SCIENTIFIC AMERICAN

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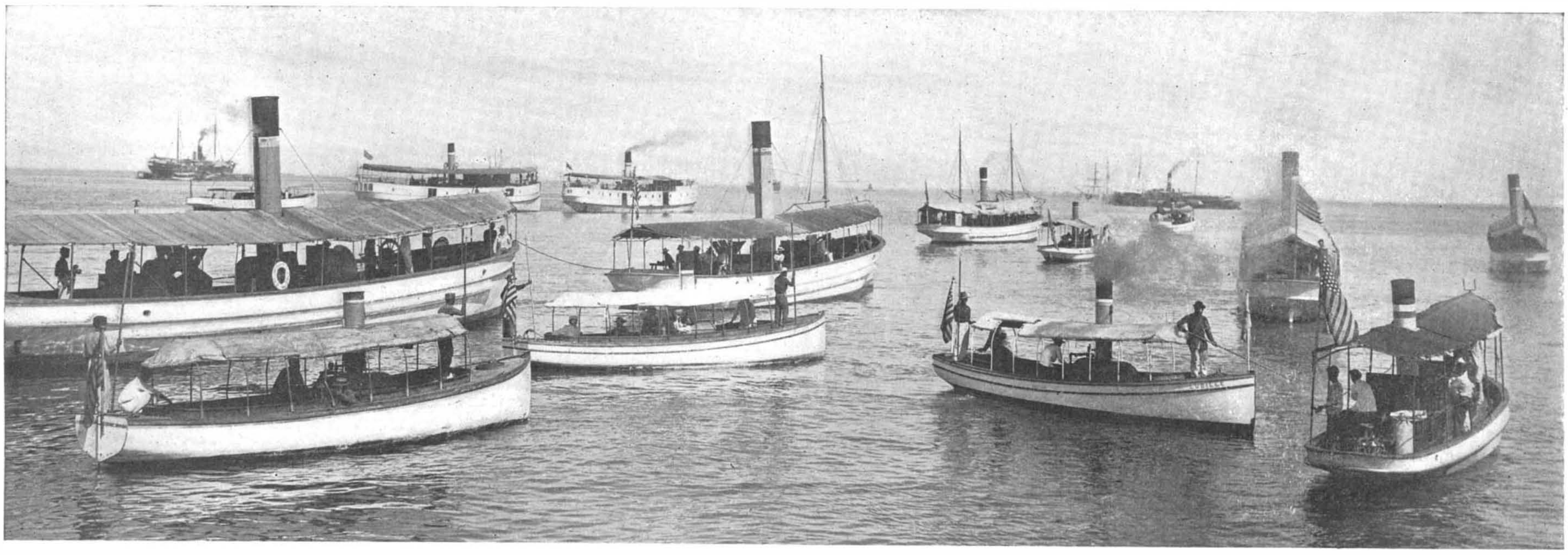
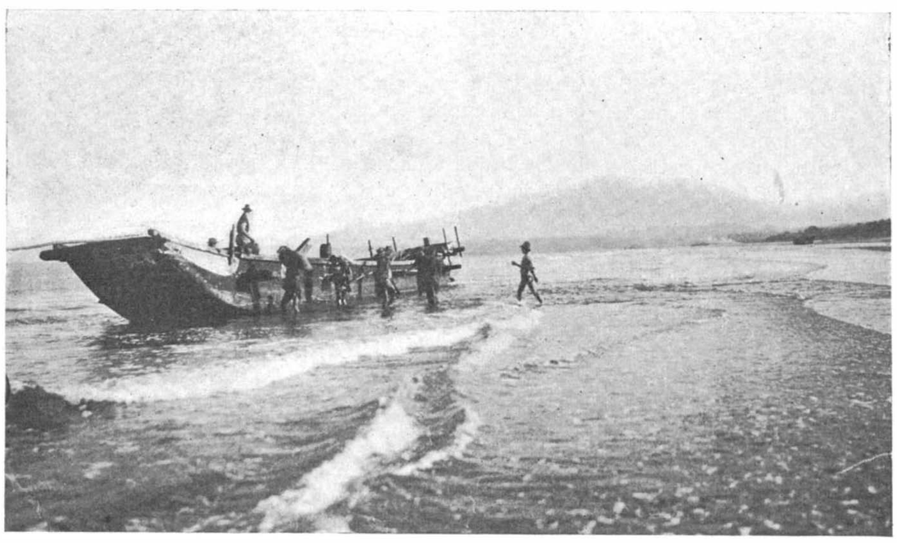
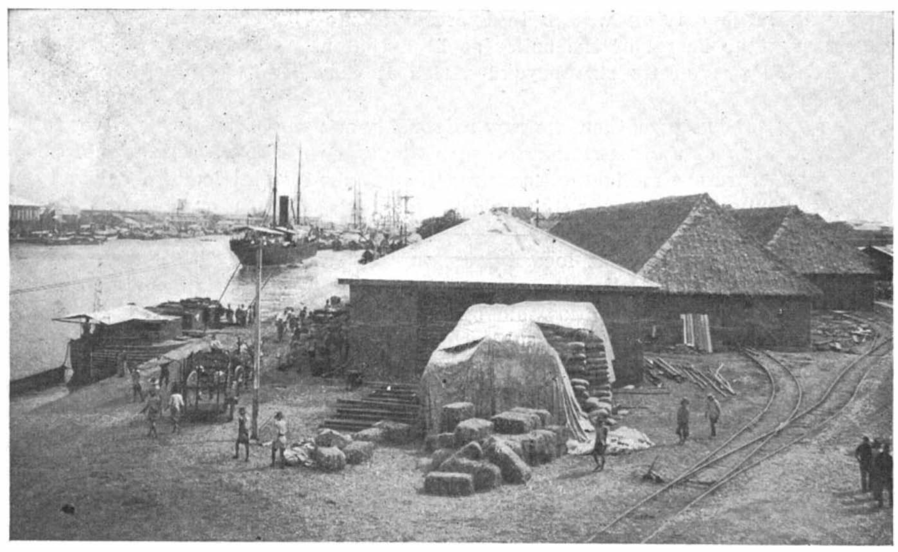


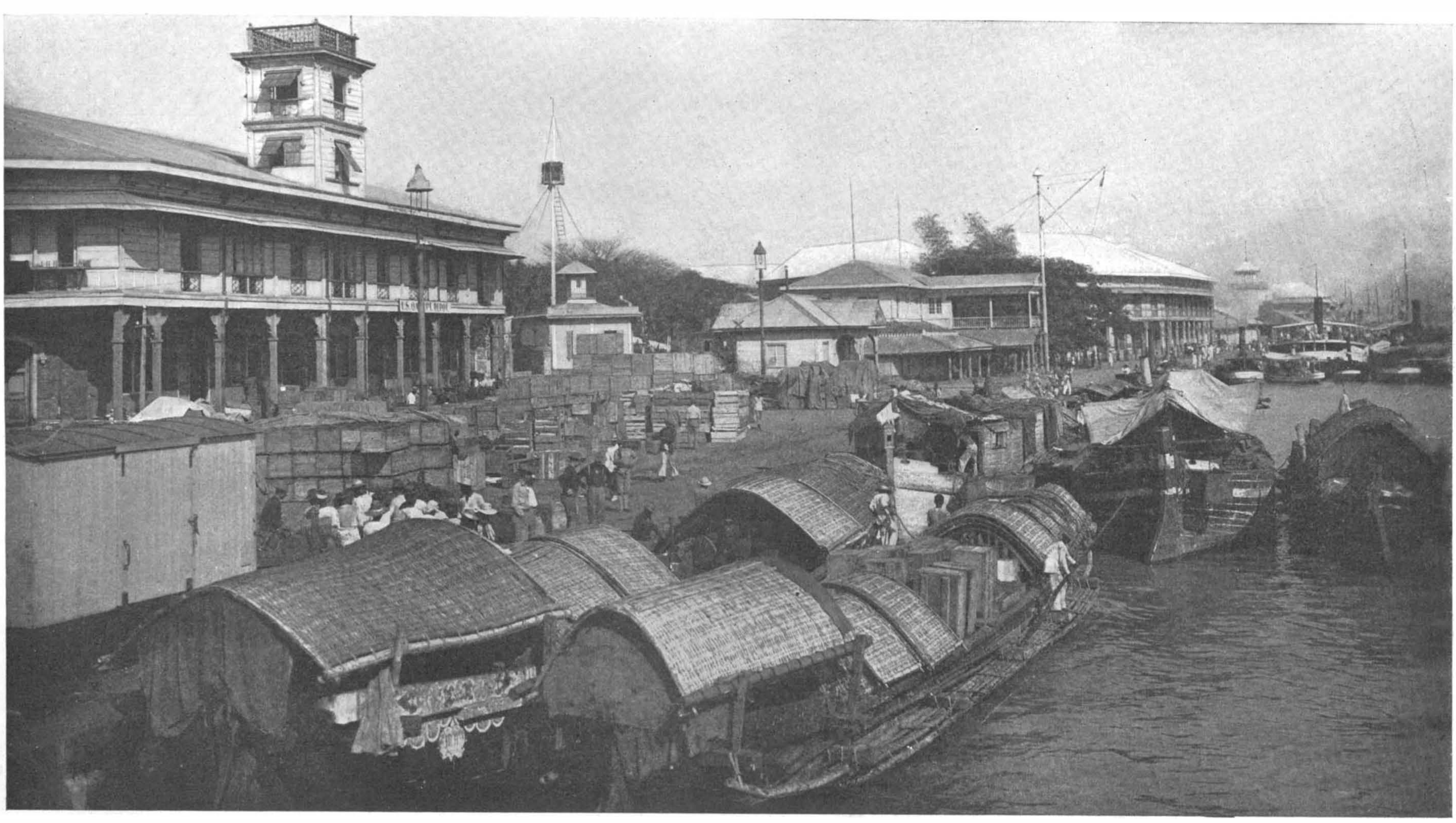
Fleet of Launches and Chinese-Built Tugboats Employed in Towing Lighters at Manila.



Unloading Supplies on the Beach, Manila Bay.



Quartermaster's Hay and Grain Stores on the Pasig River Front.



Native Cascoes and Lorchas Lightering Supplies at the Quartermaster's Depot, Pasig River, Manila.

ARMY TRANSPORT SERVICE IN THE PHILIPPINES.—[See page 262.]

Scientific American.

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NEW YORK, SATURDAY, APRIL 27, 1901.

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

THE LOCOMOTIVE OF THE FUTURE—A SUGGESTION.

The really remarkable rate of increase in the size and power of the modern locomotive, especially in the past four years, brings the locomotive-builder face to face with the question of making some very radical changes, if he is to satisfy the inevitable demand of the twentieth century for locomotives of greatly increased power and endurance. We recently illustrated a locomotive built for the New York Central Railroad, which showed a boiler capacity not far from double that of the celebrated No. 999 of the same road. The great dimensions of the boiler were rendered possible by the adoption of the Atlantic-type method of disposing the driving wheels, whereby the firebox may be extended to the full width of the loading gage. The diameter of the barrel, however, in locomotives of this type cannot be increased in proportion, the necessarily large driving wheels in express locomotives placing the barrel of the boiler so high that a restriction is put on its size beyond which it cannot go.

At the present juncture, then, we may reasonably ask whether, in view of the restrictions upon boiler space offered by the present method of carrying the engines and the boiler upon one frame, it would not be advisable to remove the engines and driving-wheels to the tender, replacing the present locomotive frame by a low frame or platform, designed simply for carrying a boiler of the full diameter allowable by the present loading gage. We have given the subject considerable study, and are satisfied that, as far as the tender is concerned, there are no structural difficulties to prevent the engines from being carried upon the same frame as the coal and water.

It is a common occurrence in the history of engineering for a device to anticipate the true era of its usefulness; witness Brunel's "Great Eastern," which was forty years ahead of its time, and is only now being equaled in size. The suggestion of engining the tender is not new; for between 1855 and 1860 Sturrock introduced, upon the Great Northern Railway, England, some locomotives which, in addition to the engines on the locomotive proper, had a set of engines carried beneath the tender. So great was the increase in hauling power that the device defeated its own ends, the sidings of the railroads at that day being all too short to accommodate the long trains of cars that these steam-tender locomotives could haul. Two other difficulties encountered by Sturrock were the fact that the dust and grit raised by the locomotive caused a rapid deterioration of the wearing parts of the tender engines, and that it was impossible in those days to provide a satisfactory flexible joint in the steam pipe between boiler and tender. The difficulties above mentioned would not be encountered in a present-day application of the system, the platform and siding space being ample, while the dust and grit difficulty could be overcome by running the locomotive tender first. Moreover, a three-joint ball-and-socket connection in the steam pipe might be used between engines and boiler; or, if this were found to be impracticable, it might be replaced by a large-diameter coil of pipe, made of steel of a high degree of elasticity. We are free to admit that this connection would probably be the most difficult problem in the design; but there is no reason to suppose that it would be beyond the possibilities of modern workmanship and materials.

By this separation of engines and boiler, it would be quite practicable to produce an express locomotive of from two and one-half to three times the power of the most powerful express locomotive existing today. In the first place, the boiler platform could be carried on two low, six-wheeled trucks, and by utilizing its full ten feet of width to carry a water-tube boiler of the Yarrow or some other first-class torpedo-boat type, and installing the necessary fans for forced draft, (the latter, by the way, a device tried as long ago as 1830 by Seguin on one of Stephenson's engines), it would be possible to provide three times as much heating surface as is found in the boilers of our largest express locomotives.

As to the utilization of this great steam capacity, the tender might contain two independent sets of engines, arranged on the Atlantic type system, with the cylinders carried over four-wheeled trucks at either end, and two independent sets of four-coupled driving-wheels between them. Such an arrangement, using blind drivers of 6 feet 6 inches diameter, with only an inch of clearance between them, could be accommodated on a rigid wheel-base not to exceed 31 feet. The decreasing weight on the drivers when the engine is running, due to the consumption of fuel and water, could be compensated by utilizing an adjustable fulcrum to transfer an increasing amount of weight from trucks to drivers. The coal space on the tender could be built with its sides and ends sloping to the center, after the fashion of a hopper-car, and a small bucket or screw conveyor could be arranged to bring a constant feed of coal from the bottom of the coal space up to the footplate of the boiler.

A water-tube boiler, built up to the full limits of the platform on which it was carried, would provide an ample supply of steam at 225 pounds pressure for two sets of the largest-sized engines that the adhesive weight of the tender would allow.

If the steam tender were provided with four 22 x 28 inch cylinders, and the maximum load on each set of coupled drivers were 110,000 pounds, the total draw-bar pull would be about 60,000 pounds, or sufficient to haul a train of fifteen Pullman cars over a road of normal gradients and curvature at an average speed of 60 to 65 miles an hour. A common cab would do duty for the engineer and the two firemen, the arrangement being similar to that adopted on the well-known Fairlie type of locomotive.

As to the method of using the steam, it might be found preferable to expand it in three or four stages; but if the simple, high-pressure system were used, there would be the advantage that, the boiler being supplied with independent forced draft, the exhaust nozzles could be greatly enlarged and the back pressure reduced.

It will be seen, at once, that should the development of the locomotive follow along the lines indicated above, there would be a considerable increase in the total load on a given wheel-base, with the result that even our first-class roads would have to consider once more the question of replacing, or considerably strengthening, their bridges and track structures. This, however, will have to be done, in any case, before the locomotive of the present type has reached its limit of power and weight.

BEHR ON HIS HIGH-SPEED MONORAIL SYSTEM.

At a meeting of the Society of Arts, held last month, F. H. Behr read a paper upon his proposed high-speed electrical monorail between Manchester and Liverpool, which gives a better insight into the theories and aims of this indefatigable engineer than was obtained from any previous published account of the system. Mr. Behr states that he himself lays no claim to the propounding of the original idea, the credit due him being based upon his having developed the general ideas and principles of others in the designing of the practical details, and in having constructed monorails which have been worked successfully in carrying passengers and goods on a commercial scale for a number of years. He admits that the form of monorail which he has adopted was invented by Charles Lartigue, a French engineer, who constructed some primitive and simple lines in Algeria and Tiflis.

The first practical line built on the Behr system was a short length of passenger and freight railway in the north of Ireland. It was opened in 1888, and has been operated ever since without any difficulty or accidents. Another line was built on this system in 1893 in France as a branch line of the Paris, Lyons and Mediterranean Railway. Originally the inventor was impressed only with the advantages to be derived from applying the principle of the monorail to light railways in countries where the population was sparse, such railways to act as feeders to the main lines; but as electric traction became more perfected, Mr. Behr was impressed with the fact that an even more important application of the principle was to be found in the construction of high-speed railways.

The first experimental line designed to show the practicability of high-speed monorail travel by cars of standard size was built in the neighborhood of Brussels, as an annex to the exhibition of 1897. It was constructed under the auspices, and with the financial assistance, of the Belgian government; and although the electrical horse power furnished from the exhibition was only a quarter of the amount promised, and although over 75 per cent of the line consisted of curvature, a maximum speed of 70 miles an hour was obtained on the curves, on an elliptical track whose total length was about 3 miles. This structure consisted of a single rail, elevated 3 feet from the ground, and supported on A-shaped steel trestles. On each side of the structure were fixed two guide rails, 18 inches apart, whose duty it was to engage the thirty-two horizontal guide wheels which were provided on the car, and thereby prevent oscillation, and counteract the effect of the centrifugal force when rounding curves. The car was 60 feet long, 10 feet 10 inches wide, and weighed 70 tons. It was driven by 200 horse power electrical motors. During three months of the exhibition passengers were carried with safety at a speed of 70 miles an hour around curves of 540 yards radius. In the opinion of the Belgian government, the results obtained, considering the unsatisfactory conditions, were promising, and Mr. Behr was authorized to reconstruct the generating plant and make certain changes in the way of lightening the extremely heavy car. With a car weighing 59 instead of 70 tons, a speed was recorded of 83 miles an hour on curves of 540 yards radius, and it is considered probable that higher speeds than this were obtained for short distances. The report of these experiments stated that there was a marked absence of vibration, and it was thought that the results of the trial were such that, with a properly constructed generating plant, speeds of as high as 120 and 130 miles an hour could be obtained with absolute safety and at moderate expense.

The proposed line, for which Parliamentary sanction is being sought, will run from the city of Manchester to the heart of Liverpool. The trains will consist of single cars, with accommodation for from 60 to 90 passengers. The power station is to be located at Warrington, which is exactly half way, or 17½ miles from each terminus. According to Mr. Behr's calculations, he will require about 7,500 horse power to maintain this service at a maximum speed of 110 miles an hour, which speed is to be attained within 1¾ miles from the start. With a car accommodating 90 passengers the capacity of the line is estimated at 18,000 per day, although this could be doubled by providing a five-minute train service.

