SCIENTIFIC AMERICAN

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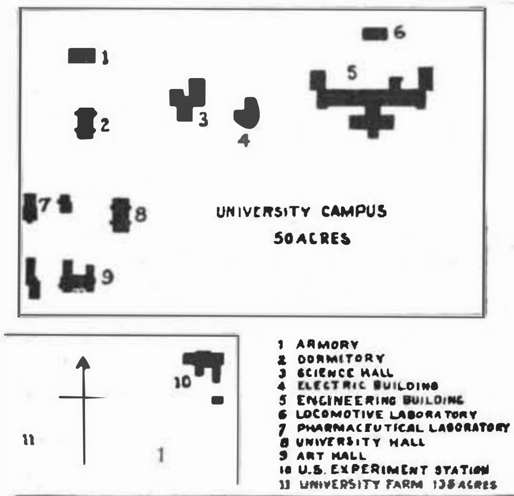

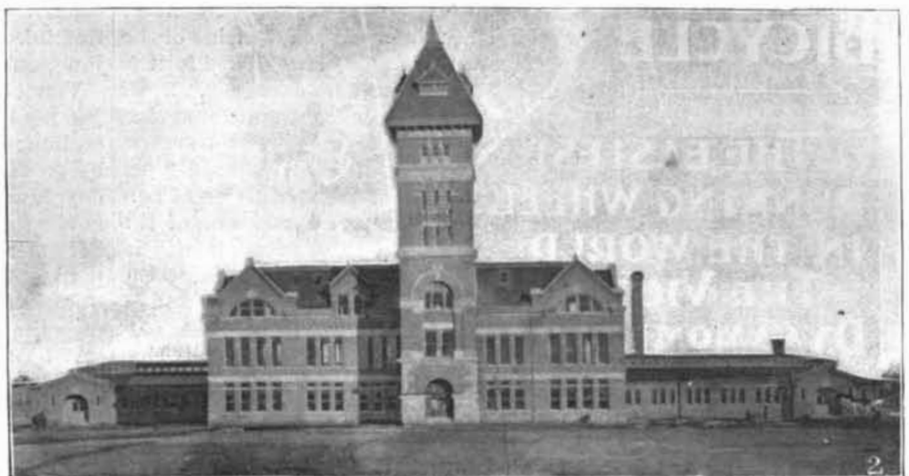

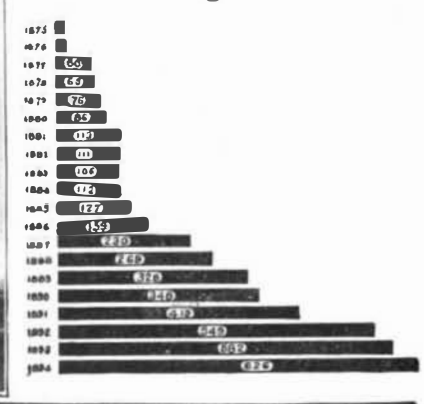

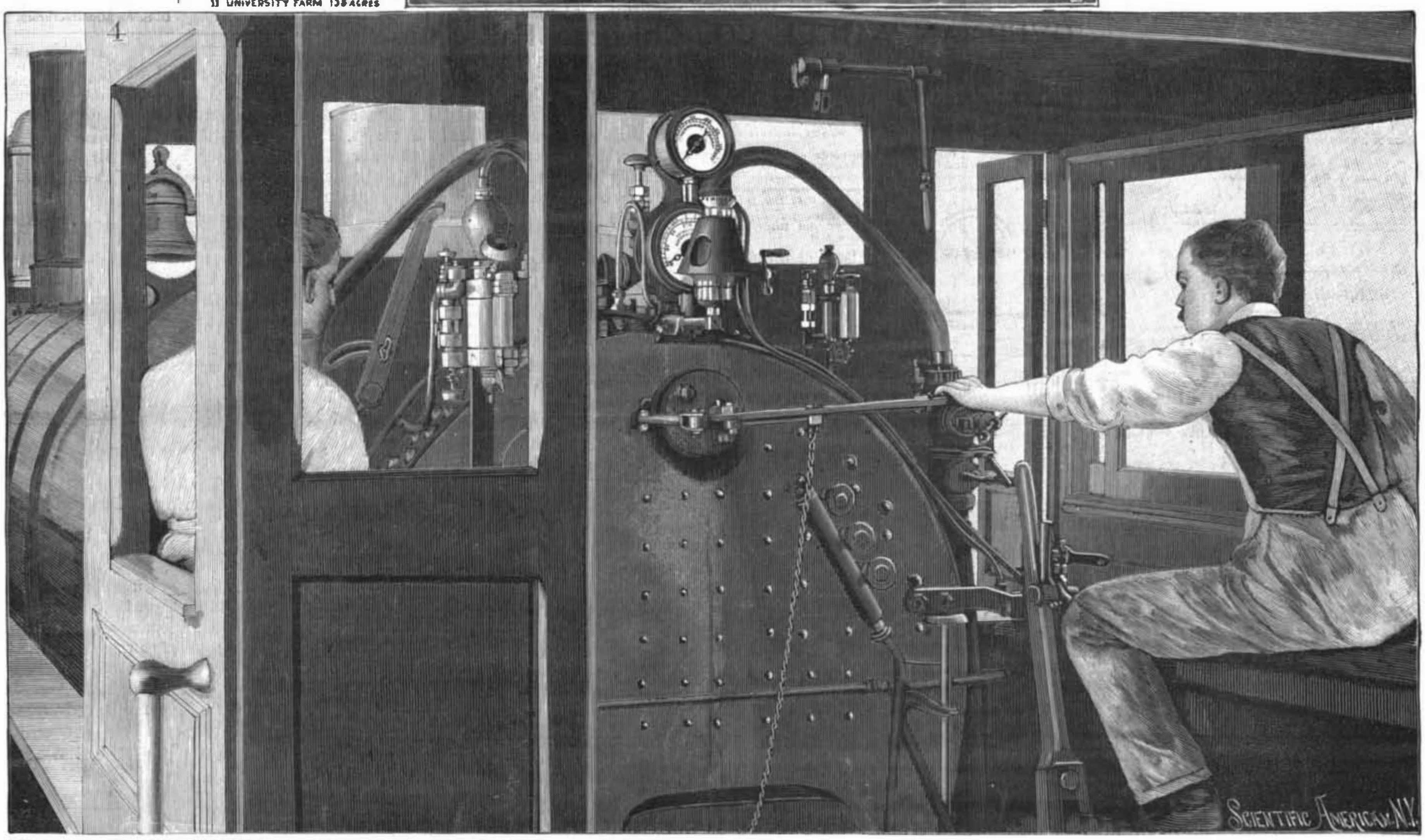

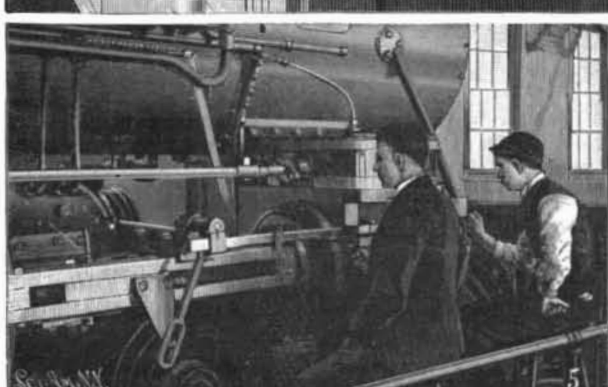

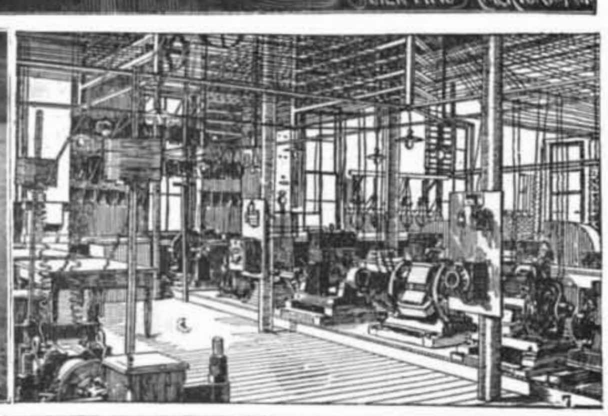

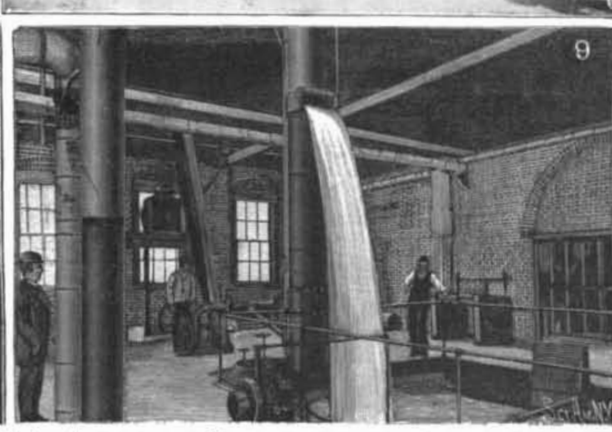

1. Plan of campus, showing location of the more important buildings. 2. Engineering building. 3. Diagram showing number of students in attendance, 1875–94. 4. Locomotive testing: In the cab. 5. Taking indicator diagrams. 6. Field engineering. 7. A corner in the dynamo room. 8. Testing strength of beams. 9. Testing centrifugal pump. 10. Working up a test.

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Scientific American.

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NEW YORK, SATURDAY, MAY 11, 1895.

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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 1010.

For the Week Ending May 11, 1895.

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FORCE AND ENERGY.

In the usual treatment of the science of mechanics and physics, three central ideas are generally made very prominent. These are force, work, and energy. The order in which they are given is an index of the treatment of the subject. Force is defined; then work is described as the exercise of force along a path through space; and, finally, energy is defined as the capacity for doing work. Nothing is more certain than the fact that a complete and working understanding of the relations of force and energy is essential to the study of mechanics and physics, and the great errors of the world of scientists and investigators have been due to ignorance or misconception of these relations. It is but a few years since the mistaken doctrine of the conservation of force was definitely abandoned for the true doctrine of the conservation of energy. Such abandonment indicated a very recent understanding of the true relations of force and energy, for the erroneous expression conservation of force is hardly yet extinct. The many attempts at the production of perpetual motion indicate a want of appreciation of the fundamental bases of science. The search is still in progress, hopeful enthusiasts refusing to accept the truth that energy is as indestructible as matter, and as impossible of creation.

But it would seem that in the threefold division force, work and energy, there is either one word too few or one word too many. Energy can be expended, and if expended, produces an exact equivalent of other energy. As fast as one quantity of energy is expended or disappears, another quantity exactly equal, though it may be of widely different form, is produced. The sum of all the energies of the universe is always equal. Now, what distinct existence can work be said to have? When energy is expended it does work; it reproduces an equal amount of energy; therefore the term work must be accepted as the synonym for the "production of energy." It would seem better to abandon the term "work," as ordinarily used, to establish the basis of mechanics, unless a synonym for the "expenditure of energy" could be found. The term "working" might supply this synonym. But the real basic terms in mechanics should be either the two, force and energy, or the four, force, energy, expenditure of energy and production of energy.

The terms work and working may be substituted for the last compound terms. As it stands now, there is a strong tendency to place energy in its definition as a sort of subsidiary to work. It should be treated as the all-important thing, and work as a convenient expression of a single one of its phases. An advanced treatment of the subject of mechanics might be based on the entire omission of the term work, making it a science of force and energy, treating work as the expression of the concrete only.

The realization of the true meaning of work makes the understanding of the impossibility of perpetual motion much clearer. No machine can produce energy or do work without an exact equivalent of energy being put into it. There is a further aspect of the subject. After all the coal is burned, after the sun has cooled down and after all the possibilities of establishing differences of temperature will have disappeared, the energy of the universe will be the same as ever, but no work will be possible, no energy can be produced. This supplement to the doctrine of the conservation of energy tells us that the available energy of the universe is tending to zero.

But as the first doctrine proscribes perpetual motion, the second opens up a possibility of a false or pseudo-perpetual motion in the conversion of unavailable into available energy. This is in the suggestion of Clerk-Maxwell, who fancifully imagines a "demon" at some future time separating the particles of matter into two divisions moving in opposite directions, without expending any energy, but simply rendering available the existing energy of all things.

If man could but separate the molecules of a gas into two sets, one as they beat to the right, the other as they beat to the left, he would be doing the act of Maxwell's demon, and the energy of the air would be made available. It would be utilized in the remixing of the molecules, and the work done would be measured by the energy abstracted from the air. The molecular motion would be lessened, or, what is the same thing, the temperature would be lowered. But the same sum of energy would exist, could we but render it available.

It is as if man started in the world with a quantity of matter or weights placed at a height and an equal quantity of weights at an equal depression below his level. Since the beginning of the human race man would be industriously raising one set of weights by lowering the other. Thus all would tend to reach the same level, and when this would be reached neither set would have any advantage of position over the other, and available energy would have reached its zero. But the same total of energy would be present, and if not zero would involve the idea that the middle plane is above the zero point. This is the same as saying that if the universe lost all its available energy it would not reach the absolute zero, where all molecular motion stops. But if the degradation of energy shall ultimately bring all matter to the absolute zero, then Maxwell's demon would find his occupation gone, and like Macaulay's New Zealander could only sit still and contemplate the ruins of the past.

THE HEAVENS IN MAY.

The interesting assemblage of planets in the evening sky will be increased in number during May by the addition of Mercury, which is in superior conjunction with the sun on the evening of the 4th. But not until the end of the month will the little planet be far enough east of the sun to be well seen. At that time it will be near Jupiter in the constellation Gemini. Early in June it will be in rather close conjunction with Jupiter.

Venus moves during May from Taurus into Gemini, passing a little more than two degrees north of Jupiter an hour before noon on the 18th. As Venus has now become so bright as to be visible to a keen eye at midday, it will be possible, on this occasion, to find Jupiter in the daytime with the aid of Venus, and to see them both with the aid of a strong field glass. The experiment should be made between two and three o'clock in the afternoon, when the two planets will be near the meridian. At the end of the month Venus will be near the twin stars of Gemini, Castor and Pollux. She will then have attained about one-half of her maximum brightness.

Mars, which passed Jupiter on April 25, will continue to move eastward during May, and at the end of the month will be in the eastern part of Gemini, near Venus, with which planet it will be in close conjunction on the 5th of June.

Jupiter, following the example of Mars, whom he replaced in the public eye during the latter part of the winter, is becoming less conspicuous as he draws nearer the sun, and early in June he will cease to adorn the sunset sky. Jupiter remains in Gemini, moving slowly eastward, and at the close of May will be near the third magnitude star Epsilon.

Saturn replaces Jupiter, advancing with the annual revolution of the heavens from the east. This splendid and unique planet crosses the meridian at the opening of May about 11:30 P. M., and at the end of the month about 9:30 P. M. It is in the eastern part of the constellation Virgo, near the fourth magnitude star Kappa. The only star in its neighborhood comparable in brightness with Saturn is Spica, the leading brilliant of Virgo, which shines about 12° almost directly west of the planet. Saturn's rings now present a beautiful appearance with a 3 inch or 4 inch telescope. It is the north pole of the planet that now leans earthward, and consequently it is the north side of the rings that we see. The earth is between 16° and 17° above the plane of the rings. Their major axis appears about 42" in length and their minor axis about 12". A good 4 inch telescope is capable of showing five of Saturn's satellites, Japetus, Titan, Rhea, Dione, and Tethys. The other three, Hyperion, Enceladus and Mimas, are visible only with more powerful instruments. No one who has an opportunity to look through a telescope should fail to see Saturn. Its rings are an unceasing source of wonder, and no picture ever made of them is a perfect likeness.

Uranus is in Libra close to the fifth magnitude star Nu and about 4° east of Alpha, a star of the third magnitude. It may assist the reader in finding the place of Uranus to know that it is about 14° east-southeast of Saturn. As a telescopic object for amateurs it is hardly worth attention. Uranus is in opposition to the sun on the 8th.

Neptune is very near the fifth magnitude star Iota in Taurus, between the horns of the imaginary bull, and there, on the 19th, it will be in conjunction with Mercury. The conjunction will not be close, however, Mercury being 3½° to the north.

May opens with the moon at first quarter in Cancer. The moon fulls on the evening of the 8th in Libra and attains last quarter on the afternoon of the 16th, in Aquarius. The new moon phase for May occurs in Taurus on the 24th, at 7:46 A. M., and the second occurrence of first quarter for the month happens on the morning of the 31st in Leo.

