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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 ELECTRIC POWER DEVELOPMENTS AT NIAGARA FALLS.

The Niagara River, in its course from Lake Erie to Lake Ontario, falls a distance of 327 feet. A survey by the United States engineers who measured the flow of the river below the falls shows that it discharges 230,000 cubic feet of water per second from the one lake to the other. By a simple calculation it appears that in its descent of 27 miles from lake to lake, Niagara River develops the equivalent of about 9 million theoretical horse-power. If the whole of this 230,000 cubic feet of water and all of its 327-foot fall could be utilized in hydraulic-electric power plants, it must not be supposed that 9 million horse-power would be available for the various industries that might wish to use it. As a matter of fact only about 4½ million horse-power would be available, the other 50 per cent of the theoretical horse-power being consumed in overcoming the roughness of the river channel, friction in canals, sluices, penstocks, draft-tubes, etc., friction in the water turbines, and losses in the process of electric generation and distribution.

The fall of the river from the commencement of the cataracts, about three-quarters of a mile above the Falls, to the river below the Falls is about 210 feet, of which 50 feet occurs in the Rapids and 160 feet in the great Falls themselves. This is equivalent to 5 million theoretical horse-power, or say 2½ million horse-power available for industrial purposes. Between the head of the Whirlpool Rapids and the lower end of the Whirlpool there is another fall of 90 feet, and it is estimated that the 230,000 cubic feet of water per second, in its fall through this distance (most of which is included in the stupendous Whirlpool Rapids), has a theoretical capacity which if transformed into available power would represent about 1¼ million horse-power. The total energy developed by Niagara River in its course from just above the upper rapids to below the Whirlpool is equal to about 7½ million theoretical horse-power, or, if we allow for losses by friction, electrical generation, etc., it represents 3,750,000 horse-power that would be available for use in the industrial and for general power purposes.

At the present time, on both sides of the Niagara River, there are in operation or under construction electrical power plants whose combined horse-power is about 500,000. If we include the amount of power for which charter rights have been granted the total amount of power which will be developed at Niagara when the full limit of these charters has been reached will amount to over 900,000 horse-power. In the Scientific American Supplement of March 3, 1900, appeared a series of illustrated articles describing the development that had taken place at Niagara at that date. They included the 50,000-horse-power plant of the Niagara Power Company, and the 20,000-horse-power plant of the Niagara Falls Hydraulic Power and Manufacturing plant, which at that date were the only installations of any note. So successful was the first installation of the Niagara Falls Power Company, that a second power station of slightly larger size was commenced, raising the total power developed by that company to 105,000 horse-power. So quickly did these new ventures at Niagara establish their great commercial value that in the brief space of seven years the total development has increased on the New York side alone from 72,000 to 150,000 horse-power.

In the present issue we commence a series of articles on the present conditions at Niagara, in which the vast enterprises which are being carried through on the Canadian side of the river will be described and illustrated in full detail. The truly enormous scale on which the works have been planned is little understood, and it must come as a revelation to many of our readers.

It was inevitable the time should arrive when the public would be roused to protect Niagara Falls from the encroachments which were so rapidly being made upon it, and the fate of bills that were introduced at the last Legislature seeking further charter rights for the use of the Niagara water indicates that the public is well able to protect this splendid scenic feature from the absolute extinction which threatens to overtake it within the present generation.

THE CAUSE OF ACCIDENTS TO SUBMARINE BOATS.

In the course of an interesting lecture, recently delivered before the British Society of Naval Architects, relative to the subject of accidents to submarine boats, Capt. Bacon, the submarine expert to the British Admiralty, stated that, broadly speaking, submarine boats are liable to two classes of accidents—the admission of water into the interior, and explosion. Both have their counterpart in surface warships, namely, collision and boiler explosions or ammunition accidents. The confined spaces and small reserve of buoyancy of the submarine boat, however, intensify the danger to the crew. Water may enter a submarine boat through two causes—either through a hatch or through a leak, and in the case of such admissions protection can be exercised by the provision of watertight bulkheads. The most probable cause of water entering the boat is through a hatch, and in the four cases of foundering of submarines during the past few years the accidents have been attributable to this cause. The fact of the hatch being the primary source of weakness is very suggestive, and most reassuring as regards the safety of the boats; since, with the practical elimination of this source of danger, the main cause of accidents up to the present would be obviated. Of all the other possible causes of boats foundering from taking in water, it may be fairly claimed that the only one that was fairly possible was when the boat was injured by collision in the hull above the center line.

