

The Potash Industry of Canada

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TORONTO, CANADA



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By E. B. BIGGAR, OF TORONTO, CANADA

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The chemist of to-day who thinks of the production of potash in terms of the output of Stassfurt will be surprised to learn that at the middle of the last century between two-thirds and three-fourths of the world's product of potash came from Canada. Regarding this product as a Canadian industry it will be equally surprising to learn that for many years the export of pot-ash and pearl-ash ranked next to lumber in the shipment of forest products to other countries. In the fifties the export of potash and pearl ash from Upper and Lower Canada for several years exceeded a million dollars in value per year and a million dollars was a big sum to the Canadians of those days. It was very important to the individual settler in the first half of the last century, because it was the one product of all his varied labors that could be depended on for ready money. It was paid for in cash whereas most of his other earnings and crops were traded for groceries, dry goods and implements. His wool went to the custom woolen mill and came back in cloth or in roll cards for the settler's wife to spin; the wheat went to the grist mill and came back largely as flour and feed, and butter and home-made cheese came back in other groceries but potash always came back in real money.

In many parts of the country the manufacture of pot and pearl ash became a specialized industry carried on all the year round. Men were employed in going through the settlements, collecting the ashes saved by the farmer who burnt his timber, not more for the sake of clearing the land than for the sake of the money obtained from the sale of ashes. Many farmers had their own pots and converted their wood into potash, while every new settlement established an "ashery" in which both pot and pearl ash would be made, from ashes hauled in from neighboring clearings. In 1851 there were 237 asheries in Upper and Lower Canada (Ontario and Quebec). In 1871 there were 519; but by 1891 these had dwindled

to 128 for the whole of Canada, and now the industry on this plan is almost extinct. However, during the last few years up to the outbreak of the war the exports of potash from Canada averaged about 500 barrels per year, valued at nearly \$25,000, or \$50 per barrel. While during the last century Canada was the world's chief producer of potash she has now become an importer, the imports before the war averaging about 250,000 pounds, valued at about \$9,000. During the first half of the last century Great Britain was the world's chief market for potash, and the pre-eminence of Canada in this industry is indicated by the fact that in 1831, for example, Great Britain imported potash and pearl ash to the amount of 228,757 cwt. of which 169,891 cwt. came from British America; 15,835 cwt. from the United States, and the balance from Russia and Poland.

Most of this output was exported direct to England, the shipments by the St. Lawrence often amounting to more than a million dollars a year. Considerable quantities went out from Upper Canada by way of Buffalo, and frequent schooner loads came down the Grand River every season for delivery here to New York and New England ports. Potash entered England free from Canada, but until free trade was adopted there was a duty on American potash of six shillings per cwt. The price in England in the thirties was about £1/5/6 for pearl ash, and £1/4/6 for potash.

A Canadian work of reference, published in 1863 and edited by Prof. Hind, the geologist, and T. C. Keefer, the well known civil engineer, described the process of manufacture in Canada as follows: "The produce of the forest of most importance next to lumber has always been pot and pearl ashes. Potashes are made from the crude ashes by dissolving the soluble portion of the ashes with water, evaporating to dryness and fusing at a red heat into a compact mass, which although gray on the outside is pink within. Pearl ash is made by calcining potashes upon a reverberatory hearth until the carbon and much of the sulphur are dissipated. Water is then added and a lye formed which, when evaporated to dryness yields the pearl ash of commerce. Canadian potashes contain on an average 60 per cent. of carbonate of potassa. Pearl ash contains generally about 50 per cent of caustic potassa."

In the fifties the cost of manufacturing was estimated at \$10 per barrel when the selling price in Montreal was \$40, and, therefore, the manufacture of potash was strongly urged as an industry whose

profits were certain and permanent. One advocate stated the case thus: "No one item of our available exports is of higher importance than potashes and pearl ashes. In a country where it is necessary that vast tracts of wild land should be cleared,—land covered with a heavy growth of timber, useless in the main for other purposes than the manufacture of ashes,—this needs only to be looked at to discover its utility."

To-day the forests of Ontario are worth for other industries twenty to thirty times the value of their potash and Canadian lumbermen will learn with vexation that in the tract referred to,—that is, the region lying between London and Detroit,—the timber spoken of as worthless for any use other than potash, comprised birch, beech, oak, pine, maple, elm, cherry, hickory, ironwood, black walnut and many other woods which are now rare and costly.

