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NEW YORK, SATURDAY, JUNE 15, 1901.

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

THE GREATEST OF POWER STATIONS.

Undoubtedly the most interesting electrical installation now being carried out is the equipment of the Manhattan Elevated roads with electricity. The great power house, two hundred feet in width by four hundred feet in length, will be the largest in existence, and its compound engines will, we believe, without exception, be the largest single steam units to be found anywhere in service on land. The normal capacity of the power station will be 65,000 horse power, and the maximum capacity about 100,000 horse power. The steam plant will be made up of eight compound engines, which will be capable of running under a continuous load of 12,000 horse power each. These engines are of an entirely new type, and they are placed in pairs on each end of a shaft which carries a Westinghouse generator with a revolving field 32 feet in diameter and weighing 185 tons. The chief novelty of the engines consists in the fact that the high and low pressure cylinders are placed at ninety degrees, the high-pressure being horizontal and the low-pressure vertical. As there are two engines to each shaft, the turning moment is perfectly even, so much so that the customary flywheel is dispensed with, its place being taken by the heavy revolving field of the generator. The high-pressure cylinders are 44 inches and the low-pressure cylinders 60 inches in diameter, the common stroke being 88 inches. To find engines that will compare with these in size, we must refer to the engine rooms of some of the largest ocean steamships. The most powerful marine engines are those of the "Deutschland;" each quadruple expansion engine on this ship has indicated in twenty-four hours as high as 18,500 horse power, or 50 per cent more than the maximum capacity of the engines above described.

A COSTLY EQUIPMENT.

Apropos of the new power station of the Manhattan Railway Company, it is of interest to note that the mere electrical equipment of the rolling stock will cost just $3,000,000. Hitherto the motive power on the elevated system has been furnished entirely by steam locomotives, and the trains on the most important lines have averaged, during the rush hours, five cars in length. Under the new system the average length of the trains will be six cars, of which the leading and trailing cars will be equipped with motors. The General Electric system of train control will be used, the motor circuits on the motor cars being opened and closed by magnets which are themselves actuated by a train circuit under the direct control of the motorman. The electrically equipped experimental train, recently described in this journal, is running steadily on the Second Avenue line in this city, and valuable data as to cost of operation, etc., are being thereby secured.

RAPID TRANSIT TUNNEL TO BROOKLYN ASSURED.

Although the temporary delay to which the Rapid Transit Tunnel from New York to Brooklyn has been subjected by obstructionist tactics on the part of certain members of the Municipal Assembly of Brooklyn has been vexatious, it has served the good purpose of drawing forth from President Orr a masterly defense of the conduct of the affairs of the road by the Commission over which he presides. There is no question that President Orr's vindication will receive the unanimous approval of the citizens of Greater New York. It will be two or three months before the final survey of the tunnel is completed and the plans drawn up, but there is no reason why work should not be under full swing during the fall of this year. Without the Brooklyn tunnel the scheme would have been incomplete; but with this connection we may look for the time when the Brooklyn half of the Rapid Transit scheme will be as extensive as that in Manhattan Island, and only second to it in the density of its traffic.

THE WAVE LINE OF THE "GEORGIA."

As the result of a slight error in the numbering of the official plans which were furnished us from the Navy Department, Washington, the titles to the photographs showing the wave line of the model of the "Georgia," which were reproduced in our recent article on the model basin at Washington, are reversed. The wave line which is credited to a speed of 27½ knots actually accompanies a speed of 19 knots, and vice versa. The height and bulk of the bow wave vary, of course, with the speed, and are greater as the speed increases. In connection with these photographs, we would draw attention to the fact that the enormous piling up of water around the bow of the model at the higher speed affords a graphic evidence of the fact that the resistance to a vessel (and therefore the horse power required to drive her) increases as something more than the cube of the speed. Although surface or skin friction accounts for some of the ship's resistance, it is chiefly the displacement of the surface water in a vertical direction—the continual lifting of so much dead weight through such a height in such a time—that calls for rapidly-increasing expenditures of power at the higher speeds.

