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NEW YORK, SATURDAY, MAY 18, 1901.

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

THE EXISTENCE OF BODIES SMALLER THAN ATOMS—THE CORPUSCULAR HYPOTHESIS.

If Prof. J. J. Thomson's corpuscular hypothesis be absolutely demonstrated, our ideas in regard to chemistry will be revolutionized. In a recent lecture before the Royal Institution he selected as his subject "The Existence of Bodies Smaller than Atoms." He briefly referred to work which had been done by others in theory and practice, in order to determine the size of an atom. One method of doing this was by ascertaining the charge of electricity which an atom carried during the process of electrolysis, and from the charge to calculate the mass. The experiments of the lecturer were made with the view of ascertaining the mass of small particles which carry an electric discharge through attenuated gases. The next experiment was made with the object of ascertaining the mass of all the particles used to carry the charge and also their number. For this purpose some of the experiments of Mr. Wilson on the sudden expansion of a gas saturated with moisture were used. He found that a cloud was not produced by the sudden expansion if the air was quite free from dust. It was also found that if either the dust or the charged particles of gas were present a cloud was formed. The total quantity of moisture in the cloud can be calculated from the expansion. Some experiments of Prof. George Stokes were then employed to ascertain the volume of each particle. These experiments had for their end the careful determination of the rate at which particles of water would fall, the speed being dependent upon the dimensions. From the formula which Prof. Thomson obtained, he was able to ascertain the size of the particles by observing the time it took for the cloud formed in the tube by a sudden expansion to fall. Once he knew the size of one particle and the total mass, it was not difficult to make calculations. He concluded that the small particles carrying the charges of electricity were only one-thousandth of the size of an atom. These experiments were all made with discharges of negative electricity. It was also found that these small particles negatively charged were given off from incandescent matter and from radium.

Prof. Thomson expressed mathematically the laws of Becquerel and cathode rays and then showed from his equations that the rays possessed momentum and, therefore, must have mass. When he first enumerated his theory to the scientific world three or four years ago, it was received with considerable incredulity, but has now been adopted by many scientists. He regards the chemical atom as made up of a large number of similar bodies which he calls "corpuscles." A normal atom forms a system which is electrically neutral. The electrification of a gas consists in the breaking off from the atoms of a few corpuscles. The remainder of the atom is positively electrified, and the more corpuscles that are broken off the stronger is the attraction that binds the remainder to the atom.

Prof. Thomson has calculated from the results of his experiments on very different substances that the mass of a negative corpuscle is about the five-hundredth part of the hydrogen atom. The subject is treated at considerable length in the current issue of our SUPPLEMENT.

PROPOSED ABOLITION OF THE ARMY TRANSPORT SERVICE ON THE ATLANTIC.

We greatly regret to learn that the United States Army Quartermaster in this city has received notice from the War Department to close contracts with the steamship companies running between New York and the West Indies, for the transfer of men and material between the United States and Cuba and Porto Rico. The reason given for this radical change of policy is, that the steamship companies concerned are said to have offered rates to and from the West Indian military depots, which are lower than the actual cost for similar service as carried on by the regular army transports. This statement, however, is not authenticated, and we seriously doubt its truth.

If our readers turn to the articles published in the SCIENTIFIC AMERICAN for March 23 and April 27, 1901, giving an account of the army transport service on the Atlantic and Pacific, they will find some statement of the costs of operation as compared with the cost of similar service if carried on by the civil lines. A recent voyage of the "Crook" from New York to San Juan and return cost $9,761.39, whereas the cost estimated at the current rates of the civil lines of steamships at the time the voyage was made would have been $19,907.00, a clear saving of $10,145.61. Another voyage of the "Crook" between the same ports would have cost $26,419.28 if the men and supplies had been carried by the regular lines, whereas the actual cost by the army transport vessel was $14,062.93, a clear saving of $12,356.35. In the presence of such figures as these one is filled with very natural astonishment on learning that it is proposed to abolish a system which has proved itself so highly economical, and to transfer the whole of the service into the hands of civil corporations. The change may well prove to be highly profitable to the latter; but the profit will be at the expense of the government, and the whole proceeding will savor of that paternalism and pseudo-benevolence, the last vestige of which we had hoped was disappearing from our national affairs.