With the clearing of the forests of Eastern Canada the potash industry declined, and this decline was hastened by the opening of the great deposits of Stassfurt, Germany. But since the war has cut off the German supply, and since Great Britain, the United States, and Canada and the other British Dominions seem to have determined that they shall be self-dependent as to such products, the present problem is to discover new sources of potash and nitrates,—both essential in the field of agriculture, as well as in chemistry. While it is true that in Canada and the United States there has been throughout the last hundred years an enormous waste of material in almost every industry, and none of greater enormity than in wood, yet all that can now be saved of the remnants of our forests will never restore the potash industry on the old basis. It will be interesting to note that the Town of New Toronto is now installing under the supervision of its engineers, Messrs. James, London & Hertzberg, a system of incineration for the treatment of garbage, by which potash is recovered to the value of \$7 to \$10 per ton. Thirty of these were installed at the military camps in Ontario and I understand they have been adopted in the United States Army camps where a thousand are now in use. Such endeavors to utilize the waste of cities should be encouraged, but, at best, they can only yield a small fraction of the potash required.

There is still, however, a source of potash in the feldspar rocks of America, vaster than has ever been exploited from wood, and without doubt chemists will sooner or later solve the problem of profitably extracting it. There are millions of tons of feldspar rock

in Canada and in some sections the potash contents run from 10 to 14 per cent.

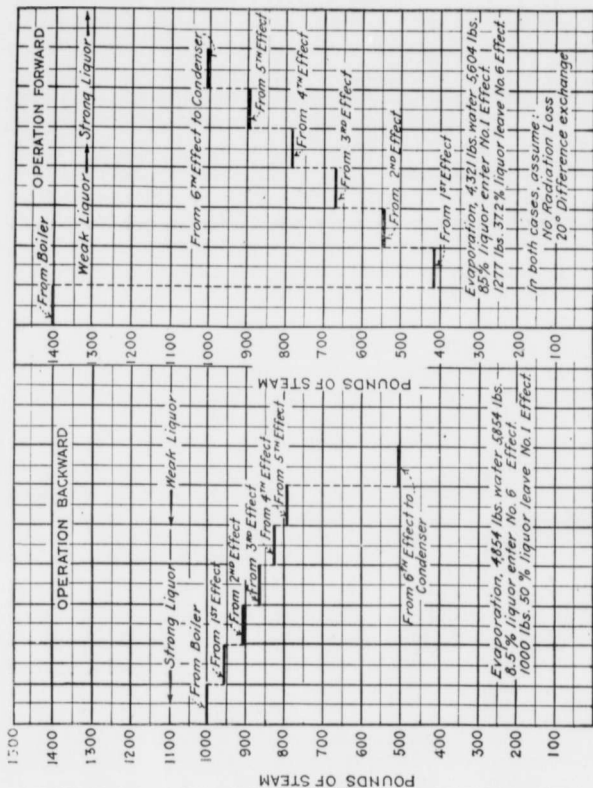
The cost of extracting the potash must be reduced by using other elements of the rock as by-products, and aluminium compounds, porcelain and Portland cement can do this in some districts. The making of potash as a by-product of the cement industry is now much talked of in Canada, but the claims made for the processes have not yet been demonstrated on a commercial scale; and, in any case, the output in this class is necessarily measured by the market obtainable for the cement.

Generally speaking, the areas of feldspar rock in the northern half of this continent yield a porcelain that is whiter and freer from iron, and for this reason large quantities of Canadian feldspar are shipped to the United States, ranging from 11,000 to 18,000 tons per year,—to be used in the pottery and porcelain industries, and for the manufacture of artificial teeth, etc., and there would seem to be room for further development of such industries and for aluminium in both countries in combination with potash production. When the nickel areas of Sudbury were opened up, the peculiar combinations of the ore presented a knotty problem to be worked out, but patience, skill and money solved every difficulty, with the result that to-day the Sudbury district now supplies 80 per cent of the nickel output of the world. There is every reason why all obstacles will be overcome likewise in the production of potash, and if so, the primacy in the manufacture of this most essential material will be restored to America.

