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HAWAIIAN

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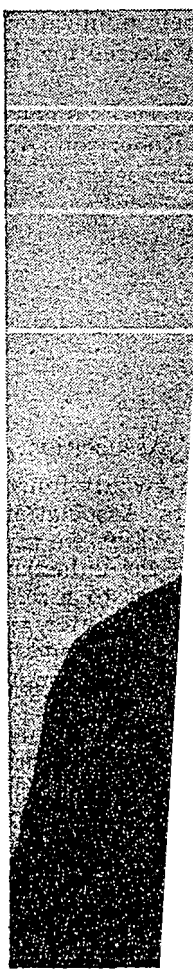

F. M. Swanz

PLANTERS' MONTHLY

SHED FOR THE

PLANTERS' ASSOCIATION.

LU, NOVEMBER 15, 1904. No. 11

t Hawaiian Sugar Planters' Association.

ANNUAL MEETING HAWAIIAN SUGAR PLANTERS' ASSOCIATION.

The twenty-fourth annual meeting of the Hawaiian Sugar Planters' Association was held in Honolulu on the 16th, 17th, 18th and 19th of November. The reports of the various committees presented at the meeting are interesting and this number of the Monthly is entirely devoted to their publication.

The Trustees and officers of the Association elected for the coming year are:

F. M. Swanzy, President; H. B. Baldwin, Vice-President; W. O. Smith, Secretary and Treasurer; G. H. Robertson, Auditor; W. G. Irwin, F. A. Schaefer, H. A. Isenberg, S. M. Damon, and E. D. Tenney.

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PRESIDENT'S ADDRESS.

To the Members of the Hawaiian

Sugar Planters' Association.

Gentlemen:—We are now assembled for the twenty-fourth annual meeting of the Hawaiian Sugar Planters' Association. It is well for us to remember that the industry which we represent is predominant in these Islands, and that the industrial and financial conditions of this community reflect to a very great extent those which surround the cane planting interests. We have developed from a very small beginning in the middle of this century to a pre-eminent position in the cane sugar producing countries of the world.

The progress which has been made and the results which have been accomplished are due largely to the untiring efforts put forth by those in charge of the executive branches of the work on the sugar estates of these Islands. We must develop along the lines which will keep us in the very fore-front of the cane sugar producing countries, and the accomplishment of this is to be largely attained in the gatherings of our sugar men in these and other meetings, and the exchanging of views, and experiences acquired, in carrying on the work connected with production and manufacture.

In so far as the market prices realized for our finished product are concerned, the last year has averaged well. During the greater portion of the year the price of raw sugar has

been more than three and three-quarter cents, and for some time past has been over the four cent. mark. Unfortunately for some of the plantations, a large portion of their crops were marketed before the higher prices went into effect, and the benefit therefrom has not been as evenly distributed as we could wish, but, notwithstanding this, the average price realized will be the highest obtained for some years past. At the present time the prospects of good prices during the larger portion of the coming season seem to be bright.

To offset the better conditions prevailing in the sugar market, we were confronted with serious loss in sugar production occasioned by insect pests and other causes. It will be seen from the report of sugar production presented by your Secretary that the total for the 1903-1904 crop is 367,475 tons, as against 437,991 tons last year, showing a decrease of 70,516 tons from last year's crop, and you will notice that few of the plantations show any increase of output over the previous year. The final outturn of the crop is considerably below the preliminary estimates made at the beginning of the campaign, and the large shrinkage in yield can largely be attributed to the damage resulting from the attacks of leaf-hopper, although the long-continued storms of high wind and heavy rains, which prevailed in February and March, are responsible for no inconsiderable portion of the shortage. We have had, taken all together, a favorable year for the growth of the young canes; the winter was warm and the cane was vigorous in growth up to the time of the cold rains in the early part of the year. With the return of fair weather, they rapidly recovered, and throughout the summer the growth has been unusually rapid in most localities; and, had it not been for the leaf-hopper and other pests which tended to stunt the growth and decrease the sugar content, we would be justified in expecting the coming crop to be one of the largest ever produced in these Islands.

One of the most important matters which your Trustees have taken up during the year was the thorough reorganiation and enlargement of the Experiment Station conducted by the Association. A Bureau of Entomology has been established, with a complete staff of skilled men. The force at the agricultural division of the station has been increased by the employment of a skilled agriculturist and additional chemists. With the addition to the staff of a Plant Pathologist, familiar with cane diseases, your experiment station will be second to none in the world and the results obtained should be of immense value to the sugar industry. Additional stations are to be established in the different districts for the purpose of conducting agricultural experiments, which will, it is expected, prove of great local value.

The conditions in many localities being so radically differ

ent from those existing at the central station in Honolulu, it has been the belief of many of you that the experiments carried on here were not particularly beneficial to the plantations as a whole. This departure from the custom of the past will remove this cause of complaint, and it is hoped each manager will take interest in and observe closely the experiments conducted by the branch station in his particular district.

The immediate reason for the enlargement and expansion of the station can be laid to the damage done by leaf-hopper and other insect pests and cane diseases; an active fight against these has been instituted, and a measure of success will certainly attend our efforts. The establishment of the station on its present basis has entailed considerable expense in the purchase of new grounds and the erection of buildings. The running expenses from now on will be considerably more than ever heretofore. The amount lost, however, in the past year alone, by the ravages of insect pests, would have paid the cost of establishing fifty stations on the new basis and operating the same for a number of years to come. The report of the experiment station committee will deal fully and in detail with the work undertaken at the station and the addition to and enlargement thereof. It would be well if you would devote at least a portion of one day to a careful and thorough examination of the station, from the results of the operation of which so much is expected.

The Trustees of your Association have held 47 meetings during the year. Mr. B. F. Dillingham, one of your Trustees, resigned in the month of September, and Mr. S. M. Damon was elected by the remaining Trustees to fill the vacancy. There have also been two meetings of Delegates and Trustees. These meetings have become a regular feature of our Association, and as they tend toward a better understanding of all matters of plantation management, I consider them of great importance, and hope you will see to it that interest therein does not flag.

There is now on each of the Islands an Association of the Plantation Managers. These organizations should receive your united support and co-operation, and I urge upon you that they be made as strong and effective as possible; that regular meetings be held and all managers endeavor to be present.

The labor conditions of the plantations at the present time, as indicated by the monthly reports, are fairly satisfactory. The report of your labor committee will deal with these matters in detail.

The meeting this year, extending over a period of four days, we hope will carry out more nearly the objects of the Association. The reports of the various committees have been printed and placed in your hands before the meeting, for the

purpose of enabling you to read and digest the same and be prepared to discuss the subjects therein referred to. The members of the committees are all busy men and these reports are compiled with much thought and care and at the expense of considerable labor and time, and should receive the careful consideration which they deserve. There is due to the members of each committee the thanks of the Association.

I desire to take this opportunity to impress upon you the advisability of a thorough understanding, and co-operation, between the various departments of the plantations, and the exchange between the plantation managers of ideas and experiences, and the results worked out by them. We are all working for the same ends, and the interest of one is the interest of all. The men who conduct the executive branch of the sugar industry here are trained in their profession, and are applying to the various problems which they are continually meeting, the experience and skill which has been acquired during long periods of years. The discusssion of the various matters arising in practical sugar work, and the interchange of ideas upon such matters, will necessarily result in economy in sugar production.

We must produce sugar at the minimum of cost in order to meet the competition of other countries, and the recommendations or suggestions of your committees of any plans or methods whereby the cost of production may be decreased, should receive your most careful attention. The proper utilization of waste products, and the use of scientific knowledge in field and mill, open to you all the widest scope for the application of practical ideas.

I wish to express my appreciation of the assistance which you have all freely rendered me during the period in which I have had the honor to be the President of your Association. The enterprise in which we are engaged demands the hard and conscientious work of every man connected with it, in order that the standard which has been set shall be maintained. The interests of all are the same and we should stand together as one man for the common good.

I regret exceedingly that circumstances prevent my being with you at this meeting, and at the banquet on Friday night, which will, I hope, in the future be a regular feature of our annual gatherings, and that it will promote the growth of good fellowship among you, and that you will return to your respective duties with the feeling that this has been the most successful of all the annual meetings of the Hawaiian Sugar Planters' Association, and each be determined to attend next year and do everything in his power to make that meeting even more successful. Very truly yours,

E. D. TENNEY,
President Hawaiian Sugar Planters' Ass'n.

Honolulu, Nov. 1st, 1904.

SECRETARY'S REPORT.

The last Annual Meeting was held on November 23rd and 24th, 1903, at which meeting the following named Trustees were elected.

E. D. TENNEY,
F. M. SWANZY,
G. H. ROBERTSON,
F. A. SCHAEFER,
H. P. BALDWIN,
H. A. ISENBERG,
B. F. DILLINGHAM,
W. G. IRWIN, and
W. O. SMITH.

The Trustees organized and elected the following officers: Mr. E. D. Tenney, President; F. M. Swanzy, Vice-President; Mr. W. O. Smith, Secretary and Treasurer, and Mr. G. H. Robertson, Auditor.

The standing committees appointed were:

Labor.—E. F. Bishop, Chairman; P. McLane, F. B. McStocker, H. A. Baldwin, H. H. Renton.

Cultivation.—Andrew Adams, Chairman; B. D. Baldwin, John Hind, E. Madden, John A. Scott, C. B. Wells.

Fertilization.—C. F. Eckart, Chairman; D. Forbes, Geo. Ross, Wm. Stodart, Geo. Gibb, Aug. Ahrens.

Irrigation.—W. W. Goodale, Chairman; L. Barkhausen, John Sherman, F. Weber, F. Meyer.

Handling and Transportation of Cane.—Geo. F. Renton, Chairman; C. C. Kennedy, John M. Horner, Geo. Chalmers, H. P. Faye, D. C. Lindsay.

Manufacture.—J. N. S. Williams, Chairman; T. C. Davies, C. H. Fairchild, J. T. Moir, Aug. Ahrens, S. K. Gjerdrum.

Machinery.—C. Hedemann, Chairman; Aug. Ahrens, T. C. Davies, James Scott, Wm. Stodart, John Hind, C. C. Kennedy.

Utilization of By-Products.—C. H. Fairchild, Chairman; James Gibb, W. G. Walker, Andrew Adams, H. Deacon, J. N. S. Williams, T. C. Davies.

Diseases of Cane.—R. C. L. Perkins, Chairman; C. F. Eckart, G. H. Fairchild, Aug. Ahrens, James Gibb, H. A. Baldwin, D. Forbes.

Forestry.—L. A. Thurston, Chairman; Walter Dillingham, H. A. Baldwin, E. E. Olding, D. Forbes, Geo. Ross, J. M. Lidgate.

Experiment Station.—W. M. Giffard, Chairman; Geo. Robertson, Andrew Adams, H. A. Isenberg, J. M. Dowsett, E. E. Paxton, G. M. Rolph.

Labor Saving Devices.—J. A. Low, Chairman; F. Meyer, J. N. S. Williams, F. B. McStocker, A. Lidgate, T. S. Kay, E. K. Bull.

In the month of September last Mr. B. F. Dillingham resigned from the Board of Trustees and Mr. S. M. Damon was elected in his place.

The tabulated crop returns appended hereto give the number of tons of sugar produced on each of the plantations for the twelve months ending September 30th, 1904; also the number of tons of sugar produced on each of the plantations.

The total crop for the last year was	367,476 tons
For the preceding year it was	437,991 tons
Showing a decrease of	70,515 tons

The crops of each Island for the past two years have been as follows:

HAWAII.

1902-3	170,665 tons
1903-4	122,866 tons
Decrease	47,799 tons

MAUI.

1902-3	84,776 tons
1903-4	77,985 tons
Decrease	6,791 tons

OAHU.

1902-3	121,066 tons
1903-4	102,019 tons
Decrease	19,047 tons

KAUAI.

1902-3	61,484 tons
1903-4	64,606 tons
Increase	3,122 tons

The loss in the total amount of the crops in the year is due very largely to the destructive work of insect pests, particularly of the leaf-hopper. The report of the Committee on Experiment Station will deal with the subject of insect pests.

The seasons during the past year have on the whole been

favorable, although the protracted rains of the early winter were not advantageous. The coming crop, about to be harvested, looks well, but the total yield will probably fall short of the past year's crop.

The plan adopted at the last annual meeting of having the reports of committees presented in advance so as to be printed and ready for distribution at the time of the annual meeting, has been followed, and the reports of the following committees have been so printed:

Fertilization, Handling and Transportation of Cane, Manufacture, Machinery, Utilization of By-Products, Forestry, Experiment Station, Labor-Saving Devices.

Having these reports in hand at the time they are read at the meeting will add much to the interest and afford better opportunity for discussion.

The work and responsibilities of the Board of Trustees is constantly growing, and the reports of the various committees show advances which are being made in the sugar industry of these Islands. With greater competition and increasing danger from insect pests and plant diseases, as well as labor difficulties, the successful and profitable production of sugar in these Islands is demanding effort and work of higher scientific standards than ever before.

Respectfully submitted,

W. O. SMITH,
Secretary H. S. P. A.

Dated November 15, 1904.

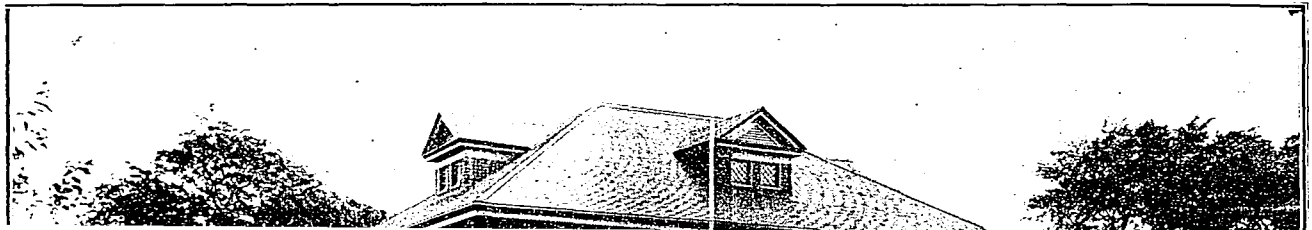
REPORT OF COMMITTEE ON EXPERIMENT STATION.

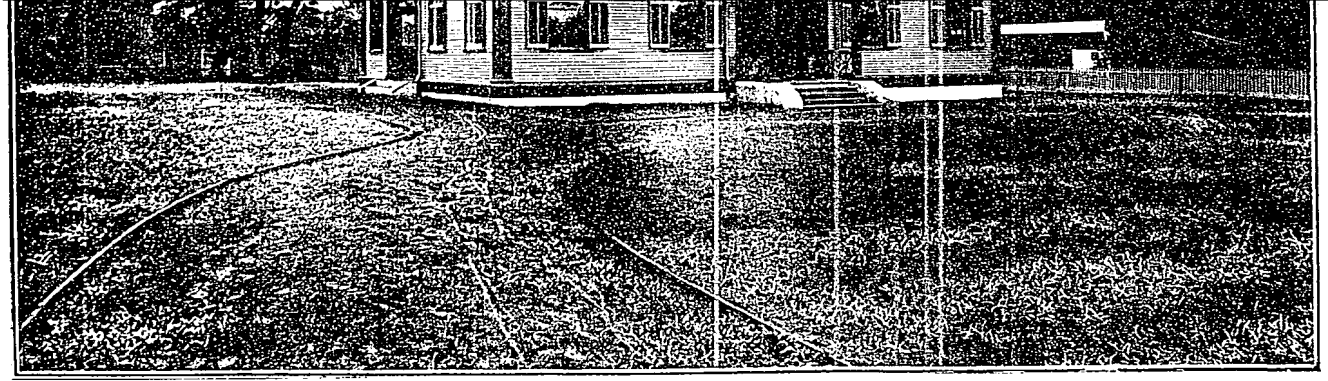
To the President, Board of Trustees and Members of the Hawaiian Sugar Planters' Association, Honolulu.

Gentlemen:—Your Committee on Experiment Station begs to submit its report for the twelve months ending September 30th, 1904.

DIVISION OF CHEMISTRY.

The work conducted in the laboratories of this Division has increased very considerably during the past two years, necessitating during that period not only an increase in the number of chemists employed, but also an augmentation of the salaries paid them. The steady increase in the number of soil, fertilizer and other analyses indicates the fact that the





HEADQUARTERS EXPERIMENT STATION.

work of the laboratories continues to be appreciated by members of the Association, the latter realizing the importance of being provided with fertilizers based on the analyses of their soils. Your committee wishes to draw particular attention to the Directors' report in connection with the close conformity between manufacturers' guarantees and Experiment Station findings with regard to fertilizers. This will show a radical improvement over former years.

The Director of this Division will in his report (See Appendix 1) submit details of the nature of the work done in the laboratories during the past year.

AGRICULTURAL DIVISION.

UTILITY OF STATION.

There has been for some time past a difference of opinion among some Managers of Plantations relative to the value of results obtained from the field work at the Station, the conditions existing there in reference to climate and soil being radically different from those existing at most other localities in the Islands. There appeared to be, moreover, a well-settled sentiment among Managers in general that substations should be established on the plantations by the Director or someone in his charge, permitting the pursual of agricultural investigations under diversified Island conditions. With a view to obtaining authentic information as to the utility of the Station and whether the result of its work justified the expense of its maintenance, a circular letter was sent in March last to each Manager for an opinion as to the retention of the Station and your Committee received in reply communications from 42 Plantation Managers, classified as follows:

In favor of continuing the Station	26
In favor of abolishing	10
In favor of a Hilo branch	4
No opinion at all	2
Total	42
No replies received	3
Grand Total	45

It was therefore apparent to you Committee that the great majority were in favor of continuing the Station, and, judging from oral, as well as many written expressions of opinion received on the subject of an Entomological Department (independent of the one organized by the Government), all mana-

gers were practically unanimous that such a Department should be organized by the Board of Trustees of the Association. There furthermore seemed to be considerable expression of opinion that sub-stations should be started in the several districts of the Islands, and that an experienced agriculturist should be engaged to conduct experiments at these under direction of the Director of this Division.

RECOMMENDATION OF COMMITTEE TO BOARD OF TRUSTEES.

After discussing the matter of the utility of the Station in all its details, your Committee unanimously made the following recommendations to the Board of Trustees, which the latter adopted on April 21st, 1904, viz:

(1) That the field and other work conducted at the Experiment Station be continued in the future as in the past, and that a skilled agriculturist be employed to visit the plantations regularly and work in conjunction with the Experiment Station at Honolulu, such agriculturist being employed under the direction and instruction of the Director of the Experiment Station.

(2) That the Hawaiian Sugar Planters' Association establish a Division of Entomology at the Head Station, and appoint thereto a suitable staff of competent and experienced entomologists and one plant pathologist, their duties to be mainly in the direction of introducing and distributing parasites for cane leaf-hopper and other insect pests injurious to sugar cane, and determining and classifying the numerous fungus diseases attacking the same.

(3) That the Hawaiian Sugar Planters' Association purchase or lease for the joint use of the Divisions of Entomology and Agriculture an additional area of land on which to erect suitable offices, laboratories, insect rooms and propagating houses, and also for the purpose of extending the area now under cultivation at the present station.

AGRICULTURIST AND SUB-STATIONS.

Following up the adoption of these recommendations, your Committee, with the approval of the Board of Trustees, secured the services of Mr. E. G. Clarke as Agriculturist for the Station. Mr. Clarke has had an extended experiencee in agricultural experiment work under Dr. Stubbs of the Louisiana Station, as well as under Dr. Maxwell and Messrs. Blouin and Eckart of the Honolulu Station. He has been engaged in agricultural operations for a period covering twenty years in which time he has become thoroughly familiar with the sugar industry of Louisiana. For twelve years Mr. Clarke has followed Experiment Station work of an agricul-

tural nature, and before that time was assistant manager of the Foley Plantation of Louisiana under John B. Foley. Mr. Clarke will, under the supervision of the Director, establish Sub-stations in the several Island districts, and will periodically visit these for the purpose of co-operating with managers on such experiments as may be under way. It has been decided by the Board of Trustees that the fertilizers and expenses attending the services and transportation of the agriculturist will be defrayed by the Association, but that the cost of all labor required for the maintenance of said Sub-stations shall be borne by, and the product belong to, the plantation on which the Sub-station is established.