GERMANY'S FOREIGN TRADE IN MACHINERY.

The returns of the foreign trade of Germany for the year 1900, recently published, acquire particular interest from the fact that for the first time the imports and exports of machinery have been specialized. The total imports of this kind amounted to $18,639,360, an increase of $3,109,000 over the value of machinery imports in 1899. The value of the exports of machinery was $42,776,000, an increase of $500,000 during the year. As the statistics show the proportion of the import trade in machinery that comes from this country, we commend them to the attention of our manufacturers, as indicating the lines along which their efforts might be profitably expended in increasing our imports into Germany of articles which are now supplied almost exclusively by other countries. It is not surprising to learn that out of a total importation of 28,825 tons of agricultural machinery, over 20,000 tons came from the United States. Great Britain supplied a little over 5,000 tons, and the remainder was imported in relatively small amounts from half a dozen other European countries. The second largest item in the list is that of cotton spinning machinery, the imports of which amounted to 10,863 tons. As regards this commodity the conditions are entirely reversed, Great Britain contributing 9,876 tons and the United States nothing at all. Here, surely, is an industry to which our manufacturers might well turn their attention. The demand for cotton-spinning machinery is increasing rapidly all over the world, and many countries, such as Egypt, Turkey, Bulgaria and Greece, which up to the present time have imported large quantities of cotton goods, are now making a determined effort to establish cotton industries of their own. There is also a demand for cotton-spinning machinery in South America and the far East. The manufacture of cotton machinery seems to be to-day in a somewhat similar position to the tin-plate industry fifteen years ago. That is to say, it is practically non-existent, at least so far as the export trade is concerned. There is, of course, some exporting of cotton-spinning machinery to South America, but the sum total of our export trade in this most important branch of machinery is not at all commensurate with our exports in other branches of machinery. The statistics indicate that European countries place a high value upon the possibilities of foreign trade in this line, and consider that successful competition with Great Britain is quite feasible. Germany herself exported over four and a half million marks' worth of cotton-spinning machinery in the year 1900.

The imports of machine tools into Germany amounted to 6,270 tons, of which 4,757 tons came from the United States; but out of a total importation of 4,308 tons of locomotives and locomobiles our share amounted to only 189 tons, as against 3,196 tons (chiefly portable engines for agricultural work) imported from Great Britain. There is no doubt that the latter country excels in the manufacture of these engines; but there is nothing in the nature of the case to prevent the United States from supplying an agricultural portable engine which will be just as serviceable in its way as the agricultural machinery, in the manufacture and export of which this country is preeminent. Another item to which we would direct the attention of our manufacturers is that of electrical machinery, the imports of which into Germany amounted in 1900 to 4,350 tons, of which we contributed only 343 tons, as against an importation from Austria-Hungary of 2,080 tons and from Switzerland of 977 tons. We have already in these columns directed attention to the valuable work which the Budapest engineers are doing in the electrical field. Although our electrical exports to Great Britain and elsewhere are valuable and growing, it behooves our electrical manufacturers to study the possibilities of the Ganz high-pressure alternating system, which, it will be remembered, was at first adopted on its merits by the London underground roads in preference to the direct system, and was only finally rejected after a vote of a majority had been secured by those interested in the installation of the latter type.

Another export to which we might profitably turn our attention is that of weaving machinery Out of a total of 8,184 tons, 6,138 tons were imported into Germany from Great Britain, 1,420 tons from Switzerland and nothing from this country. Summarizing the imports of lesser accounts: out of a total importation of 4,365 tons of steam engines, 1,738 tons came from Switzerland, 1,061 from Great Britain and 200 tons from the United States. Of 1,666 tons of lifting machinery, 574 tons were contributed by this country; of 1,055 tons of flour-milling machinery, 182 tons were contributed by the United States; while of 473 tons of rolling mill machinery, 77 tons came from this country.