The moon pays her May visits to the planets on the following dates: To Saturn on the 7th at 8:35 P. M.; to Uranus on the 8th at 9:04 P. M.; to Neptune on the 25th at 5:53 A. M.; to Mercury on the 25th at 10:44 P. M.; to Jupiter on the 26th at 7:42 P. M.; to Venus on the 27th at 10 A. M.; to Mars on the 27th at 6 P. M.

Among objects of special interest to possessors of small telescopes that may be noted this month are a number of beautiful double stars. One of the finest of these is Gamma Virginis, a wonderful binary star whose components were so close together in 1836 that no telescope then in existence was able to separate them. Now, however, a 3 inch splits them easily, their distance being nearly 6". They are both of the third magnitude and their equality in this respect adds to the beauty of the sight. To me there is always an impression of rivalry in a double star whose components are nearly equal. Each seems to be shining its best, as if conscious of the presence of the other. A still more beautiful double, though more difficult, and requiring a better telescope to be well seen, is Epsilon Bootis. The peculiar charm of this star depends upon the splendid contrast of colors presented by its two unequal components. The larger star of the two is of the third magnitude and deepyellow; the smaller star is of the sixth magnitude and bright green. Their distance apart is less than 3", and on account of the inequality of their magnitudes a 4 inch glass is likely to give a more satisfactory view of them than a 3 inch, although the latter is capable of separating them and of showing their colors also.

Another double star much resembling Epsilon Bootis, but easier to separate, is Gamma Leonis. The larger component is of the third magnitude, and the smaller of the fourth, the first being yellow and the second green or greenish blue. The distance is about 3¾".

Look also with a 3½ or 4 inch glass at Iota Leonis, whose larger star is of the fourth magnitude, color pale yellow, and the smaller star of the seventh magnitude, color light blue; distance 2½".

A very beautiful and easy double, now well placed for observation, is 12 Comæ Berenicis. Even a 2 inch telescope will show this readily, as the distance of the components exceeds one minute of arc. Their magnitudes are fifth and eighth, and their colors yellow and rose red or lilac.

Everybody of course knows the splendid Mizar in the middle of the handle of the Great Dipper. An average eye sees its companion Alcor without optical assistance. With a 2 inch or 3 inch telescope Mizar is seen to be itself double, the larger star being of the third magnitude and white, and the smaller of the fifth magnitude and light emerald.

The beautiful Cor Caroli, the brightest star in the constellation Canes Venatici, must also be mentioned. The telescope shows that it consists of two stars, about 20" apart, the larger of which, of the third magnitude, is white, while the smaller, of the sixth magnitude, or under, is distinctly lilac.

Those who are not familiar with the constellations will need to use a star atlas for finding the double stars just described. Their places cannot be satisfactorily indicated by mere description.

GARRETT P. SERVISS.

THE NATIONAL ACADEMY OF SCIENCES.

The meeting of the National Academy of Sciences that was held in Washington recently was of more than usual interest, owing to the special character of the business transacted.

The Academy, as many of the readers of the SCIENTIFIC AMERICAN know, but of which fact the general public persists in remaining very ignorant, is the highest scientific body in the United States, and an election to its membership is the greatest honor that an American can expect to receive at the hands of his countrymen. To this Academy all questions of scientific importance that come up in the administration of the government are referred for final decision. Even matters of the utmost delicacy, such as one involving the life or death of a geological survey, have been passed upon by them and their decision accepted without an appeal. Its membership is limited by law to 100 members, and it is never full. Indeed, in recent years, owing to the large number of candidates proposed, no choice was possible, and the number of members had been reduced by death to below ninety.

Two meetings are held each year. One on the third Tuesday in April, always in Washington, D. C., and the other, usually elsewhere, about the 1st of November. The stated meeting, as the one held in the spring is called, was convened on April 16 in the audience room of the United States National Museum, and continued its sessions until April 19.

Among the features of this year's meeting that gave it unusual prominence was the election of a new president. In the more than thirty years of its existence, for it was founded in 1863, by an act of Congress, the Academy has had but few presiding officers. Alexander D. Bache, who for so long a time filled the high office of superintendent of the United States Coast Survey, was the first to receive the presidency from the hands of his associates. From the inception of the Academy until his death, in 1868, he filled that place. His able colleague in Washington, Joseph Henry, the first secretary of the Smithsonian Institution, came next, and for ten years, with courtly grace, he presided over the meetings of the Academy. He died in 1878, and William B. Rogers, the founder and president of the Massachusetts Institute of Technology, was chosen as his successor. His term of office was comparatively short, and scarcely had four years elapsed when he was called to join the silent majority. The Academy then inaugurated a different policy, and Professor O. C. Marsh, of New Haven, so well known for his studies in paleontology, being at that time vice-president of the Academy, was confirmed in the higher office by his associates at the ensuing election. Professor Marsh was then and is still in the prime of his mature manhood. He filled the office with ability and judgment for two terms of six years each, and, having declined a third term, stepped down into the ranks again.

To fill his place the Academy has chosen a veteran, and Wolcott Gibbs, of Newport, R. I., the Nestor of American chemists, was given the high office of president of the National Academy of Sciences. To even briefly review the career of this eminent scientist would be an arduous undertaking and one that, to be well done, must be lovingly done; for among the teachers of science no one has so thoroughly succeeded in attracting students by the charm of his personal magnetism since the time of Louis Agassiz as Dr. Gibbs. A word or two must be given of his record.

Seventy-three years ago in February he was born in New York City, and after graduation at Columbia and study in Europe, he became a teacher of chemistry. In 1849, a date when several of the members of the Academy were not yet born, he was called to the chair of chemistry and physics in the College of the City of New York, and, in 1863, he went to Cambridge to accept the Rumford professorship in the Lawrence Scientific School of Harvard University. Having served there for more than a quarter of a century, he was made emeritus, and then retired to his home in Newport, where he devotes the leisure of his maturing years to the prosecution of original investigations. During the civil war he was a member of the executive council of the United States Sanitary Commission, and to him credit is given for the idea out of which the Union League Club has grown, of which he is the senior honorary member. In returning to its earlier traditions and choosing to its highest office the most distinguished of its members, the Academy has adopted a course that cannot but be of benefit to it.

A home secretary was also chosen at the recent meeting. Asaph Hall, who found the moons of Mars for the World in 1877, and achieved fame at the same time, was continued in the place that he had so acceptably filled for many years. The headquarters of the Academy are in Washington, and therefore it is desirable that the office of the secretary should be there also. Professor Hall was for many years connected with the United States Naval Observatory, and is now on the retired list, with leisure at his command.

In addition to the officers mentioned, George J. Brush, of the Sheffield Scientific School; Benjamin A. Gould, of Cambridge, Mass.; Simon Newcomb, of the United States Nautical Almanac; Ira Remsen, of Johns Hopkins University; George L. Goodale, of the botanical department of Harvard University; and Othniel C. Marsh, of the Peabody Museum of New Haven, were elected new members of the council.

Interest was not only confined to the election of new officers, for it extended to the new members who were chosen. Notwithstanding the number of vacancies, never more than five new members are chosen to the Academy at one time, and members can only be elected at the stated meeting. No candidates have been chosen since 1892, but this year four were agreed upon. They were: William L. Elkin, of the astronomical department of Yale University; Charles S. Sargent, who fills the chair of arboriculture in Harvard University, Cambridge; William H. Welch, of the Johns Hopkins University, whose recent researches in biology have been so valuable, especially in the direction of determining with exactness the presence of rabies in persons bitten by animals afflicted with hydrophobia; and Charles O. Whitman, whose researches in marine life have resulted in his recent appointment to the University of Chicago.

Besides the home members, three foreign associates were chosen. They were: Prof. Rudolph Lenckart, who for so many years has been in charge of the Zoological Institute in Leipsic, Germany; Prof. Sophus Jie, the famous Norwegian astronomer, who now fills the chair of that science in Leipsic; and Prof. Julius von Sachs, the director of the Botanical Gardens in Wurzburg, Bavaria. It is perhaps well to add that foreign membership is likewise restricted, and there are never more than fifty foreign members.

The Academy has also a substantial way of honoring scientists, for it is the custodian of several trust funds, from the interest of which gold medals are awarded from time to time for discoveries or advances made in special branches of science. Conspicuous among these is the Watson medal, derived from a fund of $13,000 left some years ago to the Academy by James C. Watson, from the interest of which "a medal is to be prepared to be awarded to the person in any country who shall make any astronomical discovery or produce any astronomical work worthy of special reward and contributing to the progress of astronomy." Four times has this medal been given; first to Benjamin A. Gould in 1887; then to Edward Schoenfeld, of the University of Bonn; then to Arthur Auwers, of Berlin, and last year it was awarded to Seth C. Chandler, of Cambridge, Mass., for his researches on the variations of latitude and the variable stars. The public presentation of the medal took place in Washington this year. The medal is accompanied by a gold purse of $100.

A medal resulting from a fund left to the Academy by Frederick A. P. Barnard, who for so many years was president of Columbia College, valued at $200 and known as the "Barnard Medal for Meritorious Service to Science," a copy of which is to be presented at the end of "every five years to the person who, during that period, shall have made such discovery in physical or astronomical science, or such novel application of science to purposes beneficial to the human race, as shall be deemed the most worthy of such honor," is also at the disposal of the Academy. The first award of this medal was made this year, and the fortunate recipient was Lord Rayleigh, to whom it was given for his discovery of argon in the atmosphere.

Comparatively few papers were read at the recent meeting. In fact, the original programme contained only twelve titles; but others were announced subsequent to the arrival of out-of-town members. The scientific session, which is held in the autumn, is more likely to afford a larger number of contributions from the members. It will be held on October 20, in Philadelphia. One feature of the Academy that deserves a word, in conclusion, is that of the reading of biographical memoirs of each deceased member. This year one on Dr. Lewis A. Rutherfurd was read by Benjamin A. Gould.

George M. Phelps.

Seldom has death occurred with more sudden stroke than in the case of Mr. George M. Phelps, president of the Electrical Engineer. He was at the office of the journal on April 6, busily occupied with his duties, but suffering from a cold which kept him at home the following Monday. His associates attached no importance to it, but pneumonia set in swiftly and they, with a host of other friends, were dumfounded to learn that he had succumbed to the disease on Thursday afternoon.

Mr. Phelps was born at Troy, N. Y., in 1843, and received there a public and high school education, which he supplemented by continuous study through life. In 1861 he became connected with electrical interests in the shops of the American Telegraph Company, of which his father was superintendent up to its absorption by the Western Union Company in 1866. It will be remembered that the senior Phelps was one of the distinguished and successful inventors in the first telegraph group—a worthy companion of Morse, Vail, Bain, Hughes and House, and one whose work still stands in the Phelps ticker, Phelps telephone, Phelps printer and other apparatus. The son closely resembled the father in a love of beautiful mechanism and in a fine sense of accuracy and finish in the construction of electrical devices. From 1871 to 1879 the two were associated in the conduct of the Western Union factory in New York, and when the latter shop was given up, Mr. G. M. Phelps, Jr., was appointed superintendent of the New York factory of the Western Electric Company, a position he held until December, 1885. Early in 1886 he joined Mr. Franklin L. Pope, an old friend, in the conduct of the Electrician and Electrical Engineer, then published monthly. He took so kindly to electrical journalism that he acquired a proprietary interest in the property. When in 1890 the Electrical Engineer was expanded into a weekly and its business was incorporated, he was unanimously elected its president. He filled that capacity down to the day of his death, taking the most active part in the business management of the paper. Besides this, he was a frequent contributor to its editorial pages, rendering invaluable literary and technical service. Of many questions he was an easy master, and his judgment was at all times sound and keen.

Electrical Appliances in the Japanese War.

The war between China and Japan has shown that the Japanese readily turn to account any advantage offered by scientific appliances. Their seizure of the telegraph lines in Corea strengthened their position at once, and any breaks were quickly repaired by men who had been trained in actual construction as well as the manipulation of the instruments. The Japanese are facile copyists, and have brought the telegraphs of their insular kingdom to such a state of perfection since their introduction in 1870, that there is hardly a point on the vast coast line which could not be put into communication with the capital in a short time should a hostile fleet be sighted.

In field telegraphy the Japanese have made great advances. Their instruments are modeled upon the latest European forms. The poles are made in sections, the bottom one being provided with a brass foot to be forced in the ground, and the wire runs out from reels carried on light hand barrows. The telephonic system of police and fire alarms in Japan is very complete. The greater number of the Japanese vessels are lighted by electricity, and the skillful manipulation of their search lights in the war has excited favorable comment. Owing to the war, many of the lights and beacons have been extinguished on both the coasts of Japan and China, and false lights substituted, so that navigation has become perilous. The "submarine sentry" has rendered efficient aid in preventing disasters. This recently invented electrical instrument gives warning to a vessel going ten knots per hour when the depth of water falls below twenty fathoms, so that the usual soundings may be taken.

PURDUE UNIVERSITY, LA FAYETTE, INDIANA.

One of the most interesting and, at the same time, one of the most important problems of the last quarter of a century has been that concerning the nature of the work to be done in the higher educational institutions. The value of that system which had been pursued in colleges for centuries began to be seriously questioned, and out of this questioning grew the conclusions that institutions were needed differing radically in ultimate purpose as well as in curricula from those already existing. Out of this belief arose the various schools of technology which have been such an important factor in the educational progress of this generation.

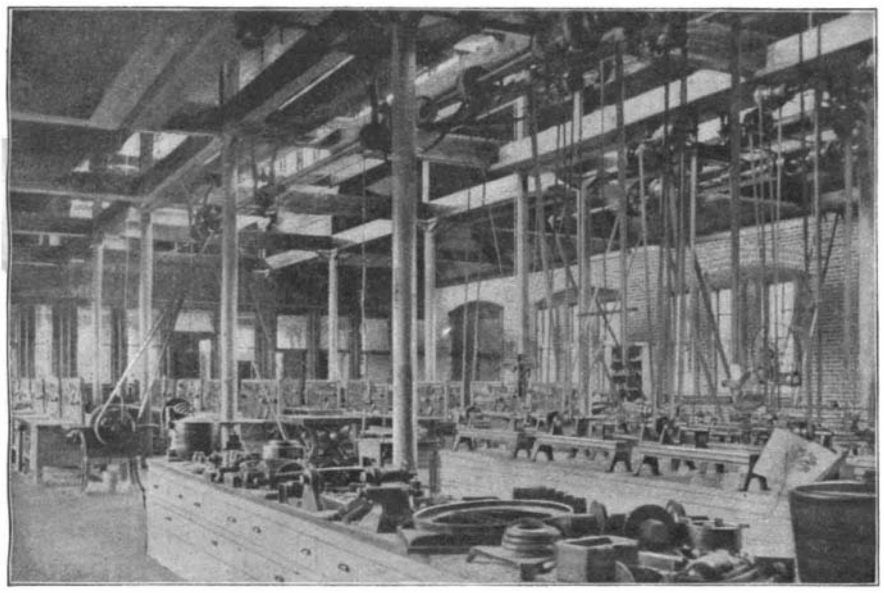
The establishment of such institutions led to problems of extreme intricacy, and the various solutions of these problems rendered the work of these schools, for many years, largely experimental and tentative. From the results of these experiments, however, we have the technical school of to-day, which, with its magnificently equipped laboratories and its faculty of specialists, is each year making possible new applications of science, to new industries, and to new problems of everyday life.

In the central States the growth and development of technical schools within the past decade has been marvelous. These schools have been able to utilize the experience of older institutions, and, by avoiding the errors of the earlier experimental years, have reached in a very short time the highest degree of efficiency. Recognizing the importance of the work of such schools we give in this issue a description of Purdue University, at La Fayette, Indiana, which stands perhaps as the most prominent type of such schools in the West.

