

this study has now progressed to the point where one can find, by consulting a reliable authority upon the subject, data which will enable him to predict the nature of almost any alloy of which he can conceive.

DISCUSSION.

MR. PARR:

Mr. Chairman, I think it is always dangerous to talk about anything that has not yet reached the point where you are satisfied with it. However, I do not know that we are ever quite satisfied with anything we are doing, so I will venture a word as to my work on alloys.

It may not interest any one with a laboratory fund so liberal as to make it an easy matter to keep up their platinum supply to the full extent of their requirements, but the case is different with me where I have been obliged to keep actively on the job after sixteen years of almost daily service a piece of apparatus which has in its make-up some three hundred dollars worth of platinum. I refer to a Mahler bomb of the Atwater type. But more than that, instead of a single bomb to serve the needs of two or three men in investigations, and twenty-five to thirty students in class work, I want at least a half dozen. I have therefore been attempting to develop an alloy with properties as resistant to nitric and sulphuric acids as platinum.

We have reached a very satisfactory degree of success with an alloy of the nickel-chrome type having an amount of the latter constituent approximating 20 per cent. We have been able to produce quite a number of such pieces showing in 4N.HNO₃ or 4N.H₂SO₄, or a mixture of the above acids when preferred, a unit of 100 sq. cm. of surface and one hour of time, a solubility factor of 0.0 milligram. Other tests have shown dissolved metal to the extent of 0.09 mg., still others 0.17 mg., etc. Our greatest difficulties, however, have been met with in attempting to cast this material, the shrinkage upon solidifying being very great. With an alloy of high melting point, above 1200° C., this feature has made the case at times almost hopeless. However, we have so far succeeded that a solid cap has been cast of this material and the same has been in use for over six months on our Atwater oxygen bomb with exceedingly gratifying results.

MR. BUELL:

I should like to ask Mr. Bassett with regard to the amount of ammonia produced from the decomposition of organic material in the various localities and if it is sufficient to materially affect brass. We occasionally have cartridges returned from some of the damp warm climates such as occur around Calcutta and in the vicinity of Memphis in this country, which crack in storage from no apparent reason. These cracks are not such as would come from heat cracking or from imperfect annealing or wrong composition. I would like to know if any one has had any such experience with brass.

MR. BASSETT:

With regard to the question that Mr. Buell asked, I do not believe I know entirely as to all of the causes for this disintegration of brass. Those mentioned are some that I had had experience with. The exposure of brass articles to ammonia fumes from a dirty stable, particularly if the brass is in a hard condition, might cause it to break. An experience which I had at one time illustrates how rapidly and seriously ammonia will attack brass. A solution of copper sulphate and ammonia was mixed in a brass pail on Saturday afternoon. When the work with this solution was finished an assistant was directed to clean out the pail. He failed to do this, and on Monday morning it was noticed that the solution had begun to leak out, and the pail dropped apart between wind and water, although it was made from heavy metal. The brass in the lower section was a most

perfect example of the so-called "disintegration of brass." The ammonia solution had simply rotted the alloy.

The difficulty in melting aluminum by itself, or in alloys, is its affinity for oxygen, and the failure of the oxide of aluminum to separate itself from the metal. The aluminum oxide stays in the metal, making a mess and causing all sorts of trouble. It leaves the alloy rotten and full of dirt.

MR. PRICE:

I think I can supplement these remarks of Mr. Bassett by stating a specific instance which came to my notice. We make brass acetylene generators for automobiles. We had one of these returned to us that was disintegrated. Upon investigation, it was found that the disintegration was due to ammonia salts formed with the acetylene gas when the calcium carbide was acted upon by water.

WASTE AND CONSERVATION OF POTASH AND PHOSPHORIC ACID.

By F. K. CAMERON.