An examination of the list of exports from Germany of machinery shows that Russia is by far the largest buyer of German goods. Thus of nineteen and a half million marks' worth of sewing machines, Russia was by far the largest buyer, as she was also of locomotives and portable engines, taking 4,024 tons out of a total export of 12,293 tons. Of 21,555 tons of steam engines, Russia purchased 5,586 tons and France 4,247 tons. The total export of electric machinery was about 13,000 tons, of which Russia again was the largest buyer, taking a total of 3,077 tons. Russia was also the largest buyer of agricultural machinery from Germany, taking about half of a total export of 13,000 tons. The exports of machine tools from Germany amounted to 9,267 tons, of which Russia purchased 2,370 tons and Austria Hungary 1,236 tons. The full figures of Germany's machinery trade are given in an article in the current issue of the SUPPLEMENT, which we commend to the careful reading of our manufacturers in the special lines to which reference has been made above.

LAWS OF ABSORPTION OF X-RAYS FOR DIFFERENT BODIES.

M. Louis Benoist has lately made a series of experiments at the physical laboratory of the Sorbonne concerning the transparence of different bodies for X-rays. In a former series of experiments he showed that these rays are not homogenous and undergo a selective absorption by the different bodies traversed. In studying a certain number of bodies it appeared that the transparence to X-rays is not entirely a function of the mass, but that the absorbent power, or *specific opacity*, increases in general with the density. He showed also that different bodies possess a property which may be called radiochroism, as it is comparable with the coloration of substances which are transparent to light, and in virtue of which the relative opacity of two bodies changes with the mass traversed and with the nature of the X-rays used, the most rapid change taking place with the denser bodies. In continuing these researches he has studied about 120 different bodies, simple and compound, and has obtained results which enable him to deduce the principal laws of transparence of matter for X-rays. A prism of paraffin, 2-5 inch square at the base, and 3 inches long, is taken as a standard; its absorption for X-rays of a determined character is measured, and the absorption of other bodies compared with it by finding the length of a prism of the same base which will give the same absorption as the standard; the mass of this prism thus determines the *equivalent of transparence* of the body. This equivalence permits of calculating the mean specific opacity of the body for the thickness corresponding to that of the standard. The measurement of these equivalents brings out some interesting results, of which the principal are as follows: First, the specific opacity of a body appears to be independent of its physical state; for instance, it is the same for water and ice, it is independent of temperature, etc. Second, the specific opacity seems to be independent of the mode of atomic grouping of the body, that is, of crystalline forms, allotropic states, etc. (allowing for differences of purity); it is the same, for instance, for anhydrous alumina and corundum, for the different forms of carbon, crystalline and amorphous, for yellow and red phosphorus, etc., also for isomeric organic compounds. Third, it appears to be independent of the state of freedom of the atoms, and the equivalent of transparence of a mixture or combination may be calculated from those of the elements which compose it (taking account of possible difference of radiochroism); thus for silicon the equivalent measures 15.7, and for oxygen 44.5, from which that of quartz is calculated at 24, corresponding to the measured value, 24.1. In another case, caustic lithia measures 57 and oxygen 44.5, giving for lithia a calculated value of 113.8, the measured value being 115. The specific opacity for X-rays, measured under determined conditions, may be considered as a property of bodies allied to that of atomic weight, atomic calorific capacity, etc. As it depends entirely upon the nature of the atoms, the experimenter sought a relation between it and the atomic weights of different bodies, and plots a curve which is quite regular, having somewhat the form of a hyperbola. This curve may be modified by varying the conditions of the experiment, which may be done in three different ways. First, by modifying the character of the X-ray tube; second, by changing the thickness of the standard, which causes, for the different bodies, a variation corresponding to their mass, and in consequence a more or less complete selection of the rays; third, by placing screens of different character in the path of the rays. A series of curves is thus obtained, varying with each experiment. By interposing various screens in the path of the rays, those of greater penetrative power may be sifted out, and it appears that these rays show nearly a direct proportionality between the specific opacity and atomic weight.

