POSSIBLE SOURCES OF POTASH IN THE UNITED STATES.

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INTRODUCTION.

It is traditional in European countries for the several Governments to maintain a peculiarly active interest in the salt supplies, this state of affairs being especially well exemplified in the historical "salt monopolies" by which the Governments were assured of a certain revenue from a necessity for every citizen. About 1845 the German Government authorities, in an effort to increase the output of salt from the Magdeburg-Halberstadt region (better known as the Stassfurt region), drilled into the salt-bearing strata. Ultimately the main body of rock salt was penetrated, but in the upper layers or overburden there were found to be large quantities of "bitter" salts or a mixture of potash and magnesium salts which, designated as "abraunsalz," were regarded as worthless impedimenta. About 1870, mainly under the influence of the distinguished savant Liebig, the value of the bitter salts as a soil amendment or "fertilizer" was established, and from that time hence the potash salts have been the most valuable output of the mines. The use of potash salts became widespread throughout the world, wherever intensive agricultural methods and fertilizers were employed.

Practically, and with a few comparatively unimportant exceptions, the world's supply has always come from the German mines, and the Government, as a practical conservation measure, regulates and controls the mining and sale of the product. The material is marketed through a "Kali Syndikat" made up from all the mine ownerships and under the supervision of governmental officials, the quantity which may be produced and marketed being allotted amongst the mines, and prices fixed by the Syndikat, with the general restriction that no greater amount shall be exported than is sold in the German Empire.

It is obviously desirable that the United States should be independent of any other nation for its supply of a necessary product. Quite aside from the political arguments usually advanced in this connection, the Stassfurt deposits are not inexhaustible and are, moreover,

subject to various vicissitudes which might at any time spell disaster for this nation, which is so largely dependent upon agriculture for its welfare and stability. From time to time, and in spite of every care and precaution, a boring has become flooded, with the inevitable abandoning of the mine and permanent loss of the potash contents at least. In the past this has attracted considerably less general attention than its importance deserved, because the general market was not affected greatly and because often the particular management affected has sunk new shafts in the neighborhood and resumed operations. Recently one of the mines has been flooded, with the result that overnight, as it were, 1 per cent or more of the world's visible supply of potash disappeared.

Within the past few years certain American importers of potash salts, endeavoring to develop trade arrangements of greater advantage to themselves than had hitherto prevailed, brought on a controversy with the Kali Syndikat, which in turn led to diplomatic exchanges between the Governments of the United States and Germany and attracted considerable attention in the public prints. In consequence of the attention and interest thus aroused, Congress directed that special investigations be promptly instituted by the Bureau of Soils and by the United States Geological Survey to determine the possibility of obtaining, on a commercial scale, potash salts of American origin.

These investigations have been in progress at the present writing for about 18 months. They have stimulated private enterprises to a considerable extent, and the result of these several activities appears to be sufficient to show that the commercial production of potash salts from American sources and in quantities sufficient to meet the growing needs of the Nation is quite practicable. The investigations in this direction are by no means completed, are, in fact, yet in their infancy, and what the ultimate possibilities of American potash may be can not be predicted as yet. Before describing the more important American sources of potash, a brief résumé will be given of some possible minor sources.

MINOR SOURCES.

WOOD ASHES.

Of the minor possible sources of potash, the one which has attracted most attention is wood ashes. The quantity of sawdust produced in this country amounts to nearly 6,000,000 tons annually, which, if burned properly, might yield approximately 6,000 tons of potassium carbonate. But the sawdust is accumulated at so many widely distributed points, many of which are so poorly situated as regards transportation and other economic facilities that there seems

but small possibility of sawdust ever having any importance as a source of potash, except, possibly, in a very local way under exceptionally favorable conditions.

