

NIAGARA FALLS POWER AND
AMERICAN INDUSTRIES

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(Reprinted from the Transactions of the American Electrochemical Society, Twenty-ninth
General Meeting, Washington, D. C., April 27-29, 1916)

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The Chemical Industries

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THE CHEMICAL INDUSTRIES

By A. H. HOOKER

It is interesting to note how a despised and perhaps, for the time, a harmful by-product, may develop into the chief product of an industry, and a shortage seriously affect the general comfort and economy of our lives.

Just now gasolene is an everyday example. In the time of the early coal-oil lamp, many dangers lurked in the poorly refined oil, and every effort was made to increase the yield of high-flash kerosene and remove for this reason gasolene from the oil. This gasolene was then little more than a waste product, to be disposed of when possible or thrown away and allowed to evaporate, or even to run into the rivers with the resulting danger of fire. Now all is changed, and the utmost effort of the chemist and engineer is called for to devise means of increasing the yield of this despised by-product at the expense of the higher boiling fractions in the crude oil. The Government takes part in the research to meet the situation, and even legislation is asked for to assist in regulating the supply and demand.

Chlorine produced in this country entirely by electrolytic processes and with Niagara Falls as the center of the industry, offers another example of an originally annoying by-product becoming a necessity.

It is no flight of fancy to say that our lives and the lives of our families in Niagara Falls, Buffalo and over one thousand other cities, depend on the use of either liquid chlorine or chlorine in the form of "bleaching powder" or hypochlorite for the sterilization of our water supplies to a point where epidemics of typhoid are avoided. Niagara Falls, now free from typhoid, was a plague spot, nothing less, until we improved our filter system and treated the water with hypochlorite or chlorine. Our own army is now using the same chlorine treatment to

avoid the dangers from typhoid, which beset our soldiers during the Spanish-American war. In Europe the best preventative of blood poisoning and infection from dirty wounds is reported to be a mixture prepared from "chloride of lime" or "bleaching powder." Without this same "bleaching powder," our mills and printing establishments turning out or using book paper and writing paper could not turn out their product; our cotton dresses and sheeting would no longer be white; our shirts and collars from the laundry would be a dirty yellow; and, what is worse, a serious menace to health would result through lack of disinfection. Also, white cotton batting, bleached shellac, chloroform for surgical operations, even the disinfection of our garbage and sinks, call for chlorine in the form of "Bleach." This same chlorine is used for the production of carbon tetrachloride, which in the form of "Pyrene" has become a household necessity as a fire extinguisher.

To meet the shortage in coal-tar dyes, by the combination of chlorine with coal-tar benzol and toluol, we are now beginning to produce in quantity those necessary "intermediates" formerly made in Germany, from which are made sulphur black, picric acid, benzoic acid, trinitrotoluol, benzaldehyde or "oil of bitter almonds," and dozens of other products of like nature for which we are beginning to feel such urgent need.

Side by side with the production of electrolytic chlorine, we have caustic soda and caustic potash, resulting from the same electrolysis of either sodium chloride or potassium chloride. Caustic soda and caustic potash are equally indispensable in our daily economy. The amount of soap used per capita is said to mark the state of civilization of a people. Without these alkalies we cannot make soap, and it is equally important for the production of mercerized cotton, refining of oils, the manufacture of dyes, explosives, pigments, and many chemicals and medicines, the cleaning of metals for electroplating, and in the small can of household lye with its dozens of uses.

At several of the plants at Niagara Falls, the electrolysis of chloride solutions takes place in the cells where the products are directly united to form chlorate of potash or chlorate of soda. Every match we strike, every primer for a rifle cartridge, contains chlorate. Also, it is a necessity for certain dyes and

colors, and we may even use it in our tooth wash or as a lozenge for a sore throat.

A reference to the by-product stage of chlorine is perhaps of interest. The great heavy chemical industry of England developed from the acid and soda plants using the Leblanc process for the manufacture of alkali. The principal product sought for was soda ash obtained by decomposing salt, and the chlorine, driven off in the form of hydrochloric acid, was produced, as the industry grew, far in excess of any demand. As a by-product this was allowed to escape from the chimney top, to the detriment of the surrounding vegetation, or it was run into the rivers where it destroyed the fish until the authorities called for some means of abating this nuisance. It was then that the hydrochloric acid was treated with manganese, and the free chlorine in turn absorbed by lime to form "bleach." As this chlorine was considered a valueless by-product, all that was considered necessary was to create a market which would perhaps pay for the lime, package and handling, and the early price for this by-product "bleach" was therefore very low. Gradually, however, a demand for the product was created, and a new industry, the bleaching of cotton and wood pulp, came into existence.

At this time, the Solvay process for the manufacture of soda ash was developed; a process which was able to produce soda ash and leave the chlorine in a harmless form as calcium chloride, and at the same time produce this soda ash at a much lower price than had been charged by the old Leblanc process. The old process had found a very satisfactory profit selling soda ash at \$60.00 per ton, and "chloride of lime" at perhaps \$12.00 per ton. When the Solvay people began to offer soda ash at \$30.00 to \$40.00 a ton, the Leblanc plants were unable to compete, and one after the other began to close down. To whatever extent this closing down took place, there developed a shortage of "bleaching powder" and muriatic acid, and in a very short time the price of bleaching powder was increased, owing to this demand and shortage, from \$12.00 a ton up to \$40.00 or \$50.00 a ton. The result was that the Leblanc plants were able to compete with the Solvay plants and reduce their price of soda ash accordingly, so long as they were able to obtain the higher prices for "bleaching powder" which now, of course, became their principal product and not a by-product,

and caustic soda a secondary product. Again the pendulum has swung and we have chlorine as the principal but limiting factor around which the electrolytic production of caustic and chlorine products is built.