It is self-evident that the most crucial problem to be solved in a line of this kind is that of proper braking power. Mr. Behr relies upon experiments made with the Westinghouse brake, which prove that it is possible to apply a retarding force of 3 miles per second. That is to say, a train running at 60 miles an hour can be brought to a stop in 20 seconds, or in a distance of 360 yards. Behr believes that with the Westinghouse brake alone it will be possible to bring a train that is traveling at 110 miles an hour to a stop in 37 seconds, or in a distance of 995 yards. He proposes also to equip this railway with an electric brake as an auxiliary to the Westinghouse brake. After the current from the generating station is cut off, the current generated by the rotation of the motors is to be passed through a set of electro-magnets, thereby creating a strong magnetic field. There will be four magnets, each about 18 inches long, which will act on corresponding lengths of guide rail, the pull being equal to 200 pounds per square inch. The inventor considers that he can obtain this result with magnets each weighing less than 1,000 pounds. The combined effect of the Westinghouse and electric brakes is supposed to be sufficient to stop a train running at 110 miles an hour in 500 yards. The combination is only to be utilized in cases of emergency. The stopping of the trains is to be further assisted by a grade of 24 feet in 1,500 yards entering Liverpool, and a rise of 46 feet in 1,200 yards entering Manchester.

SUBMARINES FOR THE BRITISH NAVY.

After prolonged experiments and consideration, the British Naval Department have decided to construct five submarine vessels for the English navy. They are of the Holland type with some improvements carried out by their own experts, the exact nature of which, however, is not divulged. When presenting the Naval Estimates before Parliament the First Lord of the Admiralty remarked in connection with this latest acquisition to the fleet: "What the future value of these boats may be in naval warfare can only be a matter of pure conjecture, but the experiments with these boats will assist the Admiralty in assessing their true value. The question of their employment must be studied and all developments in their mechanism carefully watched by this country." From these remarks it is apparent that the English Admiralty, in view of the success that has attended the trials of this type, both in this country and in France, have at last realized that they are destined to play an important part in naval warfare of the future. The French are zealously following up the invention, and their latest experiments have resulted in a new use being discovered for the submarine. The storing of torpedoes upon a battleship is always attended with considerable danger, and the French naval authorities have been endeavoring to solve the problem by carrying the torpedoes in the submarines, and then taking the latter in tow by a battleship. The trials were undertaken with the "Gustave Zede," and it was proved that the submarine could be towed in this manner under water and submerged for several hours at a stretch.

Messrs. Vickers, Sons & Maxim have the British vessels under construction at their shipyards at

Barrow-in-Furness. They will each measure 63 feet 4 inches in length, with a beam of 11 feet 9 inches and a displacement, when submerged, of 120 tons. The main engine will be of the gasoline type for surface propulsion and will be of 160 horse power. The fuel capacity will admit of a run of 400 knots without replenishing. The maximum surface speed will be 9 knots per hour. The main motor is of the electric waterproof type, capable of propelling the craft when submerged at 7 knots per hour with a storage battery capacity for four hours at this speed.

The vessels will be very substantially constructed. The plating and frames are of steel of sufficient strength to withstand water pressure at a maximum depth of 100 feet. For the purpose of stiffening the hull, and to insure safety in the event of collision, bulkheads are provided. The superstructure is built to admit of an above-water deck 31 feet in length when the vessel is light for surface running. The conning tower will be of armored steel with an outside diameter of 32 inches, and a minimum thickness of 4 inches, adequately provided with observation ports. The interior of the vessels will be lighted with electricity. Compressed air will be stored aboard, and ventilators provided for the circulation of the outside air throughout the vessel.

The armament will comprise one torpedo tube in the extreme forward end of the vessel, opening outboard 2 feet below the light water-line. The vessels will be equipped with five torpedoes each, measuring 11 feet 8 inches in length. The torpedoes are to be discharged while the vessel is in the following positions: At rest or during a run on surface; before or after submergence; while awash, either at rest or when running full speed; and while running full speed when submerged.

When it is desired to descend, the boat will be brought to an awash condition, with only the conning tower ports visible above the water, and will then dive at a gentle angle until the desired depth is attained, at which point the vessel will be brought to a horizontal position, either automatically or by manual power. It is anticipated that the first of these craft will be launched early in May.

THE NATIONAL ACADEMY OF SCIENCES.

BY MARCUS BENJAMIN, PH.D.

The regular annual meeting of the National Academy was held, as usual, in Washington city, on April 16, 17 and 18. After an absence of three years this distinguished body again convened in the National Museum, to the new lecture hall of which it was welcomed by Secretary Langley, thus happily dedicating to the cause of science the recently reconstructed hall.

The sudden death of Henry A. Rowland occurred early in the morning of the first meeting of the Academy, and it was with much feeling that Secretary Remsen announced the passing away of him who for a quarter of a century had been his colleague in the faculty of the Johns Hopkins University. For twenty years Rowland had been a member of the Academy, and his death was a cruel shock to many of his friends, who so well know the great value of his eminent contributions in physics.

During this session, which is the one at which the Academy transacts its business, the chair was held by Asaph Hall, the acting president. At the first meeting the committee on the Draper medal recommended that this distinction be conferred upon Sir William Huggins, of London, England, for his researches in astro-physics. This report received the approval of the Academy. Those who have previously received this honor are Samuel P. Langley, in 1885; Edward C. Pickering, in 1887; Henry A. Rowland, in 1889; H. C. Vogel, in 1892, and James E. Keeler, in 1899. It was also at this meeting that the following foreign associates were elected: A. Bornet, M. Cornu, J. Jannssen, and M. Loewy, of Paris, France; Sir Archibald Geikie, of London, England; and H. Kroniker, of Bonn, and Frederich Kohlrausch, of Berlin, Germany, all of whom have naturally attained unusual prominence in their several branches of science.

The meeting on Tuesday was largely devoted to the election of officers; and to the presidency of the Academy, made vacant by the resignation of Wolcott Gibbs, a year ago, Alexander Agassiz, of the Museum of Comparative Zoology, in Cambridge, Mass., was chosen. He had for many years been foreign secretary. Ira Remsen was elected to the resulting vacancy. Also the following additional members of the Council were chosen: John S. Billings, director of the New York Public Library; Henry P. Bowditch, of the Harvard Medical School; George J. Brush, former director of the Sheffield Scientific School; Arnold Hague, of the United States Geological Survey; Samuel P. Langley, secretary of the Smithsonian Institution; and Simon Newcomb, formerly of the United States Naval Observatory. Samuel P. Langley and Thomas C. Mendenhall were delegated to represent the Academy at the funeral of Henry A. Rowland.

The final business session of the Academy was devoted to the election of new members, and those who were so fortunate on this occasion as to receive the approval of the members were George Ferdinand Becker, who, since 1879, has been connected with the United States Geological Survey; James McKeen Cattell, who fills the chair of Psychology in Columbia University, and is the editor of Science; Eliakim Hastings Moore, Head Professor of Mathematics in the University of Chicago since 1896; Edward Leamington Nichols, who, since 1887, has held the chair of Physics in Cornell University; and Theophile Mitchell Pruden, Professor of Pathology in Columbia University and director of its histological laboratory.

During the afternoons sessions were held at which papers were read. They were, for the most part, highly technical, and only very brief descriptions of them can be given. The first was on "The Climatology of the Isthmus of Panama," by Henry L. Abbot. He compared the temperature and rainfall in a number of places in the tropics, and showed that the annual temperature in Panama was 79.1 deg. F. The average of the hottest month was 80.4 deg., and that of the coldest month 78 deg. F., thus showing that the temperature is equable, the difference being only 2.4 deg. He contended that under proper conditions it was quite possible to endure the climate on the isthmus, but after two or three years it was desirable to remove to a colder climate. Robert S. Woodward, of Columbia College, presented a technical paper on the "Effects of Secular Cooling and Meteoric Dust on the Length of the Terrestrial Day," showing by means of mathematical formulas, derived from recorded results, that in the course of several million years the length of the terrestrial day would be slightly reduced. "The Use of Formulæ in Demonstrating the Relations of the Life History of an Individual to the Evolution of Its Group," by Alpheus Hyatt, consisted of an exhibition of a series of charts showing how, by the use of formulas, the life history of very many of the mollusks could be determined at a glance. Incidentally, by the application of these formulas, he showed that individuals in different geological formations exhibited a development which naturally was an evidence in favor of evolution.

Edmund B. Wilson briefly offered an explanation of Artificial Parthenogenesis and its Relation to Normal Fertilization. His experiments had revealed some exceedingly interesting facts with relation to normal fertilization, and he presented tentatively a theory which explained how fertilization could be accomplished in certain magnesium solutions. Under the title of Simultaneous Volumetric and Electric Graduation of the Condensation Tube, Carl Barus showed how the computation necessary to express the co-ordinates of cloudy condensation in terms of the number of nuclei in action were explained. Two methods were investigated by Prof. Barus. The work was mathematical in character, and does not admit of full presentation without diagrams and formulas. John S. Billings presented a Table of Results of an Experimental Enquiry regarding the Nutritive Action of Alcohol, prepared by Prof. Wilbur O. Atwater, of Middletown, Conn. The title clearly indicates the nature of the paper, and it is not possible at this place to give the various results. Theodore Gill discussed the significance of the Dissimilar Limbs of the Ornithopodous Dinosaurs, which was of a highly technical character, and described his studies made on the skeletons of these early reptiles, which once populated the world. The Place of Mind in Nature and the Foundation of Mind, by John W. Powell, were philosophical presentations of the subject which they described, and form chapters in the scheme of philosophy to which this eminent anthropologist has devoted to recent years. Under the title of Conditions Affecting the Fertility of Sheep and the Sex of Their Offspring, Alexander Graham Bell described the peculiar experiences that he had observed in his flock of sheep in Nova Scotia. He found that the food given to the animals seemed to have a direct relation to the sex of their young. His paper was illustrated by curves on which he showed the proportion of males and females that had been born, and the different periods of their growth. The closing paper presented to the Academy was one by Samuel P. Langley, in which he showed by means of a long chart the infra-red portion of the spectrum which he had mapped out by means of the bolometer. It was simply a statement of results without any descriptions or explanations of what would ultimately be the result of his research. In connection with this he also presented to the Academy the first volume of the Annals of the Smithsonian Astro-Physical Observatory.

In closing, Acting President Hall formally announced the death of Henry A. Rowland and named Ira Remsen to prepare the biographical memoir. The preparation of a memoir on John G. Barnard was assigned to Henry L. Abbott. Arnold Hague, of Washington city, was chosen home secretary to fill the vacancy caused by the election of Ira Remsen to the place of foreign secretary. The Academy then adjourned to meet in Philadelphia on November 12, 1901.

THE ORDNANCE BOARD'S TEST OF THORITE.

As a result of the tests made by the Ordnance Board with thorite the class of ammonium-nitrate shell-fillers have been rejected for the use of the army artillery. In all, eighteen reports on thorite have now been made. The board finds that in eight tests made with 12, 7, and 5-inch shells thorite failed to explode uniformly; for after fragmentation much of the explosive was recovered.

A good filler should be completely burnt and break the shell into pieces neither too large nor too small. The fragmentation secured in the tests was in the main poor. A 12-inch armor-piercing shell charged with 36 pounds of compressed thorite, the pressure varying from 7,000 pounds at the point to 4,900 at the middle and 5,400 at the base, was buried in nine feet of sand. So bad was the fragmentation that only thirty-seven pieces were recovered, the smallest of which weighed one-half a pound and the largest 271 pounds. Over 30 pounds of explosive were undischarged. The most satisfactory of these fragmentation tests was made under the following conditions which could not be actually realized. The fuse was embedded 1½ inches in 36 pounds of thorite rammed in a 954-pound cast-steel armor-piercing shell. About 2,600 pieces were recovered, the largest of which weighed 31 pounds.

The explosive is not only unsatisfactory in its fragmentation, but also tends to pack in the point of the shell, without being ignited by the fuse. An unfused 12-inch armor-piercing shell, charged with thorite, was fired through 5¾ inches of tempered steel, with results not very encouraging. The explosive was driven forward, and so solidly compressed as to leave in the rear a clear space of over a foot, with some four inches of loose thorite. As a whole, the best results were secured with those shells which before fragmentation had passed through steel plates.

The experience of the board with mixtures of thorite and black powder is no more flattering than are the tests made with thorite alone. The entire ammonium-nitrate class of shell-fillers, it is considered, is not to be compared in efficiency with the explosives at present in use.

DEATH OF PROF. HENRY A. ROWLAND.

Prof. Henry A. Rowland died at Baltimore April 16, and by his death America has lost one of her most illustrious physicists. He was born at Honesdale, Pa., 1848, and graduated as a civil engineer at the Rensselaer Polytechnic Institute, at Troy, in 1870. His earliest work was on a railroad survey. He then taught for a time in Worcester University, where he became instructor in physics, and finally assistant professor. He spent a year in Europe about this time, studying under Helmholtz and examining physical laboratories. His reputation grew rapidly, and in 1876 he was tendered the chair of physics in the newly founded Johns Hopkins University at Baltimore, which he held at the time of his death. He was well known as an inventor, and his numerous devices include the multiplex telegraph instrument and a machine for making diffraction gratings. His investigations resulted in a large number of electric and optical discoveries and improvements, and some of the photographs which he succeeded in making of the solar spectrum were the finest ever secured. As a consulting engineer he was retained to direct many great works, such as the electrical plants at Niagara Falls. His work as a member of the Electrical Congress of Paris in 1881 brought him a decoration. He received the Rumford medal in 1884 for his researches on light and heat. He was the author of many papers, and was a member of many learned societies.

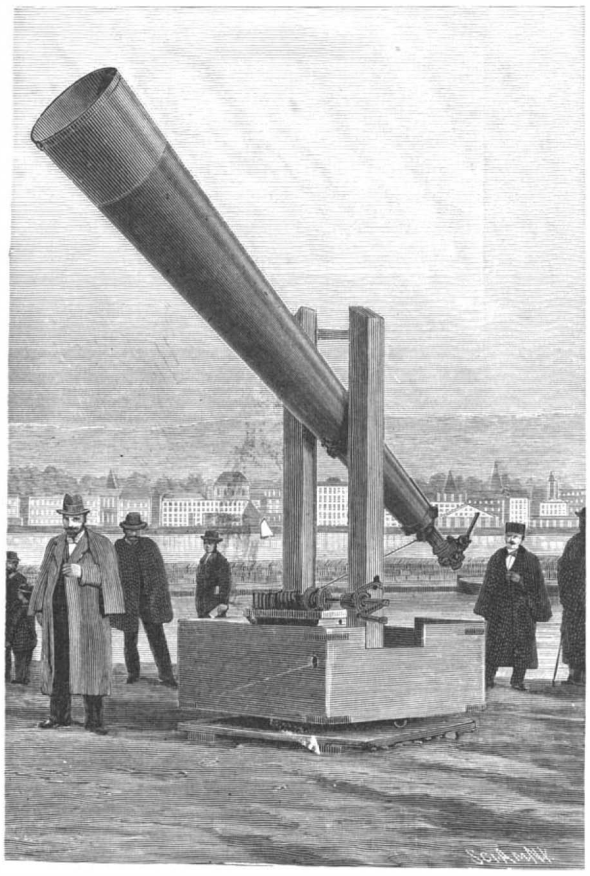
DEATH OF RICHARD P. ROTHWELL.

Richard P. Rothwell, a mining engineer, and the editor of our esteemed contemporary, The Engineering and Mining Journal, died in New York April 17. He was born in Canada in 1837. He was graduated from the Rensselaer Polytechnic Institute, at Troy, N. Y., in 1858, where he took a course in civil engineering. He afterward took a three years' course in the School of Mines, at Paris, and then entered a mining academy at Freiberg, Saxony. His active career commenced in a cable and wire rope manufactory in London. In 1864 he returned to America, where he followed the profession of mining in the Pennsylvania coal fields. At about this time he also invented some wire-rope-making machinery which is in use at the present time. He came to New York in 1873, and soon after became editor of The Engineering and Mining Journal, which position he held until his death. He was also editor of The Mineral Industry, a most important technical and statistical volume published annually. He had charge of the statistics of the gold and silver of the United States Census of 1890. He founded the American Institute of Mining Engineers, at Wilkesbarre, in 1871, and in 1882 became its president. He was a member of scientific societies, both at home and abroad.

A NEW WEATHER CANNON.

Ever since "weather shooting," as it is called in Germany and Switzerland, met with such pronounced success in Styria, upper Italy, Hungary, and France, meteorologists have been engaged in a very wordy battle as to the merits of the scheme. That something has been accomplished cannot be denied. Indeed, so successful have been the efforts in preventing hailstorms in upper Italy that since the experiments of 1898 some twenty thousand stations have been established. At the Agricultural Congress held in Padua last November by far the greater number of the members were in favor of the building of "weather-shooting" stations. The congress was very decidedly impressed by an account of one of last summer's hailstorms in the vicinity of Vicenza. So violent was this particular storm, the story runs, that for miles the land was completely devastated. But in this ravaged section, one spot was spared, because there it is asserted a number of stations had been located which had warded off the danger.

The shooting apparatus hitherto used has been very primitive in construction. For a cannon, a mortar with a funnel-like barrel was often used. In some places the funnel is fixed vertically in masonry. This method of mounting the cannon is not only crude, but also dangerous, for often enough serious accidents have occurred. In order to avoid these dangers as well as to improve the apparatus in general a Hungarian editor named Kanitz has devised a simple form of cannon which is essentially a breech-loading mortar



THE KANITZ WEATHER GUN

some thirty feet in length. The mortar is journaled in a rotatable carriage, so that it can be raised and lowered and swung from side to side. The charge is a metallic cartridge of blasting powder. After the discharge a loud, shrill whistling is heard, lasting for about fourteen or fifteen seconds. French and Italian wine-growers insist that by means of the gun clouds are torn asunder, so that rain instead of hail falls.

The grape growers of five departments of the French Alps have formed an alliance for buying cannon and powder for next summer. The Italian government has such faith in weather-shooting that it supplies wine-growers with powder at the rate of three cents a pound.

