to show and record the vibrations consisted of a weighted drum hung in elastic slings and operated by clockwork, with paper and a pencil, the apparatus being so arranged that the pencil was made to shake by the vibration of the vessel, but the drum and paper remained at rest. In this way the pencil was made to mark the vibrations on the paper. The experiments were made on board of a fast torpedo boat in which the engines made 248 revolutions per minute. The author found that the vibration was not due, as has been heretofore commonly believed, to the action of the propeller in the water, but is caused by the unequal balancing of the machinery—of the cranks, piston rods, cams, etc. So great was the vibration of the experimental vessel that when held fast by cables in still water, the propeller being removed and the machinery set in motion, the vibration of the hull was communicated to the surface of the water, and the waves so produced photographed. Different parts of the hull of the vessel showed different degrees of vibration in the water; that is to say, the shake varies in intensity at different points in the length of the hull. There are places where it is excessive, and places, termed "nodes," where it does not exist. We give an illustration on next page, which is from a photograph. It shows the vibrating sections and the nodes, and the effect produced on the water. The vessel on which these experiments were tried was 130 feet in length, 13 feet 6 inches beam, 1,100 h. p., and had a speed of from 22 to 23 knots.

Mr. Yarrow shows that by the application of balancing or bob weights and devices to the machinery the vibration can be very greatly reduced. The vessel was tried under three conditions: First, without any balancing weights whatever, with engines as usually constructed; second, with balance weights on the cranks only; third, with balance weights on the cranks and with bob weights. The use of the weights effected a very great reduction in the vibration.

This subject of the vibration of small steamers reminds us of an experience we had a few years ago. We were invited to witness an experiment with a steam launch for which it was claimed a velocity of 30 miles an hour had been obtained. This launch was built at Amesbury, Mass., chiefly from English designs, and the builder pledged himself the boat had made the above time, and he would prove it to us by giving us a test of her speed. We duly attended, and the boat was put in motion. The builder said the way he had been accustomed to test the speed was by timing from on board, a watch being held in the hand and stakes on shore observed.

The boat was started with the builder at the engine, and when the highest speed was attained the watch was observed, but so terrific was the vibration that it was impossible to see the position of the pointers, and observance of the correct time by that method was out of the question. We subsequently ascertained by a stop watch and other means that the vessel could not, on that occasion, at her highest speed and shortest spurt, reach 20 miles per hour. Where unusual speeds are claimed by private owners or interested parties, the tests should be conducted by reliable persons who have no interest in the result, and the precise method of taking the speed should be fully explained.

World's Fair Notes.

An effort is being made to collect $25,000, with which to build at the exposition a headquarters for the Sunday schools of the United States. The scheme contemplates asking each school to contribute an amount equal to ten cents for each officer and teacher and one cent for each pupil.

As an illustration of the rapidity with which the work of erecting the exposition buildings is being pushed at Jackson Park, it may be stated that on March 1 sketches were made for a building to serve as permanent accommodations for the construction bureau, the Columbian guards, emergency hospital, central fire alarm service, etc. The contract was let on April 2, and on April 30 the building was finished and occupied. The structure measures 200 by 300 feet, is covered and ornamented with staff, and is substantially put up.

The scene which the exposition grounds now afford, with most of the buildings nearing completion and the construction being pushed forward by more than 6,000 workmen, is accounted so interesting and wonderful that from 1,000 to 5,000 visitors a day willingly pay the admission fee of 25 cents to witness it. Before the abolition of the free pass system, the visitors often numbered as high as 15,000 or 20,000. The work of construction was interfered with, so that it was thought best to charge an admission, and thus diminish the size of the crowd of sightseers and at the same time add to the financial resources of the exposition.

The construction of the exposition buildings is progressing in the most satisfactory manner, and there is no reason for doubt that all will be completed in time for dedication. The rough carpentry work is practically finished on all of the large structures except Machinery Hall and the Manufacturers' building, and on these it is in an advanced stage. Six or seven of the buildings have the exterior appearance almost of finished structures, and look like imposing marble palaces. The erection of a number of the State buildings is now progressing. Landscape gardening and other work of beautifying the grounds is being pushed by a large force of men, and sodding, walk making, and the planting of thousands of trees, shrubs, etc., is in progress.

The Ammonia Motor.

The Standard Fireless Engine Company had a run of their ammonia motor, Sunday, April 24, on Jackson Park, the World's Fair site, for the benefit of those who could not come week days. On this occasion 36 persons rode around the grounds on the motor. In our issue of January 23, we gave a description of this novel motor and its operations; but since that time improvements have been made which have decreased the cost of running the motor from $1\frac{3}{10}$ cents per mile, as stated in that issue, to less than one cent per mile, while adding to the smoothness of the running. The distance traversed on the construction tracks was 14 miles with two thirds of a charge. Among these present were several street railroad men and capitalists, some ladies of note and representatives of the press. This motor is a portion of an exhibit for the World's Fair of 1893, when the company will have a select location for operation in the front of the grounds terminating opposite the Administration Building.

Rapid Railroad Building.

In an article in a recent number of the *Engineering Magazine*, Mr. J. S. Coleman describes the process of track laying on the Texas and Pacific Railway, where as much as three miles of track were laid in one day, which is stated to be a record performance for a single force of tracklayers working from one end. The main difficulty in such performances is said to be the supply of the material. In this instance the sleepers had to be transported a distance of nearly 800 miles, and delays were therefore frequent, consequently reducing the rate of progress considerably. The arrangement of forces for laying was as follows: A tie squad in advance of all others who laid the ties. These ties were loaded in wagons and hauled by teams along the roadbed, and set and spaced under the care of the engineer who accompanied the squad. In the most rapid work this gang numbered 125. Behind the tie-setters and spacers came the iron gang, who brought with them the truck into which the rails were loaded; as they advanced, the rails were taken out of the car by twos and dropped into place on the ties. The ends were then brought snug with the last rails laid and placed at the proper gauge. The car was then advanced over these rails and the process repeated until it was empty, when it was tipped off the line to make way for a second truck and gang, who continued the work. Close behind this gang came the "strappers," who make the joints between the rails, and the first spikers who simply spiked the centers and ends of the rails to the ties, which held them securely enough for the loaded iron trucks to pass over them. These were followed by the main force of spikers who finished the work, so that the material trains could deliver the ties and rails as near the working point as possible. The "lining," "surfacing," and "black filling" was done by three separate squads of men in the order named, who left the work ready for inspection.

Eye Measurements.

A good mechanical eye is an almost essential requisite in a good mechanic, says the *Manufacturers' Gazette*. No one can ever attain distinction as a mechanic unless he is able to detect ordinary imperfections at sight, so that he can see if things are out of plumb, out of level, out of square, and out of proper shape, and unless he can also detect disproportioned or ill-shaped patterns. This is a great mechanical attainment, and one which can be readily attained by any ordinary person. Of course there are defective eyes, as there are other defective organs; the speech, for instance, is sometimes defective, but the eye is susceptible of the same training as any organ. The muscles, the voice, the sense of hearing, all require training. Consider how the artist must train the organ of sight in order to detect the slightest imperfection in shade, color, proportion, shape, expression, etc. Not one blacksmith in five ever attains the art of hammering square, yet it is very essential in his occupation. It is simply because he allows himself to get into careless habits; a little training and care is all that is necessary for success.

Sutro's Great Mining Tunnel.

Adolph Sutro recently delivered an interesting lecture before the mining students at the University of California. In speaking of the development of the Comstock, he said :

New obstacles now developed themselves, one of which was the rapid increase of heat. As a usual thing, the increase of heat in nearly all parts of the globe amounts to one degree of Fahrenheit for every 60 feet of descent. On the Comstock the increase was more rapid, and when the mines had reached a depth of 2,000 feet, it was a common occurrence to find the thermometer in the lower drifts rise to 110 degrees and over. Such a temperature, in an atmosphere saturated with moisture, is almost unbearable, and it would often take three men to one pick ; that is to say, one man would work ten minutes or thereabout, and then retire to the cooling station, while the second man took his place, to again retire in order to make room for the third man, and so the rotation went on during eight working hours. The miners received $4 per day. In this mode of working, a day's labor amounted to $12.

I visited Nevada for the first time in the early spring of 1860, and, traveling over the country, saw at a glance what an advantage to the mines a tunnel would be driven into the mountain from the valley of the Carson.

Actual work on the tunnel was commenced in 1869, and it is my special object to allude to its construction and some of the obstacles encountered.

At first all the work was performed by hand labor, and the progress was slow ; but as more ample means were procured, drilling machinery driven by compressed air was introduced and the advance was more rapid, amounting to an average of 300 feet per month. Ten, twelve or fifteen holes would be drilled in the face on each side, going toward the center, so when all these holes were charged with dynamite and exploded by electricity a wedge-shaped mass of rock would be blown out from the center to a depth of 6 or 8 feet, and afterward more holes were drilled on the side and similarly exploded, making an advance for the whole width of the tunnel of 6 or 8 feet or thereabout.

After the tunnel had penetrated some thousands of feet, the air became worse and worse, and the heat commenced to increase. It was therefore necessary to have (besides the air derived from the drills) additional air thrown in by means of blowers placed at the mouth of the tunnel.

Here I will note a curious fact, which I have never seen explained, and which is worthy of close investigation by means of experiments. We found that the compressed air used for driving the machine drills, after having been compressed and expanded, and discharged from the drills, was not wholesome to breathe, and the men and mules would all crowd around the end of the blower pipe to get fresh air suitable to be inhaled by the lungs.

Whether the air in being compressed has parted with some of its oxygen or become vitiated from some other cause, I do not know, and I hope that this subject will at some future day be carefully examined into.

Speaking of mules reminds me of some of the peculiarities of these intelligent animals, which were extensively utilized in the underground workings. We soon found that horses would not do, for if anything touched a horse's ears, it would throw its head upward, and so be apt to injure itself, while a mule, if anything touched its ears, very wisely dodged.

We had as many as 200 mules employed in the transportation of debris from the works and otherwise. Going along through the tunnel a torch would be fastened to the mule's head, but coming out of the darkness into the sunlight their eyes became dazed, and returning into the darkness from the bright sunlight the mules could not see anything and stumbled about, so a remedy was found, and that was to bandage up one eye before coming to daylight, which bandage was removed after the mule had re-entered the tunnel, thus enabling it to see perfectly with that eye.

In driving the tunnel all the length of four miles many obstacles were encountered. As regards the surveys, it was not an easy matter to keep a perfectly straight line, for sometimes observations had to be made at short distances on account of the mist, and the slightest variation in centers would throw it to one side or the other.

After the tunnel, however, was completed and the connection made with the shafts at the Comstock lode, the foul and moist air was driven out within the first 24 hours, and for the first time daylight was seen from its farther end, appearing as a small, tiny star of the fifth magnitude.

If the tunnel had been driven a few miles more daylight would have been lost altogether, though the opening at the mouth was quite large.

In this connection, speaking of surveying, we had another curious experience.

Under the act of Congress the Sutro Tunnel Company was given a right to all the mines discovered for a width of 2,000 feet on each side of the tunnel for its whole length. When the time came to survey this grant, application was made to the General Land Office at Washington for the survey of those 4,000 feet. The law provided that 2,000 feet should be projected at the tunnel level, but the Land Office at Washington proposed to run the lines on the surface to that width, to which we objected, for a line measured 1,500 feet or 2,000 feet under ground would have a greater width projected up to the surface, being a portion of the radius of a circle commencing at the center of the earth ; it would have given us several feet more on the surface, which might have been of great value in that country of bonanzas.

The Land Office, however, refused to make that projection, and so we had to accept the 4,000 feet as measured on the surface.

In driving the tunnel we encountered all sorts of ground, nearly always rock, some as hard as flint, and some of ordinary hardness. In very hard rock, the drills striking against it would illuminate the face of the tunnel with a thousand sparks, and give the men and the machinery quite a ghastly appearance.

At many points great bodies of accumulated and often hot waters were struck, which came out through the crevices with such force as to throw the men down. At still other points great bodies of clay were encountered, especially when approaching the Comstock lode. This clay, after being cut through, would swell, and timbers 16 inches square would break in two like mere reeds. The pressure in some places was so great that a cap 16 inches square, placed on posts of the same dimension, would be found to be pressed through by the posts within 24 hours, showing an almost inconceivable force. In one place the track did swell up every day, and had to be cut down thirteen times before it remained level.

The heat in the face, though very high, could be endured on account of the fresh air constantly being blown in, but a few hundred feet back of the face the air would be insufferably hot, and so much deprived of oxygen that a candle could not be kept lighted.

In the dry atmosphere of Nevada, electricity accumulates very rapidly in the human body, and I could, first walking over the carpet, on almost any day, with my fingers light the gas. This was the cause of several accidents. We had a special house for the storage of electric exploders, and two men in charge of this house were terribly injured at different times through touching the wires of these exploders with their naked fingers, which caused several thousands of them to explode together. One man was killed outright, being penetrated with thousands of pieces of the copper which forms the exploder caps, while the other poor man lost his eyesight. This last accident occurred notwithstanding the precautions which had been taken to make the men, before entering the exploder house, wet their shoes, while on the floor of the house was placed an iron plate connecting by means of wires with the water flowing below to carry off the electricity.

Then followed a graphic account of the various theories on the origin and formation of the Comstock lode, and the difficulties of mining at great depths, and how they had been overcome.

The lecture concluded with a display of excellent lantern slides illustrating the lecture, which Mr. Sutro had prepared in London and which were thrown on a screen by Prof. Christy.

Transportation by Water in the United States.

In *Census Bulletin* 179 are presented statistics showing the condition of the industry of transportation by water in the United States in all its branches, except that of canals, for the year ended December 31, 1889.

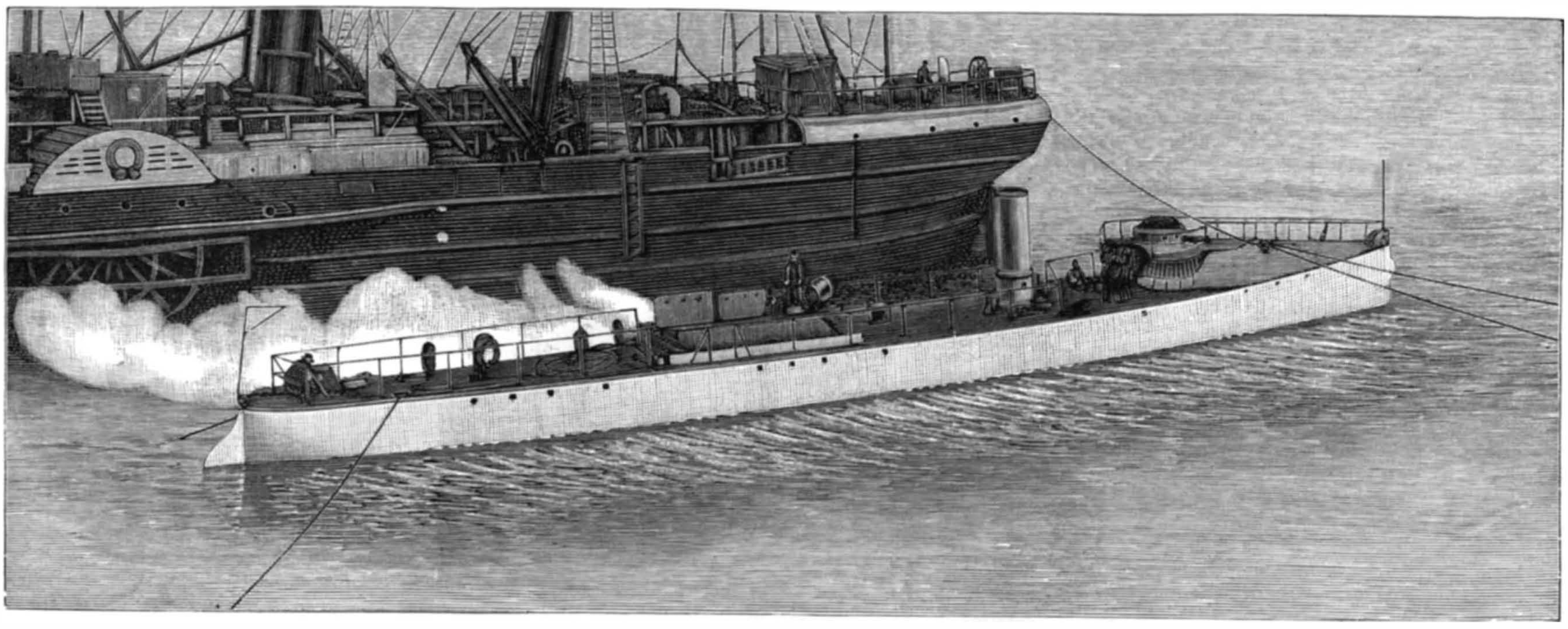
The text and tables have been prepared by Mr. Thomas J. Vivian, in charge of statistics of transportation, under the general direction of Prof. Henry C. Adams, expert special agent, and the work exhibits rare ability.

This is the first census that has undertaken to gather, compile, and publish full statistics concerning all classes of transportation by water, and the totals given in this bulletin are indications of the importance of the industry and the success made in reporting it.

Among these totals are those which show that the transportation fleet of the United States at the beginning of 1890, with the exception noted above, numbered no fewer than 25,540 vessels of all classes, of which 6,067 were steamers, 8,912 were sailing vessels, and 10,561 were barges or unrigged vessels, whose gross tonnage was 7,633,676 tons, and whose estimated value stood at $215,069,296. Other totals show that during the preceding year the freight movement by the whole operating American mercantile fleet amounted to 172,110,423 tons of all commodities. Others show that the number of persons of all classes employed to make up the ordinary or complementary crews of all operating vessels of the United States, exclusive of pleasure craft on the Atlantic coast and Gulf of Mexico, numbered 106,436, and that the total amount paid out in wages was no less than $36,867,305. There are other totals of an equally interesting nature, but enough figures have been quoted to show how vast this industry of transportation by water has become. It is, moreover, almost wholly conducted in vessels of American construction.

A Big Saw for Work on Metal Plates.

