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TABLE OF CONTENTS.

DIVISION OF FORESTRY.

FOREST AND ORNAMENTAL TREE SEED AND SEEDLINGS FOR SALE AT THE GOVERNMENT NURSERY.

The Division of Forestry keeps constantly on hand at the Government Nursery, seed and seedlings of the important native and introduced trees. These are sold at prices just covering the cost of collection or growing.

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RALPH S. HOSMER,
Superintendent of Forestry.

DIVISION OF ENTOMOLOGY.

To give information about insects free of charge is one of the duties of this Division and Hawaiian readers are hereby invited to make inquiry in person and by mail. In order to be able to advise intelligently or send the right kind of useful insects for relief we like and sometimes it is indispensable for us to see the insect suspected or caught in the act, also specimens of the injury. In a tin with a hole or two, or a wooden box specimens may be mailed at 3rd class rates. When specimens are not accompanied by letter *always* write your name and address in the upper left-hand corner of the package. Address all communications SUPERINTENDENT DIVISION OF ENTOMOLOGY, P. O. BOX 207, HONOLULU, HAWAII.

EDW. M. EHRHORN,
Superintendent.

THE HAWAIIAN

FORESTER & AGRICULTURIST

VOL. VIII. MAY, 1911. No. 5.

The palm weevil is attacking sugar cane in Trinidad.

An article in the Agricultural News (W. I.) on the fungus causing pineapple disease quotes Cobb and L. D. Larsen, the latter from a bulletin of the Hawaiian Sugar Planters' Association, upon the pest as affecting sugar cane and pineapples in these islands.

This number of The Forester contains the conclusion of the valuable series of articles on "Soil Amelioration," by Mr. Hagens, and that of Professor MacCaughey's paper on "The Use of Plant Materials in Nature Study Teaching," which ought to be of great service to school teachers.

The Tropical Agriculturist of Ceylon is reprinting from this magazine the article of Mr. F. G. Krauss on rice and cotton investigations in China and Japan, also the study of the composition of the rice plant by W. P. Kelley and Alice R. Thompson from a bulletin of the Hawaii Experiment Station.

At a meeting of the general purposes committee of the International Rubber Exhibition, to open in London on June 24 and close on July 14, the president, Sir Henry A. Blake, G. C. M. G., gave a statement of countries that he had been informed were exhibiting officially, among them being the Hawaiian Islands.

"Forest Nurseries for Schools" is the title of Farmers' Bulletin No. 423 of the U. S. Department of Agriculture. It is by Walter M. Moore, first assistant, and Edwin R. Jackson, expert, of the Forest Service. Circular No. 99, from the office of Experiment Stations, is entitled "Farmers' Institutes for Young People," the authors being John Hamilton and J. M. Stedman, specialist and assistant specialist respectively. Both of these treatises would undoubtedly be useful in all schools where agriculture and forestry are in anywise taught.

In its March number the Philippine Agricultural Review gives, from the census reports, a synopsis of the development of the sugar industry in Hawaii, translating values into Philippine terms.

An exchange quotes the Straits Bulletin as containing an article by Dr. Boon Keng recommending pineapples as a good catch-crop between Hevea rubber trees, if widely planted. With the trees set 30 by 15 feet apart, "the pineapples should be planted three feet away from each rubber plant, and the lines should be arranged on hill slopes that they serve as terraces to prevent too much wash from rain water. In this way we can get in, say, about 2000 pineapple plants in an acre."

In a collection of banana planting news, Tropical Life for April states that, from the results now published regarding the industry in Trinidad, W. I., "it appears probable that a profit of $200 per acre may be expected from the intensive cultivation of bananas under the present conditions and prices if an adequate dressing of pen manure is available at a reasonable cost. The cheapest method of obtaining pen manure is from pens on the cultivation, and with a supply of green fodder within reasonable distances a small profit on the stock might also be expected."

Noel Deerr is author of a new book entitled Cane Sugar, which a review in the Agricultural News (W. I.) says "virtually forms a new and extended edition of the author's well-known text-book Sugar and the Sugar Cane." Mentioning various matters treated in one chapter, the review says that irrigation "naturally occupies a fairly prominent position in view of the author's experience in Hawaii." Fault is found with the handling of rotation, in that "there is very scant reference to its bearing on the control of insect and fungus pests." Norman Rodger, Altrincham, is the publisher.

Mr. James is welcomed as a contributor to The Forester's pages of practical information. His article on the effect of fertilizers on the growth of pineapples can scarcely fail to prove of highest value to the pineapple industry. It is based upon experiment on a considerably large scale. A series of articles on the same subject, it may be mentioned, is running in the Tropical Agriculturist of Ceylon, the leading topic of the portion given in March being "the effect of fertilizers upon the quality of the fruit." A. W. Blair and R. N. Wilson are the authors, and their plotting of the ground appears to be much like that of Mr. James. Blood, which Mr. James dismisses on account of its being practically unavailable, enters into nearly all of the fertilizers tested by the Ceylon experimenters.

BOOK REVIEW.

"Notes on Soil and Plant Sanitation on Cacao and Rubber Estates," is the title of a book lately received from London. Its author is Mr. Harold Hamel Smith, who has written other books and is editor of Tropical Life, one of our most valued exchanges. There is an introduction by Professor Wyndham Dunstan, Director of the Imperial Institute, who wisely suggests that, since agriculture is a profession, tropical agriculture must be taught by trained professors at a college situated in the tropics. This suggestion may fairly be treasured by the authorities of this Territory, as the nucleus of a vision of the College of Hawaii becoming a world university of tropical agriculture. As a matter of fact, methods of doing things in Hawaii are quoted by periodicals devoted to tropical agriculture in every quarter of the globe, and the very book here under brief review contains much of reference to rubber experiments in Hawaii.

Including the index the book contains 632 pages, besides fifty-two pages of prefatory matter. The author pleads the necessity of treating plant diseases the same as maladies affecting human beings, with regard both to prevention and eradication. A score or more of authorities are quoted, including our own Messrs. Jared G. Smith and E. V. Wilcox, in confirmation of the views advanced and elucidation of cultural methods presented. Among many illustrations in the book two are from Hawaiian photographs. Horner's deep tillage implement and Horner's cultivator, used on Hawaiian sugar plantations, are mentioned as having been recommended for rubber and cacao plantations by Mr. Frank Evans, attached to the Trinidad agricultural department, but temporarily engaged by the Hawaiian Sugar Planters' Association. "Why Hawaii Suits Ceara" is the leading topic of Part V of the book.

There is valuable information in the volume, supported by leading authorities, on the advantages of forest and isolation belts, or of stump pulling, the evils of deforestation, and the serious losses occasioned by soil erosion, reduced or uncertain rainfalls, etc., and how they can be avoided or partially remedied. Several emphatic pages are devoted to rat extermination. It is stated that the present epidemic of plague in India, from its appearance in 1896 up to April last year, had caused 5,250,000 deaths. Plague is universally conceded to be disseminated chiefly by rats.

John Bale, Sons & Danielson, Ltd., medical publishers, Oxford House, 83-91 Great Titchfield street, London, W., are publishers of the book, whose price is $2 net.

THE CEARA RUBBER TREE.

Nahiku, Maui, May 4, 1911.

Editor Forester and Agriculturist:—I beg to enclose herewith an extract from a very interesting article on the Ceara rubber tree, which has been found to be the tree best suited to our local conditions, for cultivation.

The prejudice against this tree for plantation purposes is being gradually removed, and it occurs to me that this article may prove of interest to your readers, both as indicating the position of a recognized authority, and as tending to show that the Ceara tree appears to have found the Hawaiian climate peculiarly favorable for latex production.

Very truly yours,

W. A. ANDERSON.

Extract from Paper by William Wicherley, F. R. H. S., in the Rubber World for Dec. 29, 1910, on the Ceara Rubber Tree (Manihot Glaziovii).

"The Manihot Glaziovii, which produces the Ceara rubber of commerce, enjoys a much wider sovereignty as plantation rubber then does the Hevea or Para rubber tree, and it is therefore astonishing to find existing throughout the whole of the Mid-East a grounded prejudice against this valuable and exceedingly profitable tree. . . .

"After making careful inquiries in other districts, I found that the real cause why these trees had been condemned was that the planter, after having got his tree to maturity, did not know what to do with it; and there appeared to be nobody who could assist him in the matter. The areas of Ceara rubber that would be priceless now as producing lands had been sacrificed to this want of knowledge.

"From my own observation I should say that the tree, which was introduced into Ceylon by the botanist Cross, was from seed obtained in the Rio de Janeiro district, with the result that most of the Ceara in Ceylon is of a hybrid character, and therefore the true Manihot is only met with in a few isolated districts. It is, nevertheless, a very good tree, and, if properly handled, will *always be more profitable to the planter than any other kind of rubber he can grow,* provided that the district and the rainfall are suitable."

The paper goes on to describe proper conditions and methods of cultivation and continues:

"There should not be the slightest difficulty associated with the

tapping of this tree; yet throughout both Ceylon and Southern India planters unanimously agree that this difficulty does exist."

He then describes at length the proper method of tapping, which is now being tried at Nahiku, and concludes:

"In many cases, alienated Manihots assimilate habits of marked eccentricity, due doubtless to local climatic conditions and environment, against which it is powerless to struggle in a proud attempt to assert its own inherited characteristics. This is very marked in regard to the behavior of the latex, which is generally thick and sluggish of movement, and therefore extremely difficult to manipulate except in the form of 'scrap' or naturally coagulated 'ball' rubber. In Ceylon, however, and also to a large extent in India, Hawaii and the Philippines, the Ceara tree yields a latex as fluid and as ready as that of Hevea, with the result that a very fine, translucent, elastic, resilient, amber colored 'biscuit' is being produced, and is being much sought after by tire manufacturers all over the world."

