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THE MAMMOTH POWER STATIONS OF NEW YORK CITY.

In an age when the excessive use of superlative and extravagant terms is one of the glaring faults of journalism, one hesitates before applying such words as "colossal," "mammoth" and their kind in the description of modern works. The rate of progression in the broad field of engineering is so rapid, however, the courage and daring of the engineer are so great, that the world is ever and anon confronted with works which call for superlative terms to give them adequate expression. Of such a kind are the great power houses which are either being planned or built for the three largest railway systems in New York city. When completed they will each exceed any other aggregation of motive power in the world so greatly as to be by comparison positively mammoth in their proportions. The first of these to be completed will be the central station of the Metropolitan Street Railway Company, with a total capacity of 70,000 horse power and following this will be an 80,000 horse power station for the electrical operation of the system of the Manhattan Elevated Railways, and an even larger station, with a reported maximum capacity of 100,000 horse power, for operating the electric roads of the Third Avenue Railway Company.

It is a curious fact that only a few years ago the largest aggregation of horse power was to be found in the engine rooms of the big Atlantic liners. The twin engines of the Cunard liner "Campania," for instance, indicated 33,000 horse power on her trial trip, each engine developing about 16,500 horse power. This has probably been surpassed by this time in the power house of the Niagara Falls Power Company, where the erection of the last of the ten 5,000 horse power turbines must be nearing completion. Apart from the hydraulic installations at Niagara and elsewhere, there is to-day no single power station in the world where the collective horse power of the steam engines equals or even approaches that to be found in the "Campania," "Lucania," "Kaiser Wilhelm," or "St. Paul."

The Metropolitan Street Railway Company's station, however, will exceed the maximum output of the "Lucania's" engine room by over 100 per cent. When completed, it will include eleven cross-compound engines of 6,600 maximum horse power, and the whole series could be completed and in operation early in the coming year should the demands of the system call for such an output by that time. The preliminary design for the power house of the Manhattan Elevated Railways provides for eight huge four-cylinder compound engines, each capable of developing 10,000 indicated horse power. Two of the cylinders will be carried vertically above the crankshaft on the usual A-frames, and the other two will be placed horizontally, all four cylinders working upon a common shaft. The huge size of these engines may be judged from the fact that each one will be capable of developing more power than the total output of any but a few of the largest steam-driven central stations in the country.

SOIL PARASITES.

Many of our farmers have observed in the past few years that crops which they formerly cultivated with success could no longer be grown. They tilled and fertilized their fields with their usual care, but the plants withered and died from no apparent cause. A careful investigation of the evil by the Department of Agriculture has shown that the soil in many regions of the United States, devoted to the cultivation of special crops, is infected with several most deadly varieties of parasitic fungi. The experiments and researches of the department have been exhaustively described by Dr. Erwin Smith in a paper which he read before the Botanical Section of the American Association for the Advancement of Science, and which we publish in full in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT.

Dr. Smith's investigations show that soil fungi have ravaged the fields of the watermelon region, the cotton section, the cabbage district of New York State, and the tomato lands of Florida. To such an extent has the melon fungus infected the soil of our Southern States that watermelon growing has been sometimes rendered impossible, and in certain parts of South Carolina, Virginia, and Mississippi the industry has been almost given up. In one of the finest cotton-producing districts in the world (the "Sea Island" belt, extending from South Carolina to Georgia) many growers have been compelled to abandon their devastated fields. The cabbage growers of New York and the tomato farmers of Florida have suffered similarly.

