At these Nottodden works cheap water power is to be had, and in many places in Sweden power may be produced for the very low rate of $3.00 per horse power year.

With the above figures in mind i. e. $3.00 worth of power for the production of one half ton of nitric acid, it is proven that the nitrate of lime as produced at Nottodden can successfully compete with Chili nitrate of soda at current prices.

The Birkeland-Eyde process being new, is susceptible to material improvement.

A new improved plant, recently put up, turns out over fifteen hundred pounds of nitric acid per killowatt year.

The much dreaded nitrogen famine so often predicted of late years, may in the very near future be entirely eliminated by electro-thermic methods for the direct fixation of atmospheric nitrogen.

FERTILIZING MATERIALS.

BY LORENZO A. WILSON

Mr. President, Ladies and Gentlemen:

The fertilizer question has been so ably handled before this Association during its nineteen meetings it would appear there was very little left to be said regarding it. My friend, Mr. Painter has told you some of the things he knows on several occasions and has also issued some very intelligent books that nearly all of you have read. During the past twelve years I have written articles myself, sending them broadcast over the State to nearly every one of you I think, and there is only left for me now the rehashing of the same matter.

There are so many growers in the State who have made such a close study of the question of plant foods and are so well-posted on it that I find it a very difficult matter to-day to get a traveling salesman to work for me, who knows as much on this subject as many members of this Association do. I have always said it was a bad plan to put a fertilizer manufacturer on this Committee as it is almost impossible for him at times to leave out some of the good things he might say of his own brands when he writes or talks on fertilizers. In the following article I have tried to write with the idea before me all the time, that I was a fertilizer broker in New York, selling materials to the manufacturers of Florida.

First I would like to say that the fertilizer industry has been very thoroughly developed in Jacksonville during the past two years. To-day the fertilizer factories of this city have a capacity for making approximately two hundred thousand tons of complete goods, if they had the market for them the year round, and the equipment to move them with.

PRICES.

The small growers of Florida buy their fertilizers cheaper to-day in this State than many of the larger buyers do on Long Island, New Jersey or Connecticut or Massachusetts. All of this has been made possible by the development of the fertilizer business in Jacksonville; the

fact that the market has grown as it has; that the materials are imported direct to this port from their points of production and the fact that the State of Florida itself produces practically the Phosphate supplies for the world. I have heard many growers say they were raising orange groves, pineapple patches and vegetable crops for the fertilizer manufacturer, as they get all the money. The question must necessarily then be of all-absorbing interest to the horticulturalists of the State.

The greater proportion of the groves and pineries are on high pine lands, which are composed of from 95 to 98 per cent. sand. The rest are mostly on hammocks that were quite rich to start on but under the draft of heavy crops of oranges their fertility was soon reduced to the same degree of poverty as the high pine lands so that the fertilizer question began to appeal to all alike and the whole country set in to study this subject.

In this article I will only take up the question of fertilizing materials, principally those that are used by the orange grower.

Under the influence of the German Kaili Works the first article that seems to interest the orange grower the most is Potash. In the modest opinion of the writer they have worked Potash rather strong on the grower, claiming for its excessive use a great many things that cannot be sustained.

The first or crude produce of the German mines is Kainit, which gives 26 per cent. of Sulphate Potash, Salt, Magnesia, etc. This is purified and the Double Manure Salts of Potash, Magnesia was formed, which gives 50 to 52 per cent. Sulphate of Potash or 26 per cent. K_2O and about 35 per cent. Sulphate of Magnesia, with 2.50 per cent. of salt. This is still further purified and the chemist obtains the almost chemically High Grade Sulphate of Potash, 90 to 96 per cent Sulphate of Potash or 49 to 52 per cent K_2O.

On account of the supposed good effect of the Sulphate of Magnesia on the soil and the fruit a great many orange growers prefer to buy Double Manure Salts, paying the difference in price and freights over the High Grade. I do not know whether they are justified or not in this belief,

I will pass over the Murate of Potash because it is so little used by the grower, its high content of chlorine or salt making it objectionable to the orange tree.