In accordance with this new policy of the Board of Trustees the Director of the Station has already started two Sub-stations on the Island of Hawaii. These are at Waiakea and Laupahoehoe, each of these plantations presenting certain problems bearing on the subject of fertilization and being particularly suitable for the work in hand. The Agriculturist had already started visiting the plantations in Hilo district when he had to be recalled to the Head Station owing to the serious illness of the Director. During the visits of inspection of the Agriculturist, he will familiarize himself as much as possible with plantation conditions from an agricultural standpoint, taking copious notes for future reference. Your Committee hopes that all managers will render the Agriculturist all possible assistance in his duties and co-operate with him and the Director in all matters likely to be of service to plantation interests generally.

EXTENSION OF EXPERIMENT STATION.

Your Committee, under the direction of the Board of Trustees, looked over several pieces of land in the suburbs of Honolulu, which it was thought might be available on which to locate the Entomological Bureau and the present Experiment Station, the idea being to get a piece of property of sufficient area to accommodate both branches of the work, and particularly with a view to giving the Agricultural Division more land for its experimental work. After considering all matters investigated in detail, and comparing values of sites visited and figuring the relative cost of retaining the Station where it is and moving to an entirely new site, your Committee recommended strongly to the Trustees that the Experiment Station be retained at its present quarters and that a portion of the adjoining property, which was offered for sale, be purchased by the Association; a portion for the use of the Entomological Division and the balance as additional area for the purpose of carrying on experiments in the production of new varieties of cane. Acting upon this rec-

ommendation, the Trustees purchased 1¾ acres of the property in question and erected thereon offices, laboratories, insect houses, etc., for the use of both the Divisions of Agriculture and Entomology. The laboratories of the chemists will remain where at present located.

PRINTED BULLETINS OF EXPERIMENTS CONDUCTED.

Your Committee has within the past few months instructed the Director to adopt a system of issuing printed bulletins on the subjects of his experiments as soon as the latter were complete. This system will no doubt meet with the approval of all managers, as in the past they complained of having to wait for the results of the work of the Station until the annual meeting, at which these results were read in the shape of reports. This new system was only decided upon a couple of months ago since which time the Director has issued two bulletins, viz:

A press bulletin, or circular, entitled, "Varieties of Cane."

A bound bulletin entitled, "Recent Experiments with Saline Irrigation."

The Director has in course of preparation another bulletin giving the results of investigations bearing on the dwarfed condition of Lahaina cane in the Hilo District, which it is being demonstrated is due to a root disease caused by fungus in the soil. Owing to the fact that the Experiment Station has not as yet added a Plant Pathologist to its staff, it has been found necessary to submit samples of the diseased cane to the Department of Agriculture at Washington for identification of the fungus infesting its roots before material bearing on this question will be ready for publication. There will very shortly be published a second bulletin on "Varieties of Cane," which will deal more in detail and be more of a technical nature than the previous one on the same subject.

IMPORTATION OF SEED CANES AND PROPAGATION OF CANE SEEDS.

The Director of the Station has been in communication with Dr. Maxwell in connection with new varieties of seed cane and with the approval of the Board of Trustees has arranged with that gentleman to have a few new Queensland varieties introduced here, the canes, however, being subject to the examination of Entomologists Koebele and Perkins (now in Queensland) previous to shipment, and by Mr. Craw, the local Government entomologist and inspector, upon their arrival here. These precautions have to be taken with all canes intended for introduction here, owing to numerous insect pests and fungus diseases which are prevalent in other countries but which are fortunately not yet in this country.

The Director of this Division and your Committee have already made preliminary arrangements at the Station with a view to raising our own canes from seed. This has already been tried in previous years, but nothing of importance has ever emanated from the experiments. Your Committee is in hopes that renewed efforts in this direction may now meet with some success.

During the past year a limited amount of seed cane from promising varieties was distributed among the plantations for trial under their conditions. The showing made by some of these canes is very gratifying and there appears to be little doubt that a number of the varieties will in the near future replace the "Lahaina" and "Rose Bamboo" in some localities. Too much importance cannot be attached to these variety tests.

ENTOMOLOGICAL DIVISION.

ORGANIZATION.

Because of the seriousness of attacks by insect pests and fungus diseases, the Board of Trustees of the Association determined upon the organization of a division of entomology in connection with the present Experiment Station. (See Committee's recommendation (2) mentioned in the first part of this report.) This matter being of paramount importance to plantation interests in general, and in view of the fact that such an establishment in connection with the Station would entail considerable special committee work, the Trustees decided to appoint a Special Committee consisting of Messrs. W. M. Giffard, G. M. Rolph and E. D. Tenney, for the purpose of starting the new organization, adapting it to the general system of the present Experiment Station and further, for securing the services of competent entomologists to conduct the same. During the past six months, the above gentlemen have, with the unanimous approval of the Trustees, undertaken the work contemplated in the Experiment Station Committee's Report to the Trustees, and your Committee is pleased to report that the Division is now fully established with a competent staff of entomoligists, and will soon be in a condition to give practical evidences if its usefulness to plantation interests generally.

SUB-DIVISION OF DEPARTMENTS AND STAFF EMPLOYED.

Your Committee particularly wishes to call attention to the sub-division of the various departments made necessary by the changes above referred to. Up to the present, the Divisions of Agriculture and Chemistry have had full sway,

under one head, but your Committee, with the approval of the Trustees, decided that, with the advent of the Entomological Division, it would be more systematic and result in a better understanding between departmental heads if the departments were sub-divided, and made entirely independent of one another. The Station at this time is therefore divided up as follows:

Divisions of Agriculture and Chemistry:

C. F. Eckart, Director and Chemist.
E. G. Clarke, Agriculturist.
S. S. Peck, 1st Asst. Chemist.
F. Thompson, Asst. Chemist.
F. R. Werthmuller, Asst. Chemist.
A. C. Jordan, Asst. Chemist.
T. Lougher, Field Foreman.

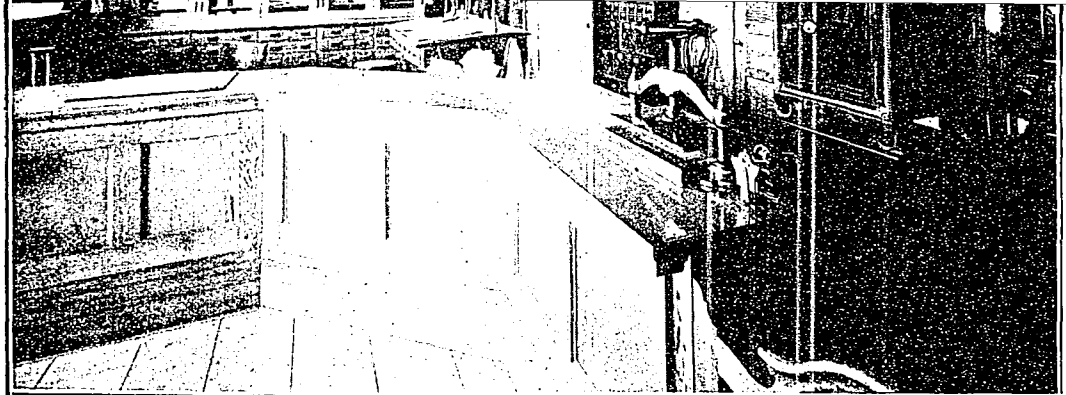
Division of Entomology:

R. C. L. Perkins, Superintendent.
A. Koebele, Consulting Entomologist.
Alex. Craw, Consulting Entomologist.
G. W. Kirkaldy, Asst. Entomologist.
F. W. Terry, Asst. Entomologist.
Otto M. Swezey, Asst. Entomologist.

Messrs. Koebele and Craw are in the joint service of the Territorial Government and of this Association, the former having been abroad for some time past making strenuous efforts to secure parasites to prey on the cane leaf-hopper, whilst the latter has lately been engaged by the Territorial Board of Agriculture for the purpose of inspecting all vegetable matter introduced into the Territory. Mr. Craw's long service and experience as Deputy Commissioner of Horticulture and Quarantine Plant Inspector for the State of California well qualified him for the very important position he now holds and his co-operation with our own entomologists will undoubtedly be of future value to the Association. The entomological reputation of Messrs. Koebele and Perkins is well known to all members of this Association, and therefore needs no comment on the part of your Committee. Assistant Entomologists Kirkaldy, Terry and Swezey have all had considerable experience in special entomological work at other stations with which they have been connected.

PLANT PATHOLOGIST AND FUNGUS DISEASE OF CANE.

Your Committee is at present in correspondence with Plant Pathologists in the United States, Australia and the West



Business Office, Experiment Station.

Indies, with a view to securing the services of a competent man, experienced in the determination and classification of fungus diseases attacking sugar cane. Such a scientist on our Experiment Station staff is very necessary, inasmuch as one of the results of the recent attacks of the cane leaf-hopper has been the increase and spread of numerous "wound" fungus diseases peculiar to cane which had been to some extent dormant in the Territory for years past. It has been stated by our Agricultural Director that in his opinion the losses caused to plantations by fungus diseases have been fully as great as those by the cane leaf-hopper itself—in fact, he is inclined to the view that the cane leaf-hopper is not altogether responsible for the unfortunate condition of affairs as reported on many plantations during the past twelve months or longer.

CAUSES OF DELAY IN WORK CONTEMPLATED.

Although the Division of Entomology was really organized by the Board of Trustees last May, the delay in construction of suitable quarters for the staff and for the propagation of beneficial insects necessitated a similar delay in the actual appointments of the working staff, these taking effect only during the months of August and September. Previous to these months, the entomological work performed for the Hawaiian Sugar Planters' Association was conducted jointly by Messrs. Perkins, Kirkaldy and Terry, all of these gentlemen being at the time Government employees and, with the exception of Mr. Perkins, also receiving indirectly, compensation from this Association. Owing to the peculiar nature of the work required by the plantations, it was soon found that, under existing conditions, this system of obtaining the services of the entomologists was far from satisfactory. To make matters worse, Mr. Perkins, on whose knowledge of our local entomological conditions the other entomologists to a very great extent relied, was off and on confined to his home by sickness, and one of his assistants, Mr. Kirkaldy, was also laid up through a serious accident, the latter having ever since been to a more or less extent incapacitated for anything but office work. Your Committee appreciates the necessity of these explanations to show why there has not been up to the present time more propagation and distribution of indigenous beneficial insects among our plantations. Now that we have our own organization, the Association may look for as good results from this particular Division as it does from the Agricultural Section. In August last Mr. Otto Swezey was employed primarily for the purpose of making an inspection of all plantations, and up to the time of this report has already visited the estates on

Main Laboratory—Chemical Division.

the islands of Oahu and Maui, reporting entomological conditions to the Superintendent of his Division, who in turn forwards copies of these to the Manager and Agents only of the plantations visited.

EXPEDITION TO AUSTRALIA BY KOEBELE AND PERKINS.

In May last, after much unavoidable delay, arrangements were satisfactorily concluded with Messrs. Koebele and Perkins to undertake field work in Australia for the special purpose of securing a parasite for the cane leaf-hopper. Word has since been reecived that these entomologists have so far been successful in their mission, i. e., several species of parasites and other insects attacking cane leaf-hopper in the egg state, in the larval state and when mature, have been discovered by them in Queensland, all of these having undoubtedly been the means of keeping the cane hopper in check in that country. All of these insects the entomologists hope to introduce here successfully, the great drawback at this time being, however, the distance in transportation. So far as possible all consignments have been kept in the refrigerator from the time of shipment to time of receipt in Honolulu. Many of the first consignments, however, came from Cairns and owing to the distance and to unsatisfactory means of transportation from that place to Sydney, were far from satisfactory when received at Honolulu. These particular shipments might have been made from Brisbane, which is much closer to Cairns, and then have been reshipped by the Canadian-Australian line from that point, but it was found that the local boat from Cairns to Brisbane arrived at the latter point always a day or two after the departure of the Canadian-Australian steamer, thus necessitating a delay of several weeks awaiting the next boat. These reasons made it necessary, as before stated, to have the Cairns shipments sent by way of Sydney to catch the Oceanic S. S. Co. boats, connection with the latter being more regular but the distance greater. In regard to these several parasites, Messrs. Koebele and Perkins write that, providing the climatic conditions in Hawaii are as suitable to their propagation and distribution as they are in Queensland, the time is not far distant when the cane leaf-hopper pest will be a thing of the past. The final success of the experiment will, however, entirely depend upon the successful breeding of the parasites after arrival in Honolulu. What is said to be the most important of these parasites arrives in an immature condition, i. e., in the form of a parasitised egg of the cane leaf-hopper. As an illustration of the careful attention these consignments require, it may be here stated that the parasite upon emerging from the egg of the hopper is so minute as to require the use

of the strongest kind of a lens to detect it, and the glass jars in which are placed the small sections of cane leaves containing the parasitised eggs have to be inspected and gone over with the lens several times each day. It is unfortunate that your Committee is unable, at the date of this report (September 30th), to record the successful breeding out of these most important parasites of which two consignments have so far been received. The Entomologists, however, report the successful breeding of several new species of ladybird and an earwig sent from Australia by Koebele and Perkins, all of which feed on the cane aphis and the very young hoppers.*

PRINTED BULLETINS.

It is the intention of this Division to publish from time to time Bulletins on such subjects as it may have had under examination and which have been sufficiently investigated to warrant an official publication. Up to the present time the only Bulletins published have been those of our Superintendent whilst acting in a similar capacity for the Board of Agriculture of this Territory.

SUPERINTENDENT'S REPORT.

Owing to the absence of the Superintendent of this Division, your Committee is unable to submit any detailed report of the work actually accomplished by him and Mr. Koebele. No doubt a report will be forthcoming from both the gentlemen upon the termination of the expedition. Appended hereto (See Appendix III) are short reports by Acting Superintendent Kirkaldy and Assistant Entomologist Terry, setting forth such work as has been performed by the Division during the short period of its organization.

Respectfully submitted,

W. M. GIFFARD,
Chairman.

H. A. ISENBERG,
G. M. ROLPH,
GEO. H. ROBERTSON,
ANDREW ADAMS,
J. M. DOWSETT,
Standing Commitee.

W. M. GIFFARD,
E. D. TENNEY,
G. M. ROLPH,
Special Committee.

Honolulu, October 15, 1904.

*Since the closing of the report the Committee has been informed by the Acting Superintendent of the Division that some of the much desired hopper egg-parasites from the last consignment sent by Perkins and Koebele have hatched out.

(APPENDIX I.)

REPORT OF CHEMICAL DIVISION.

To the Experiment Station Committee of the Hawaiian Sugar Planters' Association.

Gentlemen:—With regard to work of the Chemical Division of the Experiment Station for the year ending September 30th, 1904, I beg to submit the following report:

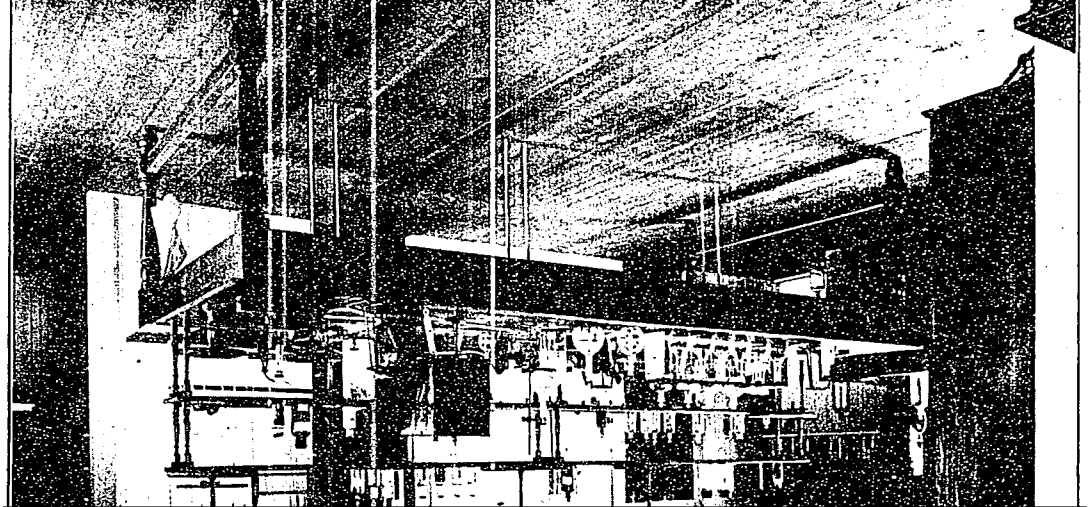
LABORATORY WORK.

The total number of analyses completed in your laboratories numbered 1317, of which 650 were for plantations and 667 for experimental work conducted by the Station. The work of the laboratories may be summarized as follows:
For plantations—

Fertilizers	333
Soils	285
Water, entrainment	2
Water, sanitary	1
Water, boiler	3
Canes	2
Molasses	6
Sugar	1
Press cake	2
Coral	2
Lime	3
Miscellaneous Fert. Materials	10
Total	650

Experiment Station—

Soils, Aspartic Acid Method	40
" Nitrogen, 2 forms	135
" Complete Agric. Method	4
" " Asp. Acid Method	2
Drainage waters, (1903 experiments)	12
" " complete (1904 expts.)	252



New Addition to Laboratory—Chemical Division.

Drainage waters, partial (1904 expts.)	24
Fertilizers, complete	68
" partial	20
" for use in lysimeters, etc.	16
Mauritius Beans, (ash, etc.)	6
Cane juices	32
Cane fibers	20
Chlorine in juices	1
Cane ash analyses	17
Trash analyses	17
Water, Kalihi	1
Total	667
Analyses for Plantations	650
Analyses for Experiment Station	667
Total	1317

This is a material increase in the work accomplished by the laboratories over that of previous years. The following comparative summary shows the number of analyses for the years 1902-1904 inclusive:

ANALYSES FOR THREE YEARS,

Analyses.	1902	1903	1904
Soils	91	225	331
Soils (Special determ.)	..	....	135
Fertilizers	239	368	437
Waters	179	111	295
Cane Juices	31	96	32
Cane Ash	56	40	34
Molasses	3	13	6
Miscellaneous	15	35	47
Total	614	888	1317

FERTILIZER ANALYSES.

During the past 12 months there has been a closer conformity between Experiment Station findings and Manufacturer's Guarantees than in former years, as may be seen from the following figures:

Total Fertilizers, received from plantations	333
Fertilizers with Guarantees	268
" without Guarantees	65
" below Guarantees	47

Rebate, allowable on 268 Fertilizers.....$2,486 66
" calculated on 333 " 3,089 77

The material and steady decrease in rebates charged to manufacturers indicates the value of this fertilizer control work. During the year 1900, only 75 fertilizer samples were submitted to the laboratory for analyses and these showed a shortage in the original lots amounting to $12,000. Had there been no improvement in the conformity of actual findings and guarantees for the year 1904 over that for 1900, 333 fertilizers would have been entitled to rebates amounting to $53,280. When this sum is compared with the rebates for 1904, amounting to $3,089 the result is gratifying.

Rebates for the past five years have been as follows:

	1900	1901	1902	1903	1904
Fertilizer samples received	75	189	229	368	333
Difference between valuation of Manufacturer and Experiment Station	$12,000	$11,000	$9,000	$4,900	$3,089

SOIL WORK.

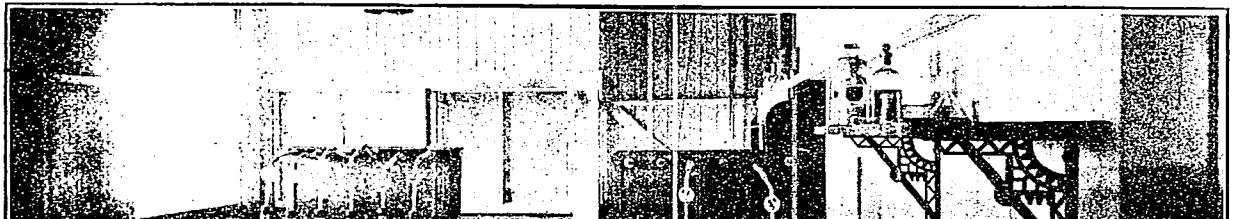
The Division has been pleased to note that the demand for soil analyses, which showed such a considerable increase last year, has been maintained during the past 12 months. In addition to the regular routine work of analyzing soils and furnishing fertilizer recommendations for the same, three series of soil experiments bearing on the behavior of fertilizers have been carried out with interesing and valuable results. These latter investigations will form the subject of a bulletin to be issued by the Chemical Division in the near future.

