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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,