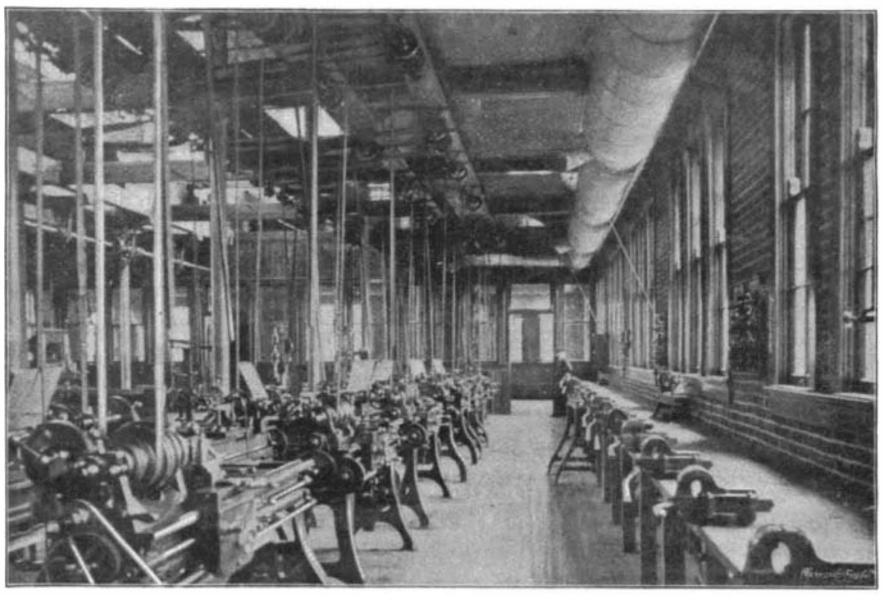
A visitor at Purdue cannot fail to be impressed with the number and excellence of its laboratories. In the department of science are laboratories for chemistry, biology, geology, physics and art; the agricultural department boasts of a fine agricultural experiment station; and the engineering department possesses unusual facilities for laboratory practice in mechanical, electrical and civil engineering. Some of the engineering laboratories have already been described and illustrated in these columns* and others constitute the subject of the present article.

Two years ago there was erected a large building for the accommodation of the engineering departments. A few days after its dedication this building, with its acre and a half floor space and its elaborate equipment, altogether representing an investment of nearly $200,000, was swept away by fire. The loss was severe, but through the wise administration of Purdue's energetic president, Dr. James H. Smart, it has been made the basis of a new development. A large amount of new apparatus and machinery was soon running in temporary quarters. The wood room, foundry, forge room, machine room, the engineering laboratory, and the new annex laboratory for locomotive testing, were all in complete order before the beginning of the present school year, less than seven months after the fire. The construction of the front portion of the building, including the tower, is now going on, and the whole building will be entirely completed by the first of next October. A view of this building from a photograph before the fire is given on our first page.

* May 14, 1892.



ENGINEERING LABORATORY—THE WOOD ROOM.



ENGINEERING LABORATORY—THE MACHINE ROOM.

The incidental gain which has been brought about by the fire is to be found in the improved character of the equipment. The machinery is new, its arrangement is improved and the amount of apparatus in all departments has been greatly increased.

The apparatus for work in steam engineering consists largely of typical engines. Each experimental engine has its full complement of accessory apparatus for determining the performance of the machine. Altogether there are in the laboratory 36 steam cylinders, aggregating about 1,500 horse power; six friction brakes, which together are capable of absorbing 1,000 horse power; and six surface condensers.

Among the important experimental steam plants may be mentioned a large triple expansion Corliss engine, a Buckeye engine, a straight line engine, two Atlas engines, a Westinghouse compound engine, a pair of Baldwin compound locomotive engines, a De Laval steam turbine and a locomotive testing plant.

The locomotive testing plant occupies an annex laboratory and consists of an ordinary locomotive mounted in such a way as to allow its action to be studied and its performance tested while the engine is run at any desired speed and under any load, the conditions being similar to those of the track. The locomotive has 17 by 24 inch cylinders and weighs 85,000 pounds. When in use, it is fired and its motion controlled precisely as if it were upon the road, and while thus run its performance may be tested with the same accuracy which attends the testing of any stationary plant. All parts of the mount are adjustable to suit the dimensions of any locomotive whatsoever. Purdue's engine may be readily run out of the laboratory and any locomotive from any part of the country may take its place. It is expected that from time to time different locomotives will be available for the use of students.

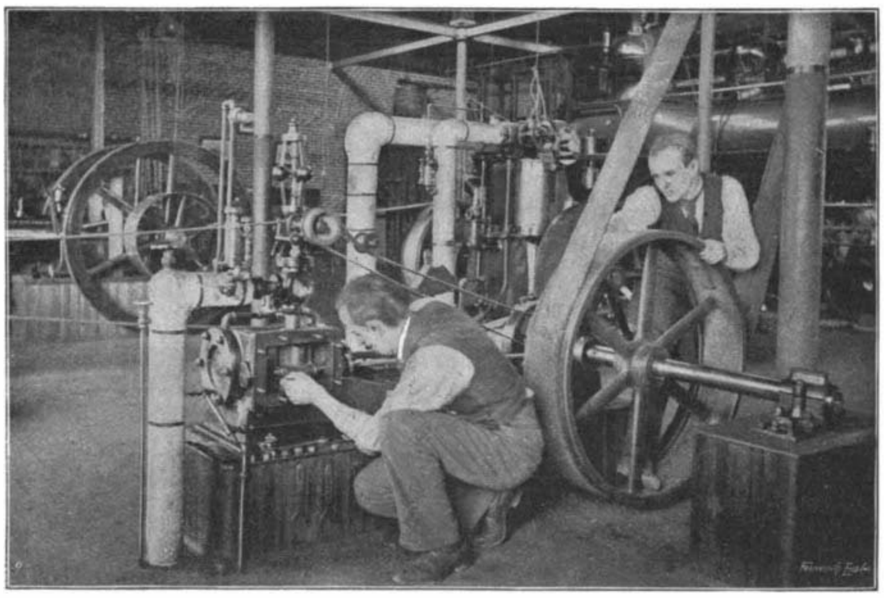
For determining the strength and other physical properties of constructive materials, the laboratory has three large machines, one of which is of 300,000 pounds capacity and of a size sufficient to allow tensional and compressional tests to be made on specimens 8 feet in length.

The several pumps, motors and other machinery making up the equipment for work in hydraulics are grouped about an experimental stand pipe. The pumps draw their supply from a low-level cistern and deliver to the stand pipe. Water from the stand pipe may be used to supply hydraulic apparatus, or it may be discharged directly into an iron weir tank, from which it flows to the low-level cistern. The combined capacity of the several experimental pumps is about 1,000 gallons per minute.

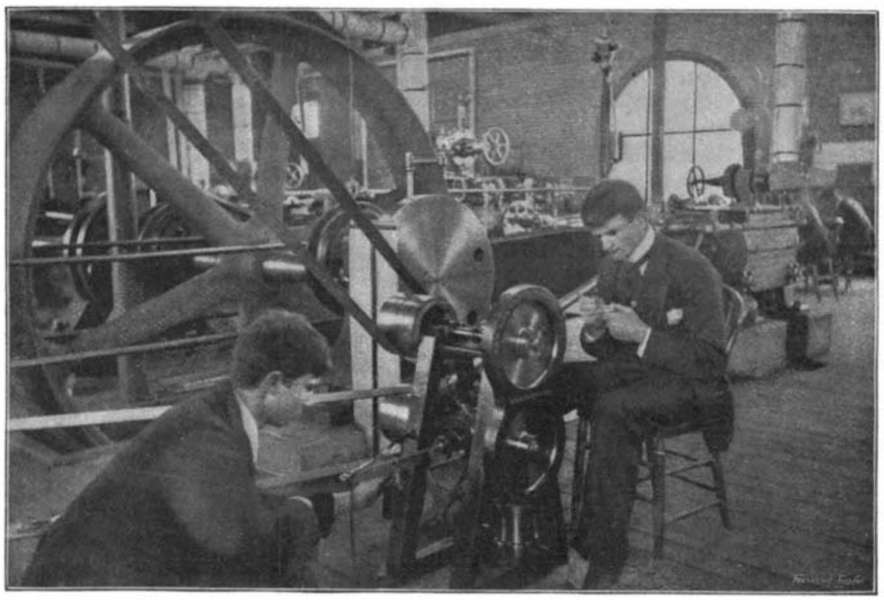
The laboratories of the electrical department occupy a building by themselves. The dynamo laboratory contains over twenty dynamos and motors of different types and outputs, aggregating over 200 horse power. For direct current working, there are both incandescent and arc dynamos and motors of different voltages. For alternate current working, there are alternators and multiphase machines of different outputs and a large equipment of transformers of nearly every American type.

The circuits from all machines, instruments and pieces of apparatus throughout the pier rooms and laboratories of the electrical building can be connected to a large switchboard providing 400 terminals. By this means, any desired combination of machinery, apparatus and instruments may be readily secured.

The equipment of the civil engineering department affords the student abundant opportunity for making himself familiar, by actual use, with the excellent assortment of surveying instruments, embracing those usually employed in actual work, as well as those used in geodetic and astronomical observations.



ENGINEERING LABORATORY—VALVE SETTING.



ENGINEERING LABORATORY—PRACTICE WITH TRANSMISSION DYNAMOMETER.

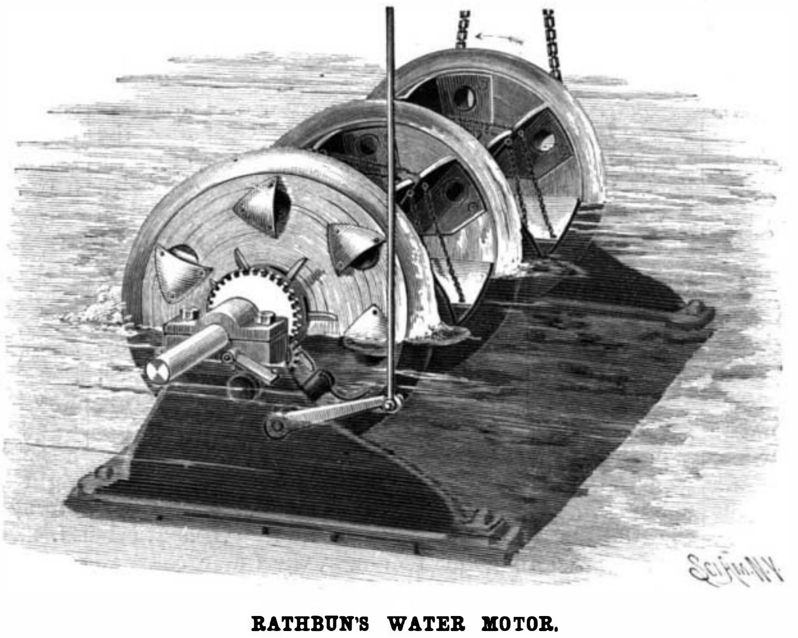
In connection with the work in civil engineering, courses are offered in architecture and in sanitary engineering.

A GOLD medal of the value of $200 is offered by the Bologna Academy of Sciences for the memoir describing the best system or apparatus for putting out fires by chemical, physical or mechanical means. The papers must all be in by the end of May, 1896, and may be written in Latin, French, or Italian, or in any other language if accompanied by an Italian translation.

AN IMPROVED WATER MOTOR.

This is a wheel which may be run when either partially or entirely submerged, is designed to be very efficient in proportion to the speed of the current, and has a very simple and easily actuated mechanism for throwing it into and out of gear. It has been patented by Mr. Benjamin F. Rathbun, No. 99 Winslow Avenue, Buffalo, N. Y., and its inventor reports having made some highly satisfactory tests of its efficiency. On a common shaft is a series of wheels, as many as desired, according to the width of the stream, there being on the sides of the wheels outwardly swinging gates adapted to close into recesses in the sides of the wheels when the motor is not in gear. The end wheels have gates on their inner sides only. The gates on one side of a wheel are connected together by chains, so that when one gate swings out to the current it pulls the next one open.

Opposite the gates are holes preventing excessive suction and permitting the current to enter and assist in turning the wheel, but the holes on the end wheels have their outer sides partially covered by deflectors. When the gates open, their inner edges strike against the teeth of ratchet wheels on the shaft, these teeth serving as abutments. Parallel with the shaft are rods on which are arms adapted to turn opposite the gates to hold them closed, but which may also be turned back of the gate hinges to permit the gates to swing outward, as shown in the illustration, which shows the gates as they would appear in a tide or two-way current, while in an ordinary stream the gates on the lower half of the motor would open while those on the upper half would close. The rods parallel with the shaft have end crank arms projecting through slots of two concentric wheels, the outer one of which has teeth to engage a pinion, and these wheels being movable in relation to each other. The gates are held normally locked by the parallel rods, but by pushing the pinion into engagement with the outer wheel the gates are permitted to swing into the current. The machine is thrown out of gear by a pawl or arm engaging the crank arms on the parallel rods. The motor is well adapted to be placed in a stream, to be run by the force of the current.



RATHBUN'S WATER MOTOR.

THE HOTEL MAJESTIC, NEW YORK.

New York possesses some of the finest hotels in the world, and to the Waldorf, the New Netherlands, the Savoy, the Holland, the Imperial and the Plaza, has recently been added the palatial hotel on Central Park West, between Seventy-first and Seventy-second Streets, the Hotel Majestic.

The structure is 150 by 204 feet and the height of the twelve stories is 165 feet. The building, a modified Renaissance structure, is made fireproof and contains 600 apartments. An open exposed court 40 feet wide gives abundant light and air to all the rooms not fronting on the street. Nearly four million dollars were spent in the erection and furnishing of this hotel. The architect was Mr. Jacob Rothschild, who was assisted by Messrs. Reeves and Livingston.

Some of the special features of the hotel deserve attention. A covered driveway for carriages runs entirely through the hotel. The main entrance and foyer are marvels of beauty, being richly decorated in Renaissance designs. The grand salon is furnished in the style of Louis XIV, the dining room in the Empire style of decoration, etc. A spacious winter garden gives the effect of a conservatory. A novel feature is the arrangement of the musicians' gallery, it being so constructed that the orchestra, which plays nightly, may be enjoyed by those in the main dining room, music room, grand assembly, and promenade halls at the same time. In summer the roof garden, occupying a surface area of thirty thousand square feet, offers the guests and their friends a nightly promenade concert, and by day an unobstructed view of the city, the Hudson and the Palisades, while at the door is the Park. The Hotel Majestic is in one of the choicest residence districts, of the city. It fronts directly upon and overlooks the Central Park, with its lakes, trees, green swards, flowers, winding paths, and driveways. The views from the Majestic are wonderful and enchanting.

THE HOTEL MAJESTIC, OPPOSITE CENTRAL PARK, NEW YORK CITY.

Liquid Glue.

Chloral hydrate	250 grammes.	
Gelatine	400	"
Water	1000	"

The solution is ready in forty-eight hours, and is said to be excellent for mounting photographs.

The Fate of the Rural Town.

We have heard much in late years of the development of our mountain towns. We have thought the trouble to be in their elevation and the hardness of the soil; but Mr. Fletcher is now telling us in the April Forum that a similar fate is visiting the rural town in such States as New York, Ohio, Indiana, Illinois, Michigan, and Iowa. Indeed, the blight is peculiar to no one section, but extends to every part of the country. The population of the whole country has immensely increased, while scores and hundreds of the rural towns have steadily declined in population and wealth. In view of these facts, we must look for a deeper cause, and that cause we find in the new facilities for travel and transportation. The railway is an immense centralizing power. We are only beginning to awaken to the tremendous significance of this recently introduced material force in our civilization. In its presence all things pass and the whole world is made anew. The immediate results from the introduction of steam as a motive power were felt long ago; the remoter consequences are now being revealed in every cause and in every line of business. The change is nowhere more clearly seen than in the relation of the inland town to the commercial metropolis. When men reached the interior by horse power, by the ox team, or on foot, the rural town had a living chance to advance in population and wealth. For the industrial army which had moved into the wilderness or the open country, the rural village was the new base of supplies. The commissariat must go along with the columns. The large center was too far away. But the coming of the railway abridged distance. It brought the village ten or twenty miles away in touch with the great city, making it a sort of suburb. The outlying depot of supplies is no longer needed; the railway train has taken the place of the country storehouse. Does the change mean the destruction of the rural town? Not at all. The rural town is as important as ever, but in a new way. The railway took up the old base of supplies and carted it away as of no further use. The fortifications around it have been pulled down, and the soldiers of industry who had occupied them have been drawn back to the main base. The industries now find their center, not in the rural village, but in the city a little farther away. What is taken out of the town is simply drawn back into the city. The fictitious importance of the rural hamlet has disappeared, while the agricultural value of the land remains. The agricultural resources of the country must forever be the bulwark of the city. The only peculiarity now is that the city reaches out farther, drawing its supplies, by the aid of steam, not only from an area of five or ten, but of a thousand or three thousand miles around. It draws from the cheapest market, without respect to distance.—Boston Standard.

The Trolley in Rome.

At the present time omnibuses and a few horse cars constitute the principal means of travel in the streets of Rome.

A concession has, however, just been granted to the Societa Romana degli Omnibus for the building of an electric road to run from the general post office to the principal railroad station in that city.

Grades of considerable size will have to be overcome. The overhead Thomson Houston trolley system will be adopted, and it is expected to have the line open for business on September 17 of this year.