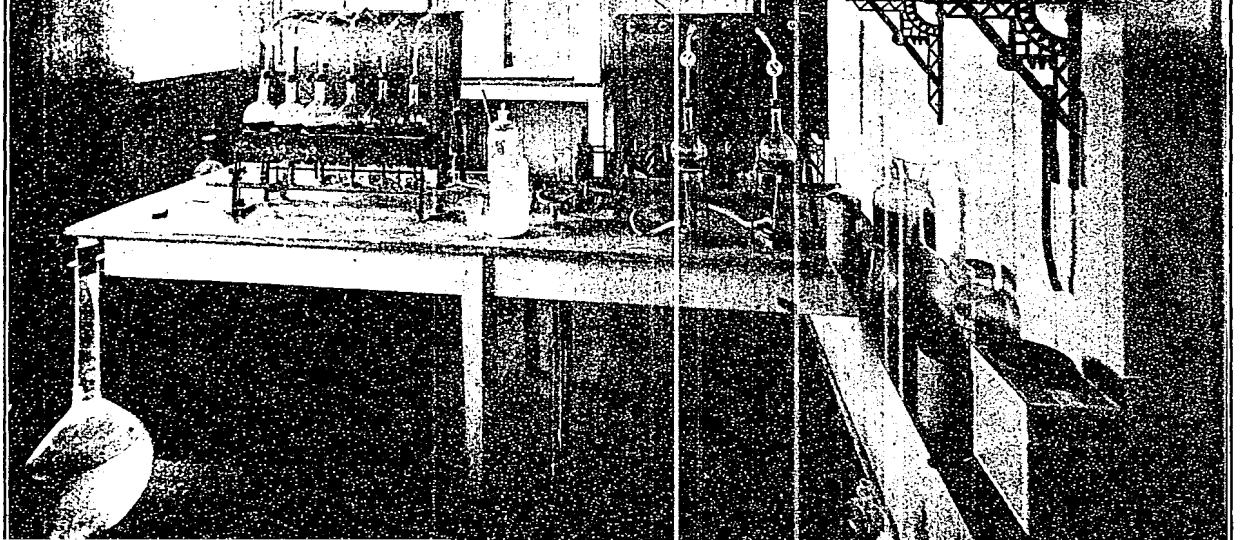
NEW LABORATORY BUILDING.

The new laboratory which was completed at the close of 1903 has been adequately equipped for such chemical investigations as the Experiment Station is called upon to pursue. During the past year this laboratory has been primarily used for the pursual of experimental work on soils which will form the basis of a special report to be issued shortly.

SAFF OF THE CHEMICAL DIVISION.

This Division was fortunate enough to secure the services of Mr. Firman Thompson at the beginning of the present year. Mr. Thompson who was an employee of Dr. Maxwell at the Station some years ago has had considerable experience in Experiment Station work in the United States, Hawaii, and Queensland and is particularly qualified for analytical in-





Distilling Room—Chemical Division.

vestigations. The staff besides the Director is composed of
S. S. Peck, First Assistant Chemist.
F. Thompson, Assistant Chemist.
F. Werthmueller, Assistant Chemist.
A. E. Jordan, Assistant Chemist.

Messrs. Peck, Werthmueller, and Jordan have rendered the same excellent services as heretofore and their assistance has been very gratifying.

Respectfully submitted,

C. F. ECKART,
Director, Chemical Division.

Honolulu, October 1, 1904.

(APPENDIX II.)

REPORT OF AGRICULTURAL DIVISION.

To the Experiment Station Committee of the Hawaiian Sugar Planters' Association.

Gentlemen:—I herewith submit a report on the work of the Agricultural Division of the Hawaiian Sugar Planters' Association for the year 1904.

FIELD WORK.

Seventeen varieties of cane were harvested during the latter part of April and formed the subject of a press bulletin entitled "Varieties of Cane" published in May of this year. A second bulletin of a more technical character will be issued shortly showing the chemical analyses of these canes and comparing their productive worth with their respective demands for the plant foods of the soil.

A number of plats bearing on the subject of saline irrigation were also harvested and furnished material for a bulletin "Recent Experiments with Saline Irrigation" published in August.

The ratoons from the varieties mentioned above were cut back on the 27th of July and will be harvested in 1906. They comprise the following canes:

Cavengerie.
Gee Gow.
Tiboo Merd.
La. Striped.
La. Purple.
Queensland No. 1.
Queensland No. 4.

Queensland No. 7.
Queensland No. 8A.
Demerara No. 74.
Demerara No. 95.
Demerara No. 117.
Yellow Bamboo.
Yellow Caledonia.
Big Ribbon.
Striped Singapore.
White Bamboo.

The cane on one half of the field area devoted to these varieties will be allowed to mature, and the other half will be cut in the early part of next spring to furnish seed cane for distribution among the plantations for trial under such diversified conditions as obtain on the various islands. New varieties of cane planted this year are as follows:

Striped Tip.
Daniel Dupont.
Demerara No. 115.
Demerara No. 116.
Demerara No. 145.
Demerara No. 1135.
Demerara No. 1483.
Unknown.
Dark Colored Bamboo.
Moirs White.
Demerara No. 1937.
Queensland B. 5.
Queensland B. 8A.
Queensland B. 147.
Queensland B. 156.
Queensland B. 176.
Queensland B. 208.
Queensland B. 244.
Queensland B. 306.
Altamati.

Of these new varieties, Moirs White, a "sport" from Big Ribbon, is at the present time making the best showing, having produced a marvelous growth since planting during the latter part of June and indicating the value of carefully testing the merits of such sports as emanate from well known canes of little repute.

FERTILIZER EXPERIMENTS.

A large part of the field is devoted as usual to fertilizer tests and it is believed that the results obtained on harvesting will to a greater extent than heretofore be capable of general application. They deal chiefly with the times of applying

PORTION OF CANE FIELDS, EXPERIMENT STATION.

fertilizing material, and also as to the division of the total amount for the several dressings. The plats are 14 in number and of 1000 sq. ft. area. They are as follows:

Plat No. 1.—No fertilizer.
" " 2.—One application with seed, 1904.
" " 3.—One application in August, 1904.
" " 4.—One application in April, 1905.
" " 5.—One application in Aug., 1904; 300 lbs. of Nitrate of Soda, in May, 1905.
" " 6.—Two applications; with seed $\frac{1}{3}$, April $\frac{2}{3}$.
" " 7.—Two applications; Aug. $\frac{1}{3}$, April $\frac{2}{3}$.
" " 8.—Two applications; Aug. $\frac{1}{2}$, April $\frac{1}{2}$.
" " 9.—Two applications; Aug. $\frac{2}{3}$, April $\frac{1}{3}$.
" " 10.—Two applications; Aug. $\frac{2}{3}$, April $\frac{1}{3}$, 300 lbs. of Nitrate of Soda in June.
" " 11.—Three applications; Aug. $\frac{1}{3}$, Mar. $\frac{1}{3}$, May $\frac{1}{3}$.
" " 12.—Three applications; Aug. $\frac{1}{3}$, Mar. $\frac{1}{3}$, May $\frac{1}{3}$, 300 lbs. of Nitrate of Soda in July.
" " 13.—Three applications; Aug. $\frac{1}{3}$, Mar. $\frac{1}{3}$, May $\frac{1}{3}$, 150 lbs. Nitrate in Sept., 1904, 150 lbs. Nitrate in July, 1905.
" " 14.—Three applications; Aug. $\frac{1}{3}$, Mar. $\frac{1}{3}$, May $\frac{1}{3}$, Nitrate of Soda, 100 lbs. per application in June, July and August.

These plats will be harvested in 1906.

FALLOWING AND GREEN MANURING EXPERIMENT.

These experiments comprise three plats of 750 sq. ft. area planted in Lahaina cane. They are as follows:

Plat No. 1.—Land which has been cropped continuously.
" " 2.—Twenty months' fallow and one four months' crop of Mauritius Beans turned in.
" " 3.—Sixteen months' fallow and eight months' crop of Mauritius Beans turnd in.

The cane from these plats will be harvested in 1906.

IRRIGATION EXPERIMENTS.

Two plats of 6,300 sq. ft. area were planted in Lahaina cane during the latter part of June and will be harvested in 1906. One plat will receive 2 inches of water weekly, irrigation being stopped for 1.5 inches of rain during the week, while the other plat will be irrigated according to a formula which takes into consideration the temperature and humidity of the air during the week preceding irrigation. For the plat which receives the

varying amounts of water the irrigation factor is to be determined from the following formula:

$$T+\frac{100-H}{2}=X,$$ in which T = average temperature for week preceding irrigation, H = average humidity, and X = irrigation factor.

Factor.	Irrigation.	Factor.	Irrigation.
75	0.5 in.	88	1.5 in
76	0.5 "	89	2.0 "
77	0.5 "	90	2.0 "
78	0.5 "	91	2.5 "
79	0.5 "	92	3.0 "
80	0.5 "	93	3.5 "
81	0.5 "	94	4.0 "
82	0.5 "	95	4.0 "
83	0.5 "	96	4.0 "
84	0.5 "	97	4.0 "
85	1.0 "	98	4.0 "
86	1.0 "	99	4.0 "
87	1.5 "	100	4.0 "

During June and July, young cane just planted, to receive 1 inch irrigation per week (maximum.)

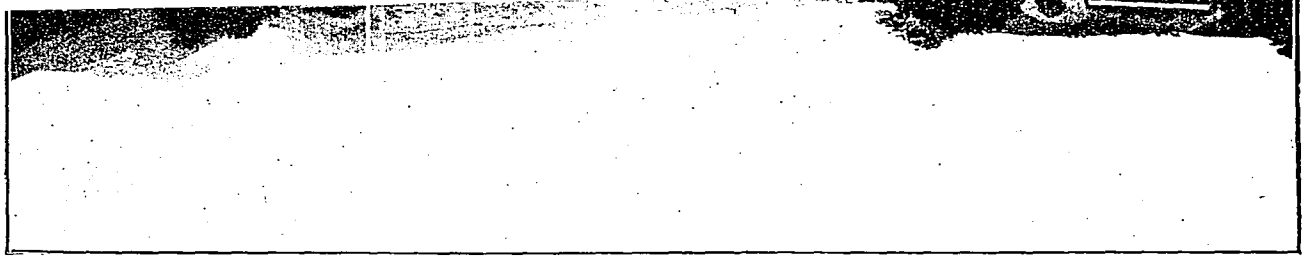
Young cane during Aug., Sept., Oct. and Nov. to receive irrigation according to table (2" maximum.)

Cane over 6 mos. old to receive irrigation according to table (4" maximum.)

TIMES AT WHICH CANE IS NOT TO BE IRRIGATED.

Canes 6 mos. old and under.

Factor.	Rainfall.
75	0.50 in.
76	0.50 "
77	0.50 "
78	0.50 "
79	0.50 "
80	0.50 "
81	0.50 "
82	0.50 "
83	0.50 "
84	0.50 "
85	0.75 "
86	0.75 "



PORTION OF CANE FIELDS, EXPERIMENT STATION.

Factor.	Rainfall.
87	1.00 in.
88	1.00 "
89	1.50 "
90	1.50 "
91	1.50 "
92	1.50 "
93	1.50 "
94	1.50 "
95	1.50 "
96	1.50 "
97	1.50 "
98	1.50 "
99	1.50 "
100	1.50 "

TIMES AT WHICH CANE IS NOT TO BE IRRIGATED.

Cane over 6 mos. old.

Factor.	Rainfall.
75	0.50 in.
76	0.50 "
77	0.50 "
78	0.50 "
79	0.50 "
80	0.50 "
81	0.50 "
82	0.50 "
83	0.50 "
84	0.50 "
85	0.75 "
86	0.75 "
87	1.25 "
88	1.25 "
89	1.50 "
90	1.50 "
91	2.00 "
92	2.50 "
93	2.50 "
94	2.50 "
95	2.50 "
96	2.50 "
97	2.50 "
98	2.50 "
99	2.50 "
100	2.50 "

CANE TO BE HARVESTED IN 1905.

The cane to be harvested in 1905 will be from fertilizer and irrigation tests which have been described in previous reports which have been published by the Director.

ROOT DISEASE.

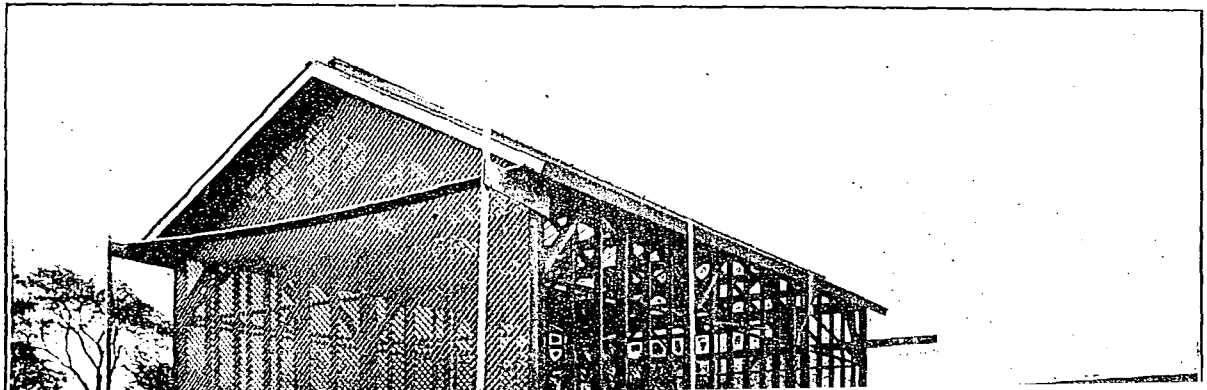
Experiments have been conducted by the Division during the past year with relation to stunted growth of Lahaina cane in the Hilo district, also of Lahaina and Rose Bamboo cane under certain conditions. It has been definitely established that the foundation of the trouble lies in a root disease caused by a parasitic fungus. Tests by the Division with cane growing in tubs were carried out and microscopical examinations were made by Mr. R. C. L. Perkins and by the U. S. Department of Agriculture. The root disease in question will be made the subject for a future bulletin when further necessary data, which will soon be forthcoming, is obtained.

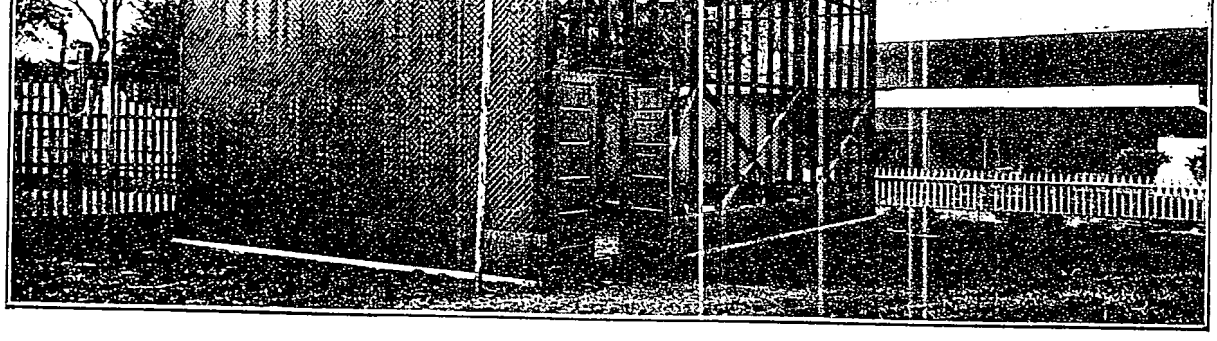
ESTABLISHMENT OF SUB-STATIONS.

Following the new policy formulated by the Trustees of the Association for increasing the efficiency of the Agricultural Division, two sub-stations have already been established through the courtesy of Mr. Kennedy, at Waiakea, and of Mr. McLennan at Papaaloa. Both sub-stations are for the present dealing with questions on fertilization, and it is expected that the results obtained from these investigations will not only be of great value to the localities in question, but also to surrounding plantations. By the end of next year sub-stations will have been established in all of the districts of the islands.

EXTENSION OF FIELD AREA.

Following the purchase of the premises adjoining the old Experiment Station Field, the land available for plat experiments has been increased by an area of about one acre. This extension will add greatly to the efficiency of the Agricultural Division and hasten the carrying out of contemplated experiments which otherwise would have awaited available space in the old field. The construction of the commodious cane propagation house which the Experiment Station Committee saw fit to add for the use of the Division, will be of utility in the growing of imported seed canes. Owing to the very fine mesh screen forming the walls of this house the danger of liberating such insect pests as might have escaped observation in the consignments will be reduced to a minimum.





CANE PROPAGATING HOUSE.

In this enclosure a proper temperature and humidity can also be maintained during the winter months for the pursual of work bearing on the propagation of varieties of cane from true seed.

STAFF OF AGRICULTURAL DIVISION.

This Division has been particularly fortunate in procuring the services of Mr. E. G. Clarke as Agriculturist. Mr. Clarke has had an extended experience in agricultural operations, covering a period of twenty years, of which twelve have been devoted to Experiment Station work. Mr. Clarke will spend the greater part of his time travelling among the plantations, where he will establish sub-stations under the direction of the Division and from time to time report on their progress.

The staff of the Agricultural Division at the present time comprises beside the Director,

E. G. Clarke, Agriculturist,
T. Lougher, Field Foreman.

Respectfully submitted,

C. F. ECKART,
Director Agricultural Division.

Honolulu, October 1, 1904.

(APPENDIX III.)

REPORT OF ENTOMOLOGICAL DIVISION.

General Report of Acting Superintendent.

To the Special Committee on Experiment Station, Honolulu.

Gentlemen:—It is difficult to prepare a special report of the work accomplished by your entomologists during the past year, as this has been so interwoven with their work for the Bureau of Agriculture of the Territorial Government; at the same time, the greater proportion of the work accomplished during this period has been in connection with the pests of Sugar Cane and especially with the cane leaf-hopper (*Perkinsiella Saccharicida.*)

PAST DIFFICULTIES.

Work has been much hampered during the period above referred to by a variety of causes. Firstly, for a considerable

period, Mr. Perkins was exceedingly ill, although still devoting great care to special work; secondly, I myself had a most unfortunate accident in April last, with the result that I am now, after six months, still a cripple. I was able, however, to be present at the office the whole of the time, with the exception of about one month entirely away, and another six weeks usually absent in the hot afternoons. Work of any value was practically impossible in the old Capitol Building, and while conditions were very materially ameliorated at the King street nursery, the entomologists' rooms there are, in my opinion, far too hot to be of value for the finest work in breeding insects. Again, in the past we have been considerably hampered by the lack of a suitable scientific library, as we had to depend almost exclusively upon the private libraries of Prof. Koebele and myself.

NEW QUARTERS.

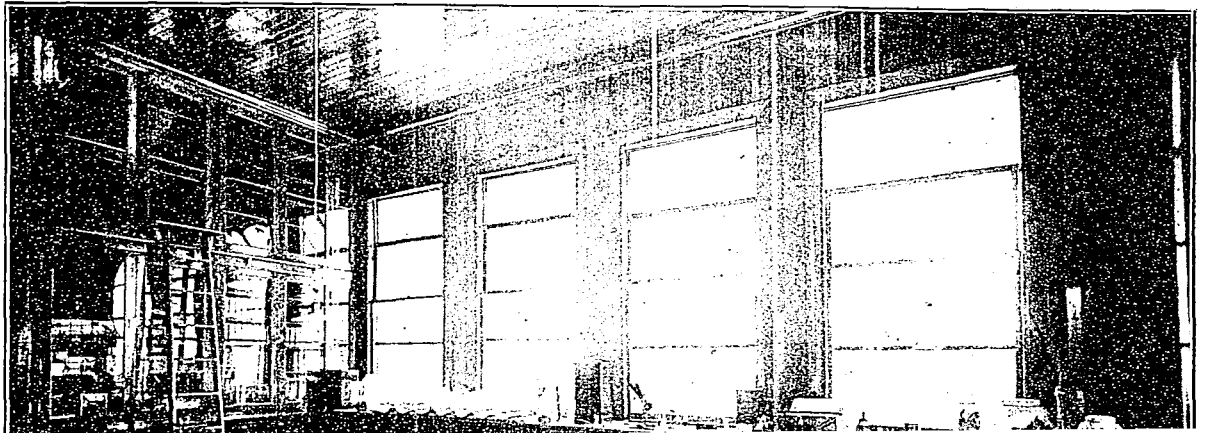
Many, if not all, of the difficulties that have attended our labors in the past, have become overcome by the erection of the spacious and excellent quarters for this Division on Keeaumoku street. The building there is equipped in modern fashion, with especial regard to the use to which it is to be put. The rooms are large and are provided with sufficient shelves, drawers, etc., the special bug room and the outdoor cages furnish ample facilities for conducting breeding experiments; and, in fact, almost everything in the way of equipment is present that could be desired.

