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NEW YORK, SATURDAY, MAY 9, 1903.

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.

## FILTRATION PLANTS AND TYPHOID FEVER.

Once more the vital question of the filtration of city water supply as a preventive of typhoid fever has been brought forcibly to public attention by the ravages of typhoid epidemics in widely-separated districts. The most serious of these outbreaks, and the most pitiful in its results, is that which occurred recently at Ithaca, where the dreaded disease cut a wide swath among the students of Cornell University. The experience gained by those cities in America which within the past few years have installed filtration plants through which the whole of the city's drinking water is passed before it is turned into the city mains, has given the strongest kind of proof that the reports of the wonderful efficacy of such plants, which have reached us from time to time from European cities that have already made the experiment, are not in the least exaggerated. Prof. Siebert of this city, a leading authority upon the subject on both sides of the Atlantic, in a recent work upon the relation of typhoid to water filtration, gives statistics to prove that for the decade previous to the installation of filtration plants in certain of the larger European cities, the death rate from typhoid epidemics reached the high percentage of one in every 2,600 inhabitants; whereas in the six years immediately succeeding the use of filtered water in these cities, the death rate fell to 1 in every 11,000 inhabitants. The SCIENTIFIC AMERICAN always has been a most earnest advocate of the filtration system, and from time to time we have illustrated various plants that have been installed in American cities, notably these at Albany and Philadelphia. Although it is not claimed that filtration gives absolute immunity, this only being possible where the water is boiled, this dread disease can be so far controlled by this means that the possibility of an epidemic in a city so protected is extremely remote.

## HIGH SPEED ON AMERICAN RAILROADS.

Although it cannot be disputed that the French railways hold the first place in respect of the number and speed of fast expresses that run over their principal lines—a distinction held up to a few years ago by Great Britain—there are some roads in this country which are running trains, that on certain stretches accomplish speeds that are equal to anything that is made on European roads. The most notable trains are those which are run from Camden to Atlantic City, where a train recently covered a distance of 59 miles in 44 minutes, which is a rate of 80½ miles per hour. These Atlantic City trains fully deserve all the credit for fast running which is given them, although it must be borne in mind that the conditions are particularly favorable to high speed, the line being straight and level, the engines of great power, and the trains, considering the weight of the engines, comparatively light. There is another service of fast express trains in this country which scarcely receives the credit that is due to it. We refer to the remarkable hourly service over the Reading route between Jersey City and Philadelphia, in which seven trains are started on the hour from each city, and make the run of 90½ miles in a couple of hours, many of the trains having to make several station stops in entering and leaving each city, when called upon to do so by signal. In a recent run from Philadelphia, in which six intermediate stops were made, we timed the mile posts by stop-watch, and found that several of the miles were run in from 45 to 48 seconds, the timing being taken at every post between mile posts 53 and 32. The average for this distance was 72 miles per hour, while the distance from mile post 46 to mile post 35 was run at the rate of a fraction over 76 miles per hour. Our readers may also remember the trip taken by the editor of this journal on the Twentieth Century Limited, when a 352-ton train was hauled from Albany

to Spuyten Duyvil, 131.7 miles, in 131 minutes, one stretch of ten miles being run at the speed of exactly 75 miles an hour.