Turning again to the electrolytic products of soda at Niagara, we find the production of metallic sodium taking an important place. This forms the basis for the manufacture of the sodium cyanide supply of the country, and without this many of our most important gold and silver mines would be compelled to shut down, to say nothing of the great plants dependent upon the use of cyanide in electroplating. This same sodium is the basis again for sodium peroxide, used by the analyst as a means of determining fuel values, and as a means of generating oxygen for laboratory use, or in hospitals and in submarines and mine rescue apparatus for preserving the breath of life. It is also used for the manufacture of hydrogen peroxide, used not only for bleaching purposes, but also entering so freely into our daily lives as a simple household disinfectant.

Another electrochemical industry which has its chief center in Niagara Falls is the production of phosphorus. While yellow phosphorus is no longer used in the manufacture of matches, the sesqui-sulphide is an essential ingredient in the "strike-anywhere" match, and amorphous phosphorus in the safety match. Whenever you strike a match (not made in Sweden) think of chlorates and phosphorus made by Niagara power, and contemplate the possibility of a general return to the use of the flint and steel of our grandfathers' time, should these industries be expatriated (to Norway for example) for cheap power, and an embargo like the present one exist. Phosphorus also finds an important and irreplaceable use in the metal industry as a deoxidizer and hardener in certain non-ferrous alloys, chiefly in the phosphorizing of copper for the manufacture of phosphor bronze used on battleships and for certain bearings on machines, automobiles and some chemical apparatus.

To sum up it will be seen that a large number of our most important manufactures and products of the utmost importance to the country are directly dependent upon the electrochemical industry at Niagara Falls. Among these we find the

paper mills, soap factories, gold mines, the manufacture of chloroform, disinfectants, matches, explosives and dyes, water purification, cotton finishing, oil purification, and a dozen other activities which would be seriously hampered or closed entirely without the chemicals electrolytically produced at Niagara.

Permanent chemical self-containedness and preparedness to keep pace with this country's growing needs and population calls of necessity for an increase in the production of these plants. This increase cannot take place without an increased power consumption. The needed power stands ready for development without injuring in the slightest degree the scenic beauty of the Falls. The skill, energy and ability to utilize this power for the needs of the country are at hand. Only a maudlin sentimentality, not based on fact, stands in the way of a greater development and infinite gain to the country.

We have already noted the fact that some of the coal-tar "intermediates" so much needed for the manufacture of dyes, explosives and medicinal preparations, are now being made at Niagara Falls. As a rule these products need nitrogen to complete the product—nitric acid or ammonia—and this can be obtained by the fixation of atmospheric nitrogen by means of cheap electric power. The same fixed nitrogen is of equal importance to the agricultural interests of the country. The art is well started, but still in its infancy, and a tremendous advantage to the entire country must ultimately accrue from the solution of the cheap fixation of nitrogen.

Let me close by repeating what I said in New York in February at a local section meeting:

"As this was written, I saw from my window the waters of the Niagara River flowing by with a capability of being developed into perhaps five million horsepower—the most uniform and constant water power in the world. I am very fond of the impressive beauty of its mighty Falls and the wonderful gorge and rapids below, and only as a last resort in the event of a national defense necessity would I do anything to injure that landscape. Such injury, however, is not necessary. As I study the daily moods of the Falls, I see the ebb and flow of water due to the direction and velocity of the wind on Lake Erie, making far greater differences in the volume of water passing over the brink of the Falls than is caused by

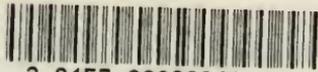
the present diversion of water producing some five hundred thousand horsepower. I also see that the beauty of the Falls is not at its best when the largest volume of water is passing over its brink. From careful study I am satisfied that well over one million horsepower more could be diverted, and not an iota of injury would be done to the scenic grandeur of the Cataract if a little engineering skill were used in placing the proper breaks and deflectors. If this is true, think of the tremendous increase in national efficiency and preparedness this development would mean! Arrange now with Canada for a development of water power at Niagara three times as great as at present—the time is ripe.

“For every one hundred thousand horsepower diverted, provide say ten thousand horsepower shall be devoted to the fixation of atmospheric nitrogen. The more varied the methods used the better. **Make Niagara the commercial research laboratory of the nation** in this field by supplying private enterprise with power at nominal cost for this purpose. Under these conditions, power, even if developed by private enterprise in large amounts, could in the above percentage be supplied as cheaply if need be as Norwegian power, and would be infinitely better adapted and centralized for the purpose. Such power would be within a night’s ride of Washington, New York or Chicago. Already located at Niagara Falls is the largest group of electrochemical workers in the world. Such a development would double their number.

“Is it through lack of foresight, or ‘a dog in the manger policy’ that some of our largest and most important electrochemical industries are even now compelled through lack of cheap power to go to Norway and other fields, there to start the training of a foreign army of electrochemical workers upon foreign soil, while unused water which could be utilized without injury goes to waste?

“I have been told that the Niagara River is a border stream; that plants situated near the border would be peculiarly open to foreign attack. Conceding that England be our enemy this is true. But did Germany give heed to an even stronger reason against making her experimental and peaceful development in Norway, where, as at Niagara, the economic conditions were right?

“Not in a day, a month, nor a year can these problems, alike of peace and war, be worked out, the equipment developed and installed, and above all the workers trained. The goal is an ever-increasing internal independence both as regards food and chemicals. For an increasing population, this may well mean the regeneration of a worn-out soil, the re-fertilization of our farm lands from New England to the West with ammonia and nitrates from the air.”



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