Your Association has been most liberal in its expenditure of money to provide requisites for the conduct of our scientific work, but I feel constrained to say that, in my opinion, the expense will be more than justified by the results hereafter to be derived.

LIBRARY.

Through the generosity of the Association, I have been enabled to spend a not inconsiderable preliminary amount on works necessary for the scientific equipment of the library, and in the course of a year or two, there should be a library second to that of no experiment station in the world, and in addition to having the finest entomological library in the Islands, I believe, in fact, that we will have the most thoroughly equipped entomological library in the Australian region.

Communications have been opened up with all Experiment Stations and the principal Museums all over the world. Arrangements have been made to exchange our mutual scientific publications, as a result of which we have already received



LABORATORY—ENTOMOLOGICAL DIVISION.

many valuable bulletins, papers, reports, etc., and, in many cases, complete files. These bulletins, papers, reports, etc., are reaching us by every steamer and greatly enhance the scope and value of our library.

INSPECTION OF PLANTATIONS.

Up to the present time, Mr. O. H. Swezey, who was engaged to make a thorough inspection of all the plantations under your control, has finished his examination of plantations on the Island of Oahu. His observations of entomological conditions on such plantations have been embodied in comprehensive reports to this office, which have been summarized and distributed in accordance with instructions received from your committee.

With the cordial co-operation of your agents and managers, these visits of Mr. Swezey should prove of the highest practical value.

Mr. Swezey is now inspecting the plantations on the Island of Maui, after which he will visit the other islands.

OFFICE WORK.

In connection with the above subject, I would like to express my sense of appreciation of the work done by Miss Melika Peterson, the clerk of the Board of Agriculture and Forestry, who devoted a large number of Saturday afternoons and other time to the work of the Association before the engagement of Mr. McBride.

Mr. C. H. McBride, who was employed to act as bookkeeper, stenographer and general office man, is now in charge of the office and is speedily getting the various work into systematic shape. He has put in vogue various systems for filing letters, reports, etc., in connection with card index systems, and the benefit of his labors in that respect will be felt in a short time, as by systematizing the office work, any matter on a given subject can be referred to at once without loss of time or confusion.

The offices of the new building are thoroughly equipped and in addition to being a great benefit in our work, are a permanent monument to the generosity and business-like manner in which your committee has supervised this branch of our work.

BREEDING OF LOCAL PARASITES, ETC.

Previous to the departure of Professors Koebele and Perkins, a great portion of your entomologists' time was taken up in the breeding of the local parasite Ecthrodelphax fairchildii

and of the Ohio parasites sent over by Prof. Koebele from America. The breeding up of these parasites and supplying them with suitable pabulum occupied a very large portion of your entomologists' time.

AUSTRALIAN PARASITES.

It is too early yet to expect any practical results from recent dispatches of parasites by Messrs. Koebele and Perkins, except to say that Ladybirds (*Coccinellidae*) have been sent over, which it is expected will be of value, and also that emergences have taken place of an exceedingly minute hymenopterous parasite which it is hoped can be established here, in which case it is probable that the future control of the leafhopper is assured.

Entomologist Terry has had the principal charge of the breeding experiments of above parasites and predators, and the result of his labors in that respect is embodied in a special report attached hereto and made a part hereof.

NEW GOVERNMENT ENTOMOLOGISTS.

Your entomologists have left the service of the Territorial Government, which has engaged in their place Mr. Alexander Craw of San Francisco, one of the best known and most successful of economic entomologists, and Mr. Kotinsky, late of the U. S. Department of Agriculture, Washington, D. C. In this behalf, it may be pleasing to you to note that not only is Mr. Craw fully in sympathy with the aims and methods which have been adopted by your entomologists here, but that most cordial co-operation exists between the entomologists of both divisions.

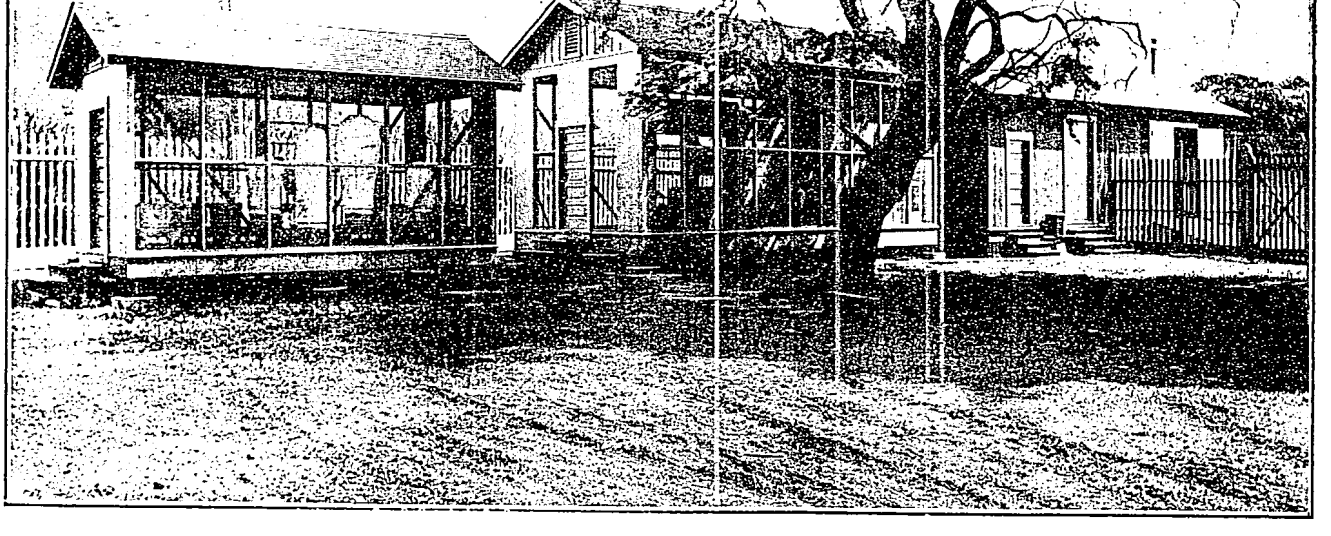
CONCLUSION.

In conclusion, I venture to predict that, with the new building, spacious and thoroughly equipped in all respects as it is —with the benefit of an extensive library and scientific publications from all parts of the world,—with the good work now being done in Australia by the absent chiefs of your Division of Entomology,—with the thoroughly equipped business department in charge of a competent clerk,—together with the knowledge heretofore gained of local conditions by your entomologists,—the forthcoming year has in store very good results for your Division of Entomology, and that it will be pregnant with permanent good to the sugar growing industry of the islands.

Respectfully submitted,

G. W. KIRKALDY,
Acting Superintendent, Division of Entomology.

Honolulu, October 14, 1904.



INSECTORIES.

SUPPLEMENTARY REPORT OF THE ENTOMOLOGICAL DIVISION.

Report of Assistant Entomologist on the Introduction, Breeding and Distribution of Beneficial Insects.

To the Special Committee on Experiment Station, Honolulu.

Gentlemen:—Since my arrival, a year ago last September, my time has been divided between work for the Bureau of Agriculture of the Territorial Government and your Association. During the latter part of 1903, and the new year, continual experiments were being made to establish Leaf-Hopper parasites upon the cane leaf-hopper, which were being collected during the late fall in Ohio by Prof. Koebele. The results so far are not apparent, and I am afraid that our efforts have not succeeded. The reason of this, I think, is largely due to the fact of the very different local conditions existing in Ohio; light frosts were occurring when the later shipments were collected there; and as you are aware, the excessive rains during that period here, were certainly not conducive to the establishment of new arrivals. During this period, numerous consignments of Fairchild's cane leaf-hopper parasite were being bred up and distributed to the various plantations. Owing to the suspicions of Mr. Perkins that possibly a hyperparasite (i. e., a parasite upon the parasite) might exist, it was requested that all parasites for distribution should be reared at our Bureau; this was done from the beginning of May until August. During that period, numerous consignments were bred up and distributed, but no hyperparasites were observed. On May 11th, Messrs. Koebele and Perkins left for Australia, arriving in due course at Cairns, N. Queensland, where they continued their observations and collecting for several weeks. On June 21st, the first consignment of Australian insects arrived. These were all Ladybugs in an extremely feeble condition, and the few survivors, when sufficiently recuperated, were released.

On June 29th a similar consignment of Ladybugs arrived; some of these were in excellent condition; one species, Alesia frenata, feeding upon cane aphis, being taken in considerable numbers to Oahu plantation and released.

Oahu plantation has been selected for experimental purposes, because of its varied and very suitable conditions, and close proximity to Honolulu. A special area has also been reserved there, for the convenience of the entomologists' experiments.

On August 12th, Mr. Craw arrived, and I was then relieved

of the fruit and plant inspection, which, owing to its extreme importance, had occupied a very considerable amount of my time.

On August 22nd, the third consignment arrived with two more species of ladybugs, Verania lineola and Orcus cyanocephalus, both feeding upon cane aphis, and also a hymenopterous parasite for the cane leaf-hopper. Of this shipment only a few ladybugs survived.

On September 13th, the fourth consignment arrived; with several more of the above mentioned ladybugs, a species of earwig, and a second parasite, together with the one previously mentioned. The ladybugs and earwigs were released as before, some, however, being bred up at the Bureau for experiments and observations on their life-history.

On September 21st, the fifth consignment arrived, having missed the Canadian boat at Brisbane, and being, consequently, as far as I can judge, three weeks late. It is hardly surprising, therefore, that out of this lot only a few ladybugs survived.

The last consignment up to the time of my writing, arrived on October 4th, consisting of the previously mentioned species of ladybugs, earwig and parasites. So far, this is distinctly the most satisfactory shipment. This is probably accounted for by the fact that Messrs. Koebele and Perkins have returned south to Bundaberg and are therefore much nearer to Brisbane. One of the much-desired parasites has at last shown itself, and although so microscopic and delicate, I think (and Mr. Craw agrees also) that this insect, if we can only establish it, will effectually reduce the cane leaf-hopper.

Several have been bred out and released on Oahu plantation under most suitable conditions, and I hope per the next shipment to have greater success and establish a colony under cover at our new station. So far, the other parasite has not yet shown itself. In addition to the rearing of beneficial insects relating to cane, several pests or suspects have also been bred, for the purpose of ascertaining their habits, and methods of depredation.

In conclusion, I must express my sincere thanks for the kind co-operation of Messrs. Craw and Kotinsky of the staff of the Board of Agriculture in helping me with these later consignments, the long experience of the former gentleman being particularly acceptable at such a time.

Respectfully submitted,

F. W. TERRY,
Assistant Entomologist.

Honolulu, October 14, 1904.

STATEMENT OF HAWAIIAN SUGAR CROP, 1903-1904

From October 17, 1903, to September 30, 1904.

ISLANDS	Tons	Total Tons
HAWAII.		
Hawaii Mill Co	1,728	
Waiakea Mill Co	6,151	
Hilo Sugar Co	7,701	
Onomea Sugar Co	10,940	
Pepeekeo Sugar Co	4,907	
Honomu Sugar Co	5,489	
Hakalau Plantation Co	8,396	
Laupahoehoe Sugar Co	4,336	
Ookala Sugar Plantation Co	2,214	
Kukaiau Plantation Co	1,275	
Kukaiau Mill Co	1,274	
Hamakua Mill Co	4,691	
Paauhau Sugar Plantation Co	7 533	
Honokaa Sugar Co	7,402	
Pacific Sugar Mill	3,388	
Niulii Mill and Plantation	1,189	
Halawa Plantation	1,016	
Kohala Sugar Co	2,663	
Union Mill Co	1,776	
Hawi Mill	3,631	
Kona Sugar Co	897	
Hutchinson Sugar Plantation Co	5,741	
Hawaiian Agricultural Co	10,954	
Puakea Plantation	201	
Olaa Sugar Co	13,788	
Puna Sugar Co	3,146	
Puako Plantation	438	
		122,865
MAUI.		
Kipahulu Sugar Co	1,415	
Hana Plantation Co	2,662	
Maui Agricultural Co	13,521	
Hawaiian Commercial and Sugar Co.	29,829	
Wailuku Sugar Co	6,451	
Olowalu Co	1,125	
Pioneer Mill Co., Ltd	17,036	
Kihei Plantation Co., Ltd	5,461	
Maui Sugar Co	485	
		77,985
OAHU.		
Waimanalo Sugar Co	2,963	
Laie Plantation	597	
Kahuku Plantation Co	6,360	
Waialua Agricultural Co	18,682	
Waianae Co	5,500	
Ewa Plantation Co	29,797	
Apokaa Sugar Co	874	
Oahu Sugar Co	20,870	
Honolulu Plantation Co	16,376	
		102,019
KAUAI.		
Kilauea Sugar Plantation Co	1,850	
Makee Sugar Co	7,840	
Lihue Plantation Co	14,611	
Grove Farm Plantation	1,679	
Koloa Sugar Co	6,172	
McBryde Sugar Co	10,535	
Hawaiian Sugar Co	11,493	
Gay & Robinson	1,665	
Waimea Sugar Mill Co	627	
Kekaha Sugar Co	7,447	
Estate V. Knudsen	687	
		64.606
TOTAL		*367,475

AGENTS	Tons	Total Tons
W. G. Irwin & Co., Ltd.		
Honolulu Plantation Co	16,376	
Paauhau Sugar Plantation Co	7,533	
Hutchinson Sugar Plantation Co.	5,741	
Hakalau Plantation Co	8,396	
Hilo Sugar Co	7,701	
Kilauea Sugar Plantation Co	1,850	
Waimanalo Sugar Co	2,963	
Olowalu Co	1,125	
		51,685
H. Hackfeld & Co., Ltd.		
Lihue Plantation Co	14,611	
Grove Farm Plantation	1,679	
Koloa Sugar Co	6,172	
Kekaha Sugar Co	7,447	
Pioneer Mill Co., Ltd	17,036	
Kipahulu Sugar Co	1,415	
Kukaiau Plantation Co	1,275	
Oahu Sugar Co	20,870	
Hawaii Mill Co., Ltd	1,728	
		72,233
Theo. H. Davies & Co., Ltd.		
Waiakea Sugar Co	6,151	
Laupahoehoe Sugar Co	4,336	
Kukaiau Mill Co	1,274	
Hamakua Mill Co	4,691	
Niulii Mill and Plantation	1,189	
Union Mill Co	1,776	
McBryde Sugar Co	10,535	
Puakea Plantation	201	
		30,153
C. Brewer & Co., Ltd.		
Hawaiian Agricultural Co	10,954	
Wailuku Sugar Co	6,451	
Honomu Sugar Co	5,489	
Onomea Sugar Co	10,940	
Ookala Sugar Plantation Co	2,214	
Pepeekeo Sugar Co	4,907	
		40,955
Castle & Cooke, Ltd.		
Waialua Agricultural Co	18,682	
Ewa Plantation Co	29,797	
Apokaa Sugar Co	874	
Kohala Sugar Co	2,663	
Waimea Sugar Mill Co	627	
		52,643
Alexander & Baldwin, Ltd.		
Hawaiian Sugar Co	11,493	
Maui Agricultural Co	13,521	
Hawaiian Commercial & Sugar Co.	29,829	
Kihei Plantation Co., Ltd	5,461	
Kahuku Plantation Co	6,360	
		66,664
F. A. Schaefer & Co.		
Honokaa Sugar Co	7,402	
Pacific Sugar Mill	3,388	
Maui Sugar Co	485	
		11,275
M. S. Grinbaum & Co., Ltd.		
Hana Plantation Co	2,662	
		2,662
Henry Waterhouse Trust Co., Ltd.		
Laie Plantation	597	
Gay & Robinson	1,665	
Halawa Plantation	1,016	
		3,278
Bishop & Co.		
Olaa Sugar Co		
		13,788
Puna Sugar Co.		
Puna Sugar Co		
		3,146
Makee Sugar Co.		
Makee Sugar Co		
		7,840
J. M. Dowsett.		
Waianae Co		
		5,500
Hind, Rolph & Co.		
Hawi Mill	3,631	
Puako Plantation	438	
		4,069
H. M. von Holt.		
Estate V. Knudsen		
		687
Kona Sugar Co.		
Kona Sugar Co		897
TOTAL		*367,475

* 2,000 pounds to the ton.

Hawaiian Sugar Planters' Association,

HONOLULU, November 1, 1904.

By its Secretary,

WILLIAM O. SMITH.

APPENDIX IV.

VARIETIES OF CANE.

BY C. F. ECKART.

(Experiment Station and Laboratories of the Hawaiian Sugar Planters' Association. Press Bulletin No. 1.)

Probably no subject pertaining to the cultivation of cane in the Hawaiian Islands during recent years, has held more interest for the planters, in various localities, than that relating to the introduction and trial of new varieies.

In the Hilo and Hamakua districts, the Lahaina first made way for the Rose Bamboo, and the latter, after a strong stand for many years, is now being rapidly succeeded by the more vigorous Yellow Caledonia. This cane with its upright growth and deep rooting propensities has proved a most valuable acquisition in wet and dry localities alike. Growing erect, with a natural tendency to shed its dried leaves, it becomes an admirable cane for rainy districts, where varieties that are prone to fall to the ground and remain in contact with a frequently saturated soil have shown extreme sensitiveness. The frequent stripping, required for Lahaina and Rose Bamboo in these wet places, has necessarily added to the cost of cultivation, and the ready manner in which Yellow Caledonia tends to strip itself is no small item in favor of economy. Again the manner in which it keeps down weeds, which were such a menace to its predecessors on the unirrigated plantations, is another strong point in its favor. In dry districts subject to occasional drought, it has amply demonstrated its hardihood over Rose Bamboo, which in turn is more resistant to such unfavorable climatic feature than Lahaina. By sending its roots down deep into the soil it draws from a larger reserve supply of water than the older varieties, which are more shallow feeders and which soon feel the effects of a rainless period.

The substitution of hardier varieties, in localities subject to varying and adverse weather conditions with their train of insect and fungus depredations, as well as the constant aim to produce a cane of higher sucrose content, less fiber, and superior milling qualities in more favored regions, has formed a subject for continued investigation in nearly all sugar growing countries. Within the past ten years we note the passing of Rappoe (our Rose Bamboo) in certain districts of Queensland, where through

gradual deterioration it finally reached a stage when it could not longer cope with diseases from which it had previously suffered but little damage. In 1890 the Bourbon (identical with the Lahaina), which had grown for many years as the standard variety of Barbados, began to be replaced by varieties which showed a greater resistance to disease and insect attacks, and we note a favorable report concerning Caledonian Queen, Striped Cane, Queensland Creole, etc., with regard to their immune characteristics. Today a superior variety and a seedling has come to the front under the name B. 147 and has become firmly established as the standard cane of Barbados and other points in the West Indies.

The introduction of new varieties into the various sugar-growing countries of the world, while attended with profitable results in many instances, has given rise to considerable confusion regarding their nomenclature. Often, on becoming established in their new homes, the canes receive local names, which in time entirely replace those under which they were imported. A signal success with one of these newly introduced varieties, under its new environment, results at times on its being returned, on request, to the country in which it originated, under the impression that it is a new cane with valuable qualities, and consequently worthy of trial. Naturally this change of habitant is productive of certain modifications in the cane, which, though superficial in some instances, cause it to be grown for many years along side of its near relative, descended from the same stock, before it is identified as the same variety. We thus find our Lahaina passing under the name of Bourbon, Colony Cane, Otaheite, Loucier, Portier, Bamboo ii, China ii, and Cuban. The Rose Bamboo has received the appelation of White Transparent, Caledonian Queen, Blue Cane, Light Purple, Rappoe, Mamuri, Hope, and Light Java.