SOIL AMELIORATION.

By J. F. C. Hagens.

III.

(Concluded.)

Correction of unfavorable conditions due to the natural location.

TERRACING.

In a hilly country it is frequently observed that while the hill-tops and slopes produce but scant crops, the hollows show a very much better growth. This is due not only to displacement of the fertile clay and silt of the surface soil by rain and other natural causes, but also to a certain degree to human influence in the course of cultivation. After a heavy rain storm in these islands, the sea is often colored for a considerable distance beyond the mouths of the mountain streams. This is caused by the fine soil particles, consisting mostly of the valuable clay, carried away by the rain, and always means a heavy loss to the landowner. It is, as a rule, exceedingly difficult to stay this natural denuding of the soils, particularly with steep slopes, yet there are often ways by which much of the valuable soil, so washed away, could be preserved to agriculture. As a matter of fact the greater portion of soil particles, especially the so-called silt, carried away by the water, will precipitate wherever the rapid flow of the water is arrested. The formation of large banks of detritus at the mouth of large rivers on the mainland proves this sufficiently. A great

deal of valuable soil, that would otherwise be washed away every year, can be retained by terracing the hillsides and heavy slopes. Were it not for such terracing the grape vine would not grow in many parts of Europe today. It is not always possible to carry out these principles, but where stones and wood are available in sufficient quantities a great deal can be accomplished to save the land from gradual impoverishment. Stone walls or fascines built at certain intervals across the slopes or hollows will tend to arrest the rapid flow of the water during a rain storm and cause the precipitation of much of the soil particles carried along by the water.

WINDBREAKS.

Soils of a sandy or dusty nature are often carried away by strong winds during a dry season. It is extremely difficult to prevent this but often the planting of suitable trees in rows at regular intervals has been found very beneficial.

Improving the mechanical and physical condition of soils.

LIMING.

Usually all soils contain sufficient lime to serve as plantfood for any number of crops, although the form in which the lime is present may not be suitable for certain plants. Lime is, however, frequently used to correct unfavorable mechanical, physical or chemical condition of soils. The reasons for the use of lime on soils are manifold and consequently it is important to know which form of lime to use in order to produce the best results under the prevailing circumstances. It depends entirely upon the soil to be treated, and the object of the treatment. It is easy enough for a chemist to say, "Your soil needs lime, you should apply, say, 1000 lbs. of burnt or slaked lime per acre and you will see a great improvement." Very often this improvement fails to materialize, and it is not seldom that reverse results are produced or the results will only show after several years. The fact of the matter is it is extremely difficult to determine, from a chemical analysis alone, in what form the lime should be applied to a given soil; many other circumstances have to be taken into consideration. There is usually no other course to pursue than a practical experiment in the field.

The forms in which lime is usually applied are as follows:
Quicklime, powdered, slaked or hydrated.
Carbonate of Lime.
Sulphate of Lime (gypsum or land plaster).
Phosphate of Lime (as mono-, di-and-tricalcium phosphate).

Each of these has its special advantage and disadvantage, and under certain conditions will do better than any of the others.

MANURING.

The use of stable manure, organic waste products as also concentrated organic manures is not alone beneficial from a standpoint of increasing the fertility of a soil, but it also improves its mechanical and physical condition, to say nothing of the valuable services rendered through the presence of favorable bacteria usually found in these products. The waterholding power, the permeability and the temperature of the soil are favorably affected by these organic manures. Soils are often dead or sterile owing to the lack of humus, although a chemical analysis may show the presence of sufficient plant food for any number of crops. A suitable treatment with organic manure will render these fertile. When mixed with chemical fertilizers organic manures are sterilized more or less, whereby their favorable bacterial action on the soil is practically destroyed. Wherever possible they should be used alone, therefore.

CORRECTION OF ACIDITY OR ALKALINITY.

Good arable soils should be neutral in their chemical reaction, or nearly so, to be fertile; a more or less pronounced acidity or alkalinity is harmful to plant-life. To correct such unfavorable conditions the underlying causes must first of all be ascertained before deciding on the proper remedy. Most acids, with perhaps the exception of carbonic acid, are injurious to plant-life. Lime in one form or other is the usual antidote against soil acidity; others are wood ashes, carbonate of potash, etc. Neutralizing an alkaline soil depends chiefly on the nature of the alkali present. Superphosphate is often a good remedy, but frequently special treatment with acid material is necessary to overcome the causes of sterility.

GENERAL.

The inoculation of soils with nitrifying bacteria is of great value in the improvement of soils, likewise the use of carbon bisulfide.

THE EFFECT OF FERTILIZERS ON THE GROWTH OF PINEAPPLES.

By Carlton C. James.

BIBLIOGRAPHY.

In reviewing the literature with a view to finding out what had previously been done along this line, it was noticed that the bibliography of the pineapple plant is short and confined almost entirely to the reports of experimental stations and brief technical articles concerning the analysis of pineapple fruit. These articles are scattered and in some cases difficult to obtain. It will readily be seen that this bibliography is not complete, but represents the articles and publications to which we have had access and which have been consulted. The papers bearing directly upon the effect of manures and fertilizers upon the pineapple number less than ten. Among these should be mentioned the bulletins of the Florida Agricultural Experiment Station, Porto Rico Experiment Stations and the Department of Agriculture and Stock, Queensland. Little, if any, literature is available from the Philippine Islands and Straits Settlements, although it is well known that extensive pineapple operations are carried on there.

Curiously enough while dilatory experiments have been made in Hawaii from time to time, results were either not obtained or else were not deemed worthy of publication, for local literature upon the subject is decidedly meagre. It should be mentioned, however, that experiments have been started by the Hawaii Agricultural Experiment Station, the results of which have not yet been published.

Ananas—Paul Hubert—Paris, 1908.

Annual Report, Department of Public Gardens and Board of Agriculture, Jamaica, 1900 and 1903.

Annual Report, Hawaiian Experiment Station, 1904-7-9.

Annual Report of the Porto Rico Agricultural Experiment Station, 1906-7-8.

Bananes et Ananas—Yves Henry—Paris, 1905.

Chemical Composition of Some Tropical Fruits, Bulletin 87, Bureau of Chemistry.

Experiments with Pineapples, Florida Agricultural Experiment Station, Bulletin 27, November, 1894.

Fruits of Queensland, A. H. Benson, Brisbane, 1906.

Manganese in some of its relations to the growth of Pineapples, W. P. Kelley—Jour. Ind., and Eng. Chemistry Vol. 1, No. 8, p. 533.

Neuere Untersuchungen uber Ananasfrüchte—W. Bonewitz, Chemiker Zeitung No. 15, 1908.

Pineapple Culture—Soils—Florida Agricultural Experiment Station, Bulletin 68, 1903.

Pineapple Culture—Varieties, Florida Agricultural Experiment Station, Bulletin 70, 1904.

Pineapple Culture—Fertilizer Experiments, Florida Agricultural Experiment Station, Bulletin 83, 1906.

Pineapple Culture—Handling the Crop, Florida Agricultural Experiment Station, Bulletin 84, 1906.

Pineapple Culture—Effect of Fertilizers on Quality of Fruit —Florida Agricultural Experiment Station, Bulletin 101, 1910.

Pineapple Growing—P. H. Rolfs, Farmers' Bulletin No. 140.

Pineapple Growing in Florida, H. H. Hume, "Tropical Life," August, 1908.

Pineapple Growing in Porto Rico, Bulletin 8, Porto Rico Agricultural Experiment Station.

Report of Board of Agriculture—Jamaica—1902.

Report of the Department of Agriculture and Stock, Queensland, 1904-5-6.

HISTORICAL.

The pineapple industry is comparatively young in Hawaii, but has grown rapidly and is well established. Naturally the first work was the exploration of the possibilities of the industry, then the exploitation and financing, and finally we find a tendency toward conservation and thrift. Not until about three years ago was a determined and systematic search made for an effective pineapple fertilizer, and the attention of the growers attracted to the fact that such a material was becoming necessary. Previous to this time the pineapple soils had been analyzed by various chemists[1] and phosphoric acid recommended. This was applied in about all the various forms, mainly as basic slag, with more or less uncertain success. Steamed bonemeal and reverted superphosphate were said to have given equally good results. A few haphazard tests were initiated by different people but were never carried to completion.

During the year 1907 and spring of 1908 material was gathered, conditions observed, and plans made for the experiments reported in the paper. The piece of land selected was cheerfully placed at the writer's diposal, by Messrs. Ginaca Bros. It was plowed, harrowed and put into condition to receive the plants which were set June 15, 1908.

OBJECT.