DISCUSSION

Mr. HUGH K. MOORE: Mr. Chairman, I made a few notes on this and it seems that for many of the processes described cheap evaporation is one of the most important conditions necessary for the success of the processes. If you figure out the interest on the investment and the amount of yield in multiple effect evaporators,—it oftentimes does not pay to have over three effects, sometimes four effects, under rare circumstances five effects. The reason for this is that you start with a cold liquor and most of the input of the steam is used in the first effect in heating the liquor up to the boiling temperature. So in a calculation that I made on some evaporators once I figured that an input of steam on a multiple

effect system—I think it was ten effect—would be 33,000 pounds, but for the first effect you would only get 3,000 pounds of steam for an input of 33,000 pounds of steam, but as you go on from



effect to effect this liquor which has been heated gives up its heat generating steam, so that the greater part of the heat goes off through the condenser in the last effect. This inefficiency of the first effect

is what limits the number of effects which you can put into an evaporator. The increased efficiency does not compensate for the interest on investment.

When you deal with inorganic salts there is another method of evaporation by which practically there is no limit to the number of effects that you can use. You can get a reverse curve. In other words, instead of getting the maximum evaporation in the last effect and having all your heat going up through your condenser, you can get your maximum evaporation in the first effect with a slightly sliding line towards the last effect. In other words, in ordinary multiple effect evaporation you have a step up effect in the amount of steam liberated from each evaporator, but if you put your liquor into the last effect and pump it successively forward from one to another and put your steam into the first effect, then you flatten out this step effect curve and get nearly the same amount of evaporation in each effect. I do not believe there is any limit to the amount of effects you could use.

Of course, this kind of evaporation cannot be used on such things as cane sugar where you get invert sugar, because your final product comes off at very high temperatures; neither can it be used in glues or in any such things. But, based on experience of using sulphite liquors, we are already designing an evaporator of ten effects to concentrate digester liquor simply for its fuel value. Now, sulphite digester liquor contains about 6000 B.T.U. per lb. of solid matter. Figured on the price of Birdseye Mill at Berlin it would be only \$1.75 per ton. Nevertheless the figures based upon the work which we have done show that that liquor can be evaporated and burned for fuel with a possible yield of dividends after paying all expenses in fuel value of from 75% to 80% of the cost of the plant by running the operation backwards where it would be absolutely impossible and uneconomical to do it frontwards in the ordinary mill, so it seems to me that in this beet-sugar industry where you have only 4% and the salt is an inorganic salt which is not going to change, that the backward evaporation would solve that problem, especially where you have high fuel values, and the high price of potash. With the additional saving of the nitrogen content this could be accomplished in the above way and eliminate to a large degree the cost of evaporation. It might be worthy of consideration and considerable money might be spent in experimentation—in fact, we had already started on it when the Govern-

ment interfered with our work, taking our chemists for one thing and another.

What I am now going to say will seem at first as if one were trying to lift himself by his boot straps, but it is not so and is mathematically correct. For instance, the steam going to the condenser contains a very high per cent of the total heat which is put into the evaporator. Assuming under a vacuum that it contains 1100 B.T.U. most of which is latent heat, if you had electric power so that you could compress that steam, raising it to a high potential of temperature, you are only adding about 100 B.T.U. to it, but you are recovering 1000 B.T.U. plus the 100 B.T.U. which you have added in compression, and that steam can be put right into the first effect so that the only heat then that you lose is what you lose by radiation and what goes out in your drip liquor. Mathematically it is a sound proposition. Practically we do not know what difficulties are going to come up in the compression as we have not completed our experiments and do not know if we can get over the mechanical difficulties, but from what experiments we have made, it looks as if a large portion of this steam can be put into a positive blower and compressed say to somewhere near atmospheric pressure, and then putting it into a reciprocating pump and compressing it up so that you get your temperatures required in the first effect, then you get the whole latent heat of your evaporation into your first effect and could cut down your coal bills tremendously. As I say, we have not gone far enough to give any definite results on this, but I think it is a subject the possibilities of which chemical engineers do not realize, and if they will go into the mathematics of it they will see they are not trying perpetual motion. Of course, if you tried to compress that with steam you could not do it, because a steam engine would use up more than the heat which you would get by compression, but if you had electric power to furnish the power of compression then you get the most of the heat for your compression, and all the heat practically that goes out is in the drip, and in the final product which comes out in the last effect—which by the way is at a high temperature—but very small in amount, and what experiments we have made seem to show that this will in a short time be worked out on a practical basis.