The question of the abolition of the transport service, however, is to be deprecated on higher grounds than that of mere finance. One of the great lessons which we have learned, or rather which we ought to have learned, during our war with Spain, a lesson, by the way, which has received strong indorsement in the naval transport operations of the South African war, is that army transport service on the sea is second only in importance to army transport service on land, and that it is just as essential that the army should have a fleet of its own furnished with accommodations suited to its particular needs, as it is that it should have its own special wagons and packing outfit for transportation on land. If we are to abolish army ships and put up with the haphazard accommodation of private steamships, let us be consistent and abolish army wagons, cars and what-nots and benevolently call in the farmer and huckster to help us out with whatever vehicles may be on the farm or in the stable, much after the fashion of poor old Braddock when he went to his defeat in colonial days. As a matter of fact, the needs of the army transport service are so special that it is impossible for any private steamship to meet them. Proof of this is shown in the fact that when such steamships have been purchased for the transport service, it has been necessary to spend about $400,000 in the mere work of refitting them with the necessary bunks, lavatories, hospitals and accommodations for provisions and freight.

Nor must we forget the most powerful argument of all in favor of a separate service, namely, that since wars come swiftly and with but little warning, a fleet of troopships specially fitted for the conveyance of an army and its supplies, and available for duty at any time that it may be called upon, is an imperative necessity. For proof of this statement, it is enough to refer back to the precipitate scramble which occurred in scraping together enough ships to carry our army to Cuba, and to the pitiable sufferings to which the invalided troops were subjected on account of the insufficiency and unfitness of the extemporized troopships which brought home the sick and wounded soldiers.

Looked at from any and all points of view, there are very positive advantages in the possession by the navy of a large fleet of thoroughly equipped transports, with as many of them on the active list as will meet the needs of the army when it is on a peace footing, and the rest in reserve in such a state of readiness that they can be rushed into service at a few days' notice. Indeed, so firmly are we convinced of the wisdom of this policy that we think the construction of ships designed and equipped specially for this service is as necessary to efficiency as the construction of ships of war for line of battle and for scouting on the high seas.

A NEW TYPE OF COAST DEFENSE GUN.

The Gathmann gun, a detailed description of which will be found on another page, was built in consequence of an appropriation made by Congress in March, 1899, and was proved at the Bethlehem Steel Company's proving grounds in the summer of 1900. The Bethlehem Steel Company undertook to design and build the gun complete—the problem set being to produce a gun weighing about 59 tons which would fire a projectile weighing 2,000 pounds with 1,800 feet velocity, and would safely withstand a chamber pressure of 18,000 pounds per square inch.

In a recent communication to this journal Lieut. Meigs, Ordnance Engineer of the Bethlehem Steel Company, informs us that the ratio of the muzzle energy of this gun at 2,200 feet velocity, which the gun can safely reach, to its weight is to that of the ordinary type of gun usual in this country and abroad as 125 is to 100. That is to say, for a fixed weight of gun this one is about 25 per cent more economical in its performance, that is, in its rendering of muzzle energy, which constitutes the destructive power in projectiles. To look at it in another way, this gun will have great power upon armor or any other target in consequence of the weight of its projectile, which is very great as compared with the weight of the gun. Its *smashing* or *racking* effect, to use a term which was often met with in artillery matters at the time our monitors were built in the civil war, is very great.

The gun is now at Sandy Hook, and at its last session Congress made an additional appropriation which will enable the inventors to purchase a number of projectiles for the further proof of the gun. For while the gun is interesting as above indicated, owing to its large bore for its weight, the primary intention of its inventors is to use it as a torpedo gun. The projectile will carry 500 pounds of guncotton or other high explosive, and it is believed that, upon detonation of so large a mass of guncotton, even outside of a fort or ship, great destruction will ensue. It is now to be shown that a charge of this size can be safely landed on a structure which it is intended to destroy, and there completely detonated by the action of the fuse. Even, however, if the danger of firing so large a charge from a gun prohibit its use, or if so large a charge cannot be completely detonated in close contact with a target, which is necessary for the full effect of the explosive, it still remains that the Gathmann 18-inch gun is an extremely interesting one; for the reason that, for the weight of the gun, it strikes a more destructive blow, except possibly at very great ranges, than existing guns. If the greater blow it strikes includes practically all distances at which ordinary targets can be hit at all, which distance artillerists will place perhaps between 4,000 and 8,000 yards, then these large-bored guns have much to recommend them.

"SHAMROCK" AND "CONSTITUTION."