The experiment had for its object the determination of the fertilizer best suited to the particular requirements of the pineapple, the effect of phosphoric acid, nitrogen and potash in their different forms upon the life and growth of the plant, and approximately the quantity necessary for its proper nourishment. We were also desirous of determining if the experinece gained in other

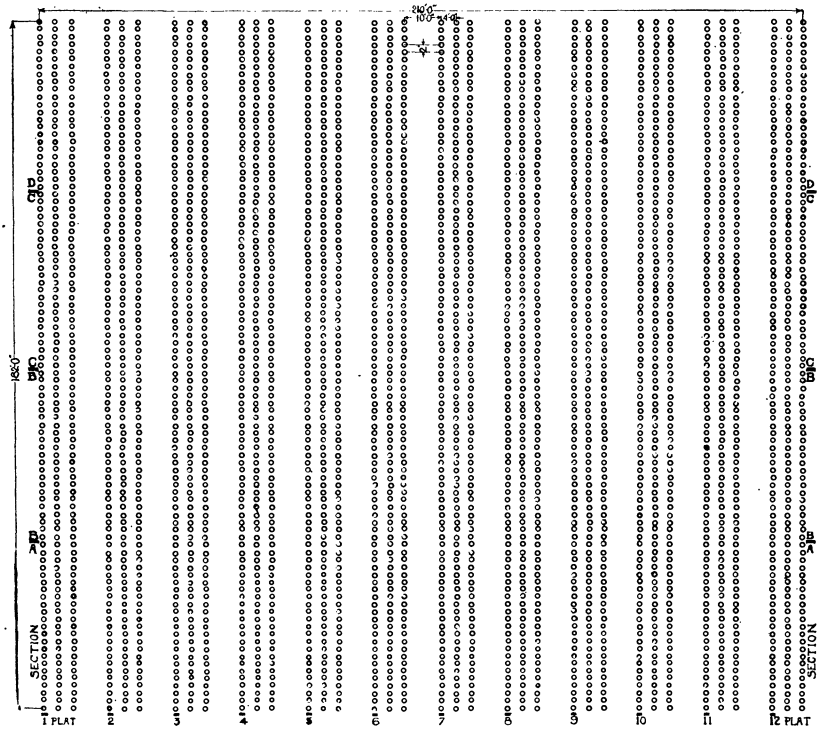
[1] Annual Reports, Hawaii Agr. Exp. Sta. 1904-1907-1909.

pineapple sections were applicable to conditions as they exist in Hawaii.

GENERAL PLAN OF EXPERIMENT.

The ground selected for the experiment, about one acre in area, is situated in Waimea on the island of Oahu. It has an elevation of about 535 feet and a six per cent. grade in a directly westerly direction. It was the writer's intention to obtain a piece

General Plan of Experiment.



of land which had already been cropped to pineapples for some time, but, as no such land was available in this locality, he was content with this piece of virgin soil. Samples of soil and subsoil were taken from forty-eight places corresponding to the forty-eight sections into which the experiment was divided. These were later combined into one average sample each of soil and subsoil which were analyzed mechanically and chemically with the results which are given below in comparison with Florida, Australian and Jamaica soils:

SOIL ANALYSIS.

MECHANICAL ANALYSIS.

	Diam. in m.m.	Waimea Soil	Waimea Sub-soil	Florida Exp. Sta.[1] Soil	Florida Exp. Sta.[1] Sub-soil	Australian[2] Soil	Jamaica[3] Soil
		%	%	%	%	%	%
Rock and gravel	2.0 —1.0	0.43	0.32	1.66	2.24	2.8	2.74
Coarse sand	1.0 —0.5	0.66	0.71	28.78	29.32	14.6	4.05
Fine sand	5.5 —0.1	0.95	0.89	43.30	43.16	32.2	30.62
Very fine sand	0.1 — .05	1.16	0.83	22.92	22.92	5.4	.....
Silt	.05— .02	46.53	48.65	0.74	1.12	9.6	55.59
Very fine silt	.02— .01	.....	.....	0.00	0.04	3.4	0.81
Clay		34.43	36.80	0.26	0.36	23.5	0.83
Organic		15.84	11.80	1.38	0.20	....	25.34

CHEMICAL ANALYSIS.

	Waimea Soil	Waimea Sub-soil	Florida Exp. Sta.[1] Soil	Florida Exp. Sta.[1] Sub-soil	Australian[2] Soil	Jamaica[3] Soil
	%	%	%	%	%	%
Insoluble matter	40.800	42.400	99.370	99.567	79.750	18.17
Soluble silica	3.680	5.270	0.013	0.016	0.410	.....
Potash	0.515	0.470	0.006	0.005	0.079	0.17
Soda	0.840	0.450	.....	.....	0.090	.....
Lime	0.392	0.510	0.008	0.000	0.110	0.25
Magnesia	0.224	0.253	0.006	0.005	0.150	.....
Ferric oxide and alumina	37.220	38.338	0.017	0.177	12.360	.....
Phosphorus pentoxide	0.165	0.362	0.008	0.006	0.081	0.39
Carbon dioxide	.....	.....	.....	.....	0.048	.....
Volatile	15.820	11.800	0.420	0.248	.....	25.34
Manganese oxide	0.450	0.570	.....	.....	.....	.....
Nitrogen	0.324	0.122	0.010	0.005	0.084	0.13
Hygroscopic moisture (air dry)	10.770	16.750	.....	.....	{ 2.030 3.290	5.66

[1] Bulletin 83, Florida Agricultural Experiment Station, 1906.
[2] Report Department of Agriculture and Stock, Queensland, 1906-1907.
[3] Report Board of Agriculture, 1902.

It will be seen by comparison that the soil differs greatly from either that of Florida or Australia. It is a heavy clay, very sticky when wet, and forms in a shotty condition when dry, due probably to the flocculation of the clay. From a chemical standpoint it contains many times more plant food than either of the above mentioned soils. Nevertheless it has been noticed that the pines on these soils respond readily to the action of certain fertilizers, which might indicate that in spite of the quantity of plant food present it is not sufficiently available for the needs of the plants.

In order to ascertain in what proportion the mineral constituents were removed from the soil, ash analyses were made of the pineapple plant and fruit. Following are the results:

	Plants	Fruit
Phosphoric acid	.07%	.018%
Nitrogen	1.380	.073
Potash	.656	.263
Lime	.124	.034

Other investigators found the following percentage of plant nourishment in the pineapple fruit:

	A1	B2
Phosphoric acid	.0423	.040
Nitrogen	.0707	.110
Potash	.2256	.342

These results correspond as closely as might be expected and tend to show that the per cent. of phosphoric acid, nitrogen and potash removed does not vary considerably. Tolman and Munson[3] found that the ash of pineapples did not vary appreciably, even with different varieties.

While proper conclusions as to fertilizer requirements can not be based upon the proportion of the mineral matter in the fruit with any degree of accuracy, yet a knowledge of their proportion allows an estimate to be made of the amount of plant food removed by the crop. Considering the plant food removed and also the mineral content of the soil, it was decided that an application of seventy-five pounds per acre of each of phosphoric acid, nitrogen and potash would be amply sufficient for the production of one crop of fruit, and this quantity was therefore arbitrarily taken as the amount to be applied.

DETAIL PLAN OF EXPERIMENT.

The experiment was laid out in twelve plats, each 12x182

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1 Miller and Blair, Florida Bulletin No. 83.
2 Wilhelm Bonewitz, Chemiker Zeitung, No. 15, 1908.
3 U. S. Department of Agriculture, Bulletin 87, Bureau of Chemistry.

Diagram Showing Kind and Quantity of Materials Used.

PLAT	SECTION A	B	C	D
		CHECK		
2	Superphosphate 400 LBS. PER ACRE	Superphosphate 400 Lime 750	Superphosphate 400 Potassium Chloride 127.5	Superphosphate 400 Potassium Chloride 127.5 Sodium Nitrate 485
3	Bone Meal 300	Bone Meal 300 Lime 750	Bone Meal 300 Potassium Sulphate 150	Bone Meal 300 Potassium Sulphate 150 Ammonium Sulphate 365
4	Reverted Superphos. 375	Reverted Superphos 375 Lime 750	Reverted Superphos 375 Potash-Magnesia Sulphate 150	Reverted Superphos. 375 Potash-Magnesia Sulphate 290 Organic 535
5		CHECK		
6	Sodium Nitrate 485	Sodium Nitrate 485 Lime 750	Sodium Nitrate 485 Superphosphate 400	Sodium Nitrate 485 Bone Meal 300 Potassium Sulphate 150
7	Ammonium Sulphate 365	Ammonium Sulphate 365 Lime 750	Ammonium Sulphate 365 Bone Meal 300	Ammonium Sulphate 365 Reverted Superphos. 375 Potash-Magnesia Sulphate 290
8	Organic 535	Organic 535 Lime 750	Organic 535 Reverted Superphos. 375	Organic 535 Superphosphate 400 Potassium Chloride 127.5
9		CHECK		
10	Potassium Chloride 127.5	Potassium Chloride 127.5 Lime 750	Potassium Chloride 127.5 Sodium Nitrate 485	Potassium Chloride 127.5 Bone Meal 300 Ammonium Sulphate 365
11	Potassium Sulphate 150	Potassium Sulphate 150 Lime 750	Potassium Sulphate 150 Ammonium Sulphate 365	Potassium Sulphate 150 Reverted Superphos. 375 Organic 535
12	Potash-Magnesia Sulphate 290	Potash-Magnesia Sulphate 290 Lime 750	Potash-Magnesia Sulphate 290 Organic 535	Potash-Magnesia Sulphate 290 Superphosphate 400 Sodium Nitrate 485

feet, and each plat divided into four equal sections. It will be seen that each plat included one-twentieth of an acre, and each section one-eightieth of an acre in area. The plants were set three rows to the plate, four feet between rows and two feet apart in the row. There are a number of different methods of planting in vogue, but as the writer's idea was to employ the one most widely in use in Hawaii the above method of planting was decided upon. The plats were set six feet apart so that a space of ten feet intervened between the outer rows of any two plats. This is not common practice, but was done so that under these conditions there was no danger of the pineapple roots from one plat penetrating to another and obtaining nourishment not intended for them. Plats 1, 5 and 9 were check plats. Numbers 2, 3 and 4 were treated with superphosphate, steamed bonemeal and reverted superphosphate, respectively. Plats 6, 7 and 8 had applications of nitrate of soda, sulphate of ammonia and steamed hoofmeal, respectively. The potash plats, 10, 11 and 12, were treated with muriate of potash, sulphate of potash and sulphates of potash magnesia, respectively. These ingredients were applied singly

in section A. Section B is the same as the corresponding plats in A, but with the addition of 750 lbs. of lime per acre. Two ingredients were combined in section C. For instance: the different forms of phosphoric acid were applied together with potash. In section D complete fertilizers were added. It will be seen by referring to the diagram that the fertilizing ingredients were applied so as to supply the same amount of phosphoric anhydrid, nitrogen and potash, viz., 75 lbs. per acre, and that only the forms have been changed. For example: plat 2, section 1, has been treated with 5 lbs. of superphosphate, or at the rate of 75 lbs. phosphoric acid per acre, and plat 7, section A, received 6.7 lbs. of hoofmeal, which is also at the rate of 75 lbs. nitrogen per acre. It will also be noticed that in any plat the sections B, C and D were formed from section A by the addition of one or more fertilizer ingredients, always at the rate of 75 lbs. per acre, so that section A has 75 lbs. plant food per acre, section B the same together with lime, section C 150 lbs., and section D 225 lbs. plant food.