Carnegie, Phipps & Co., who have the government contract for a portion of the armor plates of the new navy, are to add to the finishing plant of the armor department at their Homestead mill, near Pittsburg, a gigantic saw, weighing 110 tons, that will cut a nickel steel armor plate as an ordinary saw does a plank. The armor plates range in weight from 8 to 38 tons, and are sometimes 29 feet long and 20 inches thick. The saw has a blade 7½ feet in diameter, geared from above and revolving horizontally. With it an angular slab of cold nickel steel, weighing perhaps a dozen tons, is taken off like the slab of a pine log. The saw is the first of its kind used in this country and cost $35,000.

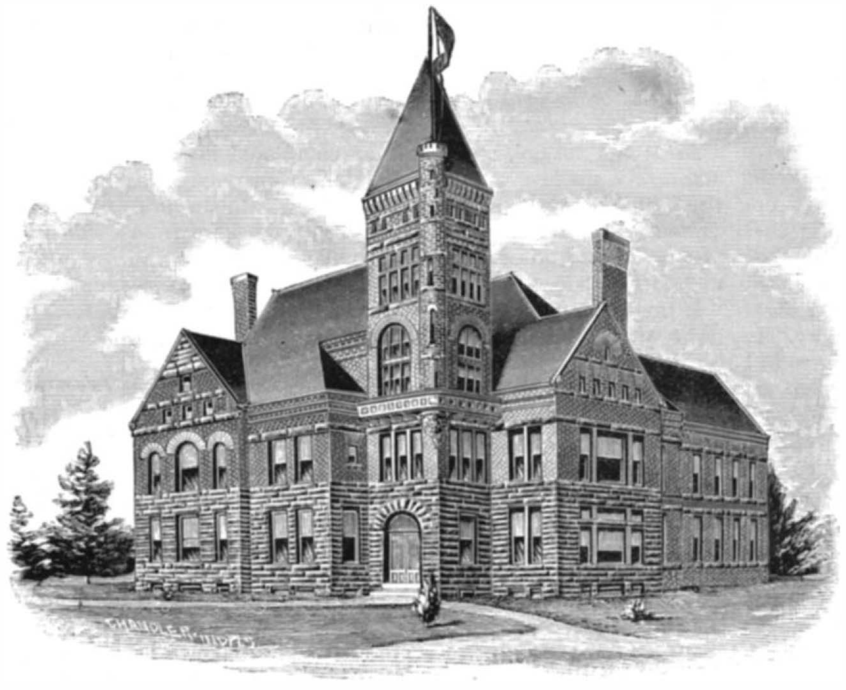


VIBRATIONS PRODUCED BY THE MACHINERY OF STEAM VESSELS.

PURDUE UNIVERSITY, LAFAYETTE, IND.

Purdue University is beautifully located at Lafayette, Ind., a thriving city in direct line of communication between the cities of Indianapolis and Chicago, Toledo and St. Louis, and Louisville and Chicago. Under the wise and energetic management of its president, Dr. James H. Smart, extensive laboratories have been developed for every branch of its scientific work. It is the purpose of the present article, with its accompanying illustrations, to present some features of the laboratories of the schools of mechanical, civil and electrical engineering. These laboratories, by bringing the students into direct contact with machines of many kinds, by giving them an opportunity to study systematically their action, and to test their efficiency, constitute a most important element in the work of their college course.

The technical work of all engineering students during the early part of their course at Purdue is such as will afford practice in working wood and iron. Practice is given in benchwork, turning, pattern making, moulding and casting, forging, and in machine work. The extensive shops of the department of practical mechanics, wherein all of this work is accomplished, are equipped with tools and machines for the accommodation of 150 students at a single time. Later in the course, the laboratory work for each of the several schools becomes more distinct.

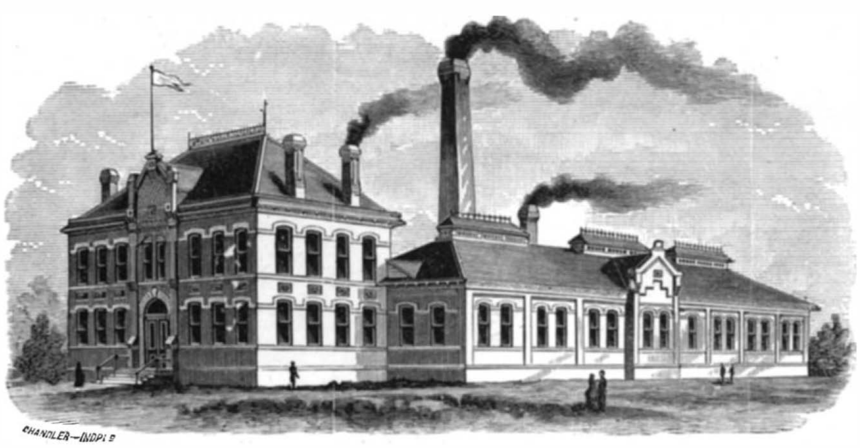


ELECTRICAL LABORATORY, PURDUE UNIVERSITY.

The mechanical engineering laboratory is a handsome room, 50 by 110 feet, and there is a boiler room attached, 25 by 40 feet. The equipment of this building is such as will provide for a large range of experimental work in steam engineering, applied mechanics, and hydraulics. The character of its equipment may be seen by reference to the following enumeration, which includes some of the more important pieces of apparatus which have thus far been put in place.

A 100 horse-power triple-expansion steam engine has been designed and constructed especially for this laboratory. The engine cylinders are 8, 15, and 22 inches in diameter respectively, by 24 inches stroke. The pipe connections are such that any of the cylinders may be worked singly, or they may be worked in combination under any one of six possible arrangements, thus giving, for the purposes of the laboratory, what is equivalent to nine different engines. The steam jackets of the cylinders and of the intermediate receivers may be thrown out of use at will. The crank of the high and of the low pressure cylinder may be set at an angle of 90, 120, and 180 degrees with that of the intermediate cylinder. Connected with the engine are a surface condenser, an independent air pump, tanks on scales in which may be weighed the condensed steam given up by the engine, tanks on scales in which may be weighed the cooling water which passes the condenser, permanent indicator rigs, and the usual gauges and counters.

A 104 horse-power boiler, having its safety valve set at 160 pounds, supplies steam at high pressure for the triple-expansion engine, and for general purposes. Accessory appliances are provided for use in making boiler tests.



LABORATORY OF PRACTICAL MECHANICS.

A high-speed passenger locomotive, weighing 85,000 pounds, is mounted upon supporting wheels in the laboratory in such a way as to allow its action to be studied and its performance tested while the engine is run at any desired speed or load; the conditions being similar to those of the track. The power of the engine is absorbed by powerful friction brakes of special design, and its tractive force is measured by a suitable dynamometer attached to the draw-bar. The boiler may be fired with coal in the usual way. A powerful steam blower above the engine, but not in pipe connection with it, takes up and carries off whatever may be given out from the locomotive stack. There are problems of great scientific and economic value relative to the performance of the locomotive that cannot well be solved experimentally on the road; it is expected that some of these will be subject to easy management in the laboratory.

There is also for work in steam engineering a specially fitted slide-valve engine for practice in valve setting; a compound Westinghouse engine, and a Pyle high speed engine. Altogether, the laboratory contains fourteen steam engines of different forms.

A 12 horse-power gas engine, especially arranged for experimental work, is supplied with natural gas from the same pipe which feeds the fire under the fixed boiler. Means are thus afforded not only for carefully testing the performance of the gas engine, but also for making a direct comparison of its efficiency with that of the steam engine.

For work in applied mechanics there is a 100,000 pound testing machine driven by power, for determining the strength of constructive materials under tensional, compressional and transverse stresses; a 2,000 pound cement tester for determining the relative value of cement and cement mortars; and a good supply of vernier and micrometer calipers, scales and gauges.

For work in hydraulics there is a direct-acting steam pump; two centrifugal pumps; a turbine water wheel; two water motors, and apparatus for measuring the flow of water over weirs, in pipes and through orifices. A steam pump delivers the water supply from a well to a storage tank of 1,000 barrels capacity, and an experimental stand pipe affords means for maintaining any desired range of water pressure.

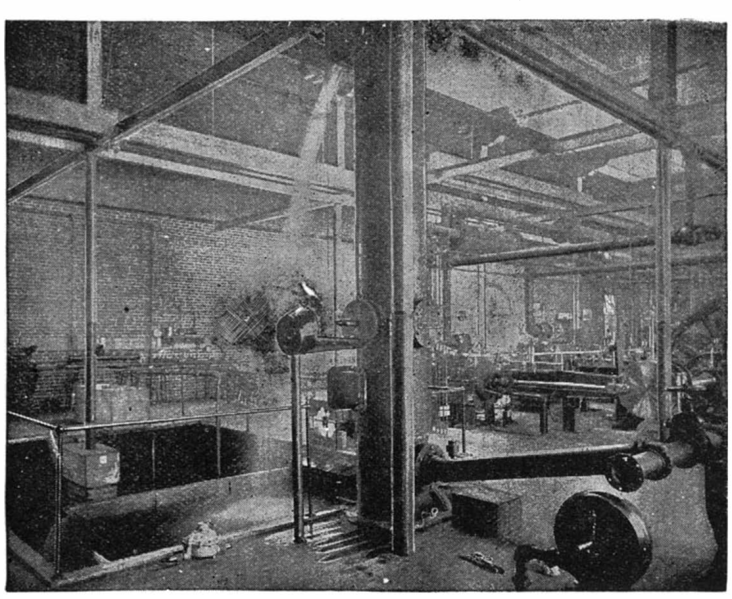
In civil engineering, instruction is offered in railway engineering, bridge engineering, and hydraulic and sanitary engineering. For work in the field, the department is well equipped with instruments of the highest grade. These consist of four complete sets of instruments, by different makers, and include transit, level, chains, tapes, rods, etc. In addition to these, for refined field practice and geodetic work, the department possesses a ten-inch alt-azimuth instrument, made to order for the department by Fauth & Co., of Washington, D. C. For work in river hydraulics, there is a current meter, and other apparatus designed by students in the department. In bridge engineering there are several models of various types of bridge and roof trusses, in wood and iron, and the instruction is made as valuable and practicable as possible, by requiring the student to make complete designs of framed structures, including the calculation of strains, proportioning of members, and making complete detail shop drawings.

The electrical laboratory is in a special building having facilities for exact experimental work. The dynamo room of this laboratory contains a 22 horse-power straight-line steam engine, and the following dynamos and motors: An original French Gramme, a Thomson-Houston arc, a Brush arc, an Edison incandescent, a Slattery alternator, with full line of converters of various sizes and makers; a large Thomson-Houston motor-type generator, a 5 horse-power Perrett motor, a 5 horse-power Thomson-Houston motor, and several smaller motors. A large Brackett cradle dynamometer, a bank of incandescent lamps, resistances for large currents, photometric apparatus, and other testing appliances have been provided. The apparatus is of the latest design and from the best foreign and domestic makers. With the usual commercial testing bridges, ammeters and voltmeters, there are also the finer pieces, such as a Kew magnetometer, two Thomson balances, a Thomson quadrant electrometer, ten of the best mirror galvanometers, standard resistances, electrodynamometers, etc. The pier rooms and other laboratory rooms are well lighted and are pleasant rooms for work.

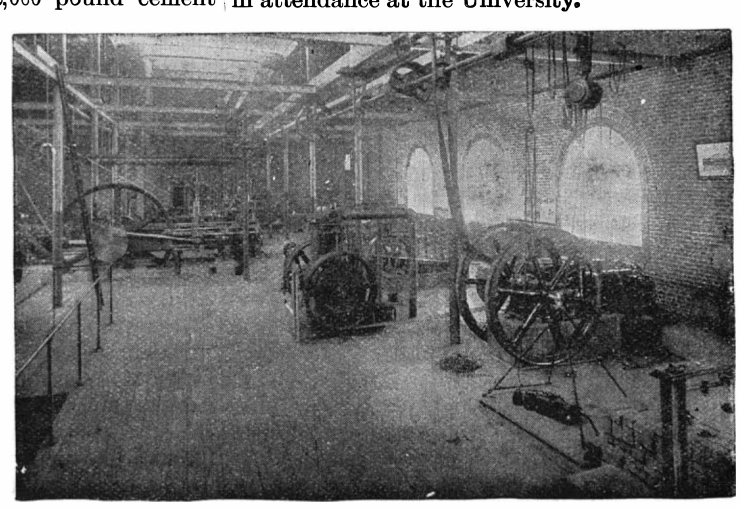
Instruction and practice in mechanical drawing are continuous throughout all engineering courses. In the solution of problems and in the designing of new work the methods of the drawing room are constantly employed.

The engineering chairs at Purdue are filled by W. F. M. Goss, Professor of Experimental Engineering and Director of the Mechanical Engineering Laboratory; J. J. Flather, Professor of Mechanical Engineering; A. E. Phillips, Professor of Civil Engineering; A. P. Carman, Professor of Physics and Applied Electricity; and M. J. Golden, Professor of Practical Mechanics. They are assisted in their work by an efficient corps of instructors and assistants.

There are at present six hundred and forty students in attendance at the University.



ENGINEERING LABORATORY—STAND PIPE AND WEIR TANK.



ENGINEERING LABORATORY—GENERAL VIEW.

PURDUE UNIVERSITY, LAFAYETTE, IND.

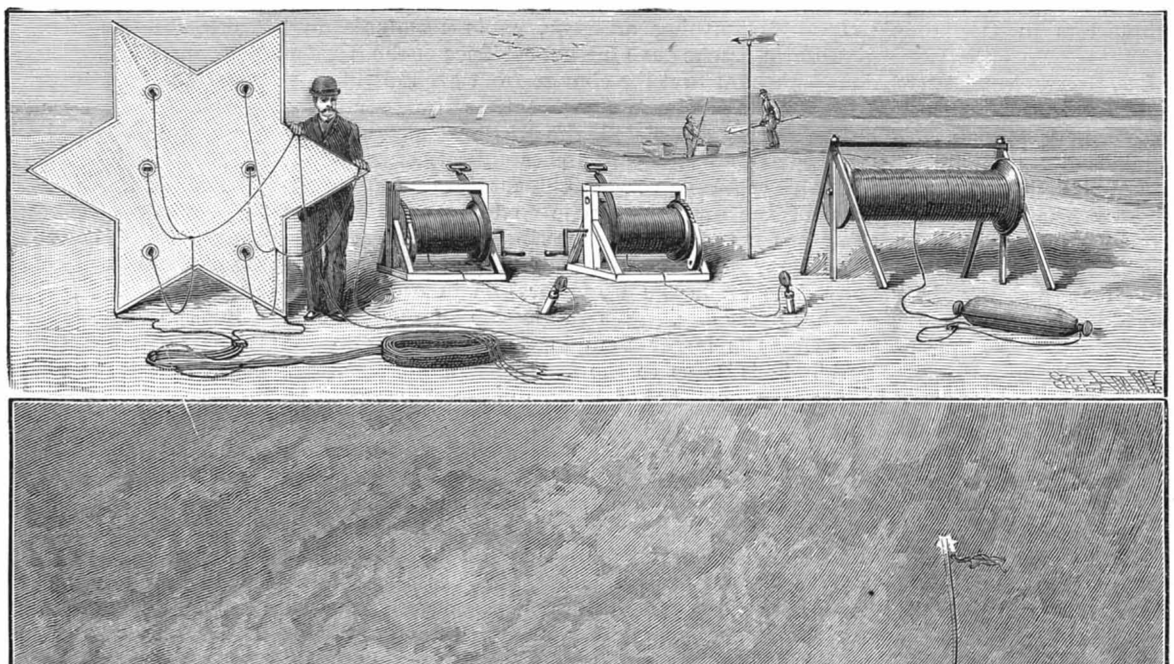
CARRYING A LIFE LINE ASHORE BY A KITE.

A few weeks since, on two different occasions, experiments were made on some islands in the East River, near New York City, to test a new method of carrying a life line ashore from a vessel in distress, as represented in the accompanying illustration. The trials, however, were not made from a vessel actually in need, as portrayed by the artist, but the kite was made to carry the buoy, with the life line attached, across a strip of water five-eighths of a mile wide, in which the current was running at the rate of two and a half miles an hour.

The kite used in the experiment was made with three sticks, each 7 feet long by ⅜ of an inch thick, their width tapering from 1⅛ inches at the center to ½ inch at the ends. The weight of sticks and bolt is 3½ pounds. The kite is foldable and can be made into a small package of convenient shape. To make ready it is only necessary to spread the sticks and tie four strings to the ends of two of them, the covering being already tied to the ends of one stick while folded. Oiled muslin or duck is used for the covering, and the tail is made of clothes line knotted in loops.

This kite is designed to stand any wind up to fifty miles an hour, having a safety factor of seven in a forty-mile wind, the breaking of one of the six bridle strings in such a wind still leaving a safety factor of one and a half. In sending up the kite the three bridle strings of each side are connected to a single line, each of these lines leading to a separate reel, provided with a brake and ratchet, as shown in the detail view. By means of the cords from the two sides to the separate reels the kite can be held at an angle to the wind, so that it can be flown in a direction up to 67° off the wind on each side of the dead to leeward point, and held to keep the given direction. The ability to do this was fully demonstrated in the experiments. The kite having been raised a sufficient height and started in the required direction, the two lines are connected to the buoy to which the life line is attached. The weight of the buoy is a little less than the lifting power of the kite, when the forward movement of the latter is arrested, so that ordinarily the buoy will be held down to the water by the life line, although the kite can drag it over reefs, bars, and floating spars, obstructions which stop such devices as self-propelling torpedoes, etc. When the kite is traveling its lifting power diminishes, and it simply tows the buoy, so that it is possible to take ashore in this way a much heavier line than can be sent by rocket or shot. The pressure of a forty-mile wind upon the 22 square feet of this kite, the kite being held vertical, equals 176 pounds; the strain upon the lines in flying, when the kite is inclined 30° from the vertical, is calculated at 130 pounds, with a horizontal pulling force of 117 pounds and a lifting force of 56 pounds.