Only three causes of accident from explosion inside the boat are possible. To cause an explosion with gasoline, first a leakage is necessary, and secondly, a spark to ignite the mixture. A leakage, should it occur, can invariably be detected by the odor, but in a properly-designed system, leaks should be practically non-existent. Even with vapor in the boat no direct danger existed, provided the boat was properly ventilated and no switch was moved or anything done to cause a spark. As a matter of fact, in practise the smell of gasoline inside a boat was almost unknown.

In the accident to the British submarine boat "A5," where a gasoline explosion occurred, the cause of the leakage was a badly packed gland of the gasoline pump, the gland being screwed down metal to metal; but in spite of one man being overcome by the gasoline fumes the main motor was started, and the sparks determined the explosion. Had the very explicit and simple regulations provided been carried out, no accident would have occurred. The British boats have covered 30,000 miles under their engines and, with the exception of one small flash in an early boat, no explosion except that in "A5" has occurred. The second possible cause of an explosion is the hydrogen given off by the batteries in charging; but as this operation is only carried out when the boat is opened up for ventilation, no danger from this source should exist. The explosion which occurred recently in the British boat "A5," two hours after its foundering, was probably due to the formation of this gas. The third cause, namely, the failure of the air reservoirs, is but a mere possibility. It might, therefore, be assumed that danger to the boats from explosions is really small, and not greater in comparison than the dangers which attended the introduction of increased boiler and gun power in the navy as a whole.

AN EXCELLENT PRECEDENT.

If the attitude of the general public toward big corporations, and of these corporations to the general public, could be marked by the mutual consideration which has characterized the recent negotiations between the Merchants' Association and the New York Telephone Company, there is little doubt that the adjustment of rates and other debatable matters on a basis equitable to both parties concerned would, in many cases, be readily secured. How excellent are the results that have been obtained in the case in question may be judged from the fact that the New York Telephone Company has agreed to reduce its rates on direct lines from as much as twenty per cent for 600 messages to ten per cent for 4,500 messages. Under the new schedule, the old rate of $75 for 600 messages becomes $60, while for 2,400 messages the rate has been reduced from $165 to $135, and on 4,500 from $228 to $204. This gratifying reduction, which affects the boroughs of Manhattan and the Bronx, took effect some two months ago, and the credit for the reduction is due to the initiative of that most worthy body, the Merchants' Association, the list of whose successful agitations for the improvement of commercial and civic conditions of New York city is constantly growing.

It was in April, 1904, that the Merchants' Association took up with the New York Telephone Company the matter of telephone service and charges in this city, with a view to bringing about a reduction of rates in case it were found that the existing rates were excessive. The company offered to establish a new tariff if after a thorough investigation had been made it should be found that the company's profits exceeded ten per cent of the capital invested. Moreover they established a most notable and highly commendable precedent, by consenting to open their books and supply a committee of the Merchants' Association with all the necessary details of investment, gross earnings, operating expenses, and net earnings, as a preliminary to a readjustment of rates upon the agreed equitable basis, if such adjustment should be warranted by the facts disclosed by the investigation. The committee thereupon made provisions for an examination of the telephone company's accounts, and further examined personally and through experts into the financial and operating details of telephone management in this and such other cities as were germane to their purpose, with the result that the New York Telephone Company prepared and put into effect a new schedule of rates, some of the items of which we have given above, adjusted to the basis accepted by the special committee of the Merchants' Association as equitable.

The inquiry developed some interesting facts regarding the conditions of telephone service under varying conditions; and it was found that in all American cities having a population of over 50,000 there was a wide variation in the rates charged for telephone service. A close examination of the subject shows that a comparison of telephone rates in different cities fails to give correct deductions as to the reasonableness of rates in any given city. It was found that the outlay for labor, rent, taxes, real estate charges, etc., varies widely in the different cities of the world, those in America being much higher than those in Europe, and in America being much higher in large than in small cities. There are wide differences in the quality, range, and quantity of service rendered, particularly in the methods of charging for the service. There were differences also in the number of subscribers who take different grades of service. In 80 American cities having a population of over 50,000, the ratio of residence telephones to the total number of telephones varies from 15 per cent to 71 per cent; of party line telephones to total telephones from 4 to 84 per cent; of private branch exchange telephones to total telephones from 1 to 41 per cent, etc. There are also striking conditions peculiar to telephone business in large and small cities. In a small city a single central station suffices for prompt intercommunication between 2,000 or 3,000 users of individual stations. A single switchboard and single operator complete each connection called for, and the area served being comparatively small, the wire-mileage is relatively small. In large cities such simple conditions cannot, in the very nature of things, exist.