As far as the phosphates are concerned, there is a great deal of waste in the Florida fields. It varies there quite a little, but sometimes amounts to as much as 200 or 300 per cent.; that is to say, for every ton of phosphate rock mined there and ground for fertilizer, twice as much phosphate rock in a comminuted condition generally is thrown away, wasted. In Tennessee, where large deposits of phosphate rock are found, the mining is very much cleaner than in Florida, and there is very little waste. The mining methods in that section have been greatly improved in recent years, and the waste is falling off. In the Charleston, S. C., fields there is still a great deal of waste.

The great problems in handling phosphates are to insist upon clean mining, and to develop methods for segregating phosphoric acid from the rock phosphate and thus make low-grade material available.

At the present time there is practically no high-grade rock, that is 72 per cent. bone phosphate, used in this country. All of the high-grade rock that we mine, or practically all of it, is shipped abroad and the American market takes only the lower-grade material. It is improbable, so far as we can judge, that there will be any very great consumption of the high-grade material in this country so long as the foreign demand keeps up, and we have to utilize the lower-grade material.

The estimates which we have been able to make from the survey of the existing fields of this country, indicate that the deposits of the high-grade rock are so large that, at three times the present rate of consumption in this country, it would last something like 1200 years; that is, excluding any new discoveries. We have not only the Florida fields, the hard rock, the pebble rock, the Charleston field, the Arkansas field, the Kentucky field and the Tennessee field, but the largest deposits of high-grade rock in the world have been discovered in Montana, Utah, Idaho and Wyoming. There are a good many fields in this country that carry some phosphorus in the rock, which makes it useful locally from the fertilizer point of view; for

instance, up in the Shenandoah Valley some rocks run two or three per cent. phosphoric acid, and some deposits are known in North Carolina, along the Piedmont Plateau, that run quite high in phosphoric acid.

The next big waste that we have to consider is the nitrogen waste. This is more or less intimately connected with carbon waste, already discussed. By the introduction of a by-product oven in this country, we are saving some of the nitrogen from the coal, as well as making gas. Both the ammonia and the gas are finding a market, but their values depend largely upon the location of the plant, and the overhead charges, which vary with the different installations. That it pays can be illustrated by the fact that one concern in a coal-mining district is taking the product from the mine, coking it, returning it to the mine owner, and paying him a royalty on it, and it is paying him very handsomely; so much so that they have made a contract for a good many years.

For press of time I can only interject here the fact that we are making in this country about one-third as much ammonium sulphate as we are importing, and what we are getting is about one-eighth as much as it is possible to make from the coal being coked at the present time.

The amount of nitrogen that is wasted in the form of fish refuse is enormous, especially on the Pacific Coast. I have seen enormous amounts of fish refuse thrown in the rivers, a perfect nuisance to the towns, washing up along the shores and banks of the rivers, and no attempt being made to utilize this most valuable material.

One of the big carbon wastes, which might have been spoken of this morning, and which contains potash, nitrogen and phosphorus, is the city wastes—the garbage and night soil. There is very little effort made to conserve these. Some doubt exists in this country as to their value as fertilizer, it being claimed by some that it is practically nil, and we are at a loss to know what the true values of these materials are. Night soil is utilized very largely in China and Japan, and some of the American gardeners in this country also use it, but there is a great objection here to its use on account of the danger from pathogenic germs. It has been found to be very good fertilizer in those countries, while in Europe and this country it has not been found to be so good. But here it has not been used under the same conditions. All of the material of this kind used in Japan and China is first worked over in appropriate pits or vessels, and "fermented" before it is applied to the field.

The biggest problem of all, for us, has been the possibility of using raw materials, waste materials if you please, for the production of potash salts. With the prospect for 1200 years of phosphates before us, we need not be very much worried at present on that score, and with the prospect of getting all the nitrogen we want from by-products of one kind and another, or by utilizing atmospheric nitrogen,

bacteria, etc., we need have no serious concern on this score.

We have, however, been in a quandary as to what to use for potash, and the public mind has been very much exercised on account of the well known difficulties between this country and the one country that contains the principal source of potash for the world's supply, namely, Germany.