It was the writer's opinion that by this method of experimenting very conclusive results could be obtained by a reference to and comparison of the field notes taken during the progress of growth of the plant and the yield as finally weighed. For instance: by referring to the record of plat 7 in toto; plat 3, section D; plat 10, section D; and plat 11, section C, one may obtain a very definite idea of the effect of sulphate of ammonia upon pineapples when used alone and when in combination with other material.

The fertilizer was applied in the furrow about two days before planting and thoroughly mixed with the soil before the plants, young suckers, were set. While the writer did not believe this to be as desirable a method of application as broadcasting, he accepted it as one very much in use and which under existing circumstances was the more convenient. The suckers were all fumigated with hydrocyanic acid gas before planting to kill any scale or mealy bug which might have been present. Only healthy plants were taken and as nearly of a size as it was possible to get them. All the plants in the experiment were set on June 15, 1908.

The fertilizers used were carefully analyzed in the laboratory and the proper amount for each section was weighed into a bag marked and tagged before shipping to the pineapple plantation. It should be mentioned that the reverted phosphate used in plat 4 is a material containing 22% total phosphoric acid, about half of which is in the form of di-calcium phosphate, possibly 1% as mono-calcium phosphate, and the balance tri-calcium phosphate. The reason for including this

in the experiment was that it had been used previously as a pineapple fertilizer by a number of growers with moderate success. The bonemeal used was steamed and finely ground. The reasons for considering steamed hoofmeal as a nitrogen carrier were that it is more easily obtainable, blood always being at a premium, and that there has been some prejudice against its use which we hoped to prove unwarranted. The other materials used are from the stock ordinarily carried by fertilizer manufacturers.

CLIMATIC CONDITIONS.

During the growth of the pines the rainfall was moderate, but sufficient, and conditions were very favorable for pineapples. At planting and during the fall of 1908 the precipitation was mostly in the form of showers, which allowed the pines sufficient moisture, but which were never heavy enough to give the ground a good wetting. In March and April, 1909, there were heavy rains, thoroughly moistening the ground and making radical differences in the various plats perceptible. The fall of 1909 was rather dry, but in the spring of 1910 sufficient rain fell to supply a liberal amount of moisture just as the fruit was setting. From forty to fifty inches a year is the average rainfall in this section, as will be seen from the following table showing the precipitation during the growth of the pineapple:

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1908	.....	.....	.....	.....	.....	2.74	1.67	2.69	5.00	2.29	1.85	3.46
1909	4.31	3.35	12.62	6.18	.....	4.70	5.14	2.00	3.11	3.13	2.35	8.50
1910	4.95	1.80	5.26	3.74	5.23	5.47	.....	.....	.....	.....	.....	.....

FIELD NOTES.

During the progress of the experiment field records were kept, indicating the relative conditions of the different plats. These notes in a great many cases were borne out by the results which were later actually found, but in some cases the appearances as recorded were not at all permanent and plats which were termed very good and excellent in appearance did not yield the fruit that might be expected. For example: 3-D and 4-D were considered the best from the first, and from all appearances were destined to give a very heavy yield, but instead of giving extra heavy fruit they matured earlier than the balance of the crop; 4-D produced the most fruit at the first picking, and on July 1, 1910, was practically harvested, while the fruit on many of the other plats was just ripe enough for the first picking.

Six-A never did well and was considered poor, fair and indifferent from the start. There were only nine plants in the

entire field which failed to fruit, and, of these nine, five were in 6-A.

Ten-A was another section in which two plants failed to fruit and which was considered poor. The plants were yellow, and during the colder weather almost ceased growing. The other sections of plat 10 showed similar symptoms, and were not considered even among the average good until the fall of 1909 and the spring of 1910, yet all these sections gave a yield equivalent to over 13 tons per acre. Judging from the field notes, the best plats would be arranged somewhat in this order of superiority: First, 4-D and 3-D, followed by 11-D and 12-D, then 7-C and 8-C, 6-C, 8-A, 12-B, 3-A, and 4-A would be considered fair, and the poor plats were 6-A, 7-A, 10-A and 12-B. Many of the plats did not show sufficiently striking results either way to merit particular attention. In general, the field notes have indicated the good and the poor plats, but it will be seen by reference to the tabulated results that the sections as indicated being the best according to field notes did not show the greatest gain per acre or the largest profit. It may be said, therefore, that too much confidence cannot always be placed in the field notes, although in many cases they actually forecast the final results.

An important point brought out by field notes and observation which could not well be tabulated with the other results was that the fertilized plats came to maturity and fruited approximately from two to four weeks before the check plats had ripened sufficiently to be weighed. While this tendency was noticeable more particularly in 3-D and 4-D, it was more or less general throughout the experiment.

STUDY OF THE CROP.

The pineapples have to be picked as they ripen, and this necessitates painstaking and constant work in the field, as only a small number of pines ripen at the same time. Therefore, in order to get the average results the field must be gone through every day or two, the ripe pines picked, weighed, and recorded under the proper plat and section for a period of about seven weeks. The first regular picking was made on June 22, 1910, and the last August 15, 1910. In weighing the pines all the ripe fruit from one section of a plat were placed in a tared box and weighed together, the date, number of pines and combined net weight recorded. Owing to the premature fruit, difficulty in securing sufficient labor and the fact that the experiment ripened during the busy season, it was practically impossible to weigh every fruit. Nevertheless, at least 90 per cent. of the fruit was weighed in almost every section, and in a number of sections every fruit was counted and weighed. The average fruit from each section was calculated from the results obtained and the yield per acre then determined.

TABULATED RESULTS SHOWING YIELDS, GAINS AND LOSSES PER ACRE.

Plat	Section	Average Pineapple	Yield in tons per acre	Gain in pounds over check plat per acre	Gain in dollars over check plat per acre	Pounds of fertilizer used per acre.	Value of fertilizer in dollars per acre.	Profit per acre due to fertilizer.
1	A-D	3.78	10.29	....	.....	....	.....	.....
2	A	4.96	13.50	7,425	+$74.25	400	4.50	+$69.75
	B	5.24	14.27	8,049	+ 80.49	400*	8.25	+ 72.24
	C	4.99	13.59	6,588	+ 65.88	527	8.25	+ 57.63
	D	4.70	12.90	5,009	+ 50.09	1,012	21.37	+ 28.72
3	A	4.67	12.71	3,593	+ 35.93	300	3.37	+ 32.56
	B	4.93	12.92	5,009	+ 50.09	300*	7.12	+ 42.97
	C	5.03	13.70	5,554	+ 55.54	450	7.87	+ 47.69
	D	4.76	12.96	4,084	+ 40.84	815	21.37	+ 19.47
4	A	4.28	11.60	273	+ 2.73	375	3.75	— 1.02
	B	4.58	12.47	1,906	+ 19.06	375*	7.50	+ 11.56
	C	4.62	12.58	2,124	+ 21.24	665	8.25	+ 12.99
	D	4.98	13.56	4,184	+ 41.84	1,200	23.25	+ 18.59
5	A-D	4.23	11.52	....	.....	....	.....	.....
6	A	4.06	11.06	926	— 9.26	485	13.12	— 22.38
	B	4.16	11.33	381	— 3.81	485*	16.87	— 20.68
	C	4.22	11.49	54	— .54	885	17.62	— 18.16
	D	4.87	13.26	3,485	+ 34.85	935	20.99	+ 13.86
7	A	4.08	11.11	1,634	— 16.34	365	13.50	— 29.84
	B	4.55	12.39	926	+ 9.26	365*	17.25	— 7.99
	C	4.61	12.55	1,243	+ 12.43	665	16.87	— 4.44
	D	4.86	13.23	2,614	+ 26.14	1,030	21.75	+ 4.39

TABULATED RESULTS SHOWING YIELDS, GAINS AND LOSSES PER ACRE.—Continued.