Freight Car Doors.

At the January meeting of the Central Railway Club a paper upon the subject of "Freight Car Doors and Fixtures" was read by Mr. J. D. McIlwain, superintendent of the Union Car Company, in which the author presented the claims of a number of door appliances and concluded as follows, in which he represented a committee appointed to consider the subject given in the title of the paper:

"We wish first to repeat the statement made in our previous report, that the coming freight car door, to be perfect in every particular, and satisfactory to both the transportation and mechanical departments, requires the following essential points:

"First, safety; second, protection to the property in transportation, from theft, fire, and water; third, ease of operation; and last, but not least, economy in production and maintenance. We do not believe that the freight car door has yet been produced that embodies all of these requirements perfectly. In our opinion the perfect door should be hung at the top, on antifriction rollers which cannot be derailed. The bottom girders should permit sufficient play between the doors and the car to give the door ease of motion at once after the fastenings are loosened. The fastenings should be designed to close the door tight against the car when locked, and release it when unlocked. There should be a permanent stop or cleat at the back edge of the door when closed, for protection from fire and water. The door posts should be trussed to prevent bulging outward, which is the principal cause of doors binding and the attendant evils. We question if there is a complete door that is not weak in some one of these features, and leave the subject for your digestion."

In the discussion Mr. McIlwain said he thought that door construction was the leading question of to-day in car design, that is, the providing of "proper doors, properly hung, that will properly protect the property in the car and that will not cost too much for operation and maintenance." The discussion was continued in the March meeting of the club when it was opened by Mr. Perkins, joint freight agent of East Buffalo, who represented the "men who look after the freight and keep track of it." He stated that the number of box cars, not counting those belonging to private car owners, in use in the country was about 512,000, which makes the car doors number over a million. Based upon 200,000 doors opened, closed, and fastened each day, allowing one minute for every complete operation, he figured that it cost $500 per day for this insignificant item, which would become $2,500 if the time occupied was placed at five minutes. This showed the importance of furnishing doors which may be opened, closed and sealed easily and quickly. He spoke of the safety of employes as the matter of first importance in the car door question, applying to the dangers to men in opening and closing the doors as well as those resulting from improperly secured doors upon the road. After enumerating some of the defects which lead to danger of falling doors, he said: "The door of which the least complaint is heard among freight handlers is that hung on rollers or pulleys at the top, with projecting door guides below the bottom of the door and wedge shaped pieces on the bottom of the door to fill guides when the door is closed. These doors always work well, even when bolts that hold pulleys to the door are loose or the door gets old or shaky. . . . Freight men are well satisfied with doors hung this way, and if made a few inches wider than the doorway, the lap over the door post at the back and the door stop in front make the necessary protection against sparks and rain."

New Lake Steamers.

At the Cleveland Ship Building Company's yard, April 20, was launched the steel steamer Chili, built to the order of Captain Drake, of Buffalo; Captain A. B. Wolvin, of Duluth; Wm. Dickinson, of Chicago; Captain David Vance, of Milwaukee, and others. The Chili measures 342 and 324 by 42 and 27 feet. Her engines are triple expansion, 20, 33 and 54 by 40 inches, the two boilers being 12 feet 4 inches by 13 feet. A 12 by 12 inch hoisting engine operates a fore and aft shafting, by which freight is lowered into and hoisted out of the hold. She will be ready for sea about June 1, and will carry 3,200 tons on 15 feet draught.

On the same day the steamer J. J. McWilliams, building at the Wheeler yard, West Bay City, was launched. She is building for the Mitchell-Gratwick syndicate, and is 370 feet over all, 352 between perpendiculars, 42 beam and 27 depth. Her engines are 20, 32 and 55 by 42 inches. Her boilers were made by Wicks Brothers, of Saginaw, and are 13½ by 12 feet. She is expected to be out in about four weeks.

The Detroit Dry Dock Company launched, April 20, at their Orleans Street yard, Detroit, a fine lumber steamer, the Argo, for C. R. Jones & Company, the Fisher-Wilson Lumber Company, and others, of Cleveland. She is a single decker, 203 feet in length, with 185 feet keel, 35½ feet beam and 15 feet depth, and will carry 800,000 feet of lumber on 12½ feet draught. Her engine is a fore and aft compound, 22 and 46 by 36 inches, with cylindrical boiler 12 feet 3 inches by 11 feet. She will carry two pole spars and one stack. She is expected to be out in three weeks and will tow two of the A. G. Comstock's barges.—Marine Record.

AN IMPROVED GASOLINE TRACTION ENGINE.

The illustration represents a gasoline traction engine which has been used in the field for several seasons, doing most efficient service. It is manufactured by the Charter Gas Engine Company, of Sterling, Ill. It is of neat design, strong and well built, the frame being all iron and steel, and the rear axle has roller bearings. The platform is suspended on springs. The steering wheel and levers are within easy reach of the operator, and the traction motion can be reversed instantly. The gearing is arranged to give two speeds, two and a half or four miles per hour.

THE "STERLING" GASOLINE TRACTION ENGINE.

The Prevention of Window Cleaning Accidents.

According to the report of the registrar-general, the number of fatal falls from the window in England alone is eighty per annum, but notwithstanding this fact, little has been done either on the part of the government or on the part of house owners to take means to lessen this unnecessary mortality. In 1892 the corporation of Glasgow passed a by-law enacting that in dwelling houses all window sashes above the ground floor should be hinged or constructed so as to admit of the outsides of the windows being cleaned from the inside of the apartment; and we believe that an old act, passed in 1847 and applying to English boroughs, made it an indictable offense to allow any one to stand outside a window, with a fine of 40s. payable by the occupier. But this act is undoubtedly a dead letter in the country, and would anyhow be impracticable in a large city like London. The proper remedy obviously lies in the fitting of the window itself. If this can be so constructed that the operation of cleaning can be performed from the inside, while the framework is both air and water tight, the safety of the cleaner is assured, but before any such innovation can become popular among those who have grown up among sashes and are returning to casements, it must be made clear that the new invention does not lose in comfort for its user what it may gain in safety for his servants. --The Lancet, London.

The Gateway to Lake Superior.

For many years the United States has had possession of the gateway to Lake Superior, for such may be termed the lock at the St. Mary's Falls Canal, and quite as much so as Gibraltar is the key to the Mediterranean.

It appears that Canada, or rather the imperial government, could not rest quietly under this state of affairs, which in a sense debarred access to their territory on the north shore of Lake Superior. This feature was brought strongly to the front a quarter of a century ago, when Canadian vessels with military supplies for Manitoba were refused permission to lock through the canal, which was then under the jurisdiction of the State of Michigan.

It may be assumed that from the above episode sprung the idea to have a national waterway whereby Dominion tonnage could pass on to Lake Superior under all conditions, and now this has been accomplished. Furthermore, it will be remembered that three seasons ago the Canadian government, by an order in council, so changed the rules governing the imposition of tolls in the Welland Canal, their gateway to the coast, that a rebate to the tolls would only be allowed to vessels that discharged their cargoes at a Canadian port. While the new order appeared all right and just on the face of it, there was really a strong discrimination against the port of Ogdensburg, N. Y., and as a consequence against American tonnage consigned there, and this meant the building up of Kingston, Ont., as a terminal lake point at the expense of Ogdensburg. Remonstrance on the part of commercial and transportation interests with the Dominion government proved futile, and finally a law was enacted by Congress exacting toll from all Canadian vessels passing to or from Lake Superior. This state of affairs lasted only about five months, when such pressure was brought to bear on the Dominion government that the order in council was abrogated relative to the Welland Canal tolls, and at the same time the American "Soo" Canal was again thrown open to the use of Canadian vessels free of all charges.

Canada is now independent regarding access to her Lake Superior ports. She has a splendid canal in her own territory and need not be under any further obligations to the United States for permission to reach her northern limits. In addition to this feature she holds the key to the coast via the St. Lawrence route, and with these facts in mind it has been a consideration for some time past to know whether the Welland Canal tolls would not be put in force again, seeing that the Dominion could no longer be checkmated by the United States in the same manner as formerly, and it is of particular interest to note that Canada seems to have no inclination at this time to reimpose burdens on American commerce, for not only is the new canal at Sault Ste. Marie declared free of tolls for all tonnage, but the Welland and St. Lawrence Canals remain as formerly relative to toll charges. This is the more magnanimous on the part of Canada considering that she has spent vastly more money, considering the meager population of the country, in improving natural and forming artificial waterways than has the United States, and the announcement that the Canadian St. Mary's Falls Canal is free to all vessels shows the spirit and feeling which the Dominion bears toward this country, for, of course, only American tonnage is meant when it is said that the canal is free to all.

Such concessions, or international courtesies, if so they may be called, will no doubt go far toward smoothing over rough places which crop up from time to time in the usual order of events, and questions involving international rulings are much easier settled in an amicable manner when a mutual feeling of friendliness predominates, and such must be regarded the recent action of Canada in throwing open the new Sault Ste. Marie Canal.—Marine Record.

THE average production of ice, by means of the expansion of cold air, in what are known as cold air ice machines, is two and one-half tons of ice per ton of coal. Other machines vary from two and one-half tons to twelve and one-half tons of ice per ton of coal.

Notes on Aluminum.

From a large number of experiments made by the author, the following results have been obtained:

Alloys Containing Gold.—Alloys of aluminum and gold, although interesting, are of little practical use except for decorative purposes. With 6 per cent of gold, the alloy is as white as pure aluminum, but more brittle; and with 10 per cent the product has a light violet brown color, is harder than aluminum, and only works well at high temperatures. A 15 per cent gold alloy is almost white, with a violet shade, very soft, and a fine grained metal. An alloy of 50 per cent gold is soft and spongy, and possesses a beautiful violet color; while with 78 per cent of gold it is very brittle, and of a pinkish violet color. With 90 cent of gold, the color is a pale violet, and with 94 per cent it approaches a pink. Alloys containing small percentages of aluminum leave a bright violet color on the cupel under the blowpipe. An alloy of 50 per cent of gold, 45 per cent copper and 5 per cent aluminum takes the color and polish of 14 carat gold, but easily tarnishes.

Alloys Containing Silver.—Alloys of aluminum with 4 to 8 per cent of silver are harder than pure aluminum, and not brittle, and take a fine polish. The color is similar to that of fine silver; they are used for medals, charms, etc.

Alloys Containing Nickel.—An alloy of 50 per cent nickel and 50 per cent aluminum is of a dull gray color, very porous, and too brittle to use. The following alloys of copper, nickel, and aluminum are very strong, hard, and fine grained: With 66 per cent of copper, 24 per cent of nickel, and 10 per cent of aluminum an alloy is formed which takes a fine polish, and has the color of 10 carat gold. With 55 per cent of copper, 33 per cent of nickel, and 12 per cent of aluminum the color is a beautiful golden brown; and with 72½ per cent of copper, 21¼ per cent of nickel, and 6¼ per cent of aluminum, the color becomes richer and deeper.

Melting of Aluminum.—The temperature should be kept even, and not much above the melting point of the metal, which should be fed into the crucible in small pieces. The most useful flux is a little tallow. A crucible mainly of siliceous material must not be used, as the aluminum attacks the silicon. In alloying, the aluminum is put into the crucible after the other metals have become liquid.

Restoration of the Mat.—Aluminum can be cleaned and its mat restored by dipping for 1¼ minutes in a solution of 3 ounces of caustic potash or soda in a quart of water, then washing well, and dipping in a solution of three parts nitric and three parts sulphuric acid (by volume).—G. F. Andrews, J. Amer. Chem.

The Wonders of the Joints.

Dr. J. H. Hanaford, in the Phrenological Journal for May, gives the following interesting facts relative to a most important function of the human body:

The more than two hundred bones of the body would be of but little service to us aside from their joint connections. Some of these are of a remarkable character.

The twenty-four ribs are attached to the spine by a kind of immovable joint, the seven upper ones to the breast bone, by cartilages; three, more movable, are tied to each other and then fastened above, while four are "floating ribs;" these, with the six above, affording elasticity and motion in the act of breathing, accommodating themselves to the varying size of the chest.

In the place of these ribs a solid plate of bone would be cumbrous, heavy, not admitting of the motions needed at this part, while the curved and elastic ribs afford similar protection to the organs within. The wedge-shaped bone of the lower spine fits firmly into a corresponding cavity in the hip bone—a grand foundation bone of great strength, admirably adapted to its use.

Of the two other kinds of joints, the "ball-and-socket" and the "hinge," much might be said if space would admit. The ball-and-socket is well represented by the joint at the shoulder, which allows the arm to move in all needed directions.

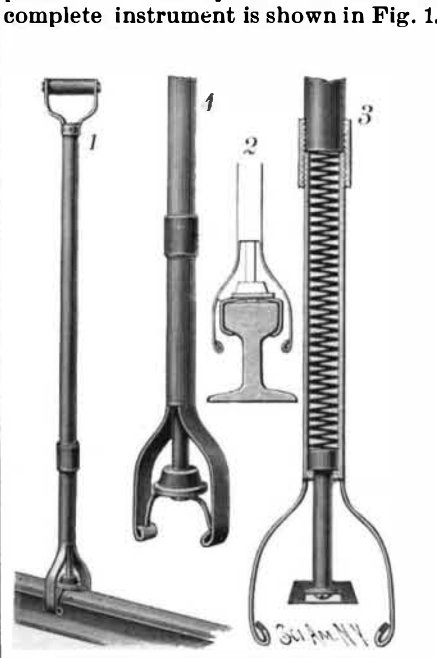
That the arm may have a wider scope, the socket is very shallow, so that when "out of joint" it may be easily put back again, almost by the unfortunate boy, if he only understood the matter. (It would not be safe for him to attempt to walk on his hands, instead of his feet, as the "ball" would slip out too easily for safety.) In this respect the hip joint differs, the socket being quite deep, at the bottom of which there is a round, strong cord, which is so attached to the thigh bone as to prevent dislocation, unless from a severe accident. In consequence of this depth the leg is not afforded much movement, its principal movement being that of walking—a boy need not kick! This depth is needed to bear the weight of the body, with that of burdens which must be carried, in active life. This "ball" cannot get out without breaking the cord, in which case it is useless to put the "ball" back. In the case of a dislocation, the "ball" being pressed up, nature (God in nature) by the aid of the nerves, blood, etc., performs a miracle, making a "socket" around this "ball," so that, after awhile, one can walk tolerably well, always limping, however, because the leg has become shorter than the other.

The other joint is the "hinge joint," like that of the common door, admitting of motion only forward and backward. In the case of the arm, which demands so many motions, the two joints are supplied, making the limb wonderfully useful, adapting it to various, if not numberless, employments. Think of the friction of walking naturally resulting from our motions, particularly of the bones of the leg and thigh, caused by the weight of the body! Indeed, if these were made of steel, without any means of lubrication, only a few years would be required to wear them away so that a man would be cut down to one-half his height. To prevent this, the ends of the bones are provided with a smooth, gristly matter, which is repaired as fast as it wears away, the joint supplying its own oil, with no care on our part. Thus the wonderful machinery of the body goes constantly on.

INSTRUMENT FOR PLACING TORPEDOES.

One of the indispensable danger signals used on railroads is the torpedo, which is exploded by the passing train, but to place the torpedo on the track in position to be acted on by the wheels of the train to be signaled, it has heretofore been necessary to stop the train leaving the signal to enable a man to place it in position on the rail.

Mr. James D. Seamands, of 623 Buena Vista Street, San Antonio, Texas, has recently patented a very simple device by means of which the torpedo may be placed on the rail by a man on a moving train. The complete instrument is shown in Fig. 1. In the tubular end of a long handle is placed a spring pressed follower, carrying at its lower end a foot of soft material, such as rubber, which rests on the upper surface of the torpedo. The latter, which is of the usual description, is furnished with a spring capable of embracing the head of the rail when allowed to assume its natural shape. The spring is held in an extended position by the downwardly extending arms of the instrument, as shown in Fig. 1.



SEAMANDS' TORPEDO PLACER.

The operator grasps the handle and carries it in position to hold the torpedo-supporting spring over the head of the rail. By a quick downward pressure the handle is disengaged from the torpedo spring, which instantly contracts and embraces the rail head, as shown in Fig. 2. Figs. 3 and 4 are enlarged sectional views clearly showing the construction.

World's Fairs in 1896.