There is another thing I wish to mention here, that is the action of the phosphide of soda on the silicates. Some years ago I was interested particularly in cheap production of ethane and

in making ethylene. I would use phosphoric acid at a temperature of about 250 degrees C. I found that it would eat right through glass or any of these things we used in the laboratory in the course of an hour. I even used fused quartz vessels and found phosphoric acid at this concentration would actually eat through these fused quartz vessels, but not so rapidly as in the compounds that contained potash and soda. The phosphoric acid, if you consider simply the potash from the fertilizer standard, can be made very, very cheaply. It is quite a problem in some mills to dispose of their chlorine. The chlorine can be made and you get muriatic acid from your electrolytic salts by combining the chlorine with the hydrogen. Your muriatic acid can be made cheaper than it can be made by using salt and sulphuric acid. Now if you treat ordinary phosphate rock with hydrochloric acid, you get a solution of calcium chloride and phosphoric acid which acts just the same as phosphoric acid, and this has a very marked action on the silicate rocks, but with the advantage that it has a selective action at the comparatively low temperature of 200 degrees C., dissolving out potash and soda, leaving to a large extent the silica, and this phosphoric acid is not a waste then because the phosphates are as necessary to the fertilizer industry as the potash, and the final product contains phosphate of potash. I think this is a line of investigation which might be attempted and which might prove very profitable.

Mr. GARLAND E. LEWIS: I do not happen to be a member of your Society, so that I will take up but just a moment of your time. I came all the way from Nebraska because I am interested in the subject of the morning and have enjoyed these papers very much, especially Mr. Meade's. I noted his explanation there of the occurrence of potash salts in the alkali lakes of Nebraska, and, by the way, this same opinion has been offered by the State Geologist of Nebraska; however, there is considerable difference of opinion on the point, and I think a proper investigation may prove the theory to be erroneous. The fact that those lakes or a part of them are strongly alkaline, particularly in potash, while lakes of a similar situation and evidently equally as susceptible to drainage from a burnt area have no appreciable potash content would seem to throw cold water on this theory. There have been no extensive borings whatever in the State to my knowledge. They have simply been utilizing the alkali potash water where it is found and it does not seem unreasonable at least to suppose that there may be an underground potash supply

from which these lakes are fed and which would account for the fact that a part of these lakes are very good paying lakes in potash content while lakes of a similarly favorable situation have no appreciable potash whatever. As I say, I think it is not unreasonable that borings and investigations in these regions may uncover an underground source of this potash supply.

There has been one other source which has not been mentioned this morning which I am interested in just now, and that is the alunite or the crude potassium aluminium sulphate of some of our western states, and I am going to spend the summer investigating one of those fields. The same problems, of course, present themselves up there as in some of the other sources here, namely, that we have the problem of getting rid of alum while the potash is probably more marketable. If we can find men of the East who are interested in the aluminium side or can utilize that side of the product I think it is not unlikely that the alunite deposits of some of our Western states may prove amply profitable as a source of potash.

Mr. LUDWIG A. THIELE: In considering all these papers of this morning, it seems to me, that while we have arrived at a certain production of potash in this country, it is not of such consequence as to warrant a great outlay for the future. These potash deposits are too low and the cost of production too high and by-products are not available. If you stop to think that the German potash industry obtains enormous amounts of by-products, such as bromine, chlorine, magnesium chloride and sulphate, their production is far in advance of the methods advocated right now. Really, my candid opinion is, that we should try to find better resources for potash in this country. If we would devote more of our time and money exploring this country, possibly by drilling in Arizona and the Western sections where we might be able to find rich deposits of potash salts, this would solve the proposition absolutely; but to find it out of cement mills, the beet sugar industry and so on, is a makeshift only for the present and cannot last.

Mr. WILLIAM M. BARR: In connection with Mr. Lewis' suggestion on the theory of a continuous underground supply of potash in the Nebraska fields, I may say that in connection with the study of water supply of the district west of the Mississippi River and particularly Nebraska, I have made a good many borings, both of deep and shallow wells, and I have never found anything that would lead me

to believe that such a theory would ever prove to be correct. The deposits there must certainly be more or less localized, as has been the prevailing opinion among chemists.

I was very much interested in Mr. Meade's description of the Cottrell process for the precipitation of the cement dust in the obtaining of potash and particularly in the use of feldspar at the Riverside plant. I would like to ask him in this connection if he considers that it would be possible to substitute a leucite bearing rock. My understanding is that the feldspars used run in the neighborhood of 8 to 10 per cent K_2O . We have leucite bearing rocks which carry at least 11 per cent and some of them higher, and I have been wondering if such a material might be substituted for feldspar with profit to the potash content and without detriment to the cement product.