A patent for this improvement has been applied for by Mr. J. Woodbridge Davis, of No. 645 Madison Avenue, New York City.



DAVIS' METHOD OF CARRYING A LIFE LINE ASHORE BY A KITE.

A COMMOTION was caused in all technical circles when, in 1885, congo red heralded the many-colored array of that class of dyestuffs which dye cotton without mordants, that is direct. Like the fuchsine discovered by A. W. von Hofmann in 1858, and the first alizarine synthetically produced by Graebe and Liebermann in 1869, Boettiger's congo red was a red dyestuff forming the marking stone of a new period in the history of the development of the tar dyestuff industry and at the same time of the dyeing industry.

[FOR THE SCIENTIFIC AMERICAN.]

The Bessemer Steel Discovery.

Mr. Bessemer was a very learned metallurgist, and was seeking a short and cheaper way of producing steel from cast iron by reducing the excess of carbon. His process was to force air through the molten mass and burn out the excess of carbon and such base minerals or metals as it contained, and stop the blast at the proper time and thereby save the expense and labor at the puddling furnace; but there was no way to effect uniformity or to ascertain just when to stop.

One day in his experiments a very happy thought struck him, which was to burn out all of the carbon, or as near all as possible, and then restore a proper quantity of carbon by pouring in a very high grade of metal and as free as possible from base materials injurious to steel. This he found in certain qualities of ore called spiegel or "spiegeleisen." His first experiment proved quite successful, but here he found a stumbling block. Some man had patented a method of melting wrought iron and restoring it to steel by supplying it with molten spiegel, and he was quite successful except that the metal must go through the puddling process, and then the remelting added another cost, which made it quite as expensive as to convert wrought bars into blister steel, then melt it in the crucible and pour it into ingots in the usual way. Under the English patent laws there must be an annuity paid after a certain number of years or the patent becomes invalid. The inventor of this process of melting wrought iron and restoring it with spiegel was in Mr. Bessemer's way, but in a short time, unless he paid the government installment on his patent, it would become invalid. So Mr. Bessemer watched the records until the poor unfortunate let it run out, then Mr. Bessemer that same day entered his claim, and his patent was granted, covering the entire process. I learned these facts in 1869 while at the John Brown Bessemer Steel Works, in Sheffield, England. But when Mr. Bessemer applied for a patent in Germany, it was refused on the ground that it was not new, and yet I was told when in Essen, at Mr. Krupp's works, that Mr. Fried. Krupp paid Mr. Bessemer $50,000 to go to Essen and teach them the method. Krupp had already spent considerable money and time in trying to make Bessemer steel and failed to do so.

Mr. Bessemer in 1869 was said to have amassed a fortune of about twenty millions from his invention, and it was said then to be the largest amount ever made by any one inventor, and probably was.

The John Brown works were then the largest Bessemer steel works in the world, and I went there to see about twenty tons converted at one time. A two hundred horse power engine was used at the blast furnace alone, and it was indeed very interesting to see the immense converting pot poured full of molten iron, and then the blast turned on, and see it boil and intensify with the varied colors as each base ingredient was destroyed by the heat, and when all was consumed except the quite pure iron, then the molten spiegel was poured in, and the affinity of the molten mass was so great that one could see its greedy appetite for the carbon, like a hungry swine for its swill. I was told that Mr. Bessemer for a long time anticipated the making of steel by his process equal to the best cast steel, but in this he of course failed. Still, while I was in Sheffield I was at a steel rolling mill where they used the *sculps*, as they are called, that come out of the converting pot. These were broken up, remelted, and a small mixture of better material used and melted together and poured into ingots, and that rolled into sheet metal and crosscut and pit saws made of it for the Russian market; and I was told that over six hundred thousand of them were sold there every year, besides saws made from it were sold all over the world. If there is any cheap method of producing anything of metal, England is among the first to adopt it. An immense amount of work that is done in America by men is done there by poor women for a mere pittance that will keep soul and body of part of them together; but when sickness comes or their job is lost, it is the pauper house or the grave. No American can ever appreciate the glories of our free and liberal country and government until he goes to foreign lands.

J. E. EMERSON.

Photography of Inks.

Dr. Jeserich claims it is possible to demonstrate differences in the colors of the inks which cannot be seen, the one ink appearing light and the other dark. This process depends on the following considerations:

As is well known, the tints of the inks that are called black are either brown, red, green, or blue in shade. Such tones have but little effect on the eye, as it is chiefly sensitive to the yellow and red rays, but the chief sensitiveness of photographic plates, on the other hand, lies in the blue, violet, and ultra-violet. As, with ordinary sensitive plates, yellow and green subjects are rendered dark, and blue ones light, the same will follow in photographing inks of various tones. This difference can be considerably intensified by the use of suitably colored light and color-sensitive plates. In this manner marked differences in the various inks can be clearly and distinctly demonstrated.

Among the subjects with which the author deals is the application of photography to the detection of the falsification of handwriting. In such cases photography can be of great service, as in an enlarged photographic picture erasures and alterations can be more clearly seen than in the original.

The Telephone in New York.

The New York Electrical Society has been engaged in practical missionary work in connection with the present agitation in the metropolis over the question of telephone service. It is generally believed that the opposition to the telephone companies is due largely to a misconception on the part of the general public and that the daily papers are in a great measure responsible for this condition of affairs. It was thought that an actual inspection of a representative telephone exchange would do more in the way of removing popular errors than any amount of argument or mere statement of facts. Accordingly the society arranged with the Metropolitan Telegraph Telephone Company for a meeting at the Cortlandt Street exchange to which the members might invite their friends. The opportunity was accepted by many persons interested in the agitation which has been stirring New York for several months, and on the evening of April 21 a large party gathered at the headquarters in Cortlandt Street.

The visitors were received by J. J. Carty, electrician of the Metropolitan Company. Mr. Carty first described the outfit employed at the subscriber's station. He alluded to the fact that the public had been told that a telephone cost $1.45 to make and that the rest of the apparatus was proportionally cheap. The subscriber would thus be led to figure out how many times he paid over and over again for the instrument during the year. The public gave no thought to the army of engineers and electricians employed in the building and repairing of lines, the laying down and testing of cables, and the equipment of exchanges, to say nothing of the staff of inspectors and the wire men who set up instruments and trace out the maze of wires running through the exchange from the ends of the cables to the switch board. The subscriber was too busy to gauge exactly the value of such facts as that, in addition to other appliances, the telephone service necessitated the use of 10,000 small dynamos in various parts of the city, that 30,000 cells of battery were employed, that these 30,000 cells have to be renewed every eleven weeks, and that in New York alone the company had over 30,000 miles of wire underground. It has been the fashion, Mr. Carty said, to imply that other nations were better off in the matter of telephone service than America, while as a matter of fact no other nation is so well supplied. Representatives of corporations from the principal countries in Europe, and even from Japan, had visited New York to study the working of the telephone system. Both in technical equipment and general organization the Metropolitan Telegraph and Telephone Company was recognized as a model, not only by other companies in this country, but by all the continental governments of Europe. It was very suggestive of the state of the telephone service in England, as compared with our own, that in that country the parsons are taking an active part in the agitation for better service, on the ground that it will materially reduce the national profanity. There are in New York City alone more underground telephone wires than there are in the whole of Europe. No expense has been spared by the company to bring the service to the highest state of efficiency. Within the last five years every single wire, cable and switch board in use by the company has been removed in order to permit the use of metallic circuits. It was found that with wires put underground on the old system there was constant and confusing induction, and it was impossible to utilize the instruments of increased efficiency which progress in telephony had developed without intensifying the trouble. The result of using the new instruments with the old wires would be that everybody could hear what everybody else was saying. To overcome this difficulty metallic circuits were adopted, and as two wires then became necessary instead of one, the heavy cost of wire throughout the system was doubled. All the metallic circuit subscribers, the only ones now taken by the company, are equipped with the highest type of long distance apparatus, which will enable the subscriber to talk not only to any part of New York City, but to any part of the eastern section of the United States, *i. e.*, to Buffalo, Pittsburg, Washington or Boston, and to the most distant points that are now reached or ever will be reached. With one of these instruments Mr. Carty made connection with Boston, and 40 additional instruments were connected, so that the members of the society could listen in relays of 40 to the conversation. And thus for a while the Gothamites held pleasant communion over the wire with the telephonic representative of the City of Culture; whistling, whispering and vigorous denunciation were all distinctly audible. Connection was also made to Boston over an instrument which was supplied with current from a thermopile. By means of this appliance, the use of which for this purpose is in the initial stage, an efficient current of electricity can be generated by the heat from a gas flame. The visitors were next conducted to the operating room on the eighth floor of the exchange, and Mr. Carty described the operation of the enormous switch board, which alone entailed a cost of $350,000. In his remarks Mr. Carty showed that, aside from its technical interest, the switch board furnished an interesting paradox in the laws of trade, in that it illustrates how the telephone business, unlike other branches of industry, is vastly more expensive under wholesale than retail conditions.

A switch board sufficient to install 100 subscribers would cost, at the very outside, $500, but where 100 subscribers are added to an existing 5,000 the additional expenditure necessitated would be over $5,000. The cause of this is that in the first instance facilities are required for the intercommunication of only 100 stations, but in the second the connection of fifty-one hundred stations is necessary. And thus the expense of new installations "rolls up," as Mr. Carty expresses it, "like a snowball running down hill." After following the course of the 12,000 wires throughout the switch board, the visitors passed into the long distance room and investigated its many remarkable features. A descent was then made to the basement, where bewildering ranges of lightning arresters, cable terminals, and distributing racks gave further evidence of the tremendous upheaval that the change from grounded to metallic circuits involved. By the time the tour of the building was completed, the visitors, although astounded at the magnitude and complexity of the plant, were able to form a very intelligent idea of the operation of the exchange. The company provides one operator for every nine subscribers, so that each subscriber may know that one man in the telephone company does an hour's work for him in some way or another every day. This proportion of operators to subscribers is larger than in any other city in the world. This is due to the fact that New Yorkers are notoriously impatient of delay, and the company seeks to give them the highest class of service. Considerable surprise was expressed when not long ago a quantity of American cutlery was sent to Sheffield, the cutlery fastness of England, but a still more remarkable industrial innovation has lately been recorded in the shipment of American telephone cables to London, the home of the cable manufacture. This is a gratifying recognition of the fact that in telephone cables, as well as in all other telephonic appliances, this country leads the world. An inspection of the costly and perfectly appointed Cortlandt Street exchange, in which the utmost resources of engineering and ingenuity are drawn upon to furnish service that is unequaled, should convert the veriest carper to the belief that he is getting excellent value for his money, even though he may not be able to go so far as did an eminent lawyer, who publicly stated, a month ago, in England, that if he paid $60,000 a year for his telephone, it would be cheap at the price.

The New Star in Auriga.

BY PROF. C. A. YOUNG.

During the months of February and March astronomers have been in something like a state of excitement over a new or "temporary" star which has been visible in the constellation of Auriga, about two degrees north of *Beta* Tauri. As compared with some of the recorded "temporaries," it did not really amount to a great deal, since it never much exceeded the fifth magnitude in brightness, while the stars of 1866 and 1876 both surpassed the second magnitude, and the famous star of 1572 more than equaled Venus at her brightest. The new star, however, though not at all obtrusive, was easily visible to the naked eye, and the circumstances of its discovery show that it is quite possible for such objects to appear and disappear entirely unnoticed.

It made its first appearance some time in November or early in December, but was first discovered about January 30 (after it had actually begun to decline in brightness), by a Mr. Anderson, of Edinburgh, who, on February 2, sent a postal card announcement to Dr. Copeland, the astronomer royal for Scotland. Our statement as to its first appearance rests upon the fact that, while it is not visible upon any of the numerous photographs of the region made previous to November 2, 1891, it is conspicuous on a negative taken at the observatory of Harvard College on December 10. During the remainder of that month and in January a considerable number of negatives were taken, and from their comparison it appears that the maximum brightness of the star (4½ magnitude) was attained and passed about December 20—at least a month before it was noticed by any one.

On February 5 the star was a little above the fifth magnitude, and, excepting some peculiar fluctuations, it remained without much change until the 15th; then it began to fade pretty rapidly, so that by the end of the month it was barely visible to the naked eye, and by March 20 had run down to the eighth magnitude. At the time of writing (April 2) it is hardly of the tenth, and probably will soon disappear entirely, like the last of the "temporaries," which appeared in August, 1886, in the middle of the great nebula of Andromeda, and had utterly vanished before the end of the year.

The Andromeda star presented very little of interest in its spectrum; with the new star the case was different. Its spectrum was crowded with lines and bands, both bright and dark, which undoubtedly contained the record of a wonderful story if we could only decipher it completely. The most conspicuous feature was the brightness of the lines of hydrogen; the whole series appeared to be present, including the remarkable group in the ultra violet which are invisible to the eye and come out only upon the photographic* plate. Many other bright lines were also visible, especially the two D lines of sodium, a series of four very conspicuous ones in the green, and some twenty or more fainter ones in the region between F and H. As to the lines in the green, a very interesting question has arisen whether the two brightest of them are or are not coincident with the two brightest lines in the spectrum of the gaseous nebulæ. Lockyer asserts the identity, while Huggins denies it. The observations of Vogel, with which my own agree very closely, support the view of Dr. Huggins, and the comparison with the spectrum of the nebula of Orion, which was favorably situated for observation at the time, was so easy and direct that there is hardly a possibility of mistake. Speaking generally, the bright lines in the star spectrum seem to have been for the most part identical with those which are most frequently conspicuous in the solar chromosphere; and yet the line known as D_3, which, next to the hydrogen lines, is by far the brightest of all the lines in the spectrum of the chromosphere, appears to have been wholly absent from the spectrum of the star—a very puzzling circumstance.

But the most curious thing about the spectrum of the new star was that every one of the bright hydrogen lines (not the other lines) was accompanied by a heavy, dark line on its "upper"—*i. e.*, its more refrangible—edge. The natural explanation is to suppose that *two* bodies, at least, are concerned in the phenomenon—one of them showing the dark lines of hydrogen alone, like any ordinary star of the so-called "first type," while the other shows them bright, and accompanied by a multitude of other lines. The dark-lined star is rushing toward us and the other receding from us, each with a speed exceeding a hundred and fifty miles a second. The spectrum of the well known variable star *Beta* Lyræ presents a similar phenomenon at certain times.

It is obvious that this doubling of the hydrogen lines agrees very well with the hypothesis which Mr. Lockyer has proposed as an explanation of the phenomena of temporary stars, viz., that two meteoric swarms encounter each other, and light up for a short time, either in consequence, as he maintains, of actual collisions between the meteors or else, more likely, by means of electric discharges and other interactions between the particles as they pass near each other without actually striking. A different hypothesis, originally proposed by Dr. Huggins, regards the phenomenon as substantially the same which the sun presents in its eruptive prominences, but on an immensely vaster scale. This also agrees equally well with the general aspect of the spectrum, and especially with the apparently composite character of some of the bright lines in the star spectrum, which, as has been said, correspond very closely to certain groups of lines in the chromosphere; but the absence of the "helium" line (D_3) is unfavorable to it, nor does it so readily explain the doubling of the hydrogen lines.—*Popular Science News.*

* By a misunderstanding it was stated in the last number of the *News* that the writer had obtained photographs of the spectrum of the star. The non-completion of the prism train of our new spectroscope prevented this; but Lockyer and Huggins in England, Vogel in Germany, and the astronomers at the Lick Observatory were all very successful in this line.

Maple Sugar.

According to the returns of the census of 1890, there were in the United States in 1889, 62,074 producers of maple sugar, and the quantity of sugar produced was 32,952,927 pounds, and the quantity of maple sirup was 2,258,376 gallons. The sugar was produced in the following States, in quantity as shown herewith:

	Pounds.
Arkansas	335
Connecticut	8,617
Illinois	13,260
Indiana	67,329
Iowa	45,120
Kentucky	11,259
Maine	84,537
Maryland	156,284
Massachusetts	558,674
Michigan	1,641,402
Minnesota	34,917
Missouri	20,182
Nebraska	12
New Hampshire	2,124,515
New Jersey	210
New York	10,485,623
North Carolina	7,713
Ohio	1,575,562
Pennsylvania	1,651,163
Tennessee	9,167
Vermont	14,123,921
Virginia	26,991
West Virginia	177,724
Wisconsin	128,410
Total	32,952,927

Correspondence.

To the Editor of the Scientific American:

I send you the inclosed photo. to show what an amateur can do when he tries, the dynamo having been made by me from your description from the patterns up. You will observe some changes from the standard model, dictated by expediency. They do not impair the efficiency. It has been tested and lights ten 16 candle power lamps to full power at the standard speed. C. D. PARKHURST, Lieut. 4th Artillery.

Fort Monroe, Va., April 25, 1892.

[The photo. sent by Lieut. Parkhurst shows a dynamo which could not be distinguished from the Edison machine were it not for the few alterations referred to. The machine both in appearance and performance does credit to its builder.—ED.]

Electrical vs. Cable Cars.

To the Editor of the Scientific American:

In the article on the "Transformation of a Cable Road," in your issue of April 23, the statement is made that it is the only one in the world that has been completely torn up from end to end and entirely replaced with new equipment. Allow me to say that exactly the same was done in this city last year. There was the same trouble from cables wearing out here on account of so many sharp corners, and nearly all of the expensive machinery and equipment was broken up and sold for old iron. The engines are being used, however, to drive the dynamos that furnish the current for the new system.

The grip slots and rails are retained on the hill lines, and an auxiliary brake has been fitted on the cars to catch on these rails in case of an emergency.

The increased amount of patronage, together with the better facilities for doing business, will doubtless repay the company for the great expense in making the change. D. EGERY.

Grand Rapids, April 26, 1892.

Controlled Torpedoes.

