# The European War and Potash Supplies

## A Consideration of the Possible Sources of Material for Home Manufacture

By Thomas J. Keenan

In the closing years of the eighteenth century, when the French revolution was at its height, conditions in France as regards the supply of soda bore a curious resemblance to the situation in America to-day as regards our supply of potash, the political conditions being of course very different. France was wholly dependent on Spain for barilla, a variety of soda ash made by burning saltwort and sea plants, and also imported large quantities of Spanish potash. Commercial intercourse between France and Spain had ceased on the outbreak of the revolutionary war, and all the potash which France produced was required for the manufacture of saltpeter and gunpowder in this emergency. The National Convention made an appeal to the chemists of France to devise a process in which common salt might be made available as a source of soda. The call was heard by an obscure chemist, Nicolas Leblanc, who came forward with a process for the conversion of sodium chloride into sodium carbonate that has made his name an immortal one in the annals of chemistry. The Leblanc process has never been entirely superseded; indeed new plants are constantly being established, despite the superior advantages of the Solvay process for most purposes in the production of carbonates of soda.

Now that the supply of German potash for agriculture and industrial uses has been cut off completely by the European war, a situation has been created in the United States not very dissimilar to that which prevailed in France in revolutionary days, and fame and fortune await the American inventive genius who will arise to solve the great problem of producing potash economically and abundantly from the potash rocks, brines, and bitterns native to the United States. Leblanc achieved fame, but died a pauper.

The primitive product of the lixiviation of wood ashes, known for centuries as potash, is not an article with which twentieth century chemists can lay claim to much, if any, familiarity. The article supplied in sticks—potassium hydroxide—is what is recognized as potash in the laboratory. Our forefathers knew the wood ash product better, and there are doubtless many now living who can recall early days on the farm when potash was collected for domestic soapmaking by the simple process of leaching the ashes of burnt hickory or other logs. A century or more ago, however, when vast natural forests existed and the value of lumber was little more than that of the labor of felling it, the manufacture of potash from wood ashes was an industry of considerable importance.

Although potash is still manufactured from the ashes of wood in the forests of Northern Michigan and in portions of the provinces of Canada, the quantity so produced is negligible and finds use in a local way only.

The German potash industry dates from 1861, when the first factory for refining crude potash was established by Prof. Adolph Frank at Stassfurt. Stassfurt has been known for its salt industry for more than 500 years, the records of the town showing that a guild of saltmakers had worked the salt beds of the district as far back as the thirteenth century. At the time the deposits were taken over by the Prussian government in 1798, and some time later worked on a commercial scale, the potash was treated as a useless by-product, but the researches of Justus von Liebig in agricultural chemistry in 1860, having established the fact that plants depend for their nutrition on the existence in the soil of nitrogen, potassium, and phosphorus in certain definite proportions, and that it was useless to feed a plant on nitrogen and phosphorus unless the right proportion of potash was also supplied, intensive inventive work was begun to discover sources of soluble potash. Liebig's discovery had the effect of directing efforts to the extraction of the potash from the salt beds at Stassfurt as a main product, and this was successfully accomplished after the establishment of the factory by Frank. The potash salts were henceforth worked exclusively and salt became the by-product. In this way was developed the great German potash industry on which the whole world is now dependent for its supply of soluble potash for use in agriculture and the industries.

At the outbreak of the war Germany was exporting annually to the United States 1,115,505 tons of potash for use as fertilizer and in the manufacture of chemicals, this representing about one tenth of the annual output of the German mines, which exceeds eleven million tons.

The German potash minerals are now mined over a large extent of country, and it is no longer accurate to speak of them as "Stassfurt deposits." Reaching to a depth, from the top of the upper to the bottom of the lowest stratum, of some 5,000 feet, the beds underlie a tract of country extending from Stassfurt to Thuringia on the south, to Hanover on the west and to Mecklenburg on the north; while deposits were discovered and mines opened a few years ago in Alsace near Mülhausen, where the German troops are now repelling a French invasion.

Notwithstanding the apparently inexhaustible extent of the German salt deposits they are really insignificant compared with the abundance and variety of potash rocks (feldspar, etc.), which occur everywhere in the earth's crust. It is their solubility in water and consequent ready amenability to chemical treatment which gives the German salts their great industrial importance, and makes it appear altogether impossible for any other known sources of potash-containing minerals to compete successfully with them. Deposits similar to the German have lately been discovered in Spain, and, if they prove to be as soluble and as accessible, competition may be expected, but adequate reports on this source of supply are not available at the present time.

Although German potash is not contraband of war and none of the nations at war objects to its movement in neutral ships, it has not been possible to move it from the mines and storehouses to the coast on account of the monopolization of railroad and river traffic by the army and navy, so that not a ton of potash has been shipped to the United States since hostilities started last August.

Potash has a wide and necessitous use in many fields of industry besides pharmacy—in agriculture, glass manufacture, and soapmaking, to mention some of the more important. The serious problem now confronting the country is to find substances that will yield water-soluble salts of potash in sufficient abundance to provide relief from the deprivation of the German supply and at the same time put our farmers and chemists in a position of economic independence for the future.

The mineral sources of potash include the salts and brines found in the lake basins of the arid West, notably in Utah, Nevada and California; the mineral alunite, a double sulphate of potassium and aluminium, lately found near Marysvale in Utah; and certain natural silicates or potash-bearing rocks, as feldspar, etc. Although a great deal has been published concerning potash mines and deposits in Nevada, no one out there appears to have ever heard of their being worked.

