Bearing Coffee Trees, Makaha Coffee Company, Makaha, Oahu

verse agriculture can be built up, coupled with excellent transportation facilities, rendering it possible to place the products from Makaha Plantation upon the markets in the very pink of condition.

The company, in order to make their property available, have constructed a road some four miles in length, which connects with the station established by the O. R. & L. Co.

Concerning the addition of new cultures and new industries to the Makaha Coffee Company's lands, there yet remains a wide field for development along those lines, which in time will be embodied in the scope of their operations.

Following is the list of officers and principal owners in the above estate:

W. H. Hoogs, President.
Frank Hustace, Vice President.
W. George Ashley, Treasurer.
J. S. Walker, Secretary.
James A. Low, Auditor.
W. Ellerbrock, Superintendent.

HAWAIIAN FERTILIZER CO., LTD

The manufacture of fertilizers is so closely allied with the sugar industry of the islands that any information bearing upon that all-important subject is read with considerable interest.

The Hawaiian Fertilizer Company, Limited, was established many years ago by Mr. Frank Cooke, who conducted the concern quite successfully until absorbed by the firms of Brewer & Co., Alexander & Baldwin and Castle & Cooke, all of Honolulu. Under the incorporation many extensive improvements have been made in the way of buildings and machinery.

The works of the company cover an area of four acres within one half of a mile from Honolulu, where are manufactured all grades of mixed fertilizers, and where are handled all grades of raw material used as fertilizers or fertilizer ingredients.

The magnitude of the operations of this company can be thoroughly appreciated when it is known that all the ingredients used in the manufacture of high grade fertilizers are purchased in shipload lots direct, such as refined nitrate of soda from Chile, acid phosphates from South Carolina and Florida, bone meal from Calcutta, sulphate of ammonia from England, etc. Tankage and dried blood are used extensively as ingredients in mixed fertilizers, which come from Western packing houses, and consist of bone, blood and flesh, ground to a very fine state.

In the process of manipulation and manufacture much room and many buildings are required of large dimensions, the floors of which are laid with concrete. In addition to the above a most complete chemist's department is maintained, where soils and fertilizers are analyzed, soils for the purpose of determining a recommendation for fertilizers, and the fertilizers for the purpose of keeping the goods up to the standard.

The carrying of a large stock of fertilizer ingredients is made imperative, owing to the different weather conditions on the various islands and the varied character of the soils, each plantation having its own formula. This necessitates the carrying of large stocks of raw materials. Of late many plantations are using large quantities of island coral, which is finely ground and mixed with nitrate of soda, and in this manner placed upon the soil. The object in using the ground coral is for supplying soil with that necessary ingredient, lime, which is deficient in the soil on many of the plantations.

Many of the plantations throughout the islands adopt their own formula, while a number are guided to some extent by the laboratory connected with the above works. The trade in nitrate of soda has increased enormously the past few years. This is one of the ingredients of mixed fertilizers, although many of the plantations are applying it to the lands in a raw state. Acid phosphates are also used very extensively; sulphate of ammonia, which enters largely into the manufacture of fertilizers, is the product of the gas works of England, which country supplies the world's market with that product.

For the storing of fertilizer material there have been erected several large buildings having a combined capacity for holding 12,000 tons. The entire mechanical appliances connected with the works, such as mills, mixers, screens, bagging machinery, etc., are operated by steam power.

The constant daily shipping of sacked fertilizers to the various plantations calls for a large amount of trucking and drayage, which is performed by the company, who maintain a large number of trucks and horses.

The Hawaiian Fertilizer Company has for years kept in close touch with the sugar cane growers of the islands, supplying them annually with fertilizers, and has ascertained by actual experiments and by consultation the mixtures best adapted for the various plantations, thereby producing cane of the greatest purity and highest sugar content.

In conclusion it can be stated that through the agency of the above fertilizer works many of the plantations have been enabled to maintain for years an evenness of growth and an increased mill output.