EXPECTED RETURN OF ENCKE'S COMET.

BY M. PROCTOR.

Among the periodic comets due in 1901 is Encke's comet, which is expected to return to perihelion about the middle of September. Its last return to perihelion took place on May 24, 1898, the same day on which it also occurred at the first predicted return in 1822. The prediction was made by Johann Franz Encke (after whom the comet has been named), and he detected the periodicity of the comet in 1819.

The comet had been frequently observed during the preceding fifty years, and as soon as the elements of its orbit had been computed and compared with the elements of the orbits of comets which had previously appeared, it was found to be the same comet which had been observed in 1786, 1795 and 1805. Having thus identified the comet at four different returns to perihelion, Encke was enabled to ascertain the period of its revolution with great precision, the result being 3½ years, the comet having the shortest known time of revolution and being the first of the short-period comets.

Encke predicted its return for 1822, making due allowance for planetary perturbations, and on account of its position in the heavens, he announced that the comet would only be visible in the southern heavens. The return of the comet was therefore looked for by astronomers living in that part of the world, and during the month of June was sighted by Rumker at Paramatta, in New South Wales. The next return was predicted to take place in 1825, and on the 13th of July—true to its appointed time—the comet was observed by Valz at Nismes.

The next return took place in 1828, when it was first seen by Struve, at Dorpat, in Russia, on the 13th of October of that year, and remained under observation at the European observatories until December 25. On November 7, 1828, Prof. Struve made a series of observations of the comet, and he noticed a star of the eleventh magnitude so near the center of brightness in the comet that he mistook it at first for the nucleus. The brightness of the star was not in the least perceptible degree diminished by the mass of cometary matter through which its light had passed. By November 30 the comet had greatly increased in brightness, and this must be ascribed to the contraction and consequent condensation of the nebulous matter of which it is composed, as it receded from the sun.

In 1832 the comet again returned to its perihelion, but being unfavorably situated for observation, it was only seen by Harding, at Göttingen, on the 21st of August. However, it was observed by Henderson, at the Cape of Good Hope, during the entire month of June, and was also seen at Buenos Ayres. In 1835 it was observed from July 22 till August 6, and in 1838 it was seen at Breslau on the 14th of August as a very faint, ill-defined object. It subsequently increased in brilliancy and continued visible until the middle of December.

In combining all the observations which had been made from 1786 to 1838 inclusive, Encke found that the period of revolution of the comet was regularly diminishing by about 2½ hours at each return to perihelion. This effect he attributed to the retarding action of a resisting medium in space. This theory seemed to be confirmed by observations made at the return of the comet in 1842, 1848, 1852, 1855, 1858, 1862 and up to 1868; but at its return in 1868 the acceleration had fallen to one-half its customary and, until then, constant value. The change has proved permanent, and accumulated facts bid fair to banish the theory of a "resisting medium" out of existence.

The comet has been seen at every return to perihelion lately, the dates of its visits being 1895, 1898, and it is now looked for in 1901. It has been described as irregular in form and "lumpy" in appearance, seldom showing a well-defined nucleus. Under very favorable circumstances it can be seen with the unaided eye, but is usually visible only in the telescope. It does not exhibit much in the way of jets and envelopes, and the train, when visible, is but a degree or two in length. As the comet approaches the sun, a peculiar contraction takes place in its volume, while it resumes its original dimensions when receding from the sun. For instance, at a distance of 130,000,000 miles from the sun, it has a diameter of nearly 300,000 miles, but when it is near perihelion (at a distance from the sun of only 33,000,000 miles), its diameter shrinks to 12,000 or 14,000 miles, the volume then being less than one-ten-thousandth of what it was when first seen.