Two countries will hold world's fairs in 1896, one in the old world and one in the new. The Exhibition of Industries and Fine Arts which will be opened April 2, 1896, near the castle of Chapultepec, city of Mexico, will be of special interest to Americans. Under the enlightened rule of President Diaz, Mexico has had an opportunity in the last few years to cultivate her great resources, and is now in a position to look for purchasers of her products and bid for the articles she requires. She needs agricultural and mining machinery, printing presses, pianos and canned goods as well as thousands of other articles which the United States is in a position to supply in return for her minerals, cereals, fruits, and coffee. Important inducements are offered to exhibitors, such as the importation of goods in bond and low transportation rates. Senor Ignacia Bejarano, the official mayor of the federal government, is acting as director-general. California, Oregon, Nebraska, Kentucky and Iowa have already appointed State commissioners to look after their interests and a stock company has been organized in Chicago to build the exposition palaces.

An industrial exposition will be held in Berlin in 1896. Special reference is to be paid to exhibits which shall illustrate the history of firearms. One of the features will be an exposition of sports, including a museum of rare objects of the chase and hunting trophies. A dog show will also be held.

BY means of the quadruple effect distilling apparatus thirty-six pounds of water may be evaporated with one pound of coal.

Lightning Freaks.

As the season for lightning flashes is upon us, it may be well to call attention to one or two points and to urge their careful observation and study. The camera has added greatly to our knowledge of these interesting phenomena, and every one in a position to do so should aid in photographing these flashes. We have the multiple flash, the dark flash, the ribbon flash and so on, and these have caused widespread discussion.

Some photographs show a series of parallel flashes following precisely the same path at some distance apart. That separate discharges can make such similar paths for themselves side by side seems incredible. In July, 1892, on an exceedingly hot afternoon at Bay Ridge, Md., a violent thunder storm passed quite near my point of observation. At one point in the storm I saw flash after flash in exactly the same path. There were four or five of these flashes and the whole display lasted more than a second. If a camera were moved very rapidly over such a display, it might give the many distinct parallel flashes, and if it should be moved with less speed, such a broad ribbon flash as is illustrated in La Nature for March 2 might be secured. This "poly flash" or "poly phleg" (Greek, many and flash) should receive some designation to distinguish it from the so-called "multiple flash."

Observations of lightning with the unaided eye may add a good deal to our knowledge. It is highly probable that the estimates of the duration of an ordinary flash of 0·002 to 0·0001 of a second are far too small. It is certain that no broadening of a single flash as sudden as that could ever be had upon the swiftest moving camera. To the unaided eye most single flashes are not more than 0·01 of a second. It is also entirely possible to follow the direction of motion of a flash in the sky.

On April 13, 1895, while a thunder storm was passing directly overhead, I observed a sharp lightning stroke, and, simultaneous with the sound of the thunder, which came four or five seconds later, there was an unmistakable increase in the air pressure. This was not due to the wind, as the air was still at the time. It may be of a good deal of value to obtain additional observations of this kind. H. A. HAZEN.

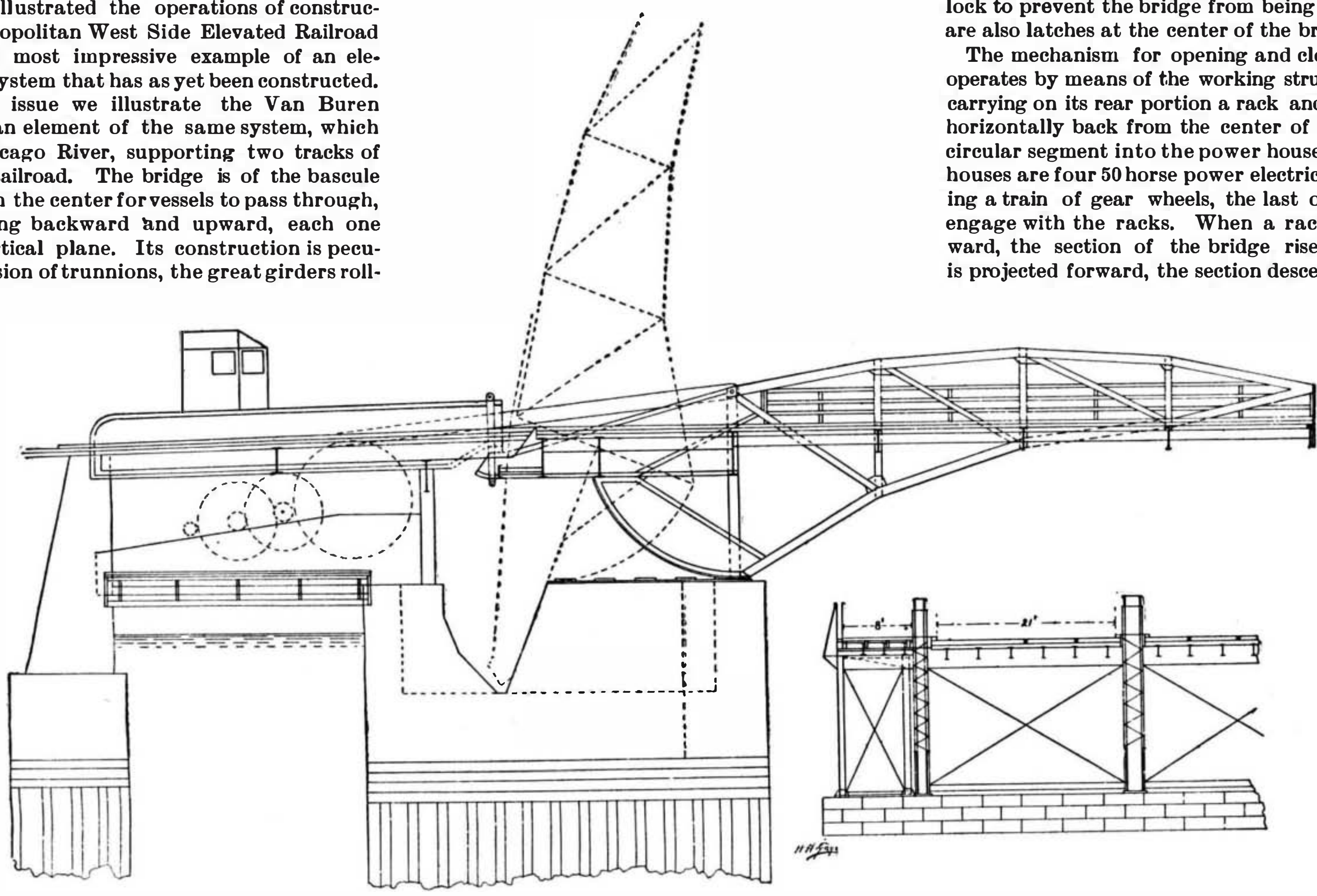
Cycling and the Heart.

The Popular Science Monthly for May condenses from a lengthy paper on bicycling by Dr. B. W. Richardson, who represents cycling as differing from other exercises, in that it tells primarily and most distinctly upon the heart. It produces at once a quickened circulation, though the riders may not be conscious of it; and this accounts for the astonishing journeys a cyclist can undertake, and his endurance as against sleep. Although the heart increases in action and sometimes undergoes enlargement, the author has never seen a rider embarrassed by overstrain of it, faintness, breathlessness, angina or vertigo, so as to oblige him to dismount. Indeed, he had known a practiced rider who climbs hills on his machine, but could not mount a flight of stairs on his feet without breathlessness and a slight palpitation; he had never seen a sudden death from cycling. He had met with instances in which, after several years of cycling, there was evidence of heart disease, with general languor and inability to sustain fatigue if exercise were again tried on the machine; and, on the other hand, he had known examples in which even an octogenarian had kept up the exercise in a moderate degree apparently with benefit to the circulation. He had seen in some cases apparent benefit arising from cycling even where there was an indication of some disease affecting the circulation, and had known good to arise from it in cases of varicose veins and of fatty degeneration, and in conditions of anæmia. In other cases excessive cycling had been a definite cause of injury to the circulation. The author believes that cycling in moderation may be permitted and even recommended to persons with healthy hearts; that it is not necessary to exclude it in all cases of heart disease, while it may be even useful where the action of the heart is feeble and signs of fatty degeneration are found; that, as the action of cycling tells directly upon the motion of the heart, the effect it produces on that organ is phenomenally and unexpectedly great compared with the work it gets out of it; that the ultimate action of severe cycling is to increase the size of the heart, to render it irritable and hypersensitive to motion; that the overdevelopment of the heart affects in turn the arterial resilience, modifies the natural blood pressure, and favors degenerative structural changes in the organs of the body generally; that in persons of timid and nervous natures the fear incidental to cycling is often creative of disturbance and palpitation of the heart, and should be taken account of; that, in giving advice, it is often more important to consider the peripheral conditions of the circulation than the central; that venous enlargement is often rather benefited than injured by cycling; and that straining to climb hills and meet head winds, excessive fatigue and alcoholic stimulants should be avoided, and the proper number of meals of light, suitably selected food should not be neglected.

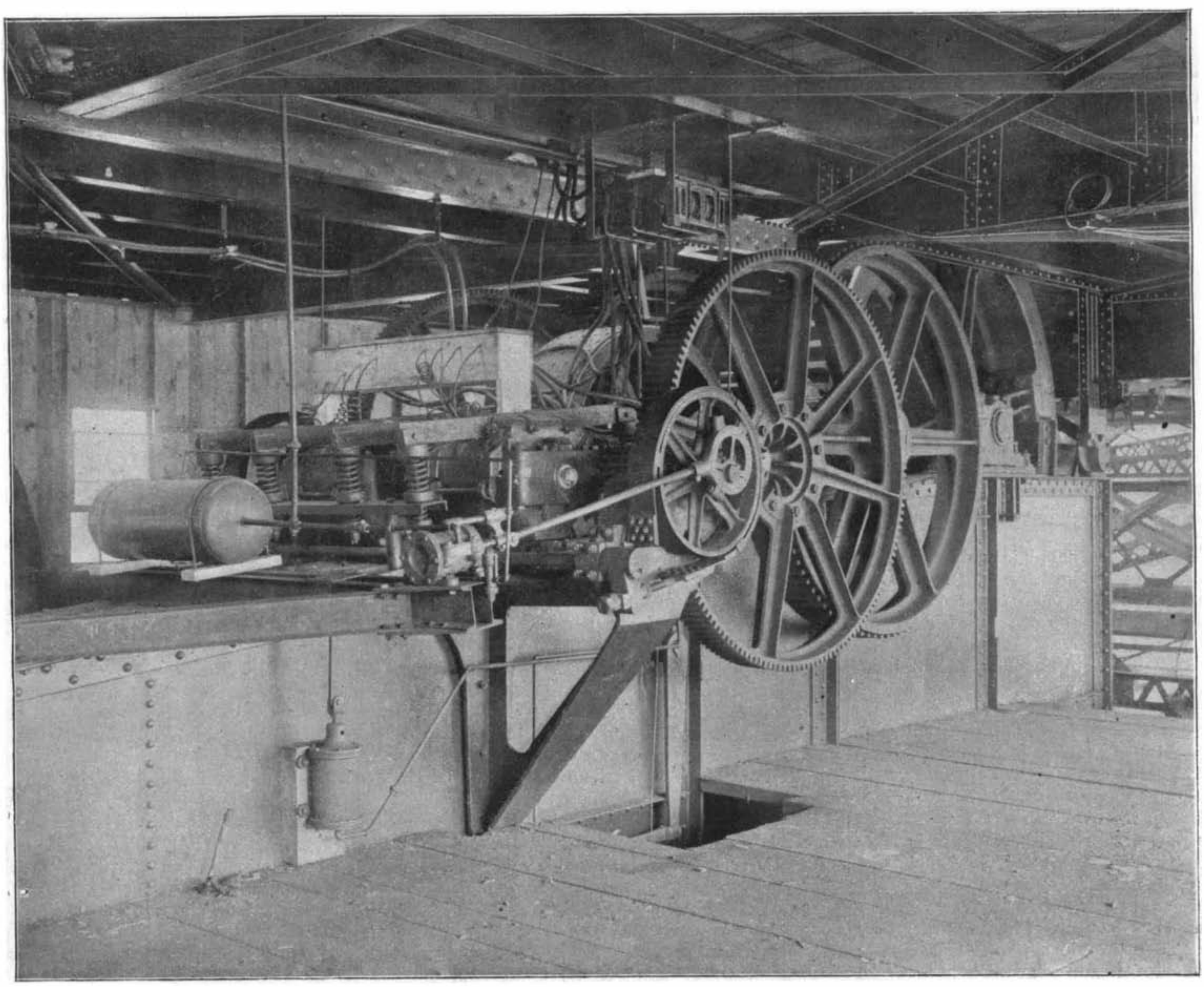
THE VAN BUREN STREET DRAWBRIDGE OF THE METROPOLITAN WEST SIDE ELEVATED RAILROAD OF CHICAGO.

(Continued from SCIENTIFIC AMERICAN of April 27, 1895.)

We recently illustrated the operations of construction of the Metropolitan West Side Elevated Railroad of Chicago, the most impressive example of an elevated railroad system that has as yet been constructed. In our present issue we illustrate the Van Buren Street bridge, an element of the same system, which crosses the Chicago River, supporting two tracks of the Elevated Railroad. The bridge is of the bascule type, opening in the center for vessels to pass through, the trusses rising backward and upward, each one moving in a vertical plane. Its construction is peculiar in the omission of trunnions, the great girders rolling on a segment of a circle, one of which is formed on the backward prolongation of each of them.



THE VAN BUREN STREET BRIDGE. CHICAGO—DIAGRAM OF CONSTRUCTION.



THE VAN BUREN STREET BRIDGE, CHICAGO—OPENING AND CLOSING MECHANISM.

On reference to the cut, two small diagrams will be seen illustrating the bridge, open and closed. The rocking operation of the bridge is made clear in these cuts. They indicate two additional features. The working struts, as they are called, by which the bridge is opened and shut, constitute one of these features. One such strut for each half of the bridge is connected to the point representing the center, from which the circular segments are struck, and runs back horizontally or nearly so to the machine for opening. In the two diagrams this working strut is indicated by a single line extending from such center back along the fixed roadbed. The cuts also show how part of the deck carried by the trusses, as they rock backward, descends beneath the level of the fixed decks on either side of the river.

Referring to the general view of the bridge, it will be seen that each section of the bridge comprises three parallel trusses, each with a circular segment. For the circular segments to roll on, there are provided steel ways on which are projections or teeth of steel, which enter pockets in the faces of the segments. This insures alignment of the three trusses in their operation. On the right hand of the picture is seen the portion of roadway extending back of the center of curvature, which portion goes down when the bridge rises; it is cut off obliquely at its rear end, and a latch or link swings over this end, operating as a lock to prevent the bridge from being opened. There are also latches at the center of the bridge.

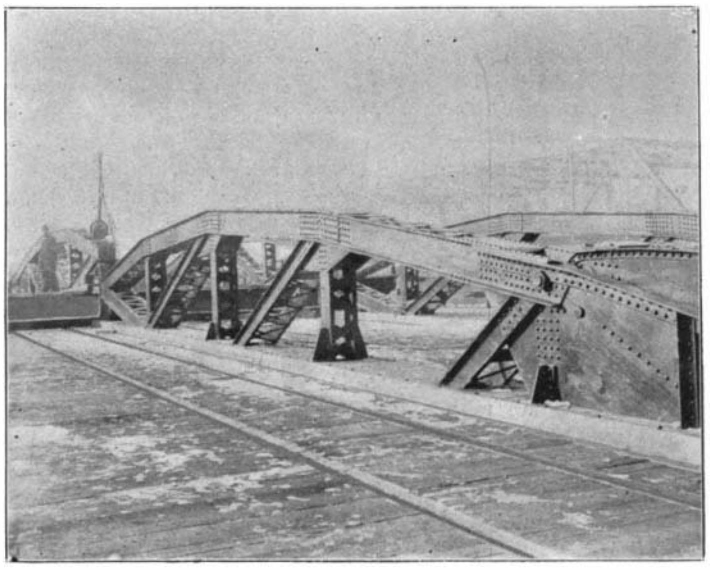
The mechanism for opening and closing the bridge operates by means of the working strut. This is a bar carrying on its rear portion a rack and running nearly horizontally back from the center of curvature of the circular segment into the power houses. In the power houses are four 50 horse power electric motors, operating a train of gear wheels, the last of which wheels engage with the racks. When a rack is drawn backward, the section of the bridge rises; when a rack is projected forward, the section descends. Within the backward extension of the roadway just alluded to ballast is placed to bring the center of gravity into proper position. The effect of this is that the bridge naturally rests partly open, and if it is stirred from this position, tends to rock back and forth. The working struts are attached by pin connections to the central trusses; one strut operates each half of the bridge.