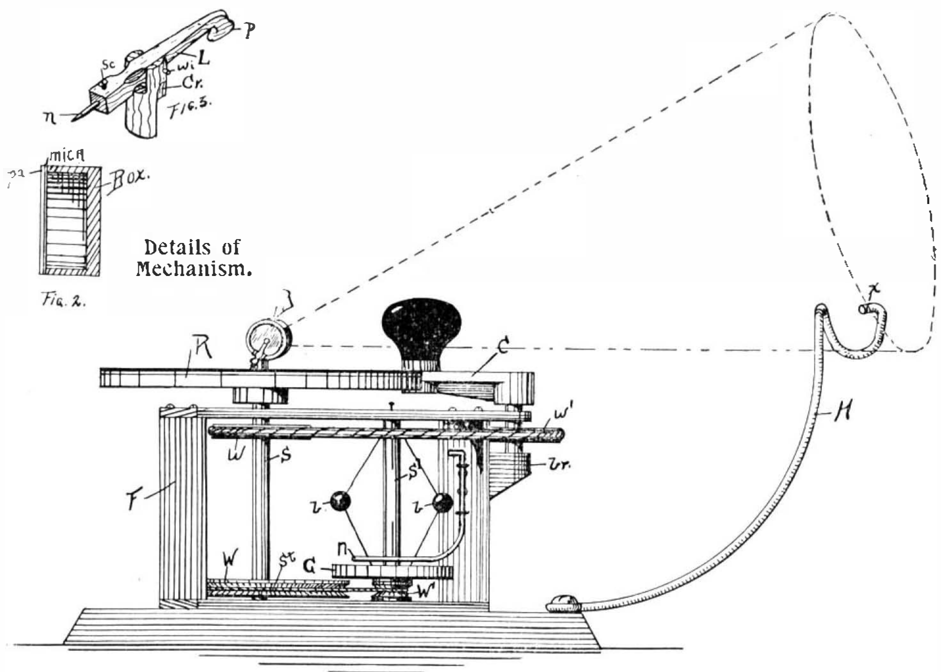
HOW TO MAKE A GRAMOPHONE.

BY WILL. B. STOUT.

A gramophone which will produce very good results with the ordinary gramophone records may be made, with very little work, by any one who can use a jackknife. It costs nothing, except for the record, and will certainly repay any boy or man who will spend a few hours making it.

As shown in the drawings, it consists principally of two parts; one for rotating the disk or record, and the reproducing part. The disk or record is supported on the circular piece, *R*, cut from half or three-eighths-inch pine, and mounted on the shaft, *s*, which, in turn, revolves in the wooden frame, *F*, which is of half-inch pine, an inch and a half wide. On the shaft, *s*, are also two pulley wheels, *w* and *W*, the former two inches in diameter, and the latter three and a half, both grooved to receive a round belt. These, too, may be cut from half-inch pine. The smaller wheel, *w*, is mounted just below the upper crosspiece of the frame, the larger one, *W*, just above the lower crosspiece, as shown.

The governor, which is mounted next to the record axle, but far enough away in the frame to clear the wheel, *W*, consists of a shaft, s^1, with the three-quarter-inch pulley, W^1, cut on it, on which is mounted a wheel, *G*, rimmed with a strip of lead from an old lead pipe. This wheel fits loosely on the axle, s^1, so that it can slide freely up and down on it. The lead rim should be at least an eighth of an inch thick and half an inch wide, or the width of the wheel, *G*. Running through two awl holes a quarter of an inch from the axle, s^1, in the wheel, *G*, is a string or small wire, as shown, which runs at the top through an awl hole driven crosswise through the axle, s^1. On this string, which is fastened from slipping through the awl holes in the wheel, *G*, by knots, are two split shot or fish-line sinkers. When the shaft, s^1, is revolved, the balls, *b*, fly out, and, when sufficient speed has been reached, lift the weighted wheel, *G*, till it presses on the wire stop, *n*. This stop is a loop of wire, fastened to the side of the frame so as to be adjustable up and down to regulate the speed. At the opposite end of the frame to the disk, or record axle, *s*, is mounted a second two-inch pulley wheel, w^1, between an extension of the upper crosspiece and a small wooden bracket, *br*. It is connected with the pulley, *w*, by a belt, and is turned by means of a crank, *C*. The pulley, *W*, is also connected with the governor pulley, W^1, by a waxed string pulley belt, *St*. By this means, when the crank, *C*, is turned, the wheel, *w*, is turned through the medium of the belt connecting the pulleys, *w* and w^1. Thus the pulley, *W*, is turned, and, in turn, the pulley, W^1, and axle and governor, as shown, the governor regulating the speed. The upper part, or surface, of the wheel, *G*, should have glued upon it a piece of flannel, to prevent undue noise when the wire, *n*, rubs upon it, and to increase the friction. The disk, *B*, should run as true as possible, and the axle should project up through it a quarter of an inch, and be as large around as the size of the central hole in the record. A record is seven inches in diameter. The sound-reproducing part consists principally of the "sounding box" and its lever, and the horn. The box may be an old wooden pill box, or may be cut from inch pine. It should be circular, about an inch and a half in diameter, inside measurement, and an inch deep. If cut of inch pine the central hole will be cut clear through the piece and a quarter-inch backing, or bottom of the box glued on. A three-quarter-inch hole is drilled in one side of the box to receive the horn. To the front of the box is glued a thin diaphragm of isinglass, outside of which is glued a paper ring, or washer, as large as the rim of the box. The writer used one machine for a while which had a tight paper diaphragm; but the isinglass is better. The box is shown in section in Fig. 2. The lever (Fig. 3) is cut out of hard wood in the shape shown; the distance from the wire axle, *wi*, to the center of the part, *p*, being the radius of the box outside. The other end of the lever is a trifle shorter than the inner end, and holds at its end the needle, *n*, in a small awl hole. This needle is held



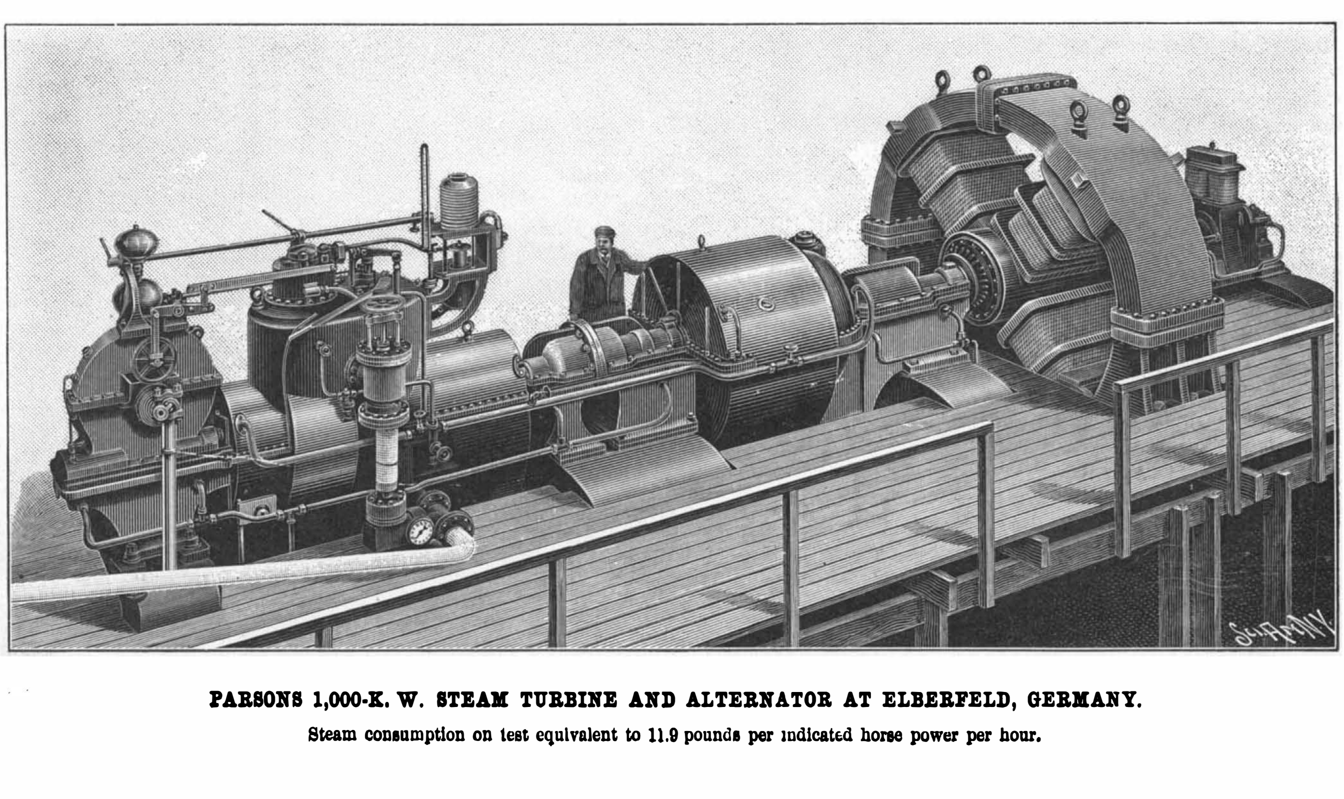
A HOME-MADE GRAMOPHONE.

in place by a small screw, *Sc*, so that its projection from the wood may be adjusted till the clearest effect is produced. The lever is mounted in a crotch, *Cr*, cut also from hard wood, the axle, *wi*, being a wire. The crotch part is glued on to the side of the box at an angle of about 120 deg., with the hole already cut to receive the horn, the part, *p*, of the lever being fastened to the center of the mica or isinglass diaphragm with glue or sealing wax. The horn, which may be made of stiff bristol board or tin, is now thrust into the hole in the side of the box or, better, fastened to the outside, so as not to obstruct the hole. If of pasteboard it may be glued in place by slitting the end and gluing on the flaps thus made. If of tin it may be soldered to a tin ring or band surrounding the box, or the flaps may be fastened on with brads.

The disk-turning mechanism is now fastened cornerwise on a wooden baseboard and a wire holder, *H*, fastened with a screw to one corner. This should reach up a little higher than the level of the record, but this may be adjusted by bending the wire. Also the distance from the needle to the guard may be adjusted in the same way till the right weight rests on the needle. A short "hook," as at *x*, may project in through a hole in the horn or funnel to keep it from turning. When all is ready put on your record, with the needle resting in its groove at the outside edge, and turn the crank. You will find by experiment how best to adjust the different adjustable parts to get the best results, but you will be surprised at the results you obtain with the crudest made machine. While not up to a machine-made product, yet it is not far behind, and for the satisfaction to the maker for the time spent in its manufacture, it "can't be beat."

PARSONS 1,000-K. W. TURBINE AND ALTERNATOR.

We illustrate a 1,000-kilowatt turbine and alternator, one of two built by C. A. Parsons & Co., of Newcastle,



PARSONS 1,000-K. W. STEAM TURBINE AND ALTERNATOR AT ELBERFELD, GERMANY.

Steam consumption on test equivalent to 11.9 pounds per indicated horse power per hour.

England, for the Electrical Supply Works of the city of Elberfeld, Germany. Before shipment one of the sets was tested by W. H. Lindley, M. Inst. C.E.; Herr M. Schröter, Professor of Mechanical Engineering at the Politechnicum, Munich, and Dr. H. F. Weber, Professor of Physics at the Politechnicum, Zurich. From the report we learn the following facts:

The specification required that each machine should have an output of 1,000 kilowatts useful effect at 4,000 volts, and with 50 complete cycles per second. The speed of the turbine was to be 1,500 revolutions per minute, and the admission of steam to the steam-chest to be once in each eight revolutions of the turbine, or 187.5 admissions per minute, so as to synchronize with the revolution of the reciprocating engine. The steam consumption was defined as follows: With at least eleven atmospheres absolute pressure, and 50 deg. Cent. (90 deg. Fahr.) superheat of steam at the stop valve, and with circulating water of not more than 18 deg. Cent., supplied at the rate of 430 cubic meters per hour for full load, the steam consumption per net kilowatt-hour, measured in the alternating current at switchboard, shall not exceed 24¼ pounds at full load, 24.9 pounds at three-quarter load, 25.45 pounds at half load and 30.8 pounds at quarter load. The consumption of steam at no load shall not exceed 2,337 pounds per hour.

The tests were made with an average superheat of 14.3 deg. Cent. (25.7 deg. Fahr.), instead of 50 deg. Cent. (90 deg. Fahr.) as stipulated for, and consequently somewhat better figures might have been attained under more favorable conditions.

When the figures are corrected to the average superheat of 12.3 deg. Cent., they stand as in Table II.

It will be seen that Messrs. Parsons exceeded their guarantee very considerably, except at quarter load. At full load they were 4 pounds below the stipulated amount.

The average variation of speed when the load was gradually altered from nothing to full, and vice versa, was 3.6 per cent. When a part of the load varying from 16 to 63 per cent was suddenly switched off, and the regulation was entrusted to the centrifugal governor, the revolutions varied from 1 to 1.9 per cent immediately after the sudden change of load, while the permanent variation in speed amounted to from 0.4 per cent to

TABLE I.—STEAM TRIALS OF TURBINE AND ALTERNATORS.

	Exact Value of Output in Kilowatts.	Steam Consumption per Kilowatt hour.		Steam Consumption in One hour.
		pounds.	kilogs.	kilogs.
Preliminary trial........	1172.7	18.22	8.26	9,689
Overload	1190.1	19 43	8.81	10,485
Normal load.............	994.8	20.15	9.14	9,092
Three-quarter load.......	745 3	22.31	10.12	7,542
Half load.	498.7	25.20	11.42	5,695
Quarter load.............	240.5	33.76	15.31	3,774
No load with alternator excited.....	0	....	....	1,844
No load without excitation..................	0	....	....	1,183

1.3 per cent. The electrical governor, under similar conditions, kept the average variation of potential within 1.1 per cent of the initial potential. Between no load and full load the drop of potential on a non-inductive load was only 1.02 per cent, or 20 per cent of that permitted by the speed. The drop of potential with inductive load amounted to 11 per cent between no load and 1,000 kilowatts.

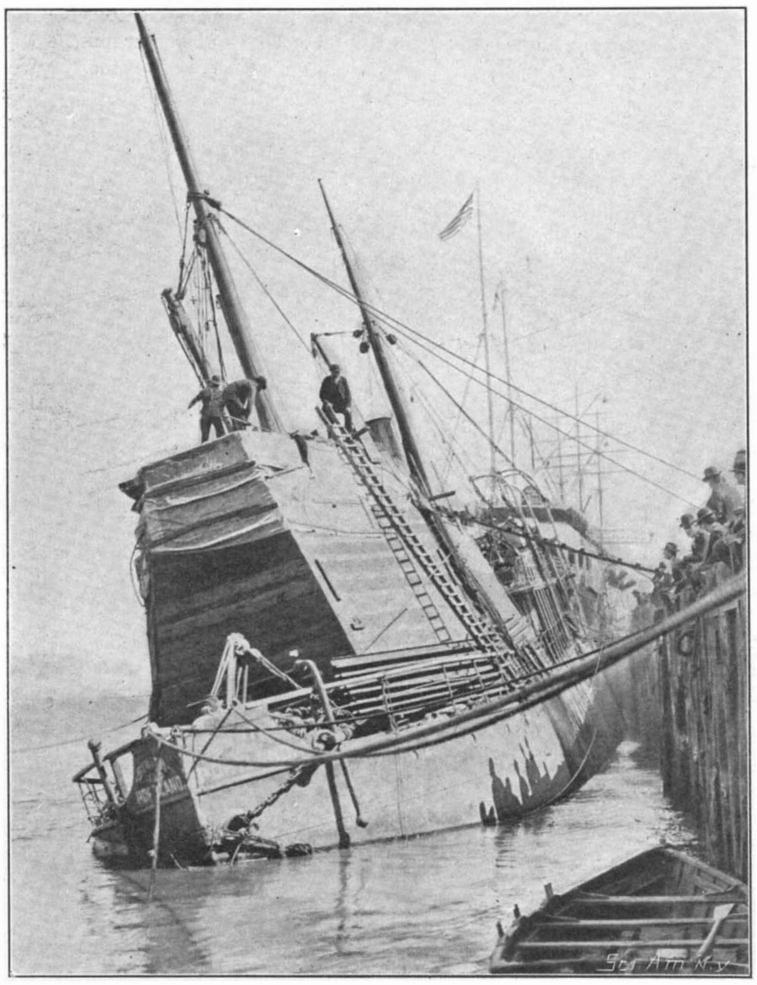
These results are superior to any that have been achieved by reciprocating engines. In a letter to the SCIENTIFIC AMERICAN, published in our issue of January 12, 1901, Mr. Parsons quoted Profs. Schröter and Weber as saying:

"At the overload of 1,200 kilowatts, and with a steam pressure of 130 pounds at the engine, and 10 deg. Cent. of superheat, the engine driving its own air pumps, the consumption of steam was found to be at the rate of 18.8 pounds per kilowatt hour. To compare this figure with those obtained with ordinary piston engines of the highest recorded efficiencies, and assuming the highest record with which we are acquainted of the ratio of electrical output to the power indicated in the steam engine, namely, 85 per cent, the figure of 18.8 pounds per kilowatt in the turbine plant is equivalent to a consumption of 11.9 pounds per indicated horse power, a result surpassing the records of the best steam engines in the production of electricity from steam under the conditions named."

For the original from which our engraving is made we are indebted to Engineering, of London.

RAISING A SUBMERGED STEAMSHIP.

The first-class iron steamship "South Portland," 200 feet in length, with a carrying capacity of 1,000 tons, arrived in San Francisco on February 5, 1901, with upward of 600 tons of lime, in barrels, in the hold. Proceeding to the seawall, the unshipping of the cargo was promptly undertaken; but when it was about completed it was discovered that fire, started by the lime, had taken hold and was spreading rapidly through the vessel. At that time there remained on board 2,000 barrels. Engines were summoned and water in large quantities was poured into the burning vessel. To the amazement of the spectators, and contrary to all expectations, the bow of the steamer began to sink, and before any attempts to prevent such an unlooked-for event could be taken the forward portion was submerged and sank in 40 feet of water. A wrecker was promptly summoned, who first directed his efforts to sustaining the portion aft which remained above the tide. This was successfully accomplished, and the best mode of preventing the ingress of water to the part submerged was then considered. Two coffer dams to cover the forward hatches were constructed, one 18 feet high, 23 feet long, and 14 feet 5 inches wide, and the other 18 feet high, 12 feet long and 10 feet wide, and secured over the deck openings. Then seven pumps, having a capacity of 71 tons a minute, were set to work, and the process of emptying the vessel began. Either the deck was too weak to sustain the weight of the coffer dams or the pressure from the water above was more than the frame of the vessel could endure, but in any event the deck between the coffer dams collapsed, and the recovery of the vessel seemed farther off than before. The two dams were taken away and replaced by one which covered the entire forward part of the deck, being 18 feet high, 54 feet long, and 24 feet wide. Pumps throwing 54 tons of water per minute were started, and in 40 minutes the "South Portland" was high and dry. At low tide the bow was 17 feet under water. The damage to the steamer was not great.



THE STEAMSHIP "SOUTH PORTLAND" WITH COFFER DAM.

TABLE II.