Kelp, or seaweed, contains a notable quantity of potash in combination with chlorine, and the stretch of giant algæ groves on the California coast are rich in potassium chloride, being estimated to contain up to 30 per cent of potash in the ash, and in some cases up to 2 per cent of iodine, which substance it is considered would largely pay the cost of production of the potash.

The most promising source among the lake beds of the West is Searles Lake in San Bernardino County, California. Borings show that the deposits in this lake bed consist of a mass of salts about 70 feet thick. These salts are made up of sodium chloride. The structure of the mass reveals a coarsely crystalline and honeycombed form, the spaces being filled with brine. Below a salt bed extending down for a distance of 23 feet, a brine is found which analyses about 4½ per cent of potassium chloride. A plant has been recently started for the extraction of the potash by a spraying and evaporating process. This is expected to have an output of 120 tons a day when working at full capacity, but the entire deposit, according to Government estimates, amounts to only 600,000 tons —less than a year's supply!

A promising source of potash as a by-product is the Portland cement industry. By replacing the clay ordinarily used in cement manufacture with finely ground orthoclase or potash feldspar, it would be possible to obtain as a by-product a quantity of potash equal to about one million tons a year. Any granite rock, gneiss, feldspar, or phonolite would do as a substitute for clay in this process. All that is necessary would be to grind the rock, mix it with limestone and heat the mass to a higher temperature than is ordinarily done in cement work, or say, 1,400 deg. Cent. The potassium is driven out by the lime, and converted into a carbonate, more or less mixed with impurities from the cement, but easily soluble and readily refined. The product obtained by this process is said to yield 65 per cent of $K_2O$.

Among the minor sources of potash that might be worked for industrial purposes, for the manufacture of pharmaceutical salts, etc., the waste liquors from the manufacture of beet sugar are worthy of note. Some 15,000 tons of potassium salts are obtained annually in Germany from this source alone, and as Prof. Lloyd has pointed out, the waste liquors of the French beet sugar industry were at one time a fairly good source of potash, large quantities of a crude carbonate obtained in this way being at one time imported by American chemical manufacturers. On the assumption that the molasses of the American beet sugar industry contain the same proportion of potassium that is present in the German and French sugar beets, there would seem to be an opportunity in this country for the exploitation of potash manufacture as a by-product of this industry. Beet molasses, or the residues left after the extraction of the sugar, contain the total potash salts of the root. This material is either charred directly, yielding *schlempkohle*, or it is desaccharized, or fermented and the final liquors (*vinasse* or *schlempe*) from these processes are evaporated to dryness and the residue calcined to a black porous mass which, after appropriate treatments, yields a product containing about 85 per cent $K_2CO_3$ and 8 per cent $Na_2CO_3$.

It has also been suggested that the waste liquors of the sugar industry in the South might be utilized as a source of potash, but it is not known how large a yield might be expected, or if the process of extraction could be operated so as to prove a commercial success.

An interesting source of potash is sheep's wool. In the internal economy of the sheep, the potash ingested by the animal as constituents of the roots, herbs, and grasses on which it feeds, is excreted mostly as sweat, one third of the weight of raw merino wool being said to consist of potassium compounds. No attempt has been made in American sheep-raising districts to save this potash, though in France as much as 1,125 tons of wool potash are produced annually by several wool-washing plants. Wool yields about 160 grammes to 190 grammes of potassium carbonate per kilo of combed wool, or from 16 to 19 per cent of potash. The raw wool is washed with cold water, whereby the potash soaps, with some of the neutral fat and cholestrol, are extracted. The solution is evaporated to dryness and calcined, giving a residue containing about 85 per cent $K_2CO_3$ the remainder being $Na_2CO_3$, together with $K_2SO_4$ and KCl.

Among plants the ashes of which are particularly rich in potash, sunflowers, tobacco, and fumitory may be mentioned. Potassium carbonate once went by the name of salt of wormwood, the ashes of this plant being largely used at one time for its production, just as it was called salt of tartar from the fact that cream of tartar was once employed as the source of a pure article. In a table published in Crooke's translation of Wagner's "Chemical Technology," the following figures are given of ash and potash yields of 1,000 parts of the woods named:

| Wood. | Ash. | Potash. |
|---|---|---|
| Pine | 3.40 | 0.45 |
| Beech | 5.80 | 1.27 |
| Ash | 12.20 | 0.74 |
| Oak | 13.50 | 1.50 |
| Elm | 25.50 | 3.90 |
| Willow | 28.00 | 2.85 |
| Vine | 34.0 | 5.50 |
| Dried ferns | 36.4 | 4.25 |
| Wormwood | 97.4 | 73.00 |
| Fumitory | 219.0 | 79.90 |

Familiarity with the extent of the available supply of potash in Germany, and the cost of production there, leads to the conclusion that it would be a hopeless undertaking to attempt competition with our present resources. If 150 of the mines now worked in Germany were to cease producing potash, enough would be available in the forty remaining mines to supply the world's requirements. It is said that the best grade of potash sold could be mined, refined and delivered at the port of New York for about $8 a ton and still clear a profit, if the authorities in control of the mines were compelled to do so by stress of competition. The price paid in cargo lots by American consumers of this grade of potash is from $33 to $35 a ton. The prices realized explain why the Kali Syndicate is able to expend a million dollars a year in advertising, one fourth of which is spent in propaganda work in the United States.