Assuming the bridge now to be closed, if it is desired to open it, the machinery is started so as to draw the racks backward. As each rack moves, its first effect is to revolve a cam by which pin latches at the center of the span are withdrawn and the latches at the heels of the trusses, one of which is shown in the general view of the bridge, are swung backward, leaving the trusses free to move. As the motion continues, the bridge opens, twenty seconds sufficing for the entire operation. In closing, the reverse succession of operations takes place. The pin latches at the center are designed to prevent lateral movement and to insure the ends of the rails abutting in line; the other latches hold the trusses closed. Each truss may be treated as a cantilever, the tail girder representing the anchoring span.

We have referred to the counterpoise weights. They are placed within the tail girders and between them, beneath the railway floor. As these weights are sufficient to prevent the bridge from naturally coming to a horizontal position, in the closing operation force has to be applied to bring the end down. To work each half of the draw span, two of the fifty horse power electric motors are provided, which are wired to operate together or alone. If by any accident the current is cut off, compressed air brakes are automatically applied, which instantly bring the bridge to rest.

In the closing process, before the ends come together the sections are automatically brought to a full stop, so that the final closing has to be performed with special care. A powerful emergency brake is supplied to guard against accidents, which brake can be made instantly to act upon the structure. It is believed that all these precautions and structural features make an accident impossible. Owing to the height of the bridge, it will have to be raised for comparatively few vessels, as most can freely pass under it.

One of the cuts shows the lifting mechanism placed beneath the roadway, the under surface of the roadway or deck forming the ceiling. The general relation of the trusses to the abutments is shown in the larger diagram, giving a view partly in section of the structure, the open position being indicated by dotted lines. The small illustration gives a view of the deck of the bridge. The distant section in this cut is shown partly raised, a further descent of about three feet being required to complete the closing.



DECK VIEW OF THE VAN BUREN STREET BRIDGE, CHICAGO.

The "Blow Hole," Kiama, N. S. W.

One of the most pleasant as well as famous tourist resorts in New South Wales is situated on the coast some 70 miles south of Sydney. The center of this district is Kiama, a picturesque and thriving town surrounded by rich agricultural country, and which has been built upon an old igneous flow of basalt that has solidified and crystallized into huge columns of what is popularly called "bluestone." This formation is seen to perfection on the west coast of Scotland and north of Ireland at St. Fingal's Cave and other places; and those who are acquainted with the rugged appearance of the coast in these places can form a good idea of the appearance of the New South Wales coast at this point. Kiama, unlike other tourist resorts, can be thoroughly enjoyed in either fair or stormy weather, and those who visit the town when a good gale is blowing have an opportunity of witnessing a sight the like of which does not exist elsewhere on our globe. The famous "Blow Hole" here situated, in the middle of a rocky headland running out into the sea, forms a truly wondrous sight. With each successive breaker the ocean spray is sent shooting up into the air sometimes as high as from 300 feet to 400 feet, descending in a drenching shower and accompanied by a rumbling noise as of distant thunder, which can be heard for many miles around.

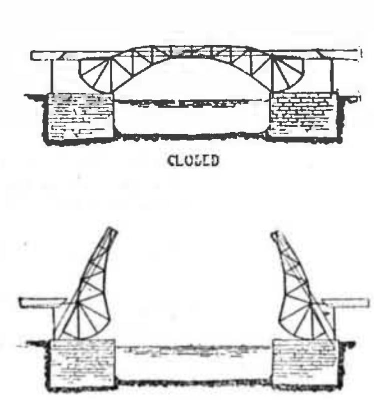
This "Blow Hole" is a singular natural phenomenon, and consists of a perpendicular hole, nearly circular, with a diameter of about 10 yards across, and has the appearance of being the crater of an extinct volcano. This is connected with the ocean by a cave about a hundred yards in length, the seaward opening of which is in all respects similar to St. Fingal's Cave on the west coast of Scotland, the same perpendicular basaltic columns forming the side walls of each. Into this cave towering waves rush during stormy weather, and as the cave extends some distance further into the rock than the "Blow Hole," on the entrance of each wave this cavity becomes full of compressed air, which, when the tension becomes too great, blows the water with stupendous force up the perpendicular opening.—Aust. Photo. Jour.

The Palais de l'Elysee, Paris.

The Elysée Palace, where the President of the French republic lives, was built in 1718 by a banker. In 1748 Madam de Pompadour purchased it, and in 1768 Louis XV bought it from her heirs; later, he sold it to the financier Meaujou, the only proprietor that died in it. Louis XVI bought it for $260,000 and gave it to the Duchess of Bourbon, who, in 1790, presented it to the French nation. In 1803 Murat acquired it and gave it to Napoleon I, who was very fond of the garden. In 1814 Emperor Alexander I, of Russia, resided here. Then the Duke of Berry, the Dauphin, lived in it, and, after his death, the baby Duke of Bordeaux. In 1848 it was assigned to Louis Napoleon. Since 1873 Presidents McMahon, Grevy, Carnot, and Casimir-Perier have dwelt in it. Now M. Faure is the master.—Cincinnati Commercial-Gazette.

RAW silk waste machine wipers, instead of the cotton waste wipers heretofore almost universally used, are said to be entirely free from danger by spontaneous combustion, and this one fact should be sufficient to highly commend them to all who have charge of running machinery. These wipers are manufactured by the American Silk Manufacturing Company, of Philadelphia, and their cost in use is lessened, where used in considerable quantity, by means of a special washing compound, enabling the washers to be employed over again as many as eight to twelve times. These wipers are also said to more thoroughly clean the machinery on which they are used, leaving no small detached fibers or shreds on parts wiped.

DIAGRAMS of BRIDGE



THE VAN BUREN STREET BRIDGE CHICAGO—GENERAL VIEW.

Collodio-Chloride for Transparencies.

Pyroxyline (Hopkins & Williams ordinary)	32	gr.
Ether (725)	3¼	oz.
Alcohol (805)	2½	"
Chloride of zinc	40	gr.
Nitrate of silver	92	"

Dissolve the chloride of zinc in the alcohol (and this is a valuable quality of chloride of zinc, that it will dissolve in the alcohol without the addition of water), put in the pyroxyline when soaked, add the ether, and shake. Now put the silver into a test tube, add 40 minims of distilled water. At this stage I prefer to use a non-actinic light. A single thickness of amber glass will do. There is no necessity for working in a dull light. We now dissolve the silver by heat over a spirit lamp flame, and at the same time heat 6 drachms of alcohol in a small flask; when the silver is dissolved, add about a drachm of hot alcohol to it by degrees. Then add to your collodion, a drop or two at a time, and shake well between, rinse out the tube with the remaining alcohol. If the operations have been carried out properly, a few drops of the emulsion put upon a plate will show an orange tinge; a fairly thick film, a full orange, inclined to ruby when held up to a light. The emulsion must be kept for not less than twenty-four hours.

This emulsion may be washed in the ordinary way. I use it without washing as a rule, as washing entails the consumption of twice the quantity of solvents. To filter, place a plug of wool or good sponge in a glass funnel, and run the emulsion through. Moisten sponge or wool wit ha few drops of alcohol first.

Coat the plates, and place them in a dish of water until the water runs smoothly over the surface, then rinse with two changes of water. Wipe the backs, and drain on blotting paper; or, when plates are wanted quickly, a piece of blotting paper may be placed on face of the plates, and gently pass a finger over to absorb all surface water. After this, they dry in five to ten minutes by the use of such a piece of apparatus as I show you. The usual drying cupboard will do, of course.

With this emulsion no preservative is at all necessary. I have found no difference in the results. One thing I have forgotten to mention in the proper place, that is, the use of a substratum to prevent the film slipping off the plate during washing. I strongly recommend edging the plates with India rubber solution. This is quickly done with a small camel hair brush cut to about a quarter of an inch long in the hair. A dozen of lantern plates can be done in five minutes easily.

The results which I show you have been developed with Abney's—

Ferrous citro-oxalate	1	part.
Ten per cent bromide potassium solution	1	"

Glycin I have only tried one formula given by the makers, that for hard development; and hydroquinone, as follows:

Hydroquinone	4	gr.
Bromide potassium	24	"
Sulphite of soda	48	"
Water	1	oz.

Three minims of a ten per cent solution of carbonate of soda.

Development was from five to twelve minutes. All these developers may be used repeatedly. Hypo must be used for fixing; 2 ounces to the pint is strong enough. Washing in the hand for about a minute is enough to remove the fixing salt.

The light used by me was magnesium, 6 to 36 inches. The colors are black, claret, and most beautiful purples to purple black.—J. S. Teape.

Fog Signals.

The subject of fog signals was discussed recently before the M. P. Club at its meeting in the Institute of Technology, Boston, the speaker being Maj. W. R. Livermore, of the United States army, who has charge of the lighthouses and signals in this district.

The Boston Commonwealth says the paper was a most interesting one, embodying, as it did, the experiments undertaken by Maj. Livermore along our New England coast, experiments which shed much light on several vexed questions.

The lights of the lighthouses in clear weather, said the speaker, are obscured only by the curvature of the earth, but in fogs, since even the sun is hidden, they become invisible. Sound, however, travels well under some conditions of storm, and a century or two ago the use of bells was begun as a warning in times when the light could not be seen. At Boston Light a cannon was once used as a signal, and many other devices have been invented to warn mariners as they approach the shore.

The United States is the only nation in the world which makes an attempt to line its entire shores with signals, the theory here being to place such signals sufficiently close to permit of shore navigation in any weather; but practically the system is not quite complete. In 1851 the transmission of signals through the air was investigated by Gen. Duane; afterward it was taken up by Henry and continued by him with more or less activity up to the time of his death. During the past year a systematic series of experiments was undertaken by the Lighthouse Department, and Maj. Livermore, who had this investigation in charge, had been able to secure quite a number of observations which throw light on matters which have been puzzles to all previous experimenters.

The signals which are in common use are the siren, devised in 1870 by Brown, which can be heard ten or twelve miles; whistles, which will carry eight or ten miles; trumpets, with a range of six miles; and bells, which can be heard not more than three-quarters of a mile. In addition, there are floating bells, which can be heard for slight distances only, and whistling buoys, which are nearly as powerful as the trumpet.

The experiments of the last season had to consider the efficiency of the signals and their expense. The sirens can be heard for long distances, but they are very expensive. On the other hand, bells are not costly to operate, but they are audible for short distances only. A portion of the experiments dealt with larger bells and with the giving of the present bells a harder stroke with the hammer, both of which give the bell signals a higher efficiency.

With reference to the transmission of the signals through the air, previous experiments or comparisons have been uneven. For example, no trumpet has ever been constructed large enough to be properly compared with the siren. Maj. Livermore's experiments concerned themselves with the efficiency of the signals, the details of their construction and position, the reflections and the refractions of the "sound rays," and the effect of obstacles near to and distant from the source of the sound.

For this purpose one of the lighthouse steamers was fitted for the work, and observations in all kinds of weather and under differing conditions were secured. With reference to obstacles, it was found that intervening obstacles tend to diminish the intensity of the sound, irregular surfaces near and in front of the signals effectively lessen their efficiency, obstacles behind the signal cut off the sound in that direction, and obstacles at a distance from the signal cut off the sound in their immediate shadows.

As to the effect of weather conditions, these facts appear: Rain and snow do not of themselves modify the transmission of sound, but in affecting the temperature of the atmosphere they do influence the refraction of the sound and may, indeed, under certain conditions, cause it to be lost to objects on the surface of the water. This is a most important discovery, for it accounts beautifully for the so-called "ghosts," which are areas within which no sound from the signals can be heard. These silent areas have been accounted for in different ways, Tyndall having given a "flocculent material" solution, which, while within the limits of laboratory experiment, seems hardly possible on so large a scale as it must be in nature. Maj. Livermore finds that under certain conditions of wind relative to the position of the signal, the sound rays become refracted upward in certain places, reaching the surface of the water at more distant points in precisely the same line.

A curious example of this was once observed in experimenting near Boston Light. At a distance of about a mile from the light, no sound whatever was heard from the signals at the light, and it was thought that they had been stopped. Suddenly, however, they were heard in full intensity, and the steamer was stopped and backed again into the silent area. A man was sent up the mast, and he reported that he could hear the signals, although no sound could be heard on deck.

This experiment was repeated several times, and a position was found where the noises could be heard at the bow of the steamer but not at the stern. The signals employed on this occasion included a bell, a fog horn, a whistle and a gun; and although the smoke of the gun and the steam of the whistle could be seen from the steamer, no sound reached its deck while in the silent area. The sound rays, refracted through the conditions of the atmosphere, formed an arch over the silent area.

As the outcome of these experiments and investigations, there are many matters of interest and importance. Scientifically, the explanation of the atmospheric conditions which cause the silent area and the underlying principles of refraction of "sound rays" are of great importance; while, practically, there are many matters closely related thereto. The location for signals so that their efficiency may be to seaward, and not, as now, oftentimes to landward, where, as the speaker said, "the inhabitants of the cottages do not seem to appreciate their value," the placing of them so that the silent area may be overcome, and other matters of this nature, are of the greatest practical advantage.

The lecture was throughout of the greatest interest, being fully illustrated with graphic drawings, photographs of the fog signals and of the prominent lighthouses along our northern coast. The most striking of the graphic drawings was a series representing the intensity of the signals throughout the course of the experimental trips, the relation of the silent area to the direction of the wind in its upper and lower currents being indicated.

The Boiling Point of Milk.

Dr. Edmunds, writing in the British Medical Journal, makes the following observations on this subject: Referring to the temperature at which typhoid bacilli are killed, a correspondent assumes that milk boils at 180° to 190° F. This is a mistake which needs correction. Milk boils at a temperature higher than that of water, and it is well known that boiling milk inflicts a much more serious scald then boiling water. The point at which milk boils will vary half a degree or more, according to the amount of its saline and other non-aqueous constituents, but I find that a fair sample of milk, taken from my own kitchen, boils at 213·5° F. when tested with a standard chemical thermometer. I have always advised that milk boiled for one minute is made safe by the killing of any infective germs which it might have contained. The butter contained in the milk does not seem to raise its boiling point, but it is well known that butter and other fats and fixed oils boil at a very much higher temperature, and that boiling fixed oils destroys the skin as effectually as melted lead. In the manufacture of tin plate—that is, sheet iron plated with tin—the tin is kept melted under melted tallow, and the clean sheet iron is tinned by being passed through this bath of molten tin. Fixed oils may be heated to about 500° F. without undergoing material change, but at about 600° F. they begin to boil, owing to the evolution of gases, which are set free as a process of destructive distillation. It is generally held that the typhoid infection of milk is due to contaminated water used for washing the milk vessels or for augmenting the bulk of the milk by fraudulent additions. My own opinion is that an escape of fecal matter from the cow while being milked often falls into the milk pail, and that this is generally the real cause of typhoid infection in milk. I have actually seen this to occur when inspecting dairies and examining suspected cows, and I am perfectly sure that it often takes place. The polluted water theory seems to me to be far-fetched and inadequate.

An Exposition of California Products to be Held in Berlin.

An interesting exhibition of California food products is about to be opened in Berlin. The exhibition has been prepared by private enterprise in the effort to educate the people of Germany and of other foreign countries in the use of American products and to open, if possible, a new field for their consumption. A large building situated in the Thiergarten is being fitted up for the purpose, and the exhibition, it is announced, will be open to the public from the 5th of May to the 5th of July. The building is to be divided into octagonal courts, in each of which there will be a separate exhibition.

In one court, for example, will be shown bitter beers and cordials, another will be devoted to the orange products, and in other courts will be found dried fruits, vegetables, fish, canned fruits, oysters, etc. A novel feature will be a cafe for women, in which all kinds of breakfast foods will be served by colored attendants. The redwood industries of California have combined to build a redwood cottage, in which a unique exhibition will be made. The cottage will contain, besides other products, redwood shingles and burl, and experiments will be made to demonstrate the adaptability of redwood for the manufacture of lead pencils. Scattered about the building there will be some twenty booths attended by young women in Quaker costume, who will distribute prepared dried fruits, mushes, and baking powder products. There will also be glass-inclosed corn poppers, with the idea of introducing this delicacy into Berlin. A model American business office is also to be on exhibition, and it is believed that the many labor-saving devices and conveniences common in this country may be introduced in Germany.

The exhibition, it may be seen, is to be carried out on a very ambitious scale. Some three hundred business firms in California are enlisted in the enterprise, and these represent a capital of nearly $400,000,000. The exposition is not competitive, but purely of a commercial character, and, it is confidently believed, will prove a very effective advertisement for the Pacific coast.