Some very pertinent remarks on the torpedo question have lately been given by the *Engineer*, from which we make abstract as follows:

Recent experiments with the Sims-Edison torpedo have so far demonstrated that a heavy charge of explosive can be set in motion and controlled throughout its course from a given point, whether on land or afloat. These attributes have never been contested, and are equally capable of proof with any other torpedo of this class. Though the Brennan torpedo is worked from certain fixed points on shore, the apparatus can be placed in a tug or gunboat with equal facility, and many consider its value diminished by the limitation of mobility now imposed. Several of the early experiments with it were carried out from a floating base, and the original proposal was to employ it in this manner. As such an installation would have placed the weapon in naval hands, and the Admiralty had no faith in a weapon of this nature, the Brennan was taken up by the Royal Engineers as a part of their fixed defenses in certain localities where it is now being installed with great elaboration. We are not concerned, therefore, to make any comparison between the different types of controlled torpedoes, but rather to consider whether this method of submarine attack has the advantages claimed for it over other forms now in use. Now, the dirigible torpedo is dependent upon one or more wires connecting it with the ship or shore from which it is directed. The wire may be of steel, and of fine dimensions, working a mechanical apparatus, as in the Brennan, or it may be an electrical conductor as in the Sims-Edison. In either case the source of power is outside the torpedo, and transmitted to it by means of the wire. But the fact of thus trailing a wire behind is sufficient to cause its rejection by the navy as a ship weapon for general use.

In action, the ship must be free to move in any direction, and a captain would be terribly hampered if he had to regulate his movements by an external object of this nature. His anxiety would be constant lest a turn of the helm should bring his propeller in contact with the wire. Such an occurrence would not only at once render the torpedo useless, but might also endanger the ship using it. Hence, a controlled torpedo is inadmissible as regards battleships and cruisers. But it is urged these objections would disappear if the torpedo were placed in special vessels whose movements would be entirely subordinated to the manipulation of the torpedo. They would not have to approach within close range, and would thus escape the deadly fire of machine guns. If the operation could be carried out at a distance, say, of two miles, such a contention might hold good. But though it is often stated a torpedo can be controlled and directed beyond the limits of machine gun fire, practical experience has not hitherto demonstrated the fact. Its effective action may be considered at the outside as 1,500 yards. The difficulty is to know how near the torpedo is to the object. It may appear to be close, while in fact there is considerable intervening space—and a slight miscalculation would render the attack abortive.

As the torpedo runs below the surface the projection above to show its position—which may be a disk or a flag on a pole—is not a conspicuous object to those guiding the torpedo, and is only visible in clear weather. As the small quick-firing guns, now so numerous afloat, make good shooting up to 2,000 yards, the craft using the controlled torpedo at sea would probably be disabled before her weapon could come into play. Her chance would be better if able to carry out the operation at high speed, but that has not been demonstrated, and we do not believe it feasible. We have only alluded to the difficulty by day, but at night the difficulty of directing the torpedo successfully would be much increased. There does not appear, therefore, any field for a controlled torpedo at sea. It remains only to consider its value for harbor defense, and for this purpose we may compare the controlled torpedo with the other forms of submarine attack. What we have specially to guard against and provide for is the case of a hostile vessel rushing past certain points with a view to attain a position from whence damage could be effected afloat or on shore. Such raids were common enough in the old days, and we have no reason to suppose they will not be repeated. They will probably take place more often at night than by day.

Now, under certain local conditions, no better preventive can be found than in submarine mines. When once placed they act equally by night or day, in thick or clear weather. No hostile vessel would venture to pass through water where it was believed mines existed; but, on the other hand, their efficient use depends on the absence of current, and on a moderate depth of water. Moreover, if the area of approach is extensive, an enormous number of mines is required to render it secure. There is also a strong objection to the indiscriminate use of mines, as liable to impede the movements of our own vessels seeking the harbor as a refuge, or in their ordinary trade avocations. For such reasons stationary mines can only be recommended to a limited extent. Over them the controlled torpedo has this advantage, that it is practically independent of depth of water and strength of current, though at night its use would be difficult and uncertain, while in thick weather it would be of little value. Now, the torpedo boat is free from these objections. It is a submarine mine with the power of locomotion; it may be considered a controlled torpedo with vastly increased range. It does not wait till the predatory craft is at your gates, but goes to meet him and prevent his approach. Night and mist favor in this case the defense, and the ubiquity of the torpedo thus carried enables it to guard an extensive area, and more than one approach.

Not only does it insure the safety of the vessels within the port, but it protects those without seeking shelter. A raider who remained outside and said to the latter, "Stand and deliver!" would soon find it necessary to shift his quarters. The squadron hovering beyond the effective radius of mines and controlled torpedo, with the object of shelling at long range, would find the attack of these wasps sadly interfere with such an operation. It is sometimes claimed for the controlled torpedo that it carries a larger charge of explosive than the Whitehead, but the latest type of the latter weapon is charged with 200 pounds of gun cotton, sufficient to disable any vessel, and a slight increase in the dimensions of the torpedo would enable this amount to be doubled. We have seen within a few months an ironclad sunk in less than five minutes by the explosion of 60 pounds of gun cotton, and the usual charge for electro-contact mines does not exceed 100 pounds. Hence there is no necessity to employ excessive charges.

In thus comparing the controlled torpedo with the Whitehead, we have not alluded to the liability in the former of a break in the connecting wire. When this happens to be an electrical conductor, circumstances compel it to be of a fragile nature, so that its rupture would follow any check to the course of the torpedo, whether the wire fouled any object on the surface, or if it did not unwind with perfect freedom. In this respect the Brennan has an advantage, because it is controlled by steel wires of considerable strength. These are details, however, which do not affect the main principle of all such weapons. Their want of mobility, limitation of range, and difficulty in effective use, render them in all cases inferior to the locomotive torpedo carried in fast boats and manipulated with the skill and enterprise examples of which have been frequently given in our naval maneuvers.

It may be rightly estimated that the Brennan torpedo has cost the country a quarter of a million sterling, of which nearly half has gone into the pocket of the inventor; and we believe that only one locality has been provided with an installation of the weapon. For this sum we could have had twenty first-class torpedo boats, which, divided between three ports, would have been a more efficient protection. But the procedure in this matter only shows how costly to the country is the system which delegates to two departments the responsibility for the defense of our shores, and allows each to work independently as if the other had no existence. It is time that this important question was placed on a more satisfactory footing, or we may see repeated the blunder of acquiring some new weapon of such limited value as the controlled torpedo.

When the Sun Gives Out.

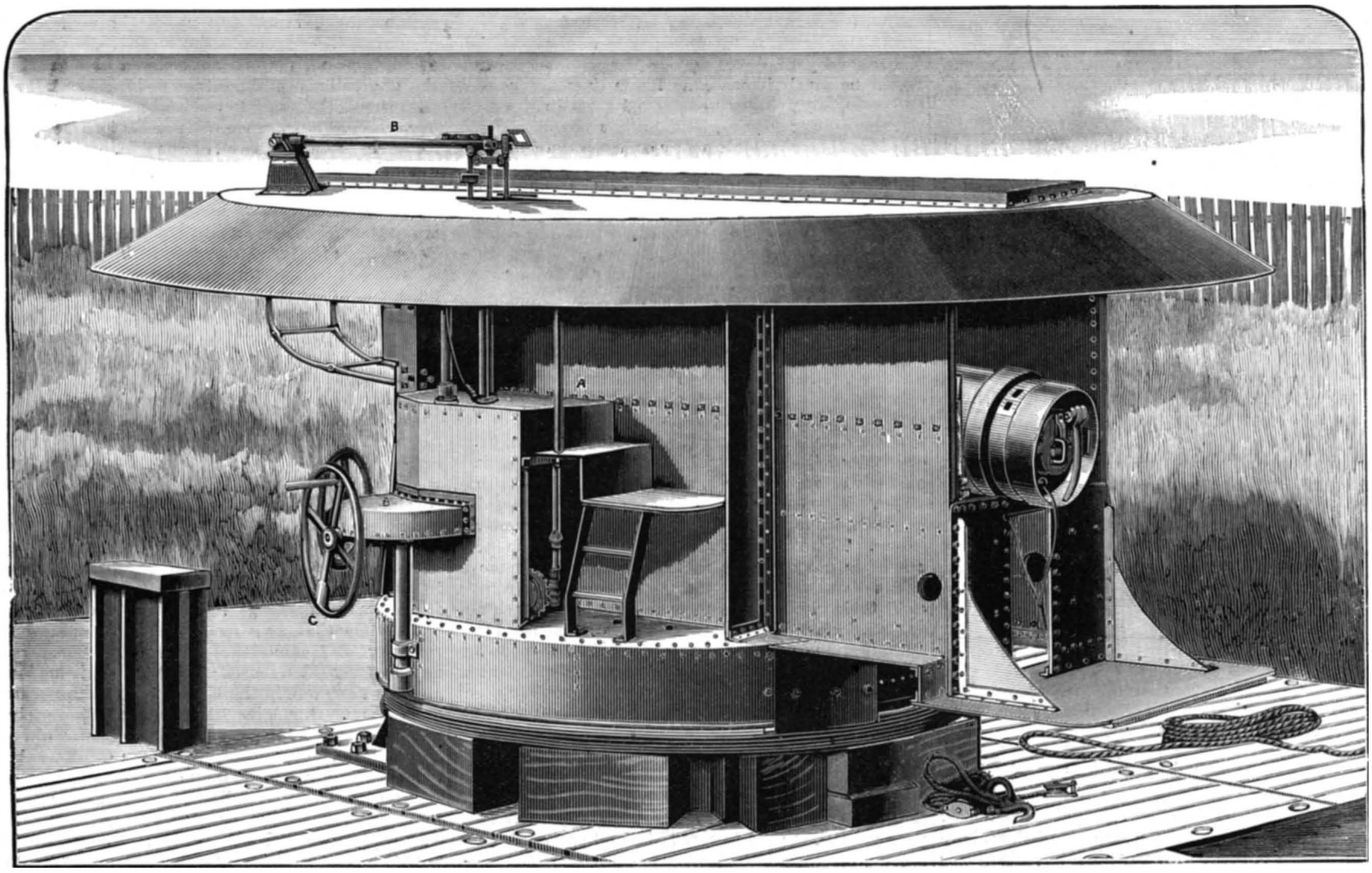
Sir Robert Ball, who is one of the foremost astronomers in Great Britain, speaking from scientific knowledge, places the day when the world will come to an end, as we know it, about four or five million years distant, but he gives us every reason to believe that this will be the final winding up of the existence of the human race. It is comforting to have the date of this event so far off. It does not concern us personally, or the generations of the future, so far as we have to do with them. It is simply the statement of a scientific fact which is based upon our present knowledge of the resources of the earth and of the sun. Sir Robert Ball in his *Fortnightly* article on this subject uses the determinations of our own Prof. Langley as the basis of his calculations. The amount of heat which he estimates that the sun originally contained would supply its radiation for 18,000,000 years at the present rate. It is believed that the sun has already dissipated about four-fifths of the energy with which it may have originally been endowed, and this brings us to the conclusion that at the present radiating energy it will last, perhaps, 5,000,000 years longer. This is all that we really know about this matter.

The dependence of human life on the sun is absolute. Even when the sun is withdrawn during the winter season to only a slight degree from the extremities of the earth, it is difficult to sustain life on this planet. What must it be for the whole planet if there should be any considerable diminution of its radiating energy? This statement shows that, while the exhaustion of heat is not an immediate danger, it is a state of things that at some time must be realized, and that nothing can stand in the way of this culmination. In a lesser degree there are many things in life, as we know it to-day, which show that, as a race, we are living beyond our resources, and exhausting the supplies which nature ages ago provided for us. The coal supply in England and Germany and in the United States has its assignable limits. Our later life is almost absolutely dependent for its large development upon the discovery of unlimited supplies of coal, or, in other words, the ability to supply heat in quantities sufficient for all the needs of advanced civilization, but already the coal beds give signs of exhaustion. It is true that new mines are discovered and can be opened, but the opening of new deposits simply transfers the day when the energy that is found in coal must be supplied from some other source. In the distant geological ages the sun itself was the principal agent in supplying the forces that incarnated heat in this form. It is not now possible to supply any new kinds of fuel. What we have exhausted is lost for all time to come, and it is the loss in these material ways that limits the ability of the earth to sustain life.

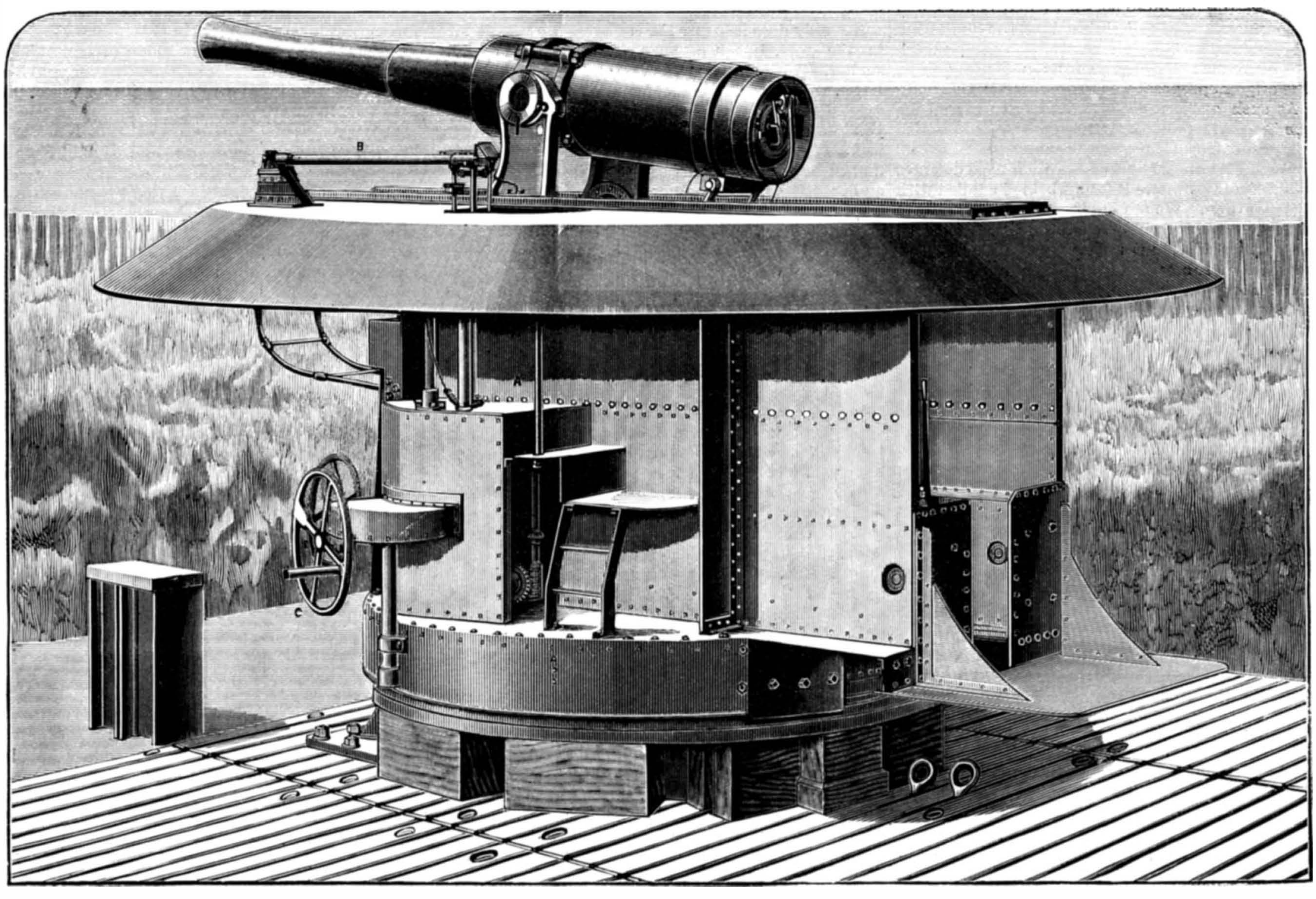
It is thus seen that the duration of human life on this planet has certain definite and fixed limits. There is no danger that the world will come to an end in our day, but science is right in fixing a limit to the sun's capacity to heat this planet to a degree necessary to support life, and there is a fixed limit for the supply of the amount of heat necessary for carrying on the operations for expanding life. It has been a subject of vague speculation heretofore as to when and how the earth would come to an end and the human race pass off the stage as a finality. Science has now in a general way told us as much as we can ever know probably on this subject. Human life within the limits of history goes back only about 3,000 years. Whatever else can be traced in the life of man is a matter of tradition and is obscure. The human race is much older than 3,000 or 4,000 years; but there is every indication that there was a long period in the world's history when human life, as we understand it, did not exist, when the earth was, so to speak, "without form and void," and neither the animal nor the spiritual life was anything more than a germ yet to be realized. In the light of what Sir Robert Ball states, that early condition of things is again to be realized, and this planet will by and by become a vast mass of dead matter in the universe. We have the consolation, before that day comes, that we shall be where it will be no concern of ours whether the planet is one thing or another; but it is one of the wonderful things about our scientific developments to-day that we can put out our measuring lines and make estimates upon problems over which we have no physical or material control. It is only the mind that rises to the greatness of these issues and measures them with its own rules and feels their gravity by its own elasticity and comprehensiveness. It is a singular evidence of the value of the sciences which seem to be most remote from a practical bearing that one of them should throw light upon the question of the length of time that the sun will survive, and this earth itself will be able to sustain life.

NEW DISAPPEARING ELSWICK GUN MOUNTING.