It is interesting to note the changed characteristics of the same variety after having been subjected to different soil and climatic influences during many years. For instance, if we endeavor to trace back to their original ancestors our Lahaina, introduced into these islands from the Marquesas Group by Captain Pardon Edwards and the Otaheite, received from Louisiana some years ago, it appears that they came from the same stock. From the coast of Malabar, India, this variety (for they are the same), was shipped to Reunion, Mauritius, and Madagascar, and from these points it was received by the West Indies and the islands of the Pacific. From the West Indies "Otaheite" was introduced into Louisiana and from Louisiana into Hawaii, while the "Lahaina" came from the other direction and reached Hawaii by way of Marquesas. When brought together at the Experiment Station and grown side by side under the same conditions of soil, climate, irrigation, and cultivation they resembled each other closely and only differed in their value as sugar producers

and in the diameter of the stick. A comparison of these canes at the Station may be shown by the following figures:

	Lahaina.	Otaheite.
Cane per acre	116,015 lbs.	120,516 lbs.
Sugar per acre	18,377 lbs.—	13,450 lbs.
Fiber	11%	10%
Brix of juice	19.62	15.07
Sucrose of juice	17.8	12.4
Purity of juice	90.72	82.28

In 1903 a small lot of Otaheite was harvested which made a somewhat better showing than the above.

The difference in yields and other characteristics, manifested by the same cane under different climatic conditions, indicates forcibly the necessity of experimenting with a variety in as many localities as possible before it is condemned as a poor sugar producer in these Islands. This point is brought out most clearly in the case of the Yellow Bamboo, which thrives at high elevations in Kau and at a point where Lahaina would prove a failure. At the Experiment Station, on a low level with corresponding differences of soil and climate, the Yellow Bamboo produces only one-half as much sugar as Lahaina. Another good illustration of this point is amply afforded by the Salangore variety. In the Straits Settlements after being tried in competition with many varieties, it was found to take the lead with Lahaina standing second. Grown at the Experiment Station in Honolulu, Salangore made but a poor showing compared with other canes, and owing to the limited area of land was dropped from further trial in order to make room for more promising canes.

Salangore at the Experiment Station:

Cane per acre	95,832 lbs.
Sugar per acre	13,081 lbs.
Fiber in cane	11.37%
Juice analysis:	
Brix	17.67
Sucrose	15.4
Purity	87.15

Climate and soil are the paramount influences exerted on the sugar producing capacity of different varieties, and of these two conditions it is difficult at times to note which has the more determining effect on crop production. At a central station where varieties are grown on the same soil, a different order as regards their yields is often manifested from year to year, and if attention to this change in the scale of production is supplemented by a careful comparison of weather conditions during separate periods, an indication is afforded as to the localities in which certain canes may profitably be tried. Another cause which tends to change such an order among varieties is the difference in the rapidity in which canes become acclimated. One which

becomes adapted to its new environment more quickly than another, is not necessarily going to hold a superior position over the other when it in turn has gradually become accustomed to its new home.

A difference in the time of maturing may also prove prejudical to the showing some varieties may make when grown in competition with others, and this point is worthy of consideration. For instance, if we cut all of the varieties at one time (as is usually done) for the purpose of comparing their relative productiveness, some of them which matured earlier than others may be already "going back" as we say, and this brings them into unfavorable comparison with the more slowly maturing canes. Demerara No. 95, for instance, has been observed to deteriorate rapidly after it has become fully ripe. This difference in the rate of maturing must also affect in some measure the vitality of the seed cuttings. For instance, if we are growing a dozen varieties for seed to be planted out in competitive plat experiments, it can readily be seen if these are cut at a certain age (say at 11 mos.) some varieties will furnish more mature cuttings than others and consequently the eyes germinating with different degrees of vitality will influence the ultimate yields of sugar.

Such considerations as the above make it necessary that varieties shall be grown in competition through a number of seasons before we attempt to draw conclusions as to their relative worth and take one from among the rest as a standard cane.

As the Experiment Station a number of varieties were recently harvested and the weights of each were taken from an area sufficiently large to indicate their respective merits under such conditions as obtained at the Experiment Station during 1902-3. The yields were as follows:

Variety	Sugar per Acre.
Demerara No. 117	26,540 lbs.
Cavengerie	25,995 "
Striped Singapore	22,661 "
Queensland No. 1	21,878 "
Yellow Caledonia	21,808 "
La. Purple	21,232 "
Queensland No. 7	21,100 "
Big Ribbon	19,812 "
Demerara No. 74	19,354 "
La. Striped	19,067 "
White Bamboo	18,604 "
Tiboo Merd	18,044 "
Queensland No. 4	15,996 "
Demerara No. 95	15,158 "
Queensland 8A	14,622 "
Gee Gow	14,402 "
Yellow Bamboo	12,307 "

The Fiber stood as follows:

Variety.	Fiber.
Cavengerie	12.7 %
Gee Gow	12.2
Tiboo Merd	10.0
La. Striped	10.0
La. Purple	9.8
Queensland No. 1	10.75
Queensland No. 4	11.0
Queensland No. 7	12.5
Queensland 8A	11.0
Demerara No. 74	9.8
Demerara No. 95	11.1
Demerara No. 117	11.5
Yellow Bamboo	12.3
Yellow Caledonia	11.1
Big Ribbon	11.3
Striped Singapore	10.3
White Bamboo	13.1

Analysis of juice:

Variety.	Brix.	Sucrose.	Glucose.	Purity.	Gums.
Cavengerie	18.14	15.8	.752	87.1	.60
Gee Gow	17.76	16.1	.301	90.7	.39
Tiboo Merd	16.23	13.9	1.044	85.6	.44
La. Striped	17.56	15.9	.413	90.5	.45
La. Purple	17.11	15.5	.381	90.6	.48
Queensland No. 1	16.13	13.9	.978	86.2	.57
Queensland No. 4	16.33	14.2	.845	87.1	.54
Queensland No. 7	18.98	16.8	.205	88.5	.85
Queensland 8A	16.91	14.8	.339	87.5	.51
Demerara No. 74	16.47	14.2	.404	86.2	.56
Demerara No. 95	17.43	15.7	.324	90.1	.42
Demerara No. 117	17.16	15.2	.459	88.5	.52
Yellow Bamboo	16.99	14.7	.472	85.9	.56
White Bamboo	18.54	16.1	.288	86.8	.72
Yellow Caledonia	18.74	16.2	.325	86.9	.74
Big Ribbon	17.29	14.7	.549	85.0	.64
Striped Singapore	17.36	15.5	.563	89.3	.48

Demerara No. 117 still holds the lead among the recently introduced varieties, and is a promising cane worthy of trial under the diversified conditions of the Islands. Yellow Caledonia, Demerara No. 74, Cavengerie, Striped Singapore, Queensland No. 1 and Queensland No. 7 also produced heavy yields. White Bamboo, Queensland No. 7, Yellow Caledonia, and the unstriped cane which occasionally appears in a stool of Big Ribbon are closely allied; in fact between White Bamboo and Yellow Caledonia there appears to be no difference, and after four years trial it is impossible to distinguish one from the other.

The following new varieties will be planted out in June of this year and will be harvested in 1906:

Striped Tip,	Demerara No. 1937,
Daniel Dupont,	Queensland B. 5,
Demerara No. 115,	Queensland B. 8A,
Demerara No. 116,	Queensland B. 147,
Demerara No. 145,	Queensland B. 156,
Demerara No. 1135,	Queensland B. 176,
Demerara, No. 1483,	Queensland B. 208,
Unknown,	Queensland B. 244,
Dark Colored Bamboo,	Queensland B. 306.

Some of these are very promising canes and have a noteworthy reputation in other countries, chief among them being: D. No. 115, D. No. 145, B. No. 147, B. 156, and B. 208. Regarding B. No. 147 one West Indian planter writes: "B. No. 147 has the inestimable advantage of being a rough cane outside, with a tough rind, and covered with a coating of dry leaves, which, however, drops off readily when the cane is fully ripe or cut. A spot of this cane which was lately cut for plants, was remarkably free from the common cane borer of which it was very difficult to find a single specimen."

If B. No. 147 sustains its reputation when tried in Hawaii, it will certainly prove a valuable acquisition in some localities.

All of the varieties mentioned in this bulletin as having been cropped during the present year and those which will be planted in June, will be grown for seed for distribution in the spring. It is believed that some of them will be found of value when grown under the various Island conditions.

[APPENDIX V.]

RECENT EXPERIMENTS WITH SALINE IRRIGATION.

By C. F. Eckart, *Director Division of Agriculture, Hawaiian Sugar Planters' Association.*

LETTER OF TRANSMITTAL.

W. M. Giffard, Esq.,
Chairman, Experiment Station Committee, H. S. P. A.

Sir:—I, herewith, submit the results from a series of experiments bearing on saline irrigation, for publication as Bulletin No. 11 of the Agricultural Division.

Yours very respectfully,

C. F. ECKART,
Director, Agricultural Division.

Honolulu, T. H., August 8th, 1904.

In the annual report of the Experiment Station for 1902, considerable space was devoted to results obtained from irrigating sugar cane with water containing 200 grains of salt per gallon. The investigations discussed at that time comprised small lysimeter experiments and dealt with the solvent action exerted on the soil elements by saline water, and the toxic effect of various salts on the growth of cane.

It was found that when occasional excessive irrigations were applied to cane growing in tubs, (constructed so as to allow of free drainage), the use of irrigation water of high salt content only checked in small measure the growth of the cane. It was also shown that large quantities of lime were liberated from the lysimeter soils through displacement by the sodium in the irrigation water, and it was indicated that the lime chloride so formed and a smaller toxic effect on the cane than a like amount of sodium chloride in the water. The data contained in the report are the results of investigations pursued in the field, where the information gained from the lysimeter tests was applied on a larger scale for confirmation of results.

Nine plats, each 1500 sq. feet in area, were laid off in the Experiment Station field, planted with Lahaina cane, and treated as follows:

Plat No. 1.—Fresh water was applied in irrigation. Fertilization was at the rate of 100 lbs. of Nitrogen (1-3 organic, 1-3 from nitrate of soda, 1-3 from sulphate of ammonia); 200 lbs. of potash as sulphate of potash; and 50 lbs. of phosphoric acid as double superphosphate per acre.

Plat No. 2.—Irrigation was the same in quantity as in Plat No. 1 but contained 200 grains of salt per gallon. Two tons of lime in the form of ground coral were added to the plat after the cane was a foot high and partially incorporated with a superficial layer of the soil. Mixed fertilizer applied as in Plat No. 1.

Plat No. 3.—Irrigation and mixed fertilizer applied as in Plat No. 2. Instead of ground coral, 2 tons of lime in the form of gypsum were mixed with the soil.

Plat No. 4.—Irrigation and mixed fertilizer, the same as in Plat No. 2. No lime added.

Plat No. 5.—Same irrigation as in Plat No. 2. Mixed fertilizer at the rate of 100 lbs. nitrogen as nitrate of soda; 200 lbs. potash as sulphate of potash; and 50 lbs. phosphoric acid as double superphosphate per acre.

Plat No. 6.—Same irrigation as in Plat No. 2. Mixed fertilizer at the rate of 100 lbs. nitrogen as sulphate of ammonia; 200 lbs. potash as sulphate of potash; and 50 lbs. phosphoric acid as double superphosphate per acre.

Plat No. 7.—Same irrigation as in Plat No. 2. Mixed fertilizer at the rate of 100 lbs. nitrogen as dried blood; 200 lbs. potash as sulphate of potash; and 50 lbs. phosphoric acid as double superphosphate per acre.

Plat No. 8.—Irrigated with fresh water, a heavy irrigation being applied every eighth watering. Mixed fertilizer applied at the rate of 100 lbs. nitrogen as sulphate of ammonia; 200 lbs. potash as sulphate of potash; and 50 lbs. phosphoric acid as double superphosphate per acre.

Plat No. 9.—Irrigated with same quantities of water as Plat No. 8, water containing 200 grains salt per gallon. Fertilization the same as in Plat No. 8.

IRRIGATION OF SALT WATER EXPERIMENTS.
(INCHES.)

Month.	Rainfall.	Irrigation. Plats 1-7.	Irrigation Plats 8 & 9.
June, 1902	.96	2.0	2.0
July	2.21	5.0	5.0
August	1.46	4.0	8.0
September	2.19	4.0	4.0
October	2.25	5.0	9.0
November	8.35	2.0	2.0
December	8.12	1.0	1.0
January, 1903	3.28	2.0	6.0
February	4.32	1.0	1.0
March	.68	5.0	5.0
April	2.11	3.0	7.0
May	2.05	4.5	4.5
June	.83	7.5	11.0
July	1.67	8.0	8.0
August	2.20	8.0	11.0
September	4.98	8.0	8.0
October	1.75	6.0	8.0
November	2.24	5.0	5.0
December	1.30	...	...
January, 1904	4.88	...	...
February	24.10	...	...
March	6.04	...	...
April	2.11	...	...
	90.08	81.0	105.5

Plats Nos. 1 to 7 inclusive received the same volume of irrigation water, 2 inches being the maximum amount applied at one time. Plats Nos. 8 and 9 received ordinarily the same irrigation as the other plats, but for every eighth watering this was increased to 5 inches. The dates on which Plats 8 and 9 received a 5-inch irrigation were: August 6th, and October 2nd, 1902, and January 20th, April 21st, June 17th, August 5th, and October 21st, 1903.

The volume of rainfall and irrigation received, together with amounts of salt applied per acre are next given:

Plat.	Rainfall Gallons.	Irrigation Gallons.	Salt per Gal. Grains.	Salt Applied per Acre Lbs.
1	2,446,032	2,199,474	....	.....
2-7	2,446,032	2,199,474	200	62,842
8	2,446,032	2,864,747	....	.....
9	2,446,032	2,864,747	200	81,850

Plats Nos. 1 to 4 constitute the lime tests. It is to be regretted that limited field space would not permit the carrying out of experiments in which fresh water and gypsum, and fresh water and ground coral were applied for comparison of results, so obtained, with results from Plats Nos. 2 and 3 receiving ground coral and gypsum respectively but irrigated with salt water. We would then know more exactly the percentage of gain in sugar yields which could be attributed to the ordinary agricultural value of the lime applications, and also the gain due to the neutralization of the salt carried into the land with the irrigation water. It is quite safe to assume, however, that owing to the nature of the station soil it would not show any appreciable gain from treatment with gypsum and ground coral where fresh water is used in irrigation. The lime in this soil is unusually high, showing by absolute analysis 1.01 per cent, by the agricultural method, .861 per cent, and by the aspartic acid method, .325 per cent. The gypsum through its indirect action would liberate considerable quantities of potash, which would allow the presence of so much more available potash in Plat No. 3; the heavy potash fertilization of these plats, 200 lbs. per acre, however, together with the amount made available by the salt would minimize the effect of potash liberated by the gypsum. This latter point is clearly brought out by the yields of sugar from Plats Nos. 2 and 3 which are almost identical.

The quality of the juice and the quantity of cane and sugar produced per acre in the first four experiments are shown in the following tables:

QUALITY OF JUICE.

Plat.	Salt per Gal. of Water Irrigation	Form of Lime Added	Brix of Juice	Sucrose of Juice	Glucose of Juice	Purity of Juice	Gums of Juice	Chlorine per Gal. of Juice	Salt per Gal of Juice
1....	None	No lime	20.28	18.90	.312	93.20	.43	9.8	16.17
2....	200 grains	G. Coral	16.46	14.40	.264	87.50	.53	93.1	153.63
3....	200 grains	Gypsum	16.56	14.50	.271	87.60	.56	84.94	140.17
4....	200 grains	No lime	15.89	13.80	.280	86.8	.50	105.24	173.67

CANE AND SUGAR PER ACRE.

Plat.	Salt per Gal. of Water	Form of Lime Added	Cane per Acre, Lbs.	Sucrose in Cane per cent	Sugar per Acre, Lbs.	Percentage Gain Through Use of Lime
1.....	None	No lime	151,675	16.91	25,648	....
2.....	200 grains	G. Coral	42,311	12.88	5,449	46.6
3.....	200 grains	Gypsum	42,108	12.97	5,461	46.9
4.....	200 grains	No lime	30,085	12.35	3.715	....

The most striking point in regard to these results is the great difference in sugar yields displayed between the plat receiving fresh water and the plats receiving irrigation containing 200 grains of salt per gallon. The difference in the amounts of

sugar produced, approximated 11 tons, and this was caused by the application of no salt in the one instance and practically 31 tons per acre in the other.

The juice of the cane receiving saline irrigation was characterized by lower density, less sucrose and glucose, a lower purity, and a much larger content of salt, than the juice of the cane receiving fresh water. Where lime in the form of ground coral and gypsum was applied a better showing was made in regard to density, sucrose, glucose, purity, and salt content, than where no lime was added. The percentage of gain in the former instance was a trifle higher than in the latter.

The gain in the sugar of the cane where ground coral was applied was 46.6 per cent., and with gypsum 46.9 per cent., compared with the plat that was not limed. The difference in the amounts of available sugar would be somewhat higher than these figures owing to the difference in the purity and salt content of the juices.

The influence of the form of nitrogen applied in mixed fertilizers, on the yield of sugar in salt water plats may be seen from the following figures:

QUALITY OF JUICE.

Plat.	Form of Nitrogen in Mixed Fertilizer	Salt in Irrigation Grs per Gal Juice	Brix of Juice	Suc. of Juice	Glue. of Juice	Purity of Juice	Gums of Juice	Chlorine of Juice Grs per Gal	Salt of Juice Grs per Gal
4	3 forms of Nit.	200 grs.	15.89	13 80	.280	86 8	.50	105 24	173.67
5	Nit of Soda	200 "	16 86	14 70	.286	87.2	.53	66.04	108 98
6	Sul. of Am.	200 "	16.80	14.90	.297	88.7	.62	67.67	111.62
7	Blood	200 "	16.96	15.2	.328	89.6	.63	86.10	142.08

CANE AND SUGAR PER ACRE.

Plat.	Form of Nitrogen in Mixed Fertilizer	Salt in Irrigation Grs. per Gal.	Sucrose in Cane per Acre Lbs.	Cane per Cent	Sugar per Acre Lbs.
4.....	3 forms of Nitrogen	200 grs.	30,085	12.35	3,715
5.....	Nitrate of Soda	200 "	35,515	13.15	4,670
6.....	Sulphate of Ammonia	200 "	31,218	13.13	4,161
7.....	Blood	200 "	57,963	13.6	7,882

The largest production of sugar was obtained where the entire amount of nitrogen was applied in the form of dried blood. While a small gain was to be expected, owing to the salt water having but little effect on nitrification, (see report for 1902, page 61), from the use of dried blood for Lahaina cane under Experiment Station conditions, we were surprised at the large difference in yields. The yields of sugar from Lahaina cane harvested at the same time, and which received the same fertilization, but to which fresh water was applied in irrigation were as follows:

Form of Nitrogen in Mixed Fertilizer.	Sugar per Acre. Lbs.
Dried Blood	22,254
Nitrate of Soda	21,262
Sulphate of Ammonia	19,262

The order of yields in the salt water plats was the same as the above, although the percentage of gain from dried blood was greater. The more vigorous cane produced by fertilization with dried blood, withstood the deleterious action of the salt in a more pronounced manner than the cane in the other plats.

EFFECT OF OCCASIONAL HEAVY IRRIGATION ON YIELDS OF SALT WATER PLATS.

It was shown in the report for 1902, that when cane was grown in tubs, allowing a perfect drainage, an occasional heavy irrigation, by leaching accumulations of salt from the soil, permitted an almost normal growth. In the field this perfect drainage cannot be obtained, but a heavy irrigation, now and then, is capable of reducing the salt content of the soil to such an extent that the cane is checked in less measure than where the salt is allowed to accumulate in larger quantities.

This is fully shown by the following figures:

QUALITY OF JUICE.

Plat.	Irrigation	Salt in Irrigation per Gal.	Brix of Juice	Sucrose in Juice	Gluc. of Juice	Purity of Juice	Gums of Juice	Chlorine of Juice Grs per Gal	Salt of Juice Grs per Gal
6	Normal	200 grs.	16.80	14.90	297	88.7	.62	67.67	111.62
8	Excess	None	20.02	18.7	.288	93.4	.54	8 63	14 24
9	Excess	200 grs.	16 08	14.0	.272	87.1	.30	109.44	180 6

CANE AND SUGAR PER ACRE.