Nitrate of potash or salt petre is used to a limited extent. There are several grades, the highest 16 per cent. ammonia and 44 per cent of potash K_2O, giving the ammonia a valuation of $3 per unit per cent. we find this a little cheaper source of potash than the sulphate. At a selling price of $92 per ton at Jacksonville the 44 per cent. of Potash is worth $42 or less than $1 for each per cent. It is very quick in its action and does not seem to combine readily with the soil elements and is in great danger of being washed out by heavy rains.

The next important element in a fertilizer is the phosphoric acid, without it no blossom or seed is perfect. It is derived from a great many sources. Animal bone gives 4 to 5 per cent. ammonia and about 24 per cent. phosphoric acid of which from 6 to 10 per cent. is available to the plants, the rest gradually undergoes decomposition in the soil and it will take from three to five years for it all to become used up. Steamed bone gives

about 3 per cent. ammonia and 25 per cent. phosphoric acid and on account of its fineness is more readily available to the plants. The spent bone from the sugar refineries is treated with sulphuric acid to make its phosphoric acid available at once, and is used and sold under the name of dissolved bone black. It contains then from 16 to 18 per cent, available phosphoric acid.

Florida phosphates or fossil bone is the greatest source of phosphoric acid. This is mined in the central and southern parts of the State and immense quantities are exported to Europe. This phosphoric acid in our Florida phosphates is entirely insoluble. If it had been soluble it would not have remained, but would have been dissolved by the soil water and long since have disappeared from our country into the Gulf of Mexico. Chemistry has come to our relief in making this and other phosphatic materials available to the plant. Sulphuric acid is used in rendering water soluble the insoluble phosphoric acid in animal bone and the fossil bone in Florida. Each contains phosphoric acid and lime combined in the same proportion; one part of phosphoric acid and three parts lime which is called bone phosphate of lime, which is insoluble. Now to make the material, either bone or the Florida phosphates soluble and available to the plants it is ground and combined with sulphuric acid diluted with water to 52 per cent beaumae. The sulphuric acid has more affinity for the lime than the phosphoric acid has and combined with two parts forming sulphate of lime or land plaster, leaving the phosphoric acid combined with one part of lime which is soluble in soil water and available to the plants. The sulphuric acid combining chemically with the lime is no more sulphuric acid and there is no more danger of your getting free sulphuric acid in this preparation than you would in sulphate of potash or sulphate of ammonia. This idea of danger from free sulphuric acid is a humbug and not worthy of the slightest attention by the intelligent horticulturalists of this State, an idea advanced by a northern manufacturer. Soluble phosphoric acid is identical no matter from what source it is derived, and when some growers realize this they will save money.

One of the northern firms for the last twenty years has been trying to make the Florida grower believe that all other complete fertilizers have free sulphuric acid in them, claiming that through a secret process by steaming he makes bone, Peruvian guano and other phosphatic materials all available. This statement has been made to many growers in the State but would never be made before a fertilizer manufacturer or some one who knew because the party making this claim knows only too well there are no elements in water or steam to combine with the lime in bone or phosphate to make it available even though he should put it through a secret steaming process for seventeen years.

Peruvian Guano is another fine source of phosphoric acid. High grade will give 9 to 10 per cent. ammonia, 9 to 12 phosphoric acid partly available and three to four per cent. potash. Lower grades will give 3 to 4 per cent. ammonia, 18 to 20 per cent. Phosphoric Acid and 3 to 4 per cent. Potash. All of its phosphoric acid sooner or later becomes available in the soil. They are not susceptible of treatment with sulphuric acid.

The by-products of the slaughter houses, tankage or blood and bone furnish variable quantities of phosphoric acid and ammonia.

The next and most important element of all fertilizers is ammonia or nitrogen. it is the life, the growth of all plants. It is derived from a great many sources, which are divided into non-organic or chemical and organic. Of chemical ammoniates sulphate of ammonia heads the list, giving 25 per cent ammonia. This is one of the slowest of all, gradually changing into nitric acid in the soil. Nitrate of soda or Chili salt peter gives 17 to 19 per cent ammonia in its most available form, the nitric acid separating from the soda at once, being immediately available to the plants. As it does not readily combine with the soil elements it is in danger of being washed down below the reach of some plants by heavy rains. Nitrate of potash mentioned before has the same tendency.