The advantages of having a gun mounted on a disappearing carriage are now too well known to need recapitulation. It will suffice to say that hitherto it has only been successfully carried out by employing compressed air and a liquid, on what is known as the hydro-pneumatic system, with which there has always been certain accompanying disadvantages, the principal of which are the necessity of using air pumps, lowering pumps, pressure gauges, recoil valves, by-pass valves, cup leathers, and packings, all of which give trouble in inexperienced hands, and so discount to a great extent the value of the disappearing mounting. Moreover, the cylinder cannot be emptied of liquid to guard against frost or for examination without all the air pressure being blown off, and, unless air reservoirs are employed, several hours are required to pump up the air supply again. It is particularly necessary that there should be no leakage, as otherwise, owing to the carriage having to stand a long time with pressure up, a very small escape either of air or water would reduce or entirely let off the pressure. Recognizing these facts, Elswick has recently designed a new disappearing carriage, which has, among others, the following advantages: (1) No pumps of any sort are required; (2) there are no pipes about it at all; (3) no cup leathers or other packings are used; (4) there are no valves whatever; (5) no pressure gauges are wanted, as no air pressure is used, its place being taken by steel springs; (6) the recoil press is practically a plain cylinder, standing almost vertically in the center of the carriage, and constructed so that there are no joints or packings needed; (7) the liquid used in the recoil press is buffer oil, and the recoil press and ram are of bronze, so that no question of rusting can arise. Oil cannot be used in the high pressure cylinder, as it is found to



LOADING POSITION.



FIRING POSITION.

NEW ELSWICK DISAPPEARING CARRIAGE FOR SIX INCH B. L. GUN.

froth too much; (8) the gun is shown in the loading and firing position in Figs. 1 and 2 respectively, can be lowered by turning a crank handle in connection with gearing which is arranged so as to slack off some of the springs, or without slacking off the springs, by a small block and tackle attached to the breech end of the gun.

The makers have also embodied the following improvements in this mounting: (*a*) Automatic sighting gear, the same as has been so successfully applied to turret guns for the navy; (*b*) a sighting platform—A in Figs. 1 and 2—placed at the side of the gun clear of its recoil, and fitted up with training, elevating, and firing gear, so that the eye may be kept on the target up to the moment of firing; (*c*) a pair of reflecting mirrors, moving with the leaf of the tangent sight B, by means of which the sights can be seen from below the shield. It should be noted that no inaccuracies can arise from the use of the mirrors, as the actual sights are reflected in them, and they are arranged so that the image is not inverted. Night sights and a telescopic sight can be used if required; (*d*) various alterations and improvements about the shield.

These advantages are obtained by designing and constructing the carriage in the following manner: The weight of the gun is counterbalanced in any position of its path by steel springs, designed so that at every point there is always a proper proportionate amount of spring power to support the gun, with a trifle in excess, to cause it to rise to the firing position if allowed to do so. This counterbalancing of the gun is in no way connected with the recoil press, but is an action carried on independently of it. The strength of the springs can be regulated by compressing them or allowing them to extend, by a screw and nut arrangement worked by a hand wheel. When the springs are sufficiently slacked off, their tension is insufficient to support the weight of the gun, and it lowers to the loading position. This gear therefore takes the place of the lowering pump of the hydro-pneumatic disappearing carriage, but has the advantage of taking less time and labor. There is no danger that too much of the supporting power will be removed, because the springs can only be slacked a definite amount sufficient to lower the gun carefully, but not to let it fall at a dangerous speed. The recoil press would also check any undue speed. The springs are placed in compression, not tension, so that the breaking of a spring would be a matter of no great moment. It is not, however, at all likely that a spring will break, as experience has shown that the same pattern of spring in the six inch quick-fire mounting stood hundreds of rounds, and in that case the spring is compressed at the same speed as the gun recoils, whereas in the disappearing mounting the spring is only compressed at a third the rate of recoil. Provision is, however, made for inserting a new spring if necessary.

The recoil press is made as a plain cylinder, mounted on trunnions, and fitted with a piston rod and piston. On recoil, all the liquid below the piston passes to the upper side of it through a port, which varies in size to suit the varying velocity of the recoil in such a manner as to produce an equal pressure throughout the stroke and at the same time to give always a full recoil. It is important to have a full recoil with disappearing guns, even with a three-quarter or a half charge, so as to bring the gun to the proper height for loading. The recoil press is cast with a tank on the top of it, to receive the liquid displaced by the ram or piston rod on the recoil of the gun, and this tank is made large enough to give a certain storage of liquid, so as to insure the cylinder always being full. A most important point is that leakage of oil is guarded against by not fitting plugs or cocks in the cylinder, the necessary filling and air plugs being inserted in the tank. When necessary the oil can be drawn from the cylinder by a siphon or syringe, so that there is no need for a draining cock or plug. To prepare the recoil press for service: With the gun down fill up the press by the filling plug on the tank until no more oil can be got in.

To increase the efficiency and rate of fire it is proposed to use a quick-firing gun, and for this purpose a rear platform is provided, and two sets of ammunition boxes to carry the metal cartridge cases. The numbers loading will be carried round as the mounting is trained, and will, therefore, be able to load the gun as rapidly if mounted on a naval carriage, an extra five seconds only being required for the gun to rise.

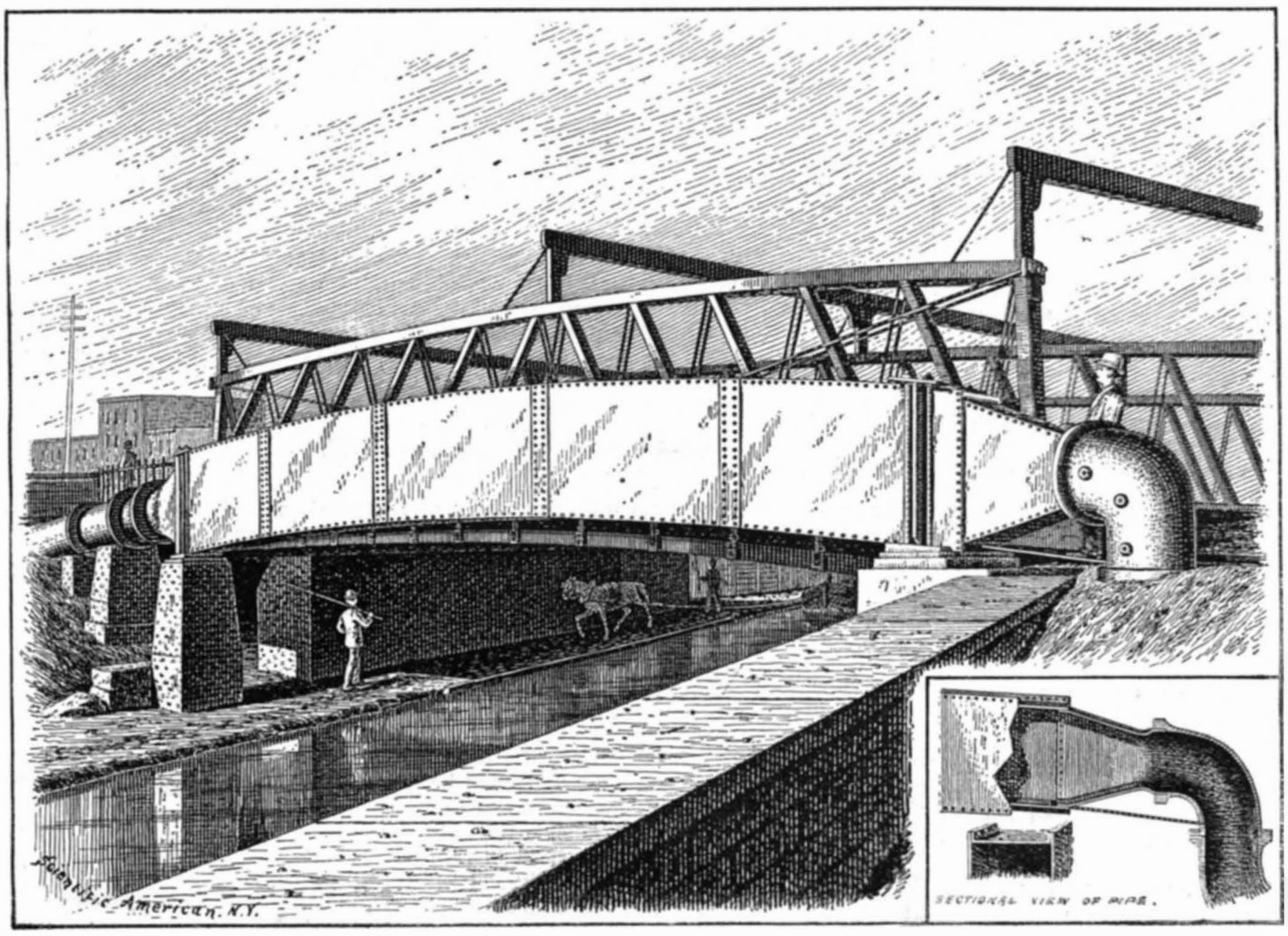
Both the training and elevating gear are arranged so as to be worked either from the emplacement floor or from the sighting platform. At the sighting platform two training wheels are provided, one within reach if the ordinary or the telescopic sight is being used, and the other when the mirrors are in use. Only one elevating wheel is necessary, as it is well within reach at all times. C shows the winch and training gear worked from the emplacement floor. The mounting can be trained on the object, and the elevation adjusted while the gun is in the loading position, so that on the gun rising to the firing position, it may be fired immediately, as no further adjustment is necessary. With the automatic sights the greatest accuracy and ease of movement is secured for laying on the object before the order to raise the gun is given, so that the gun need be above the shield only some two or three seconds at the most. This mounting will go on the same racer and live rollers as the present six inch hydro-pneumatic disappearing carriage, and the same training rack may be used.

The electrical firing gear is arranged so that the circuit can only be completed after the gun is properly in the firing position, and with the quick-firing gun the further precaution of having the gun closed and locked. The shield is rigidly supported on platework, so that the gun and sights may always retain the same relation to one another. A combing is raised round the edge of the port or opening in the overhead shield, through which the gun rises, and when out of action this opening is covered in by a tarpaulin stretched tightly over the combing. This will be found handier than using a tarpaulin large enough to cover the whole of the shield.

The official trial of the mounting was carried out at the Silloth range on October 23, 1891. The following officers were present on behalf of the War Office: Colonel Colquhoun, R.A., Colonel Walker, R.A., and Major Penton, R.A. Three rounds were first fired with a three-quarter charge, at a target 9 ft. square at 1,000 yards range, using the automatic sighting gear, with very satisfactory results, each shot striking the target. Three rounds were then fired with the full charge, at angles of elevation of 5 deg., 10 deg., and 15 deg., respectively, for testing the strength of the structure. Finally two rounds were fired with a half charge, in order to show that the recoil of the gun was practically the same as with the full charge. The first of these was fired at 5 deg. elevation and the second at 4 deg. 20 min. depression. The time taken by the gun, not loaded, to rise to the firing position was found to be four seconds. When fully loaded with 55 lb. of powder and 100 lb. projectile, it was five seconds. The trials were most successful, and we understand that the officers attending were impressed with the simplicity of the new mounting and the facility with which it could be handled.—*The Engineer.*

A GIRDER GAS PIPE.

This self-supporting gas pipe was erected across the Morris Canal by the United Gas Improvement Company, of Jersey City. The canal is the old dividing line between old Jersey City and Lafayette. To span the canal at the least possible cost the company erected a pipe made of plates of sheet iron. It is made of ¼ inch iron and is 42½ feet in length from pier to pier. It is 3½ feet in height and 1 foot in width. It is put together in five sections, each section being 8½ feet in length. The top and bottom sections of the pipe are flanged and are closely riveted to the side pieces. The side pieces are made secure by means of ¼ inch iron plates, 11 inches in width, riveted over the joints. The pipe is curved and rises in the center about 12 inches. The ends of the pipe rest in grooved castings on the tops of the piers and are made secure by means of bolts 1 inch in diameter, which pass through the castings and up along the sides and through the iron plates on the top of pipe, where they are held in place by heavy iron nuts. Small iron braces placed about 8 feet apart and fastened to the bridge keep the pipe from swinging back and forth in case of storm or high winds. The street pipe which projects above the ground surface is about 2 feet diameter, and is made in two sections riveted together. The connection between the two pipes is V shaped, and made of the same material as the main pipe, the small end being hammered out to conform to the shape of street pipe. The pipe weighs about four tons and was erected at a cost of about $900.



A GIRDER GAS PIPE, JERSEY CITY, N. J.

The Sugar Trust.

By the purchase or rather admission into the trust of the refinery of Claus Spreckels, at Philadelphia, the Sugar Trust completed its operations for the control of the sugar refineries of the country. The following are the refineries owned absolutely by the trust, with their daily capacity in barrels:

The Havemeyer & Elder S. R. Co., Brooklyn	8,000
The Brooklyn S. R. Co., Brooklyn	3,000
The Decastro & Donner S. R. Co., Brooklyn	3,000
The Havemeyer S. R. Co., Brooklyn	3,500
The Havemeyer S. R. Co., Jersey City	500
The F. O. Matthiessen & Wiechers S. R. Co., Jersey City	4,500
The Standard S. R. Co., Boston	3,000
The Boston S. R. Co., Boston	1,500
The Continental S. R. Co., Boston	500
The Forest City S. R. Co., Portland	500
The St. Louis S. R. Co., St. Louis	1,000
The Louisiana S. R. Co., New Orleans	3,000
The Louisiana S. R. Co., New Orleans, and the Planters' S. R. Co., New Orleans	3,000
The Franklin S. R. Co., Philadelphia	6,000
The E. C. Knight S. R. Co., Philadelphia	1,300
The Spreckels S. R. Co., Philadelphia	3,500
The Delaware S. R. Co., Philadelphia	500
The Baltimore S. R. Co., Baltimore	1,500
Total daily capacity	44,800

—*N. Y. Com. Bulletin.*

Sending Insects by Mail.

Large-bodied insects should never be mailed or sent by express when pinned, without first fastening the bodies so that they cannot break, and thus damage the rest of the specimens in the box. A little cotton drawn out and turned around the pin so that it holds tightly near the thorax, and then brought around the end of the abdomen and again fastened to the pin, will be found sufficient, especially if a few pins are used around the body to prevent its otherwise moving.

THE ACOUSTIC PROPERTIES OF ALUMINUM.*

At the April meeting of the Physical Department of the Brooklyn Institute, Prof. Alfred M. Mayer, of the Stevens Institute of Technology, delivered a very interesting lecture on the acoustic properties of aluminum. From the beginning to the end of the lecture the interest was maintained by the instructive and entertaining manner of the lecturer, no less than by the subject matter of the lecture and the many interesting experiments by which it was illustrated.

The lecturer began by describing the methods of various physicists of obtaining the modulus of elasticity of metals, and told how he, knowing the modulus of elasticity of any metal, could calculate the rate of vibration of a given body of that metal. He then performed several experiments illustrating the elasticity of aluminum, the first being that of vibrating longitudinally a rod of aluminum. The rod was grasped at the middle by one hand while it was rubbed lengthwise by a glove charged with resin and worn upon the other hand. The rod emitted a sound of very high pitch. The exact rate of longitudinal vibration of the

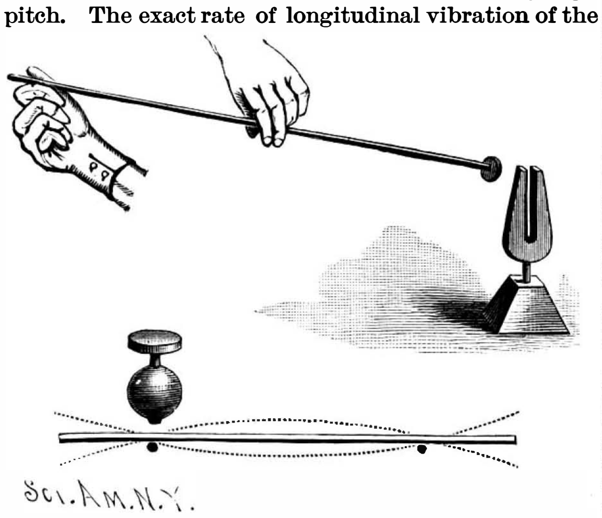


Fig. 1.

rod was ascertained by comparing the sound with that of a tuning fork having a known rate of vibration; then the fork was made to vibrate sympathetically by causing the rod to vibrate in the vicinity of the fork, as shown in Fig. 1. The next experiment was one in which a column of confined air was vibrated in a tube by the longitudinally vibrating rod. Some light dust contained by the tube was heaped up at the nodes, or points of no vibration, and removed from the venters, or region of greatest vibration, thus showing how the air column is divided up into vibrating segments. He said the aluminum rod was divided into two vibrating segments with a node at the middle.

In the next experiment a number of aluminum bars were supported at the nodal point upon a frame elevated a short distance above the table, something after the manner of a metallophone. These bars were tuned to the 1st, 3d, 5th and 8th of the scale, representing the major chord. When these bars were struck with a mallet of suitable weight, beautifully clear notes were emitted, and the sound was prolonged beyond that produced by metallophone bars made of other metals.

To show accurately the location of the nodes, bars were sprinkled with very fine sand and vibrated. The sand was piled up in fine transverse lines at exactly two-ninths of the length of the bar from the ends; a resonator applied at different points along the bar (lower part of Fig. 1) readily located the nodal lines. To re-enforce the sounds and more strikingly exhibit

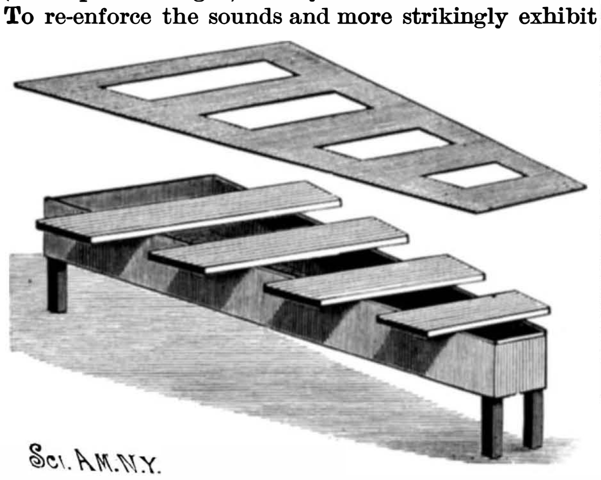


Fig. 2.

the quality of the tone emitted by the vibrating bars, a Helmholtz resonator was placed under each bar, when the sound was very loud and rich. The bar when struck bends downward at the center and upward at the ends, then by its own resiliency bows upward at the center and bends downward at the ends, thus producing opposite effects which partly neutralize each other. The lecturer said that the end portions of the bars outside of the nodes seriously diminished the total sound emitted by the bar. He therefore produced a piece of cardboard (Fig. 2) having apertures in it corresponding in width, length and position with the several segments of the bars, and placing this over the series of bars so as to cover the portions lying outside of the nodal lines, the effect was like that of a resonator, the sound having much more volume.