Mr. R. K. MEADE: You can substitute almost any substance high in silica and alumina for at least a certain part of the clay element in cement. With the exception of the Lehigh Valley District in Pennsylvania, all of the cement in the country is made from limestone and either clay, blast furnace slag or shale. Any material can be substituted for the clay or shale which can be ground easily and that will give a mixture in which approximately the percentage of silica is about twice that of the iron and alumina together and in which the proportion of the iron is less than one-third of the alumina.

Mr. WILLIAM M. BARR: That is the question I had in mind, Mr. Meade, was whether the leucite rock should be used without reducing the aluminium content too far.

Mr. R. K. MEADE: I do not remember the exact composition of leucite but I believe it is quite high in alumina. As a matter of fact, a great many limestones used for the manufacture of cement are too high in silica, and in such cases I believe the cement could be materially improved by adding thereto some material high in alumina, so that I have no doubt that there are lots of places where leucite could be used to actual advantage.

Mr. WILLIAM M. BARR: Well then of course the commercial considerations would enter in.

Mr. R. K. MEADE: I think probably 50 per cent of the plants in the country could use some leucite to advantage to bring up the alumina in their cements.

Mr. MAXIMILIAN TOCH: Mr. Chairman, I would like to know whether anybody has any knowledge as to what England and

France have been doing with reference to potash since the beginning of the war. I would also like to know whether anybody has any definite knowledge other than perhaps hearsay as to the truth of the statement that Russia has been trading with Germany throughout the war, getting large quantities of potash in return for other materials. I have heard this several times, and the fact that the Russian wheat crops and other crops have not been a failure would point to the fact that they had been trading with each other in spite of the fact that they are at war. But it would be of interest to know how England and France have been getting along, and whether any progress has been made in the manufacture of potash in those two countries.

The last paper has been of great interest, but there is one point I have learned since the paper has been read with reference to the garbage incinerator that is being erected near Toronto. I understand that that incinerator is at a large military camp and I have asked, but the gentleman in question did not know, the exact facts as to whether the grease at this military camp is to be extracted from the garbage before it is to be burned. It looks to me as though in these days incinerating fresh garbage is almost criminal, because the garbage contains such a very large amount of grease. In the City of New York you are probably aware there are over 1200 tons per day of poor garbage collected. When I say "poor garbage" I mean nothing from the wealthier quarters or from the hotel districts is regarded as garbage. All the hotel garbage is sold for the feeding of pigs in and around Jersey, because it is very rich material, but the other garbage, amounting to a minimum of 1200 tons per day, is extracted first, the grease taken out, and the remainder is sold as a fertilizer base. Before the war this fertilizer base which is known commercially as tankage, was sold on its nitrogen and potash content. Now, of course, it is of very great value simply on account of its potash content, but it was very difficult to sell it before the war because it was so low in nitrogen. It may be of interest to the Institute to know that while I know practically little or nothing on this subject and very seldom take anything outside of my own line, I was consulted on this fertilizer base because they had a mountain of it which ran so low in nitrogen it could not be sold and it had to be removed and there was no way of adding any nitrate salt to it, because that would have made it entirely too expensive, so that the thought struck me—and six months time was given to this investi-

gation—of planting soya beans on this tankage, which would extract the nitrogen from the air and increase the nitrogen content. And it so happened. The nitrogen content went up to the required amount and the green soya bean growth was turned under at the proper time and this amount of fertilizer was sold.

Mr. H. O. CHUTE: Mr. President, Mr. Meade's paper has so well reviewed the subject of the potash manufacture that there is very little left for me to say on a subject that I thought might perhaps be of interest, and that is the manufacture of potash in the West. I may, however, supplement his remarks to some extent and mention some of the developments that he has not touched on.