A relatively unimportant quantity of wood ashes is produced in this country. Some is imported from Canada. For the fiscal year ending June 30, 1910, there was imported a little more than 5,000 tons, valued at about $66,000. Figures for the tonnage of the succeeding years are not available, but as the valuation of the imports of ashes, beech wood, and lye were $50,973 (1911), and $40,212 (1912), it is evident that wood ashes as a source of potash is not only comparatively unimportant in the United States, but such as it is, it is rapidly falling off. Wood ashes command, however, a comparatively high price. Thirteen brands on the Massachusetts market, averaging 3.77 per cent potash (K_2O), sold for an average price of $12.60 per ton.

WOOL WASHINGS.

Next to wood ashes may be considered wool washings, or "suint," which in some parts of Europe have been utilized as a source of potash. The foreign matter removed from wool by scouring varies widely, from 15 to 70 per cent, and is known commercially as "wool yolk." This material contains: (1) Sand, earth, etc; (2) wool grease, which is insoluble in water but which forms emulsions with soaps and alkaline solutions; and (3) "suint," or dried sweat, soluble in water and containing the potash salts. By treating the raw wool with warm water previous to scouring, the suint is dissolved, and in this way the potash salts of wool yolk may be recovered. Generally, however, all three classes of constituents are removed together in the scouring process and allowed to go to waste, since the recovery of potash and fatty acids can not be accomplished economically, except on a large scale.

Suint consists chiefly of the potassium salts of fatty acids which, when calcined, yield an ash having a composition approximately as follows:

	Per cent.
K_2CO_3	73
K_2SO_4	3
KCl	7
Na_2SO_4	5
Insoluble	12

The quantity of potash which might be recovered from suint can not be accurately estimated. Wool in the grease, or raw wool, contains potassium which, expressed as potassium carbonate, approximates 5 per cent. The wool cut in the United States may be taken, in round numbers, as 160,000 tons, so that the maximum possible yield of potassium carbonate would be something less than 8,000 tons,

worth possibly $500,000. Considering the wide distribution of the wool cut in America and the slight probability that the individual scourers could be induced to recover potash, or even suint, wool does not promise much as a possible source of potash. It is reported that some of the larger slaughterhouses and packing establishments are running washings from their sheep through peat, thus absorbing quite completely the potash and enriching the peat for subsequent use as a filler in mixed fertilizers.

POMACE AND VINASSE.

The pomace from wine presses, vinasses from sugar mills, and other wastes are possible, but not probable, sources of potash. Generally these wastes, if usable at all, could be more advantageously employed in some other manner, possibly for direct application to the soil. On the other hand, no very definite statements in this connection are justified, for these substances have not been thoroughly investigated.

ARTIFICIAL NITER.

The artificial production of niter or potassium nitrate is still practiced largely in various parts of the world, notably in India, where recent governmental investigation seems likely to bring about some technical improvements in the time-honored practices. The United States imports annually about 3,000 tons of potassium nitrate, worth approximately $200,000, a very small percentage of which goes into fertilizers, it being utilized mainly in the manufacture of certain types of explosives and fireworks. The United States could, of course, if necessity arises, produce enormous quantities of potassium nitrate. But the economic and social conditions in this country are such that it is extremely improbable that any commercial production will ever be attempted.

SUNFLOWERS AND DESERT PLANTS.

In Russia sunflowers grown on waste lands are gathered and potash obtained by incinerating the stalks. It has been proposed to follow this idea by growing sunflowers on some of the desert areas of the United States, and several propositions have been advanced to gather indigenous plant growths on desert and waste lands and produce potash by burning them. None of these proposals have yet assumed sufficiently definite shape to warrant consideration as a commercial proposition. While some attention has been given the matter by the Bureau of Soils, the data have not justified any serious expectations of commercial possibilities in this direction.

CARBONATE PONDS OF NEBRASKA AND VICINITY.

