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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.

DIVERSION OF NIAGARA RIVER.

Thanks to the initiative of the Merchants' Association of New York, acting in conjunction with the American Civic Association, it is likely that the preservation of Niagara Falls will be made a matter of joint international control. The President of the United States has expressed his great interest in the subject and favorable opinions have been obtained from former Attorney-General Griggs, Attorney-General Moody, and former Attorney-General Knox. The concurrence of these opinions leaves no doubt that the necessary action must take the form of a treaty between the United States and Great Britain, a point of view which seems to be shared by the authorities on the Canadian side of the border. Former Attorney-General Griggs expressed the opinion that whatever jurisdiction the State of New York has over the waters of the river and their use, is subject to the power of the national government, in two respects: First, with respect to navigation, as to which the laws of Congress are supreme; and second, as to the subject of boundary between this State and Canada, in respect to which the United States and Great Britain have the right by treaty stipulation to impose such conditions and regulations upon the use of the river and its waters as they deem mutually proper.

The ethics of this question of the preservation of Niagara Falls are very simple; for it resolves itself into a contest between the claims of a few people who see in the stored energies of the Falls a means of producing merchantable electric power more cheaply than it can be produced by an ordinary steam plant, and the interests of those unnumbered thousands the world over who, if they visit the Western Hemisphere, set down a visit to Niagara Falls as one of the indispensable features of their programme of travel. The widespread sympathy with the movement to protect this majestic and most beautiful spectacle of nature is a refreshing sign that mercenary and utilitarian considerations have not obtained the absolute sway, which the trend of recent events has seemed to suggest.

TWO IMPORTANT TUNNEL PROPOSALS.

Some of our more important railroads are considering the question of reducing the height of the summit elevations on the main line of their systems by the construction of lengthy tunnels. According to recent dispatches, the Pennsylvania Railroad Company is about to lower the summit of the Alleghany Mountain division by driving a great tunnel, which will be either 9 miles or 11 miles in length, according as one or other of two alternative surveys is adopted. On the eastern slope the road would enter the tunnel in the vicinity of the Horseshoe Curve; on the western slope the portal would be in the neighborhood of Crescent. At present, the enormously heavy traffic of this road has to be hauled over a summit which is 2,160 feet above mean sea level, and by the construction of the tunnel, this would be cut down probably to about 1,500 feet. The importance of the reduction is not shown by the mere statement of reduction of vertical height; for on the eastern slope the grade is particularly steep, and the portion of the summit line that would be eliminated has an average grade, we believe, of something like two per cent. Another road, which has an important tunnel under consideration, is the Lehigh Valley Railroad, which by a change in the location of its line, and the construction of seven miles of tunnel through the mountain range in which the Lehigh River has its source, will eliminate many miles of heavy grade and reduce its summit elevation by several hundred feet.

STEAM TURBINE ECONOMY.

Rooted prejudices die hard, even in a field of effort as barren of sentiment and so essentially practical as that of steam engineering. In proof of this, witness the belief, which even to-day is held by many engineers, that the steam turbine requires an extravagant amount of steam and increases the coal bill to an extent that more than neutralizes its other economies in space, weight, and labor. As far as our observation is a guide, the only conditions under which the steam turbine has failed to show a marked economy over the reciprocating engine are those in which the speed of revolution has to be cut down in order to accommodate certain speed conditions imposed by the nature of the work that is to be done. The one case in which this has occurred has been in the application of the steam turbine to ocean liners of the largest size, in which the design of the propeller governs the design of the turbine. The rather low (for a turbine) speed of revolution increases the size of the turbine to a point at which it does not as yet appear to be able to show the remarkable efficiency which has been achieved by the marine steam turbine in vessels of moderate dimensions. With this exception, the data of turbine performance which are at hand prove that it is markedly superior, compared on a basis of steam consumption, to the reciprocating engine, when both are doing similar duty. This is true of the steam turbine when used in stationary plants, irrespective of its size, and it is also true of the marine steam turbine until it comes to be built in sizes of 10,000 horse-power and over. In one of the largest central power stations recently erected in this city the turbines, which are of 7,500 horse-power capacity, were built under a guaranteed steam consumption, when using 175-pound dry saturated steam at the throttle, of 11.47 pounds of steam per horse-power hour. This may be compared with the guarantee given for reciprocating engines of the same capacity in another large power house in this city, which was 12.25 pounds per horse-power per hour.

A most significant proof of the strong confidence which marine engine builders have in the steam economy of the turbine, has lately been afforded in connection with the letting of a contract for an 18-knot mail steamer for the Roumania State Railway service. The specifications called for a 1,500-ton steamer driven by twin-screw engines of 7,000 indicated horse-power. The contract requirements were extremely severe, and heavy penalties were provided for. It was stipulated that with reciprocating engines the consumption should not exceed 1.454 pounds of coal per indicated horse-power per hour, which works out for the given horse-power and speed at 10,801 pounds per hour. Among the designs was one for a triple-screw vessel driven by Parsons steam turbines, for which the bidders guaranteed a coal consumption of 7,716 pounds per hour. Here, then, was a firm which was prepared to guarantee for its alternative design with turbines a fuel consumption less by 30 per cent than the maximum allowed by the railroad for reciprocating engines of the same horse-power.

THE SHIPPING BILL IN A NUTSHELL.

Since there appears to be some uncertainty as to the present status of the shipping bill framed by the President's Merchant Marine Commission, we give the following digest of this important measure. The provisions of the bill are as follows: First, the creation of a volunteer naval reserve of 10,000 officers and men of the merchant marine and fisheries, trained in gunnery, etc., subject to the call of the President in war, and receiving retainer bounties as 33,500 British naval reserve men do.