According to Sir John Herschel, the explanation of this peculiar contraction in Encke's comet is optical rather than real, "that near the sun a part of the cometary matter becomes invisible, having been *evaporated*, perhaps, by the solar heat, just as a cloud of fog might be."

THE ST. LOUIS EXPOSITION OF 1903.

The preliminary work is progressing with much vigor at St. Louis for the Louisiana Purchase Exposition, and the current month will show the selection of a site for the Exposition. The organization is proceeding with the fully formed purpose of having the Exposition open on May 1, 1903. We are informed by the Secretary, Mr. W. B. Stevens, that work begins with a capital of $15,000,000, fully secured. In June, 1900, Congress made a part of the Sundry Civil Bill a section pledging an appropriation of $5,000,000 to the Exposition, if the organization of St. Louis should show, to the satisfaction of the Secretary of the Treasury, $5,000,000 raised by popular subscription and $5,000,000 of bonds voted by the city of St. Louis. At the following election in Missouri, November, 1900, the Constitution of the State was amended not only to permit the city of St. Louis to issue $5,000,000 in bonds, but also to authorize an appropriation of $1,000,000 by the State for its own participation in the Exposition. Since that election, the Legislature has carried out its part by making the appropriation of $1,000,000. The Municipal Assembly has by ordinance authorized the issue of bonds, and the people of St. Louis have subscribed for over $5,000,000 of stock. In February of this year, the Secretary of the Treasury was furnished with the evidence that subscriptions for the full amount stipulated by Congress had been secured, and that the bonds had been legally authorized. He certified these facts to Congress. A special committee reported the bill providing for an appropriation of $5,000,000, and the House passed it by more than a two-thirds vote. The action of Congress in appropriating $5,000,000 to the Exposition, making the government a financial partner to the extent of one-third, constituted the most notable provision yet made in the history of exposition legislation. President McKinley has appointed a government commission, and the first meeting has been held in St. Louis.

Those who have visited the Pan-American Exposition at Buffalo have admired the splendid arrangement, the architecture, the landscape gardening and the lighting. It is a triumph and exceeds any other Exposition in beauty. All this was accomplished with $5,800,000 capital and appropriations. With such a sum as $15,000,000 there is no question that St. Louis can give the most artistic though not the largest exposition ever held.

TWENTY-FIVE KNOT NAVAL SCOUTS.

At the Annual Conference of the Institution of Naval Architects in London, Rear Admiral C. C. P. Fitzgerald outlined a scheme he has had formulated for scout vessels of high speed and good seagoing qualities. His idea is by no means original, for the French government some two years ago sanctioned the construction of two such vessels for the purposes advocated by Rear Admiral Fitzgerald, although so far they have not been constructed. The vessel suggested by this officer would be a twin-screw steamer 400 feet in length, with a beam of 44 feet, 3,800 tonnage, draught 14 feet, 17,000 horse power, and a continuous ocean speed of 23 knots, rising, if the exigencies demanded it, to 25 knots per hour, a bunker capacity of 1,200 tons, and a normal supply of 500 tons of coal. She would be provided with a protective deck 2 inches thick on the slope, and would carry six 4-inch guns, with twelve machine guns. Although not intended for fighting purposes, she would yet be capable of defending herself against torpedo attack. The radius of action of this scout would be 1,500 miles at 25 knots, 2,000 miles at 23 knots, 3,000 miles at 18 knots, and 8,500 miles at from 10 to 15 knots. The maximum speed would enable her to escape from first-class cruisers. Her estimated cost would be $1,350,000. Commander Clover, of the United States Navy, who entered into the discussion, remarked that in the Spanish-American war the Americans employed liners such as the "New York" and "St. Paul" for this class of work, and they were found to fulfill all the necessary requisites, either as dispatch or scouting vessels. The result of their experience had convinced them that it was undesirable to construct special vessels as scouts, since in order to be efficient the vessels would have to be of large dimensions, so that high speed might be maintained at sea at all times.

SCIENCE NOTES.