In the list of organic ammoniates we have dried blood, giving 17 per cent. This changes quite quickly into nitrate with a reasonable amount of soil water. Blood and bone or tankage contains from 10 per cent. to 6 per cent. ammonia according to grade and changes rather slowly in the soil into Nitrate.

Cotton seed meal furnishes 7 1-2 to 8 per cent ammonia. Castor pomace contains from 6 to 6 1-2 per cent. ammonia. Tobacco stems furnish a small amount of ammonia from 1 to 3 per cent. and some potash, one grade giving 3 ammonia and 10 potash which is in a very available form.

You will see from the above list of ammoniates that you have quite a lot from which to choose but the intelligent horticulturalist knows that the chemical ammoniates give the best results on orange trees and I will conclude by giving an extract from an article by Mr. Herbert J. Webber, Assistant in Division of Vegetable Pathology at Washington, and who is well known to most orange growers.

"Probably no element of plant food used in the fertilization of orange trees should be more carefully considered with respect to both form and quantity than nitrogen. It is the most costly and at the same time the most dangerous element to use, as excessive applications are liable to result in extensive splitting and dropping of the fruit or in the production of the serious disease known as die-back."

"The mineral nitrogen manures, nitrate of soda and sulphate of ammonia apparently stimulate the production of fruit more than organic manures, and yet produce a fair general growth. The fruit produced by fertilization with these salts used in correct proportions with the other elements, which it is necessary to apply, is usually of good quality, being solid, rich and juicy, with thin skins and little rag. Sulphate of ammonia has the effect, growers testify, of sweetening fruit to a great extent.

"Sulphate of Ammonia has been very widely used among orange growers. Nitrate of soda has been but little used thus far, but is apparently in favor. Its insecticide and water attracting properties are probably much greater than those of sulphate of ammonia.

"Organic manures are of doubtful utility. Barn manure is largely used by many growers who still hold to the tradition that chemical manures are injurious to the plants. The benefits of barn manure in an orange grove are a serious

question. The fruits produced from nitrogen from this source are usually large, coarse, thick skinned, with abundant rag and inferior flavor. If barn manure is used and most growers have a limited quantity and desire to use what they have, it should be spread over the grove lightly so that each tree receives only a small amount. When such manure is depended upon as the main element of fertilization, liberal dressings of sulphate of potash should be occasionally applied. This will tend to correct the evils of an overbalanced nitrogenous fertilizer. What has been said as to the effects of barn manure on the quality of the fruit applies equally to the effects produced by muck, cotton seed meal, blood and bone, tankage etc. In general, organic fertilizers do not stimulate fruiting to the same extent as the mineral fertilizers. It is probably better to apply such fertilizers to annual crops, garden truck, etc.

"In fertilizing the orange, potash is most frequently used either in the form of sulphate or wood ashes.

"The noticeable effect of the potash on orange trees appears to be its aid in completing and maturing the wood; apparently an insufficiency of potash is shown by an excessive growth of weak, immature wood, which does not harden up as winter approaches and is liable to be injured by frost."

"The phosphoric acid, which is a very Florida orange lands, is mostly used in the form of dissolved bone, superphosphate, bone, bone black, raw bone, guano etc. The immediate effect of phosphoric acid on the orange tree and its fruit is little understood. Several intelligent growers claim to be able to recognize the necessary element of fertilization on effect of phosphorus starvation by the appearance of the new growth of leaves. If these, when they first push out, or while they are young and tender, present a slightly variegated appearance, mottled with light and dark green it is claimed that they are suffering from a lack of phosphorus and if a liberal application of some soluble phosphoric acid is applied this appearance may be checked. If this can be shown to be the case it will prove a valuable index to the available quality of phosphorus in the soil. A similar appearance may, however, appear in light cases of so-called frenching, a disease, or more properly a symptom of disease which is not uncommon. Phosphorus starvation may have some effect in inducing this disease."

Having watched the irrigation question since the dry Spring of 1890 I can say that not one plant in a hundred has paid a dividend on orange groves. If the trees are properly fertilized early in the season and kept cultivated until the rainy season sets in, I do not think that irrigation need be resorted to.