That the evil is primarily due to soil parasites or fungi is fully proved by Dr. Smith's experiments. Merely by burying the fungus in the earth the characteristic signs of contamination are obtained in the plant. Microscopic examinations show that the parasite completely fills the water-ducts of the stem. The leaves wither; and, if the weather be dry, the plant never recovers. Even if the weather be moist, the plants soon droop under the heat of the sun. A plant may be contaminated at any stage of its development, from the seedling just shooting from the ground, with no leaves except cotyledons, to the full-grown vine with ripening fruit and dense foliage. From external indications alone the disease can not be diagnosed. Only by a microscopic examination of cross-sections of the plant stem is it possible to ascertain the true cause of the wilting of the foliage, for the white, cotton-like stuffing which fills the passages is an unmistakable sign of soil-fungus infection. As the plant dies the fungus comes to the surface, and in fruiting changes its form entirely. In his attempts to cross-inoculate the varieties of fungi Dr. Smith has been unsuccessful. Morphologically the parasites are apparently similar; physiologically they seem altogether different from one another.

The farmer naturally asks: What is the remedy for this soil-infection? Unfortunately no answer can be given. The malady is of such recent discovery, and so little is known of the fungi, that, for the time being, only precautionary measures can be recommended. The usual methods of curing vegetable diseases are utterly ineffective. A field once attacked by a particular parasite can henceforth produce no healthy plants subject to contamination by that parasite. Perhaps, as Dr. Smith suggests, the disease may be due to a disregard of one of Nature's first requirements—the rotation of crops. Year after year, the grower of especial crops will plant his ground with the same vegetables, until at last the soil, besides becoming "sick," accumulates a mass of decaying tissue which constitutes an excellent culture-bed for parasites. The moral is plain enough. The crops grown in soil still untainted should be carefully changed every two or three years. Contamination can be prevented only by burning diseased plants and by exercising the utmost care in separating the infected vines from the hay and other crops stored away during the winter; for so tenaciously do these fungi cling to life that, if not destroyed, they will attack the soil in the following spring with the same deadly effect as in the previous year.

BIDS FOR THE PROPOSED CRUISERS.

The SCIENTIFIC AMERICAN, as our readers are well aware, has taken a firm stand against the proposal to add a fleet of 15½ to 16½-knot half-protected cruisers to the United States navy. We have felt that the construction of these ships would be so prejudicial to the interests of the navy as to call for a most emphatic protest. It is not necessary to say that in criticising the department's plans and specifications we have been satisfied that they were drawn up with the best possible intentions, and that the objects aimed at in these vessels were considered by the department to more than outweigh their obvious deficiencies.

The position taken by the SCIENTIFIC AMERICAN is that, if the department was sacrificing speed and protection in favor of coal capacity and steaming radius, it has certainly failed to show adequate compensation in the latter particulars. We pointed out some weeks ago that a fine opportunity was presented to the private shipbuilding firms of the country to show what they could do in offering their own alternative designs, and we are glad to know that the bids which have recently been opened for the construction of these cruisers prove that the country possesses private shipbuilding yards which are prepared to build on their own plans and specifications cruisers which, although they are of the same displacement as contemplated in the department's design, will carry more coal and have from 1 to 2½ knots per hour greater speed. We have not been able to obtain the particulars as to the amount of protection contemplated, but we know that in every case the coal capacity has been increased, and we presume that the armored protection is not less than the 2 inches which is specified in the plans of the department. It is also gratifying to note that this increase of efficiency is obtained with practically no increase in cost, the amount of the bids being about the same for the improved designs as for those of the department.

Of the bids which have recently been opened, the one which commends itself most on the score of speed and coal capacity combined is put in by the William R. Trigg Company, of Richmond, Va., on their own plans and specifications. They offer to build one cruiser of 3,283 tons trial displacement, 19 knots speed, and 770 tons bunker capacity, for $1,079,000, the vessel to be completed in twenty-four months: or they will build two vessels of the same type, in the same time, for $1,039,000 each. Compared with the department's design, this vessel, on 83 tons more trial displacement, will have 2½ knots increase of speed, and an increase of 70 tons in the total bunker capacity. The same firm puts in a design for a vessel of the same displacement and of 18 knots speed and 830 tons bunker capacity, of which they will build one for $1,041,000; and two for $993,700 each. They will build a vessel of 18 knots and 785 tons bunker capacity for $1,073,000; or two of the same type for $1,024,700 each. The Fore River Engine Company, of Baintree, Mass., will build a 3,200 ton vessel, with a speed of 18 knots, and a total bunker capacity of 866 tons, for $1,065,000: or they will build two of the same type for $1,020,000 each. They will also build a vessel of the same coal capacity and displacement, but of 18½ knots speed, for $1,100,000; or they will build two for $1,066,800. Townsend & Downey, of New York, offer to build a 3,250 ton vessel of 17½ knots speed, total bunker capacity not stated, for $1,059,500.

