by its use, has led to the development of a whole series of new and most valuable industries.

Thus, for instance, the smelting of the metal aluminum, which has risen from a few pounds in 1885 to 69,000 tons in 1913, with a fall in price of from $6.85 per pound in 1886 to about 18.63 cents in 1914.

It is unnecessary to more than refer in passing to the widespread employment of this metal at the present time. The Northern Aluminum Company at Shawinigan Falls has a capacity of 20,000 h.p. The metal zinc and certain kinds of iron are also smelted from its ores by the electric furnace.

Calcium carbide is formed by heating quick-lime and coke together at the temperature of the electric arc. This, when brought in contact with water, gives rise to acetylene gas, now so extensively used for lighting purposes. This industry was started in Ottawa, Ont., in 1895, with Mr. Wilson* as one of the pioneers. In 1913, 340,000 tons were made. It is manufactured in Canada at Ottawa, Thorold, and at Shawinigan Falls. The management of these three plants are now united under the name of The Canadian Carbide Company.

Nitrogen Products.—The principal sources of nitrogen for fertilizing purposes are manure, dried blood, wool wastes, sulphate of ammonia obtained in coking coal, nitrate of soda obtained from mines in South America, nitrate of lime and cyanamide. These two latter are produced by the electric furnace, and their manufacture is an interesting chemical operation.

The air consists of a mixture of nitrogen and oxygen. These, when passed together through any ordinary furnace, do not react on one another in the slightest degree, but when the air is submitted to the extremely high temperature of the high-voltage electric discharge, the nitrogen unites with the oxygen with the eventual production of nitric acid, which may be obtained as such or obtained in combination with lime or soda.

The world's consumption of nitrate of soda annually is about 2½ million tons. Norway last year exported 70,171 tons of nitrates. The United States imports it to the annual value of $21,000,000. Most of this comes from Chili but the Norwegian Nitrogen Co. have now in operation plants for the manufacture of nitrates requiring 180,000 h.p. and are undertaking the construction of others which will require a total of 540,000 h.p.

Calcium cyanamide is an artificial fertilizer containing nitrogen, carbon and calcium. This material, when buried in the ground, liberates ammonia and is hence a valuable fertilizer. It is obtained by passing a current of nitorgen over carbide of calcium when made red hot in the electric furnace. There is a plant for its manufacture at Niagara Falls on the Canadian side which has a capacity of 24,000 tons per annum.

There are other products of which mention might be made if space permitted, *viz.*, caustic soda and bleaching powder, carborundum, alundum, artificial graphite, etc.

The Use of Water Power Will Conserve Our Coal Supplies.—Water power is perhaps unique among the resources of a country in that it is not diminished by use nor conserved by non-use. By using it, however, the drain on the fuel supplies of a country are lessened. It can be shown that it takes five tons of coal to produce energy to the extent of one horse-power per year. So that every horse-power of energy which runs away unused in a waterfall in an inhabited country is equivalent to the depletion of coal resources of this country by five tons annually.

An example of this saving on a small scale is afforded by the Cobalt district. This district in 1909 imported 63,739 tons of coal between June and December. In 1910 during the same period it imported 17,349 tons of coal, this saving of 46,390 tons being effected by the introduction of electric power in that year and its introduction into all the mines.

Furthermore, while it is a good and economical steam plant which will utilize 10% of the energy of the fuel, the hydro-electric plant can make available as much as 70% of the energy of a waterfall. "It is, I believe, within reason to hope," said Prof. Herdt, of McGill University, in his recent address before the Royal Society of Canada, "that the use of coal for the production of power in our large cities will before long be almost entirely abandoned and that hydro-electric power, economically transmitted and distributed, will in time light every home and drive the machinery of every factory in the country."

Amount of Water Power Available in Canada.—As may be easily understood, the accurate determination of the amount of horse-power represented by the hundreds, or rather thousands, of waterfalls to be found in Canada is a task which involves so many facts and such extended observations that many years must elapse before a final result can be secured.

The height of each fall, the volume of water passing down it at every season of the year, the effect of ice in winter, the area of the catchment basin, the average rainfall of the district, and many other facts must be known, and can only be known accurately after observations extending over a long series of years. Such observations and measurements are now being made by the Commission of Conservation of Canada, by the Water Powers Branch of the Department of the Interior, and other bodies.

An address on the subject, given as far back as 1869 by the late T. C. Keefer, C.M.G., as president of the Royal Society of Canada, has attracted a good deal of attention. In it an attempt was made to show in a general way the extent of the water powers in the central portions of Canada. The problem was approached as follows:—

One of the most striking physiographic features of Central Canada is that great area of rocky country lying between St. Lawrence and Great Lakes on the south and the Arctic Sea on the north. This has an area of about two million square miles and an average elevation of about 1,500 feet above sea level. There are other elevated tracts in this portion of the Dominion, as, for instance, the highlands along the Notre Dame Mountains. Now, all the water falling on this area falls 1,500 feet on its way to the sea; consequently all the rivers draining it, in addition to courses of swift water, have along their course many waterfalls, some of them of great height. There are also innumerable lakes.

Mr. Keefer states that if we take the rainfall as 24 inches and assume half of this power as available, every ten square miles would yield on an average nearly one horse-power for every foot of fall. A million square miles would give 100,000 h.p. per foot of fall. Now, if there is a fall of 1,500 feet, there would be power to the amount of some 300,000,000 h.p.

Such estimates, however, are misleading, for they are far in excess of any figures which can be realized. Most of the falls are too small and will ever be too remote to be available. Many others would require the expenditure of too much capital to render the power available. Still others are frozen up for a considerable portion of the year; and so on.

*See *The Canadian Engineer* for July 29, 1915, page 212.