Now this country takes about one-fifth of the potash salts mined in Germany, and about one-half of the amount that is exported from Germany; and we had no other source of supply until quite recently. There is a possibility of our getting potash from some of the arid basins, of getting a small amount from smelter fumes, from wood ashes, and from sawdust. There is made annually in the lumber mills of this country something like 5,850,000 tons of sawdust. This is equivalent to about 5,200 tons of potassium carbonate. But when you recognize that it is scattered around the country, there is no possibility of its being of much importance for general use.

Practically all the salt wells in this country carry a small amount of potash, and when the water in the wells is evaporated, the mother liquors would give a material which compares fairly well with the so-called manure salts. It is possibly one of the waste products which could be used, but at present it will hardly pay.

Another source of potash in which people have been interested is the silicate rocks carrying potassium. There have been quite a number of processes suggested, patented or secret as the case may be, for extracting potash from silicate rock. It is possible to do so, but it is very difficult to do economically, and practically none of these processes as yet have any commercial value. There are several of them that are being tried at the present time, and some may later prove extremely valuable.

There is a silicate rock process that has given promise of becoming commercially valuable. The extraction of potash is commercially possible so long as they can get a certain by-product which, I am sorry to say, I cannot yet mention in public. This process is perfectly possible as a source of potash to the extent of 40 to 60 tons a day, but if they try to go beyond that they are certain to lose money, because they cannot get the necessary raw products, aside from the potash mineral, at figures which will enable them to make a profit. This is one of those very curious processes that the larger you make it the less it pays.

There is one substance which has been a waste product, and which has been a nuisance in that part of the country in which it grows, and that has turned out to be a very good source of potash.

Along the Pacific Coast of the United States and Alaska, there are a number of seaweeds, or kelps. In fact, we have them along the New England coast. The seaweeds have been used along the New England coast for fertilizers, and also along the coasts of the British Isles, Norway, Denmark, Sweden, the Hebrides, and have been considered extremely valuable.

Kelp rights were one of the important assets of the owners along the coasts of the countries named. But kelps have heretofore been used principally as a source of iodine, and when iodine was developed from the mother liquors of the Chile saltpeter, kelps went out of fashion and little has been thought of them until quite recently.

In examining the Pacific kelps we found that some people were interested in them as a source of iodine, and some from the standpoint of their being a nuisance. When our attention was directed to this waste matter, we were at the same time interested in potash. We organized three parties to investigate the extent of these kelp areas, mapped out the kelp beds in half of Puget Sound, and found that about 210,000 tons of the principal kelp were produced there annually; there is a great deal along the California coast from the Golden Gate down to Point Sur, and from Point Sur south there are enormous beds of very large kelps, the main kelp there being quite different from that growing in the Puget Sound region. Some of these beds, along the Southern California coast, extend from two to five miles in length and from a half to two miles in width, or even larger, and some of the large beds are extremely thick. We have mapped this past summer about one hundred square miles of kelp beds, the two principal areas being in the north, in Puget Sound, and in the south, from Point Sur southward. The plants grow in strong tide-ways, or where they are exposed to the full force of the open sea. All of the groves are within the three-mile limit.

We have found that the kelps in the Puget Sound area, when dried, contain as much as 30 per cent. potassium chloride and two-tenths per cent. iodine. In the South, they contain 20 to 30 per cent. potassium chloride and rather more iodine than those in the north. The kelps in the Puget Sound region (probably the same as those in Alaska) are annuals, are in best condition for cutting and have finished fruiting the latter part of July. If these kelp beds are to be a source of profit, they should be protected and should not be cut until after the middle of July. In the south, the important kelps are probably perennial and if cut not more than two feet below the surface, become as thick as before in about forty days.

It is quite impossible to give an exact estimate of the amount of potassium chloride in sight from this source. The analyses would indicate that the amount of potassium chloride to be obtained from these kelp beds annually is something like 8,000,000 tons. This is pretty big, so we are standing by a very conservative estimate of 1,000,000 tons as the probable production of potassium chloride from the Pacific kelp beds, if the beds are properly protected. This gives a source of potash at least three times as great as the total potash importations from Germany. If the larger estimates prove true, it means a possible production of potassium chloride about the same, or even a little larger than the total production in Germany.