Load.	Guarantee at 50 Deg. Superheat.	Consumption at 14.3 Deg. Superheat.		Difference.
kw.	kilo. per kw. hour.	kilos. per kw. hour.	lb.	kilos. per kw. hour.
1250	....	8.63	19.0	
1000	11.0	9.19	20.2	— 1.81
750	11.3	9.99	22.0	— 1.31
500	12.0	11.41	25.1	— 0.59
250	14.0	15.28	33.7	+ 1.28
No load				

THE STEAMSHIP "SOUTH PORTLAND" AFTER SINKING.

The Latest German Quick-Firing Field Gun.

Profiting by their experiences of the war in South Africa, the British government is pushing forward its scheme for the rearming of the army. The initial step has been taken by ordering 120 of the new quick-firing Ehrhardt guns, which, with the exception of the latest Elswick gun, is the most efficient arm for field artillery. The Ehrhardt guns are of two calibers—the fourteen-pounder, which fires a projectile slightly under three inches in diameter, called by its inventor the "normal gun," and another which carries a projectile slightly over three inches in diameter.

The Ehrhardt gun differs from the existing type of arms in the use of steel tubes, which are manufactured by a special process, instead of using solid metal for the carriage and mountings. By this means the minimum of lightness consistent with the maximum of strength is insured, and the handling of the piece is facilitated. The energy of the recoil is absorbed by a hydraulic brake.

The weight of the gun, without its carriage, is 8½ hundredweight; the carriage represents nearly 10¾ hundredweight, and the limber, with its complement of one hundred rounds of ammunition, about 30 hundredweight. The length of the barrel is 7 feet 7½ inches—thirty-one calibers.

The ballistic energy of the arm is great. A projectile weighing 14 pounds is discharged at a velocity of 1,740 feet per second. The velocity, however, decreases so gradually that at a range of 600 yards the aim is almost point blank. At 3,300 yards the velocity diminishes to 965 feet per second. With the larger gun even greater velocity is attained, resulting in a flatter trajectory of the projectile and greater accuracy in the aim. The powder employed is about one pound of a high explosive. The rapidity of fire is about sixteen shots per minute.

But it is claimed that the greatest effect obtained with this arm is in the discharging of shrapnel. The Ehrhardt shrapnel shell is formed out of white-hot, solid steel, and then drawn through successive narrow rings to toughen the metal and to render it more elastic. Each shell is filled with 300 bullets, each weighing about a third of an ounce. The fuses are regulated by hand, without any mechanical assistance, the burning period being 20 seconds, sufficient to make them effective at a range of about 6,000 yards. It is claimed that the maximum rapidity of fire with shrapnel would concentrate a ceaseless stream of 5,000 bullets a minute upon any desired area.

Public telephones will soon be installed on street corners in New Haven. They will somewhat resemble fire boxes. On each of the four sides is the well-known blue bell. The box is ordinarily locked, but is opened by dropping a coin into a slot. When the door is open the process of obtaining telephonic connection is the same as at any public pay station, the telephone list being hung against the door. When the receiver is hung up, the door shuts automatically.

ARMY TRANSPORT SERVICE IN THE PHILIPPINES—II.

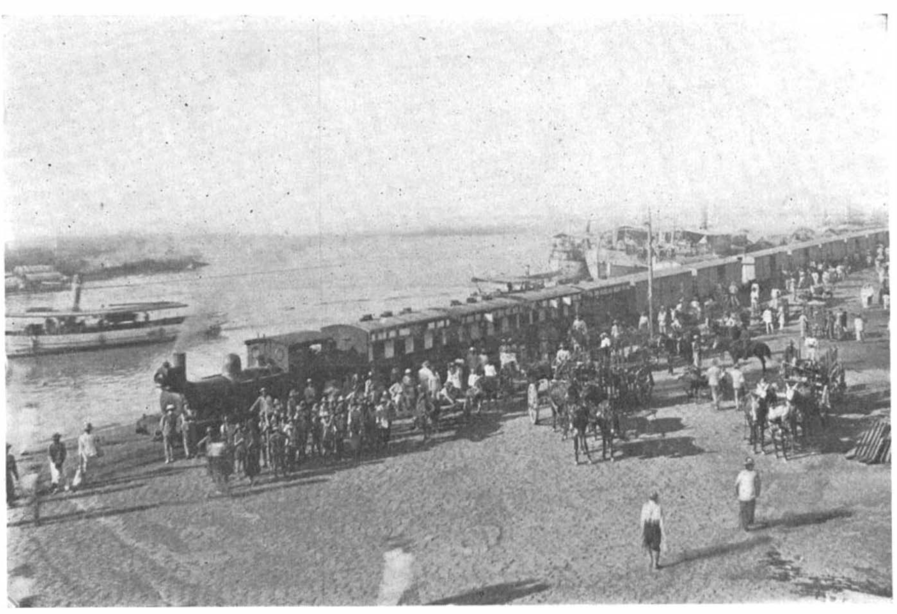
In the SCIENTIFIC AMERICAN of March 23 we gave some account of the Quartermaster's Department of the United States Army, and illustrated the fine fleet of transports which is engaged in carrying troops and supplies to the Philippines and our West Indian possessions. The United States Army transport service is under the direction of General Charles Bird, with headquarters at Washington, D. C., with two General Superintendents, Major C. A. Devol at New York, and Major O. F. Long at San Francisco. By the courtesy of Major Devol, we are enabled to present a second series of illustrations, dealing with the headquarters of the Quartermaster's Department in Manila, and the system employed in distributing troops and supplies from that center throughout the Philippine Islands.

When the transports conveying the United States troops that were to cooperate with Admiral Dewey's fleet arrived in Manila Bay, the shoalness of the water necessitated their anchoring some two miles from the Pasig River, which flows between the towns of old and new Manila, and along whose banks are located the only wharves and dockage facilities of which the city can boast. Having brought the troops to Manila, the immediate and pressing question to be solved was how to land the army with its baggage and general impedimenta. In times of peace lighterage at Manila has been carried on by means of a native scow or barge, known as the casco; but the thunder of the United States guns had scared away the native watermen, who had fled to hide themselves and their craft up the river Pasig, and in the creeks and inlets of Manila Bay. There was nothing for it but to search out the owners of these craft and by suasion or force bring them into service. As fast as the cascoes were discovered, a soldier was placed upon each, and they were utilized as lighters. It was not long before the rumors of good treatment and good pay by the Americans brought the natives from their hiding places, and within a few weeks the Quartermaster's Department had over a hundred of these boats, duly numbered and registered, employed in the lighterage service. The casco is a broad, shallow barge, with a bamboo deckhouse at each end, in which the owner and his family live and sleep, very much in the same manner as the canal boat population on our own Erie Canal. Along the side of the casco, from stem to stern, there is rigged out a platform of bamboo poles. By means of this runway and a long pole the boatman propels his craft. One end of the pole is placed upon the river or harbor bottom and with the other end against his shoulder he walks from bow to stern of the boat, pushing the craft forward and away from him with his feet. Each casco is capable of accommodating 100 men and 25 tons of freight.

The native system of poling the boats was altogether too slow for army transport work, and accordingly Major C. A. Devol, to whom fell the difficult work of organizing a system of unloading, storing and redistributing the army supplies at Manila, purchased for towing purposes a fleet of eleven Chinese-designed and Chinese-built launches of the kind which are illustrated on the front page of this issue. These launches, which are 75 and 80 feet in length, and can make 10 knots an hour, are built at Hong Kong by Chinese firms for general transport service in Hong Kong Harbor and on the Canton River. The plans and workmanship of the hulls, boilers and engines are entirely Chinese, and in view of the competition in all lines of manufacture to which Europe is certain to be subjected as soon as China is more thoroughly awakened to the sense of her own potentialities, these launches are extremely interesting. We are informed that they have proved to be stanch and seaworthy, and that the engines and boilers have given satisfactory service. The finish, both of the boats and their machinery, is very rough, the Chinaman evidently having an eye to profits and not putting any more work upon them than is absolutely necessary. The 75-foot launches cost $7,500 and the 80-foot launches $8,000 apiece. These launches are assisted in the work of towing by several smaller launches, of the regular navy type. In addition to the 116 cascoes, the department works 15 lorchas, the latter being a native lighter of some 60 tons capacity, which is decked over and carries a deck-house in which perishable freight can be shut in from the weather and locked up. One of the 80-foot launches is capable of towing five or six cascoes at a time, and as about 100 men can be accommodated on the launch itself at every trip, some 700 men, together with two days' rations and camp equipment, could be carried from the transport to the docks by each tow. As there were sometimes as many as fifteen transports in Manila Bay at once, all landing horses, troops and supplies, it can be understood that there was ample work to keep the fleet of launches and cascoes busily employed. Coaling the transports was carried on also from the same cascoes, each of which would take out 20 tons of coal to the ships, the transfer of the coal from the cascoes to the bunkers being accomplished by Chinese "coal coolies," who carried the coal in baskets slung from poles, there being two men to each basket.

Launch Towing Loaded Cascoes from the Transports to the Docks at Manila.

Bamboo and Thatch Barracks for 1,200 Men Built by Chinese Contractor in 23 Days.



Terminus of the Manila and Dagupan Railway at Manila.

ARMY TRANSPORT SERVICE IN THE PHILIPPINES.

As there is an army of from 63,000 to 64,000 men in the Philippines scattered among 400 separate stations, of which over a hundred are located on the coast lines of the various islands, it can be understood that the work of redistributing the supplies is a task of a very formidable nature. The redistribution to coast stations throughout the islands was accomplished by means of a fleet of eleven steamships of about 350 tons burden. One of these ships will be noticed anchored in the Pasig River. (See front page illustration showing the Quartermaster's hay and grain stores.) These little vessels, which are of a type which has been developed by the necessities of the inter-island trade, can steam from 9 to 10 knots an hour, and have proved to be just the thing for the needs of the department. The Dagupan Railway, which runs from Manila northward to the coast, forms, of course, the main line of distribution for the island of Luzon. From the various points on the railroad, supplies are carried to the many stations and commands in army wagons, drawn either by mule teams or by the water-buffalo, a native animal which has proved itself invaluable during the rainy season in this campaign. Give the buffalo his time, and he will cover about 1½ miles an hour. He is not so rapid as the mule team, but he has the advantage that he will push his way steadily through swampy districts, going for hours with water up to his belly. The mule, on the other hand, has small feet, and knows it, refusing to haul in ground where the footing is insecure. The buffaloes are used with the native cart and native drivers, and they cost the department about $3.25 a day Mexican money, $1.62½ gold. Where the country is suitable the regulation army wagon with four mules is used, and where roads are not available the supplies are carried by mule pack-trains.

One of the first things to be done in making Manila the distributing center for troops and supplies was to provide suitable storage and barracks. Our large front-page engraving shows the Quartermaster's depot on the left, and further down the wharf is seen the depot of the Commissary Department, which is responsible for providing all the food supplies for the troops. Another of our engravings shows the method of storing at Manila the hay and grain, of which enormous quantities have to be carried to the Philippines, the islands not furnishing either sufficient or suitable supplies of this kind. As the stores are unloaded from the lighters, they are placed on trucks and run into the shed by means of temporary tracks which have been laid down by the department. Another view shows a group of barracks buildings sufficient for the accommodation of 1,200 officers and men, which was erected by a Chinese contractor, employing native and Chinese labor. The barracks consist of six buildings, 35 feet wide by 250 feet long, seven smaller buildings for officers' quarters and six lavatories and bathroom buildings. The woodwork or framing, which is built entirely of bamboo, was constructed by Chinese carpenters, and the thatching was done by the native Filipinos. The Chinese contractor engaged to put up these buildings for $32,000 in thirty days. The morning after signing the contract he had 500 laborers at work, and the whole barracks were ready for occupation in twenty-three working days. We are indebted for our illustrations and particulars to Major C. A. Devol, Superintendent of the Army Transport Service at New York.

Gases Produced by Bacteria.

W. C. C. Pakes and W. H. Jollyman have described before the Chemical Society a new apparatus for the collection of the gases produced by bacteria when grown either under aerobic or anaerobic conditions. Experimenting with the *Bacillus pyocyaneus*, which is supposed to be a strictly aerobic organism, they found that it grew in media containing 1 per cent of potassium or ammonium nitrate under the strictest anaerobic conditions, as the term is at present understood (that is, in the presence of hydrogen, or in the absence of any gas). They concluded, therefore, that the terms aerobic and anaerobic must be extended to include the presence of oxygen in the form of nitrates. Upon analyzing the gases produced by the organism from media containing nitrates, they found that both free oxygen and free nitrogen were evolved, the former in small quantities, but constantly.

At the collieries of the John Cockerill Company, in Belgium, concrete has been used instead of brickwork for lining circular shafts, drifts and other passages with great success.

Composition and Nature of the Red Rain.

BY DR. T. L. PHIPSON.

The newspapers of various countries of Europe have recently called attention to a red rain which fell between the 11th and 13th of March, 1901, in Sicily, Naples, Leghorn, Venice, Coburg, Hamburg, Schleswig-Holstein, and at Malvern, in Worcestershire.

The deposit left by this rain in the form of an exceedingly fine dust is described as reddish or fawn-colored, and greasy to the touch. At Leghorn 4½ grammes were swept from the marble table in front of a café, and it was calculated from this that many thousands of tons of this fawn-colored dust must have fallen throughout Italy between the dates above-mentioned.

I am indebted to Capt. C. J. Gray, F.R.G.S., for a small quantity of a precisely similar product that fell with the rain at Melbourne, Australia, on the 12th of December, 1896, and I have submitted it to as full an examination as the very minute quantity would allow.

In my recently published work, "Researches on the Earth's Atmosphere," I have alluded to salt rain, and to colored rain produced by volcanic ash, or desert sand uplifted by the wind and suspended in the air; there have been also blood-red deposits found upon the ground, which consist of cells of the *Protococcus nivalis*, or *Palmella sanguinea*, and similar microscopic plants that have shown themselves after a fall of rain or snow. I have invariably found abundance of unicellular algæ in the first fall of snow in early winter, and the red rain deposit examined formerly by the French chemist Cahours (in 1852) was found to consist of organic cells, and burnt away entirely, leaving little or no residue.

The fawn-colored dust left by red rain is, on the contrary, of a mineral nature; it is always similar in color, fineness, and microscopic appearance. I have made a careful examination of this reddish deposit, and the result has been rather unexpected and interesting.

When dry it is of a fawn-color, rather paler than oxide of cerium, but becomes darker when wet. Under the microscope it is seen to consist of exceedingly minute grains, *mostly flat*, and of various colors; they are also of various shapes and sizes. The largest are about 2-100 of a millmeter; the greater number are about 5-1,000, and the smallest 5-100,000 of a millimeter in diameter. The irregularity of their forms gradually disappears as they get smaller, so that to the eye the smallest appear circular. Many are white, and more or less transparent, gray, greenish-gray, slate-colored; others are yellow, and brown, and translucent; a few are ruby-red, and others are dark and opaque.

When calcined at a red heat this dust darkens, and loses 14.3 per cent of water and organic matter (this is exactly the amount of water and organic matter found in the Orgueil meteorite). On cooling after calcination it becomes fawn-colored again, and the colors of the grains seen under the microscope have not been much altered by calcination.

When boiled in hydrochloric acid (finally adding a few drops of nitric acid), a notable portion is dissolved, and yields a solution containing *iron*, and other substances, *among which is nickel.*

After this boiling in acid the fawn-color becomes much darker, similar to the dark crust seen on meteorites where it is very thin. Having placed the existence of nickel in this substance beyond doubt, I am of opinion that it is partly, if not wholly, of cosmic origin, and not merely desert sand uplifted by the wind, nor volcanic dust; it would appear to be the mineral dust left in the higher regions of the air by the explosion of meteors, or shooting stars.

The only thing that makes me hesitate to assert this absolutely is the fact that oxide of nickel has once been found in the *rapili* of the Kölerberg, in Silesia, to the extent of 0.1 per cent (the analysis by Zulkowski is given in my work on "Meteors, Aërolites, and Falling Stars," p. 118). In the fawn-colored products of the red rain I estimate that there is considerably more nickel than that, more than ten times as much; and in the ash or cinders of Etna and Hecla no nickel has ever been found, nor in those of Vesuvius.

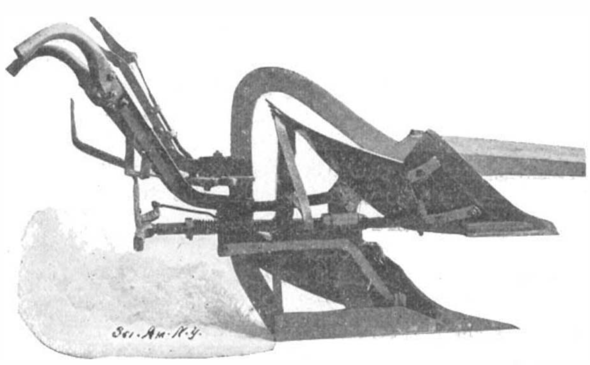
I may add to this that both March and December are known to be meteoric "periods."—Chemical News, London.

The forestry division of the Department of Agriculture is engaged in drafting a working-plan looking to the conservation of timber on a tract of 300,000 acres in the neighborhood of Millinocket, Me., belonging to a private paper corporation, says The New York Tribune. It is a part of the general policy to be inaugurated by the department for the conservation of timber land throughout the United States to secure a perpetual crop of timber in the areas under consideration. The private concern will pay all the expense of the work, except the salaries of the government experts, who are directed by Prof. Pinchot.

AN IMPROVED PLOW.

Plows provided with two shares and moldboards located at opposite sides of the beam and with mechanism for bringing either share and its moldboard into operative connection with a common landside have proven highly efficient. But the construction has not always been of the simplest. To secure this simplicity of construction is the primary object of an invention for which John N. Hanna, of Moline, Ill., has taken out a patent.

The arched beam of the plow has guided movement horizontally in a slotted plate provided with teeth which are to be engaged by a spring-controlled thumb-latch on the handles of the plow. By this arrangement, the beam can be swung from side to side on



AN IMPROVED DOUBLE-SHARE PLOW.

the plate and locked in place by the thumb-latch. Friction-rollers both facilitate and guide the movement of the beam.