Ten firms have put in bids on the department's plans for a 3,200 ton 16½-knot cruiser of 700 tons bunker capacity, the lowest bid being that of Townsend & Downey, New York, who offered to build one boat for $954,500 in twenty-one months, or two boats for $950,000 each in twenty-seven months. The highest bid is that of Moran Bros. Co., Seattle, Wash., who offered to build one boat in thirty months for $1,122,000.

It is evident that unless there are defects in the alternative plans and specifications offered by the builders or the Department has doubts of the ability of the firms that make these bids to carry out the contract, the United States navy is in a fair way to secure vessels which are fairly well up to modern requirements. The William R. Trigg Company, which offers the highest speed, also puts in the lowest bid but one, the lowest being that of Townsend & Downey, of New York, to build two of the 16½-knot cruisers of 700 tons coal capacity for $950,000 each. This bid, however, in respect of value for price, is far inferior to that of the Trigg Company, who offer to build two 18-knot vessels with 830 tons coal capacity for $993,700 each. The Trigg Company, which has lately launched the "Shubrick," has other ships upon the stocks for the United Sates navy, and is unquestionably well able to live up to the full terms of its proposal.

In any case we trust the Department will give the preference to such proposals as guarantee high speed and superior coal capacity. No mere saving of a few thousand dollars can warrant the acceptance of inferior designs. The whole country is fully alive to the merits of the question, and will watch the making of the awards with close and intelligent attention.

NAVAL TESTS OF MARCONI TELEGRAPHY.

In the current issue of the SUPPLEMENT will be found illustrations of the tests of the Marconi system of telegraphy recently carried out on the warships "New York" and "Massachusetts." The illustrations are reproduced from photographs taken during the course of the trials. Messages were sent and received between the two ships up to a distance of forty-five miles, beyond which the apparatus proved to be unable to record the messages with distinctness. The great difference between these results and the eighty-mile transmission accomplished in the British naval maneuvers is explained by Marconi on the ground that he only brought to this country apparatus designed for the limited distances necessary in reporting the yacht races to a ship stationed at the Sandy Hook lightship. The sending and receiving instruments installed on the "New York" and "Massachusetts" were the same as those used on "La Grande Duchesse" and the "Mackay-Bennett" cable ship, and their operation is stated to have been thoroughly successful up to the limit named. Mr. Marconi informs us that it was only two or three years ago that Mr. Preece, who was so active in introducing the system in England, named ten miles as the probable limit for wireless transmission, and the fact that in so short a time messages have been sent over eighty miles of sea and one hundred and ten miles of land and water, augurs well for the future development of the system.

OPENING OF THE NEW YORK ZOOLOGICAL PARK.

With fitting ceremonies the new Zoological Park in Bronx Park was formally opened to the public on Nov. 8. Special trains took the guests to the Fordham Station, where conveyances were waiting to take them to the main entrance, where Director W. T. Hornady received the Hon. Levi P. Morton, President of the Society, the Controller, Mr Coler, and Park Commissioner Moebus. After brief exercises the guests were allowed to wander at will through the beautiful grounds.

Twenty-five buildings have been completed, and already 850 specimens have been assigned to their proper buildings or grounds.

REPORT OF THE BUREAU OF STEAM ENGINEERING.