In certain of the Western States, notably in western Nebraska, are a number of small lakes or ponds whose waters are quite saline, and contain noticeable proportions of potassium carbonate. The explanation of the origin of the potassium carbonate which has received most credence is that the vegetation of the surrounding country has been repeatedly burned over and that the potassium carbonate from the resulting "wood ashes" has been leached out by rain and carried into the lakes, which have no outlet or relatively inefficient outlets. The climate being semiarid, the evaporation is high, and consequently a considerable segregation and concentration of potassium carbonate has occurred in some of the lakes. None of these lakes, nor all of them in the aggregate, probably contain enough potash to give them any great general economic importance, though some of the individual localities might justify working. Indeed, preparations have been made to work one or more of them. There is no present expectation, however, that the potassium carbonate to be recovered is to go into the fertilizer market.

ROCK SALT AND BRINES.

The United States contains a number of rock-salt deposits and many salt wells. An examination of a large number of the brines, salt, and bittern from these wells and deposits has been made, as well as a study of the theoretical and practical principles involved in the separation of potash salts from the other products yielded. Potash is invariably a constituent, but never in quantities that would justify any attempt to obtain it thus commercially, excepting possibly in the case of the potassium carbonate lakes of Nebraska already discussed, and at Searles Lake, in California, which will be discussed presently in connection with the desert basins. Certain of the American salt deposits, notably those in New York, Michigan, Ohio, Kansas, and possibly in Louisiana, are enough like the deposit at Stassfurt in origin and general geologic features to suggest the probability of segregated deposits of potash. From theoretical considerations as well as practical experience at Stassfurt, it would be expected that potash layers, if existing at all, would be found above the main salt bed. No such layers have been observed in the case of any American deposit, and they have been sufficiently explored now to make quite remote the probability of American sources of potash from such deposits.

MAJOR SOURCES.

ALUNITE.

Turning attention now to the more important possible sources of American potash, alunite may be conveniently considered first. This mineral is a basic potassium alumino sulphate, is quite widely distributed in the United States, and is found in notable quantities at several points in Colorado, California, Arizona, Nevada, and Utah. Alunite has long been used in Spain and Italy as a source of alum, obtained by roasting the mineral, lixiviating the roasted mass, and evaporating the solution. Roman alum, produced thus from the mines at Tolfa, has long been known in the trade. Investigation has been made by the Bureau of Soils of the temperature and other conditions best suited to the production of alum or potassium sulphate from alunite and the possibilities of producing potash commercially from the alunite from various localities, of which only one has offered as yet any great promise. Near Marysville, Utah, occurs a large deposit of massive alunite, known for a number of years, but recently investigated by agents of the United States Geological Survey, who state, as a conservative estimate, that the Marysville deposit will yield 300,000 tons of alunite or 30,000 tons of potash for each 100 foot depth. How deep the deposit is can not yet be stated, but it occurs at elevations from 9,000 to 11,000 feet, and there is apparently good evidence that the main vein is a deep-seated one. Most if not all of the workable area is now in the hands of private parties who have substantial resources, and there seems to be good reason to think that potash from alunite may soon be a commercial product on the American market.

FELDSPAR AND POTASH SILICATES.

There are within the United States many and large deposits of rocks and minerals containing potassium. The potash feldspars, orthoclase, and microcline are abundant, frequently massive, and widely distributed through nearly all sections. Another potash silicate, leucite, found in lavas, is important only in the region of the Leucite Hills, Wyoming, but occurs there in very important quantities. The percentage of potassium in these potash-bearing silicates varies considerably, not only with the mineral species, but with each mineral. Probably it would average between 8 and 10 per cent, sometimes running as high as 16 per cent, and it has long been the dream of inventor and chemist to develop a commercially practicable method of extracting the potash from them. To this end a long list of patents has been granted in the United States and other countries. Of the methods so far proposed only a few merit consideration here. A general investigation of the various methods for which

patents have been issued has been made in the laboratories of the Bureau of Soils. It was found, as has been noted by others, that there is small probability that any "potash from feldspar" proposition which depends on the production of potash salts alone can have a commercial future, but that commercially available by-products must also be produced.