The Hawaiian Islands have been intensively cultivated for sugar for a number of years, using a considerable quantity of fertilizer, including Stassfurt salts. The molasses produced from the cane contains from $1\frac{1}{2}$ to 2 per cent of potash as K_2O , and before the war some of the plantations had dumped the molasses into the irrigation water, which being spread on the fields, probably retained the nitrogen, and potash was probably absorbed by the natural zeolites and held there for a future crop. At the present time about 250 tons of molasses daily come from the Hawaiian Islands and are distilled for alcohol around San Francisco. The largest plant treating 150 tons of molasses daily is saving the potash. The molasses is fermented with a dilution of from four to seven times its amount of water and probably the amount of potash in the slop is not very great. This is evaporated or was evaporated a year ago in Porion evaporators such as those described by Mr. Moore yesterday as being used in sulphate mills formerly; that is, flat furnaces containing disks revolving on a shaft. These, of course, only give a single effect evaporation, but at the present time it pays, and a large amount of potash salts are recovered. The slop is evaporated to a sludge in the rear pans with the stirrers and then thrown into the forward compartment, where it burns in the furnace down to a char. This is brought out and sometimes sold direct, perhaps in other cases treated for chloride of potassium. There is one instance in the utilization of beet sugar molasses residue in the form of Steffens waste as described in a previous paper of which our member Mr. Edgar Baruch is in charge, who has written a letter to the Secretary, who gave it to me, but the letter says little about what he is doing. He merely mentions beet sugar waste.*

*See letter on page 101.

By the processes described in Dr. Zitkowski's paper, a hastily erected plant last year was constructed by which this dilute solution of Steffens water was sprinkled down a tower up which the fire gases were ascending and the solution was thus evaporated. A rather large amount of loss by K_2O by volatilization took place rather unexpectedly, and the lime salts in the Steffens water were also troublesome in forming scale. I think that this year a much improved apparatus has been put up.

The manufacture of potash from kelp has been touched on rather extensively by Mr. Meade in his paper, but while the kelp is undoubtedly in smaller quantities than was originally supposed, yet the Pacific Ocean is rather large and though it is only in favored spots that the kelp grows, there is quite a considerable shore line along the United States and Canada and Mexico that is as yet untouched. The kelp nearest the plants, of course, disappears rather rapidly, so that they have to go farther away. The Diamond Match Company has a rather large plant seemingly in rather successful operation at Los Angeles harbor, San Pedro, and the other plants have been mentioned.

I might state that the plant of the American Products Company that was presumably making knife handles has been reorganized as a potash producing plant again and I think is producing on a fairly commercial scale now at rather profitable prices, having suffered from some early contracts where they contracted for potash at much too low a price. The developments at San Diego have been mentioned. The Swift plant could best be described by Mr. Richardson and I hope he will give us some information on the subject. And the Hercules Powder Company's plant down at Chula or San Diego Bay is worthy perhaps of more mention than has been given.

The idea of utilizing the kelp by first fermenting it, is perhaps novel, and has the great advantage of destroying the colloid form. This colloid has as its special mission in life the retention of potash against a world of salt water, but after fermentation you have merely a crystalline solution of potash and other salts. After fermentation as described in the presence of calcium carbonate, sodium sulphate is added forming acetate of soda, and the precipitation of the residual lime as calcium sulphate, and lately another step has been added, the addition of carbonate of soda and the elimination of sulphate of lime, which is troublesome in later evaporation. This fermented solution is decanted or separated in a Dorr separator or

thickener. The separated clear liquid is not filtered but the sludge is filtered in Kelly filter presses and in Oliver rotary filters with very successful results, particularly with the Oliver rotary filter.

The presscake coming off is very hard and very satisfactory and the solution is quite clear and is evaporated in two sets of quadruple effect evaporators of large capacity, of the Kiestner style with tubes about 22 feet long. The evaporators are six feet in diameter, and evaporate many hundred thousand gallons per day, and in their quadruple effect the evaporation is necessarily quite cheap. Were it not for a previous fermentation, the elimination of the water by multiple effect would be impossible, and this is the big problem in kelp utilization, the elimination of the water which in the best case is at least 85 per cent of the volume of the kelp as received. Unfortunately, in their fermentation some water has to be added. At the present time there is no pure culture of yeast or bacteria or anything used except the natural bacteria which accompanies the kelp, and I do not think that they are using the process which we call in the alcohol business yeasting back, or as our sanitary friends call it, using activated sludge; that is, transferring active bacteria to an incoming solution that may be later on fermented, but it is merely the bacteria which accompany the kelp which suffices for fermentation.