## ACCELERATION TESTS ON THE GREAT EASTERN RAILWAY.

The powerful engine for suburban service on the Great Eastern Railway, England, which we illustrated in our issue of May 2, has undergone its trials successfully, and proved that it is capable of a rate of acceleration unprecedented for a steam locomotive. The engine was designed to start from rest with a suburban train of eighteen cars, fully loaded, weighing 350 American tons, and attain a speed of 30 miles per hour in 30 seconds, which is an acceleration of 1.46 feet per second. It will be remembered that the engine has only 3,010 square feet of heating surface for three 18½ x 24-inch high-pressure cylinders; and doubt was freely expressed as to whether this amount of heating surface would keep these cylinders supplied with steam in sufficient quantities for such a supreme effort. In the preliminary trials trouble was experienced with the priming of the boiler (a very natural result), but by modifying the steam supply to the cylinders, this trouble was remedied; and on a recent occasion, with a train of new cars weighing 377 American tons, and a new engine that had not worked down to its bearings, an acceleration of 1.40 feet per second was accomplished. It was, therefore, considered to be proved that the desired acceleration could be easily secured. The test was carried out by means of a series of evenly-spaced electrical contacts arranged alongside the rails, which were acted upon by a brush upon the engine, the time of contact being automatically registered in a cabin placed near the line. The results achieved are certainly very remarkable, and prove that the steam locomotive is certainly going to die hard before it is completely ousted by the electric motor from this class of service.

## RAPID DEVELOPMENT OF THE STEAM TURBINE.

In the development of what might be called the epoch-marking inventions of the day, it is noticeable that there has been in almost every case a point at which the invention, having clearly demonstrated its commercial value, entered suddenly upon a period of rapid and widespread development. Evidently we have reached such a point in the history of the steam turbine. The story of the determination of the principles of operation of the steam turbine, and of the embodiment of those principles in a practical and commercially-useful machine, will be forever identified with the names of De Laval and Parsons, the first-named having proved the usefulness of the steam turbine for work that required a small, high-speed motor of moderate power, while Parsons met and satisfied the demand for a prime mover of lower speed and great power. Of late years other inventors have produced more or less successful machines of the turbine type, and chief among these are the Rateau turbine in Europe and the Curtis machine in this country.

Because of the wide variety of uses to which it may be put, and the unprecedented power of some of the larger machines that have been built and put into very successful operation, the Parsons turbine is the best-known machine to-day, both in this country and in Europe. It was already well established and had made its great reputation abroad, when the rights for the United States were secured by the Westinghouse Company, and with the powerful influence and prestige of this concern behind it, the Parsons turbine is having a remarkable growth both in this country and abroad. A case in point is the contract recently given to the British Westinghouse Company by the Metropolitan District Company of London, for four huge turbo-alternators. Each of these machines is designed for a normal capacity of 5,500 kilowatts, but will be capable of carrying an overload of 50 per cent, thereby giving for each unit a maximum output of 8,250 kilowatts, or say about 11,000 horse power. As proving how early in its career the steam turbine has shown its ability to compete in size of individual units with the largest reciprocating engines, we may mention that these engines will be not only the largest turbines ever made, but also the most powerful single-cylinder engines of any type whatever in the world. Indeed, very few multiple-cylinder engines in existence have greater maximum power. As showing the wonderful compactness of this type of engine, it may be noted that in spite of their enormous power, the Metropolitan turbines are only 29 feet in length by 14 feet in width and 12 feet in height, while the length over all of the turbine and alternator complete is only 51 feet, 9 inches.

If there is a drawback that can be urged against the steam turbine, speaking of it broadly, it is the extremely high speed which is necessary, if the best results in economy are to be secured. In the De Laval type the speed is so great that for almost every class of work to which it is put, some form of reducing gear is

necessary; and the construction of a satisfactory gear for such work is rendered practical only by the comparatively small units in which the De Laval type is built. In the Parsons turbine, a more moderate speed of revolution is possible, but even here the speed is higher than is for many classes of work desirable; indeed, for marine propulsion the high speed of revolution has placed very arbitrary limits upon the type, size, and number of propellers that may be used. For this reason among others, great expectations are being placed upon the turbine that has been developed in this country, and is called by the name of its inventor, Mr. Curtis. This machine embodies some of the features both of the De Laval and the Parsons type. Like the former, the steam is fed to the moving blades by a series of steam nozzles, and like the Parsons type, the series of moving blades are arranged alternately with series of stationary blades, while it also embodies the compound and condensing features which have conducted so greatly to the success of the Parsons machine. An element that is greatly in its favor is the fact that the axis of the machine is arranged vertically, the turbine and its alternator, in turbo-electric plants, being arranged one above the other on a common vertical shaft. This results in considerable economy of engine foundation and floor space, and will prove to be a distinct feature in favor of this type in city power plants and in installations where floor space is limited and costly. Like the Parsons, the Curtis turbine has been taken in hand by a large electric manufacturing company in this country, the introduction and development of it being carried on by the General Electric Company at Schenectady. Already several large orders for this type are being executed.