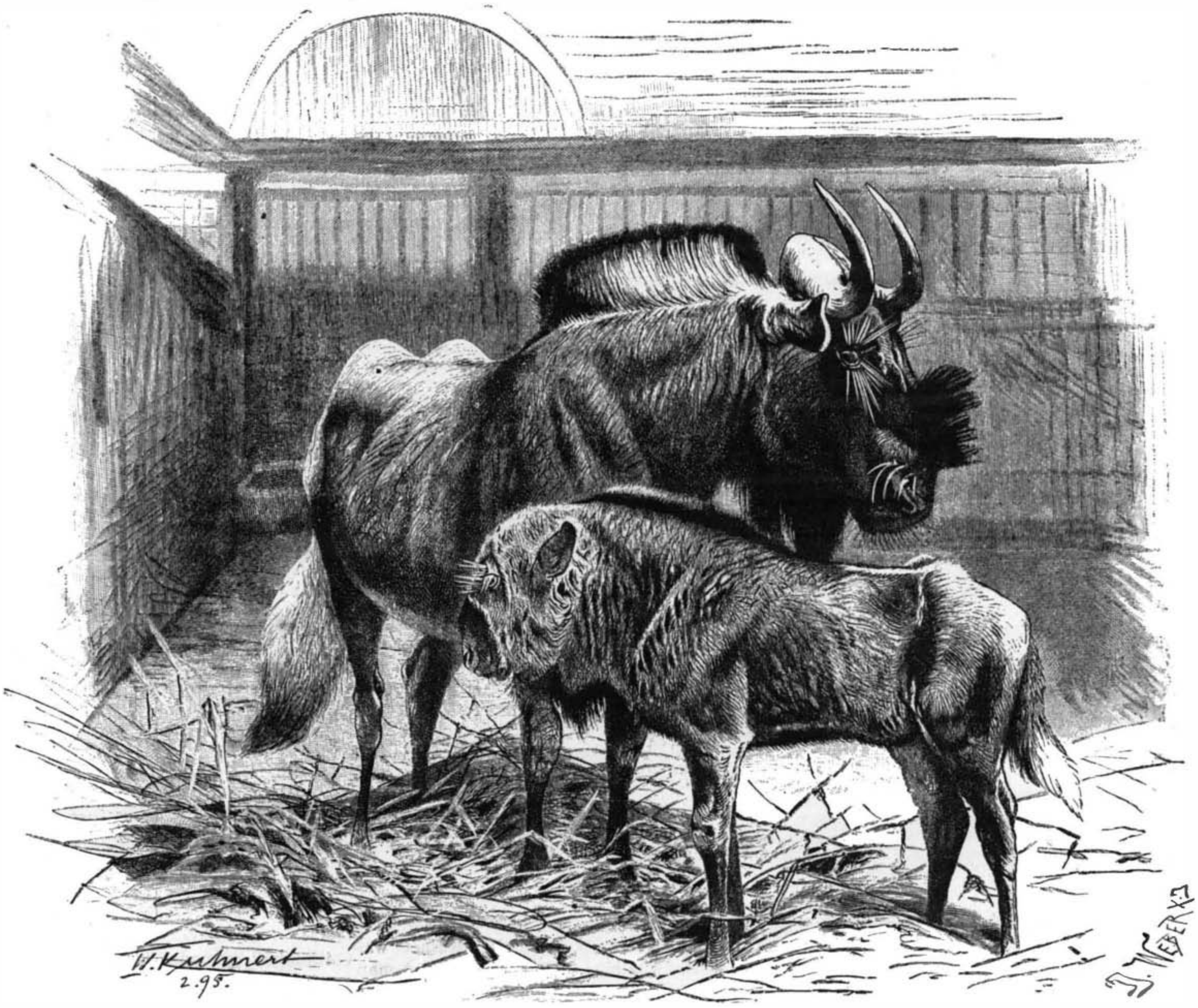
Moving a Masonry House.

The Sage house, Brooklyn and St. Mark's Avenues, Brooklyn, N. Y., has been successfully moved by B. C. Miller & Son, the house movers of that city. The building is of stone, weighing about 1,300 tons, and was built by a son of Mr. Russell Sage, of New York. The contract for removal called for its being moved 30 feet toward St. Mark's Avenue and 20¼ feet toward Brooklyn Avenue, and that it should be raised 2½ feet on its foundations. This to be done without break or crack in the walls.

THE WHITE-TAILED GNU IN THE HANOVER ZOOLOGICAL GARDEN.

The accompanying engraving, for which we are indebted to the Illustrirte Zeitung, shows the white-tailed gnu, with its calf, now in the Zoological Garden at Hanover. This garden possesses specimens of both the white-tailed gnu (Catoblepus gnu) and the black-tailed gnu, also called the blue or Gorgon gnu (Catoblepus Gorgon), but those of the former species are specially interesting. At first the young one resembled a bison calf in many respects. Its coat was a pretty brown color, its head being a sepia brown, while the brush-like bunch of hair just above the nose was black, and the short stiff main was also black. Its bushy tail, which reached almost to the hock, was round like that of a dog. The thick hair concealed the rudimentary, button-like horns, but at the end of five weeks these were half a finger long. Although, in that time, the brush-like hair on the head and the mane—very characteristic features of the gun—had become more marked, the creature still looked as if belonging to a different species from the mother. When eight weeks old its back was only about a hand's breadth lower than the mother's and its horns were about three inches long and quite straight, differing in this respect from those of the old gnu. The color of its coat was also beginning to change.

The gnu belongs to the antelope family, the members of which differ so greatly in size, proportions, color, the shape of the horns, etc.



WHITE-TAILED GNU AND CALF IN THE ZOOLOGICAL GARDEN AT HANOVER.

DRAWN FROM LIFE BY WILHELM KUHNERT.

The Alaskan Gold Regions.

Last season's yield of gold from the Yukon River district in Alaska was about $249,000, according to an estimate gathered from miners and business men in the district by the Alaska News. The returns are undoubtedly big, but the labor of getting the gold, as described by one of the oldest miners in the region, is very great. The Yukon district is remarkably difficult of access, and a great many adventurers who have started hopefully from Juneau have failed even to get near the gold region. It is an expensive journey, too. Then the character of the gold mining and the limitations under which it must be done have sent many fairly experienced miners back in despair.

In many districts the gold-bearing rock is twenty or more feet below the surface, and shafts must be sunk to that depth through ground frozen solid and by a most laborious process. The prospect holes are usually about three and a half feet wide by six feet long. Enough wood must be cut to cover this space, and a rousing fire be kept up for almost a whole day before the ground is sufficiently thawed for the miner to get out about a foot or a foot and a half of gravel and soil. One man can burn a hole down about a foot a day. The work can be done only when all the surface water is frozen, otherwise it would drain into the prospect hole. In this region wells have been sunk seventy-five feet or more, all through frozen ground, and the miners say they never got below the frost line.

In other districts the work can be done only in the very brief summer, from the middle of May until about the middle of September, and usually for only about ninety days. In these regions the ground is not frozen so deep, and the gravel and soil can be washed from the bed rock. Flumes must be built from the creeks and the water conducted to the claims. The bed rock is from ten to twenty-three feet below the surface, and all the overlying soil must be washed away before the gold is accessible. A working supply of water is rarely obtainable for more than ninety days of the year. Usually almost two entire seasons are consumed in this preliminary work before a sight of the gold is obtained, and the miner must have money as well as pluck to keep him going until he strikes pay gravel. The gravel needs to be remarkably rich to compensate for the arduous and tedious labor of reaching it.

When the claims are worked by burning prospect holes in the winter, hot water is needed for washing the gravel when it is obtained. Usually when the gold-bearing gravel has been reached the returns have been handsome. Along Miller Creek in the past season or two the yield has averaged as much as $1 or $1.50 a pan, and claims staked out two or three years ago are now held at prices varying from $2,000 to $20,000 each.

The extent of the gold belt of northwest Alaska and the Canadian Northwest Territory is still a matter of speculation. From the information brought by prospectors it is believed that the belt covers a district from seventy-five to a hundred miles wide, commencing on the head waters of the Hootalinqua River, in British Columbia, and following closely the course of the Yukon River to and beyond the Arctic Circle, a distance of about nine hundred miles. It is probable that dozens of tributary streams, as yet unmapped, many doubtless unknown, are rich in gold and silver. The vast region is practically unexplored. The mining at present going on is but nibbling on the edge of the rich region. But when the gold and silver mines are systematically opened up, it will be a region for the capitalist and not for the individual miner. The ground must be exceptionally rich in gold to pay one or two miners working for themselves. With capital large districts could be worked in a systematic way and big profits be realized. From all accounts, that is how the Yukon gold and silver region will be made to give up its riches.

Test of an Eighteen-inch Armor Plate.

An important test of an 18-inch Harveyized armor plate took place at the Indian Head proving ground on May 1. The test was particularly interesting, as it was practically a competition of the suspected Carnegie product and the successful Bethlehem manufacture. The test of the 18-inch Bethlehem plate on March 11 was described in the SCIENTIFIC AMERICAN for March 23, 1895. The Carnegie plate was tested with exactly the same grade of shells. The Carnegie plate weighed 79,300 pounds, was 16 feet 9½ inches long, 5$\frac{7}{8}$ inches wide and cost $20,000. It was the representative of ten plates, weighing 306 tons, for the battleship Oregon. The plate was attached to an oak backing three feet thick, by 26 three-inch bolts. The plate was erected on a hillside about 300 feet from the gun battery.

The first projectile was an 850 pound 12-inch Holtzer shell, propelled by 249 pounds of brown, hexagonal powder. The velocity was 1,465 feet per second, and the shell struck the plate with an energy of 12,662 foot tons. This was a cracking shot, but the plate was not cracked or penetrated, the projectile being completely shattered after entering about 6 inches. Portions of the outer shell of the plate scaled off. The next shot was propelled by 443 pounds of powder, the muzzle velocity being 1,926 feet and the striking energy 21,885 foot tons. This shot was to test for penetration, but it only passed through 10 inches of the plate, the head of the projectile being smashed on the plate. The metal of the plate where the projectile struck was fused. Notwithstanding a crack about three-quarters of an inch wide which extended from top to bottom of the plate, it was accepted by the government. It was then determined to attack it with the great 13-inch gun. A 13-inch Carpenter shell, weighing 1,100 pounds, was driven by 489 pounds of powder. The projectile had a striking energy of 25,000 foot tons. It was of course expected that the shot would demolish the plate, but instead, after penetrating 10 inches, the projectile itself was completely destroyed. The solid oak backing was, however, greatly split. A crack 3 inches wide extended some distance from the top. The ability of the plate to keep out the heaviest projectiles we now manufacture is amply demonstrated. At present the race between armor and gun seems to be in favor of the armor.

RECENTLY PATENTED INVENTIONS.

Engineering.

FEED WATER HEATER AND PURIFIER. —Daniel M. Robinson, Bay City, Mich. This is an apparatus to be incased in the flue or masonry of an ordinary boiler to utilize the waste heat for heating the feed water. It has provision for holding the water in it under boiler pressure and at the same level as the water in the boiler, is adapted to precipitate any matter in the water in the form of sediments, loose carbonates, etc., and the construction is such that it may be conveniently put together and taken apart. The improvement includes a suitably connected outer shell in which is a settling cylinder made up of a series of superimposed sections, a pipe leading from the cylinder to the upper part of the shell and discharging into a series of pans arranged one above the other.

Railway Appliances.

CAR AXLE BOX LUBRICATOR.—James S. Patten, Baltimore, Md. This is an improvement in formerly patented inventions of the same inventor which have been subjected to practical use on cars in ordinary service, rendering the lubricator more serviceable, reducing its cost and weight, and increasing its durability. It is adapted to be inserted into and contained in the usual form of axle box, on the mere removal of the ordinary packing, and the lubricant holder is preferably of galvanized sheet iron, formed from a blank, and in it are suitably supported rollers adapted to slide laterally on the axles, and breaking up and lifting the lubricant.

CAR DOOR.—William E. Hoyt, Ravenswood, West Va. This inventor has devised improved means for supporting and manipulating the flush side doors of ordinary freight cars. The car has a vertically undercut seat in a plate fixed to the front wall of the doorway, the seat being engaged by one of the arms of a vertically swinging operating lever, permitting the trainman to press down with his weight in opening the door, and to lift directly under the door in closing it. The lever lies practically in the plane of the door when the latter is closed, where it cannot be well tampered with, there being also on the lever a hasp attachment.

Electrical.

DOOR OPENER.—John Schneider, Long Island City, N. Y. This is an improvement on a former patented invention of the same inventor for a simple and durable electric door opener, not liable to get out of order, and arranged for unlocking a door from a distance. The armature lever is normally held away from the magnet by a spring, the magnet being in a circuit having a button to be pressed when the door is to be unlocked, the drawing of the armature lever causing a catch to engage a bolt in a lock on the door. To insure the opening of the door when unlocked, a spring hinge of any improved construction is employed.

ELECTRIC LAMP HANGER.—David Aitchison, Easton, Pa. This improvement is more especially designed for use with incandescent lamps, permitting of conveniently raising or lowering the lamp or moving it sidewise as desired. A spring-actuated drum fitted to slide on a pivoted horizontal arm carries a cord to support the lamp, a guide moving with the drum guiding the lamp-supporting cord. A shaft journaled in the free end of the pivoted arm carries a crank and a segmental arm adapted to engage the drum.

Mechanical.

SAW.—Henry J. Frederick, Brainerd, Minn. This is an improvement in buck saws, fret saws, and other saws having frames, by which the operator may quickly give at any time the desired tension to the sawblade, or the blade may be entirely removed from the frame without disconnecting the members of the latter. The spacer bar is rigidly secured to the rear or handle member and movably connected with the upper end of the front bar, a brace pivoted to the middle of the front bar extending to the spacer bar, while a longitudinal screw rod on the top of the latter extends through the upper end of the front bar, where it has a nut, the other end of the rod having an eccentric strap, an eccentric being pivoted to the bar. On the top of the eccentric is a handle, by the simple movement of which the tension of the blade may be increased or diminished.

SIDING CUTTER AND GAGE.—Thomas W. Purdy, Link, Ohio. Among devices employed in laying siding boards on buildings, this invention presents a strong and easily operated device, to be conveniently clamped to the window casing or corner board for squarely cutting off the end of a siding board, and also serve as a gage for the overlap. It comprises a U-shaped supporting frame, with fastening devices, a die one side of the opening and a knife to travel across the opening opposite the die, in connection with a lever to work the die, a gage being adjustable on the extension end of the frame. The clamps are spring-actuated and the knife is quickly worked.

Agricultural.

COTTON PLANTER.—Morse P. Scott, Woodville, Miss. According to this improvement the seed box and furrow opener may, by means of a simple hand lever, be conveniently elevated or depressed to provide for shallow or deep planting. They may also be carried together to the right or left sufficiently to avoid an obstruction, through the medium of a foot plate. The machine is of simple and economic construction.

COTTON CHOPPER.—This is an additional improvement of the same inventor, providing means whereby superfluous plants may be chopped from the rows and the rows simultaneously cultivated. The driver may also easily and quickly move the choppers either to the right or left, thus accommodating the machine to the unevenness of the rows, and both the cultivators and choppers may be raised to entirely clear the ground.

Miscellaneous.

VAULT CASH INDICATOR.—Samuel R. Hamilton, Farmersville, Texas. This is a device for indicating the amount of money, commercial articles, etc., in a safe or vault. It has a casing which may be conveniently placed upon a desk, safe, etc., is L-shaped in form, and comprises a series of casings, in the vertical portions of which are arranged slide blocks bearing on their faces numerals, one above the other, which are made to appear in openings in the front of the casing as the block is moved up or down. The block is on a screw rod connected with a beveled gear at the base, whereby each block may be moved up or down, to bring the figure desired in front of the aperture, by means of a key inserted in the face of the horizontal portion of the casing, the figures thus displayed in the row of apertures indicating the amount. In the front of the casing is a horizontal guideway for a slide bearing the title of the article the device is employed in indicating.

HOSE COUPLING.—Joseph S. Blackburn, Salem, Ohio. This is an improvement on a formerly patented invention of the same inventor, to adapt the coupling to hose of large sizes and dispense with some features, reducing the cost. The male section has a waterproof sleeve, adapted to be forced outward against the interior surface of the female section by water pressure against the inside surface, thus making a water-tight joint without depending upon abutting the sleeve against a shoulder in the coupling, and insuring a sure and tight waterway when the sections are brought together.

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

NEW BOOKS AND PUBLICATIONS.

CELLULOSE. An outline of the chemistry of the structural elements of plants with reference to their natural history and industrial uses. By Cross and Bevan. London and New York: Longmans, Green & Company. 1895. Pp. vi., 320. Price $4.