Ten years ago there were but 12,000 telephones in Manhattan and the Bronx. To-day there are more than 150,000. The system is by far the largest in existence, and is much larger than those of European cities of greater population. London, with a population of 6,580,000 in 1904, had 93,598 telephones, or 14.2 per 1,000 inhabitants. Paris, with 2,660,000 inhabitants, had 49,444 telephones, or 18.5 per 1,000 inhabitants. Berlin, with 1,931,000 inhabitants, had 66,744 telephones, or 34.5 per 1,000 inhabitants. But Manhattan and the Bronx, with 2,216,700 inhabitants, had the enormous number of 144,353 telephones, or 65.1 per 1,000 inhabitants.

A period of sixteen years was chosen by the Audit Company of New York for investigation, because it witnessed a complete conversion of the plant from an overhead single-wire system to an underground metallic circuit system, and again from the magneto-call local battery system to the automatic centralized battery system, as well as the great development of the system from some 12,000 to over 150,000 stations. Their investigation showed that the average percentage of net earnings to investment was as follows: For the fifteen years from January 1, 1889, to December 31, 1903, 10.89 per cent; for the sixteen years January 1, 1889, to December 31, 1904, 11.12 per cent, and for the year ended December 31, 1904, 14.54 per cent.

Of course no one supposes, nor does the New York Telephone Company claim, that this reduction is made on ground altruistic or Utopian, although the company is naturally solicitous for the good will of its vast number of patrons. As a matter of fact the reduction has been made in accordance with the well-understood economical law governing cases such as this, that a reduction in the price is, other things being equal, a sure means of securing a great extension of the service.

BLOOD CORPUSCLES ON MONT BLANC.

The red corpuscles of the blood have been counted by M. Raoul Bayeux during an ascension to Mt. Blanc, between Chamonix, Grands Mulets, and the summit. The samples were taken from the author and two other persons. After counting the globules at Chamonix, he made two determinations at Grands Mulets, the first shortly after arriving and the second the next day. At the Janssen Observatory, at the summit of Mt. Blanc, the globules were counted after passing the night. The author then mounted to Grands Mulets alone from Chamonix and made another determination. He thus studied the action of a long ascension, the action of a short stay at a high altitude, then the passage to a still higher station, then a second ascension near the first. The red globules, diluted in Marcano serum, were numbered by a globule counter of the Malassey type, with a portable Zeiss microscope. He makes the determinations upon a quantity varying from 4 to 7 million globules, and forms a table from which the deducts the following conclusions: The blood undergoes a rapid and considerable increase in the number of red globules when we pass from one altitude to a higher level. If we remain in the latter place the first number of globules is found to diminish slightly, but not to a great extent in a few hours. Descending to the starting point makes the number diminish to a greater degree, but it is still above what it was before the ascension. He finds that a second ascension, made before the number has fallen to the original value, causes a new increase which is greater than is remarked in the first ascension. A subject who is acclimated to a greater degree is less subject to a change in the number of globules. This is the first time that the corpuscles have been counted at the summit of Mt. Blanc, which, it will be remembered, is the highest point in Europe.

A PRIZE FOR A NON-POISONOUS DIAMOND CUTTER'S COMPOSITION.

Considering the fact that the setting and resetting of diamonds for cutting purposes involves the use of an alloy, consisting of tin and lead, the handling of which has been ascertained to produce injurious effects, i. e., lead-poisoning, the government of the Netherlands has decided to open a competition under the following conditions.

The government desires a medium for the setting and resetting of diamonds to be cut—which need not necessarily be an alloy—the use of which cannot produce effects detrimental to the health of those handling the same, or an elaborate project of altering the method now in use, in such a manner that no such injurious effects can be produced.

The following requirements have further to be fulfilled:

1. The medium or the method must be practicable for all sizes and shapes of diamonds in the following branches of the diamond industry, viz., brilliants, roses, and so-called *non-recoupés*, now being cut in the Netherlands.

2. The application must be such as to be learned by the workmen, adapted to the present method of work, without any great difficulty, while the setting and resetting must not require more time, or considerably more time than is usual now.

3. The application and use must not entail considerable pecuniary outlay.

The Minister of the Interior has appointed a committee of experts to consider the answers submitted, and to award the prize. The answers must be written in the Dutch, French, English, or German language, and must be accompanied by samples or objects to enable the committee to form an opinion of the practical value of the invention, and also by a legibly written address of the competitor.

The answers, and the samples or objects pertaining thereto, must be sent carriage paid, and if sent from foreign countries duty paid, before January 1, 1906, to Prof. Dr. L. Aronstein, chairman of the committee, Chemical Laboratory of the Polytechnic School, Delft, Holland.