There are all sorts of things of interest in connection

with these kelps as a present waste product. It is possible to make from them a number of foods which are used in Japan and elsewhere, known as Kombu. Another series of good products is known as Nori, and while it is probable we might develop an industry in the making of these things for the Japanese, it is rather improbable that the Americans will care for them.

It is, however, probable that a cattle food might be developed in this country from kelps. The nitrogen content of these kelps would place them about the same as hay, better perhaps than the ordinary eastern hay, if not as good as the best western alfalfa; and there is a possibility that the organic material could be used as roughage for cattle food after the salts had been extracted.

It is also estimated that the possible kelp production would give us an amount of iodine, which is easily recoverable apparently, worth about \$90,000,000, at present prices. These figures are possibly misleading, because the importations of iodine and iodine products, according to the figures of the Department of Commerce and Labor for the last year, would seem to be about \$1,000,000 worth annually.

To put the whole matter in a nutshell, if these beds are properly protected and no longer considered a waste product but a raw product of great value, if they are properly harvested, and if we attempt seriously to utilize the iodine and other products which can be made from them, we ought to be able easily to harvest a quantity which would yield annually at least 1,000,000 tons of potassium chloride, besides vast quantities of by-products, and thus make of what has hitherto been considered a waste and a nuisance, a source of enormous commercial value.

DISCUSSION.

MR. PARSONS:

Dr. Cameron's statements with regard to iodine are especially interesting. There are many chemical substances the price of which has been held up simply because some producers prefer to obtain for certain products three times the price they could obtain if the amount was increased. The output of many of these substances can be very greatly augmented, and it has almost invariably been the case where this has been done that, although the price was diminished, new uses were found which ultimately were of great benefit to the manufacturers, and increased the profit. Many instances could be cited in chemical industry where prices have been maintained which have precluded new applications although cheaper material would mean much greater consumption. I understand an immense amount of iodine is going to waste in Chile which could be readily recovered except for the fear of reducing the price by flooding the market. It is probably true if they should increase the production of iodine, the use would be rapidly increased.

With reference to potash, there is one point which has recently come to my attention, on which I have some data which may possibly interest you. I refer to the possible use of feldspar or other potash-bearing silicates such as the green sands of New Jersey, in the manufacture of Portland cement, obtaining potash as a by-product. Now I know very well this is no new proposition and I understand that Dr. Hillebrand and Dr. Richardson applied for patents covering this idea some twenty-five years ago. Indeed some more recent patents have

been issued I think, but it is not generally known how readily potassium is volatilized in a modern cement plant.

In the cement industry there is probably anywhere from five to ten per cent. of the raw material going off in the form of dust, and that dust is becoming a menace in many parts of the country, so that cement manufacturers are beginning to realize that it is going to be to their advantage to find means for recovering it before they are required to do so. A number of experiments are under way. In one of these I happen to know that the dust, which amounts to many tons per day, carries, in the first part of the collecting flues, a considerable proportion of alkali, but further along where it is collected by the Cottrell process, it is very much richer in alkali, and some of that dust has analyzed as high as 35 per cent. soluble alkali, of which one-half was potash. Now it certainly would seem that it might be possible to obtain some potash as a by-product in the cement industry, by using raw material rich in potash and making this product cover, wholly or in part, the cost of eliminating a dust nuisance. The insoluble portion of the collected dust could be returned to the kiln.

MR. SMITH:

We have been manufacturing potash from garbage in Cleveland for a long time. In the city of Cleveland, the garbage is taken care of by the city and at a profit. The material is collected every other day, put through a steam-heating process and the liquid expressed. The liquid is then evaporated and the two parts put together again, after removing the grease, and brings quite a fair price for fertilizer. The plant is operated at a profit of about \$30,000 a year.

If you will come next winter at this time to Cleveland, I hope we shall be able to show you this plant in operation.