Following is the list of officers comprising the company:

J. B. Atherton, President.
C. M. Cooke, Vice President.
George R. Carter, Treasurer and Manager.
J. P. Cooke, Secretary.
E. F. Bishop, E. D. Tenney, Directors.
J. T. Crawley, Superintendent and Chemist.

FERTILIZING OF CANE SOILS

By J. T. CRAWLEY

In view of the general belief that the methods of fertilizing in the Hawaiian Islands are as good as obtain in perhaps any sugar country, and possibly better than in any other tropical country devoted to the growing of sugar, it would seem that it would interest the readers of the Louisiana Planter to give an account of these methods together with their practical results. It would seem that a discussion of these methods would be specially pertinent at this time, because of the numerous tropical islands that we have recently become possessed of, and the paramount importance of the sugar business in these islands. The great interest attached to the question here is not that we have worked out one method of applying fertilizers for cane under all circumstances, but from the fact that our soils are so very different the one from the other, and that the climatic differences are so great in going from one district to another, and that each of these problems has been taken up separately and attacked in a scientific way. The fertilizer business has developed very fast in recent years; the kinds used and the methods of application have materially changed.

Previous to, say, ten years ago a great deal of bone meal and purely animal fertilizers, with occasional additions of potash salts, was used. This bone meal in many cases was too coarse for the plant to utilize, and was applied regardless of climatic conditions—in districts of 150 inches of rainfall per year and in other districts with but little more than twenty inches per year. Indeed in some of these districts the argument was used that the bone meal would permanently enrich the soil—a contention that is doubtless true, for it is said that this same bone meal has been dug up unchanged after lying in the soil for three years or more! A good many chemical analyses by the old methods were made of the soil by parties outside the islands, and fertilizers recommended according to these analyses, but the fertilizers themselves were rarely analyzed. This left the situation very much the same that we found in the States prior to the establishment of the various State experiment stations. Of course, under these conditions the planters did not always get an article up to the guarantee, nor yet an article suited to the conditions.

Six or seven years ago the Pacific Guano and Fertilizer Company was formed in Honolulu, for the purpose of manufacturing high-grade fertilizers, and Dr. Averdam, a German of considerable experience in the phosphate and fertilizer trade, was put in charge. This marks the first important epoch in the development of the business, as Dr. Averdam brought with him the ideas of soluble fertilizers that have been worked out so well both in Europe and in the United States. An acid plant was erected, phosphates imported from Laysan Island and manufactured into acid phosphate. Most of the fertilizer now sold by this company contains its phosphoric acid in a water-soluble form, from dissolved phosphates, the ammonia from sulphate of ammonium and the potash from muriate and sulphate of potash.

In 1895 the Hawaiian Experiment Station was established by the Sugar Planters' Association, with Dr. Maxwell as director and the writer as assistant director and chemist. Then began a systematic examination of soils both in place and in the laboratory, together with the collection of data as to rainfall and temperature, which has been the basis of much of the fertilizing that has been done since that time. It is not claimed here nor in what is to follow, that all improvements in fertilizing made since 1895 are due to the investigations of the Experiment Station and its recommendations, for some plantations have not changed their fertilizers, while many others have been guided from without; but it is due, in a great measure, to these investigations of the conditions of each plantation that the fertilizers used in one district are so different now from those used in another district, and that there is a constant tendency toward high grade fertilizers—fertilizers specially prepared for the plantation where they are to be applied.

Fertilizers have been used here for many years, but those used at first, from necessity in an experimental way, did not give the satisfaction that was expected. Raw bone meal, dissolved bone meal, fish scrap and fertilizers containing a large quantity of undissolved phosphates, were used regardless of soil and climatic conditions. The consequences were that while in wet districts the results were often good, in dry districts they were usually negative. Where the results were favorable bone meal came into favor, since this was a large ingredient of fertilizers. The following formula will represent many of these fertilizers:

Phosphoric acid, 12 to 15 per cent, 2-3 soluble and available.