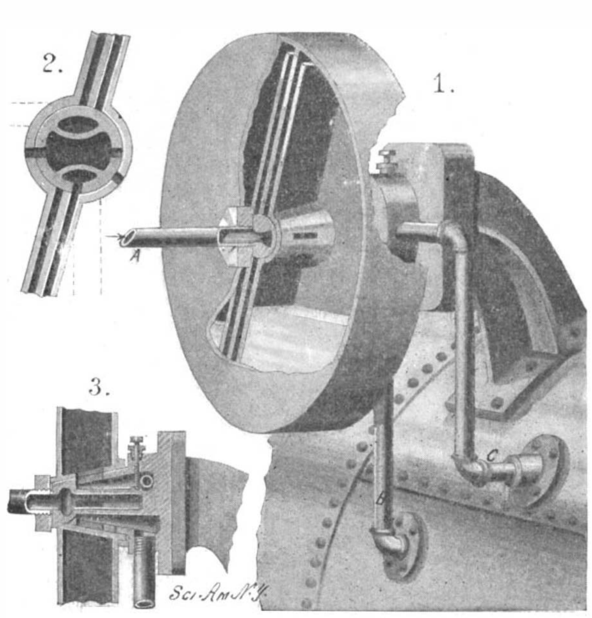
The plate referred to is supported on a standard, which in common with a second standard at the front is secured at its lower end to the landside. In these standards above the landside a tubular shaft is mounted to revolve, to the rear end of which a lever is pivoted connected with a guide beneath the handles. A slotted projection is formed on the upper surface of the landside near its forward end. Through this slotted projection an arm passes, which, together with a slotted bar sliding on the standards, constitutes a locking device to lock the moldboards to the landside, the slotted bar being operated from the lever previously mentioned by means of a link. A spring on the shaft acts to force the slotted bar forward. The combined moldboards and plowshares are located one at each side of the shaft. The moldboards are connected by straps and are provided with eyes adapted to enter the space between the members of the slotted projection on the landside and receive the arm carried by the slotted bar of the locking device.

The beam can be directed at its forward end to the right or to the left without interfering with the position of the supports for the beam and the position of the moldboards and shares. By moving the lever to the right or to the left either one or the other of the combined moldboards and shares can be brought to the ground. When one moldboard and share are in working position, the other moldboard and share will be held out of the ground. The arch of the beam permits the use of a large moldboard.

The characteristic features of the invention are the ease and rapidity of operation and the convenient reach of the lever.

AN AUTOMATIC BOILER-FEEDER.

The boiler-feeder shown in the illustration automatically maintains the water in the boiler at a certain



THE RICE AUTOMATIC BOILER-FEED.

level by employing the steam-pressure as a means of forcing water into the boiler. The invention has been patented by Jasper N. Rice, of Bethany, Mo.

The boiler-feeder comprises a shell having three superposed compartments, the central one of which communicates with a water-supply pipe, the uppermost of which is connected with a steam-pipe leading from the boiler, and the lowermost of which conducts the water from the shell to the boiler.

On this shell a drum is mounted to rock, which drum is divided into two compartments by a diametrical partition adjacent to which are false partitions forming passages from the outer part of the drum to the shell. The hub of the drum has ports communicating with the passage and with ports in the steam and water compartments of the shell.

When the ports of the central shell-compartment and of the drum-hub are in register, the water from the supply pipe flows into the drum. Steam enters the drum by way of the upper shell-compartment and passes through the upper drum-passage (formed by the true and false partitions) when one of the ports of the upper shell-compartment registers with the corresponding drum-passage. The pressure of the steam forces the water in the drum up through the lower drum-passage into the lowermost shell-compartment and thence into the boiler.

The various ports of the drum-hub and shell are arranged to move into and out of registry, such movement being brought about by the regular rocking of the drum, which in turn is due to the preponderance of water in one of its two compartments. The central compartment of the shell, as we have already remarked, communicates with the water-supply. As the water is sprayed into the compartments of the drum, the steam in the corresponding drum-compartment is condensed, thereby producing a partial vacuum and insuring the passage of the water into the drum. The operation once started continues automatically until the rising water in the boiler closes the steam-pipe and thus temporarily arrests the action of the feeder.

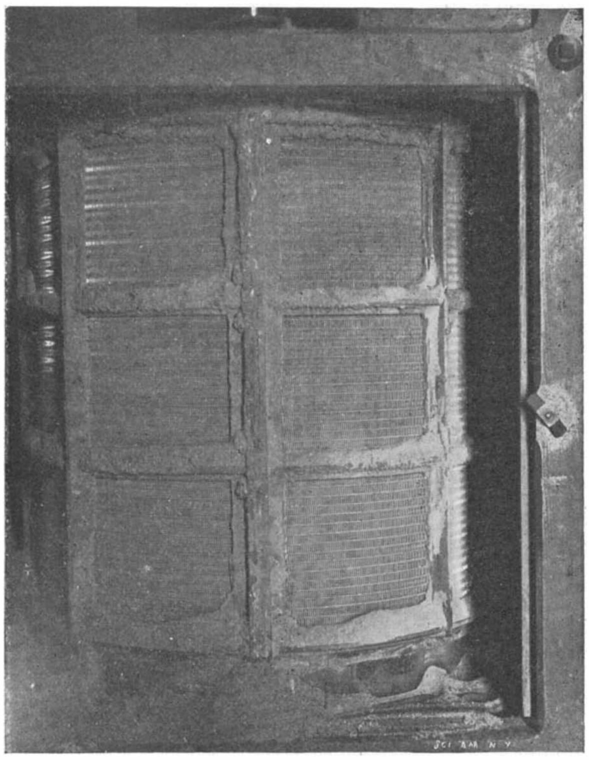
Automobile News.

Consul-General Guenther, of Frankfort, February 23, 1901, reports the appearance at Nuremberg of the first automobile sleigh. The vehicle glides along with great speed and a perfectly easy motion. It was constructed by the Nuremberg Motor Vehicle Factory Union.

The Automobile Club of France has organized its second competitive test of accumulators, which will commence the 1st of June and last one year. It will be held at the laboratory of the club in the suburbs of Paris. These tests will be carried out upon somewhat the same lines as last year's tests, which were held in the club building. In one of the rooms on the ground floor was mounted a four-wheeled wagon truck with rubber tired wheels, and below the floor was a motor-driven device by which a wheel carrying a series of projections was rotated rapidly underneath the tire, giving the whole truck a series of jolts resembling the shaking which an automobile would receive upon the road. The truck had a platform upon which the batteries were mounted, each in its appropriate box. The batteries were charged and discharged at intervals, and a series of measurements taken. The rules of the contest, which have lately been published, may be briefly stated as follows: The tests will have reference to the industrial efficiency of the battery, or the relation between the output and the energy of charge; the frequency, importance and nature of the operations of keeping in order and of repairs; the energy furnished compared with the weight of the battery; the cost per kilowatt-hour of output, taking into account interest and repairs. The number of batteries is not limited; each competitor must present two batteries of the same type of plate, also a complete descriptive notice with the necessary drawings and samples, stating the price of the battery and parts. An extra cell, without liquid, is to be kept under seal. Each battery, composed of an appropriate number of cells and contained in a suitable box, must furnish 120 ampere hours' discharge and its potential must not fall below 8.5 volts upon a régime of 20 amperes. The batteries will be ranged in two classes; first, those of great specific capacity and slow discharge, maximum weight 132 pounds; second, those of small capacity and rapid discharge, up to 208 pounds. The tests will be carried out in periods of 6 days; during each day they will undergo a 5 hours' shaking upon the machine, while discharging at a variable rate which is previously laid out. The load is varied by a revolving commutator turning once every half hour and throwing on a greater or less number of lamps. Each turn corresponds to a quantity equal to 12 ampere-hours. The load varies from 20 to 100 amperes, but the latter current is applied for only half a minute. The sixth day the batteries will have a constant discharge of 24 amperes for 5 hours. The charging will be carried out at 12.5 volts. The energy, voltage, and current will be accurately measured by a series of instruments, and the efficiency of each battery, its capacity, potential, etc., will be recorded. The club will award diplomas or medals to the successful competitors. For each group of two batteries the entry fee is $100 to the 1st of May, and $200 to the 25th, the limiting date. A complete list of the rules will be furnished upon application to the club.

A WHEAT HOSPITAL ON LAKE SUPERIOR.

The loss to American farmers every year through wet, dirty, or diseased wheat is very large. It is estimated that the loss from the loose smut alone is at least eighteen millions of dollars per year. Much in-



JACKET OF SCOURING MACHINE.

formation has been disseminated among the farmers in the way of bulletins from the Department of Agriculture in Washington, and from the various State Experiment Stations in wheat-raising States, describing the various diseases of wheat, showing how to treat the seed wheat so that it will not continue the infection, and providing remedies of various kinds.

The same conditions prevail in Canada, in the large wheat-raising regions in Manitoba and the Northwest. In order to prevent this great loss, or, at least, to reduce it to a minimum, a wheat hospital has been established at the northwestern end of Lake Superior, in Ontario, at a lake port, the little city of Port Arthur. In this hospital diseased and damaged wheats are restored to health by an elaborate system of treatment. Indeed, so apt is the figure, the institution where the work is done has come to be known in current phrase as "the hospital," and the name fits well.

It is, in reality, a large elevator in form, having many of the accessories of the common grain elevators of the States and Canada. It is built in the lake itself, upon piling and strong crib-work, so that the ships which carry the cured patients to the larger cities of Canada, or to the East for shipment direct to England, may come alongside to take on their cargoes. The hospital receives and cares for two millions of bushels of wheat per year.

Of course it would be impossible for the attendants to restore to health a patient suffering from the more virulent type of smut, the "stinking smut" or "bunt," as it is called, for, in the advanced stages of this disease the whole kernel becomes infected and is but a mass of germs or spores, which have appropriated to themselves all the nutritive parts of the wheat and rendered it but a thin shell, the breaking of which sends forth a countless number of spores bearing a pungent, fetid odor, very disastrous in its effects upon any flour with which it might come in contact.

But such kernels as are not injured inside the brown skin that surrounds the healthy wheat, are susceptible to treatment even though they be so black with smut or dirt that their original color cannot be distinguished. In addition to all the wheats which may be thus afflicted, there is a large class which may be said to have dropsical tendencies—such wheats as are so saturated with water from one cause or another, that they are unfit for milling and, as a rule, are either burned or thrown away or utilized, as far as possible, for the feeding of stock. In certain seasons there is much of this wet wheat. Frequently it causes great loss to the farmers, sometimes the total loss of an entire crop. Methods of home treatment are not likely to prove availing, and the patients are given up for lost.

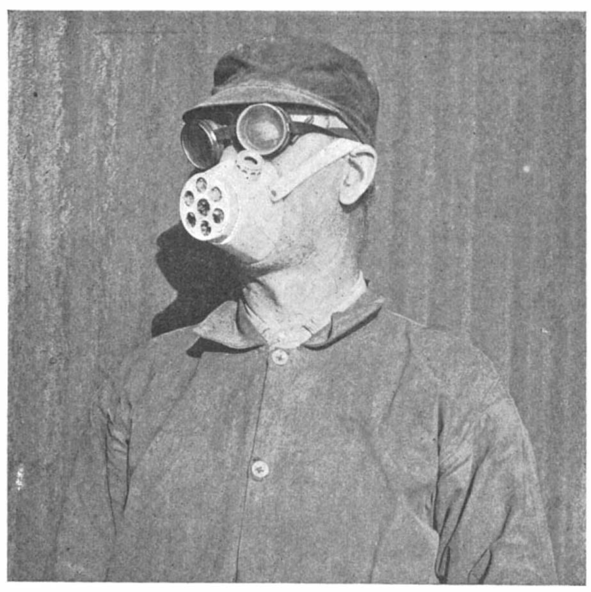
The hospital contains an elaborate drying plant in which six thousand five hundred bushels of wet wheat may be dried per hour. It consists of a series of upright frames, perhaps an inch and a half in thickness and about three feet by ten in size. These are made of perforated metal; they are, in fact, huge flat cases in which the wheat is held while streams of hot air, or warm air, are passed through them to reduce the moisture. The wheat which must pass through this treatment comes in three classes:

1. "Tough" wheat, which contains about four and one-half per cent of water above the normal amount.

2. "Damp" wheat, which has seven and one-half per cent of moisture.

3. "Wet" wheat, having an excess of from eleven to fifteen per cent of water.

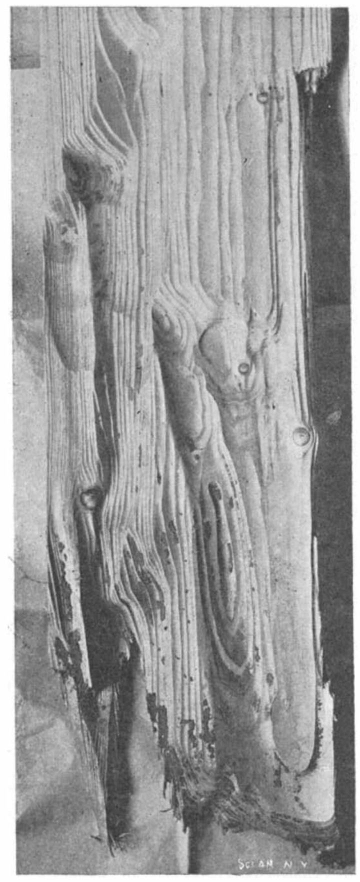
Normal wheat contains about four per cent of mois-



ATTENDANT IN A WHEAT HOSPITAL, SHOWING FACE PROTECTOR.

ture. When the wheat having an abnormal amount of moisture has been given the hospital treatment it comes out in fine condition for milling and has lost all the way from one-half a pound in weight to five pounds, the excess being water.

The entire treatment of wheat which comes in for treatment for dirt or smut might be condensed into one word—scouring. The wheat which is dark with



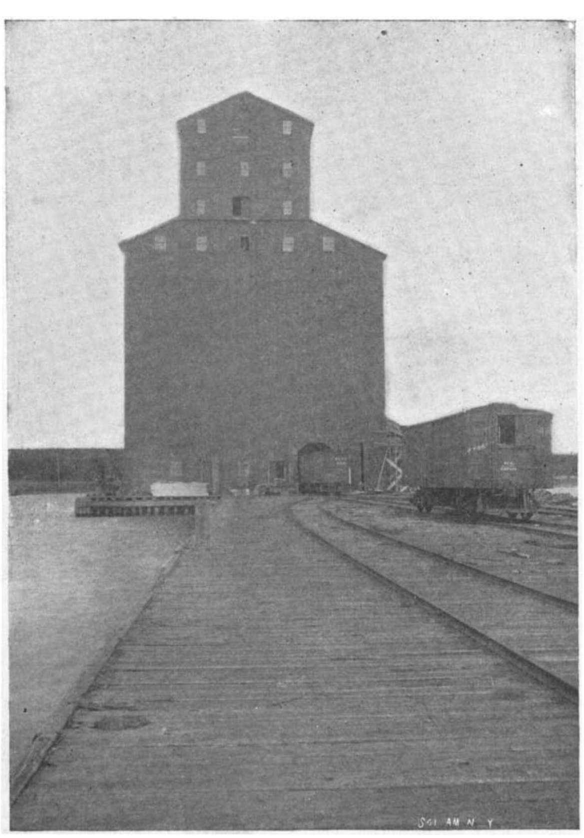
PLANK SHOWING EROSION BY WHEAT KERNELS.

dirt, but which has an honest kernel beneath its coat of black, is literally scoured between pieces of metal, passing through a rapidly revolving machine which so turns and tosses and burnishes the wheat that it comes out as clean as though it had never been contaminated.

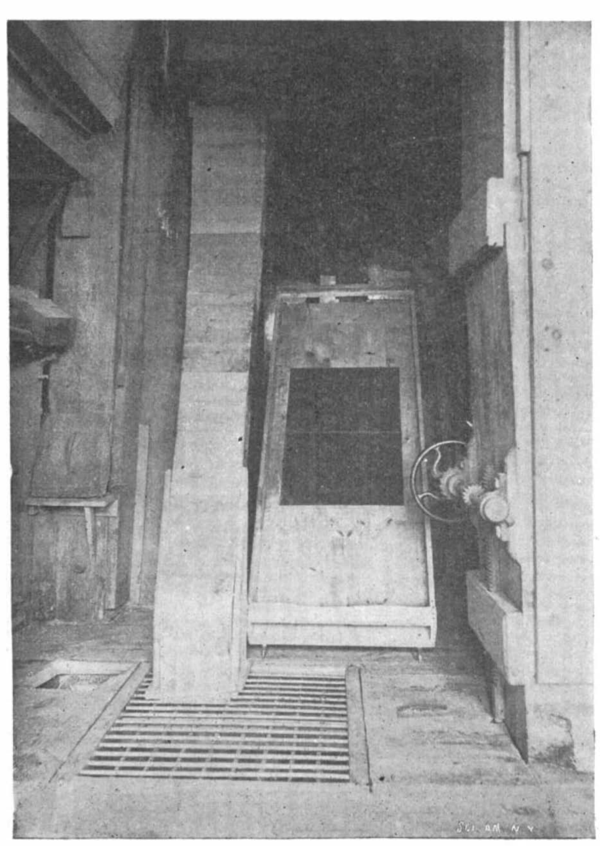
Naturally, a large amount of dust is thrown off in the hospital, so much, in fact, that the employes are compelled to wear face masks, which are made of a hard white rubber with holes in the sides in which are pressed bits of sponge to absorb the dust as the workmen inhale the air. The workmen present a curious appearance when, in addition to these masks, they wear a pair of huge, close-fitting goggles, completely covering their eyes. One might easily imagine them strange, half-human animals, so unreal are their looks.

In certain phases of the treatment the wheat falls from the upper portion of the elevator a long distance down to a lower floor, or may be, in other cases, flung out against the sides of covering frames. In either case, a remarkable thing is observed—the flying wheat will, in the course of a few months, completely wear out a pine plank two and one-half inches in thickness.

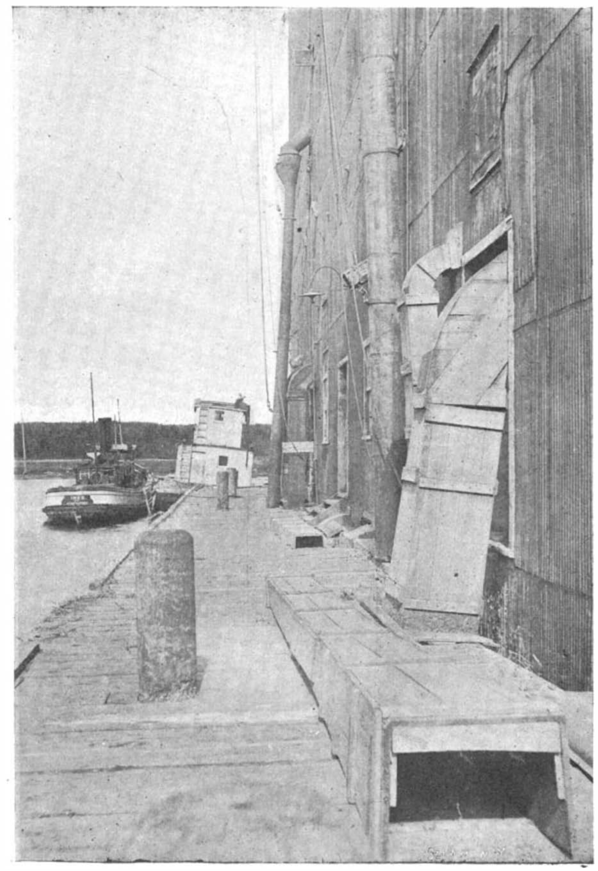
The wheat which is thus put through a course of



"WHEAT HOSPITAL," PORT ARTHUR, CANADA.