Limitations of space prevent our offering for comparison with the views of "Constitution" which will be found on another page, some photographs of "Shamrock," taken as she was starting from the Clyde. These views, which give an excellent idea of the lines of the challenger, will be found in the current issue of the SUPPLEMENT. If our readers compare the two boats, they will agree with us that the models of the yachts, as far as can be judged from their above-water lines, are radically different. The beam of "Shamrock," at least in the deck-plan, has been maintained to well abreast of the mast, while the boat begins to narrow in from slightly abaft the chain plates and is drawn out into a stern which certainly does not measure more than 6 feet across the taffrail. The photographs also show that her freeboard has been reduced to something less than four feet amidships, so that while Mr. Herreshoff has been increasing the height of his topsides, Mr. Watson has been going to the opposite extreme. What renders this more curious is the fact that, judging from her lines, the Watson boat will have less initial stability, and would, therefore, seem to require the deeper topsides to lie down upon. Another curious fact brought out by the photographs of the English cutter is that the sail-spread will evidently be much smaller than has been reported, and certainly smaller that that of the American boats. The value of the time-allowance thus gained will depend entirely upon the strength of the wind in which the races are sailed.

NEW ELECTRIC TRACTION SYSTEMS IN EUROPE.

Among the numerous systems of electric traction which are being installed in Europe may be mentioned the following: Bilbao, Spain, is to have a traction system, and the lines from that city to Durango and Arratia will be transferred to electric traction; the material has been ordered from the French Thomson-Houston Company. The energy for operating the lines will be supplied by two hydraulic plants which will furnish current at high tension, and this will be carried over a distance of 10 miles to the sub-stations, where it will be transformed to direct current at low potential by rotary converters. The total length of the tramway lines is to be 11 miles, most of which is double track. In Sicily a number of installations are in projection. Up to the present none of the cities of the island are provided with electric tramways. Palermo will be one of the first of these to have a lighting and traction plant; this is being installed by the Schuckert Company. The Allgemeine Company, another large German firm, is soon to undertake several important projects in Sicily. The Helios Company, of Cologne, has already installed a 2,000 horse power plant at Catania, on the

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east coast of the island, to operate a system of electric tramways. A French company has recently obtained the concession for an interurban line connecting Trapani, on the west coast, with Monte S. Giuliano and Paperella. Electric traction is to be substituted for steam at Messina; the existing system has a narrow gage road about 10 miles long. At Athens a system of lighting and traction is now being installed; the generating station will at first be equipped with two alternators of the triphase type, of 750 kilowatts capacity each, and the number of machines will afterward be increased to 6 or 7 according to the demands of the service. The alternating current will be sent to substations where it will be transformed to direct current; besides, the main station is to contain several direct current generators which will supply a part of the circuits.

VARIABILITY IN LIGHT OF EROS.

The discovery by Dr. Oppolzer that the light of Eros is variable suggests some photometric problems of great interest. If, as seems probable, we assume that the variation is due to the rotation of the planet, we can, from measures of its light, determine the time of rotation, and the direction in space of the axis of rotation. Owing to the varying position of the observer with regard to the planet, much information can be obtained which is impossible in the case of a variable star.

Assuming that the variation in light of Eros is due to its rotation, two explanations may be offered as in the case of variable stars of short period. First, that Eros is darker on one side than on the other, as is probably the case with Iapetus, the outer satellite of Saturn, and secondly, that it is elongated, or double, as has been assumed by M. André and others. In the first case, the successive maxima would always have the same intensity, and would succeed each other at equal intervals which would be equal to the period of revolution. The same would be true for the minima. In the second case, if the two bodies differed in diameter, the successive maxima and minima might have unequal intensities, and if the orbit were elliptical the intervals between them would be alternately long and short. This seems to be the case with Eros, and the first hypothesis seems therefore improbable.

On the other hand, if the variation in light is caused by two similar bodies alternately eclipsing each other, it is difficult to see how more than half the light can be cut off in each case, and the minima more than three quarters of a magnitude fainter than the maxima. It then becomes necessary to assume that the two bodies are of unequal brightness, that they are elongated, or that we have a single body of the shape of a dumb-bell. Some observers have found the minima two magnitudes fainter than the maxima. To account for this, we should be obliged to assume that one axis of the body was six times as long as that at right angles to it. Observations show that the light of Eros is continually varying, while if the case were that of a simple eclipse, as in the stars of the Algol type, we should expect that it would retain its full brightness for a large portion of the time.

If the bodies were of the same size, and the orbit circular, it might be impossible. from the light curve, to distinguish between the two hypotheses. The fourth of the corrections mentioned above, however, furnishes a means of distinguishing between them in any case. If the body is dark on one side, the time of revolution will equal the interval between the successive maxima, and the correction for the position of the observer will be proportional to this quantity. If then the position changes 180°, the correction will be one-half the interval between the successive maxima. In the second case, the time of revolution will be double this, that is, equal to the interval between a given maximum and the next but one, so that the correction for position will now be twice as great as before, and approximately equal to the interval between the successive maxima.