When the liquid is evaporated down to the crystallizing point, it is run into ordinary salting out evaporators which are worked at the atmospheric pressure under single effect, and salt out the sodium chloride which at first is very pure, but the later portions are very impure and are sent through a series of centrifugal separators where by washing with various waters it is purified from the potash and the potash is recovered again. After the salt is precipitated as far as possible or desirable, the solution is transferred over to what they call the cold side. These are crystallizers built with salting-out boxes at the bottom just like the ordinary salt evaporator, but they are artificially cooled with a brine solution. Here the potassium chloride crystallizes out and falls to the bottom and the sides of the evaporators are scraped, keeping them clean. The residual liquor contains almost anhydrous sodium acetate and I understand they have to add water before it will crystallize out with its natural water of crystallization. This sodium acetate thus crystallized out from the residual liquor is dried, rendered anhydrous, and the residual liquor is not, as yet, further treated for any other products. The anhydrous

sodium acetate is ground and put on a conveyor and sprinkled with the theoretical amount of sodium acid sulphate being of course the niter cake from the nitroglycerine plants, and this mixed powder runs into a horizontal tube with a screw conveyor in it, the tube being heated to a temperature by which double decomposition takes place, forming normal sodium sulphate and acetic acid. The acetic acid goes over to a catalizer which is used to convert the acetic acid into acetone. Those who are interested in that catalysis can look up Dr. Squibb's *Ephemeris* of about 1896. He worked the problem out very thoroughly.

The acetone, containing some acetic acid goes into some separators or evaporators and condensers by which the acetic acid is returned and the acetone is separately condensed as crude acetone, and then is distilled in the ordinary beer and column still of the American type, which was originally put up on the European continuous type, but the workmen being more familiar with the American type have converted it into the familiar style. But the acetone product is very pure and quite a little ketone oils are saved and the potash is sent out as potassium chloride and not as potassium sulphate, and of considerably over the standard 80 per cent.

I think that this represents a fairly good utilization of kelp and it is quite possible that even in normal times this plant may continue. The initial costs were very heavy, but having once put in the investment and as the capital is returned quickly under war prices, they need not consider capital investment, and the operation is not very expensive.

The Oregon lakes have been touched on. Analyses were given of the lime in the Summer Lake. I saw the Abert Lake, which is about 30 miles north of the last railroad in northeastern California, which is said to be similar to Summer Lake, but being 30 or 40 miles from the railroad the conditions are rather unfavorable so far as freight rates are concerned. Although they have potash in their waters, there seems to be some doubt as to how much. This I did not test.

I am reminded here by the present discussion of the deposits in Nebraska that on the side of this lake, the Salt Lake, there is a spring of what seems to be practically fresh water, with fish in it, coming up from an unknown depth and with a very strong flow of water, so that seemingly the salts that are found in those lakes do not come from underground sources. And I may say that 35 miles

further north there is what is known as Soda Lake in which there are immense beds of crystalline soda and on the shores of this lake pure spring water comes up in large quantities, so that the salts there are not derived from any deep springs, but must come from surface water.

The cement work has already been described and touched on. It is to be observed that the California cement industry is rather a leader in the potash recovery problem and that one of our members is connected with each of those plants that are prominent in that line.

Of the Utah alunite deposits something has been said and I can say nothing further.

The bitterns of the ocean water have been treated for potash at two salt works around San Francisco Bay where about 500 tons of salt daily is made.

Of the bitterns of the Salt Lake I might say that roughly speaking the great Salt Lake contains about 22 per cent of salt and a half of one per cent of potash, estimated as K_2O . The salt works evaporate off the salt in the summer during the dry season and towards fall have a large amount of bitterns containing about 2 per cent of potash. This is the substance which is being utilized at two plants, one owned by the Diamond Match Company and the other by the Utah Chemical Company. I am sorry Dr. Wesson has left, because he could give us some pretty good information about the Utah Chemical Company, and I am rather reticent in saying very much about it while he is not here, but it is merely a question of evaporating down this bitterns to crystallize out a rather crude potassium salt which is suitable for fertilizers, and that is the only thing that is desired, so that no further work is done at the present time, particularly at the Utah Salt Company, than to evaporate down the bitterns and eliminate a large quantity of salt in the salt boxes while the water is hot, and when they cool down a very large proportion of potash salts come out not containing much more than 15 to 20 per cent of K_2O . But this is very satisfactory at the present time as fertilizer.