The indications are that the steam turbine in its various forms will, before long, be in practically exclusive occupation of the electric lighting and electric power plant field. Regarding the range of its application in the merchant marine, it is less easy to prophesy. It seems to have proved its value as a motor for the propulsion of yachts, torpedo boats, and the smaller class of passenger steamships. Whether it will give equally good results in the slow freight steamer; and the large, high-powered, fast-steaming Atlantic liner, and in big battleships and cruisers, has yet to be proved. The immediate obstacle to overcome is that of reversing, which at present can only be done under limited power; but outside of this difficulty, we are aware of no fact developed in the course of the extensive trials of the steam turbine in the propulsion of ships which indicates that it will not give as good, and probably better results, in the larger as it has in the smaller class of vessels.

## NEW ELECTRICAL DISCOVERIES.

After maintaining that the numerous attempts made to show the existence of a back E. M. F. in electric arcs have all failed to give reliable results, W. Mitkiewicz, in a paper read before the Russian Physico-Chemical Society, goes on to examine more closely what happens immediately after breaking the circuit. In Blondel's experiments the current feeding the arc was broken periodically by means of a special rotating commutator. As the main circuit was broken, this commutator would immediately connect the circuit of a galvanometer with the electrodes of the arc, the time separating the breaking of the main circuit from the closing of the galvanometer circuit being about 1-600 second. As Blondel observed no back E. M. F. at all, the author tested the phenomena occurring during the interval of 1-600 second elapsing between the breaking of the circuit and the moment of observation, by investigating the curve of P. D. between the electrodes of an arc fed by an intermittent current of constant direction. This curve was found to be quite similar to that representing the E. M. F. at the terminals of a non-inductive resistance inserted in the circuit. As, however, no absolutely instantaneous break was obtained, the interval being about 0.0001 second, the author considers that his negative results afford no evidence of the non-existence of a back E. M. F. In accordance with Duddell's views, it is suggested that this force might be the difference of two thermic E. M. F.'s produced at the contacts of the incandescent gaseous medium with the ends of the electrodes, the higher E. M. F. corresponding to the hotter electrode. It is inferred that the slight difference of temperatures is compensated in an interval less than 0.0001 second, the E. M. F. of the thermo-element carbon-gas-carbon thus falling down to zero.

At a recent meeting of the German Physical Society, Mr. L. Zehner read an interesting note on what may be termed "reversible luminous effects." A distinct image of an object placed in the way of cathode rays being produced on a photographic plate, let ordinary light be allowed to act on the latter; the points previously acted on by cathode rays will, after development, appear more brightly than the surrounding portions of the plate, which recalls the so-called solarization phenomena. Cathode rays will

thus exert an effect opposed to the action of visible light, the points acted upon by the former becoming less sensible to subsequent exposure of luminous rays. These differences are clearly shown, when exposing celloidine paper to the action of either kind of rays; cathode rays, in fact, are found to produce a brown color, whereas a violet tint is observed in the case of ordinary light. If a strong brown color is produced on celloidine paper exposed to cathode rays, this colorization will gradually vanish, on subsequent action of light. Similar effects to those of cathode rays are observed when heating the paper before exposure to light, when the points colored by the influence of heat will become insensible to any action of luminous rays. The heating produced by cathode rays cannot, however, be alone responsible for the above phenomena, as the tint produced by heat will never pass away on being next exposed to light.

The author thus succeeds in reversing negative images into positives. By prolonged exposure, these images may be made wholly to disappear.