The prize to be awarded for a complete solution of the problem is six thousand florins. The committee is empowered to divide the prize among different competitors, or to award the prize partially in case of a partial solution of the problem, for instance if it is applicable to one of the above named branches of the diamond industry. The committee is also empowered to prescribe certain conditions, to be fulfilled by the competitor, before awarding the prize.

For the use of those who desire to enter the competition, the manner in which the diamond workers come in contact with the poisonous metal while engaged in setting and polishing is here briefly explained.

The metal, or solder, used, is an alloy, consisting of two parts of lead and one part of tin; by heating the composition becomes kneadable before melting; by cooling it regains its former firmness. This plasticity is an important property of the solder, as will be seen hereafter.

Before the polishing of the split and cut stones is commenced, they are given to the setter, who places them in a "dope," consisting of a nearly semi-spherical brass pan, into which a tough, thick copper wire is screwed. Into this pan solder is put, so that not only the pan is filled, but that a conical eminence is formed also, which is kneaded into shape.

When the solder is rendered kneadable by means of a gas flame, the "dope" is placed on a wooden block, called "verstelblok" (setting block); the diamond is then pushed into the top of the conical eminence by means of a pointed pair of iron pincers, so that only the facet or facets to be polished remain exposed; the setter then fastens the stone and smoothes the still plastic solder into shape with his unprotected fingers. The "dope" is then cooled and handed to the polisher.

Considering that one setter works for four or five polishers, and that about two hundred "dopes" have to be daily manipulated for each polisher (when the stones are very small this number is considerably larger), it is evident that the setter's fingers are constantly polluted with lead-laden particles, which easily attach themselves to the skin, while he is, moreover, exposed to the lead-laden fumes arising from the heating of the solder.

The polishing process is as follows:

The polisher is seated before a bench, in the center of which a metal disk is horizontally placed; this disk revolves rapidly on its own axis (about 2,400 revolutions a minute). The polishing medium consists of a mixture of pulverized diamond and olive oil. The "dopes," wherein the diamonds are fastened, are held by their copper wires in tongs, to which a fixed position in relation to the bench can be given; by bending the copper wire more or less the diamond is placed against the disk in the proper angle and is firmly pressed against the same by loading the tongs with heavy weights, for which purpose iron blocks are successfully used in Holland since 1904, instead of the leaden blocks that were used before them.

The friction occasioned by the polishing process creates a great heat, so that the "dopes" have to be repeatedly cooled. The "dope," however, never gets so warm locally that the solder turns soft, because it conducts heat well.

If the diamond were set in the cement (a mixture of resin, shellac, and sand), used in the processes of cutting and splitting, the "dope" would conduct the heat badly, turn soft, and the diamond would be immersed.

The constant manipulation, the ceaseless turning and bending of the "dopes" in the tongs (four tongs at least are being used on each bench), and also the fact that the stone and the solder-cone are wiped with the bare hand every time the polisher wants to see whether the facet has attained the required shape and size, are so many reasons why the polishers' hands are constantly polluted with particles of solder.

The way in which diamonds are cut and polished is therefore not without danger to the health of the workers. The setters and polishers are constantly in touch with metallic lead, which exposes them to the peril of chronic lead-intoxication, when no adequate precautions are observed.

Instances are given in the medical literature, a. o. by Dr. Coronel in the Netherlands' Medical Review (1864). Hirt, who verified Coronel's statement in 1870, relates that of ninety setters he examined in Mr. Coster's factory, about thirty showed traces of lead-poisoning. (Dr. L. Hirt, Die Krankheiten der Arbeiter, vide vol. i., die Staubinhalations-Krankheiten, p. 102.)

Dr. Pel, professor of medicine at the Municipal University of Amsterdam, has described a remarkable case of lead-poisoning in a diamond setter in the Centralblatt für innere Medizin, year 1897, No. 23. Dr. A. Norden, of Amsterdam, medical adviser to the Amalagamated Society of Diamond Workers (who examines the majority of the members of that society applying for sick pay), has had a large and varied experience on the subject. He drew attention to this important matter in the journal of the said organization, issues of June 28 and July 5, 1901 (Nos. 26 and 27).

PHOTOGRAPHING THE SOLAR CORONA.

BY J. W. DAVIDSON.

"Can a photograph of the solar corona be obtained without having to wait for the occurrence of a total eclipse of the sun?" is a momentous question in the astronomical mind at this time, especially in view of the approaching total solar eclipse which is to occur August 30, and to which eclipse expeditions are being dispatched. A distinguished scientist says: "Such a feat would be an astronomical discovery of the first rank."