The temperatures and other conditions necessary for extracting potash from feldspar, by fusion with lime or other reagents, was investigated, and it was shown that by substituting ground feldspar for "clay" or "shale" a satisfactory clinker for cement purposes could be produced and the potash volatilized quantitatively. A somewhat similar process has been devised by Eakel and Spenser where greensand or glauconite was employed instead of feldspar. That the flue dust from cement kilns and other similar industrial operations frequently contains potash or potassium salts has been known for some time past. In the majority of such plants it has been held that the loss of material through the stack is too small to justify the installation of a precipitating or trapping system. One large cement plant in southern California, which has recently been equipped with a highly efficient precipitating device in their flues, and which has been employing a granite containing appreciable proportions of potash feldspars, is now experimenting on the possibilities of recovering potash from the flue dust, with rather promising results so far; and experiments with a small experimental plant are now under way in the Bureau of Soils to test the results of employing a high potash-carrying feldspar.

There is in course of erection at Curtis Bay, near Baltimore, under the auspices of a well-known firm of chemical manufacturers, a small plant for the production of potash salts from feldspar, according to the Firmin-Thompson process. Essentially this consists in heating a mixture of ground spar and niter cake or acid sodium sulphate together with sodium chloride in a rotary or Wedge or other suitable furnace. Hydrochloric acid is given off and trapped in the usual manner. The solid residue is leached with water, and the percolate evaporated, potassium chloride being separated by fractional crystallization. Other products of the operation are a very pure sodium sulphate and a pulverulent soda-lime-alumina silicate, with a probable value for certain types of glazing. No potash from this process is yet on the market, but the promoters expect shortly to produce about 40 tons a day.

In the Cushman-Coggeshall method the ground spar is mixed with calcium chloride, or lime and sodium chloride. By an ingenious "clumping" device the mix is brought into the form of pellets which are then passed through a furnace with definite heat relations. The

roasted pellets are granular and in a form to be readily pulverized if desired. The product contains about 4.5 per cent of water-soluble potash, although the inventors claim a higher percentage is readily obtainable. It also contains a notable proportion of calcium chloride. It is suggested that this product is to be regarded as a fair substitute for wood ashes and should bring a commensurate price. If, however, the product must be marketed as a low-grade potassium chloride, it can be produced only at a loss. It is understood that this process has been exploited experimentally in the interests of one of the large manufacturers of fertilizers. So far the product has not been marketed.

Another of the large fertilizer manufacturers has been developing a process, the details of which are as yet not public. Essentially the process consists of heating a mixture of ground spar and coal in a stream of nitrogen or ordinary air at certain regulated temperatures and pressures. It is said that a volatile product or mixture of products is obtained which, when treated with steam and then leached yields potash, potassium carbonate, ammonia, carbon monoxide, and iron-free alumina. All of these products are readily salable, and there is left only a small mass of ferruginous material and lime silicate. A factory is now in course of construction, and if the practical results even approximate the laboratory results reported the "potash from feldspar" problem will have been solved.

While the extraction of potash from silicate carriers has been suggested in many other ways, none of them has acquired sufficient practical promise to justify a mention here.

DESERT BASINS.

Throughout the greater part of the far western States are numerous topographic units known as desert basins. In past geologic times folding and subsequent faulting produced many troughs and depressions, some of which were of stupendous depth. Into these the waters descending from the surrounding heights carried silt and dissolved mineral matter derived from the rims and carrying, of course, more or less potassium. Generally, the resulting topography was such that outlets were either nonexistent, temporary, or, at all events, insufficient, so that lakes were formed, some of vast extent, as the ancient Lahontan, or Bonneville. With the advent of arid periods these lakes evaporated, and their mineral contents concentrated, probably to the points where deposition of previously dissolved content took place. Probably periods of desiccation and of humidity alternated. But throughout all these periods all the troughs were gradually filling up with erosional detrita, until they have reached their present levels.