Plat	Irrigation	Salt in irrigation Per Gallon	Cane Per Acre Lbs	Sucrose in Cane Per Cent	Sugar Per Acre Lbs	Per Cent Gain over No. 6
6	Normal	200 grs.	31,218	13.33	4,161	....
8	Excess	None	182,981	16.73	30,612	....
9	Excess	200 grs.	62,494	12.53	7,830	88.1

The cane on these plats was grown under the same conditions except with regard to irrigation. Plat No. 6 received a normal volume of water weekly, while Nos. 8 and 9 received an occasional heavy watering (5 inches every 8th irrigation). Plats Nos. 6 and 9 received water containing 200 grains of salt per gallon, and No. 8 received fresh water.

The extra irrigation water applied to Plats Nos. 8 and 9 amounted to 24.5 inches. This quantity when fresh increased the amount of sugar by 4,964 lbs. or 19.3 per cent; where salt water was used the gain was 3,669 lbs. of sugar or 88.1 per cent.

If a gain in Plat No. 9 were entirely due to an increased growth resulting from a larger available supply of water in the soil, we would expect the percentage of gain in yield to be somewhat proportional to that in Plat No. 8; this would allow the production of 4,964 lbs. of sugar. The difference between the yield of Plat No. 9, 7,830 lbs., and 4,964 lbs. would represent approximately the gain from the leaching effect of the extra irrigation applied. The difference amounts to 2,864 lbs. of sugar or 68.8 per cent. The investigations of 1902 and those recently completed in the field justify the following conclusions.

CONCLUSIONS.

Lime is a potent agent in modifying the deleterious effect of saline irrigation on the growth of cane. On the Experiment Station field, application of lime in the forms of ground coral and gypsum and at the rate of 2 tons of lime per acre resulted in a gain of sugar amounting to 46 per cent; the irrigation water containing 200 grains of salt per gallon.

Occasional heavy irrigations given to a moderately porous soil receiving brackish irrigation, is most effective in reducing the salt content of the soil to a less toxic quantity. A gain of 88.1 per cent. of sugar was obtained in the Experiment Station field by a 5-inch irrigation every 8th watering; at least 77 per cent. of this gain may be attributed to the leaching of salt accumulations from the soil.

August 8th, 1904.

[APPENDIX VI.]

HISTORY OF THE OCCURRENCE OF THE SUGAR-CANE LEAF-HOPPER [Perkinsiella saccharicida (Kirkaldy)] IN HAWAII.†*

BY R. C. L. PERKINS.

(Revised Edition.)

1. In the latter half of the year 1900 I first observed and collected specimens of the leaf-hopper of the cane, but it was not until the end of 1901 or the early part of 1902, that it came under my notice as doing quite serious damage locally on Oahu,

*For description see Appendix (note IV.)

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and still some months later when its ravages were reported as being more extensive and it was submitted from one of the other islands—namely, Kauai.

In my report written on Nov. 15th, 1902, I remarked: "This small insect is highly injurious to cane and its destructiveness threatens to exceed that of the cane-borer"—a statement, as the sequel proves, by no means exaggerated.

As for various reasons it was not possible for me at that time personally to visit the windward islands, during Mr. Koebele's absence from the Territory, I strongly advised that precautions should be taken to keep the pest from being carried thither in seed of other cane, on the supposition, or rather in the hope, that it had not already become established there.

Not long afterwards, however, I learnt that it was already strongly established both on Maui and the northern parts of Hawaii, and that any precautions against its introduction were therefore unnecessary.

From that time to the present, samples of cane attacked by the leaf-hopper have been brought to me for examination constantly from all the sugar-growing islands and most districts of these islands, as well as many insects or other creatures supposed (rightly or wrongly) to be attacking these.

Judging from observations made by me on other imported insects, to the rate of increase of which I have paid special attention, I should consider that the leaf-hopper was introduced two or three years prior to 1900; but that until 1900 it was not in such numbers that it would be likely to come under the observation even of an entomologist, except by the merest chance. It is true that some plantation managers think the leaf-hopper has been present on their plantations for many years, but this is certainly an error of identification. During six years' continuous collecting, from 1892 to 1897, when I formed a large collection of leaf-hoppers of many species and from every island, I never met with a single individual of the present pest.

It is incredible that a species which is always gregarious, which produces on the cane the most obvious and characteristic outward signs of its presence, and which when mature is readily attracted to the lights, should have entirely escaped my notice. Then, again, it was one of the first species noticed and collected by me on my return to active field work in 1900. In the early days of my collecting here an allied species of leaf-hopper was known to me to frequent the cane-fields in small numbers, and this would certainly not have been distinguished from the present pest except by a more careful comparison than a non-entomologist would be likely to make. To sum up, it can be stated most positively that the present leaf-hopper attack is due to a pest comparatively recently introduced into the islands and not by one of old standing, which has suddenly become injurious, as some are inclined to think.

THE HAWAIIAN LEAF-HOPPER, AN AUSTRALIAN SPECIES AND NOT IDENTICAL WITH ANY OF THE HITHERTO REPORTED SUGAR PESTS IN OTHER COUNTRIES.

2. Seeing then that our leaf-hopper was an imported species, in a Report to the Hawaiian Sugar Planters' Association, written on Nov. 15th, 1902, I stated that it was of the utmost importance for us to learn whether our leaf-hopper were one of those already known to attack cane in other countries or some species hitherto unknown as a pest, and in the latter event whence it had been imported. Obviously, if the species proved to be West Indian we did not want to send to Java to look for natural enemies.

Such literature as was to be procured in the islands dealing with leaf-hoppers injurious to cane I examined with great care, and in a report written to Mr. Tenney of the Planters' Association on October 23rd, 1902, I expressed my opinion that the Hawaiian pest "was certainly none of these," and reiterated this in my report of Nov. 15th above mentioned. At the same time I called attention to the similarity in habits between the pest here and the Japanese species (*Dicranotropsis vestatrix*). Finally, after much correspondence with other countries, the matter was conclusively settled for me by Mr. Kirkaldy, who obtained from Germany cotypes of the Javanese insect described by Breddin and found it to be quite distinct from the Hawaiian one. Other authorities considered the Javanese insect and ours identical.

Meanwhile I was also corresponding with Australian entomologists in the hope of procuring specimens of a Queensland cane-infesting leaf-hopper for comparison with ours; but it was not till some six months after I began this correspondence that I had the great satisfaction of receiving from Mr. James Clark of Cairns, four specimens of this Queensland species, which proved to be the same species as our own. Mr. Clark also informed me that this leaf-hopper had been known there for years, that it was their only species, that it did no noticeable damage and was probably kept in check by some efficient natural enemy.

As I have mentioned in former reports the fact that leaf-hopper was present on cane in Queensland was discovered by me when inspecting some seed-cane imported from that country, the said seed-cane containing numerous eggs of a leaf-hopper, while a few very young insects were also present. These not being at a stage of development when their identity with our own species could be decided, it was only on receipt of Mr. Clark's specimens that this was finally settled.

GENERAL ACCOUNT OF HABITS OF THE LEAF-HOPPER.

3. It is not necessary to describe at great length the habits of the leaf-hopper, since they must now be familiar to most of those concerned, and at one time or another I have already fully re-reported upon these. The following summary may, however, be given. The eggs are laid in a chamber formed by the ovipositor of the female in the tissues of the leaf or in the stem of the cane. The number of eggs contained in one of these chambers varies considerably. Lately in Hamakua district I carefully opened up some hundreds of these chambers and found the number of eggs in each to be from one to twelve in number. That end of the egg which is nearest the external surface is the head end of the future leaf-hopper and the red pigment spots, which form the eyes of the newly-emerged insect, are conspicuous at some distance behind the narrow apical extremity of the egg before it hatches. In the leaves the eggs are deposited on either surface of the thicker parts, and being of elongate form, they usually reach about half way through the tissues. The scar is always visible and is often covered with a little whitish excretion. The apex or head end of the eggs is generally just about elvel with the surface of the leaf, but sometimes they even protrude a little from the orifice of the chamber. The young emerge perpendicularly, head first, sometimes two together from the chamber, and as they emerge, the appendages at first apparently stuck to the body become free, and the little insect is at once active, and may be seen to perform peculiar sideling or retrograde movements similar to those of older ones or of the adult. As a number of individuals generally hatch from a single chamber, and as the chambers are extremely numerous in a single leaf, very many being sometimes present in a square inch of surface, and as also in stripped cane thousands of these chambers may be present in a single stick, the total number of leaf-hoppers that can, and sometimes do, emerge from a single stick and its crown of leaves is almost incredible.

The young when they hatch are of a sociable nature and gregarious and especially congregate at the base of the leaves, and this habit is also largely retained by the adults, which often also form large flocks in the seclusion of the youngest leaves of the crown.

It is in the immature stages while growth is proceeding that the chief damage to the cane is done and the great excretion of honey-dew takes place.

It is not necessary to trace in detail the development of the insect through its post-embryonic stages to the adult, since in this point it essentially agrees with the several other island Del-

phacids, in which I have studied these points and presents no abnormal features.

The development of the tegmina and wings proceeds in the usual manner, by the outgrowth of lobes of the meso- and metathorax. The fully-winged insect is capable of at least moderately extensive flights, as is shown by the fact that it is attracted by the lights of steamers at some distance from the land, and on land to lights very far removed from its proper haunts. It is essentially nocturnal in its activities and when disturbed in the daytime flies but a short distance, or is even unwilling to fly at all, trusting to its leaping powers to escape, or is content to sidle round the leaf or stem out of sight, or to run backwards when threatened from the front.

The male, except for its rather smaller bulk, its darker abdomen, and different sexual structures, is extremely like the female. Copulation takes place at night. The adult hoppers, most of which lie still or hidden by day, emerge in crowds from their concealment at or shortly before dark. The female not rarely lays eggs by day, but probably much more often by night. When laying, the ovipositor is held at right angles to the ventral surface, and its point of attachment just behind the posterior legs is very clearly seen when the tip is inserted into the tissues of the leaf.

BRACHYPTEROUS OR FLIGHTLESS FORM OF THE ADULT LEAF-HOPPER.

4. At certain seasons of the year, in certain localities at least, and perhaps in all, a distinct form of the leaf-hopper appears, differing very greatly from the ordinary adult. This form is remarkable for the fact that the wings are so little developed as to be unfit for flight and the characteristic markings of the fully-winged individuals are lost. In fact, no one at first sight would suppose the short and long winged forms to belong to the same species, the tegmina, or upper wings, of the former not extending so far back as the tip of the body, while the lower pair are aborted into scarcely visible lobes.

Polymorphism in the development of the wings, affecting also often other parts of the body is a well-known feature of the Delphacid leaf-hoppers, and may be seen in other Hawaiian species. This appearance of a single species under two or more apparently totally distinct forms adds greatly to the difficulty of the student in determining the identity of these leaf-hoppers.

One point in connection with this flightless form is worthy of notice. Although the insect has not been with us for study for a sufficiently long time for us to speak with certainty on the point, yet, so far, the worst attacks of leaf-hopper have always followed or been partly coincident with the production of these flightless females, that is to say, during the colder months of the year, or

10 Hawaiian Sugar Crops, 1895-1904

From September 30, 1895, to October 1, 1904

HAWAII	1895	1896	1897	1898	1899	1900	1901	1902	1903	1904
Waiakea Mill Co.	5,028	6,410	8,239	7,763	9,191	9,226	10,800	8,700	9,954	6,151
Hilo Portuguese Sugar Mill Co.	.....	105	661	260	932	967	.....	.....	.....	.....
Hawaii Mill Co.	.....	.....	.....	.....	.....	.....	843	985	1,503	1,728
Hilo Sugar Co.	5,514	7,216	6,744	8,390	6,880	7,841	10,214	9,255	13,108	7,701
Onomea Sugar Co.	5,907	10,013	10,432	8,904	8,404	7,131	8,722	11,880	13,472	10,940
Pepeekeo Sugar Co.	4,097	6,502	7,474	6,914	7,350	6,207	7,173	6,627	6 000	4,907
Honomu Sugar Co.	2,895	3,844	5,181	4,932	4,968	5,328	4,401	6,235	6,384	5,489
Hakalau Plantation Co.	4,115	7,675	9,461	9,218	8,980	11,931	10,932	11,700	11,293	8,396
Laupahoehoe Sugar Co.	1,354	2,430	6,032	3,971	5,337	4,119	5,504	7,909	4,856	4,336
Ookala Sugar Plantation Co.	835	3,261	2,583	3,555	3,564	3,302	4,968	1,157	3,942	2,214
Kukaiau Plantation Co.	766	890	1,817	1,170	1,748	1,525	2,000	1,118	1,746	1,275
Kukaiau Mill Co.	800	890	1,818	1,170	1,732	1,530	2,000	1,118	1,746	1,274
Hamakua Mill Co.	3,583	7,330	9,050	4,133	6,081	6,078	7,808	2,105	6,950	4,691
Paauhau Sugar Plantation Co.	5,343	10,957	10,135	3,509	7,529	7,629	9,635	1,322	9 136	7,533
Honokaa Sugar Co.	2,905	6,774	10,018	6,198	9,111	8,117	9,903	3,089	8,587	7,402
Pacific Sugar Mill	2,931	5,885	6,700	3,327	4,650	4,774	4,948	2,517	6,059	3,388
Niulii Mill and Plantation	629	1,468	2,317	1,349	2,226	1,805	1,516	1,146	1,903	1,189
Halawa Plantation	687	1,198	1,406	800	1,049	1,571	1,357	575	1,860	1,016
Kohala Sugar Co.	2,510	3,778	4,903	1,508	4,119	3,345	3,160	1,096	5,409	2,663
Puehuehu Plantation	831	1,256	1,007	.....	.....	.....	.....	.....	.....	.....
Union Mill Co.	997	1,230	994	1,068	1,668	2,265	2,003	463	3,380	1,776
Hawi Mill.	1,604	2,775	1,823	877	1,222	2,277	2,727	1,373	5,563	3,631
Beecroft Plantation	863	1,043	1,485	426	609	632	325	.....	.....	.....
Kona Sugar Co.	.....	.....	.....	.....	.....	285	1,500	1,391	1,850	897
Hutchinson Sugar Plantation Co.	5,709	9,179	7,544	7,104	7,732	8,338	9,928	8,021	7,527	5,741
Hawaiian Agricultural Co.	1,608	6,660	8,553	4,795	11,318	9,001	10,956	11,998	18,888	10,954
L. C. Chong—Pahala	132	530	359	265	839	.....	.....	.....	.....	.....
Puakea Plantation	.....	.....	.....	.....	.....	.....	145	307	366	201
Olaa Sugar Co.	.....	.....	.....	.....	.....	.....	1,150	16,748	15,030	13,788
Puna Sugar Co.	.....	.....	.....	.....	.....	.....	.....	2,460	3,603	3,146
Puako Plantation	.....	.....	.....	.....	.....	.....	.....	.....	550	438
	61,643	109,299	126,736	91,606	117,239	115,224	134,618	121,295	170,665	122,865
MAUI										
Kipahulu Sugar Co.	976	1,787	2,047	2,250	1,931	1,890	1,992	1,427	1,622	1,415
Hamoa Plantation	1,119	1,378	852	1,411	2,026	2,114	1,450	1,748	.....	.....
Hana Plantation Co.	2,492	2,771	2,350	2,141	3,175	3,406	2,774	2,700	4,922	2,662
Haiku Sugar Co.	3,688	4,986	5,400	4,648	4,865	5,512	5,488	4,234	6,397	
Maui Agricultural Co.	.....	.....	.....	.....	.....	.....	.....	.....	.....	13,521
Paia Plantation	4,880	5,606	6,376	5,801	6,238	6,795	7,216	4,146	7,856	
Hawaiian Commercial and Sugar Co.	6,788	11,933	12,537	15,072	16,621	17,858	22,345	19,477	33,230	29,829
Wailuku Sugar Co.	4,900	5,655	6,461	6,725	7,412	7,976	7,902	5,934	7,490	6,451
Olowalu Co.	905	1,163	1,112	1,425	1,502	1,480	1,240	1,055	843	1,125
Pioneer Mill Co., Ltd.	1,987	3,818	3,912	5,560	10,589	10,316	6,568	9,960	16,530	17,036
Kihei Plantation Co. Ltd.	.....	.....	.....	.....	.....	.....	1,374	5,562	5,629	5,461
Maui Sugar Co.	.....	.....	.....	.....	.....	.....	.....	483	257	485
	27,735	39,097	41,047	45,033	54,389	57,347	58,349	56,726	84,776	77,985
OAHU										
Waimanalo Sugar Co.	1,600	3,370	2,230	3,004	2,352	2,932	3,045	2,985	3,218	2,963
Heeia Agricultural Co., Ltd	1,472	1,915	1,798	2,167	2,191	2,309	1,507	631	.....	.....
Laie Plantation	100	101	78	300	494	179	1,693	430	724	597
Kahuku Plantation Co	2,672	3,369	3,976	4,356	7,008	5,647	7,072	5,623	8,212	6,360
Waialua—Halstead Bros.	872	1,019	1,886	2,015	.....	.....	.....	.....	.....	.....
Waialua Agricultural Co	.....	.....	.....	.....	.....	1,516	17,699	17,001	19,800	18,682
Waianae Co.	2,500	3,884	3,804	4,055	3,506	4,019	4,020	5,000	5,348	5,500
Ewa Plantation Co.	8,217	12,124	15,157	18,284	22,334	21,573	33,036	38,775	33,162	29,797
Apokaa Sugar Co	.....	.....	.....	.....	.....	.....	.....	901	610	874
Oahu Sugar Co	.....	.....	.....	.....	7,935	15,450	21,454	26,724	29,256	20,870
Honolulu Plantation Co	.....	.....	.....	.....	.....	.....	10,008	9,800	20,736	16,376
	17,433	25,782	28,929	34,181	45,820	53,625	99,534	107,870	121.066	102,019
KAUAI										
Kilauea Sugar Plantation Co	4,050	5,507	4,651	4,563	5,420	5,254	5,364	3,762	3,012	1,850
Makee Sugar Co.	7,454	7,439	9,175	8,510	9,350	8,575	9,954	11,232	8 215	7,840
Hanamaulu Mill & A S. Wilcox	1,997	2,386	2,550	3,194	3,962	.....	.....	.....	.....	.....
Lihue Plantation Co.	6,872	8,883	9,642	10,914	13,333	15,289	18,356	13,674	11,375	14,611
Grove Farm Plantation	1,141	1,632	1,513	1,355	1,751	1,962	2,183	2,915	1,896	1,679
Koloa Sugar Co.	2,278	3,852	3,825	4,327	5,268	5,004	5,492	5,001	4,825	6,172
A. H. Smith & Co.	162	675	176	469	.....	.....	.....	.....	.....	.....
Eleele Plantation	977	1,232	1,400	1,489	.....	.....	.....	.....	.....	.....
McBryde Sugar Co.	.....	.....	.....	.....	1,491	1,790	2,208	9,113	11,922	10,535
Hawaiian Sugar Co.	11,172	11,407	11,167	13,200	14,350	13,480	13,419	11,480	10,324	11,493
Gay & Robinson	1,509	1,508	1,510	1,600	1,821	2,001	1,554	2,265	1,645	1,665
Waimea Sugar Mill Co.	509	1,183	1,050	1.026	1,021	976	919	565	540	627
Meier & Kruse	952	1,245	1,505	1,518						
Kekaha Sugar Co	2,054	2,602	3,483	3,480	6,942	8,287	7,412	8,978	7,064	7,447
H. P. Faye & Co.	1,102	1,357	1,824	1,961						
Estate V. Knudsen	587	742	943	988	650	730	676	735	666	687
TOTAL	42,816	51,650	54,414	58,594	65,359	63,348	67,537	69,720	61,484	64,606

	1895	1896	1897	1898	1899	1900	1901	1902	1903	1904
HAWAII	61,643	109,299	126,736	91,606	117,239	115,224	134,618	121,295	170,665	122,865
MAUI	27,735	29,097	41,047	45,033	54,389	57,347	58,349	56,726	84,776	77,985
OAHU	17,433	35,782	28,929	34,181	45,820	53,625	99,534	107,870	121,066	102,019
KAUAI	42,816	51,650	54,414	58 594	65,359	63,348	67,537	69,720	61,484	64,606
TOTAL	149,627	225,828	251,126	229,414	282,807	289,544	360,038	355,611	437,991	367,475

Hawaiian Sugar Planters' Association,

HONOLULU, November 1, 1904.