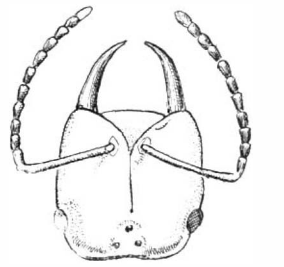


DISTRIBUTING ROOM.

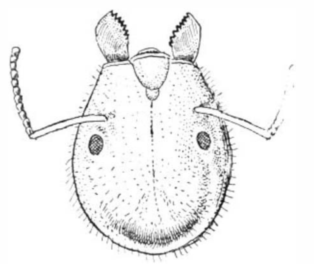


"CURED" WHEAT BEING LOADED.

treatment in this Canadian hospital is said by those who conduct the treatment to be in a better condition for the miller than it would be if it had come in as regular normal wheat, the reason for this claim being found in the fact that when the wheat has recovered from its illness it has lost a non-essential part of its outer coat which would have to be removed anyway when put through the regular milling process. So far as I know, none of this wheat is ground for flour in the United States, all of it going to Europe, mainly to England, or to various Canadian towns and cities in the eastern part of the Dominion. Whether the millers of the United States would consent to use the flour which had passed through a similar hospital treatment on this extensive scale or not, is a matter of question, though in seasons of shortage it might be found practicable, provided the kernel was up to the proper grade. There can be no question, however, as to the interest sucl a hospital in this country would have for such fa.mers as suffer loss from any one of the various diseases which the Canadian hospital treats.



HEAD OF WARRIOR ANT.
Showing pointed and curved mandibles unfitted for work.



HEAD OF WORKING ANT.
Showing toothed mandibles.

SOME NEW FEATURES IN ANT LIFE.

BY J. CARTER BEARD.

The recent discoveries of Wasman, Florel, Belt and others, added to the wonderful results of the investigations made a few years ago by McCook, Moggridge and Bates, have deservedly awakened a new interest in everything connected with the lives and habits of ants. The remarkable evidences they exhibit of something which, notwithstanding its limitations, seems akin to human intelligence; the perfection, as compared with other insects, of its physical structure; the greater porportion borne by the brain to the rest of the body; and its wonderful social life, so much more highly developed than that of the bees or of the wasps, have inclined those who study it the closest to believe that, making allowance for the great inferiority of the class of invertebrates, the Formicadæ certainly hold among invertebrates a rank commensurable with that sustained by Primates, including man, among vetebrates.

Taking into account the comparatively enormous masses of brain matter belonging to a number of large animals which exhibit a marked degree of incogitance, and the intelligence manifested by members of this division of Hymenoptera, the claim made by Darwin that the anterior ganglion in the head of an ant constituting its brain "is the most marvelous atom of matter in the world," is justified.

The hippopotamus, in the tremendous lapse of time which has attended its evolution, has learned scarcely more than to fulfill the simplest and most obvious requirements of nature, while the ant has developed competence that in some instances has anticipated mankind in acquiring arts and industries indispensable to the well-being of social life, and a practical wisdom in adjusting the conditions which govern them in their association in communities quite beyond anything mankind has yet been able to achieve.

It is interesting to notice how diverse are the methods adopted by invertebrate intelligence from that of man in attaining a desired result. Man looks entirely to the outside world about him for the means of accomplishing his purposes; insects, on the contrary, drawing upon the resources of their own natural constitutions, often adapt themselves to the conditions and requirements of their lives by structural modifications. For instance, men make the tools they require for carving or for digging, insects grow them; vessels being needed as receptacles for liquid food, man learns the art of the potter, but the curious honey ants (*Myrmecocystas melliger*, of Llave; *M. nortusdeorum*. McCook; *Camponotus inflatus*, Lubbock) transform themselves into living bottles, to which the working members of the commune resort for refreshment.

The tools of insects, exquisitely fashioned and finished, are much more perfectly adapted for the purposes they serve than are any contrived and manufactured by human beings, but there is a disadvantage connected with them—they cannot be laid aside. The tools dominate the tool-bearers and check development in any direction not connected with their use.

This leads to the extreme specialization we find among insects. Species or varieties among species become mere functional organs in the sense that the liver or the kidneys are such, devoted and limited to some one particular use, and in some cases scarcely retaining a suggestion of possible action in any other. The egg producer, the queen of the termites, although she possesses the usual number of limbs belonging to her species, is totally incapable of locomotion, as are the living bottles of the honey ants. The queen lays eggs; she can do nothing else; the living bottles store up and yield food to other members of the formicary, and are as incapable of performing other uses as if they were mere lifeless cells in a honeycomb.

Among the Formicadæ this tendency to specialization has resulted in establishing species limited to particular industries or to particular methods of living. Some species of slave-making ants, for instance, confine themselves so entirely to military affairs, and have so entirely lost the arts of peace and efficiency in domestic matters, that they are not only obliged to depend upon their slaves to care for the young in the formicary, but to have the food placed in their own warlike mouths, and would starve in the midst of plenty were this not done.

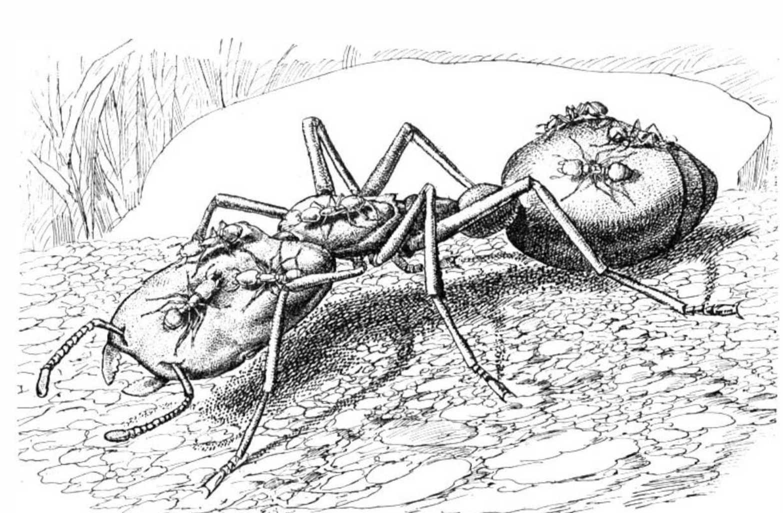
The mandibles of these ants, *Polyergus rufescens* and *P. lucidus*, the former a European, the latter an American species, are entirely unfitted for work. They can neither crush, cut nor saw; but, being sharply pointed and curved, they make most serviceable weapons; with them in attacking an enemy, Polyergus seizes the head of her foe between the points of these curved poignards and penetrates the brain at once.

It sometimes happens, however, that either the conditions are such that the instincts common in a greater or less degree to all species of Formicans cannot be followed out in any ordinary manner, or that Nature has failed to provide in the structural development of the insect proper appliances necessary to its domestic economy.

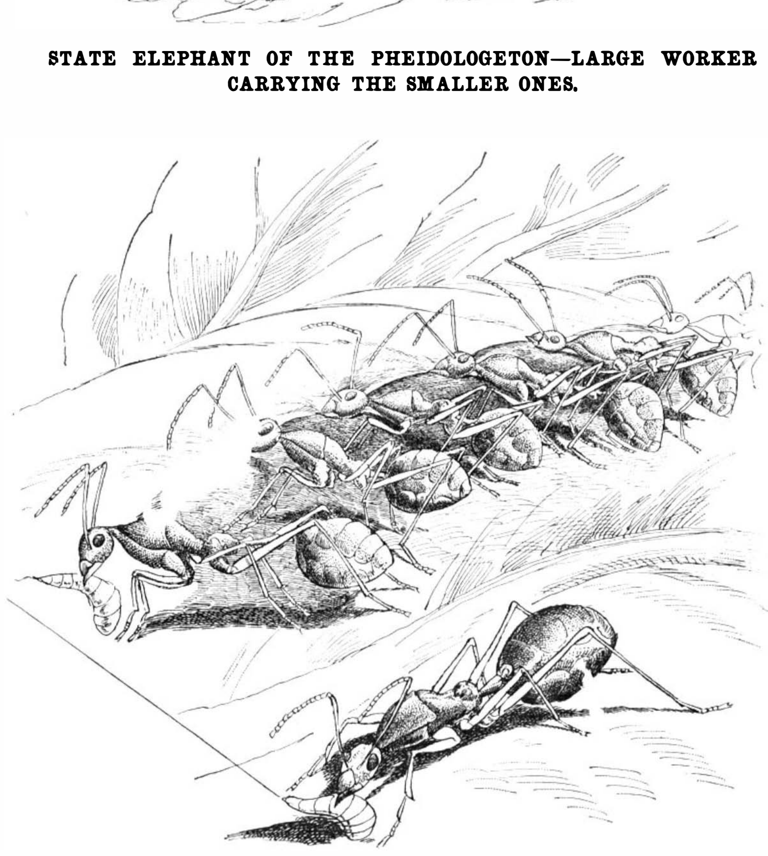
Such instances, when they occur, are not only extremely interesting, showing as they do the Formicadæ capable of utilizing in the most ingenious ways whatever can be made to answer their purposes, but the extraordinary and unexpected manner in which this is done is apt to awaken in the observer, as if he saw some comical trick performed, a mingled sense of admiration and amusement. A number of ants among those of very different species are distinguished by possessing relatively large heads, the use of which is extremely problematical. The workers of the East Indian *Pheidologeton diversus*, for instance, spiteful little things that bite venomously, have among ther giant soldier ants, a hundred times as large as themselves, and it would naturally be supposed that these big creatures with enormous heads would prove formidable defenders of the formicary, while the truth is that, so far from this being the case, they cannot bite at all, even when provoked to do so.

NEST OF THE TREE ANT, INDIA.

And yet the smaller members of the Pheidologeton commonwealths find a use for the great creatures. Numbers of them may often be seen riding about, as human beings do upon elephants, upon the backs and heads of their gigantic confreres. Even this use, however, does not account for the disproportionately large heads of the giants. But the Colobopsis ants, which burrow in branches, seem to have discovered how to profitably employ the big-heads among them. They are placed at the entrances of the Formican dwellings, their great heads fitting in and filling the dorways. As a worker belonging to the household approaches she is recognized by "the animated and intelligent front door," which draws back sufficiently to admit the entrance of its friend and then resumes its double office of sentry and of barrier.



STATE ELEPHANT OF THE PHEIDOLOGETON—LARGE WORKER CARRYING THE SMALLER ONES.



WORKERS HOLDING LEAVES IN PLACE WHILE OTHERS USE LARVÆ TO BIND AND CEMENT THE LEAVES.

The Eciton are the Arabs of the ant tribes, always at war with all other animals, with no settled places of abode, but ever wandering in journeys that have no end. Yet in their temporary resting places the necessities and instincts common to the whole Formican family impel these nomads to build habitations which conform to the character and style of the fixed and permanent abodes of ordinary ants. As, however, both the time and natural apparatus for digging possessed by the latter are wanting to excavate galleries and apartments necessary for feeding and sheltering larvæ and pupæ, these remarkable animals overcome the difficulty in a most astonishing manner by constructing living habitations, using their own bodies as building materials. Belt writes: "They make their temporary habitations in hollow trees, and sometimes underneath large fallen trunks that offer suitable hollows. A nest that I came across in the latter situation was open at one side. The ants were clustered together in a dense mass, like a great swarm of bees hanging from the roof, but reaching to the ground below. Their innumerable long legs looked like brown threads binding together the mass, which must have been a cubic yard in bulk, and contained hundreds of thousands of individuals, though many moving columns of ants were outside, some bringing in pupæ, others the legs and the dissected bodies of various insects. I was surprised to see in this living nest tubular passages leading down to the center of the mass, kept open just as if it had been formed of inorganic material. Down these holes the ants that were bringing in booty passed with their prey. I thrust a long stick down to the center of the cluster and brought out, clinging to it, many ants holding larvæ and pupæ."

But the most amusing instance of the manner in which an ant left by Nature to her own devices overcomes a difficulty is perhaps that of the *Oecophylla smaragdina.* This ant, one of common occurrence in Eastern Asia, forms shelters by bending the edges of the leaves of the trees upon which it lives and fastening them together. The adult ant possesses nothing with which to secure the edges of the leaves together after they have been brought into the required position; but its larva is furnished with glands that secrete an abundance of adhesive, gelatinous substance, by the aid of which it forms its cocoon, and these intelligent insects actually make animated mucilage brushes of their larvæ in order to effect their purpose. A number of the ants, seizing the edges of the leaves in their mandibles, bring them together into the form needed and hold them there, while other ants, each one of which bears a larva in its jaws, apply the mouths of the larvæ to such parts of the leaves as require to be cemented together, and induce their offspring to disgorge as much sticky material as they find necessary to accomplish the desired result.

Such instances as these of a knowledge of cause and effect, a seemingly conscious adaptation of means toward a desired end, and what may, perhaps, be called audacious ingenuity in devising methods of overcoming difficulties that at first sight seem insuperable, argue faculties which it is difficult to differentiate from sense and reason.

THE COOPER HEWITT LAMP.

The most recent as well as the most interesting development in electric lighting has lately been brought about by Mr. Peter Cooper Hewitt, son of Ex-Mayor Hewitt of this city, as the result of long-continued and untiring exertions on his part. This remarkable invention was recently described by Mr. Hewitt at a "Conversazione" at the Columbia University during an exhibition of recently invented electrical devices. The high-power electric lights exhibited by Mr. Hewitt were on a new principle, a gas being used as the illuminating medium instead of the usual filament. Several of these lamps are shown in the half-tone and line engravings which we publish. These lamps were all experimented with by Mr. Hewitt, and the light produced by some of them was truly remarkable, since it compared favorably with the arc light. The color of the light emitted from these lamps depends mainly upon the gas used for the filling of the tubes. Some of the tints are objectionable, but they may be varied by changing the character of the gas. The remarkable feature of these lamps is that under the proper conditions of temperature and exhaustion they may be operated by a direct current from any circuit of sufficient voltage. The light obtained has a most astonishing brilliancy and is perfectly steady. We understand that efficiencies as high as from 0.5 to 0.32 watt per candle power have been obtained. Mr. Hewitt has made a special study of the laws of conductivity of vapors, and has ascertained many curious facts in regard to their behavior as conductors in his lamp tubes.

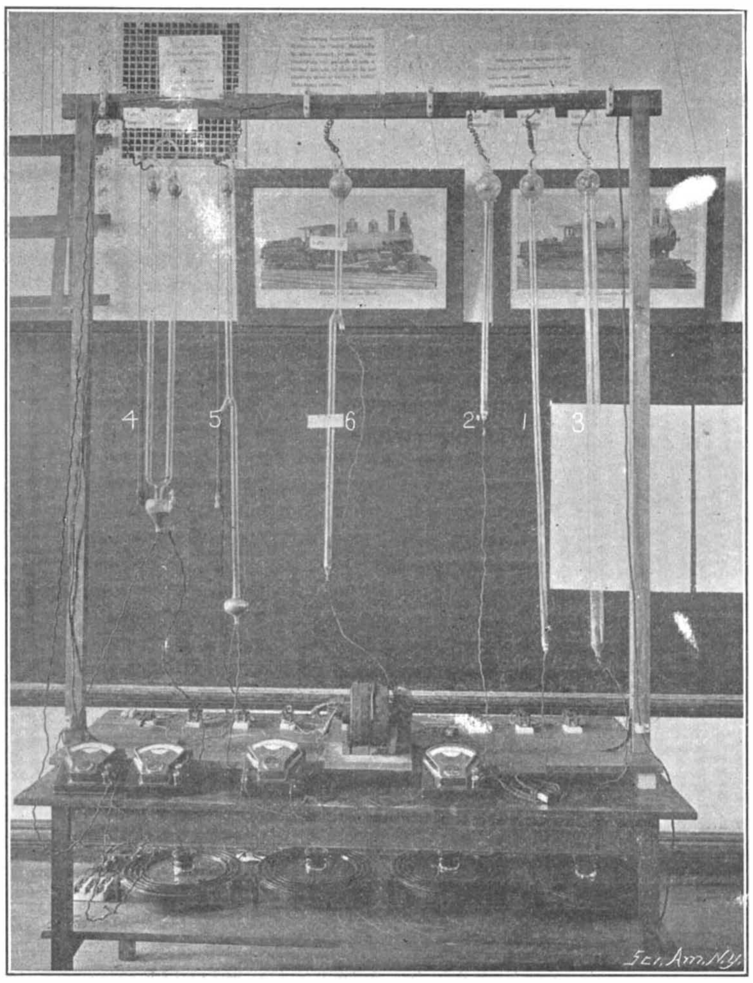


Fig. 1.—Length, 54 inches; diameter, ¾ inch; volts, 90. Fig, 2.—Length, 27 inches; diameter, ¾ inch; volts, 46. Fig. 3.—Length, 54 inches; diameter, ⅛ inch; volts, 54. Fig. 4.—In left-hand circuit, volts, 62; amperes, 4; ohms, 15.5. In right-hand circuit, volts, 64; amperes, 2; ohms, 32. Fig. 5.—In upper half, volts, 35; amperes, 1.75; ohms, 20. In lower half, volts, 47; amperes, 35; ohms, 13.4. Fig. 6.—In upper portion, volts, 28; amperes, 3. In lower portion, volts, 44; amperes, 2.98.

THE COOPER HEWITT ELECTRIC VAPOR LAMP EXHIBITED AT COLUMBIA UNIVERSITY.

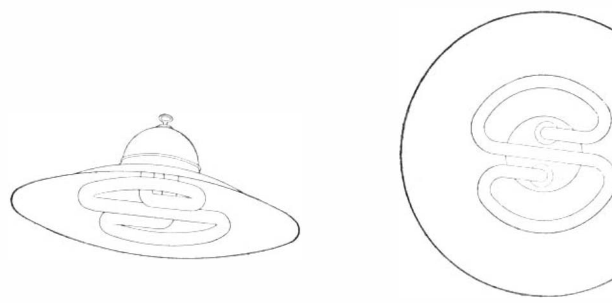


Fig. 7.