Limitations of space prevent our making anything more than a brief reference to the annual report of Admiral Melville, Chief of the Bureau of Steam Engineering, and our readers must turn to the current issue of the SUPPLEMENT for the digest of this publication. The most interesting parts of Admiral Melville's report are those in which he dwells upon the questions of the personnel, and the use of electrically driven auxiliaries on our warships. He regrets his "inability to see indications of the desired results, thus far, of the personnel bill," which according to his belief "contemplated most earnestly vast additions to the number of officers who would give earnest attention to engineering matters, and in no way implied a desire to augment the forces available for merely former line or deck duty." He still hopes that "the comprehensive union of the line and engineering vocations will be the result of the personnel change. . . . The only possible scheme is to insist upon the present line officer adapting himself as soon as possible to the new conditions, and increasing, where lacking, his knowledge of mechanical engineering."

In our issue of October 28, we drew attention to the fact that there was a danger of the tendency to replace the steam auxiliary by the electric motor being carried too far on our warships. Admiral Melville devotes considerable space to this question, and argues to the same effect. He shows that if all the auxiliaries on the "Alabama" were operated electrically there would be an increase of from 150 to 250 tons in the total weight of machinery. The increased space required in the generating rooms would accommodate 900 tons of coal or 3,600 horse power could be added to the propelling engines. Evidently the electric auxiliary is extravagant in weight.

MASSES SMALLER THAN ATOMS.

At the recent meeting of the British Association Prof. J. J. Thomson, F.R.S., gave an interesting account of recent researches on the existence of masses smaller than atoms (Phar. Jour.) He showed that several lines of investigation led to a determination of the ratio of the mass of an atom to the electric charge conveyed by it—namely, ordinary electrolysis; experiments on the velocity of charged particles, and experiments on the velocity of cathode discharges. These experiments indicated that the charge carried by an atom in cathode discharges and similar phenomena is apparently 1,000 times greater than in ordinary electrolysis, consequently either the atoms become dissociated and only a portion of their mass carries the negative charges of cathode rays, or else the atom can receive a greater charge than is assigned to it in explaining electrolytic phenomena. To discriminate between these two assumptions a method was employed to determine separately the charge carried by a known number of atoms in a case for which the charge per unit mass had the greater value. The method used was described as follows:

A flat metal plate, negatively electrified, is brought near to a very large perforated metal plate through which ultra-violet radiation can pass, the whole apparatus being inclosed in gas at a pressure of about $\frac{1}{100}$ millimeter of mercury. The radiation causes a discharge of electrified particles, from the negative plate, which move in parallel straight lines to the perforated plate which receives their charge. If now a magnetic field be set up between the plates, its direction being parallel to the plane of the plates, the paths of the particles become curved; in fact, cycloids, and the particles may not reach the perforated plate if the latter is far enough away from the negative plate. There will, therefore, be a diminution in the rate of discharge, which is the phenomenon actually observed; its amount corresponds with theory if the large value of the charge per unit mass is assumed. The charge conveyed per second is the product of three quantities—the number of "atoms," the charge on each, and the average velocity of the atoms. The charge conveyed per second may be observed and the average velocity determined by a method devised by Prof. Rutherford. If the number of atoms be determined, the charge on each may be immediately found. These electrified atoms behave as nuclei on which water drops will condense when a cloud forms in the air; it is only necessary, therefore, to know the total amount of vapor condensed and the size of each drop in order to determine the number of drops, which is the same as the number of atoms. The amount of vapor condensed is obtained by suddenly and definitely expanding air of known humidity from a given higher to a given lower pressure, and the size of the nuclei is obtained from the rate of their fall, since, like raindrops, they can only attain a definite velocity.

To ascertain if the mass is collected at a point or diffused through space, the mass is allowed to impinge against a surface which is transparent to the energy carried—such as Roentgen radiation or cathode rays—but which does not allow material of infinite size to pass through it. In all the experiments the atoms possessed, negative charges; when positive charges are carried, the results of experiments agree with those on electrolysis. The amount of charge carried by an atom depends on the gas and the nature of the electrodes. From this it would appear that electrification seems to consist in the removal from an atom of a small corpuscle, the latter consisting of a very small portion of the mass with a negative charge, while the remainder of the atom possesses a positive charge.