Plat	Section	Average Pineapple	Yield in tons per acre	Gain in pounds over check plat per acre	Gain in dollars over check plat per acre	Pounds of fertilizer used per acre.	Value of fertilizer in dollars per acre.	Profit per acre due to fertilizer.
8	A	4.54	12.36	155	+ 1.55	535	15.00	— 14.45
	B	4.40	11.98	507	— 5.07	535*	18.75	— 24.42
	C	4.88	13.29	1,916	+ 19.16	910	18.75	+ .46
	D	4.67	12.71	763	+ 7.63	1,062	23.25	— 16.62
9	A-D	4.53	12.33	....	.....	....	.....	.....
10	A	5.04	13.72	2,777	+ 27.77	127	3.75	+ 24.02
	B	5.13	13.97	3,267	+ 32.67	127*	7.50	+ 25.17
	C	4.82	13.12	1,579	+ 15.79	612	16.87	— 1.08
	D	5.29	14.40	4,138	+ 41.38	792	20.62	+ 20.76
11	A	5.26	14.32	3,975	+ 39.75	150	4.50	+ 35.25
	B	5.18	14.10	3,539	+ 35.39	150*	8.25	+ 17.35
	C	5.08	13.83	2,995	+ 29.95	515	18.00	+ 11.95
	D	5.52	15.03	5,391	+ 53.91	1,060	23.25	+ 31.72
12	A	5.64	15.35	6,040	+ 60.40	290	4.50	+ 55.94
	B	4.92	13.44	2,232	+ 22.32	290*	8.25	+ 14.07
	C	5.43	14.79	4,900	+ 49.00	825	19.50	+ 29.50
	D	5.40	14.70	4,737	+ 47.37	1,075	22.12	+ 25.25

* Received 750 lbs. of lime in addition.

The check plats gave higher results in the direction from plats 1 to 12, which indicated possible increase of natural fertility in that direction, plat 1 having an average pine of 3.78 lbs. and plat 9 an average pine weighing 4.53 lbs. It would hardly be fair to the first six plats to figure the whole experiment against the average of all the check plats, as they would have an undeserved disadvantage, while the other six plats would be receiving credit they were not entitled to. Also, if the phosphoric acid plats were figured against the first check plat, the nitrogen against the fifth plat, the superphosphate and nitrate of soda plats would have an advantage not shared by the bonemeal and ammonia sulphate. These in turn would have a certain advantage over the reverted phosphate and organic material.

In the case of the potash plats, it was thought at first that a theoretical check plat 13 could be used, against which part of the potash plats might be figured, but upon more careful deliberation it was decided that the better policy would be to confine all results and conclusions to the actual data in hand rather than indulge in theoretical speculation, however conservative it might be. Therefore, in the tabulated results, the gain and loss in the potash plats was figured from check plat No. 9. The other plats were figured against the adjacent check plats with the exception of plats 3 and 7, which have no adjacent check plat. The gain or loss in these two plats was figured against the average of the two nearest check plats.

In computing the commercial value of the fertilizer used, the schedule of trade values issued by the California Agricultural Experiment Station[1] was taken as a basis from which to figure all mixtures. The values given represent in a general way the market in Honolulu, and as all the ingredients used were figured from the same base the results are therefore comparable. The value of agricultural lime was taken as $10.00 a ton.

The canneries accept pineapples weighing more than three pounds at a general rate of $20.00 per ton. The pines which do not reach this minimum are either left on the field or disposed of for juice at half price. As all the sections averaged over three pounds, $20.00 a ton was taken as a value of the pines. The fact that the pineapples averaged three pounds does not necessarily mean that they were all over the three-pound limit, although in the fertilized plats they invariably were. Nevertheless, in the first check plat 11.25 per cent. of the pines gathered weighed less than three pounds. Here is a point which should be considered as a potential advantage of the

[1] Bulletin 207, College of Agriculture, Berkeley, California.

fertilized plats over the unfertilized. There were a large number of pines which were brought over the minimum weight by the application of fertilizer, and their value was therefore actually doubled, besides receiving the regular rate of one cent a pound for all weight over three pounds.

A glance at the tabulated results will show that the greatest yield per acre was 15.35 tons made by 12-A, while the lowest was 10.29 tons from plat 1. The greatest gain over check was 8049 pounds, obtained from 2-B, and the greatest loss recorded was 1634 pounds from 7-A. From a commercial standpoint the greatest profit from a fertilized plat was $72.24 per acre from 2-B, and the greatest financial loss was $29.84 per acre from 7-A, which was also the section showing the greatest agricultural loss. With the exception of plats 10 and 11, the greatest gain per acre and the greatest profit happened to be derived from the same section. Although this need not necessarily be true, it appears from the results to be so in a general way, with the present prices of pineapples and fertilizer material.

It has been demonstrated that superphosphate gave poor results when applied alone at the rate of eighty pounds of phosphoric pentoxide per acre, but that much better results were obtained with the same material and the addition of 750 pounds of lime per acre. While our results with superphosphate alone do not show poor results, such as were obtained in Florida, the results obtained at the Florida Station with re gard to superphosphate and lime are certainly corroborated. Where the lime and superphosphate are applied together, the water soluble phosphoric acid is changed to citrate soluble and water insoluble calcium salts, which probably accounts for the better results obtained from the limed plats.

It has also been shown[2] that nitrate of soda has given poor results when applied to pines. Our results corroborate this fact, and it might be mentioned again that of the nine plants which failed to fruit, six were in plat 6 and five of the six were in section A, which would seem to indicate that nitrate of soda not only affects the growth of the plant unfavorably but also exerts an inhibiting influence upon the productions of fruit.

If we take the actual average of the seven different sections containing a common fertilizing element, we get a figure representing the average pineapple of all the sections containing the common element. By repeating this process with all the different ingredients used, we get a series of interesting fig-

2 Florida Bulletin No. 73.

ures, which might indicate the relative agricultural value of each fertilizing ingredient, as follows:

	Average of all plats containing
Superphosphate	4.88
Steamed bonemeal	4.88
Reverted superphosphate	4.81
Nitrate of soda	4.60
Sulphate of ammonia	4.75
Organic	4.92
Chloride of potash	4.94
Sulphate of potash	5.10
Sulphate of potash magnesia	5.27
Check plats	4.19

It would seem from this that the phosphoric acid had about the same effect in all three forms; that organic matter gave the best and nitrate of soda the poorest results of the nitrogen carriers; and that the sulphate of potash was a better form to apply than the chloride.

SUMMARY AND CONCLUSIONS.

Superphosphate, reverted phosphate and steamed bonemeal showed good results when applied to pineapple plants. Superphosphate gave better results when applied together with lime.

Nitrogen is not the dominant element in pineapple fertilizing. Of the three forms studied, nitrate of soda was the least productive of good results. There was not much choice between sulphate of ammonia and steamed hoofmeal as nitrogen carriers.

Of the potash salts, the sulphates of potash magnesia gave the best results, followed by sulphate of potash and chloride of potash, respectively.

Fertilized soil tends to bring the fruit to maturity from two to four weeks earlier than the unfertilized.

In interpreting the results, too much confidence should not be placed in the field notes alone.

The results corroborate those obtained by the Florida Experiment Station in practically every instance.

In conclusion, the writer wishes to give Messrs. Ginaca Bros. proper credit for their faithful and enthusiastic coöperation in this work. Acknowledgment is also due Mr. F. G. Krauss and Mr. S. S. Peck for helpful suggestions and advice.

CARLTON C. JAMES.

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THE USE OF PLANT MATERIALS IN NATURE-STUDY TEACHING.

By PROFESSOR VAUGHAN MACCAUGHEY, College of Hawaii.

(Concluded.)

Field Studies and Excursions.—Properly planned and conducted, these are of great importance in plant study. Much of their failure in the past has been due to lack of organization, and of keeping the center of interest in the subject in hand. Field trips easily degenerate into purposeless picnics, very amusing to the children, no doubt, but yielding no permanent fruits.

In planning an excursion, the teacher should always make a thorough preliminary reconnaisance and carefully outline the trip step by step. The following plan, which will serve as an example of this, was prepared by Miss May Kluegel, of the Territorial Normal School, for use in Grade II.

EXCURSION—TARO.

Observe things of interest on streets through which we pass. Name streets.

General observation of a valley typical for taro raising (Pauoa Valley)—shape, narrow at head, wide near mouth; slope of sides, abrupt near head, sloping gradually near mouth; stream, winding from side to side of valley; location of taro patches, near lower course of stream at mouth of valley; character of land used for taro, low and level.

Observation of taro patches near at hand—banks, how built, gates; shape of patches; taro plants, conditions under which they grow, distance apart.

Note.—This excursion may also include observations upon frogs, preparatory to taking up the frog lessons in the classroom, as frogs are abundant in taro patches.

Excursions should be seasonable, coinciding, for example, with the flowering or fruiting period of the plant to be studied. This gives an additional incentive and purposefulness to the trip.

Children should be encouraged at all times to bring to school any interesting plants that they may find. In this manner very valuable local collections can be built up.

Collections.—Small plants, portions of large plants, showing leaves, flowers, etc., and leaves of trees, can be easily pressed between dry newspapers. Cut newspapers into pieces, so that when folded once, a folder is formed which is about fifteen inches long and eleven wide. In these folders the fresh specimens, showing leaves, flowers, etc., are spread, arranging them as neatly as possible. The folders are then piled one on top of another,

with a newspaper between every two folders. A board slightly larger than the folders, for example, 12x16, is placed on top of the pile and weighted by means of heavy pieces of rock. As the plants dry, the pile decreases in height, and the plants are pressed perfectly flat. The newspapers between the folders should be changed every day, for they absorb the moisture from the plants, and if not replaced daily by dry ones they cause the specimens to mold. When the plants are perfectly dry they may be glued to sheets of stiff white paper, using ordinary carpenter's or Le Page's glue. A convenient size of mounting paper is 11x16. Each sheet should contain, in the lower right-hand corner, a label giving the name of the plant, the locality in which it was found, the date of collecting, and the name of the collector. In this manner may be preserved interesting and valuable collections of flowering plants, roadside weeds, garden flowers, and other forms of vegetable life.

Seeds, nuts, fibers, bark, wood specimens, and other dry plant materials may be kept in small bottles, cardboard boxes, or manila envelopes.

Planting in the School Gardens. In Hawaii the schools are, in general, fairly well provided with land space, and there is room for setting out various plants suitable for nature-study work. This planting may be in the school garden, or may be for the additional purpose of enhancing the general beauty of the yard.