It is now announced that Dr. Hausky, of the Odessa Observatory, in Russia, has succeded in obtaining such pictures from the summit of Mont Blanc and no less an authority than the veteran French astronomer, M. Janssen, who has seen the negatives, seems to be convinced that the actual corona has been photographed.

Dr. Hausky employed particular colored screens, through which he allowed the sunlight to pass before the image fell on the photographic plate. The negative thus obtained showed a nearly uniform halo around the solar disk. From this negative he produced a series of positives and negatives alternately, and treating them in a special manner he was able to produce the form and different degrees of intensity of the corona itself. The same form was constantly produced in spite of the changes in the position of the screens. On several occasions the problem has been considered solved, but further investigation showed that the image obtained was not that of the actual corona, especially in 1885-87—when a number of attempts were made to solve this intricate astronomical problem and a great deal was written on the subject at that time.

Now comes the suggestion which is the most plausible cause of renewed interest in the scientific world, of a probable solution of the problem; so great have been the improvements in photographic processes and in making colored screens, that it seemed quite possible that the object would soon be obtained.

Before, however, the problem can be considered solved it will be well to wait until the most crucial test can be applied, namely, that of photographing the sun by this means before or after a total eclipse, and then comparing the results with a picture taken during the eclipse with an ordinary camera. The test is a simple one, and the approaching eclipse of August 30 will present an early opportunity for carrying it out. Fortunately, the track of totality passes over some high mountains in the northern part of Spain, so that a high altitude is available.

SCIENCE NOTES.

Thus far it has been difficult to throw any light upon cell-absorption and selection in many complex natural relationships by calling in the assistance of the dissociation theory and the ionic relationships of the salts in the soil. The external relationships of nutrient salts, or the relative abundance of these in substrata supporting vegetation, constitutes a problem with which the physiologist must be concerned. It is necessary only to glance at the results of work done by various experiment stations in this country to be convinced of the great physiological importance which may be attached to such studies.

If, as has been well demonstrated, the germ of typhoid fever is transmitted principally in water, there seems no reason to doubt the ability of health officers, collaborating with broad-minded municipal authority and high-class engineering skill, to perfect means whereby this deadly germ shall be practically eliminated from our water supply. Consumption may be checked by the establishment of camps of detention where the unfortunate victims of this terrible disease may receive not only the highest degree of proficiency in medical treatment, but also be so segregated from the non-infected portions of the community as to render the spread of the disease difficult.

In point of quantity and value corn is the leading cereal crop of the United States. Its annual farm value in later years has nearly equaled and sometimes exceeded $1,000,000,000. While less subject to insect damage than wheat, the next most important cereal, the corn product would be considerably greater were it not for important insect pests. The work of several of these is obscure, and many farmers are entirely ignorant of the existence even of some of the worst enemies of this crop. In this last category falls the work of the corn root worm (*Diabrotica longicornis*), which ordinarily passes unnoticed, or at least is often misunderstood. The larva of this insect feeds on the roots of young corn, and in regions of bad attack may cause an almost entire loss of the stand. The corn root worm, together with one or two allied species working in substantially the same way, causes an annual loss of at least 2 per cent of the crop, or some $20,000,000.

Acccording to the annual report of the Royal British Observatory at Greenwich during the year ending May 10, 1905, 15,842 observations of transits were made of the sun, moon, planets, and fundamental stars. Great progress has also been made in the observation of the reference stars connected with the Greenwich section of the astrographic catalogue. This section extends from 65 deg. north declination to the North Pole, and in carrying out the measurement of the photographic plates, the accurate positions of 10,000 reference stars are desired. Of each of these stars five observations are desired, making 50,000 observations in all, and of this number 9,500 have been obtained during the past year. There now remain only five stars requiring three observations each, and 1,500 requiring one observation each, to complete the work; 603 double stars have been measured, 143 of these having their components less than one second of arc apart. A large number of photographs of Neptune and its satellite and 100 photographs of comets have been obtained during the year. The measurement of the catalogue plates for the Greenwich section of the International Astrographic Survey has been completed.

The losses occasioned by insects to farm products exhibit a wide range in different years, due, as a rule, to favorable or unfavorable climatic conditions, and also to the abundance, from time to time, of natural enemies. The result is more or less periodicity in the occurrence of bad insect years. In other words, periods of unusual abundance of particular insect pests are, as a rule, followed by a number of years of comparative scarcity. Furthermore, seasons which may be favorable to one insect may prove unfavorable to others, hence there may be not only periodicity in the occurrence of the same insect, but more or less of a rotation of the different insect pests of particular crops.