Another interesting experiment consisted in placing one of the bars on cords stretched across a frame and supporting it a quarter of a wave length from the table, as shown in Fig. 3, noting the intensity of the sound as the bar was struck, then lifting the frame and bar from the table through a distance equal to several wave lengths. At certain intervals the sound was quenched, showing interference at those points. The same thing occurred on lowering the bar to its original resting place.

Prof Mayer tried a large aluminum Chladni plate, producing several intricate sand figures showing the nodes and venters. The plate was explored with a resonator which re-enforced the sound at the venters, while at the nodes the effect was practically nothing.

The experiment with the longitudinally vibrating aluminum rod was designed to show one method of getting the velocity of sound in a solid. The number of longitudinal vibrations per second of the rod, multiplied by twice its length, gives a velocity of sound in it; similarly the length between two adjoining nodes in the tube experiment is a half wave length, and the length of the rod (which gives the half wave lengths) divided by the half wave length (as shown by the dust in the tube) shows how much faster is the propagation of sound in the rod than in the air column.

The lecturer performed numerous other experiments, showing the superior resonant qualities of aluminum, and stated that all he had shown was merely preliminary to a further study of the subject. He intends to make a further investigation in Paris, with Koenig, during the coming summer, and will be able, when the investigations are completed, to publish the results.

* Abstract of a lecture delivered by Prof. A. M. Mayer before the Physical Department of the Brooklyn Institute, April 22, 1892.

Tannin in Tea.

"Some examples which have been forwarded to us," says the *British Medical Journal*, "of the results of analyses for tannin and theine in tea indicate considerable variation in the amount of tannin, according to the quality of the tea and the state of growth at which it is picked. In some blends of China teas the percentage of tannin extracted by infusion for thirty minutes was 7·44; theine, 3·11; and a similar result was given in the examination of the finest Moning; while, on the other hand, with fine Assam tea a percentage of 17·73 of tannin by weight was extracted after infusion for fifteen minutes, and two blends of Assam and Ceylon tea gave, respectively, 8·91 and 10·26 of tannin. On the whole, it is probable that the Indian teas are much more heavily loaded with tannin than the China or Japan teas. Moreover, the common method of prolonged infusion in boiling water is well calculated to extract all the tannin, while it dissipates the flavor of the tea. To be drunk reasonably, tea should not be infused for more than a minute, and with water of which the temperature does not exceed 170° F. It should be taken without sugar or milk, which would drown the flavor of the delicate and aromatic infusion thus obtained. This at least is how tea is drunk both in China and Japan, whence we have borrowed the use of it. With our European method of prolonged infusion in boiling water we destroy all the best flavor of the tea, and we extract such heavy proportions of tannin as to cultivate indigestion as the result of tea drinking. Indigestion is unknown among tea drinkers in the East, and it is in all probability only the result of our defective use of the leaf."

Parcels Post Extension.

A postal treaty has been concluded between the United States and Great Britain, by which parcels may be sent by post to and from this country and the Windward Islands. These embrace the colonies of St. Lucia, St. Vincent, Barbados, Grenada, Tobago. No parcel can exceed eleven pounds weight, or five kilogrammes. Greatest length, 3 feet 6 inches. Greatest combined length and girth, 6 feet. Postage, 12 cents per pound.

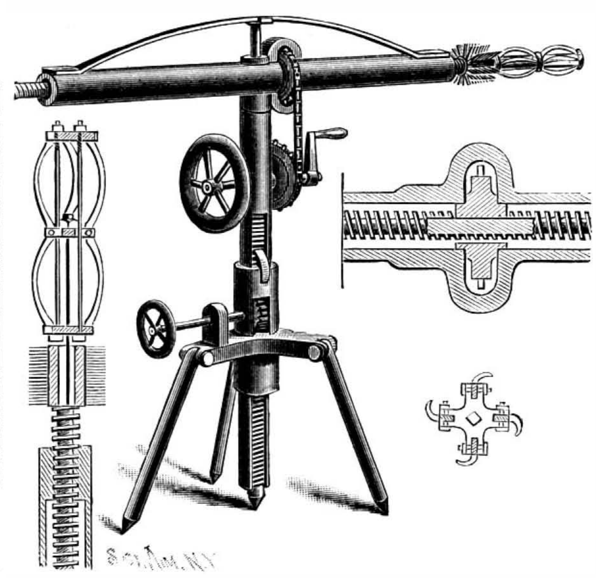
Photographing Bullets.

In a lecture on this subject, delivered recently at the South Kensington Museum, Professor C. V. Boys explained his apparatus for the purpose. It consists of box lined with black cloth, in which the photographic plate is exposed, of a condenser formed of a plate of glass about a foot square; of a smaller condenser in the form of a bottle, to act as a starter of the spark; and of a system of wire circuits and knobs to give the spark which throws the shadow of the bullet on the plate, and thus takes the photograph. The bullet enters and leaves the box by two holes, covered with paper to exclude the light, and in passing the plate the bullet touches the terminals of two wires, composed of thin lead wire, thus partly completing the circuit; a small flash passes from the smaller condenser, causing a larger flash to pass between the knobs of the plate condenser inside the box, and this flash, lasting less than one millionth of a second, takes the photograph of the bullet, no lens being employed. A wet string in the circuit of the small condenser is used to damp the electrical oscillations. Mr. Boys was able to infer from his experiments with a rifle that the bullet must have received some three per cent of its velocity after leaving the muzzle, at which point the turning effort of the rifling must have necessarily ceased.

Fig. 3.

AN IMPROVED FLUE CLEANER.

The boiler tube cleaner shown in the illustration, which has been patented by Mr. Michael J. Carbis, of Bingham, Utah Ter., is designed to be quickly set up and readily operated to clean the tubes of scale, sediment, or any obstructions, being especially adapted for cleaning the tubes of the Babcock & Wilcox and similar styles of boilers, the machine being for this purpose set on a platform having the same inclination as the tubes, or extension tripod legs may be arranged for the purpose. In a suitable tripod stand is a vertical sleeve, in which slides a post having in one side gear teeth in mesh with a pinion actuated by a hand wheel, as shown in the principal view, whereby the post is raised and lowered. On the upper end of the post a pivot engages a socket on the under side of a horizontal casing, in which screws the feed screw rod, having on its outer end a scraper and brush, as shown likewise in the sectional view. The feed screw rod has a keyway engaged by a key on a sprocket wheel on the casing, as shown in one of the views, the sprocket wheel being rotated by means of a crank on a shaft in bearings lower down on the post, whereby the feed screw rod is moved inward or outward. The scraping plates are



CARBIS' FLUE CLEANER.

preferably made of thin steel, spirally curved, the small figure showing an end view of the scraper.

The plates are sufficiently elastic to conform to the inner surface of the tube, and in a normal position are preferably somewhat in excess of the diameter of the tube. The brush is located directly in the rear of the scraper, is preferably circular in form, and has a diameter somewhat greater than that of the scraper, so that it will readily remove all the particles loosened by the latter. The feed screw rod is made in sections, readily connected together, whereby the scraper may be passed through tubes of any length. If desired, the cleaner may be geared to run as high as two and a half or three revolutions on the driven sprocket wheel to one revolution of the driving wheel, thus doing the work very rapidly. Where tubes are badly incrusted, the cleaner and brush may be taken off and a suitable cutting tool attached to the outer end of the slotted shank of the feed screw rod by means of a set screw or a key, and in this way the worst cases of choked-up tubes can be efficiently dealt with.

RECENTLY PATENTED INVENTIONS.

Engineering.

STEAM ENGINE.—John N. Kemmerer, Loganton, Pa. This invention provides a novel mechanism to apply power to the crank shaft, levers arranged side by side having a sliding connection with the crank, one of the levers being pivotally secured at one side of the shaft and the other at the opposite side, with operating devices to rock the levers, thus overcoming dead centers and increasing the power. Improved throttle devices are also provided for use in connection with several steam cylinders and steam channels leading to their opposite ends, so that steam may be admitted to the inner end of one cylinder and the outer end of the other and *vice versa*, there being likewise improvements in the valve gear for operating and controlling the valves of the different cylinders.

SPARK ARRESTER. — Langford C. Mabie, Richmond, Va. This is an improvement for locomotive and other high pressure engines designed to entirely eliminate from the products of combustion all sparks and cinders and carry them to a place of temporary deposit, also carrying off the thick black smoke. Within the stack is a novel construction and arrangement of two freely revolving wheels having radial blades set at an inclination to the plane of the wheel like a windmill wheel, the inclination of the blades of the two wheels being reversed to give them revolution in opposite directions, separating, by centrifugal action, the sparks and cinders from the blast at two different points.

CUT-OFF GOVERNOR.—Levi O. Harris, Cadillac, Mich. This is an automatic device for steam engines, designed to secure an economy of fuel and the more steady running of the engine. Within a cylindrical casing communicating with the steam chest is an annular chamber in which revolves a closely fitting sleeve having valves on its periphery, and in this sleeve oscillates another sleeve with ports corresponding to the ports of the casing, the first sleeve having an outer extension sleeve connected to a bevel gearing, while the inner one has a shaft connected with the governor levers. In operation the steam has to pass through registering openings, and the ports are thrown more out of register as the engine runs too fast, being in perfect register only as the engine is run at the speed designed.

WRIST PLATE.—James Barclay, Sioux City, Iowa. This device consists of two plates or disks arranged concentrically and mounted to turn independently one of the other, one of the disks being connected with the valve rods and the other with the hook or eccentric rod, there being also a locking device for connecting the two disks with each other. The wrist plate thus provided is of simple and durable construction and the arrangement permits the engineer to easily start the engine without being compelled to lift the hook rod and hold it up while manipulating the throttle valve and starting bar.

BALANCED SLIDE VALVE.—William T. Harrison, Pooler, Ga. This is a valve of simple and durable construction, arranged to supply the cylinder with a full charge of steam at the time the piston is at the commencement of the stroke. The invention consists of inlet ports formed in the slide valve and a balance plate provided with a port adapted to connect with the valve inlet ports at the time the steam is admitted to the end of the cylinder.

VEHICLE PROPELLING MECHANISM.—Isaac B. Jones, Xenia, Ohio. A shaft carrying a cone pulley, and adapted to be driven in either direction by a motor, is located on the vehicle body, a belt connecting this pulley with a second cone pulley on the axle of the vehicle, a convenient shifting mechanism for the belts being provided. The mechanism is simple and durable and permits of readily changing the speed of the vehicle without changing the speed of the motor, while it is also arranged for conveniently running and steering the vehicle in any desired direction.

Railway Appliances.

CAR COUPLING.—E. H. B. Knowlton, West Superior, Wis. This is an improvement in that class of devices known as "twin jaw" couplers, and the invention provides means whereby the jaws can be automatically coupled and locked when brought together, together with means for automatically locking them in an uncoupled position when they are separated. The lock can be quickly and easily operated to uncouple the jaws, and the top surface is without any irregularities or openings to afford lodgment for ice, snow and dirt.

RAILWAY GATE.—John S. Chambers, Jr., Allegheny, Pa. This is a swinging gate which will entirely close the crossing, and will fold when raised, thus clearing overhead electric wires and other obstructions. It has a main arm to which is pivoted a supplemental arm, an inclined guide pivoted to the main arm projecting over and beyond the pivot of the arms, while a cable has one end secured to the free end of the supplemental arm and is passed through the guide, its other end being secured to the support at the pivoted end of the main arm. The length of the arms is varied according to the height of the obstructions above the track.

TRAIN SMOKE CONDUIT.—Chester L. Morrison, West Point, Va. This invention covers an improvement in devices for carrying away smoke from a locomotive, providing for this purpose a simple and inexpensive apparatus by means of which the cinders, smoke, etc., will be discharged from the rear end of the train, where they cannot annoy the passengers. It consists of a conduit made up in sections and open at each end, the section on the locomotive having a flaring mouth which is open over the smoke stack, and the conduit running the entire length of the train. Simple and effective means are provided for coupling the several sections together, so that they will be smoke tight and will conform to the different movements of the cars.

Mechanical Appliances.

PUNCH. — Francis N. Simmonds, San Francisco, Cal. This is an inexpensive article to make, while designed to operate efficiently, the penetrating portion of the punch being cheaply and easily renewed after it is worn out. It has a removable face with a screw-threaded bore aligning with that of the body to which it is attached, and a bolt with an operating head is passed down through the body and face, the lower end of the bolt being threaded to engage the threads of the bore of the face. The lower end of the bolt has a slightly projecting hardened centering point, the several parts being so firmly united that there is no liability of the face getting loose upon the bolt.

COAL DRILL.—Charles S. Sheppard, Pittston, Pa. An auger is formed at one end with a dovetailed groove having its sides diverging outwardly, and a center cutter engages with its shank one side of the groove, while a cutter standing at angle thereto engages with its shank the other side of the groove, a bolt in the auger end having its head wedge-shaped engaging the adjacent inner sides of the shanks of the center and cutter. The drill is of simple construction, and is designed to easily and conveniently cut a large opening in the coal without requiring much power.

Agricultural.

PLANT FRAME. — Edward K. Jones, Portland, Oregon. This frame has a soil receptacle, with a cover and fruit protector having openings for the plants to project through, and prevents the washing away of the soil and its spattering upon the fruit. It is especially adapted for strawberry culture, and is preferably 5½ by 12 feet in size, accommodating 12 dozen plants, the openings being 4 inches in diameter. It is adapted for use in all localities, the plants being readily protected from heat or cold, and it is provided with perfect means for ventilation, irrigation, and drainage. With this frame fruit may be produced very early in the season, and its production continued until very late, young plants being forced to early maturity and made to yield large quantities the first season.

ANT HILL CUTTER. — John Tym, North Bend, Neb. This device comprises a frame with side runners, with a cutter arranged obliquely to and secured at its front end to one of the runners, while adapted at its rear end to permit trash and the like to pass off. It is designed to be dragged over the ground by a horse, when the cutter will strip the ant hills off close to the ground surface, so they can be readily removed and the ground left in condition for cultivation. By means of an adjusting lever the cutter may be lifted and held off the ground in moving the machine from place to place.

Miscellaneous.

METHOD OF MINING COAL.—Peter C. Forrester, Wilkeson, Washington. The method of mining provided by this invention consists of first forming in the vein a series of vertical cuts and horizontal cuts or drifts or cross cuts intersecting with the vertical cuts, and then undercutting or blasting from below the pillars of material formed between the cuts and cross cuts. By this method the miner will not be at all subjected to the obnoxious gases arising in blasting or undercutting, and can always go to a place of safety whenever a blast is fired, while there is also a saving of lumber used in building the cuts.

VEHICLE WHEEL. — August Bauer, Sandusky, Ohio. This wheel has a circular brace fastened to it at a point between the hub and felly, the brace consisting of two circular rings or flanges, with intermediate filling blocks or sections between the spokes, the rings and filling blocks being clamped together by bolts or rivets. This improvement may be applied to any old wheel to strengthen it and prolong its usefulness, preventing the spokes from breaking, bending or getting loose.

TAIL BOARD SPRING. — Freeman Nickerson, Jr., Fall River, Mass. This is a combined spring and catch, constructed of two pieces of metal, for keeping the tail board of a vehicle closed when shut, while readily admitting of the opening or dropping of the board when the vehicle is to be loaded or unloaded. The spring is made of sheet steel, and the catch, secured to it is very solid and strong and made to project beyond the free end of the spring, where it is of a roll or hook shape above, to form a ready handle for lifting the spring. The device is designed to be much cheaper than the ordinary devices for the purpose.

WIRING FENCE PICKETS.—Lemuel H. Slagle, East Brady, Pa. A machine of simple and durable construction, designed to be very effective for this purpose, is provided by this invention, the machine crossing the wires after the picket is inserted, and having a tension device to give a proper tension and twisting to the sets of wires. A series of levers are pivoted on a post, each lever having forked ends to receive the wires, and a retaining wire is held on each lever to extend across the fork and hold the wires in place, while a bar is pivotally connected to the levers to give them a swinging motion.

LADDER. — James F. Mitchell, Titusville, Fla. This ladder is especially designed for picking oranges and other fruit. It has a straight section, hinged to the top of which is a section that is curved and extended laterally in a plane at an angle of not less than forty-five degrees to the body of the ladder, the top section being in most cases extended at a right angle to the body portion.

FEED TROUGH.—Earl B. French, Oakland, Cal. In this feed trough the feed is supplied gradually, so that the animal will be compelled to eat his feed slowly and thoroughly masticate it. The trough is made with a side reservoir separated from the other portion by a removable partition, a ratchet mechanism holding the partition in position in the reservoir. The flow of feed is controlled by the movement of the partition by the animal feeding, this also preventing the trough from clogging, while the adjustment of the partition provides for different kinds of food.

KNOCKDOWN EXHIBITION STAND.—Herman A. J. Rieckert, New York City. This stand has two connected corner posts, sides being hinged to the posts and shelves hinged to the connecting bars of the posts, each made in two parts hinged together and resting on cleats formed on the sides. The stand is of simple and durable construction, and can be readily folded for storing and transportation. It is arranged to be conveniently set up for use in stores, hotels, and like places, for exhibiting goods.

JOURNAL PAGE FILE.—John O'Rourke, Mandan, North Dakota. Covers adapted to inclose heavy indexed pages are hinged to a central base portion, a jointed section forming the back edge and permitting the file to be closed as an ordinary book. On the base is a spring-pressed bar carrying curved file posts, the doubled-over upper ends of which enter sockets in the top of posts secured to suitable plates on the base, the pressing down of the curved posts forming the usual file loops, and enabling the journal sheets to be turned freely from one cover to the other. The improvement forms a simple file which may be conveniently operated, and in which may be kept journal sheets, statements, summaries, and matters of a similar nature, in form for ready reference.