Potash, 5 per cent, with no guarantee of its source.

Ammonia, 4 per cent, with no guarantee of its source.

Regardless of the fact that very few planters had their fertilizers analyzed, the above formula left ample margin for putting in inferior and unsuitable ingredients. We are not surprised then that hair and hoof meal was largely in evidence, and that nitrate of soda was furnished in fertilizers, because of its low price in San Francisco, intended for plantations even of 150 to 200 inches of rainfall per year. Examples of a few districts, their present mode of fertilizing and the reasons therefor will illustrate the subject of this paper.

ISLAND OF HAWAII.

Hilo District—The rainfall is very great, reaching occasionally 200 inches per annum. The soils are comparatively thin, often in the uplands being scarcely four inches in depth, resting upon an impervious subsoil from a reddish to a yellow color. This subsoil is raw and poisonous to plant life, consequently the deepening of the staple by subsoiling must be done very slowly and carefully. The following analysis represents an average of six samples analyzed by the Hawaiian Experiment Station:

Soils of the Hilo District—

Nitrogen	.633%
Phosphoric acid	.504%
Potash	.257%
Lime	.128%

These percentages, with the exception of lime, would seem to be satisfactory, but it must be remembered that these are old soils, and the heavy rainfall tends to wash out the soluble and available elements, and leave the insoluble and unavailable elements. This is notably the case with lime. The lime content of most Hawaiian soils is high, but in Hilo it has been largely washed out.

As illustrating this we give below the lime content of Hawaiian soils by districts:

Hawaii—

	Per cent.
Hilo District lime	.128
Hamakua District lime	.187
Kohala District lime	.240
Kau District lime	1.090
Oahu lime	.380
Maui	.395
Kauai	.418

When we come to consider the available lime as determined by any reliable method we find this difference between Hilo and the dryer districts even more marked. The following analyses were made by the aspartic acid method as devised by the Hawaiian Experiment Station, to determine the available plant food:

Available (pounds per acre) plant food in Hilo soils—

Lime	174 lbs per acre
Potash	78 lbs per acre
Phos. acid	29 lbs per acre

The lime shows the effects of cropping and a large rainfall. This same method applied to many of the soils of the dry districts would show an available lime content of from 2000 to 5000 pounds per acre. The land needs lime, and in some cases this is being supplied in the form of coral from Honolulu, caustic lime from the States, or in commercial fertilizers as lime phosphate and gypsum. Some planters have applied lime without seeing any beneficial effects, but we fancy that this is because an immediate effect is looked for as in the case of commercial fertilizers, whereas it can only be seen in a very gradual improvement, probably covering a period of a good many years.

Potash—It is only within the past few years that it has been proved that in a great many cases potash is deficient in Hawaiian soils, and there is now a tendency toward an increased use of potash. This is notably the case in the Hilo and Hamakua districts of the Island of Hawaii, where the potash in the fertilizers often reaches 15 per cent and even higher. Where muriate of potash is applied to the soil the chlorine unites with the lime, and this being soluble, is washed out by the heavy rains. This would tend to deplete the land of lime, and for that reason muriate of potash is not used to any extent in regions of heavy rainfall. Sulphate of lime resulting from the application of sulphate of potash is not so soluble and for that reason is now generally used.