Becquerel rays will act in a manner quite analogous to that of luminous rays; canal rays behave in a way similar to cathode rays, as well as ultra-violet light. These phenomena are likely to afford a new means of investigating and analyzing these rays, which possibly might serve to elucidate their nature.

#### ABSTRACTS OF PAPERS PRESENTED AT THE NATIONAL ACADEMY OF SCIENCES.

BY MARCUS BENJAMIN, PH.D.

The annual stated session of the National Academy of Sciences was held in Washington from April 21 to 23, 1903, under the presidency of Dr. Alexander Agassiz.

At that session, which is the business session, the Academy devoted its time chiefly to the consideration of the award of medals, the reports of committees, appointment of new committees, the election of officers, and election of members.

The Draper medal which is awarded biennially for astronomical advances, was given to Prof. George E. Hale, of the Yerkes Observatory, Williams Bay, Wis., for his recent researches on solar and stellar spectroscopy. Dr. Hale is one of the youngest members of the Academy, but he has already achieved a high reputation for his brilliant researches in the domain of celestial physics.

At the request of Secretary Hay, of the Department of State, the Academy appointed a committee, consisting of Prof. Chandler, of Columbia University, Dr. Billings, of the New York Public Library, and Dr. Remsen, of Johns Hopkins University, to consider a method by means of which the original copy of the Declaration of Independence might be preserved. It will be recollected that in the early history of the Academy a similar committee was called upon to propose a method of restoring the ink, which had become faded. At that time it was suggested that an application of a solution of potassium ferrocyanide, if washed over the parchment, would produce a precipitate of prussian blue, and so preserve the written text of that precious document, but no action was taken. The parchment is now, however, showing signs of age, and it is very essential that some satisfactory means should be adopted to prevent its entire disintegration.

The papers, which were brief summaries of progress, and for the most part highly technical, were comparatively few in number.

The first presented before the Academy was by James M. Crafts, of the Massachusetts Institute of Technology, on The Law of Catalysis in Concentrated Solutions. It dealt chiefly with his experiments on the sulphonic acids, on which he has been experimenting for the last few years. George E. Hale, under the title of The Rumford Spectroheliograph of the Yerkes Observatory, described in detail the spectroheliograph recently constructed at the Yerkes Observatory for photographing the sun in monochromatic light, in conjunction with the forty-inch telescope. Photographs which have been taken with the spectroheliograph show a finely mottled structure covering the entire surface of the sun. In certain parts of the sun, and especially in the neighborhood of sun spots, there are extensive regions of very bright calcium vapor. The photographs taken with this instrument include those which represent the denser calcium vapor at low levels in the solar atmosphere, and others showing the less dense vapor at higher levels. A series of slides showing these photographs were thrown upon the screen. Prof. Lewis Boss, of the Dudley Observatory, Albany, contributed a valuable paper entitled The Determination of Standard Right-ascensions Free from the Personal Equation for Star-magnitude, in which, after referring to the fact that the personal equation of an astronomer's vision was of less moment than the differing degrees of brightness of the light in which the star was observed, showed a series of observations, from which he obtained as a factor 0.0077 of a second as the average constant error found.

A paper of special interest was Radio-activity of Thorium Minerals, by George F. Barker. At the

outset he gave a summary of the development of radio-activity, beginning with the work of Becquerel in 1896, after which he described the discovery of polonium by Madame Curie, and the subsequent discovery of the elements radium and actinium. The four principal sources of radio-activity are the new elements mentioned, together with thorium. The investigations in Europe had led to the presumption that thorium was only radio-active when found in connection with uranium. This, he demonstrated from his own experiments, was incorrect, and that all thorium minerals were more or less radio-active. In this country the minerals samarskite and monazite, both from North Carolina, are the principal sources for thorium. His researches further showed a definite relation between the atomic weight and proportion of radio-activity in these substances, the heaviest being the most radio-active. He showed impressions of thorium and uranium taken through sheets of brass, copper, lead, silver, and other metals. Another paper, by Prof. J. M. Crafts, was The Standardization of Thermometric Measurements, in which he argued in favor of further investigation of these measurements. His own experiments, made with different varieties of glass, convinced him of the superiority of Jena glass. The subject was one, he contended, which should be taken up by a bureau of standards, and he recommended that Regnault's experiments should be revised with modern facilities. Water, mercury, naphthalene, and benzol-phenol, he contended, were excellent solutions to work with. Dr. S. Weir Mitchell, whose experiments on the venom of snakes are famous, announced, under the title of The Discovery of an Antidote for Rattlesnake Poison, that a serum had recently been prepared in Philadelphia, which, when given to animals that had been inoculated with rattlesnake poison, seemed to counteract the effect of that venom.