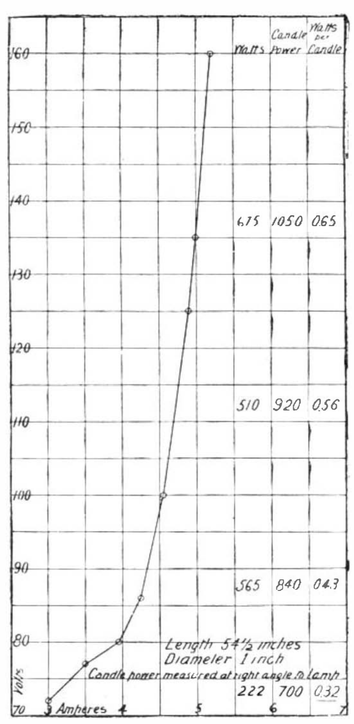


Fig. 8.

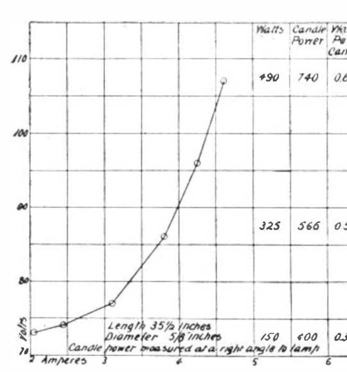


Fig. 9.

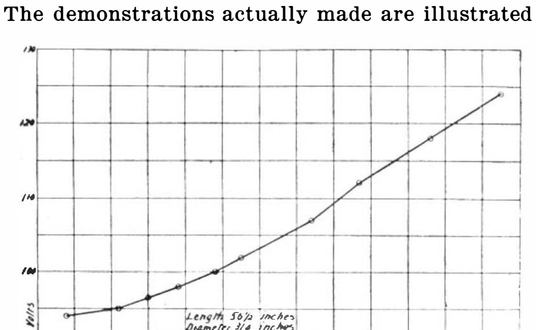


Fig. 10.

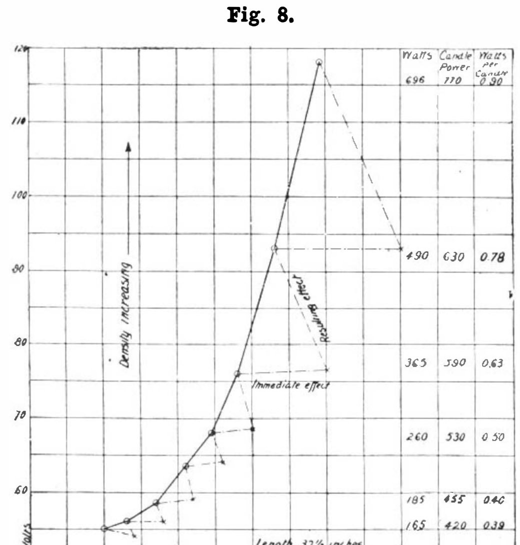


Fig. 11.

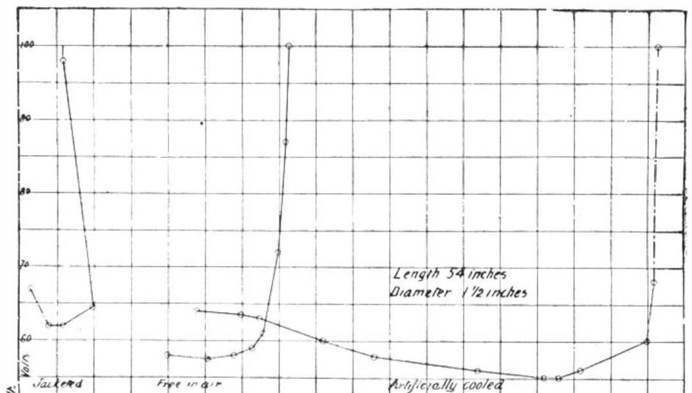


Fig. 12.

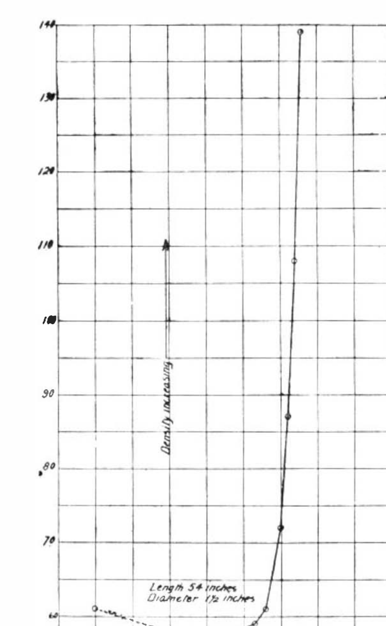


Fig. 13.

By reference to the half-tone engraving it will be seen that the lamps are exceedingly simple, being merely tubes with electrodes sealed in either end, in some cases surrounded by mercury, which supplies the vapor which fills the tube and becomes luminous on the passage of the current. These tubes are lighted by an ordinary direct current of from 100 to 200 volts, after being started by an impulse sent through a Wehnelt interrupter. The vapor tube acts like a conductor with a resistance which varies inversely as the current flowing through it.

The lamp is interesting on account of its great power and extreme simplicity. The many curious facts in regard to this lamp and other electrical phenomena discovered by Mr. Hewitt would make a very interesting volume.

We take pleasure in publishing herewith the following

NOTES ON THE COOPER HEWITT LAMP, BY PETER COOPER HEWITT.

The purpose of the exhibit which I had the honor to present at Columbia University, before the American Institute of Electrical Engineers, on April 13, 1901, was:

First.—To demonstrate that light can be produced from a gas or vapor in great quantity by means of the electric current and in the quantity desired.

Second.—To demonstrate that light can be produced from direct-current low-voltage circuits, by means of a gas or vapor.

Third.—To show that this light is extremely efficient.

Fourth.—To illustrate laws of conduction of the electric current by gases or vapors, and to show by experiment the effect of current on a conducting vapor or gas and the effect of variation in density of the conducting vapor on the current passed.

Fifth.—To exhibit the electrical phenomena at the joint of the negative electrode with a gas or vapor.

Sixth.—To exhibit electric vapor or gas lamps of very high efficiency.

Seventh.—To demonstrate that change in the color of the rays of light proceeding from a gas or vapor lamp of this character can be brought about by means of certain material.

Eighth.—To show, by means of curves, that the resistance of a particular vapor in a lamp can be made to vary in a predetermined manner within wide limits by varying the proportion of the vapor subjected to the current and the heat-radiating ability of the lamp.

The demonstrations actually made are illustrated by the accompanying drawings, and the measurements on the drawings were taken by Weston instruments while the lamps were in operation.

Figs. 1, 2 and 3 illustrate the relation of the volts to the dimensions of a gas-carrying current. The demonstration consisted in the operation of three lamps illustrating the tendency of the volts to vary directly as the length and inversely as the diameter, as seen by the figures of the drawing. One lamp is 54 inches long and three-quarters of an inch inside diameter, another is half the length and the same diameter, and the third is the same length as the first and twice the diameter; the drop in volts of the second and third is approximately one-half that of the first. The error in the lamp having the greater diameter, which measured 54 volts instead of 45, as should have been the case, was probably due to impurity developing in the vapor and a factor which appears on comparing tubes of widely different diameters.

Figs. 4 and 5 of the drawings illustrate the relation of current to resistance; the resistance varying inversely with the current, the volts tending to remain constant. Fig. 4 illustrates a divided vapor circuit, one leg carrying four amperes, while the other leg is carrying two amperes, the voltage over each leg being approximately the same.

The second demonstration, Fig. 5, illustrates a divided circuit consisting of a lamp with an additional electrode midway between the other two, whereby the current in the upper portion of the lamp is one-half that in the lower portion. The drop in volts over each of these portions should have been the same and the resistance of one should have been half that of the other, but for the discrepancy which was due to the greater vapor density in the lower portion, owing to the presence of the mercury forming the negative electrode.

The next demonstration illustrated negative electrode resistance or initial reluctance to allow current to pass. It also illustrated the passage of only a limited amount of current by an electrode prior to having its initial reluctance overcome. Fig. 6 was a lamp having an auxiliary electrode one-third of the distance between the positive and the negative electrode, which on being connected with the negative electrode by a conductor having a negligible resistance, allowed only 0.02 of an ampere to pass through this short circuit, although it was subjected to a measured electrical pressure of 44 volts, while the lamp was passing about three amperes.

These demonstrations practically illustrated results obtained by me from a great number of experiments.

Fig. 7 illustrates one form of my lamp adapted to run on an Edison 110-volt circuit with an efficiency of one-half a watt per candle.

Figs. 8, 9 and 11 show actual efficiencies of my lamp at different electric pressures, while Figs. 8, 9 and 10 illustrate the control of the resistance of the lamp.

Fig. 11 illustrates the electrical variation due to variation in gas density and an immediate effect of variation in current and a result brought about by a variation in gas density.

Fig. 12 illustrates the effect on one of my lamps of varying its heat-radiating ability.

Fig. 13 is the efficiency curve for the same lamp.

The large lamp exhibited was operated by direct current. The Weston ammeter in circuit with the lamp indicated seven amperes. The drop in volts across the lamp was 100 volts measured by a Weston voltmeter and the light given by this lamp was approximately 1,500 candles. It was, I believe, the first public exhibition of a high-power vapor lamp, and it was exhibited with standard instruments attached for measuring its current consumption; in fact, all the demonstrations were made with standard instruments attached for general inspection.

"Progress of Invention."—One of the Fifty Best Books.

In January of each year the New York State Library prints a list of five hundred of the leading books of the previous year and submits it to the librarians of the State, and others who may be interested, for a vote as to which of the fifty best books should be added to a village library. Usually about two hundred persons respond. While the list is, of course, simply an expression of opinion of persons who know as to what books are most in demand, even if they are not intrinsically the best, at the same time it so closely approximates the public taste in the matter that they may be regarded with great interest. We find that Miss Mary Johnston's "To Have and to Hold" holds the first place, while Edward W. Byrn's "Progress of Invention in the Nineteenth Century" is placed thirty-seventh. Considering that this is a serious book, and entirely different from works of fiction, biography or travel, it will be seen that the relative rank is high, especially as it leads our great American humorist, Mark Twain, by ten numbers, "The Man that Corrupted Hadleyburg" being forty-seventh. At the time this list was compiled Mr. Bryn's book had only been out some three months, which makes its inclusion with the "Fifty Best Books of 1900" most gratifying. We have received many expressions of appreciation from purchasers of this book, and the notices have been uniformly pleasing.

The Current Supplement.

The current SUPPLEMENT, No. 1321, is one of the best numbers of this edition which has appeared in some time. The leading article is devoted to the Field Columbian Museum, and it is accompanied by eight illustrations. "Searchlight Signaling at the Pan-American Exposition" is by Orrin E. Dunlap. "A Water-Softening Process" is described in detail. "The Glasgow International Exhibition of 1901" is accompanied by a map. "Animal Diseases and Animal Food" is by D. E. Salmon, Department of Agriculture. "A General Survey of Foreign Trade" is by Frederic Emory. The first installment is published in this issue, and our next issue will present a large and elaborate map showing all the countries of the world to which we export goods.

Evelyn B. Baldwin, who is to lead the Baldwin-Ziegler Arctic expedition, sailed for Hamburg April 18. He will confer with members of the German and British Antarctic expeditions, and will then go to Dundee, where his ship, the "America," is fitting out.

Contents.

(Illustrated articles are marked with an asterisk.)

RECENTLY PATENTED INVENTIONS.

Engineering Improvements.

REVERSING AND CUT-OFF MECHANISM FOR ENGINES.—WILLIAM A. MILLIGAN, Strasburg, Ill. It is the object of the invention to provide a mechanism for use on various types of engines, notably locomotive and traction engines. The mechanism is easily manipulated to shift the engine valves for cut-off or reversing purposes, and is completely under the control of the engineer.

Mechanical Devices.

SPOKE-DRIVING MACHINE.—FERDINAND UNCKRICH, Galion, Ohio. This invention relates to an apparatus for holding wheel-hubs and for driving spokes. By means of this apparatus the hub is held and turned as each spoke is driven therein; and the spokes are placed in position with mechanical uniformity, at the same time, permitting the work to be done more rapidly and effectively than by hand.

CHANGE-GEARING.—KIRK G. JOHNSTON, Piqua, Ohio. This change-gearing is particularly adapted for automobiles and comprises but two gear-wheels so arranged that adjustment of different speeds can be quickly made. The change-gearing is of very simple construction, and is not liable to be easily injured.

MOP-WRINGER.—THOMAS F. CONDON, Dorset, Vt. The wringer can be used on any ordinary pail, and squeezes the mop to any desired degree. The construction comprises a supporting frame, provided with an upwardly-projecting member. Bell-crank levers are pivoted to the frame; and squeezing rollers are mounted in the bell-crank levers. A slide is vertically movable on an upwardly-projecting member of the frame and extends inwardly above the rollers. A link connects each of the bell-crank levers with the slide.

LATHE.—WILLIAM ROBINSON, Aurora, Ill. The invention is a watchmaker's lathe which is especially designed for automatically turning articles having more than one diameter, such as balance-staffs, barrel-arbors, center-staffs, cannon-pinions, third and fourth escapement pinions, pallet arbors, type-bar pins for typewriting-machines, and the like. The novel features of the invention are a carriage supported by a spindle, mounted both to turn and to slide. On the spindle is a yoke. A revolvable-cam mechanism is employed to impart a sliding motion to the spindle and a swinging motion to the yoke, the cams being rotated to give the desired motion to the carriage so as to turn the article according to a predetermined design.

DRIVING-GEAR.—WILLIAM H. YOUNG and WILLIAM R. DANLEY, Rockyford, Col. The patent shows a means of employing a bicycle frame and gearing as a convenient means for effectively driving small machinery by foot-power. In the present instance the bicycle sprocket-wheel is geared by a chain with the central shaft of a coffee-mill.

Railway Contrivances.

SWITCH.—JOSEPH T. EVANS, Rushville, Neb. This railway-switch is arranged to be opened and closed by a mechanism under the control of the engineer of a train, so that the train can be run on the main track or on a side track. An engineer can close a switch which has carelessly been left open, and thereby prevent accidents. The arrangement comprises a switch-shifter having a three-armed lever adapted to be actuated by a device under the control of the engineer. Notched bars are connected with the lever. A shifting-lever has connection with the switch points, and is adapted to be alternately engaged by the notched bars.

Vehicle Accessories.

MEANS FOR SECURING ELASTIC TIRES TO WHEELS.—WILLIAM F. WILLIAMS, 17 and 18 Great Pulteney Street, Golden Square, London England. The means of attachment comprise inwardly-projecting flanges or wire edges on the tire or its cover, which are received in the groove of the rim; a metal strip or strips adapted to engage the flanges and to encircle the wheel-rim, so that when drawn tightly they hold the tire securely in position in the groove of the rim; and by means of which the tension may be applied to the band or bands and maintained after the tire has been put on the wheel, so as to insure a close butt-joint of the ends of the tire and prevent creeping.

Miscellaneous Inventions.

FALL-BOARD AND MUSIC-DESK.—CHARLES F. REEPS, Albany, N. Y. The invention provides a new fall-board and music-desk for pianos and organs. The construction is such that the board is noiseless in operation, and is adapted to fold very compactly to permit the music-desk or rack to come close to the keys. The music-desk is automatically moved into an active position upon opening the fall-board.

COMBINED UNDERVEST AND CORSET-COVER.—CORINNE DUFOUR, Savannah, Ga. The combined undervest and corset cover comprises a body having a front and rear flap secured to its upper end, these flaps being provided with means for securing their outer corners together. Thus the combined garment can be used for the protection of the chest and back with an ordinary dress, or employed as a corset-cover with a low-necked dress.

GARMENT-FASTENER. — WILLIAM F. SCHMIDT, Blanco, Cal. The inventor has devised an improved garment-fastener, which is designed for use on skirt-bands for properly fastening the end of the skirt-band together and for connecting the skirt-band with the waist to hold the skirt in position and give it the proper hang.

CHICKEN-COOP. — CHARLES H. CANFIELD, Bath, N. Y. The coop has two compartments in which fowl may be placed, and from which they may be independently removed. The various arrangements of parts provide proper ventilation for the fowl, and also enables them to be readily seen and inspected. The coop, when not in use, may be folded and transported from place to place, thus occupying very little space.

HORSE-BOOT.—ARTHUR COLE, Oak Lodge, Telford Park, Streatham Hill, London, S. W., England. This invention relates to improvements for boots for horses when employed on grass lands for the purpose of drawing rollers, mowing-machines, carts and the like, chiefly used in keeping golf-links, cricket-grounds, parks and lawns in proper condition. Such boots are used to prevent, as far as possible, the marking and cutting up of the grass by the animals' feet, especially in wet weather, when the ground is soft.

WEATHER-STRIP.—Mrs. ALICE HAZELTON, Lamoni, Iowa, Administratrix of Norman N. Hazelton. The threshold is formed with a longitudinal recess in its upper face, such recess being in advance of the recess formed in a lower plane than the corresponding face in the rear of the recess. A retaining-plate is secured upon the threshold in the rear of the recess, and is projected at its front edge over the recess. The weather-strip is formed with a guard-plate, and with curved ribs above and below the plane of the guard-plate. The weather-strip operates when the door is open as a wear-plate for the sill, and is adjusted by the door, in position, to serve as a weather-strip when the door is closed.

TRIPPING ATTACHMENT FOR CANE-SLINGS.—LOUIS H. AVET, Plaquemine, La. Slings for lifting sugar-cane, hay, corn, and the like, are commonly provided with pivoted hooks, which can be tripped to release the sling to discharge the load. Such hooks must be restored to their normal position by hand and re-engaged with the releasing device. Mr. Avet has devised a construction and arrangement of sling-hooks which restores them to their original position automatically, thus saving time and labor.

BOLT-HOLDER.—HERMAN STADE, Flandreau, S. Dak. The bolt-holder is provided with a lever having a chisel-shaped fulcrum made to clutch the bolt-head, while the outer end of the lever is anchored to some solid part to permit pressure to be brought on the chisel-shaped fulcrum to clutch the bolt-head and thereby hold the bolt against the turning strain, both in turning up nuts and in twisting them off. The device is practical and cheap, and holds bolts of all sizes very firmly in almost any position.

ATTACHMENT FOR REED OR PIPE ORGANS.—EDGERLY R. BAILEY, Clarinda, Ia. By the use of this attachment, chords or tones once struck continue in duration as desired by the performer, thereby permitting further execution, the tones thus produced intermingling with the sustained ones. In other words, certain keys may be struck and held depressed indefinitely without requiring continued pressure of the player's hand, so that the corresponding notes will sound as long as desired, or until the depressed keys are mechanically released at the will of the player.