INTERESTING EXPERIMENTS WITH PHOTOGRAPHIC PLATES.

Mr. W. J. Russell has presented to the Royal Society of London a series of researches which he has recently made as to the action of certain substances upon the photographic plate. It has been found that a polished metallic surface, such as magnesium, zinc, etc., or in other cases a layer of oil or similar substance, is capable of producing at a distance an effect upon the sensitive plate similar to that caused by the action of light. A certain number of hypotheses have been advanced to account for this action, among others that of phosphorescence or the emission of actinic rays by the substances in question. Mr. Russell, after having made a number of interesting experiments, concludes that this action is due to the formation of hydroxyl, and finds that by its use all the effects produced by these different substances may be equally observed. In order to observe this action upon the photographic plate, the experiment may be made very easily in the following manner. Into a small glass basin or watch-glass are placed a few drops of the liquid to be examined, and the glass is covered with the photographic plate. In the case of pure water, no action is observed at the end of twenty hours, but upon the addition of a very small quantity of hydroxyl, the plate is immediately affected, as will be shown upon developing it in the ordinary manner. This action is extremely delicate, as 1 part of hydroxyl in 1,000,000 parts of water is sufficient to produce a slight effect upon the plate at the end of eighteen hours. If a piece of blotting paper is wet with a solution of 1 : 500,000, dried and placed for two hours in contact with the photographic plate, a distinct image appears upon development.

The experiments carried out by Mr. Russell seem to indicate the conclusion that the action of different metals, etc., upon the plate is due to the formation of a minute quantity of hydroxyl, which is sufficient to cause the action. The metals which are found to be the most active are, in their order, magnesium, cadmium, zinc, nickel, aluminum, etc. It may be supposed that these metals are capable of decomposing water or water vapor and cause, in the presence of oxygen, the formation of hydroxyl. Their order of activity is exactly that in which this formation would take place, as can be proved by their action upon the test paper of Dr. Wurster. These papers, when moistened and placed in contact with the first metal of the series, take a dark blue color, which is absent in the case of the non-active metals. According to this supposition, the action upon the plate should be more strongly marked in the presence of water vapor. This may be verified by the following experiment. A glass tube containing zinc turnings is traversed by a current of air which passes into a dark box containing the plate. With ordinary air the action is feeble, but with air containing a large proportion of water vapor it is strongly marked. Without the presence of the metal no action whatever is observed. In the case of organic bodies which produce the same effect upon the plate, these are found to belong for the most part to the class of terpenes, and it is well known that these substances in oxidizing give rise to the formation of hydroxyl. Another interesting point observed by Mr. Russell is that the action takes place through certain membranes, such as gelatin, celluloid, etc., but that glass or mica cuts off the action. In considering this effect, the supposition that it is caused by the diffusion of the hydroxyl through these substances is impossible; there is probably a kind of solution or combination with the membrane or one of its constituents, which permits the hydroxyl to find its way to the outer surface. The following experiment throws some light upon this action. A solution of hydroxyl, 2 per cent, is placed in a glass basin; this is covered with a sheet of gelatin ¼ millimeter thick. The sensitive plate is placed over the gelatin and left for twenty minutes; at the end of this time no action is observed. A fresh plate is then substituted and again left for the same time, when a feeble impression is obtained. A third and a fourth plate show an increase of action, but in the case of all subsequent plates the action remains stationary. It thus appears that the quantity of hydroxyl emitted by the upper surface of the gelatin increases during one hour and twenty minutes, but after that time it remains uniform. A similar effect may be obtained by using a plate of zinc or a layer of some of the essented oils. It may then be asked by what body is the hydroxyl transmitted. It is probably by means of the water contained in the membrane. This may be observed in the case of bristol board, etc. If one interposes a sheet of dry bristol board between the active substance and the plate, no action is observed, but upon moistening the bristol, a marked action takes place. Alcohol produces similar results. Thus it may be seen that the water or alcohol serves as a vehicle for the hydroxyl in some of the membranes. In the case of celluloid, the action of water cannot be assumed. In this case it seems that the role is filled by the camphor contained in the celluloid. Although camphor is quite inactive in itself, if it is placed for some time in a solution of hydroxyl or essential oil, it will cause an action upon the plate; if one interposes a thin piece of camphor between the solution of hydroxyl on the plate for sixty-six hours, an impression is obtained. It will be seen that the camphor, which is one of the principal constituents of celluloid, may thus absorb the hydroxyl and permit it to penetrate the membrane. In the case of gutta percha or caoutchouc membranes an analogous action is supposed, for although the chemical constitution of these bodies is not yet clear, it is known that they contain bodies nearly allied to camphor.