School gardens in Hawaii are discussed in another bulletin of the Department of Botany and Horticulture, and that matter needs no repetition here. That such gardens can be successfully conducted by the schools of Hawaii was amply shown by the 1907 contest. In 1907 the Evening Bulletin offered five prizes of twenty-five dollars each as a stimulus to agricultural work in the public schools. Some twenty-five schools, representing pretty fairly the various conditions of soil and climate found in the Territory, entered the contest for these prizes, doing the work and making the necessary reports in the required form. The reports were under the following heads: condition of ground; name of crop grown; methods of cultivation; watering, weeding, etc.; amount of growth made; weather conditions; extermination of pests; and general remarks. The pupils of each competing school reported progress weekly, and at the close of the season a tabulated report of work done and results obtained was rendered. The vegetables grown were selected from the following list: lettuce, onions, cabbage, beets, tomatoes, beans, egg-plants, carrots, cucumbers, turnips, melons, sweet potatoes, parsley, Japanese cabbage, and peppers. The competition was very satisfactory to all concerned. There are now in the Territory very few schools in which no serious attempt is being made to improve and beautify the grounds.

Trees and Shrubs.—These serve not only as material for study but also are of prime importance in the aesthetic development of the school yard. "The primary object of the school is instruction. The work of beautifying the school grounds should also carry with it an element of instruction. The grounds should serve as an object lesson for the residents of the community in which the school is located. They should be laid out on sound principles of landscape gardening, and be so well executed as to induce residents of the vicinity to copy the general idea of the plan, and possibly the detail of the shrubbery groups. The idea of beauty can be emphasized in the proper grouping of trees and shrubs in relation to walks, drives, and vistas, and utility can be subserved by placing the heavy plantings so as to serve as a shield from the wind or sun. Shrubbery groups can be arranged so as to separate one portion of the grounds from another and yet not interfere with large open spaces which can be used as playgrounds, etc."

A LIST OF TREES AND SHRUBS SUITABLE FOR HAWAIIAN SCHOOL GROUNDS.

Flowering Trees.	1.	Golden shower
	2.	Pink-and-white shower
	3.	Pink Shower
	4.	Royal Poinciana
	5.	Yellow poinciana
	6.	Pride of India
	7.	Jacaranda
	8.	Plumieria
	9.	Monkey-pod
Foliage Trees.	10.	Hau
	11.	Algaroba
	12.	Mexican almond
	13.	Monterey cypress
	14.	Kukui
	15.	Koa
	16.	Hala
	17.	Banyan
	18.	California pepper tree
	19.	Kou
	20.	Milo
	21.	Araucaria
	22.	Lei-seed tree
	23.	Traveler's tree
Palms.	24.	Cocoanut
	25.	Hawaiian palm
	26.	Royal palm
	27.	Wine palm

28. Attalea palm
29. Bottle palm
30. Sago "palm"

Fruit Trees.

31. Avocado
32. Fig
33. Rose apple
34. Wii
35. Mammee apple
36. Tamarind
37. Papaia
38. Mango
39. Breadfruit
40. Sour-sop
41. Orange
42. Lemon
43. Lime
44. Loquat

Shrubs.

45. Hibiscus
46. Croton
47. Pomegranate
48. Ti
49. Coffee
50. Phyllanthus
51. Rose
52. Oleander
53. Cotton

Flower Beds.—"The love of a flower in the heart of a child is the highest thing that nature-study can hope to develop."—Hodge.

Well-kept flower-beds should be a part of the nature-study equipment of every school in Hawaii. The care of the flowers should devolve upon the children, but this demands genuine enthusiasm and constant oversight on the part of the teacher. The congested condition of the schools, and the numerous demands upon the time and energy of the teacher usually result in neglected flower gardens.

The following suggestions, excerpted from the directions issued by the Home Gardening Association of Cleveland, Ohio, 1904, are pertinent to Hawaiian conditions:

"Avoid a place where the drippings of the roof will fall on the bed. The best effects are produced by planting all of one variety in one place. Dig the bed at least one foot deep. Mix with the soil some rich earth, well-rotted manure, or leaf-mold. Rake the beds well until the soil is fine and free from lumps. Do not plant seeds too deeply. This is a common error. Sprinkle the beds as often as is necessary to prevent the soil from becoming dry. It is best to water beds in

the morning and evening. Avoid having plants too crowded. Thin the plants when they are two or three inches high, during the cooler portion of the day. Transplant seedlings pulled up to another bed, taking up a little soil with each plant. Pick flowers every day, and more will bloom. Allow a few of the best flowers to go to seed for next season's garden. Keep beautiful, fresh flowers in the school-rooms."

Window Boxes.—"Because of the conditions which prevail in a school-room, window boxes must be comparatively deep and must contain a larger quantity of soil than is commonly necessary for the growth of plants in greenhouses in order that the adverse conditions may in part be counteracted. Boxes intended for window gardens should therefore be made at least six to eight inches in depth, should be rather broad, and of a length to conform to the window opening. The soil should be rich garden loam or a compost consisting of rotted sods and stable manure thoroughly mixed together and screened through a screen with at least a half-inch mesh. Before filling the box a layer of coarse gravel should be placed over the bottom to the depth of one inch. Holes should be provided in the bottom of the box, in order that any excess of moisture which comes from watering the plants may escape from the bottom. After placing this drainage material in the bottom of the box. fill it to within one inch of the top with the soil above described. In general, the plants grown in a window box should be small and compact in habit of growth, or those which can be readily trained on strings.

Outdoor Aquaria.—These are very useful in nature-study work, for both the study of aquatic plants and animals. When once established, but little attention is necessary. A stone tank lined with cement is the most durable, but an old wash-tub, sake-tub, or a barrel sawn in half, is quite satisfactory. Sink the vessel in the ground in some unused portion of the school-yard, with the rim projecting out an inch or two above the surface. Cover the bottom with two inches of clean coral or fresh-water sand that has been washed until free from dirt. Stock the aquarium with pond weed, duck-weed, water hyacinth, etc. Be sure to put in a number of top-minnows or small gold-fish, to devour the mosquito larvae. Keep the water at a constant level by adding enough to counterbalance evaporation.

"There certainly will come a day,
As man becomes simple and wise,
When schools will put their books away,
Till they train the hands and the eyes;
Then the school from its heart will say
In love of the winds and the skies:

I teach
The earth and soil,
To them that toil,
The hill and fen
To common men
That live just here;

The plants that grow,
The winds that blow,
The streams that run
In rain and sun
Throughout the year."

—Bailey.

BOARD OF AGRICULTURE AND FORESTRY.

Minutes of the meeting of the Board of Commissioners of Agriculture and Forestry, held in the library of Government Nursery on King street, Monday, March 20, 1911, at 2 o'clock p. m.

Present: Marston Campbell, President and Executive Officer; Messrs. P. R. Isenberg, H. M. von Holt and Albert Waterhouse, members; E. M. Ehrhorn, Superintendent of Entomology; R. S. Hosmer, Superintendent of Forestry, and Dr. V. A. Norgaard, Superintendent of Animal Industry.

The Forest Nurseryman submitted routine reports for the months of December, 1910, and January and February, 1911. These were ordered approved and placed on file.

ENTOMOLOGY.

The Superintendent of Entomology submitted his routine report for the month of February, which was ordered approved and placed on file.

Importation of Birds.—The President read a letter of the Superintendent of Entomology to Mr. W. S. Wise of Hilo, President of the Keaukaha Rod and Gun Club, in reply to his of February 6, in regard to the advisability of the importation of fish, oysters and birds.

Cotton Boll Worm.—A communication was read from Messrs. Gay & Robinson in regard to the profitable industry of cotton growing in the Hawaiian Islands if some effective parasite can be introduced eliminating the great damage done to the crop by the boll worm.

In compliance with a previous request from President Campbell, the Entomologist had prepared a report regarding the cotton boll worm (Gelechia gossyfiella, Saund.), dated March 13, 1911, for consideration at this meeting, which was

read and approved, and Mr. Ehrhorn was requested to prepare a letter to Messrs. Gay & Robinson, for the President's signature, in reply to theirs of February 27, transmitting copy of this report in answer to their inquiry.

Mr. Ehrhorn stated that the Committee on Agriculture of the House of Representatives had taken a great interest in the matter of an appropriation to be used for the procuring of parasites not only of the cotton boll worm but other pests which are doing damage to various crops, and that he has prepared an outline of what we need here for the legislative committee.

Fumigatory.—Mr. Ehrhorn stated that he was badly in need of a room on the Hackfeld dock in conjunction with the fumigatory thereon. He suggested partitioning off one corner of the dock for that purpose, and asked if he might go ahead with such preparations. Mr. Campbell said lumber was exceedingly high at present, but to go ahead and obtain figures and the matter would receive further consideration.

AGRICULTURE.

Pure Seed.—The President read a joint report, dated March 10, 1911, by E. M. Ehrhorn, Superintendent of Entomology, and Ralph S. Hosmer, Superintendent of Forestry, they having been instructed at a previous meeting to act as a committee to formulate recommendations as to pure seed legislation for Hawaii. These recommendations were ordered approved and placed on file.

New Building Site.—With regard to the Cleghorn Park being taken over for agricultural purposes, Mr. Campbell stated that this was a matter which ought not to be lost sight of. The Board has both plenty of labor and money with which to care for the park.

Mr. Ehrhorn stated that as these old buildings are badly in need of repairs, the Board ought to have the place, "for it is often impossible to do any scientific work in the present laboratory on account of the constant pouring in of dust when making microscopic examinations, and again it is impossible to collect one's thoughts owing to continuous singing and playing at the school next door.