As the Nebraska deposits have been touched on, I cannot say anything more, because we have men here who know a great deal more about it than I do, but I want to refer to Searles Lake, and in this connection we have a visitor here with us, Mr. Walter L. Jordan, who has slept out in the desert on the shores of Searles Lake for a long time and perhaps he can say a few words to us as to the actual

conditions out there which would be very interesting. By the way, the Solvay Process Company, I understand, are doing very well out there now, having recently erected a plant under the supervision of our member, Mr. Shattuck, and they are reported to be shipping large quantities of potash from that locality.

The Owens Lake belongs to the same system as the Searles Lake. The Owens Lake is fed by the Owens River and at one time discharged into Searles Lake, but for ages the connection has been broken and while Searles Lake is dry, the Owens Lake contained in 1913, 11 per cent solids of which 2.8 per cent is K and about 36 per cent is sodium carbonate and bicarbonate which is crystallized out as trona. Two companies on the lake have made a start towards recovering the potash from the bitterns or residue from the trona crystallizations. There have been some attempts to obtain potash by burning the unlimited quantities of sage brush in Arizona, and the Government has conducted experiments on destructive distillation of it to produce tar or oils suitable for ore flotation. Perhaps the combination of the destructive distillation for flotation oils and the recovery of potash from the residue may be profitable.

In conclusion I may say that it can be seen that the West is doing its share of chemical engineering on this particular problem.

Mr. EDGAR BARUCH: (Communicated.) The Hercules Powder Company have an enormous plant at San Diego which cost about \$2,500,000 and they are the only people on the coast who to my knowledge are refining their potash products.

Swift & Company, also located at San Diego, merely cut and dry their kelp. The Long Beach and San Pedro plants carry the process further by making a charred ash, which runs from 30 to 40 per cent potash as K_2O , but do not attempt to purify or concentrate the potash salts. Dr. J. W. Turrentine of the U. S. Bureau of Soils is spending \$175,000 of the Government's money on a new plant near Santa Barbara with the idea of attempting to find valuable by-products from the kelp, but which as near as we can determine will merely duplicate much of the work already tried by the old promotion and pioneer plants. There is much talk about still other plants being constructed all along the coast as far north as Seattle.

To my mind, in spite of many predictions to the contrary, it appears that the shortage in kelp, already noticed and felt, will soon prevent further expansion of the industry. Moreover, the costs of production are increasing so rapidly because of the necessity of

going to distant beds for the kelp, that it is difficult to figure how the industry could survive pre-war prices for potash.

It may interest you to know that we are attempting to develop other sources of potash in this State, and the whole subject can be summarized briefly, about as follows:

- (1) Lake Beds and Deposits.
 - Searles Lake.
 - American Trona Corporation.
 - Solvay Company.
 - Nevada Deposits.
 - Hercules Powder Co.
- (2) Kelp.
 - Hercules Powder Co.
 - Swift & Co.
 - American Products Co.
 - American Potash Co.
 - California Potash Co.
 - U. S. Bureau of Soils.
- (3) Cement Dust.
 - Riverside Portland Cement Co. They also refine for K_2SO_4 .
 - California Portland Cement Co.
- (4) Beet Sugar Waste Waters.
 - Oxnard, Huntington Beach, and Los Alamitos.
 - Chino, and Spreckles in charge of Edgar Baruch, Los Angeles.
- (5) Sea and Lake Bittern Waters. (Still in developmental stage.)
 - At Long Beach the bitterns from the salt works are used for the extraction of magnesia and the final liquors saved for potash.
 - At Owens Lake after removal of soda salts bittern waters contain valuable quantities of potash.

Mr. WALTER L. JORDAN: I do not think I have anything important to add. It has been about three years since I have been out at Searles Lake. I have just thought over the analysis of the brine as I remember it. Mr. Meade gave 33 or 34 per cent of total salts in the brine. Those consist of about 16 per cent sodium chloride, 6 per cent sodium sulphate, 4 per cent sodium carbonate, one per cent

sodium bicarbonate, 3 per cent borax, and 4 per cent potassium chloride, using the conventional combinations, the ratio of potash to soda salts being about one to eight.

It seems to me that the problem at Searles Lake should have been attacked from a physical-chemical standpoint. The brine contains a mixture of ions whose equilibria is unknown. Solubilities of sodium and potassium chlorides and sulphates are known, but the separation from Searles Lake brine is complicated by the presence of borates. If this problem had been taken up several years ago in a manner similar to Vant Hoff's work on the Stassfurt salts, it would have very likely saved a great deal of time and money.