Much material already exists for determining this. Several of the photographs of Eros taken in 1893, 1894 and 1896 had an exposure of an hour or more. Owing to the motion of Eros, it formed a trail on each of these plates, which in some cases shows distinct variations in brightness. This was noticed when the plates were first examined, but was supposed to be due to changes in the haziness of the air. As this is an easy method of discovering the variability of an asteroid, it is hoped that astronomers engaged in a photographic search for such objects will examine carefully all trails, to detect any changes in intensity. An examination of forty-one asteroid trails photographed with the Bruce telescope, seven of them on a single plate, failed to show, except in one or two instances, any change beyond that apparently due to varying atmospheric absorption. Generally, more than one asteroid appeared on each plate, and in such cases all showed the same changes in intensity.

The photographs of Eros taken in 1893 and 1894 fail to show any marked variations in light, and it is probable that the range was, at the time, small. The plates taken during 1896 give more conclusive evidence of changes.

The photometric measures made in 1898 furnish an accurate determination of the times of maximum, and of the range for that epoch.

A very large number of photometric measures of Eros have been made since July, 1900. Observations have been obtained with the 15-inch equatorial on 51 nights, the number of photometric settings each night being, in general, 32, but sometimes more. It has also been observed on 56 nights with the 12-inch horizontal telescope, 32 or more settings being made each night. Some months will be required to reduce these observations completely, owing to delay in adopting magnitudes of the comparison stars.

The range of variation in the light of Eros, which has been diminishing during the spring, has now become zero.

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CULTIVATION OF RUBBER IN MEXICO.

BY ENOS BROWN.

A very large amount of Pacific coast capital has, within the past few years, been invested in the rubber plantations of the southern Mexican States. In years gone by the rubber industry of Mexico was of considerable importance, but the improvident native method of harvesting was fatal to the industry, and the large returns dwindled as the number of trees decreased, until the export of native rubber ceased to be of much account. The States of Tabasco and Chiapas, adjoining the isthmian region of Tehuantepec, have been the former sources of rubber supply. In soil, temperature, rainfall and other general conditions, these States possessed ideal qualifications for the cultivation of the tree. The soil is the accumulation of long centuries of tropical decay, while the annual rainfall ranges from 150 inches and upward. The temperature required, hot and humid, is here found, while the dense shade which the rubber tree is said to crave is afforded by the untouched forests which abound in the extended valleys of the watercourses of a labyrinth of navigable streams emptying into the Gulf of Mexico. The capability of these lands for the cultivation of the rubber tree has been remarked by consuls and travelers for many years, but the project seemed not to attract capital on account of their inaccessibility and the unhealthy nature of the occupation; but the increasing scarcity of supplies, accompanying the enormous increase of demand, has stimulated the investment of capital, until at the present time not less than 200,000 acres in the Tehuantepec provinces have been acquired, principally by Americans, who have invested $5,000,000 in planting and development.

The rubber tree responds quickly to intelligent care and cultivation, and thrives best in lands having an elevation above sea level of from 200 to 1,200 feet. It requires a rainfall of at least 100 inches in twelve months. The soil required must be rich and fertile. It is a rapid grower, like all "soft" wood trees, and in nine months has been known to attain a height of 9 feet 5 inches. In 6 years, sometimes in 5, the tree is ready to be tapped, and an average yield of 3 pounds of rubber is anticipated. At 7 years of age the tree yields 4 pounds, and at 8 years of age 5 pounds, increasing from year to year. A tree known to be 50 years old yielded 35 pounds of rubber in 1900. The companies have planted nurseries for raising the plant from the seed. It is estimated that 1,500,000 young trees are ready to be transplanted onto the cleared lands. Two hundred trees are planted to the acre. When planted they require no farther care, and in six years they begin to produce. It has been found that dense shade is not always a requisite, and cultivators find it an advantage to clear the lands to a great extent, affording more light to the growing trees, as well as a contingent profit in the marketing of mahogany and other valuable timbers which flourish in this region as nowhere else.

The principal difficulty so far met with is scarcity of labor. The natives are indolent and good-natured, but are constitutionally averse to hard labor. Arrangements have been consummated for the importation of a large contingent of Asiatics.

Throughout the State of Chiapas there are wonderful remains of monuments of a past civilization. Palenke, the capital of the ancient races who once swarmed over this region, possesses many types of ruins, covered with mysterious hieroglyphics, as yet undeciphered, which demonstrate the high standard of civilization to which these ancient people once attained.