In the present day of wood pulp factories and vulcanized fiber goods, a work on cellulose, the basis of all manufactures of this type, seems peculiarly timely. The book under review is a treatise on the chemistry and microscopy of the subject. It possesses two indexes, one of authors and one of subjects, the first one showing how thoroughly the bibliography of the subject has been consulted in its preparation. To the educated manufacturer and technologist, the book will be a sine qua non.

THE VENTILATION OF MINES. By J. T. Beard. First edition. New York: John Wiley & Sons. 1894. Pp. xiii, 170. Price $2.50. No index.

It is refreshing to find so clear and good a treatise written by an American author, and forming a work adapted for those operating American mines. Heretofore, by some fatality, many of the mining engineering books of the day have been published in England, and have been written from the insular standpoint that an Englishman takes in accentuating. The book is dedicated to the miners of Iowa, among whom the author states that he has passed thirteen years. While we note the fact that the book is without an index, we must also state that the very full table of contents makes an index almost unnecessary.

ON INDIA'S FRONTIER; OR, NEPAL, THE GURKHAS' MYSTERIOUS LAND. By Henry Ballantine. New York: J. Selwin Tait & Sons. Pp. 192. Price $2.50.

This attractive work, with its numerous illustrations, describes travels in India in a very graphic way. Readers of Rudyard Kipling will remember his admiration for the Gurkha soldiers. In this we hear something of their land, with numerous illustrations of buildings and people of the country, and have, besides, a most interesting and readable book. The author's criticisms on the method of governing are very cleverly put.

TRANSACTIONS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Volume XV. 1894. New York City: Published by the Society. Pp. 1359.

The size of this volume, its absolutely model index and the general make-up of the volume, are three things that alone are highly creditable to the society publishing it. The matter contained in the papers is of great value to the profession, and the volume itself must be read to obtain an idea of the wealth of material to be found between its covers. The existence of a professional society admits of no better vindication than that afforded by its publications. Their merit settles the permanent status of the Mechanical Engineers' Association.

DER BRUCKENBAU IN DEN VEREINIGTEN STAATEN AMERIKAS. Von Professor W. Ritter. Zurich: Albert Raustein. 1895. Pp. 66. 12 plates and 60 figures. Price $1.50.

The report of the Swiss delegate to the Columbian Exhibition of 1893 is based on a three months' journey in the United States, as the most valuable information regarding our bridges could not be found at the Exhibition itself, but had to be collected at the bridges. The author principally points out what is new relative to the bridges built in Europe. The plates are well executed and give dimensions of the parts.

RATIONAL BUILDING. Being a translation of the article "Construction," in the Dictionnaire Raisonné de l'Architecture Francaise of M. Eugene-Emmanuel Viollet-le-Duc. By George Martin Huss, architect. New York and London: Macmillan & Company. 1895. Pp. xii, 367. Price $3.

M. Viollet-le-Duc's works have attained a wide popularity. We find in this treatise on architecture a most elegant example of book making, containing very numerous illustrations introduced in the text. The eminently philosophical treatment of the subject is perceptible throughout, it is evident even from the type of illustrations used, which, by the use of perspective or isometric projection, are made to give a better representation than usual of the exact appearance and construction of the more complicated forms, such as groined arches, clustered arches and general construction. As an example of such illustrations Fig. 120, page 282, may be alluded to. No one can go through our cities without feeling regret at the perpetuation of certain architectural enormities in the more permanent type of building. This much may be wished, that the profession at large would give more attention to the appearance of beauty and architecture as determined and regulated by structural laws.

THE SNOW-CHURCH COMPANY'S LEGAL AND BANKING YEAR BOOK FOR BANKERS, LAWYERS, AND THE BUSINESS PUBLIC. 1895. Collection laws revised to January 1, 1895. New York: The Snow-Church Surety Company. Pp. 1261.

This extensive work, covering, in a general way, the laws affecting banking and collecting business, is a thorough production, and one which can be warmly recommended to the profession. When it is realized that it contains far over 1,000 pages of fine type touching on the laws of all North America, it will be seen that it is not possible to give it an adequate review. For information in regard to the commercial laws and collections, it would seem to be almost indispensable to the active practitioner.

CORTINA METHOD. Intended for use in schools, etc., and for self-study. French in twenty lessons, with a system of articulation, based on English equivalents, for acquiring a correct pronunciation. By R. D. De la Cortina, M.A. Revised by Professor J. Leroux, Professor of Modern Languages at the United States Naval Academy. Book First. New York: R. D. Cortina. 1895. Pp. x, 108. Price 50 cents.

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.

(6506) **W. T.** says: Would you please advise me how to treat cow's horns to soften them so they can be pressed in different shapes and then become hard again? A. The bony core of the horn is first removed; the next process is to cut off with a saw the tip of the horn, that is, the whole of its solid part, which is used by the cutlers for knife handles and sundry other purposes. The remainder of the horn is left entire, or is sawn across into lengths, according to the use to which it is destined. Next it is immersed in boiling water for half an hour, by which it is softened, and while hot is held in the flame of a coal or wood fire; taking care to bring the inside as well as the outside of the horn, if from an old animal, in contact with the blaze. It is kept there till it acquires the temperature of molten lead or thereabout, and in consequence becomes very soft. In this state it is slit lengthwise by a strong pointed knife like a pruning knife, and by means of two pairs of pincers, applied one to each edge of the slit, the cylinder is opened nearly flat. The degree of compression is regulated by the use to which the horn is afterward to be put. When it is intended for leaves of lanterns, the pressure is to be sufficiently strong (in the language of the workmen) to break the grain, by which is meant separating in a slight degree the laminæ of which it is composed, so as to allow the round-pointed knife to be introduced between them, in order to effect a complete separation. For combs the plates of horn should be pressed as little as possible, so that the teeth may not split at the points. They are shaped chiefly by means of rasps and scrapers of various forms, after having been roughed out by a hatchet or saw; the teeth are cut by a double saw fixed in a back, the two plates being set to different depths, so that the first cuts the teeth only half way down, and is followed by the other, which cuts the whole length; the teeth are then finished and pointed by triangular rasps. Horn for knife handles is sawn into blanks, slit, pared, and partially shaped; then heated in water and pressed between dies. It is afterward scraped, buffed, and polished.

(6507) **J. R. J.** says: What is known as the best or surest remedy to remove freckles from the face? A. Hydrarg. bichlor. .... gr. xii.
Acid hydrochlor., pure .... drm. iii.
Fruct. amygd. amar .... oz. iss.
Glycerini, Price's .... oz. i.
Tinct. benzoin .... drm. ii.
Aqua flor. aurant .... q. s.

Dissolve the corrosive sublimate in 3 ounces of the orange flower water, add the hydrochloric acid, and set aside. Blanch the bitter almonds, and bruise them in a Wedgwood mortar, adding thereto the glycerine and using the pestle vigorously; a smooth paste is thus obtained. Then add gradually about 9 ounces of the orange flower water, stirring constantly, continuing this operation until a fine, creamy emulsion is the result. Subject this to violent agitation—preferably with the aid of a mechanical egg whisk—and allow the tincture of benzoin to fall into it the while drop by drop. Then add the mercurial solution, filter, and make up the whole to the measure of 1 imperial pint with more orange flower water. This preparation is recommended by an eminent dermatologist as being invariably efficacious in the treat ment of ephelis, and always greatly ameliorating lentigo, even if it does not entirely decolorize the patches in the latter case. A general whitening of the skin is produced by this lotion without any irritation. It is as well, however, not to apply it to any abraded surfaces. It has been found far superior in practice to a preparation—which it somewhat resembles—sold at a high price in Paris under the name of Lait Antiphelique.

(6508) H. N. M. says: How can I ink typewriter ribbons? A. Take vaseline (petrolatum) of high boiling point, melt it on a water bath or slow fire, and incorporate by constant stirring as much lamp black or powdered drop black as it will take up without becoming granular. If the fat remains in excess, the print is liable to have a greasy outline; if the color is in excess, the print will not be clear. Remove the mixture from the fire, and while it is cooling mix equal parts of petroleum, benzine, and rectified oil of turpentine, in which dissolve the fatty ink, introduced in small portions by constant agitation. The volatile solvents should be in such quantity that the fluid ink is of the consistence of fresh oil paint. One secret of success lies in the proper application of the ink to the ribbon. Wind the ribbon on a piece of cardboard, spread on a table several layers of newspaper, then unwind the ribbon in such lengths as may be most convenient, and lay it flat on the paper. Apply the ink, after agitation, by means of a soft brush, and rub it well into the interstices of the ribbon with a tooth brush. Hardly any ink should remain visible on the surface. For colored inks use Prussian blue, red lead, etc., and especially the aniline colors.

Aniline black	½ oz.
Pure alcohol	15 "
Concentrated glycerine	15 "

Dissolve the aniline black in the alcohol, and add the glycerine. Ink as before.

(6509) W. B., Jr., says: Will you please tell how I can make a gallon of perfumed violet writing ink? A. One and one-sixth ounce of so-called primula violet is dissolved in 3 quarts boiling distilled water. This may be converted into a copying ink by adding 4 ounces sugar, 4 ounces glycerine. N. B.—Primula violet is known also as dahlia or Hofmann's violet, of which there exist a number of different shades. Perhaps the finest is that known as No. 6. This coloring matter consists of salts of trimethylrosaniline and triethylrosaniline. Other tints may be prepared from other aniline colors. It is best to add to the solution of an aniline color a small percentage (3 to 5 per cent) of alcohol, and also of glycerine (1 to 4 per cent). To perfume it add the essential oil, which will give the desired odor.

(6510) A. B. D. asks: 1. Why does the whistle of a locomotive in motion sometimes sound higher than it really is? A. Because the engine approaching virtually shortens the sound waves. 2. Are heat and light molecular or atomic forms of motion? A. "Radiant heat" so called and light are forms of ethereal energy; heat, properly speaking, is a form of molecular energy. 3. Is ether an atomic or molecular body? A. The ether is hypothetical and cannot be termed atomic or molecular. 4. If heat and light are molecular forms of motion, is electricity to be considered so also, as it can be changed to either of the former? A. Electricity is best treated as undefinable, and seems apt to remain so for a long time.

(6511) Gravity asks: What will prevent the formation of sulphate of zinc on the outside of the jars of a gravity telegraph battery? I am informed coal oil will give the desired result. Do you think it affects the working strength of the battery? A. Coal oil is used for the purpose named and has no ill effect. Simply coating the edges of the jar with melted paraffin wax will prevent creeping to a considerable extent.

(6512) W. G. R. asks whether there is a dynamo yet made that has no revolving wire. One without a commutator of any kind and producing constant current (not alternating) of high or low voltage. A. There is no dynamo answering fully your description. There is a theoretical or experimental one, Faraday's copper disk dynamo, described in the text books.

(6513) G. S., Jr., writes: I have got some armature punchings for the sewing machine motor described in SUPPLEMENT, No. 759. Can these punchings be wound the same as the carriage washers, and do the projections on them add or take from the efficiency of the armature? Are they ever used in large machines? A. Projections such as you allude to are often used on the armatures of large dynamos. Projections facilitate winding and diminish slightly the reluctance of the magnetic circuit. They have but little influence on the efficiency of the machine, tending to increase it.

(6514) P. C. T. asks: Can you give the size of German silver wire that will equal in resistance 5 strands of No. 20 German silver? Also what size, using 2 strands, will equal 5 strands of No. 20? The nearest calculation and the probable variance. A. A single lead of No. 13 wire is about 1¼ per cent too large; a double strand of No. 16 is about 1½ per cent too large.

(6515) H. R. O. asks: When the commutator of a dynamo is turned off there is almost always one segment worn deeper than the rest. What causes it to be so? A. Possibly the winding is a little out of balance, and sparking and arcing is accentuated at that point.

(6516) W. W. M. writes: I send a sample of a deposit which we think to be sulphur. It must have been deposited on the night of the 19th of March, as it was not noticed until the 20th, when it was seen to be accumulating at the edges of ponds and all other bodies of water throughout this section. It drifted in some places till it reached a depth of ¼ inch, where the water left it high and dry, and I gathered the inclosed sample to-day by picking it up with my fingers. Some of the old inhabitants say that this deposit occurs here every spring just after a big rainfall. But this time there was no rainfall. It seemed to come with a hard west wind. We have a sulphur mine west of here some 75 miles in Calcasieu Parish; it probably is the source of this deposit. We want to know exactly what it is, and how it came to be here. To-day, while gathering the sample, I noticed thousands of small bugs which seemed to be feeding on the material. A. The yellow powder which you send consists of the spores of a species of pine. The pine trees flower in spring, and this accounts for the presence of the spores as a sulphur-like deposit in your neighborhood every year at that season. Hardly a year passes in which supposed "rains of sulphur," such as this, are not reported from some part of the country.

(6517) A. A. S. asks how to figure the horse power of gas and gasoline engines. A. The proper way to obtain the mean engine pressure is with an indicator and card register in the same manner as with the steam engine. The variation of initial pressure of explosion varies very much, say from 100 to 150 pounds per square inch, and the mean pressure from 50 to 75 pounds, averaging a mean pressure of about 60 pounds. Square the diameter of the cylinder and multiply it by 0·7854 for the area. Then, if the explosive effect is every other revolution, one-half the number of revolutions per minute multiplied by the length of the stroke in feet or decimals of a foot will be the active travel of the piston under pressure. Then

$$\frac{\text{pressure}\times\text{area}\times\text{stroke}\times\frac{1}{2}\text{ revolution}}{33{,}000}=\text{h. p.}$$

If the explosion is at every revolution, the full number must be put in the formula. If there is cushioning or compression of the air and gas in the cylinder, it must be deducted from the mean pressure. See "Gas and Petroleum Engines," by Donkin, $6.50 by mail. For the method by Prony brake see SCIENTIFIC AMERICAN SUPPLEMENT, No. 992; 10 cents mailed.

(6518) R. B. D. writes: For the past two days we have experienced a succession of heavy vibrations with a simultaneous roar as of a distant explosion. The sky in the direction of the sound (W.S.W.) is clear with a light S.E. wind. Is it possible for us to hear the reports from the Sandy Hook grounds? If not, what can it be? We are at least 60 miles from Sandy Hook light. A. The vibrations and noise were probably from the gun trials at Sandy Hook.

(6519) F. W. S. asks: What preparation would you recommend to be applied to the bright steel and nickel parts of a bicycle to prevent rust? A. Try a colorless lacquer. You can find such in the market made from celluloid. It is very hard and durable. If you want only temporary protection, use vaseline.

(6520) H. P. says: Please give formula for best black varnish for small wooden articles, and the best method of tempering small wire spiral springs. A. Black japan varnish:

Naples asphaltum	50 lb.
Dark gum anime	8 "

Fuse, add 12 gallons linseed oil; boil, then add of dark gum amber, 10 pounds, previously fused and boiled in 2 gallons linseed oil; next add q. s. of driers and thin with oil of turpentine. How to temper a small spring. 1. Heat the spring to a light red, plunge in cold water; hold the spring over the flame of a small fire of shavings until it becomes black, then hold in the fire until the black disappears. Cool the spring by swinging it in the air. 2. Heat the spring to a cherry red, plunge in cold water, and hold over a small fire until warm. Cool with tallow and burn off the tallow over the fire; repeat this process two or three times, cool in water.

(6521) F. E. H. writes: Will you please give me information on the following subject? I have a spring of water that furnishes 21 cubic feet per minute with a fall of 100 feet in a distance of 300 feet. Please tell me the size of pipe necessary to carry this water. How much power would there be if one of Leffel's new jet wheels were used, and what size nozzle would use all of the water? How much power could be procured with same water, 21 cubic feet with a head of 60 feet, and what size nozzle would it take? A. A 2½ inch pipe will deliver the quantity flowing from the spring with an open end pipe. For power purposes you require a pressure head, for which a larger pipe, 3 inches or 3½ inches, is a better size. Use a ⅞ inch nozzle, which will spout 140 gallons per minute, which will run an impact motor of the Pelton or Leffel type at 400 revolutions per minute, and give you 3 horse power. You will lose head by trying to use all the water on the motor. At 60 feet head with the same quantity of water you may use a 1 inch nozzle and realize 1¾ horse power.

(6522) E. J. P. asks: About how much coal does one of the great ocean steamers like the City of Paris burn in twenty-four hours, at the usual five and a half or six day rate of speed? A. The great ocean steamers burn about 400 tons of coal per day.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Granted

April 30, 1895,

AND EACH BEARING THAT DATE.

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

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