"If we should be able to obtain the Ainahau place, we would have the grandest opportunities for carrying on interesting experiments, not only on injurious pests, but we shall also have the finest facilities for propagating beneficial insects and parasites, and if we are to proceed in doing such work with the appropriations asked for we shall surely have to have better facilities than we have at present for carrying on the work, and in my opinion Ainahau offers just such opportunities."

Mr. Campbell said that he had been called before the Public Lands and Improvement Committee on this proposition and the question of accepting the gift was talked over at some length. If this is taken over by the Territory, the department without doubt will be worked up so that anybody in the islands may well be proud of the place.

ANIMAL INDUSTRY.

A report of the work accomplished to date by the Territorial Veterinarian, dated March 17, was read by title, and ordered approved and placed on file.

Dr. Norgaard said that beef must be imported either from the States or from the Colonies in order to provide for the many soldiers that are being stationed here. C. Q. Yee Hop wants to make one trial importation of beef on the hoof.

Dr. Norgaard further stated that it has become more and more evident that this Territory will not be able to supply its own beef, and that sooner or later the resolution he submitted must be made a standing rule, as all of the States which have regulations requiring the tuberculin test of milking and breeding stock have a clause providing for the admission of cattle for immediate slaughter without the tuberculin test. He read the following resolution in regard to the importation of beef cattle without the tuberculin test, which is to have the same effect as a rule:

"Resolved, That cattle intended for immediate slaughter shall be admitted to the Territory when accompanied by a certificate of inspection, showing that they have been subjected to a careful physical examination and found to be apparently free from disease, or disease-producing parasites (Texas fever ticks). And the said examination must be made, and certificate issued by the same authorities as required by Rule III of the Rules and Regulations pertaining to the importation of live stock to the Territory of Hawaii, except that no certificate of tuberculin test will be required, but that the inspecting officer be requested to provide each animal with an ear-tag for identification.

"Such animals upon arrival shall be placed in quarantine on premises approved of by the Territorial Veterinarian and in the immediate vicinity of the slaughterhouse, and kept there until slaughtered. The owner or consignee shall notify the Territorial Veterinarian when he intends to butcher such imported cattle and shall keep a careful record of the number of the ear-tags, which, after slaughter, shall be removed together with and attached to one-half of the ear, and turned over to the local meat inspector or to the Territorial Veterinarian, who in turn will issue a receipt and certificate of slaughter."

Carried.

DIVISION OF ENTOMOLOGY.

Honolulu, March 31, 1911.

Honorable Board of Commissioners of Agriculture and Forestry,
Honolulu, Hawaii.

Gentlemen:—I respectfully submit, as follows, my report of the work of the Division of Entomology for the month of March.

During this month we boarded 34 vessels and we found fruits, vegetables and plants on 22 of them.

The usual careful inspection was made of all shipments with the following result:

Disposal with principal causes.	*Lots*	*Parcels*
Passed as free from pests	1281	21,037
Fumigated	17	46
Burned	49	51
Total inspected	1347	21,134

Rice Shipments.—The rice shipments during the month exceeded those of the previous month, 20,745 bags having arrived. These shipments were carefully inspected and found free from weevils and other pests.

Pests Intercepted.—As in the previous month plant shipments continued to arrive and about 4165 plants, trees and shrubs were examined. Having found previous shipments infested with scale insects and other pests I deemed it advisable, on account of the methods used in packing and the packing materials, to subject these shipments to longer fumigation. The results have been very satisfactory and no injury to the shipments has resulted. We are very careful about fumigating plants and never attempt to do it if plants are at all moist from sweating en route, as in such condition fumigation will invariably injure the foliage.

On some oranges in the baggage of a passenger from Fiji we found a new scale insect (*Pinnaspis* sp.). The white peach scale (*Aulacaspis pentagona*) is frequently found on plants from the Orient, and although we have the pest here we always destroy badly infested plants.

Some orange trees from Japan infested with the white fly (*Aleyrodes citri*) were thoroughly fumigated first, then each tree was defoliated and cut back to stumps. This pest only infests the foliage, so that after our vigorous treatment no danger of the pest remained.

All foliage and twigs were burned. We discouraged the further shipments of such plants.

Two species of ants (*Strumigenys lewisi*) and (*Pheidole sp.*) were found on Japanese plants, the first in stems of a tea plant, the latter in soil around bamboo.

Some cocoanuts from Central America were found infested with scale (*Aspidiotus cydoniae*).

Seven lots of sweet potatoes and yams found in the immigration baggage were destroyed on account of showing infected spots, which might prove a disease, although no germs have been found. The risk of bringing in a disease which would attack the sweet potato and the taro is too great and in the future all such shipments will be refused entry.

The first two lots of banana plants consisting of four sprouts from Central America and Mexico were received this month and under Rule VIII were promptly destroyed.

Brother M. Newell, inspector at Hilo, reports the arrival of six vessels, three of which carried vegetable matter consisting of 108 lots and 1778 parcels. One lot of infested cauliflower was burned.

Beneficial Insects.—At the request of Mr. D. Morrison, superintendent at Midway, we sent a good strong colony of vedalia cardinalis for the cottony cushion scale, which attacks their ironwoods. Much complaint of damage by the Japanese beetle is coming to the office and we are prepared to furnish fungus inoculated beetles, but request that parties furnish us quantities of beetles, as we are short handed and cannot get beetles.

Respectfully submitted,

EDW. M. EHRHORN,
Superintendent of Entomology.

Honolulu, April 30, 1911.

Honorable Board of Commissioners of Agriculture and Forestry,
Honolulu, Hawaii.

Gentlemen:—I respectfully submit, as follows, my report of the work of the Division of Entomology for the month of April.

During this month we boarded 36 vessels and we found fruit, vegetables and plants on 19 of them.

The usual careful inspection was made of all shipments with the following result:

Disposal with principal causes.	*Lots*	*Parcels*
Passed as free from pests	597	7,284
Destroyed	29	128
Fumigated	12	23
Total inspected	638	7,435

Rice Shipments.—The rice shipments during the month were about equal of last month, making a total of 20,371 bags, which, after a careful inspection, were found free from weevils or other pests.

Pests Intercepted.—One hundred bags of scabby potatoes were

ordered returned to the Coast. This is the first large infested shipment which has arrived here for a long time, and it was so badly infested that sorting over was out of the question.

Several lots of sweet potatoes were again found in the Oriental baggage, some infested with the potato weevil and some showing disease spots as in previous shipments, and all were promptly destroyed.

In corn seed from the United States we found the grain weevil *Calandria granaria.*

Ornamental plants from Japan infested with scale insects *Pseudaonidia duplex* and *Autacaspis pentagona,* also plant lice on pine trees, Lachnus sp.

In the mail from Florida, palms infested with scale insects and mealy bugs.

Brother M. Newell, inspector at Hilo, reports the arrival of nine vessels, four of which carried vegetable matter consisting of 92 lots and 1117 parcels. The outer leaves of a shipment of cabbage were removed on account of cabbage-leaf fungus.

During the month much complaint continued to come to the office regarding the Japanese beetles and we were able to send out 54 lots of beetle fungus in large quantities. Parties furnishing the beetles were promptly supplied. We are inoculating beetles as fast as we get them.

I also received two large boxes, estimated to contain 50,000 ladybirds (Hippodamia convergens) from Mr. E. K. Carnes, superintendent of the State Insectary of the California State Commission of Horticulture. Half of these were liberated in the upper valleys and half in the taro lands, where plant lice were abundant.

Very often the question has been asked *"How do all the pests get into the country?"* In answer to the same I will state that during this month a package of sweet potato seed arrived by mail, marked "merchandise," and passed the postal authorities as well as the Division of Entomology. It was only through the great interest for the welfare of the island shown by Mr. J. B. Castle that we were able to examine this lot of potatoes and subject them to a dip in formaldehyde. He happened to get in touch with the party who received them and before planting them thought that I had better pass upon them. How many such packages go through the mail nobody knows, but it surely goes to show that the chances for introducing pests are not all abandoned as yet. The party, of course, did not send these potatoes as merchandise to get them through without inspection, but probably thought that they would go cheaper through the mail by marking them "merchandise." I only hope that we shall have more citizens come forward like Mr. Castle and notify us if packages containing seeds and plants should happen to pass in under similar conditions.

Respectfully submitted,

EDW. M. EHRHORN,
Superintendent of Entomology.

THE WORLD'S COTTON.

According to Census Bulletin No. 110, giving cotton statistics for the year ending August 31, 1910, the number of active cotton spindles in the world has increased from 105,681,000 in 1900 to 134,526,000 in 1910, or 27.3 per cent. The consumption of cotton per spindle was 70.9 pounds in 1900, compared with 67.2 pounds in 1910. While this decrease has been due in part to the fact that the spindles were operated to a greater percentage of their capacity in 1900 than during the past year, it is probably due more largely to the increasing manufacture of finer goods.

The fluctuations in the world's commercial supply of cotton are measured practically by the variation of the annual production of cotton in the United States, as this country furnishes about two-thirds of the total commercial supply. The consumption of cotton during the year ending August 31, 1910, was 18,321,000 bales of 500 pounds gross weight.

Assuming that the consumption statistics for foreign countries have been returned in net-weight bales, and reducing the American consumption figures to net-weight bales, the world's consumption is estimated at 18,079,000 bales of 500 pounds net.

EXTENT OF COMMERCIAL PRODUCTION OF COTTON.