Prof. Bell read a paper on his kite experiments, an abstract of which was published last week.

A biographical memoir of Matthew Carey Lea, the distinguished chemist, who was an accepted authority on the actinic values of silver, was read by Prof. G. F. Barker, and Dr. Theodore Gill presented a memoir of Dr. John E. Holbrook, of South Carolina, whose researches on herpetology and ichthyology made him famous.

Owing to the absence of Prof. Henry F. Osborn, the following papers by him, An Estimate of the Weight of the Skeleton in the Sauropoda, or in the Sauropodous Dinosaurs; New Characters of the Skulls of Carnivorous and Herbivorous Dinosaurs; and Models Illustrating the Evolution of the Amblypoda, also of the Dinosaur *Diplodocus*, together with a Theory as to the Habits of the Sauropoda, were read by title only. Also, The Diffusion of Vapor into Nucleated Air, by Carl Barus, and The Nomenclature of the Topography of the Bottom of the Oceans, by Alexander Agassiz, as well as Biographical Memoir of Clarence King, by S. F. Emmons, Biographical Memoir of A. A. Gould, by Jeffries Wyman, Biographical Memoir of James E. Keeler, by Charles S. Hastings, and Biographical Memoir of Theodore Lyman, by H. P. Bowditch, were presented by title only.

In addition to the foregoing, two papers were presented by non-members of the Academy. The first of these, On the Semi-diurnal Tide of the Northern Part of the Indian Ocean, by R. A. Harris, who was introduced by Dr. Cleveland Abbe, was accompanied by a chart of cotidal lines, and had for its purpose the showing of the times of the tide over the northern part of the Indian Ocean. There is no difficulty in drawing lines, chiefly arbitrary, however, to harmonize with all reliable observations, because the latter have been confined to shores and islands. But in the chart presented before the Academy, Mr. Harris had not only as his purpose the demonstration of the agreement with the observations, but also consistency with reasonable hypotheses respecting the origin and nature of the tide. In brief, the tides are ascribed primarily to seiche-like oscillations sustained by the disturbing forces of the moon and sun, the free period of the body approximately agreeing with the period of the forces. A binodal area extends from northwestern Australia to Somali and Arabia, and a uninodal area from Mozambique Channel to Baluchistan and India; the tides in the latter area are, however, influenced by the tides south of the channel. The cotidal lines are generally crowded together near the nodal lines, through straits, and in shallow arms of the sea, while they are generally spread apart at and near the loops of the oscillations. Similarly, the tides in the Red Sea and Persian Gulf were also shown. A second was on The Melting Point of a Simple Glass, by Arthur L. Day, who was introduced by G. F. Becker, and consisted of an exhaustive study of the phenomena attending the change of state of anhydrous tetraborate of soda (borax), from the vitreous solid, borax glass, to the viscous liquid form, and its solidification again. Dr. Day found that when undisturbed this change was practically continuous, and that no melting point or solidifying point in the ordinary sense, existed. A little disturbance at any temperature between 490 deg. C. and 740 deg. C. was sufficient to produce a stable anhy-

drous crystalline form (hitherto unknown), with a constant and characteristic melting point at 742 deg. C. Another important result of the investigation is expressed by the author as follows: "That the temperature to which a liquid rises after undercooling, is not necessarily constant or in any way related to the melting point, and therefore is not entitled to be regarded as a physical constant."