It is possible that during a period of desiccation salt was deposited from the then existing lakes, and that the deposition proceeded sufficiently far for the potash salts to be laid down in segregated layers. Laboratory investigations, confirmed by observations at Stassfurt and elsewhere, show that the potash salts, if deposited at all, should be expected in the upper layers. If, now, silt deposits covered these salt layers so as to protect them more or less efficiently from subsequent floodings, a "potash mine" may exist potentially in a desert basin if not too far below the surface to make its working commercially feasible.

It is possible, on the other hand, that desiccation never proceeded to the point where potash salts crystallized from the concentrating waters, or that it was not protected by a silt covering, and though indubitably potash, and perhaps much of it gone into the basin, it is disseminated through the silt fill. In such case no potash mine can be expected.

It is impossible from any known criteria to determine or even intelligently guess a priori whether a segregated layer of potash lies or probably lies below the surface of a desert basin. The only way to find out is to bore. But before doing so it would be wise to consider the drainage area to the basin, the character of the rim rocks, and any other features which might be expected to affect the amount of potash which has been carried into the basin. About 200 basins have been examined in the past 18 months by the Bureau of Soils, and it has been possible to reduce the number in which there is any probability of potash being found to a very limited number, about 20, in which the chance may be regarded as good, and possibly as many more in which it may be considered doubtful. In any event, however, it is only a chance that a segregated layer of potash salts will be found. A boring has been put down by the Geological Survey, near Fallon, Nev., and private enterprise is putting down borings in the Railroad Valley and Dixie Valley, one of which has gone nearly 1,200 feet without "finding potash." An encouraging sign is the fact that the water from these borings has been quite fresh, and since there can be little doubt that much potash has been carried into the basins, the fresh water indicates that it is not disseminated through the fill, but probably segregated. But nothing definite has been indicated regarding the depth at which the segregations may be expected. A potash mine in a desert basin is yet a legitimate hope, but without definite promise of realization.

Sometimes the floor of a desert basin may carry a considerable salt deposit, but more often not. The surrounding mountains are bordered by "aprons" of descending slope merging finally into a flat plain in which there is at the point of greatest depression a "playa"

or possibly a small lake. Usually the playa is a mud flat, and the place of concentration of the present drainage. One such playa, that of Searles Valley, is known to be of importance as a possible source of potash. The bottom of the Searles depression or Searles Lake is a body of white crystalline salt approximately 12 square miles in area, of varying depth, reaching probably 75 feet. Saline muds and sands, more or less well cemented, underlie the surface salt, the whole being saturated by a brine. The salts are mainly the chloride, carbonate and sulphate of sodium, lesser amounts of borax, and some potassium chloride, the potassium salts being mainly in the brine. This salt body has been until recently in the control of private interests. It is reported that they have satisfactorily worked out methods for separating the commercially desirable constituents, carbonate of soda, borax, and potassium chloride, and that the materials are in preparation for the installation of a large plant to produce and market these products. What is regarded as a very conservative estimate is that this deposit may ultimately yield 4,000,000 tons of potassium chlorid. Probably it will yield more. It has now been withdrawn from entry, at least temporarily, and its exploitation thereby delayed.

If plans now being contemplated for the diversion of the flow from the watershed of Owens Lake are finally consummated, that lake will gradually dry up, and in the final residue a considerable amount of potassium chlorid will be present. The chief value of the products of desiccation, however, will probably be in the borates. Agents of the United States Geological Survey have reported that the muds of Columbus Marsh contain notable quantities of potash salts and suggest that these may be economically recovered from the mother liquors from borings. This marsh is a broad mud plain lying on the line between Esmeralda and Mineral Counties, Nev., near the station of the Coaldale, Tonapah & Goldfield Railroad. The mud is of unknown depth. Wells to a depth of 50 feet have been sunk. On the average, the mud contains about 6 per cent of soluble salts and nearly 2 per cent of potassium chlorid, and it is thought that the mother liquor from the mud, if it can be economically separated from the solid material, will have a sufficiently high potash content to justify working it. Under the recent law, amended August 24, 1912, the President withdrew from entry January 16, 1913, all the lands of Columbus Marsh which are likely to yield workable quantities of potash salts, pending further investigation of their probable economic importance.