BEER DRAWING APPARATUS.—Peter F. Gaynor, Greenbush, N. Y. This invention affords a simple means by which beer may be conveniently drawn under pressure from the cask, the device being inserted in the cask without spilling any beer or freeing any gas. The spile is of the usual external shape and within it is a seat against which fits a rubber packing valve having at its lower end a swinging flap normally pressed upward by the pressure within the cask. A novel form of stem and handle takes the place of the ordinary cock, the beer flowing as readily through it as through the usual faucet.

BAR FIXTURES. — John Neumann, Brooklyn, N. Y. This invention provides separable and interchangeable bar fixtures, such as rinsing chambers, shelves, and drain trays, that the position of the parts may be changed as desired, and so that any of the parts may be readily detached from other adjacent parts for cleansing or repair. The improvement is applicable to counters or bars where liquors of various kinds are served to customers by the glass.

LAMP BURNER.—Patrick J. F. Graeme, Beulah, Canada. A triangular frame is adapted for vertical movement at each side of the wick, and there are horizontal spring-actuated piston rods at each side of the frames, each having a head block contacting with the frames, while telescopic hoods secured to the head blocks inclose the wick tube. The construction is such that the flame may be extinguished and the wick trimmed automatically upon lowering the wick, it being also provided that the wick may be raised and lowered without operating the extinguishing and trimming mechanism.

TEA KETTLE.—John Black and Fred. C. A. Natius, South Chicago, Ill. The breast of this kettle rises above the general level of the top and above the filling opening, forming an air space when the kettle is filled, and this space is connected by a tube with the upper part of the spout, and the bail when thrown over rests on projections which prevent undue heating. By this construction the water in the kettle is prevented from boiling over at either the spout or filling opening, and in handling the kettle there is no danger of burning or scalding the hands.

COOLING APPARATUS.—Sherman L. Smith, Plymouth Penn. This is an apparatus designed to facilitate the transportation in good condition of butter and like articles in warm weather, providing therefor a tray-holding receptacle adapted to be placed in a cask containing ice or spring water, there being a locking connection between the receptacle and the cask. The receptacle is preferably made of sheet metal, and its construction is such that portions of its contents may be readily removed without disturbing others.

TOY.—George W. Galbreath, Sedalia, Mo. This is a device constructed somewhat in the nature of a target, and provided with an attached elastic cord carrying a weight which may be made to strike the target, the latter when being struck at the center automatically sounding an alarm. The toy may be held in the hand, one or both hands being employed in its use.

TRUSS. — William A. Adair, Moline, Kansas. This is an improvement in trusses to be worn on the body in cases of hernia, and is light, strong, and easily adjustable, to enable the pads to bear where necessary, while it is adapted to conform to the movements of the body, and sufficiently elastic to adapt itself to any momentary local expansion.

URINAL.—Charles G. Zeilman, Albany, N. Y. This invention provides an automatically operating flushing device, which also affords a positive seal at all times against the escape of sewer gas. The construction is simple and the parts are not liable to get out of order.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention and date of this paper.

NEW BOOKS AND PUBLICATIONS.

TRAVELS AMONG THE GREAT ANDES OF THE EQUATOR. By Edward Whymper. With maps and illustrations. New York: Charles Scribner's Sons. 1892. Pp. xxiv, 456. Price $6.

SUPPLEMENTARY APPENDIX TO TRAVELS AMONG THE GREAT ANDES OF THE EQUATOR. By Edward Whymper, with contributions from H. W. Bates, F.C.S. (and many others). London: John Murray. 1891. Pp. xxiii, 147.

These sumptuous and richly illustrated volumes it is quite impossible to review within the limits of the space at our command. Edward Whymper is the first man who succeeded in climbing the Matterhorn in Switzerland, and his graphic account of his travels and mountain climbing in South America is simply fascinating. The desperate hardships encountered at such high elevations are pictured, and the oddities of the characters met with, whether of his party or not, give an agreeable flavor of humor to the recital. The appendix, a separate volume, touches upon the scientific results of the expedition.

TRANSACTIONS OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Vol. VII. 1891. New York: Published by the Institute. Pp. xi, 635.

All that is necessary to say of this very handsome volume is that every electrician should possess it. The papers, their authors, and the discussions annexed to such papers give the highest value to the work as an exponent of advanced electrical views. The steel engraving, portrait of Elihu Thomson, will recall to many the features of the great engineer, the inventor of electric welding and investigator and inventor in many other branches of alternate current work. Among the more notable papers in it may be cited Tesla on Alternate Currents of very high Frequency, Kennelly on Inductance, with the discussion and committee's report, and reports on the Frankfort Electrical Congress. But this particularization does not affect the value of the other papers with accompanying discussions.

ENCYCLOPEDIE SCIENTIFIQUE DES AIDE-MEMOIRE, PUBLIEE SOUS LA DIRECTION DE M. LEAUTE, MEMBRE DE L'INSTITUT. Etude Expérimentale Calorimétrique de la Machine a Vapeur. Par V. Dwelshauvers-Dery. Paris: Gauthier-Villars et Fils. Pp. 213.—Transmission de la Force Motrice par Air Comprimé ou Raréfié. Par Al. Gouilly. Paris: Gauthier-Villars et Fils. Pp. 170.—Résistance des Matériaux. Par M. Duquesnay. Paris: Gauthier-Villars et Fils. Pp. 187.—La Distribution de l'Electricité. Installations Isolées. Par R. V. Picou. Paris: Gauthier-Villars et Fils. Pp. 168. Price per volume, 75 cents.

We note the reception of four little volumes of this encyclopedic aid to memory. The books are all well edited, and the subjects seem well treated. Where required they are illustrated, and the attractive appearance of the books adds materially to their value.

THE GALVANIC CIRCUIT INVESTIGATED MATHEMATICALLY. By Dr. G. S. Ohm. New York: D. Van Nostrand Company. 1891. Pp. 269. Price 50 cents.

The science series of the D. Van Nostrand Company has never received a more interesting acquisition than the present one. It is a translation of the famous paper of Dr. G. S. Ohm, published in 1827, in which Ohm's law was enunciated for the first time. The only previous translation has been hard to obtain, and electricians will generally welcome the present translation.

A MANUAL OF PHONOGRAPHY, OR WRITING BY SOUND. By Isaac Pitman. London: Isaac Pitman & Sons. Australia: Edwards, Dunlop & Co. 1890. Pp. 87. Price 40 cents.

THE PHONOGRAPHIC TEACHER. By Isaac Pitman. New York: Isaac Pitman & Sons. Canada: The Copp, Clark Co. 1891. Pp. 46. Price 15 cents.

PRACTICAL CARRIAGE BUILDING. Compiled by M. T. Richardson. Profusely illustrated. Vol. 1. New York: M. T. Richardson Co. 1892. Pp. 222. Price $1.

We have before now favorably commented on previous works on practical blacksmithing. We can extend the same favorable consideration to this book. It seems thoroughly practical and to the point, and well adapted for repairers who have many different cases of breakage and wear to deal with. Numerous illustrations are given to elucidate the text. Many contributions from practical workers make the book read like an emanation of experience.

STEREOTYPING. The papier mache process. By C. S. Partridge. Chicago, Ill. 1892. Pp. 139.

The flong process of stereotyping is given in detail by Mr. Partridge. The tools, presses, etc., required are illustrated, and every step of the process receives due consideration. The author claims to have embodied the best receipts and processes as evolved from seventeen years' personal experience.

IRRIGATION CANALS AND OTHER IRRIGATION WORKS. By P. J. Flynn, C.E. San Francisco, California. 1892. (Two vols. in one.) Pp. xx, 398; x, 283. Price $8.

The general subject of open channel irrigation as employed in the Western regions of the United States is the topic treated in the seven hundred pages of this work. The first volume is devoted to irrigation canals and other irrigation works, the second to flow of water in irrigation canals. We can only make the old complaint that space forbids anything like an adequate review of this very handsome work. It is a credit to the publisher as well as to the author, and will be found of extensive use.

SAFETY VALVES: THEIR HISTORY, INVENTION, AND CALCULATION. By William B. Le Van. New York: N. W. Henley & Co. Pp. xiv, 155. Price $2.

As the safety of a boiler and the life of its engineer and others depend on the all-important safety valve, it is eminently appropriate that a book should be devoted to so important a topic. Sticking safety valves, miscalculated levers and similar factors have been responsible for many disasters. In Mr. Le Van's work we have the full subject properly presented, calcula tions elucidated, the different constructions shown, and last, but not least, the ills that safety valves are heir to are described. The numerous illustrations are an excellent feature.

RECORD OF SCIENTIFIC PROGRESS FOR THE YEAR 1891. By Robert Grimshaw, M.E., Ph.D. New York: Cassell Publishing Co. Pp. vi, 372. Price $1.50.

In brief form the entire field of scientific work is covered by the author. The mere recital of his headings would fill the space allotted for a review. The absence of illustrations and the necessarily short treatment allotted to so many subjects are the features of the work which we can least approve of. The volume will be found, however, of use and interest. An excellent index closes the work.

HOW TO MAKE INVENTIONS. By Edward P. Thompson. New York: D. Van Nostrand Co. No date. Pp. ii, 161. No index. Price $1.

As this work covers the whole field of the arts it is certain that if reviewed carefully errors could be indicated. But in the main it is an excellent manual, and will be read by many desirous to become inventors. Considerable labor on the author's part must have been requisite to give so logical and clear an arrangement to such diversified material. As is always the case when a book of this type is well done, it is most interesting reading and can be commended to many others than inventors.

A CONCEPT OF POLITICAL JUSTICE. By J. W. Sullivan. New York: Twentieth Century Publishing Co. 1891. Pp. 58. Price 10 cents.

THE MODERN COOK BOOK. Springfield, O.: Mart, Crowell & Kirkpatrick. Pp. 320.

THE FORGING OF THE SWORD AND OTHER POEMS. By Juan Lewis. Illustrated by Charles Bradford Hudson. Pp. 103.

Business and Personal.

The charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in the following week's issue

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.
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.

(4325) N. S. P. asks (1) for a receipt for an invisible ink which can be made visible by blowing the breath on the paper containing it, and which afterward returns to its invisible state. A. Writing made with a weak solution of chloride of cobalt is blue when dry and pink when moist, therefore, if you write with this ink upon blue paper, by breathing upon it you will produce a pink color. By writing on glass with very dilute hydrofluoric acid, an invisible etching is made, which stands out clearly when the glass is breathed upon. See SUPPLEMENT, No. 378, for the full process of making magic pictures. 2. What is the metal used in the plugs connected in an electric current, and what are all of the reasons for its being used in preference to other metals? A. Tin is often used for the fusible plugs, and some of the fusible alloys are also used. The main requirements are a metal not easily oxidizable, which will fuse at a heat below that required to char wood or burn the insulation of wires. 3. Has it much resistance, and why do the plugs blow out? A. The resistance is considerably above that of copper. The plugs do not in reality blow out, but melt. 4. If two wires carrying a current of electricity are put into a bucket of water, the wires touching nothing but the water, does any current pass? If so, what per cent of the current used? A. With a low E. M. F. a very small percentage of the current will pass, and this percentage increases as the E. M. F. increases. The amount of current will of course depend upon the surfaces exposed to the water. 5. While an electric street car is running, could it be stopped quickly by reversing the motor, or would it damage it to do so? A. In most motors, if reversed quickly, there will be danger of burning out the armature. 6. While examining the bell in a telephone I noticed that the two coils were both on the same circuit and that the circuit was not broken in any way, yet the armature, which is pivoted in the middle, has each end alternately attracted. Not understanding the reason for this, will you please explain it thoroughly? It was an old telephone not in use, and I don't know whether the bell is just like the ones in use now or not? A. The bell you examined was a polarized bell, and the current which operates it is an alternating current. The armature of the bell is magnetized, and the reversals of the current cause the armature to be alternately attracted and repelled. 7. Could you tell me of a way by which the gloss or shine can be removed from clothes? A. It is said that sponging with a solution formed by dissolving 1 ounce of ammonium bicarbonate in 1 quart of water will remove the gloss from clothes.

(4326) W. T. B. asks: 1. If a motor wound to have a resistance of 3 ohms be connected to a battery having E=5 and C=10, what is the strength of C in the motor, and what is the E? A. If your E.M.F. is 5 volts and your current is 10 amperes, the resistance of your battery must be (according to $\frac{E}{R}$=C) ½ ohm. ½+3=3½. This is, according to the same formula, 5÷3½=1·428 amperes. 2. Is watts=C E correct for motor? A. Yes. 3. By what rule or formula can one determine as to what the E, C, and internal resistance of a battery must be, to be most efficient to drive a motor having a known resistance? A. The resistance of the battery should be equal to that of the external circuit. 4. For a plunge battery what should be the proportion of water, sulphuric acid and bichromate of potash, by weight and by measure? A. Make a saturated solution of bichromate of potash and water; to this slowly add one-fifth its weight of commercial sulphuric acid. 5. Which is the best way to connect the cells of such a battery to run a motor—in series, multiple arc, or multiple series? A. It depends upon the resistance of the motor; if its resistance is low, the cells may be connected in parallel; if it is very high, they must be connected in series. A little experiment will soon determine the best arrangement of batteries for a given motor. 6. Is the efficiency of a plunge battery impaired by the fact that the carbon plates are only one-half the thickness of the zinc one, although there are two carbons to one zinc, the other dimensions being the same? A. The thickness of the carbon plates is not very material, although those of medium thickness are preferable to very thin ones.

(4327) G. L. B. asks: Are there any means by which the time required for the sun to radiate all of its heat can be computed? A. There is no certainty in any computations in regard to the time that the sun will continue to give light enough to sustain life upon the earth. The temperature of the internal mass of the sun is only a conjecture. The temperature of the photosphere has been estimated by various observers at from 3000° to several millions. Professor Young estimates that 18,000° Fah. is probably nearer the truth than the extremes. From the radiant heat of the sun as observed on a given surface of the earth is computed the radiation in all directions throughout the sun's sphere. With this as a divisor, and the assumed units of heat held in the sun at some assumed temperature with the sun's mass as a dividend, the time is obtained. According to Newcomb, this is about 10,000,000 years, in which to wind up the age of life on the earth.

(4328) H. B. C. asks how kodak cameras are made to load and unload the sensitive film by daylight without injury. A. The roll of sensitive film has attached to its inner and outer ends a strip of black paper about a foot long. The roll comes in square shaped cardboard boxes with a slit in one corner through which the paper passes. To load the camera you simply drop the square box into the compartment in the camera, then draw the outer black paper across the stage to the wind-up roller. Attach the paper to the latter, put on the roll holder to the camera, and wind off the black paper until the sensitive film is brought into the focal plane. A certain number of revolutions tells you when the sensitive film is in place. When the exposures are made, the black paper on the inner end of the roll now surrounds the outside by continuous winding and protects it from light. The film is made of celluloid by the Eastman Co., Rochester, N. Y.

(4329) W. McC. asks: 1. A railway company in this vicinity have a pump to fill a tank for engine use; the pump and tank are one-half mile apart, and an electrical alarm is used to signal the engineer at pump when tank is full. Six cells of Leclanche battery are used, and a float closes its circuit. In very hot weather the alarm will not work, but in cold or wet weather it works well. What is the trouble and what will remedy it? A. Possibly the expansion of the wire at one or more of the joints may affect the resistance of the line, but if a ground is used, the trouble is probably due to the dryness of the earth surrounding the ground plates. The remedy is obviously to place the ground plates at a lower level, where they will be surrounded by moist earth. 2. Have you any books that you could recommend to show the manner of cutting in wires on a switchboard, especially a loop? Also any on the setting up of telegraph instruments, both the ordinary and "quad"? A. For answers to these queries consult Prescott's "Electricity and the Electric Telegraph," price by mail $7.

(4330) E. S. A. inquires in regard to the feasibility of constructing a large induction coil under the following data. Coil heads of black rubber ¼ inch by 6 inches square, length between heads 20 inches, rubber tube one-sixteenth inch rubber on a side 1 inch internal diameter, in which the laminated core (which is movable) will be placed. Core of charcoal iron very thin with paper laminæ between. Two layers of No. 12 double-covered magnet wire, B and S gauge, for primary, 20 pounds .011 inch or No. 29 B and S gauge for secondary. The question is, will the amount and gauge of the secondary wire compensate me, considering the previous data? Of course, extraordinary pains will be exercised in insulation, and a condenser will be placed in primary circuit. Can you inform me as to the length of spark, or an approximate idea of the coil's efficiency. A. We think the length of your coil is too great for its diameter; that you would succeed better by reducing the length to 12 inches and increasing the diameter correspondingly. Instead of using two layers of No. 12 wire in the primary coil, we would suggest the use of four layers of No. 16, with the ends brought out, so that you can use the several convolutions in series, or 2 in series and 2 in parallel, or all in parallel, to adapt the coil to different currents. The secondary wire is rather large for long sparks; however, it ought to give sparks of great intensity. The secondary coil should be made up in sections according to the method of Ritchie. You will probably succeed in producing a 4 or 5 inch spark.

(4331) W. S. asks (1) what to put in whitewash to keep flies out? A. We know of nothing that can be used for the purpose that will not be offensive and injurious to the occupants of the room. Dalmatian insect powder blown around the room occasionally is effective. 2. What chemical is put in a retort and then heated to make oxygen gas? A. Potassium chlorate and black oxide of manganese mixed are used for producing oxygen. 3. What makes the magnetized sewing needle described in SCIENTIFIC AMERICAN Reference Book, page 101, point north and south? A. The earth has magnetic poles like a magnet, which correspond approximately with the earth's axis. This polarity is now supposed to be due to electric currents circulating in the earth in planes approximately parallel with the equator.

(4332) N. C. H. asks: 1. Will you please explain to me the philosophy of the silo? Why is it the ensilage does not spoil? A. The preservation of food in the silo depends mainly on the exclusion of air. This is accomplished by placing over the ensilage a movable close-fitting cover and weighting it heavily. 2. Will you tell me of a good confectioner's receipt book and where to get it? A. The following are good books on confectionery: "Confectioner's Hand Book," price $3; "Complete Practical Confectioner," price $4; "Ornamental Confectionery," price $2. We can send you either of these books on receipt of price.