MR. HUSTON:

I am very much interested in the question, but do not know that I can add anything to this discussion. The general matter of potash supply and so on, I do not feel that I should discuss now, because there are some other important propositions that have not yet been finished, and it is not policy perhaps to make invidious remarks while those things are going on.

I was interested, however, in the remarks relative to the side products, iodine particularly. I do not know that a reduction in the price of iodine would result in a greater consumption than the reduction in the price of bromine did. This perhaps may give us some indication of what may happen in the market. As you perhaps know, the price of bromine went all to pieces and the Americans and Germans fought each other. As I heard last, the Americans were making 400 and the Germans making 300. The Americans perhaps have the best of it as their brine is richer in bromine, so the price finally came down and it is rather cheaper to run the brine into the ditch than it is to make bromine of it, and the price of bromine is probably as low as the world will ever be able to obtain it, but it has not, so far as I can learn, increased the consumption of bromine. The figures are quite worth watching, but my understanding is that it is the idea of the nitrate syndicate to make all the iodine that the world will take, but I doubt if a reduction in the price would materially increase the consumption of iodine.

MR. WHITE:

We know it is very easy to get potash from feldspar on a laboratory scale. If deposits of potash feldspar exist where it is commercially feasible to make Portland cement, it is possible as Mr. Cottrell has shown, to volatilize the potash from the cement kiln and recover it in the flue dust. It is also possible to mix feldspar with calcium carbonate and calcium chloride and by burning at a temperature of 800° C. bring the potash into soluble form. The material left after leaching might then be burned again to Portland cement. It is perhaps questionable, however, whether the process could be made to pay.

MR. BREEMAN:

The presence of potash in the dust of tubular cement furnaces, which has been referred to, is due, I think, to volatilization of potash salts. They would occur as sublimed salts like the white fumes of gunpowder (black powder) which is made up mainly of very fine solid particles of potassium carbonate. As the most volatile ingredients of the mineral substances present, these would accumulate in the dust towards the farther end of the furnace.

MR. ROBERTS:

I should like to ask, Mr. Chairman, if any experiments have been made to determine the possibility of growing these Pacific Coast kelps in other waters without reducing their power of accumulating potassium?

MR. GOLDBAUM:

Russia has for a long time exported and does now export great quantities of crude potash of which the ashes from sunflower stalks furnish a considerable part. Would it be possible or feasible to raise the sunflower plant in Western U. S. and incidentally use the stalks as an auxiliary source of potash?

MR. MOORE:

There is one point in connection with these kelps which is of great interest, and that is, on drying, the larger part of the potassium chloride comes out on the surface and can be shaken off. This makes it exceedingly easy to obtain from 40 to 50 per cent. of the potash salts contained in these kelp.

MR. CAMERON:

In answer to the question about cultivating sunflower as a source of potash, there is lots of sun out there, but where there is a lack of moisture there is an additional cost to irrigate. You see the kelps do not cost anybody anything. They have the power of absorbing very much more potassium salts than any other kelps in the world. The Atlantic kelps have not as much value commercially as the Pacific kelps, on account of their absorbing a very much smaller amount of potash.

LOSSES OF COMBINED NITROGEN.

By JOHN D. PENNOCK.

Before taking up the consideration of the losses of combined nitrogen in organic substances, to which this discussion will be chiefly confined, it may be well to devote a few words to the loss of nitrogen (1) combined in inorganic substances, and (2) the loss of nitrogen in the gaseous form freed from the oxygen of the air.

Of course, the chief source of inorganic nitrogen combined in mineral form as a natural deposit is Chile saltpeter, or nitrate of soda, formed chiefly on the western coast of South America in the province of Tarapaca, Chile.

Because of the naturally restricted confines of this mineral and the comparatively small quantity known to exist (variously estimated, at the existing rate of consumption, to supply the world's demand for 50-75 years), its conservation in every way possible is a matter of exceedingly great importance.

Now, the losses of this mineral, containing 16.4 per cent. nitrogen, which is so important to agriculture as well as the arts, may come about (1) in the mining and refining of the impure mineral, called "Caliche," and (2) in the utilization of the refined product.