The salt mixture in the ocean is chemically neutral, and hence the salt deposits of Stassfurt resulting from the desiccation of sea water are neutral. It does not follow, however, that the solution resulting from the solvent action of meteoric waters on the rock masses of any particular area will be neutral. They may be, and

probably, in general, would be alkaline, basic constituents predominating over acid if volatile carbonic acid be ignored. Thus the salt mixtures and brine at Searles are strongly alkaline chemically, as is the case with quite a number of lakes and ponds in arid areas. If much lime is brought into the water, it is largely precipitated and precipitates as carbonate, sulphate, borate, or slightly soluble solids, and the resulting aqueous salt mixture approaches a neutral condition. The water of the Great Salt Lake, the residue of the former great Lake Bonneville, is now practically neutral, although if a portion be sufficiently diluted with pure water, it will be found alkaline, as shown by the addition of a few drops of the usual alcoholic solution of phenolphthalein.

GIANT KELPS.

At the present time probably the most promising American source of potash is the giant kelps of the Pacific coast. There is a fairly large number of different kelps and rock weeds growing on the coast, from all of which it is possible to extract notable quantities of potash and iodine, and some of these algæ have been shown to have other commercial possibilities. Of the several varieties and species two are of importance as possible commercial sources of potash, *Nereocystis luetkeana* and *Macrocystis pyrifera*. These algæ grow in large beds or groves of practically pure stands. In northern waters, from about Point Sur up to the Arctic, *Nereocystis* is the important kelp. *Macrocystis* is found in fairly good-sized stands in Puget Sound and all along the coast southward, but from Point Sur southward it it the predominant kelp. In fact, the large groves of *Macrocystis* along the coast of southern California and Mexico far surpass in importance any other now known. These groves have been located and mapped from Puget Sound south. They will probably aggregate in area nearly 100 square miles on the Mexican coast and about 120 square miles on the American coast, excluding Alaska.

Nereocystis is apparently an annual. At least it dies out in the fall and grows anew in the spring. Consequently, in order not to interfere with the fruiting or development of mature spores, this plant should be "protected" and its cutting prohibited until after July 15. This is a point possibly of great importance for the building up of a kelp industry dependent on this variety. Investigation is now in progress to determine the possibility of building up such an industry in connection with the fish-scrap industry, already existing, to the material advantage of both. There are apparently great economies possible in equipment,.etc., but there are also some undetermined factors, among which the labor and season are prominent, and which have not been satisfactorily investigated as yet.

Macrocystis is perennial, or at least has a life history extending over a year. It has been reported that groves cut to a depth of a fathom or more have regrown to their former luxuriance within 40 to 60 days. Therefore several cuttings a year are practicable, apparently, especially as the main regions for spore production are on portions of the plant at much greater depths than would ever be cut. Recent observations, however, on the mechanism of regrowth after cutting make it desirable to withhold for the present any positive expressions of opinion as to how many cuts or harvests a year will be possible.

The kelp stands of Alaska have not as yet been mapped nor thoroughly investigated. Preliminary reports indicate that some very heavy stands exist in individual groves, and these reports, confirmed by the charts of the Coast and Geodetic Survey, indicate that in the aggregate the kelp groves of Alaska may equal if not surpass in extent and importance those already mapped.

There are at present on the Pacific coast four commercial organizations for marketing kelp, and a number of others have been reported as in the formation stage or about to begin operations. These companies claim to have met successfully the presumably difficult problem of cutting and harvesting the kelp. One of the more successful ones which has actually been marketing kelp has a scythe device mounted on a barge, and by an endless chain mechanism cuts and loads the kelp on barges alongside in ordinary weather. It is claimed that they cut, drain, and deliver their product on shore at a cost of less than 60 cents per ton, wet. This would be equivalent to something less than $3 a dry ton of kelp, and with experience and consequent improvements it is probably quite practicable to reduce the cost of harvesting the kelp to about $2 per dry ton.