Second, subventions at the rate of $5 a gross ton a year to all cargo vessels in the foreign trade of the United States, and to craft of the deep-sea fisheries, and $6.50 a ton to vessels engaged in our Philippine commerce—the Philippine coastwise law being postponed till 1909. But these cargo vessels in order to receive subventions must be held at the disposal of the government in war, must convey the mails free of charge, be seaworthy and efficient, carry a certain proportion of Americans and naval reserve men in their crews, and make all ordinary repairs in the United States. Ships lose their subventions if they leave our trade for that of foreign countries, or if, like the Standard Oil craft, they are not engaged exclusively as common carriers.

Third, subventions to new mail lines from the Atlantic coast to Brazil, Argentina, and South Africa; from the South Atlantic coast to Cuba; from the Gulf coast to Cuba, Brazil, Mexico, Central America, and the Isthmus of Panama; from the Pacific coast *via* Hawaii to Japan, China, and the Philippines, and to Mexico, Central America and the Isthmus of Panama, and from the North Pacific coast direct to Japan, China, and the Philippines, with increased compensation to one existing contract line from the Pacific coast *via* Hawaii and Samoa to Australasia. All ships receiving subventions must be already American by register or American-built—thus excluding the foreign-built fleet of the Atlantic Steamship Combination. Not one dollar is given to fast passenger and mail lines to Europe. Ships constructed for foreign commerce to receive these subventions can under the Dingley tariff be built, equipped, and repaired of materials imported free of duty. The maximum annual cost of the proposed mail subventions will be about $3,000,000; of the other subventions and retainers to the naval reserve, from $1,550,000 in 1907 to $5,750,000 in 1916. If tonnage taxes are increased, as originally proposed, the legislation will cost nothing the first year, but turn $616,000 into the Treasury, and the annual average net cost for ten years, with the building of new ships, will be $4,625,000. Great Britain next year will pay $6,000,000 or $7,000,000 in shipping subsidies, France $8,000,000, Italy $3,000,000, and Japan about $4,000,000. This bill was passed by the Senate on February 14, and unless the friendly attitude of the individual members of the House should give place to a collective hostility, it is likely to become a law before the close of the present session.

IS LEAD A FORM OF RADIUM?

Radio-activity is a property intrinsic to the element, and, therefore, to the atom or smallest part of the element. The radio-elements possess the heaviest known atoms. If the lightest, hydrogen, is taken as unity, uranium is 238, thorium 232, and radium 225, while the next heaviest known are the inactive elements bismuth 208, and lead 207. The element helium is the second lightest known and its atomic weight is 4. Now, if the alpha-particle is an atom of helium, the expulsion of one alpha-particle from an atom of radium will reduce its atomic weight from about 225 to 221. This must, therefore, be a new atom and represent an unknown element, for the nearest known element has the atomic weight 208.

The chemical elements run in families. Radium, for example, is the missing "big brother" of the alkaline-earth family of elements, which consists of three elements, calcium 40, strontium 87, and barium 137, and chemically radium is an almost exact copy of its nearest relation, barium. Helium, in turn, is the lightest member of a family of gaseous elements, exactly similar in chemical nature. The family forms the well-known group discovered by the joint labors of Lord Rayleigh and Sir William Ramsay. The series runs, helium 4, neon 20, argon 40, krypton 82, and xenon 128. It happens that the heavy residue of the radium atom posessing an atomic weight of about 221, left behind after the expulsion of the light helium atom, turns out to be one of the missing big brothers of helium itself, being nearly twice as heavy as the heaviest (xenon) previously known. It is new, and a gas of the same chemical nature as the others, and is produced at a steady rate from radium, one atom for every alpha-particle expelled. It is, in fact, the radium emanation.

A quantity of radium, although it is sending forth its shower of alpha-particles continuously from year to year, does not grow appreciably less. The most sensitive balance has not yet succeeded in showing any change of weight. Hence it is obvious that although the actual number of alpha-particles and of new atoms of emanation may be, indeed must be, enormous, they only represent an unrecognizably small fraction of a minute amount of radium. The radium atom turns into a new atom, the atom of the emanation, by expelling an atom of helium. If the emanation expels another helium atom another new residue atom of weight 217 will be left. This is the solid form of matter which is deposited as a film from the emanation and is the cause of the phenomenon of the imparted activity. It is called by Rutherford *radium A*, and it also is recognized solely on account of the alpha-particles it expels. So the residue from radium A is another new atom of weight 213; it is called radium B. Rutherford, as the result of a series of observations elucidated with consummate skill, has recently arrived as far as radium F, in the analysis of the later slow changes of radium. But an alpha-particle is not expelled in each case; sometimes it is the beta-ray or electron only, as in the case of the change of radium E into radium F; sometimes no radiant particle is expelled at all, and we have a *rayless* change, as for example when radium B turns into radium C, but then the next change, that of radium C into radium D, makes up by expelling both alpha- and beta-particles. Reverting to radium F we find it also gives an alpha-particle and so must change into a radium G. Now radium F, the seventh successive product of the disintegration of radium, has been shown to be the polonium of Mme. Curie, found by her as a constant companion of radium in the uranium mineral pitchblende. Polonium gives alpha-rays, but no detectable other product. We have at length reached the apparent end of the process. Radium G does not expel either alpha- or beta-particles, and so we have only a theoretical reason for believing it to exist. We can, however, make a good guess as to what radium G is. Counting the total number of helium atoms expelled in the series, we find they amount to five, or a loss of the atomic weight of 20 units, which leaves a residue