Ammonia—Nitrates, by reason of their solubility and tendency to wash out, evidently cannot be used with safety. Sulphate of ammonium is not open to the same objections, but most of the planters of Hilo prefer, and we believe with reason, to derive the greater part of the ammonia from organic material. Bone meal in past years has been used in large quantities, both alone and in connection with other fertilizers. The writer believes with Dr. Maxwell and certain of the plantation managers, that it is the ammonia and not the phosphoric acid of the bone meal that does the greatest good to the cane. Following this idea up we have recommended that tankage and fish scrap containing a large percentage of ammonia be used instead of bone meal. The most rational method of fertilizing with this article would seem to be the following:

Tankage of 10 per cent ammonia and 10 per cent phosporic acid, or 11 per cent ammonia and 8 per cent phosphoric acid, is applied in the furrow with the seed. After the cane is growing this is followed up by a top dressing of a high grade fertilizer containing a large percentage of potash in the form of sulphate of potash, a smaller quantity each of phosphoric acid and ammonia in readily available forms. In this way the most insoluble part of the fertilizer, the tankage, becomes well incorporated with the soil, and at the roots of the plants where it is most liable to be acted upon by the plant acids. Moreover, whatever particles of bone or flesh are not taken up by the crop of plant cane are in a position to be taken up by the second or rattoon crop. In this way it will be in contact with the roots of the cane for two years or more, and in that time all of the available ingredients should be utilized. The high grade soluble fertilizer is applied only to the growing crop, and in such condition as to be taken up at once. We might add here that this method in a modined form has been tried on one plantation with good results and is now being tried on others.

Hamakua District—The rainfall, besides being rather small for a sugar crop, is very uncertain. Some years are very dry while others have ample rainfall, provided it come at the right seasons. Occasionally there are very heavy rains which, because of the very porous condition of the soil, would tend to wash out all soluble ingredients not held by the soil itself. Cane is planted all the way from near sea level to 1500 or 2000 feet elevation. The uplands here, as in most Hawaiian lands, have a heavier rainfall than the lowlands.

Hamakua soils (Hawaiian Ex. Sta.) average of fourteen samples—

	Per cent.
Lime	.187
Phosphoric acid	.566
Potash	.264
Nitrogen	.572

The total potash is rather small and the lime also. The available potash here, as in Hilo, is small and the potash percentage in fertilizers has recently been increased. Sulpuate of ammonium is used almost exclusively to furnish the ammonia, while nitrate of soda, because of the uncertainty of the rainfall, is sparingly used, and is not held in much esteem. Fertilizers used in this district have about the following composition:

8% phosphoric acid soluble and available.
8% ammonia from sulphate of ammonia.
Potash from sulphate of potash varying from 8 to 15 per cent.

On certain plantations fertilizers have shown wonderful results. In two well-known cases the yield of sugar has recently increased from one or two tons to four or five tons per acre. Indeed, it is doubtful if some of the Hamakua plantations would pay for the cultivation were it not for the large use of commercial fertilizers.

A peculiar problem presents itself in this district. Most of the available cane lands at a low elevation have been taken in, and the only places where the plantations can develop further are in the uplands. These uplands are covered with a heavy growth of ferns and trees, and the nitrogen content of the soil is high, usually over 1 per cent. The first crop of cane is green and vigorous, producing, say, four or five tons of sugar per acre. This seems to exhaust the soil and the second crop is very small; and it takes several years to again produce a normal crop. This question was presented to Professor Hilgard by Andrew Moore, the manager of the Paauhau plantation, and he made some very exhaustive analyses of the soils. His conclusion was that, notwithstanding the large nitrogen content, it is so bound up with the organic matter as to be practically unavailable to the plant; that the first crop exhausts the soil of its available nitrogen. He recommended a small dose of nitrate of soda to supply the available nitrogen. His conclusions, we believe, have been partially borne out by results, though the planters still prefer the use of sulphate of ammonium rather than nitrate of soda. It is not alone in Hamakua that a dearth of available nitrogen is seen in soils of a high nitrogen content. It might be said that as a rule the nitrogen content of Hawaiian soils is rather high, as compared with the soils of other countries, and yet in almost all cases the application of ammonium compounds and organic matter gives better results and shows more quickly than any other fertilizer ingredient.

Kohala District—The rainfall is small and even more uncertain than in Hamakua.