The kelp in drying loses about four-fifths, or a little more, of its weight of water. This it does quite readily, and the fear sometimes expressed that a large heat cost is involved is quite unfounded, as generally simple air-drying is quite sufficient to remove the greater part of the water. A more serious difficulty is that, in drying, much of the salts, largely potassium chlorid, effloresce on the surface, are easily shaken off, and are likely to be lost.

One of the companies operating on the Pacific coast is chopping the kelp into small lengths and marketing it wet, to be used as a top dressing and fertilizer. Undoubtedly, with many crops and on most soil this should prove a good practice as far as crop increases are concerned. It is not certain, however, that the practice, inherently involving freight charges on a large percentage of water, will prove commercially desirable, and further experience must be accumulated before a satisfactory judgment can be formulated.

The dried kelp contains from 20 to 35 per cent, or occasionally even more, of potassium chlorid, and is more desirable than manure salts or ordinary market grades of potash salts, not only because of its high content of potash, but because of the readily decomposable organic matter, a content of about 2.5 per cent nitrogen, and appreciable amounts of readily soluble phosphates, all of which give it an important fertilizer value.

The recovery of high-grade potassium chloride from the kelp is no more difficult than from the Stassfurt salts. The recovery of iodine and organic products, leaving a residual rich in potash, is quite feasible, but has not yet been attempted in this country, except on a laboratory scale, although now practiced in Japan.

The amount of potash salts obtainable annually from kelp can not be stated at all satisfactorily at present. It is certainly large, and if careful supervision of the beds and harvesting be provided, it seems safe to assume that the yield of potassium chloride could be made to surpass the entire present consumption of potash salts in this country. Counting in Alaska, the annual yield might possibly be several times this amount. But there are a number of factors not yet sufficiently well known or understood to make possible any more than tentative estimates.

These kelp groves are a great national asset. More particularly they are an asset of the States along whose shores they occur. Being generally within the "three-mile limit" they fall under the control and supervision of the individual States, whose obvious duty is to protect them and conserve them that they may continue indefinitely. A kelp "proposition," unlike a mine, requires no amortization feature. Restrictive legislation should, however, be enacted very cautiously, as it is of the greatest importance at this time that kelp industries should be encouraged, and there is yet wanting a sufficiently definite basis of knowledge on which to found regulations conducive alike to the utilization of the kelp groves and their maintenance and perpetuation.

A characteristic of the "potash from kelp" propaganda is that large capital is quite unnecessary. A very modest outlay for harvester, dryer, and working capital is required.

That a large growth of kelp exists, capable of producing an enormous tonnage of potash salts, has been demonstrated. It has also been demonstrated that kelp can be harvested and prepared for market at a cost commercially practicable. A business in kelp actually exists, though small. It remains to be proven that a stable business, capable of meeting the national necessities, can be established, and to this end should be lent all possible assistance from Federal and State governmental activities and private enterprise.

SUMMARY.

To sum up, it may be said that the United States has at hand known possible sources of potash sufficient to supply its present and prospective needs. It has possibly, but not yet proved, sources sufficient to supply many times its own needs. Some of these have apparently so much promise, commercially, as to justify the expectation that potash salts of American origin may be a factor in the market in the near future.

Finally, however, it seems wise to repeat the warning previously given (62d Cong., 2d sess., S. Doc. No. 190, p. 48) that "while the conclusion is justified that kelp groves, alunite, or other sources of potash can be exploited commercially and even, perhaps, at large profits, it is by no means to be assumed that any particular proposition which may be promoted is safe and desirable. Prospective investors are again urgently warned to hesitate until they have obtained such information as may be given by public officials and the advice of a reliable and disinterested chemist or engineer who has carefully inspected the particular proposition in view.