The Academy adjourned on Thursday, April 23, and the scientific session, which is held in the autumn, will be convened in Chicago on November 17.

#### SCIENCE NOTES.

The Geographical Society of Paris has conferred the La Roquette gold medal on Capt. Sverdrup, the Arctic explorer, for his explorations in 1898 and 1902.

A French professor, M. Gadot, proposes to make the barometric column a standard of length. The pressure of the atmosphere will sustain a column of water 10.33 meters high, or a column of quicksilver of 0.76 meter. A long series of observations of the barometer at a given place at known temperatures and at the level of the sea would give a height that could be taken as a "natural" standard. M. Gadot assumes as his unit one-tenth of the height of a barometric column of water, which is nearly a meter, and upon this unit he has constructed a system of weights and measures not without ingenuity.

Two French officers, Capt. Truffert and Naval Ensign L'Huard, have completed an exhaustive exploration of Lake Chad and its numerous islands, hitherto very imperfectly known. According to these two explorers, the lake is 185 miles in length by 89 miles in width. Curiously enough, it is on the whole extremely shallow, the deepest part being the western side, where the water is 25 feet in depth, while on the eastern shores it is only 5 feet in depth. The lake is interspersed with eighty islands divided into three groups—the first, void of vegetation; the second, covered only with grass and herbs, but used by the natives for pasturing cattle; and the third, inhabited islands, which are thickly and well forested, and contain extensive millet plantations. Altogether, some 50,000 people dwell on these islands. One of the most notable achievements of this expedition was the discovery of a hitherto unknown tree, the wood of which is lighter than cork. The explorers found navigation in small boats hazardous, since the water becomes agitated when the wind blows from certain quarters.

The London Zoological Gardens have secured an excellent specimen of the exceedingly rare black-crested monkey (*Semnopithecus melanolophus*) first described by Sir Stamford Raffles in 1821 in the Transactions of the London Linnean Society. This species, the "Simpai" of the Malays, is confined to the island of Sumatra. The color of the fur of this monkey is chestnut red, darker on the outside of the limbs than elsewhere. The under surface is whitish; the palms and soles are black. The long, slender fingers seem all the longer by contrast with the tiny thumb. The face is bluish black; a dark line runs from the eyes to the ears. The crest is prominent. On the tail is an orange tinge. The tail is nearly twice as long as the body, and shows indistinct traces of barring near the root. This kind of marking is rare in monkeys, though there is a striking example of it in the ring-tailed lemur (*Lemur catta*), the only one in which the tail is not uniformly colored. This specimen of the black-crested monkey is housed with a hoolock gibbon, and thus affords an opportunity of comparing the different modes of progression in the two animals. The black-crested monkey leaps, while the gibbon swings and lets go, the impetus thus obtained enabling it to cover a wider space.

Some interesting discoveries of the pre-Romanic era have been made by the various parties of explorers working in different parts of Italy for archaeological treasures. One party was stationed at Ancona, where the site of a burying ground which evidently belonged to the pre-Roman era was discovered. A female and male skeleton were disinterred, together with three bronze buckles, an amber necklace, some bronze chains, and a bronze waistbelt with pendants, a heavy bronze spear, sword, and iron dagger, and a large drinking cup. A third skeleton, also of a man, was found with a sword, dagger, knife, some small rings, probably belonging to a waistband, and some buckles lying near him. In Rome under the Quirinal, where the workmen are boring a large subway, several beautiful pieces of carved marble, two fine marble tablets, adorned with bas-reliefs, representing tragic and comic plays and bacchic dances, and several tablets bearing votive inscriptions to the gods have been unearthed. In the neighborhood of Segni the finest discovery was made by a workman of a tall bronze statue of a young man, his arms hanging down by his sides, and his hair parted in the middle and flowing down over the shoulders. There is little doubt that this work is a piece of original Etruscan art.