By means of these and similar experiments, Mr. Russell seems to have proved conclusively that this action of metals, etc., upon the photographic plate is due to the presence of hydroxyl. He proposes, in later researches, to elucidate the manner in which the sensitive plate is acted upon by the hydroxyl.

COLORING BROMIDE PRINTS.

A number of processes have already been given for the coloring of bromide prints. M. Henry has obtained very good results with the use of oil or water colors as well as for pastel in the following manner:

For oil colors, a hot solution of three per cent of good white gelatine is spread upon the surface of the print by means of a wide and fine sable brush. After drying, the layer thus formed will take oil colors readily, and one may proceed to color the print as desired. For water colors, the best results are obtained by the use of a solution of 120 grammes shellac in 240 c. c. alcohol. When completely dissolved, the solution is allowed to stand for twenty-four hours, and is diluted by taking 120 c. c. of the former and 120 c. c. alcohol. This is to be filtered before using. The solution is applied to the surface of the bromide print by means of an atomizer until it appears to be slightly wet. When the print is well dried, which takes from ten to fifteen minutes, water colors may be applied as desired. If in certain parts the print does not take the color sufficiently, the process of applying the solution is repeated in these places. The fixative varnish used for charcoal drawings, etc., may be used instead of the solution of shellac. The use of pastel is especially in favor for retouching or coloring bromide prints, but it is necessary that the paper should have sufficient grain in order that the pastel may be readily applied. M. Henry has found that this grain may be obtained by the use of powdered pumice stone in the following manner: A tuft of cotton is thoroughly impregnated with the powder, and, after having applied to the surface of the print a layer of the shellac solution above mentioned, the powder is applied by tapping lightly with the wad of cotton. The print should thus be covered with the powder before the solution is dry; in this way the powder attaches itself, and is fixed during the drying of the solution, leaving below a clear image. If necessary, the operation may be repeated until the desired grain is produced.

PRODUCTION OF HYDROGEN WITH THE AID OF MAGNESIUM.

M. Lemoine, in a communication recently presented to the Académie des Sciences, has observed the introduction of magnesium into solutions of its salts, such as chlorides, sulphates, etc., gives rise to an active disengagement of hydrogen. This action is strongly marked when powdered magnesium is used with concentrated solutions of these salts. It is well known that magnesium has the property of decomposing water, even at a low temperature, but this action takes place very slowly. The presence of its salts in solution accelerates the disengagement of hydrogen in a marked degree, the gas being given off rapidly with the formation principally of hydrated oxide. The action ceases after a time, and no more gas is given off; this, however, is simply due to the fact that a layer of the hydrated oxide is formed upon the metal, which acts as a protecting covering. If the metal is taken out and cleaned, and the solution filtered, the action goes on as before. M. Lemoine considers that this action has for its point of departure a partial decomposition, to a slight degree, of the saline solution into free magnesia and free acid, which causes the metal introduced to be attacked. In the case of a solution of magnesium chloride, he supposes that an oxychloride is at first formed, which remains in solution, but is soon decomposed with a precipitate of magnesia upon the metal. The magnesium chloride thus formed acts in its turn as before, and thus the action is continuous. It has been found that zinc and cobalt used with concentrated solutions of their chlorides give negative results.