The excavations in Carthage are producing excellent results. The Punic necropolis near the altar of St. Monica, at Carthage, has resulted in the finding of painted terra cottas, censers, figurines of women, bronze razors and engraved inscriptions of human beings, birds, etc., amulets of gold, silver and ivory.

The eminent French chemist, M. Armand Gautier, has reported a discovery to the Paris Academy of Sciences which may prove of great hygienic value. He has found that finely powdered volcanic stones, treated by boiling in water at a temperature of 250° to 300° Celsius, yield a liquid identical in composition with the ordinary sulphur water of mineral springs, except that it is stronger than the latter.

Dr. Harlow Brooks has been appointed pathologist to the New York Zoological Park. The animals furnish a splendid field for the study of comparative pathology. A laboratory will be fitted up for Dr. Brooks' use. He will make regular visits to the park to examine into the hygienic conditions of the animals and recommend such treatment, and to make such autopsies and microscopic studies as will tend to advance our knowledge of the prevention and treatment of diseases peculiar to animals.

Celluloid has always been manufactured by dissolving nitrocellulose in camphor—that is to say, forming a mixture of nitrocellulose, camphor and alcohol. But there are other ways of mixing it. According to a publication of the Société Générale pour la fabrication des matières plastiques de Paris, celluloid can be made by using naphthalene instead of camphor. The celluloid thus produced, the paper adds, is just as good as, if not better than, that in which camphor forms one of the ingredients.

The Surgeon-General of the United States Army has approved the report of a special medical board by which the conclusion was reached that the mosquito is responsible for the transmission of yellow fever, and the medical department of the army is moving energetically to put into practical operation the methods of treatment for prevention of yellow fever, involving a radical reversal of the existing methods, which form the basis of the report. The liberal use of coal oil to prevent the hatching of mosquito eggs is recommended.

German papers report that an Englishman, Mr. H. Houbon, has invented a process for making very pure hydrogen from acetylene. He condenses acetylene in a Cailletet steel bomb up to 5 atmospheres, and ignites it by means of electricity. Hydrogen and carbon are formed; the latter precipitates in the form of fine soot. The process is without danger and makes it possible to generate hydrogen on a large scale very cheaply. This invention may mean much for balloon technics, as the present methods of making hydrogen are expensive.

Prof. Dr. Voges, the director of the National Board of Health at Buenos Ayres, according to German papers, has found a remedy for mosquito bites. He states that he discovered it by accident during his trip to Paraguay to study the pest. He had been supplied with all sorts of remedies, among them naphthalene, an article of no value whatever against the pest; but on using it for mosquito bites, he found it of surprising effect. It neutralizes the poison, even when the spot bitten is greatly inflamed. If fresh bites are rubbed with naphthalene, no swelling follows. The professor considers naphthalene almost a specific against mosquito poison.

The State of California has appropriated $250,000 to purchase and preserve the grove of redwoods near Santa Cruz. This excellent work was accomplished largely through the agency of a body of Californians especially organized for the purpose, called the Sempervirens Society. The area purchased is unfortunately not very large, and the finest redwoods are found further north. Several thousand acres of land will be purchased in the neighborhood of Humboldt Bay, running from the ocean back across the summit of the coast range. Two or three millions of dollars would be sufficient to make the entire purchase, and the government would do well to preserve this wonderful collection of forest trees for all time.

The heavy yoke of paternalism weighs on the pharmacists in Germany, says The American Druggist. Every detail of the practice of pharmacy is closely supervised by the government. No smoking, no loud and unnecessary conversation are allowed in stores and no domestic animal can be tolerated in them. The pharmacists are being gradually replaced by the "drogisten," who are only permitted to sell the simpler drugs and medical supplies, but cannot dispense prescriptions, and can only sell poisons under special restrictions for household use. Licensed pharmacists are required to be present in their stores from six A. M. to ten P. M., and during the night must be at all times ready to respond to the call of the applicant for even trifling amounts of drugs.