The world's commercial production of cotton in 1909 amounted to 16,558,000 bales, or 1,521,000 bales less than the consumption for the year ending August 31, 1910. The world's consumption of cotton during the year ending August 31, 1909, amounted to 19,397,000 bales, the capacity of the mills has been increased by about 1,250,000 spindles during 1910. For this reason the potential consumption of the mills of the world at the present time is estimated to be not less than 20,000,000 bales. Furthermore, the stocks of manufactured goods have materially decreased, so that, in 1910, a world crop equal to this consumption requirement of 20,000,000 bales is needed. Of this the United States would be expected to contribute at least 13,500,000 bales in order to keep the mills operating during the year and to prevent further reduction in the already low supply of raw cotton.

In respect to cotton manufactures, the United Kingdom ranks first as an exporting country, and British India as an importing country. Germany ranks second in exports, and is followed by France, Belgium, Switzerland, and British India, in the order named. In respect to the value of cotton goods imported, China ranks next to British India and is followed by Germany and the United States.

In view of the recent development of trade relations between the United States and Central American countries, it may be interesting to note that a report compiled by the Government of Honduras gives the total value of cotton manufactures imported into that country during the year 1907 as about $700,000, more than one-half of which represents imports from the United States. Out of the twenty American Republics lying south of the United States, there are only three—Honduras, Haiti, and the Dominican Republic—in which the United States leads in the trade in cotton manufactures. Germany controls the trade in these goods with Bolivia, and the United Kingdom that with the remaining sixteen Republics.

STATISTICS FOR LEADING TEXTILE FIBERS.

The relative importance of the leading textile fibers has undergone considerable change during the past century. Flax fiber, which was used to a larger extent in 1800, now ranks fourth, and the quantity of flax produced is only about three times what it was at that time. In the same period the production of wool has increased from about 500,000,000 pounds to nearly 2,700,000,000 pounds, or more than fivefold, and that of cotton from about 300,000,000 pounds to 8,505,000,000 pounds, or more than twenty-eight fold. The increase in the production of jute is the most remarkable of all. The quantity in 1850 was 60,000,000 pounds as compared with 2,918,000,000 pounds in 1909. The increases since 1889 are as follows: Cotton, 44.8 per cent.; wool, 11.4 per cent.; silk, 112.3 per cent.; flax, 85.9 per cent.; and jute, 56.9 per cent.; while hemp shows a decrease. If the figures for 1908 were taken as the basis of comparison the increase for cotton would be 81.8 per cent.

The total production for 1909 of the leading textile fibers was 17,529,174,000 pounds, of which cotton constituted 48.5 per cent.; wool, 15.3 per cent.; silk, less than one-half of 1 per cent.; flax, 10.6 per cent.; hemp, 8.2 per cent.; and jute, 16.6 per cent. The total supply of these textile fibers in commercial channels at the beginning of the nineteenth century amounted approximately to 1,400,000,000 pounds, of which cotton formed about 22 per cent.; wool, 33 per cent.; silk, 2 per cent.; and flax, 43 per cent.

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PUBLICATIONS FOR DISTRIBUTION.

Any one or all of the publications listed below (except those marked *) will be sent to residents of this Territory, free, upon application to Mailing Clerk, P. O. Box 207, Honolulu.

BOARD.

Report of the Commissioner of Agriculture and Forestry for 1900; 66 pp.
Report of the Commissioner of Agriculture and Forestry for 1902; 88 pp.
* First Report of the Board of Commissioners of Agriculture and Forestry, from July 1, 1903, to December 31, 1904; 170 pp.
Second Report of the Board of Commissioners of Agriculture and Forestry, for the year ending December 31, 1905; 240 pp.; 8 plates; 10 text figures.
Third Report of the Board of Commissioners of Agriculture and Forestry, for the year ending December 31, 1906; 212 pp.; 3 plates; 4 maps; 7 text figures.
Fourth Report of the Board of Commissioners of Agriculture and Forestry, for the calendar year ending December 31, 1907; 202 pp.; 7 plates.
Fifth Report of the Board of Commissioners of Agriculture and Forestry, for the calendar year ending December 31, 1908; 218 pp.; 34 plates.
Report of the Board of Commissioners of Agriculture and Forestry, for the biennial period ending December 31, 1910; 240 pp.; 45 plates.
"Notice to Importers," by H. E. Cooper; 4 pp.; 1903.
"Digest of the Statutes Relating to Importation, Soils, Plants, Fruits, Vegetables, etc., into the Territory of Hawaii." General Circular No. 1; 6 pp.

PUBLICATIONS FOR DISTRIBUTION—Continued.

"Important Notice to Ship Owners, Fruit Importers and Others. Rules and Regulations Prohibiting the Introduction of Certain Pests and Animals into the Territory of Hawaii." General Circular No. 2; 3 pp.; 1904.
"Law and Regulations, Importation and Inspection of Honey Bees and Honey." General Circular No. 3; 7 pp.; 1908.

"The Hawaiian Forester and Agriculturist," a monthly magazine. Vols. I to VII; 1904-1910. To be obtained from the Hawaiian Gazette Co., Honolulu. Price $1 a year.

DIVISION OF FORESTRY.

* "Forest and Ornamental Tree Seed for Sale at Government Nursery." Press Bulletin No. 1; 3 pp.; 1905.
* "Suggestions in Regard to the Arbor Day Tree Planting Contest." Press Bulletin No. 2; 7 pp.; 1905.
"An Offer of Practical Assistance to Tree Planters." Circular No. 1; 6 pp.; 1905.
"Revised List of Forest and Ornamental Tree Seed for Sale at the Government Nursery." Press Bulletin No. 3; 4 pp.; 1906.
* "Instructions for Propagating and Planting Forest Trees." Press Bulletin No. 4; 4 pp.; 1906.
"Instructions for Planting Forest, Shade and Ornamental Trees." Press Bulletin No. 5; 7 pp.; 1909.
"Na Hoakaka no ke Kanu Ana i na Laau Malumalu ame na Laau Hoohiwahiwa." Press Bulletin No. 6; 8 pp.; 1909.
Report of the Division of Forestry, for the year ending December 31, 1905. Reprint from Second Report of the Board; 77 pp.; 5 plates.
* Report of the Division of Forestry, for the year ending December 31, 1906. Reprint from Third Report of the Board; 123 pp.; 4 maps.
Report of the Division of Forestry, for the year ending December 31, 1907. Reprint from Fourth Report of the Board; 70 pp.
Report of the Division of Forestry, for the year ending December 31, 1908. Reprint from Fifth Report of the Board; 85 pp.
Report of the Division of Forestry, for the biennial period ending December 31, 1910. Reprint from Report of the Board; 86 pp.; 22 plates.

DIVISION ON ENTOMOLOGY.

"The Leaf-Hopper of the Sugar Cane," by R. C. L. Perkins. Bulletin No. 1; 38 pp.; 1903.
** "A Catalogue of the Hemipterous Family Aleyrodidae," by G. W. Kirkaldy, and "Aleyrodidae of Hawaii and Fiji with Descriptions of New Species," by Jacob Kotinsky. Bulletin No. 2; 102 pp.; 1 plate; 1907.
* "On Some Diseases of Cane Specially Considered in Relation to the Leaf-Hopper Pest and to the Stripping of Cane," by R. C. L. Perkins. Press Bulletin No. 1; 4 pp.; 1904.
"A Circular of Information," by Jacob Kotinsky. Circular No. 1; 8 pp.; 1905.
"The Japanese Beetle Fungus," by Jacob Kotinsky and Bro. M. Newell. Circular No. 2; 4 pp., cut; 1905.
Rule VII: "Concerning the Prevention of Distribution of the Mediterranean Fruit Fly"; unnumbered leaflet; 1910.
Rule VIII: "Concerning the Importation of all Banana Fruit, Banana Shoots or Plants"; unnumbered leaflet; 1911.
Report of the Division of Entomology, for the year ending December 31, 1905. Reprint from Second Report of the Board; 68 pp.; 3 plates; 10 text figures.
Report of the Division of Entomology, for the year ending December 31, 1906. Reprint from Third Report of the Board; 25 pp.; 7 text figures.
Report of the Division of Entomology, for the year ending December 31, 1907. Reprint from Fourth Report of the Board; 18 pp.; 1 plate.
Report of the Division of Entomology, for the year ending December 31, 1908. Reprint from Fifth Report of the Board; 26 pp.; 2 plates.
Report of the Division of Entomology, for the biennial period ending December 31, 1910. Reprint from Report of the Board; 70 pp.; 10 plates.

DIVISION OF ANIMAL INDUSTRY.

* "Inspection of Imported Live Stock." Rule 1; 1 p.; 1905.
* "Inspection and Testing of Imported Live Stock for Glanders and Tuberculosis." Rule 2; 1 p.; 1905.
* "Concerning Glandered Horse Stock in the Territory." Rule 3; 1 p.; 1905.
* "To Amend Rule 1, Inspection of Imported Live Stock." Rule 4; 1 p.; 1907.
* "Quarantine of Horse Stock from California." Rule 8; 1 p.; 1908.
"Rules and Regulations, Inspection and Testing of Live Stock." Rules and Laws; 11 pp.; unnumbered pamphlet; Revised 1910.
Report of the Division of Animal Industry, for the year ending December 31, 1905. Reprint from Second Report of the Board; 62 pp.
Report of the Division of Animal Industry, for the year ending December 31, 1906. Reprint from Third Report of the Board; 41 pp.; 3 plates.
Report of the Division of Animal Industry for the year ending December 31, 1907. Reprint from the Fourth Report of the Board; 104 pp.; 6 plates.
Report of the Division of Animal Industry, for the year ending December 31, 1908. Reprint from Fifth Report of the Board; 44 pp.
Report of the Division of Animal Industry, for the biennial period ending December 31, 1910. Reprint from Report of the Board; 59 pp.; 13 plates.

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* Out of print.