PROJECTILE.—DR. WILLIAM F. COLE, Provident Building, Waco, Texas. The projectile is to be used only in a gun having an elliptical bore, since this form has merits which are of much importance. The projectile is elliptical in cross section throughout the length of its body, and is also twisted to conform with the bore of the gun. The front portion of the body is likewise tapered toward the point, which is constructed with a thin edge having a twist or reverse curve. With this form of projectile the rapidity of rotation is maintained and the flight even increased, while the resistance and friction of the air are said to be reduced.

NON-REFILLABLE BOTTLES.—ALEXANDER BRIELMAYER, South Nyack, N. Y. The non-refillable bottle comprises a casing fixed in the neck of the bottle. In this casing a conical stopper having an outlet-channel is mounted to slide. An outlet-tube is fixed in the casing and opens at one end into the bottle, the other end of the tube opening into the stopper-outlet when the stopper has moved into an outermost position upon tilting the bottle. After the contents have been poured out of the bottle, and the bottle is placed upright, then the stopper by its own weight glides back to close the outlet-channel.

DISTANCE AND ALTITUDE MEASURING INSTRUMENT.—LEWIS N. HORNBECK, Minco, Ind. Ty. The instrument is an improved combination distance and altitude measuring instrument designed for use by mariners and by surveyors and engineers. The instrument is particularly noteworthy for the rapidity with which results are obtained.

POLYPHONE ATTACHMENT. — NEWMAN JENSEN, Eureka, Cal. This invention provides an attachment for phonographs which is designed to reproduce the recorded sound with double the usual volume. The arrangement consists of two styli and diaphragms fitted to two tubes opening into a common horn. Not only is the volume of sound increased, but its quality is enhanced; for the very rapid reproduction of the sound produced by one stylus gives to the tone something of that human timbre which is only too often lacking in talking-machines.

PICTURE HANGER. — I. H. SOLOMON, 48 Center Street, Manhattan, New York city. This device is intended to regulate the position, height and inclination of a hanging picture. In other words, with this attachment in use, any picture may be tilted so that it assumes the position most favorable to its proper exhibition. If, after having been thus inclined, it be found that the picture hangs too high or too low, the height desired may easily be attained. These operations may be very rapidly performed by any one. In order to secure the result mentioned it is not necessary to remove the picture from the wall, nor is the frame or wire in the least injured. The device may be operated as often as is desired and may be attached to a frame of any size with perfect safety.

LOCK-BOLT.—EDWIN F. CONBER, Selkirk, Manitoba, Can. This lock-bolt for door-locks is provided with a bolt lengthwise adjustable, so that under all conditions it will sufficiently clutch the hasp or bolt catch. This adjustment enables the bolt to be engaged securely with this hasp or catch, should the door or frame shrink, without necessitating the resetting of the lock or its hasp.

PAPER BOX.—JOSEPH T. CRAW, Jersey City, N. J. The paper box is especially adapted to be used as a wrapper for fine bricks. The construction is such that the box may be partially open at both ends, or entirely open at one end and partially open at the opposite end. The end of the box can be partially closed by side and end flaps, cushions being formed against which another box containing a brick may abut. Thus, bricks can be packed and shipped without damage.

ATTACHMENT FOR INK-BOTTLES. — LOUIS SCHOEN, Manhattan, New York city. Mr. Schoen has invented a simple device which is readily attached to the neck of an ink-bottle and which includes in its construction a pen-rack, a penwiper, and a lid which supports a cork for the bottle. A portion of the cork can be utilized for clamping pens which are to be removed from a penholder.

WINDOW-SHUTTER.—FRANK CHASE, South Sutton, N. H. The object of the invention is to provide a window-shutter arranged to permit the operator to open or close the slats conveniently from the inside of a room without being compelled to open the window-sash. A finger-lever is fulcrumed on the window-frame below the sash, the fulcrum of the lever being coincident with the sash to permit the rocking of the lever when the sash is closed. A connection between the lever and an adjustable part of the window-shutter permits the operation of the latter.

AUXILIARY BOX-COVER.—MORITZ MEYER, Manhattan, New York city. The inventor has devised an auxiliary box-cover for use on cigar-boxes. The cover can be attached to the box without disturbing the cigars or without requiring the removal of the original box-cover. The improvement permits the contents of the box to be conveniently removed, excludes dust, moisture, and the like.

BUST-FORM.—EMILY H. WRIGHT, Manhattan, New York city. The bust-form provided by this invention is easily attached to a corset, readily maintains its form, and gives the dress the proper hang. The bust-form has sufficient flexibility readily to conform to the motion of the body without discomfort to the wearer.

Designs.

SHOELACE FASTENER. — BENJAMIN F. KOCH and SAMUEL BLOOM, Brooklyn, New York city. The leading feature of this design is a cylindrical body portion having a hook-like projection at one side terminating in an enlargement.

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

NEW BOOKS, ETC.

GAME AND FISH COMMISSIONERS' REPORT. The Fourth Annual Report of the New York Game and Fish Commissions for the year ending September 30, 1898, has just been received at this office. The Commissioners deserve much credit for producing this work, copiously illustrated with handsome colored photographs of many varieties of both game and fish, which are as true to nature as art can show them. A large variety of both salt and fresh water fish are shown, colored very natural to life, while the illustrations of ducks, pheasants and plovers are most interesting. The letterpress is extremely interesting, treating in detail the habits and diseases of many kinds of fish. The increasing interest in all out-of-door sports and the living things of nature is wonderful, and is proving of great benefit to the country at large. To many sportsmen the love of nature, the propagating and protection of game and studying their habits has in a measure taken the place of a desire to kill everything in sight. The Game and Fish Commissioners are all well-known men, who have truly at heart, without any selfish motives, the protection and welfare of the game and fish of the State of New York and elsewhere.

Business and Personal Wants.

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

MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 462.—For manufacturers of aluminium.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 463.—For manufacturers of taxidermy supplies.

Motor Vehicles, Duryea Power Co., Reading, Penn.

Inquiry No. 464.—For manufacturers of spring-motor fans.

WATER WHEELS. Alcott & Co., Mt. Holly, N. J.

Inquiry No. 465.—For small motor fans for use in dwelling houses for circulating air; motor like that used for sewing machines.

Yankee Notions. Waterbury Button Co., Waterb'y, Ct.

Inquiry No. 466.—For manufacturers of sponge rubber.

Dies & Special Machinery. Amer. Hdw. Mfg. Co., Ottawa, Ill.

Inquiry No. 467.—For manufacturers of machinery for making hair felt.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 468.—For manufacturers of all kinds of rubber specialties.

"For sale New Automobile Steam—$400. Wilson Bros., Easton, Pa."

Inquiry No. 469.—For parties to make a bent wire novelty.

Sheet Metal Stamping: difficult forms a specialty. The Crosby Company, Buffalo, N. Y.

Inquiry No. 470.—For a small ice plant of about 2 tons capacity.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 471.—For manufacturers of very strong paper boards.

Our number 4 Catalogue of Automobile parts, write us, Standard Welding Co., Cleveland Ohio.

Inquiry No. 472.—For small gas engine developing about ¼ of a horse power.

Rigs that Run. Hydrocarbon system. Write St. Louis Motor Carriage Co., St. Louis, Mo.

Inquiry No. 473.—For manufacturers of small gasoline or kerosene engines suitable for farm work.

SAWMILLS.—Variable friction feed. Send for Catalogue B. Geo. S. Comstock, Mechanicsburg, Pa.

Inquiry No. 474.—For manufacturers of rubber wading pants with boots attached for fishermens' use.

Ten days' trial given on Daus' Tip Top Duplicator. Felix Daus Duplicator Co., 5 Hanover St., N. Y. city.

Inquiry No. 475.—For special rubber rivets and compounds for repairing pneumatic carriage tires.

Machine Work of every description. Jobbing and repairing. The Garvin Machine Co., 149 Varick, cor. Spring Sts., N. Y.

Inquiry No. 476.—For manufacturers of sheet iron 24 inches wide and up.

For sale and introduction in Scandinavia, of American goods, any and all. Apply to O. P. Jespersen and Sonner, Copenhagen, Denmark.

Inquiry No. 477.—For small butter making machines for domestic use.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 478.—For a street outfit for making popcorn.

For Sale.—Right to take out foreign patents on my invention, Suspender End Attachment, U. S. patent to issue May 4, 1901. Address C. H. Dome, Prescott, Ark.

Inquiry No. 479.—For manufacturers of small cheap globe or gate valves.

Will sell outright, or on royalty to manufacture my patented poison guard paper, a device to be used as a safe-guard against accidents with poison. For making Wrapping Paper, Roll Paper, Paper Bags, Boxes, Envelopes, Labels, etc., and changing any ordinary bottle to a poison bottle by pasting the paper on it: also poison packages. For Wholesale and Retail Druggists, Manufacturers of Chemicals, Paint, etc. Will stand full investigation. For particulars, Address, Patent, care of the SCIENTIFIC AMERICAN, New York.

Inquiry No. 480.—For manufacturers of cable chain made from ⅛ inch to ¼ inch wire.

Sheet Metal Novelties, Articles and Stampings of all sizes. Tools and dies manufactured on contract. Address Standard Stamping Co. Cor. 7th & Hudson Sts., Buffalo, N. Y. U. S. A.

Inquiry No. 481.—For dealers in wood engravers' supplies.

Wanted.—Skilled artist in mechanical art work. No one need apply who has not a knowledge of mechanics coupled with artistic ability and experience. Address Artist, P. O. Box 773, New York.

Inquiry No. 482.—For parties to make a cheap tin box, flat and round; of a half pint capacity.

A Winton motor carriage, model 1899, for sale. Price, $500 f. o. b. cars Syracuse. This machine is in good running order, and was run less than 500 miles. Address, William Schmidt, 339 East Genesee St., Syracuse, N. Y.

Inquiry No. 483.—For manufacturers of an electric pen for perforating maps or patterns.

Moistener and Sealer. For moistening and sealing Stamps, Envelopes and Labels. Patents for sale or on royalty. Excellent chance for manufacturer with facilities for introducing a useful device. Address, CHAS. L. VOSE, Westerly, R. I.

Inquiry No. 484.—For parties to install system for electric welding of iron tubing.

TEMPTING TERMS. — Those who are planning an early trip to the Pan-American Exposition will be interested to learn that the $12 excursion tickets from New York to Buffalo, over the Lackawanna Railroad will be on sale every day during May. The limit is ten days.—Another excursion trip is for $13 and tickets will be good for fifteen days, beginning June 1. A particularly tempting rate is a $9 excursion ticket to be sold on Tuesdays during May, good for five days, and honored only in coaches.—A beautiful guide to the Exposition, telling about its many wonderful features, is being sent out in response to requests accompanied by four cents in stamps, to T. W. Lee, General Passenger Agent, New York City. Write for one.

Inquiry No. 485.—For the makers of machines for stiching and riveting belts with solid copper two-prong rivets and fasteners.

Inquiry No. 486.—For manufacturers of boiler engines.

Inquiry No. 487.—For parties to make light sheet metal article.

Inquiry No. 488.—For dealers in new or second hand gasoline engines of about ¼ or ½ horse power, for running car of about 60 pounds weight.

Inquiry No. 489.—For manufacturers of stereoscopes and magnifying glasses.

Inquiry No. 490.—For dealers in life motion picture machines, such as the Chronophotographic Machine, the Mutograph and others.

Inquiry No. 491.—For manufacturers of round cheap mirrors 2⅝ in. diameter with metal rims; also without rims.

Inquiry No. 492.—For manufacturers of cheap mechanical telegraph instruments, key and sounder combined—no battery.

Inquiry No. 493.—For manufacturers of tin tubing of eleven-sixteenths inch and ¾ inch in diameter, the seams to be soldered.

Inquiry No. 494.—For small ice making machines and cooling apparatus to work by hand.

Inquiry No. 495.—For manufacturers of steel tubing one-sixteenth inch thick by 4 in diameter and over 2 feet long.

Inquiry No. 496.—For the present address of the Northrop Loom Co.

Inquiry No. 497.—For parties handling the Tropenas process for steel castings.

Inquiry No. 498.—For small practical and cheap typewriters.

Inquiry No. 499.—For manufacturers of glass moulding machinery.

Inquiry No. 500.—For machinery for envelope making.

Inquiry No. 501.—For manufacturers of up-to-date brick and tile machinery.

Inquiry No. 502.—For manufacturers of gasoline lighting system for buildings.

Inquiry No. 503.—For manufacturers of liquid-air motors and generators for use in a boat.

Inquiry No. 504.—For manufacturers of machines for testing lubricating oils.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(8165) W. F. G. writes: Please refer me to some article or work where I can find plain and easy directions and specifications for making and constructing a home-made apparatus for practice work and experiment (with the ordinary Morse key and sounder) in wireless telegraphy? A. We can furnish you Fahie's "History of Wireless Telegraphy," price $2 by mail. Also SUPPLEMENT 1131, 1177, 1192, 1213, 1219, price ten cents each, all containing information concerning wireless telegraphy.

(8166) A. G. asks: 1. Can I use any other metal instead of platinum on the spring and screw of the induction coil described in SUPPLEMENT 160, as I have difficulty in getting it? A. Platinum should be used because it burns very slowly and does not oxidize easily. 2. Can I use well-varnished wood instead of vulcanite as a commutator cylinder? A. Yes; but use shellac varnish.

(8167) C. A. asks: Would you kindly tell me what way to arrange the carbons in an electric arc furnace so that I could get about one square inch of heating surface, that is, the arc between the carbons; and could two large carbons be used, say, four inches long, with a quarter-inch arc, or would it be advisable to use small ones? Could you give me an idea of what heat there is in an arc, and would it be very expensive to run such a furnace? A. You can arrange the carbons as you propose for an electric furnace, and increase the number of pairs till you have the heating surface you require. The heat of an electric furnace is the highest on the earth ever produced by man. Any desired heating effect can be produced by continuing the current for a sufficient time. SUPPLEMENT 1077 gives an account of a number of electric furnaces; price ten cents.

(8168) J. K. asks: Will you please tell me whether there is any way of taking the ink from half-tone pictures or engravings on paper off on glass so as to show in a magic lantern? A. We do not know any way of removing a picture from paper to glass so as to use the glass as a lantern slide. The best way is to make a photographic copy of the picture and use that as a slide.

(8169) G. E. H. writes: 1. The instructions for the construction of voltmeter and ammeter, in SUPPLEMENT 1215, are particularly for E from O to 125. How much less wire No. 40 would I use to get a better reading for electro-plating dynamo of 8 volts, allowing a range of 0 to 15 volts? A. To change a voltmeter so that it shall give about the same deflection for 15 volts as for 125 volts, you will need about one-eighth as many turns of wire in the coil. 2. The capacity of machine will be 35 amperes. Would not No. 8 be about right for winding the solenoid for the ammeter? A. No. 8 wire carries 35 amperes with ease in the open air. 3. Wire tables give carrying capacity of wire thus: "Concealed" and "open." When is it supposed to be open and concealed? A. "Concealed" wire is wire in molding so as to be out of sight and away from a cooling draft of air. It will heat worse than open wire or wire exposed to the air. 4. Allowing 2,000 amperes per square inch phase, state rule for figuring carrying capacity of any size wire. A. A wire cut open exposes a circular end. Find the area of that circle by measuring the diameter and multiplying the square of the diameter by 0.7854. Multiplying this result by 2,000, you have the amperes of carrying capacity.

(8170) R. S. V. asks: 1. Is there any way in which I can tell the difference between iron and steel; and between common copper wire and magnet wire? A. It is not easy for an inexperienced person to tell iron from steel. Magnet wire is copper wire covered with a winding of cotton or silk thread. 2. In making a magnet close the iron core half to be covered with paper or some other non-conductor, will common wire do instead of magnet wire? The iron core should be covered so that the copper wire shall not come in contact with it. The copper wire must be covered with cotton winding so as not to come in contact with any other wire. 3. What kind of instrument measures the ohms of resistance of anything? A. There is no instrument for measuring resistance. A standard of resistance is required and a galvanometer. Books on electrical measurement will tell you the process. 4. Will those small carbon rods you tell how to make in "Experimental Science," on page 705, do for pendants for the microphone on page 585 instead of battery carbon? A. Yes; if made small enough. 5. What is meant by cautery wire? A. Cautery is cutting by a hot knife or wire heated by electricity. 6. For that water decomposer in "Experimental Science" on page 560, do you need to use platinum wire all the way to the batteries? Should it be insulated, and what size should it be? A. Platinum wire is needed only for the parts under the water. Any size will do.

(8171) R. L. S. asks: 1. What is the method for testing fields and armatures for short circuits? A. Measure the resistance as the work proceeds, and if that does not decrease there should be no short circuits. Parham's "Shop and Road Testing of Dynamos and Motors," price $2 by mail, should meet your needs. 2. How can I make a cheap rheostat to be used with current up to 30 volts and 8 amperes? A. If by your question you mean that you want 30 volts in your external circuit and will take up the rest of the voltage in the rheostat, you will proceed as follows: Suppose the voltage of the circuit is 110. There will be a drop of 80 volts in the rheostat, and 30 in your apparatus; 8 amperes will flow through both. You will require 10 ohms of wire arranged in coils with air circulating through them so as to keep them cool. No. 13 iron wire will be the right wire to use. You will need 600 feet of it. If the voltage is other than 110, proceed in the same way as above, and calculate the length of wire at about 60 feet per ohm. We should suppose it to be better to buy a rheostat from some dealer in your city.

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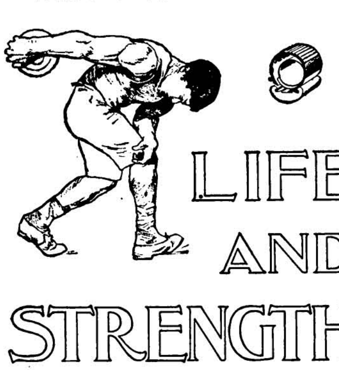

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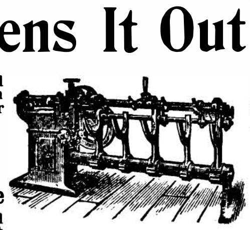

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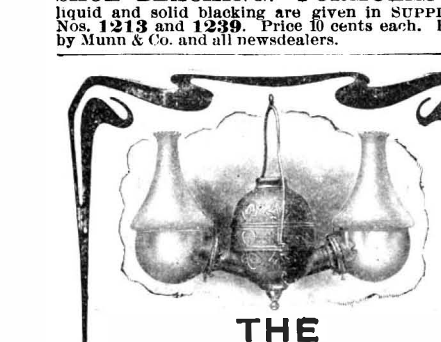

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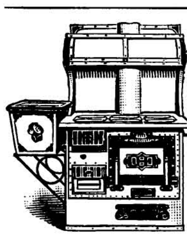

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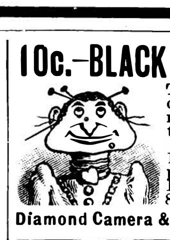

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