Mr. J. W. Ellsworth, managing director of the Chiapas Rubber Plantation Company, who is now supervising planting and improvements on the property of the company, reports, in a communication dated March 21, 1901, on the growth and yield of trees grown in the district in which the company's plantation is located. The measurements were taken and the trees tapped during the month the report was made, under the personal supervision of the director, and with precautions that insured absolutely precise, accurate and reliable results, for the purpose of determining the probable yield and growth of the rubber tree under intelligent and careful cultivation, and with the conditions existing in the department of Palenke, State of Chiapas. It was found that trees five years of age had attained a diameter of from 8 to 10 inches, and yielded from 3½ to 4¼ pounds of pure rubber. Trees six years of age were 10 to 11 inches in diameter, yielded 4 to 5 pounds per tree, and from those trees seven years old, from 14 to 16 inches in diameter, the yield was 6½ to 8½ pounds per tree. All these trees were cultivated in partial shade. From those grown without shade the yield was materially less.

SCIENCE NOTES.

Herbert Spencer was eighty-one years old on April 27, and is in fair health. He has just completed a two-volume autobiography which will be published after his death.

A farmer in West Virginia has an elephant to do his plowing. He finds that the animal eats little more than a horse and does many times the work and is gentle and docile, so that the owner is well pleased with the experiment. A small circus broke up near the farmer's place, and its property was sold at auction and the elephant was purchased at a moderate price.

On June 30, 1900, there were 4,099 petty officers in the United States navy, of whom 57.3 per cent were native born, 33.6 per cent naturalized, 6.5 per cent had declared their intention of becoming naturalized, 1.5 per cent were aliens resident in the United States, and 9 per cent were non-resident aliens, while 90.9 per cent of the whole number were citizens of the United States.

In every street car in Leipzig are hung copies of a bi-weekly newspaper, containing advertisements of the railroad, time-tables, a few jokes, and notices of performances that are to be given at different theaters. The newspapers are fastened on racks which are hung upon hooks in the corners of the cars. Passengers have the privilege of taking the papers down and reading them.

It has been found that aluminium cooking utensils permit of greater fuel economy. This has been tested in the Madras Lunatic Asylum, where aluminium cooking utensils have been adopted. During six months of the last year before the introduction of aluminium vessels, the monthly weight of wood burned per head in cooking was 34 pounds. After the change the consumption fell to 19 pounds, a reduction of nearly 45 per cent.

Young Orris Benson, the deaf, dumb and blind rival of Helen Keller, has recently heard spoken words, and by a purely mechanical process has also been taught to speak many words and even sentences intelligently, so that he no longer admits that he is mute, and his teachers usually understand his spoken efforts readily. He is an expert typewriter, working the instrument rapidly and accurately. He uses the machine for all his written work.

A new plan having for its object the distribution of young trees throughout the country will be put into practical operation next year by the Secretary of Agriculture. An investigation has been made to discover the varieties which will thrive best in the various localities, and the distribution will be made in a manner somewhat similar to that employed in the seed distribution authorized by Congress. Special attention will be given to trees of the nut-bearing, shade, and lawn variety, and oaks. Ash and lindens will also constitute a prominent portion of the distribution. The Secretary believes that the idea will prove popular.

The Internal Revenue Bureau has prepared a statement showing the receipts, by items, resulting from the additional taxes imposed by the war revenue law. The figures cover the period from June 13, 1898, the date the law became effective, to February 28, 1901. The receipts were as follows: Schedule A, documentary stamps, $98,420,099; Schedule B, proprietary stamps, $12,784,694; tobacco, $42,405,859; beer, $89,154,822; special taxes, $14,026,359; snuff, $2,393,275; cigars, $8,291,608; cigarettes, $3,547,490; legacies, $6,889,055; excise tax, $2,398,823; mixed flour, $20,609; additional taxes on tobacco and beer, $978,816; total, $281,311,515.

M. L. Beulaygue has made some interesting experiments upon the influence of darkness on the development of flowers. He finds that flowers open in darkness later than in sunlight, and that the color of the flowers is in general less intense in darkness than in sunlight, the diminution of intensity being small for some species, while others lose nearly all their color. Flowers developed in darkness have, in general, a smaller size than those developed in the light, but, on the other hand, the pedicels are sometimes more fully developed. He also found that the weight and the size of flowers developed in darkness, including the pedicels which support them, are less than for flowers developed in sunlight, except in some rare cases where the increase of size of the peduncles counterbalances the diminution of the rest of the plant.

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