(4333) N. L. writes: Will you kindly inform me, through your columns of inquiry, the voltage of a magneto-electric machine, the fields of which are composed of six 6 inch permanent magnets? The armature of one pair electro-magnets 2×1 inch, with 9-16 inch cores, wound with about No. 25 wire. A. It is impossible from the above data to estimate the voltage of the magneto-electric machine. Probably the only method of measuring the current would be by the decomposition of water and the measurement of the resulting mixed gas.

(4334) C. D. B. asks: 1. Will you state the E. M. F. of an ordinary gravity cell, and could the motor described on page 497 of "Experimental Science" be run with gravity cells? If so, how many are required? A. The E. M. F. of a gravity cell is practically 1 volt. The gravity cell is not adapted to running motors, on account of its high resistance, but with a sufficient number made up in series of six to secure the proper voltage, you can run the motor. It would probably require 60 or more cells to run it properly. 2. Will you also state the horse power of the motor? A. With a proper battery the motor will generate one horse power.

(4335) W. P. says: What is the composition of the artificial flowers and fruit used on millinery? A. Mix bread crumbs, magnesia, and finely powdered starch. When fermented, it can be formed and colored to any pattern. Use the lakes to color, and a solution of gamboge in alcohol for a varnish. From the "Scientific American Cyclopedia of Receipts, Notes and Queries."

(4336) O. D.—With gelatine bromide paper, C brand, made by the Eastman Company, Rochester, New York, and the eikonogen developer you can make prints by lamp light with the greatest ease. You should use Saxe or Rives photograph paper for blue prints. Probably the iron salts affected your paper.

(4337) F. W. D. asks: 1. Are street car motors run by the use of only one wire? A. The cars propelled by the trolley system are supplied with a current by a single wire suspended overhead, the current being returned by the track rails or by the ground, or both. See SUPPLEMENT, Nos. 707, 708, 709. 2. How can I drill plate glass? A. Make your drill of new tool steel. Do not heat it above a low red. Sharpen it, and afterward temper it by heating it to a low red and plunging it in a solution of chloride of zinc, this solution being made by dissolving the zinc in muriatic acid until it will take no more. 3. Which is the cheapest light and power? A. A steam or gas engine. 4. Describe electric welding and forging of metals. A. Electric welding is accomplished by passing a very heavy current through the pieces to be welded. You will find a full description of electric welding in SUPPLEMENT, Nos. 592, 682, 582, and 785. 5. Has anything been made to lift itself into the air? Has it wings or wheels? Describe its power. A. Up to the present time no aerial machine has been made that will lift itself and its motive power. For information on aeronautics see SCIENTIFIC AMERICAN, No. 7, Vol. 66, and SUPPLEMENT, Nos. 738, 739. 6. What dynamo will heat a bar one inch diameter to a welding heat, and at what cost? A. Write the makers of electric welding machinery for this information. 7. For experimenting purposes would you advise the purchase of a good lathe instead of having my work done by some one else? A. If you are a good workman and have plenty of time, you will probably derive more satisfaction from doing your own work. 8. Can noiseless powder be used in guns? A. We know of no noiseless powder. 9. What SUPPLEMENT tells how to make a water motor? A. You will find articles on water motors in SUPPLEMENT, Nos. 611, 617, 455, 463. 10. Will 80 lb. pressure from hydrant give eight sixteen-candle power lights with dynamo? A. With sufficient volume, yes.

(4338) J. W. S. asks: Would it be practical to propel a small boat by means of a force pump operated by foot power? The pump to take water through a tube at the bow of the boat and discharge at the stern. A. Yes. It would be practical, but a pair of oars would give you better speed and be easier.

(4339) A. B. writes: 1. I have an induction coil of about the size of the one described in "Experimental Science," which is, however, wound with No. 32 silk-covered wire straight across the spool to a depth of about three inches, each layer being separated by two thicknesses of paper well shellacked. It gives a three-eighths inch spark, and will give no longer spark with double the amount of battery. A. By your mode of winding you have removed the outer layers of the coil too far from its magnetic center; furthermore, the wire you have used is too large; but taking the coil as it now stands, you would probably get a better result by connecting your cells in parallel. 2. Which is the most injurious to life—a current with one ampere and 600 volts, or a current of one-half amperage and the same voltage? A. The voltage being the same, the larger the current the greater the danger. 3. Is it more economical to conduct a five-ampere current with an E.M.F. of 100 volts than with 75? A. More economical in the use of copper. 4. Does anode mean the positive and cathode the negative pole? A. Yes. The anode is the electrode through which the current enters, and the cathode is the one through which it emerges. 5. What is the price of platinum per gramme? A. Sixty cents.

(4340) R. A. W. states that a Sawyer-Mann 16 candle 50 volt lamp requires one ampere instead of one-half ampere, as stated in Notes and Queries some time since.

(4341) R. W.—For the information you desire concerning solar printing we refer you to Wilson's "Photographics," price $4.

(4342) E. A. asks: 1. How can I connect two dynamos together to increase the voltage? A. Connect them in series, as you would two batteries. 2. How can iron be soldered? A. Iron may be soldered with soft solder by first tinning it, after the application of chloride of zinc or soldering fluid. Wrought iron and steel may be brazed. Use borax for a flux, and spelter, sheet brass or silver solder for solder.

(4343) F. M. G.—In the construction of your dynamo, the use of gas pipe for the core of the armature is a mistake. The capacity of the machine could not be stated without experiment.

(4344) W. C. G. writes: 1. I have made a telephone described (Fig. 5) in SCIENTIFIC AMERICAN December 14, 1889, but cannot get satisfactory results, and would like to know: If a larger spool and more wire (No. 36 s. c.) were used than what is shown in diagram, would it interfere with the working of the instrument? A. Too much wire would interfere with the working of the telephone by introducing unnecessary resistance into the circuit. 2. What effect would a smaller amount have, or if the quantity on each spool was not exactly the same? A. Too little wire would produce only a slight effect. If the two spools were of nearly but not exactly the same resistance, there would be no perceptible difference in the working of the line. 3. Would it make a difference in the working of the instrument if the "positive" end of each magnet was placed on the pole of each telephone, or should the "positive" end be placed on one pole and the "negative" one the pole in other? A. It makes no difference which pole of the magnet is used. 4. Should the instrument be connected by the screws P of each instrument, or by the screw P of one and Q of the other? A. This is immaterial. 5. Would a straight, pointed magnet 3 or 4 inches long answer in place of the U magnet? A. Yes. 6. What kind of steel should I use to make a straight magnet, and would it be as permanent as the U magnet? A. Any steel that can be hardened. Machinery steel is often used for this purpose. 7. In what number (SUPPLEMENT or SCIENTIFIC AMERICAN) is the "House" telephone described? A. The "House" telephone is described in No. 20, vol. 55, of the SCIENTIFIC AMERICAN, page 303. 8. In what number is the description of an induction coil, illustrated, for shocking purposes? Not an intricate affair, but what would give a good shock and such that one could make without machinists' tools, etc.? A. Such a coil as you mention is described in SUPPLEMENT, No. 569. 9. Would two thicknesses of paper between the magnet pole and coil be sufficient? A. Yes.

(4345) W. W. L. asks: 1. What is the resistance of a 16 candle power Edison incandescent lamp? A. About 220 ohms. 2. How many amperes would flow into a storage battery connected with the Edison incandescent light wire (E. M. F. 112 volts) with four 16 candle power lamps connected in circuit thus:

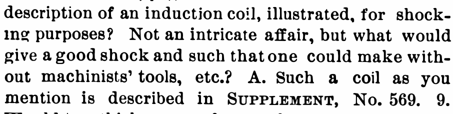


FIG. 1.

A. 0·012 of an ampere. 3. How many amperes would flow into battery with one, two, three, or four 16 candle power lamps connected in circuit thus:

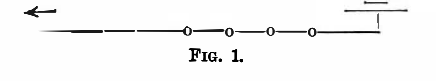


FIG. 2.

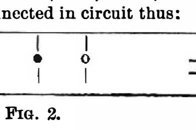


FIG. 3.

A. As shown in your diagram, Fig. 2, the amount would be limited only by the mains and service wires, as no resistance is interposed between the dynamo and battery except the conductors. You can connect the lamps in parallel in the manner shown in the third diagram. Then assuming the E.M.F. to be 125 volts, 2·27 amperes would flow through your battery. 4. What is the name given to the way the lamps are connected in each of these illustrations? A. The lamps in Fig. 1 are connected in series, those in Fig. 2 in multiple arc or parallel, and in Fig. 3 in multiple series.

(4346) W. G. C. asks: Is there any way I can remove the bottom of a green glass bottle so as not to destroy either piece, and leave the edges so they can be stuck together again? A. You can cut off the bottom of the bottle by using a curved hot wire, turning the bottle in the wire so as to cause it to heat on a circumferential line. It is well to scratch the bottle with a sharp file at some point in its circumference to start the fracture. If the bottle does not break, a drop of water applied to the scratch will generally start the crack.

(4347) E. R. H. asks: 1. What is the nature of the so-called Foucault current? A. They are currents generated in the core of the armature and field magnet by induction, in the same manner as those generated in the wire of the armature. 2. How does a laminated core promote the cooling effect in an armature core? A. Laminæ, with the insulation between the laminæ, prevent the circulation of these currents and thus prevent heat. 3. Are armature cores and field magnets wound mathematically correct with regard to the size and length of wire? A. They are practically correct; a formula has been devised which would render it possible to design a dynamo by mathematical calculations alone. Many of the formulas in electric work are impracticable. 4. What is the limit of speed in a low-speed dynamo? A. It depends on the design of the dynamo; a dynamo may be constructed to generate a current at almost any speed.

(4348) A. L. D. says: What papers or books do you publish that will give me information on the construction of an incubator, and also what works could I get to instruct me in photo-engraving process work? A. For incubators see SUPPLEMENT, Nos. 612, 630, 778, 835. Regulator, 848. For photo-engraving, see SUPPLEMENT, Nos. 612, 731,768, 849, 656.

(4349) W. F. A. asks for a simple test for iron in sal ammoniac. A. The color will show it, if in quantity. Dissolve in water and add a drop of nitric acid, boil, cool, and add solution of potassium ferrocyanide or sulphocyanide. The first will give a blue color, and perhaps a blue precipitate, if iron is present; the latter will give a red color.

(4350) G. A. W. asks: Will you please inform me how pure bisulphite lime and sulphite lime are made? A. By acting on caustic lime with sulphurous oxide. The latter may be made by burning sulphur, or by boiling oil of vitriol and with sulphur or with powdered charcoal.

(4351) G. S. H. says: A car moves around a curve at a certain speed; the outer rail is high enough to insure safety; if the center of gravity is raised in the car by building it higher, what will be the effect? Will it add to the safety or detract from it? Will it be necessary for safety to add to the elevation of the outer rail or not? A. It will make the car more liable to be upset, and the outer rail must be raised to compensate for it.

A. M. P. asks: How can I etch on steel, as knives, etc.?—Prof. McD. asks for a table giving the atomic and equivalent weights of the elements, with their quantivalence. I have such tables, but they do not include the later elements.—B. G. T. wants receipt for lutes for retorts.—C. N. asks for a receipt for bleaching fluid.—A. G. M. asks how to make gold lace.—B. S. T. wants formulas for fluorescent liquids.—P. W. S. asks instructions for polishing the edges of leather strops.—H. H. K. asks for instructions for using salicylic acid.

Answers to all of the above queries will be found in the "Scientific American Cyclopedia of Receipts, Notes and Queries," to which our correspondents are referred. The advertisement of this book is printed in another column. A new circular is now ready.

TO INVENTORS.

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May 3 1892,

AND EACH BEARING THAT DATE.

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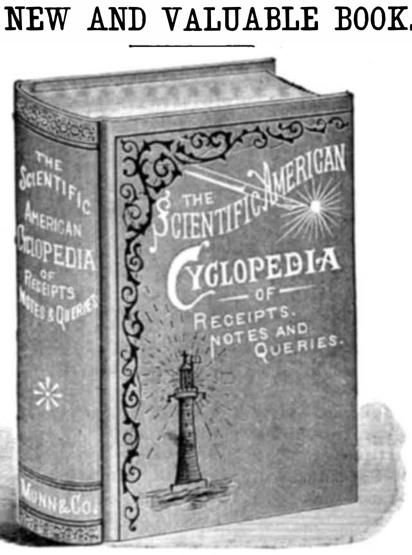

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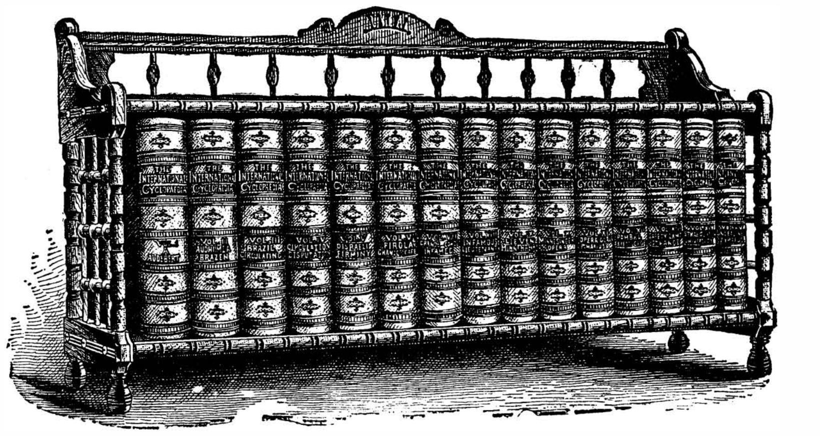

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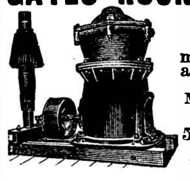

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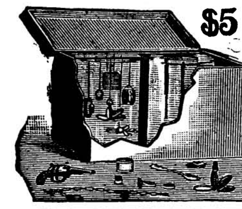

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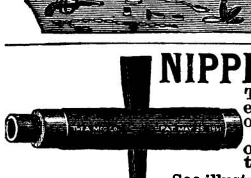

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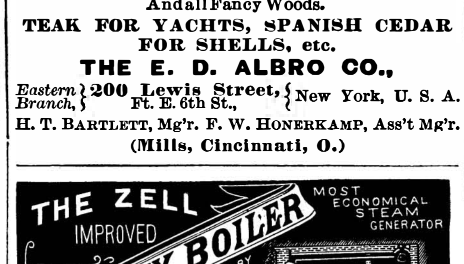

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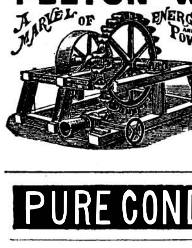

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PROPOSALS FOR STEAM POWER PLANT. Springfield Armory, Springfield, Mass., May 2, 1892. Sealed proposals, in triplicate, will be received at this Armory until 12 o'clock M. on Thursday, June 2, 1892, at which time they will be opened in the presence of bidders, for furnishing a Steam Power Plant, comprising Steam Engine, Boilers, etc., and for the delivery and erection of same in complete running order in the new shops at the Armory. The Government reserves the right to reject any and all proposals or parts thereof. Specifications and all other information can be had on application to COL. A. MORDECAI, Ordnance Department, U. S. A., Commanding.

PROPOSALS FOR OBSERVATION TOWERS.—Office of the Chickamauga Park Commissioners, War Department, Washington, D. C., April 9, 1892.—Sealed proposals in triplicate, with guarantees and designs, for furnishing six wrought-iron towers, will be received at this office until noon of May 24, 1892, and opened immediately thereafter in the presence of bidders. The right to reject any or all proposals is reserved to the United States. Specifications and blank forms of proposals will be furnished established manufacturers and contractors on application to the Commissioners, J. S. FULLERTON, A. P. STEWART and S. C. KELLOGG.

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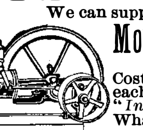

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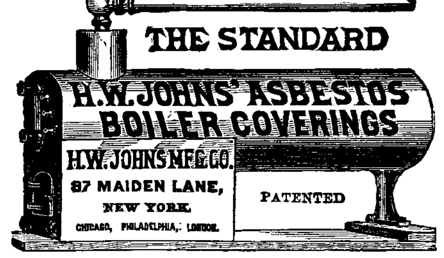

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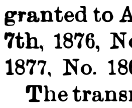

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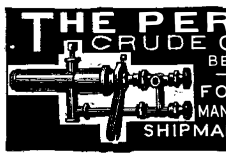

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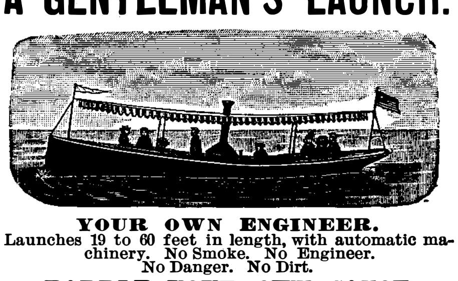

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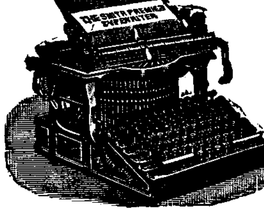

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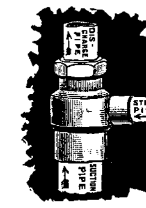

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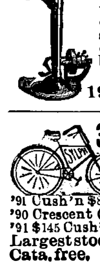

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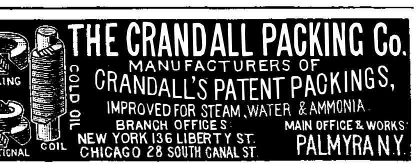

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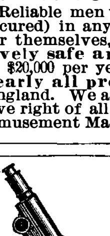

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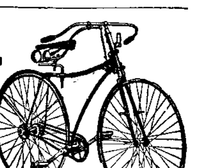

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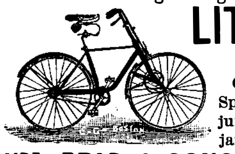

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