By its Secretary,

WILLIAM O. SMITH.

in the early summer. In the course of my recent tour of investigation through Hamakua to Olaa, I did not find a single example of the short-winged form, while in the winter months from some plantations not less than fifty per cent of the adults sent were of this form. This fact and some observations that I have made on other Hawaiian species, lead me to believe that the flightless leaf-hoppers are more prolific than the fully winged specimens.

MIGRATORY SWARMS OF THE LEAF-HOPPER.

5. As has been already stated, the leaf-hopper of the cane is nocturnal in its habits, and these insects are not seen on the wing by day except casually or when disturbed. On certain occasions, however, they have been seen flying in one direction in the day time in such numbers as to form a migratory swarm, quite like that which occurs in the case of certain locusts, dragon-flies, butterflies and other insects. I am not aware that such migrations have been recorded previously of leaf-hoppers, but they are known to be undertaken by the somewhat allied group of Aphidae. It would appear from observations made, that these leaf-hopper migrations are largely due to the fact that the food supply in the place whence they originate has become exhausted or impoverished by the number of the insects.

SIGNS OF LEAF-HOPPER ATTACK AND ITS RESULTS.

6. When leaf-hoppers are present in large numbers the midrib and sheath of the leaf often become conspicuously red either in spots or almost wholly, but such an appearance may be due to other causes. The minute discolored scars marking the opening of the egg chambers are a certain sign of the presence of the insects, even though they may not themselves be noticed. I detected the presence of the pest by these scars (on samples of cane sent for examination for other reasons) on certain plantations where at the time the leaf-hopper was said not to exist at all. Like other insects of their sub-order, leaf-hoppers excrete large quantities of a clear, sweet, liquid, called honeydew, and on this the usual fungi grow. Consequently in bad attacks whole fields of cane may be black with the usual black fungus, or in striking contrast, white with another species, or the black smut may be followed and overgrown with the white fungus. Either of these fungi, however, may follow bad attacks of other insects that excrete honeydew, while on the contrary, bad attacks of leaf-hopper are not always followed by a very large fungus growth, for apparently much depends on climatic conditions. Very heavy rains sometimes so entirely wash off the honeydew that no medium for fungus growth remains. These fungi necessarily add to

the damage done by the leaf-hoppers. Though they send no* *Hyphae* into the tissues of the leaf, yet they sometimes entirely cover these, and the white fungus may be stripped off from either surface in flakes of considerable thickness, forming a solid shield against light and air.

The result of leaf-hopper attack when very severe is seen in the drying up of the leaves (from the constant sucking of their juices) before their full functions are performed. In consequence of this the joints of the stem, even at the time when they should be thickening, become on the contrary tapering and contracted, so much so sometimes that the crown topples over and is even entirely destroyed, further growth, of course, being at an end. Young cane is sometimes entirely killed out before any considerable length of stem has been produced.

Although total destruction of a plant only occurs when the leaf-hopper is in the most excessive numbers, yet even when present in large numbers the injury done must be considerable. Should a plantation, thus attacked, after all produce a crop that comes up to the estimates, yet it is safe to say that without the pest these would be largely exceeded.

RELATIVE IMMUNITY OF DIFFERENT VARIETIES OF CANE FROM ATTACK.

7. Some varieties of cane, other things being equal, appear less subject to attack than others. It must not be for a minute supposed that were a plantation formed entirely of one of these more immune varieties it would necessarily escape with little or no damage. The mere fact that the leaf-hopper will attack graminaceous plants other than cane (in the absence of the latter) is sufficient proof that such is not likely to be the case, for there are naturally much greater differences between these and cane than between the most different varieties of the cane itself. Relative immunity from attack is a most difficult matter to judge of, because one can never be sure how much immunity is due to the nature of the variety of cane and how much to other causes. Even in a field of cane of one variety and apparently similar in growth, one can frequently see the capriciousness of the leaf-hopper in its attacks (a capriciousness notorious too in other insects) from the fact that certain spots are more badly attacked than others. In some cases this is no doubt due to causes that can be perceived by man, such as greater shelter from pre-

*Of course reference is here made only to the fungi which usually follow the attacks of Homoptera. Several species of true leaf parasites are found in the cane-fields and appear now to be more than usually dis-seminated, possibly owing to the abundance of leaf-hoppers and insects accompanying them, that carry the spores. These fungi so far as I have examined them appear all to be known in other countries and are probably importations into Hawaii.

valent winds, a ranker growth of leaf, presumably affording more abundant juice for food, but in other cases no adequate cause for this capriciousness is apparent.

It seems certain that some varieties of cane will stand the attack of leaf-hopper better than others. Mr. Eckart, Director of the Hawaiian Sugar Planters' Experiment Station, has furnished me with a list of the new varieties of cane (see Appendix Note II below), grown there, arranged in order, according to the relative injury that each sustained from leaf-hopper.

There may come, however, so severe an attack that no cane can resist it. Thus we have seen plants of "Yellow Caledonia" (at the extreme end of the list) which were of the strongest and most thrifty nature previous to the attack, some entirely destroyed and others very badly injured after a bad outbreak. It is, however, probable that from an attack of hopper which would entirely destroy a field of "Rose Bamboo," for instance, a field of "Yellow Caledonia" might recover.

MODE OF OCCUPATION OF NEW FIELDS IN A DISTRICT WELL OCCUPIED BY LEAF-HOPPERS.

8. When a field of cane is first occupied by leaf-hoppers they sometimes appear to spread over this in a very uniform manner, provided always that the conditions of growth of the cane, shelter, etc., are uniform. This can sometimes be very well seen in fields of very young cane. One that was examined by me consisted of cane about one month above ground, and on the average each plant was the home of two mature leaf-hoppers. Obviously these had migrated thither from adjoining fields, as they could not have reached maturity on such young plants.

Two fields of cane adjoining one another, one of Yellow Caledonia, the other of Rose Bamboo variety, each about five months old held a stock of 20-50 adult hoppers to each crown, uniformly distributed in either field. These also had come by migration, for, at the time, there were very few young in these fields, and the egg chambers nearly all contained unhatched eggs. This uniform distribution of hoppers over new fields, of course, only applies to such districts as have already in some parts, at least, a superabundant supply of the pest. Their first appearance in a district has (so far as such early and exact evidence as I have on the subject goes) generally been limited to a quite small area of one plantation.

ON STRIPPING CANE IN LEAF-HOPPER ATTACK.

9. As I have incidentally mentioned, leaf-hoppers like the more sheltered spots and hence it can sometimes be seen that they are in less numbers in well stripped fields than in those that

are not stripped. This probably means nothing more than that the total number of the insects present are more unevently distributed than would be the case were all fields stripped. Probably not many of the pest are destroyed by stripping, since most of the eggs laid in such leaves as are stripped have already hatched, and those which have not will produce young after the leaves are removed, as I have myself proved.

Fields of unstripped cane that already contain leaf-hopper in such numbers as to be doing considerable damage, are better left in that condition, because a large proportion (in fact most) of the eggs and pupae of some of the most active of its enemies are to be found attached to the old dead or half-dry leaves, and some of these enemies are more intolerant of exposure by stripping than are the leaf-hoppers themselves.

DIFFERENCE IN SEVERITY OF LEAF-HOPPER ATTACK ON NEIGHBORING PLANTATIONS.

10. In some cases it is evident that neighboring plantations have suffered from the attack of leaf-hopper in a very different degree. This is due to several causes and sometimes obviously (1) to the difference in the length of time that the leaf-hopper has been present in large numbers. Thus a limited area in a district becomes first badly infected and when this spot has produced a superabundant supply of the pest, it spreads (sometimes in a migratory swarm) over a much larger adjoining area, which suffers greatly, while the cane immediately adjoining this larger area is not much injured. (2) Slightly different climatic causes probably exert a restraining influence or the reverse. (3) In some cases the number of natural enemies of the leaf-hopper (especially the numbers present when first it has occupied a new locality) may turn what threatens to be a bad outbreak into a light attack. In some cases the fact that on adjoining plantations the seriousness of the attack differs greatly seems inexplicable, and due only to that apparent capriciousness of the insect, of which I have already spoken.

Some eight months ago I wrote in my report, "There is little doubt that its destructiveness will vary much with the locality and according to the season and it is by no means certain that it has as yet, even on Oahu, multiplied to the fullest extent." Later observations have fully convinced me of the truth of these statements, and I would add that were the pest allowed to multiply unchecked by natural enemies, it is by no means necessarily the plantations which hitherto have suffered most that would do so in other seasons, nor those which have escaped considerable damage this year, that would be exempt another year.

NATURAL ENEMIES OF THE LEAF-HOPPER ALREADY PRESENT IN THIS COUNTRY.

11. During my recent journey through Hawaii, very careful examination was made as to the status of all the insects present in the cane-fields in connection with the leaf-hopper attack. Some of these are direct enemies of the hopper, others are attracted by the exudations of the injured cane or the fungoid growths, while others are parasites of some of the foregoing.

The natural enemies that I observed to be present, and their parasites, were the chief source of interest on this journey, because attention to the former might naturally give some information as to what we might look to for aid in other countries, while a consideration of the parasites here present would influence one's choice in the selection of such natural enemies as it may be advisable to import.

I will now enumerate the most important species of insects or other creatures present in infected cane-fields in connection with leaf-hopper attack. The habits of a few of these are, I regret to say, not yet accurately determined, the time at my disposal on my journey through Hawaii being insufficient for examining into some of the most obscure species. Those which seemed of primary importance were, however, for the most part fully investigated.

(*a*) *The Black-Spotted Red Lady-Bird* (*Coccinella repanda*).

One enemy of the leaf-hopper is ubiquitous or nearly so throughout the cane-fields and in many parts extremely numerous. This is the red, black-spotted lady-bird (*Coccinella repanda*) long since imported into the islands by Koebele. Naturally an Aphiseater, it is taking quite kindly to feeding on the young leaf-hopper. The beetle itself probably does not do much execution, but the larva is very efficient on the young, especially at the moment when they emerge from the eggs, and in their younger stages, and also is able sometimes to obtain the eggs themselves.

In some fields of young cane, where the leaf-hoppers were all adult, or only very few young are to be found, this lady-bird was either absent or in very small numbers. The reason is obviously because they are not greatly attracted until the young leaf-hoppers appear, since these are the chief food of of the lady-bird's larva.

In Hamakua, some fields of young cane, where young leaf-hoppers were already very numerous, were estimated on June 21st to have three adult lady-birds to each stool on the average,

and very often several larvae of the same in addition, as well as numerous eggs.

(*aa*) *Braconid Parasite of Coccinella Repanda.*

Most unfortunately an enemy of this lady-bird is already in the field and generally distributed, though not yet very numerous. It is, so far as is known to me, the only lady-bird parasite at present found in these islands and probably came from America at the same time that the one foreign lady-bird, that was found here prior to Koebele's importations, was brought (accidentally) to this counrty. This parasite is the *Centistes americana* of Riley.

This parasite was known to me in 1892 as attacking *Neda abdomimalis,* some time before the *Coccinella* above mentioned was introduced, but now it seems chiefly, if not entirely, to attack the latter. It was found generally distributed over windward Hawaii and more numerous in proportion to the number of its host in parts of Hilo than in Hamakua. Several times the female of the parasite was seen grappling with and curled around the mature lady-bird in which it was laying an egg, and the dead and dying beetles could be found in some numbers any day in many cane-fields. Long after the emergence of the larva of the parasite from the interior of the lady-bird and after it has completed its cocoon, the unfortunate bettle still shows signs of life in the spasmodic twitching of its legs.

(*b*) *Scymnus and Cryptolaemus.*

The other lady-birds noticed in the cane-fields are the *Platyomus* (in small numbers locally), the *Cryptolaemus* (common locally) and the small *Scymnus vividus* (common locally). The first named was never seen to attack leaf-hopper and was no doubt attracted by Aphis, its usual food. The *Cryptolaemus* had been evidently attracted by mealy-bug, which was common on the roots and stems of a grass growing in the cane-fields. Having demolished these the larvae of this lady-bird were starving and wandering over the cane in search of food, and in several instances were seen to kill and eat the young leaf-hoppers. The *Scymnus* larva was also seen to attack the young hoppers. Neither of these species were, however, to be compared with the larva of the *Cocinella,* either in numbers or effectiveness as destroyers of leaf-hopper.

(*c*) *The Lace-Wing Fly* (*Chrysopa microphya*).

Though I have enumerated elsewhere 30 species of Hawaiian lace-wings, only the one above mentioned was found in the cane-fields.

The larva of this lace-wing fly is an excellent enemy of the leaf-hopper in the taller cane. In the young cane these larvae are absent or scarce, because this affords indifferent shelter to the delicate fly. They are also very much more numerous on some plantations than others, though present in all that were visited. Several of the flies and their larvae may in places be seen on nearly every stool of cane and the eggs and puparia were everywhere, especially on old, unstripped leaves. The lace-wing larva is not only able to destroy the young leaf-hoppers, but was also seen to obtain the eggs, its long-pointed jaws being well adapted for such work.

(*cc*) *Hemitelline Parasite of the Chrysopa.*

The lace-wing fly has also its parasite, in the shape of an ichneumon fly, which was seen laying its eggs in the pupa of this useful insect. I am inclined to think that this parasite is always comparatively rare and is not likely to become common enough to check the production of the lace-wings, but time alone can prove this. This parasite was seen in the most diverse localities, but always singly.

(*d*) *Nesomicromus vagus* (*Hemerobiidae*).

This insect was fairly common in several localities on the affected cane. Its larva was not found and hence there is uncertainty as to its food. It is possible that it was living on the minute *Psocidae* which browse on the black fungus which grows on the excretions of the leaf-hopper, and not on the latter. As no Aphis or other likely food was present it could only have been bred at the expense of one or other of these.

(*e*) *Reduviolus blackburni,* a predatory native bug.

This narrow pale-colored bug, was noticed in various localities, but not very commonly. It preys on the young of the leaf-hopper and no doubt on other small insects affecting or frequenting the cane, and it also sucks up the sweet excretion of the leaf-hopper. Another species, *R. lusciosus,* was seen in the Olaa cane-fields, but was not seen to attack the leaf-hoppers.

(*f*) *Native Pentatomid Bug* (*Oechalia grisea*).

In large numbers in some localities, but especially in fields in the neighborhood of native forest. The young were repeatedly seen sucking the juices of mature leaf-hoppers, but the fully developed bugs usually feed on caterpillars and larger insects.

(*g*) *Zelus peregrinus* (*Imported Reduviid bug*).

In my earliest reports I called attention to the efficiency of this bug as a destroyer of leaf-hopper and at the same time mentioned its demerits, as it is also a destroyer of highly beneficial insects. This bug was first seen as a great rarity in the Government Nursery in 1897. By 1900 it had become common and soon spread generally over Oahu, increasing very rapidly in cane-fields affected by leaf-hopper. Excepting possibly Kauai, it is now found on all the islands. Both the young and mature bug fed on the leaf-hoppers and they seek these when hidden at the bases of the leaves as well as in the open. Not infrequently we may see this bug with its beak thrust into the body ot a *Coccinella,* but in the cane-fields at the present time it is clearly feeding chiefly on the leaf-hopper.

(*h*) *Small Bug of Fam. Anthocoridae.**

I have not been able to determine the species of this minute and obscure bug, which exists in great numbers in badly affected cane in some localities, and is rare or absent in others. It is of nocturnal habits apparently and secretes itself during the daytime in the same way and places as do young leaf-hoppers. I have very little doubt that it preys on these, for the small *Anthocorids* are notoriously great destroyers of other small insects. Its extraordinary profusion in some samples of badly affected cane leads me to suspect that it will prove of great importance, and it is rapidly extending its range and will soon be ubiquitous.

(*i*) *Hymenopterous Parasite of the Leaf-Hopper.* (*Ecthrodelphax fairchildii*).

Appended to this report (Note III) will be found a technical description of an external hymenopterous parasite of the leaf-hopper, and one which is a very efficient enemy in some localities and will shortly be spread over the whole islands.

This interesting parasite was first submitted to me by Mr. G. Fairchild and I have named it specifically after him. There is no doubt that this parasite has transferred its attack from one or more of the native Delphacid leaf-hoppers to the imported species. I have long suspected the Hawaiian species of *Gonatopus* to be parasitic on leaf-hoppers and this supposition is greatly strengthened by the fact that the new and allied form of parasite is so External parasitic larvae on native leaf-hoppers were found by me many years ago on Hawaii, but I was unable to rediscover them on my recent hurried trip, the old locality having been spoilt,

(*) This is *Physopleurella mundulus* G. W. K.

owing to the total destruction of the forest. Could the *Gonatopus* be collected in some numbers and transferred to the canefields I suspect it would attack the leaf-hopper, as does the parasite now under consideration. The *Gonatopus* being wingless, has not the same facility for transferring its attack to the cane leaf-hopper as has the winged *Ecthrodelphax*. I may add that I believe there is at least one other hymenopterous parasite on the native Delphacids of the forest.

To return to the *Ecthrodelphax*, it is always the young of the leaf-hopper that is attacked, and a single hopper may sustain either one or two parasites. These are nearly always lodged beneath the lobes which develop into the tegmina, or upper wings; one on each side of the body, when two parasites are present in the same host.

The parasite appears externally as a small, nearly circular, impressed black object adherent to the young leaf-hopper. The latter seems to be hardly inconvenienced by the parasite, remaining as active and plump as the non-parasitized individuals.

After a time, however, (always shortly before the full growth of the parasitic larva) the hopper becomes sluggish and then entirely stationary. This may happen either shortly before or not till some time after the black shell-like covering of the parasite splits by a longitudinal (mediodorsal) fissure and exposes the back of the white maggot within. This torpidity of the leaf-hopper and the splitting of the covering of the parasite is almost certainly the outward sign of a change of habits in the parasite (probably coincident with a moult and change of form of the latter). From this time until the hopper dies and the maggot finally quits hold of its prey the sight as examined under a lens forms one of the most repulsive sights that natural history can afford.

Soon after the splitting of the black covering and the exposure of the white maggot a conspicuous change takes place in the color of the latter, it becoming pink or reddish. No doubt the maggot, which has hitherto fed delicately without doing any vital injury to its host, now proceeds to ingest the contents of the hopper in an indiscriminate manner, and the change in color is clearly due to this. If removed at this time from the hopper it is seen to have very mobile and hard (chitinized) mouth parts, while the thin and collapsed black covering still adheres some distance behind the head. Growth is extremely rapid and the simultaneous shrinking of the hopper, as its contents are absorbed by the parasite, enhances this effect. Thus when the splitting of the black covering takes place the hopper may be three or four times the size of the parasite, when the latter is full fed the proportions may be exactly reversed. The removal of the contents of the hopper can be easily seen through parts of the cuticle. Generally early in the proceedings the soft contents of one or both eyes and of the head are seen to be in rapid mo-

tion, like a boiling fluid; suddenly all the pigment is removed from one eye (usually the one on the opposite side to the parasite) and it becomes an opaque white spot, then the other is often similarly destroyed, or sometimes both more or less simultaneously.

Finally the maggot, when it has finished feeding withdraws its head, and may then some times be seen busily engaged in applying sticky matter from its mouth to its body. Its surface thus becomes strongly adhesive and when it quits its prey, it is able (though of course quite legless) to crawl freely over any surface however smooth. Soon it spins a neat white cocoon, from which it emerges as an active winged insect in about 18 days.

(*j*) *Various Species of Earwigs* (*Forficulidae*), *Etc.*

Four species of earwigs in all have been found on the cane plants, the particular species in any one field generally depending on the nature of the locality. Of these four species two have been actually seen to destroy the leaf-hopper, and there is very little doubt that the others do so also. Further it is probable that one or two other species of earwigs could be found were all the cane-fields to be thoroughly investigated. The species collected by myself in badly affected cane-fields are *Anisolabis annulipes, Labia pygidiata, Labia ?sp?,* and *Chelisoches morio.* No doubt the earwigs are always present in the cane in some numbers whether leaf-hopper be present or not, and I do not suppose that they are of any great importance in this connection. The same may be said of the green cricket (*Xiphidium*) which will eat leaf-hoppers voraciously in confinement and certainly does so to some extent in the field, while it also feeds on the leaves of the cane, which are no doubt its chief food.

(*k*) *Various Species*).

At certain times ants kill considerable numbers of young leaf-hoppers, while at other times if they do not actually protect them from their enemies they certainly do not harm them. When the hoppers are excreting an abundance of honey-dew I believe the ants rarely or never interfere with them, since they prefer this sweet excretion to the hoppers themselves. In order to determine which species of ants would kill the young leaf-hoppers, only such individual ants as were actually seen to kill these in the field were collected by me. The following species form the collection: *Tapinoma melanocephala, Prenolepis bourbonica, Pheidole megacephala, Tetramoriorum guineense, Cardiocondyla Wroughtonii* and *Monomorium floricola.*

(*l*) *Probable Dipterous Parasite.*

I include here with some doubt a native species of *Pipunculus* observed in some numbers in some cane-fields and certainly breeding there.

I have frequently observed these flies in the forests of several islands where leaf-hoppers are abundant, but never in the long course of my collecting have I previously found them in the cane-fields or outside the forest. As it is known that insects of this group are parasitic on leaf-hoppers, it is highly probable that the species observed by me in fields attacked by the cane-leaf-hopper are parasitic on this species. This species of *Pipunculus* appears to be undescribed, though very close to the *P. nigrotarsatus,* collected by me in the Kona forests.

(*m*) *Spiders of Many Species.*

In my early reports I called attention to the large number of spiders generally found in the cane-fields, and there is no doubt that owing to the abundance of food furnished by the leaf-hoppers these have in some localities multiplied to an extraordinary degree. Fully twenty species of diverse families are known to me to frequent the cane-fields, a large proportion of these being imported species. The species most numerous on one plantation are often extremely different from those on another. Thus in one locality it is a common *Tetragnatha,* in another a species of *Cyclosa or rgiope,* in another an *Attid or Thomisid,* that most abounds; in general two or three forms are abundant on a single plantation. I believe the species that hunt their prey without the use of webs are far more effective against leaf-hoppers than those that spin these. To what extent the multiplication of individuals has proceeded in parts of some plantations may be judged from the fact that as many as 50 nests of one single species of spider have been counted on a single leaf, and each of these nests will probably contain from 40 to 50 eggs on an average.

(*mm*) *Parasite of Spiders.*

Some of the most effective species of spiders are themselves not exempt from attack. Thus a *Cryptid Ichneumon* pierces the covering of the nest and lays a few eggs amongst those of the spider. Two or three of the resulting larvae are sufficient to entirely destroy every egg in the spider's nest, from which, instead of scores of young spiders, there usually emerge two or three specimens of the parasite. This parasite is widely, if not generally distributed, but where it was most common not more than 5 per cent. of the spiders' nests were destroyed at the time of my visit to Hawaii.

(*n*) *Fungi Parasitic on the Leaf-Hopper.*

Several species of fungus are well known to attack the native leaf-hoppers in certain localities and two or three of these have,

as might have been expected, transferred their attack to the sugar-cane species, while others have not yet done so. In 1892 a considerable mortality amongst native leaf-hoppers, caused by one of these fungi, was noticed in parts of Kona district and subsequently Koebele and myself found leaf-hoppers killed in the same manner in Olaa.

These diseases are very noticeable amongst the cane leaf-hoppers in Olaa, though comparatively a very small percentage of the hoppers present were affected at the time of my visit. Probably with more rainy weather (at the time of my visit it was extremely dry) these fungi would be more active agents in destroying the pests. It should be noticed that at the time when I made my observations, it was the mature leaf-hoppers, almost invariably, that were attacked, and if this proves to be usually the case, the value of these fungi will be greatly diminished, since the leaf-hopper does most damage before becoming mature, and further, of those killed a considerable proportion may already have laid their eggs.

The evidence of disease is manifest in the hoppers before actual death takes places. The infected insect is slow and lethargic and finally stations itself on the under side of the leaf in the open,—that is to say, it generally leaves its concealment at the base of the leaf or elsewhere and moves for a longer or shorter distance towards the tip. After a time the filaments or hyphae of the fungus grow out from the inside of the insect on the ventral surface and attach it to the leaf. Finally special hyphal outgrowths on which the spores are produced, are formed over the rest of the surface. Even after death during the early stages of fungus growth, the hoppers appear perfectly natural, and without close examination it is not always possible to be sure whether the insect is really dead or merely resting on the leaf. At present we cannot judge of the effectiveness of these fungus diseases, because there has been no special investigation as to their prevalence, and the percentage of leaf-hoppers killed, at the various seasons of the year. As has been mentioned, at the time I looked into the matter, the conditions were, in my opinion, unfavorable for the spread of such diseases, owing to the climatic conditions. It may be said, however, that in Olaa, and no doubt in some few cane-growing districts besides, conditions are as a rule exceptionally favorable for the growth of entomophthorous fungi, as is evidenced by the large mortality amongst insects of all kinds from such parasites. Caterpillars, moths, bettles, cockroaches, may be easily found killed by them, and the variety of the destroyers themselves is considerable. Since, however, in most localities, even in the wet mountains, such attacks are comparatively rare or rarely noticed, it is hardly probable that these fungi which destroy the leaf-hoppers could be established in the localities, still less favorable for fungus growth, that are occupied by most cane-fields.

INSECTS PRESENT IN THE AFFECTED CANE-FIELDS THAT INCREASE THE INJURY DONE BY LEAF-HOPPER, AND BUT FOR THE PRESENCE OF THE LATTER WOULD BE EITHER ABSENT OF FAR LESS NUMEROUS.

12. It would not be proper to pass entirely unnoticed the large number of insects attracted to the hopper-affected cane. Though they have no effect on the leaf-hopper itself, some of them do injuriously affect the cane. Chief amongst these are the species of *Haptoncus* (*H. tetragonus* and *H. mundus*) and two or three species of *Carpophilus* (*C. maculatus* and *C. dimidiatus*), two or more of these insects being often present in the same cane-fields. Breeding as they do in the parts attacked by the young leaf-hoppers, they certainly add to the injury by increasing fermentation and decay.

It may be noted in passing that some of the above mentioned species are under ordinary circumstances not infrequently a source of considerable loss, owing to the fact that where seed cane is allowed to lie around before planting they frequently lay their eggs in the slightly fermenting ends of this seed. Such seed-cane when planted will in some cases entirely fail to sprout, since the larvae of the beetle develop quite well under ground and cause its decay, and in fact instances are known where a very large proportion of seed planted has been ruined by these insects. Much less, therefore, under the present circumstances should seed cane be left exposed for these insects, now so abnormally numerous, to deposit their eggs in, and if not planted when cut, nor protected, it might well be given treatment with corrosive sublimate. (See Appendix, note I below).

With the more sluggish larvae of *Carpophilus* and *Haptoncus* there are frequently found the active larvae of one or two species of *Cucujidae* or *Cryptophagidae*, and it is quite likely that these may prey on the former. Otherwise, excepting that they are rarely killed by fungus diseases, they appear to have no enemies.

Similarly breeding in the parts injured by the leaf-hopper, and adding to the injury, may be mentioned several Diptera, notably species of *Drosophila*, which are extremely abundant on some plantations, *Euxesta annonae* commonly and another Ortalid in one or two instances.

Again with these (in abundance locally) were two species of *Staphylinidae*, the common imported *Homalota* so frequently attracted by fermenting vegetable matter, and a common *Philonthus*.

Finally, there may be casually mentioned a host of more or less conspicuous insects, not ordinarily seen in numbers in the

cane-fields, the species varying very much according to locality, but all attracted by the sweet excretions of the leaf-hopper.

Species of *Sarcophaga*, *Eristalis punctulatus*, *Volucella obesa*, the little cockroach, *Phyllodromia hieroglyphica*, and common *Hemiptera* being the most conspicuous. Possibly with these should be included the three *Elateridae*, *Aeolus cinnamomeus* in many localities, and two native species, *Eopenthes Konae* and *Itodacnus sp?* only in proximity to the native forests. Feeding on the black fungus may be found certain minute *Psocidae*, one extremely small and pretty species being in countless numbers on almost all plantations. None of the insects in this last section can be considered in any way beneficial or injurious, excepting that they may, and probably do, carry and spread the spores of noxious fungi.

IMPOSSIBILITY OF EMPLOYING ARTIFICIAL MEANS TO DESTROY LEAF-HOPPER.

13. When one is acquainted with the habits of the leaf-hopper, its mode of feeding, the love of concealment shown by the larger number of individuals, the hidden eggs, present in numbers at all seasons; and at the same time acquainted with the mode of growth of a thrifty cane-field, the question of insecticides as a mode of repression cannot for a moment be entertained.

As the leaf-hopper is attracted with great facility to strong lights, I thought it possible that until imported natural enemies were available these might be employed, as unquestionably myriads might be attracted and caught in receptacles containing sticky or oily fluids, placed just beneath the lights, on still dark nights. I am told by managers of plantations, who are naturally the best judges, that on account of the expense involved, such a plan is impossible.

POSSIBILITY OF NATURAL ENEMIES BEING OBTAINED FROM OTHER COUNTRIES.

14. To any one who has paid attention to the list of natural enemies of the leaf-hopper now present in these islands, as above enumerated; who considers that all these were available in these small islands, with their infinitesimally small insect fauna, as compared with that of the rest of the world; who will take the trouble to investigate the admirable work done by some of these natural enemies, there can be no doubt whatever but that an abundance of additional enemies can be introduced from other countries.

I have already in earlier reports stated that good enemies of leaf-hoppers are to be found in certain Australian lady-birds. I have since learnt that Mr. Koebele himself observed such enemies

on his former trip to Australia. That many enemies of leaf-hopper other than lady-birds can be found, there is no doubt whatever, some are already well known.

SUMMARY AND CONCLUSION.

15. In the foregoing pages I have dealt with the history of the leaf-hopper since its importation into the islands, its probable native home, its effect on cane and different varieties of cane, its habits, the various other insects that accompany it, whether injurious or otherwise; the impossibility of using insecticides against it, and the possibility of securing effective natural enemies from other countries. More especially have I considered the various natural enemies, animal or vegetable, already present here, and the parasites with which some of these natural enemies are themselves inflicted.

The fine work done by some of the natural enemies now present, added to the fact that as good or better ones can surely be imported from other countries, can leave no doubt whatever in the mind of any entomologist who has investigated the matter, that the leaf-hopper can be so far eliminated by these means as to become as innocuous, as are now a score of what were once some of the worst pests here.

For some of these latter one may now go on a long day's march in search without success. So far as the economic entomologist is concerned they are practically non-existent, and the ordinary man has even forgotten that they ever existed.

I further believe that even with the aid of the natural enemies available here on the spot, that by a constant watching for an increase of the pest and by transporting large numbers of the most efficient of its enemies to a spot threatened with a bad outbreak, the damage done by leaf-hopper could be reduced to small proportions. Obviously in the long run it will prove much more economical to send away for additional natural enemies. A few, or it may be even one, species of parasite or predaceous insect successfully introduced would render it unnecessary to pay further attention to the pest.

It is amusing to read the advice given by the leading English-speaking entomologist of a former day, the late Prof. Westwood of Oxford, to the Grenadan planters on a bad outbreak of leaf-hopper occurring in their island.

"I can see," he says, "but little ground for coming to any other conclusion that that man will not be permitted to frustrate the intention of Providence, but that we must look alone with submission to that Power for the removal of these pests."

No doubt the religious feeling which inspired the above remarks is very pleasing to contemplate, but the advice to do nothing is now a little out of date, not to say ridiculous, in the light of our present knowledge. It must, however, be remembered

that this advice was given three-quarters of a century ago (1833) and economic entomology has advanced somewhat since those days.

Appendix.

Note 1. From the following experiments made by Mr. C. F. Eckart it will be seen that treatment with corrosive sublimate solution is the most effective cure for seed-cane containing eggs of leaf-hopper, since it does not injure this seed.

RELATIVE RESISTANCE OF LEAF-HOPPER EGGS TO HYDROCYANIC ACID GAS, CORROSIVE SUBLIMATE, AND CARBOLIC ACID.

Sections of cane, eight inches long, were cut from badly affected one-year old cane. The sections were selected as a rule, from the youngest parts of the sticks, and only such portions were taken as bore evidence of hopper eggs having been recently deposited. The pieces of cane so selected were then well mixed and lots of ten sections were taken at random for use in each of several experiments.

The treatment to which the several lots of cane were subjected was as follows:

(1) Immersion in 1% solution of corrosive sublimate for 3 hours.
(2) Immersion in 1% solution of corrosive sublimate for 6 hours.
(3) Immersion in 2% solution of corrosive sublimate for 3 hours.
(4) Immersion in 1% solution of carbolic acid for 3 hours.
(5) Immersion in 1% solution of carbolic acid for 6 hours.
(6) Immersion in 2% solution of carbolic acid for 3 hours.
(7) Fumigation for 24 hours with Hydrocyanic Acid Gas (one ounce of Cyanide of Potassium for 27 cu. ft. of space.)
(8) Untreated cane (8 sections).

After treatment the respective lots were placed in boxes with tight fitting glass tops, and at intervals of from two to three days the young hoppers, which had hatched out, were counted and killed.

The various solutions of Carbolic Acid were found ineffective in destroying the hopper eggs, and the counting in such test was discontinued after one week.

The tests were started on February 21st, 1903, and the number of hoppers counted on different dates appear in the table below. The figures for carbolic acid given under date of February 28th, are for the week preceding, only one count having been made.

No. of Test.....	Feb. 21.....	Feb. 22.....	Feb. 24.....	Feb. 26.....	Feb. 28.....	March 2.....	March 4.....	March 7.....	March 10.....	March 12.....	Total for 10 days.
1.....	0	0	0	0	0	0	0	0	0	0	0
2.....	0	0	0	0	1	0	0	0	0	0	1
3.....	0	0	0	0	0	0	0	0	0	0	0
4.....	.	.	.	.	56	.	.	.	.	.	.
5.....	.	.	.	.	3	.	.	.	.	.	.
6.....	.	.	.	.	3	.	.	.	.	.	.
7.....	0	0	0	0	0	0	0	1	0	0	1
8.....	0	2	21	25	24	31	19	36	23	19	200

Another series of experiments was conducted with similar lots of cane, to note the effect of fumigating sections of stalk with Hydrocyanic acid gas for varying lengths of time, one ounce of Cyanide of Potassium being employed for 27 cu. ft. of space. It was also determined to merely dip other sections in Corrosive Sublimate and compare the results with those obtained where the cane was soaked in such solutions.

The tests may be designated by the following numbers:

(1) Fumigation with Hydrocyanic Acid Gas for 24 hours.
(2) Fumigation with Hydrocyanic Acid Gas for 12 hours.
(3) Fumigation with Hydrocyanic Acid Gas for 6 hours.
(4) Fumigation with Hydrocyanic Acid Gas for 3 hours.
(5) Dipping in ¼% Corrosive Sublimate Solution
(6) Dipping in ½% Corrosive Sublimate Solution.
(7) Dipping in 1% Corrosive Sublimate Solution.
(8) Dipping in 2% Corrosive Sublimate Solution.

The canes were put in boxes as in the preceding experiment and the insects hatching out were counted from time to time and killed. The numbers of hoppers found on different dates were as follows:

No. of Test.....	March 20.....	March 25.....	March 31.....	April 2.....	April 6.....	April 18.....	April 25.....
1.....	0	0	0	0	0	0	0
2.....	0	0	0	0	0	0	0
3.....	0	0	0	0	0	0	0
4.....	0	0	4	0	1	0	0
5.....	0	0	6	2	0	0	0
6.....	0	1	1	0	0	0	0
7.....	0	0	1	0	0	1	0
8.....	0	0	0	0	0	0	0

The gas was found to be very effective in destroying the eggs, when the cane sections were fumigated for periods of 6 hours and over. Of the Corrosive Sublimate solutions, 2% appeared the most effective, only allowing one insect to appear.

After treatment as above described, one hundred eyes for each test were planted to note the effect of Corrosive Sublimate and Hydrocyanic Gas on germination:

No. of Test.	Percentage of Eyes Which Germinated.
1	2
2	7
3	36
4	Not planted
5	70
6	57
7	73
8	70

It is seen that the length of time that the seed cane was in contact with the gas had a marked effect on the vitality of the eye. Corrosive sublimate apparently exerted no injurious influence as far as germination was concerned, except in the case of a ½% solution. It is quite possible that the difference in the percentage of germinating eyes, between test Nos. 6 and 7 was quite accidental, owing to some slight difference in quality of seed cane before treatment.

Cane which had been soaked for several hours with 1% and 2% solutions of Corrosive sublimate was not planted, but the eyes of such cane showed remarkable vitality in the glass covered boxes. At the end of a month's time, shoots six inches long projected from the canes.

The length of time in which leaf-hopper eggs may remain unhatched in the cane stick may be seen from the following figures, which embrace a continuation of the count of insects hatching in untreated canes. (Test No. 8, started Feb. 21):

Date of Count.	Insects Found.
Feb. 21	0
" 22	2
" 24	21
" 26	25
" 28	24
Mch. 2	31
" 4	19
" 7	36
" 10	23
" 12	19
" 14	26
" 18	10
" 20	11
" 23	4
" 25	3
" 28	4
" 31	3

Date of count.	Insects Found.
April 2	0
" 16	0
" 18	0
" 25	0
Total	261

Note II. Varieties of Cane.

The following list of new varieties* of cane at the Hawaiian Planters' Experiment Station has been drawn up for me by Mr. C. F. Eckart, the Director. They are arranged in order, according to the amount of damage sustained from leaf-hopper attack, Queensland 4 suffering most and Yellow Caledonia least:

(1) Queensland 4
(2) Queensland 1
(3) Queensland 8A
(4) Louisiana Purple
(5) Demerara 95
(6) Gee Gow
(7) Cavengerie
(8) Demerara 74
(9) Yellow Bamboo
(10) Tiboo Merd
(11) Louisiana Striped
(12) Striped Singapore
(13) Big Ribbon
(14) Queensland 7
(15) Demerara 117
(16) White Bamboo
(17) Yellow Caledonia.

Note III. Description of Parasite of Cane Leaf-Hopper.

I hereby give the characters of a highly interesting and important Hymenopterous parasite of the leaf-hopper, for which it is necessary to make a new generic name. Its life history has been partially written in the earlier part of this report.

Ecthrodelphax—New genus.

Generally similar in structure to *Gonatopus Perkinsi Ashm,* but winged, and the thorax consequently much modified.

Antennae evidently thickening towards the apex, second joint of the flagellum very elongate and slender, first much shorter and thicker, about equal to third in length. Head about twice as wide as the prothorax, above distinctly concave between the eyes, posteriorly emarginate. Prothorax twice as long as its width at base, wider on its anterior than on the posterior half. Mesothorax greatly narrowed in front, its sides being strongly convergent, the furrows crenate, contiguous at the scutellum and thence divergent anteriorily, so as to enclose a narrow triangular area. Tegulae placed far back on the mesothorax,

* i. e., Varieties other than the old standard ones of these islands.

and very remote from the prothorax. Legs as in the *Gonatopus* above mentioned, the front trochanters very long and clavate, the apical part being thickened, all the femora clavate, the basal part thickened; claws of the front tarsi very long, asymmetrical, but of equal length, the one knobbed at the apex, the other pointed and both denticulate.

Ecthrodelphax Fairchildii—New species:

Black; the head (except the eyes and a transverse band enclosing the ocelli) the prothorax, tegulae, wing nervures, the legs entirely or almost so, a median transverse abdominal band beginning on the apical part of the second segment, all pale in color, from yellowish to rufo-testacous. Head above, mesothorax and abdomen shining; propodeum transversely strigose, generally more regularly so posteriorly. Antennae dark, base and tips pale. Length 2.5 mm. (but variable. Female only known.*)

HAB. HAWAIIAN ISLANDS.

(Obs.—This insect would, under the latest scheme of classification of the *Hymenoptera* proposed by Ashmead, be placed with the *Sphecoidea* since the wings are remote from the prothorax. It has, however, no relationship with that group.)

Note IV. Description of Cane Leaf-Hopper.

The following is a brief technical description of the cane leafhopper *Perkinsiella saccharicida*. It is condensed from Kirkaldy's original description (Entom. 1903, p. 179).

Second segment of the antennal peduncle about one-half longer than the first, which is much wider at the apex than basally, flattened and explanate.

Long-winged form both sexes. Tegmina alongate, narrow extending far beyond apex of abdomen, interior half of clavus and corium more or less smoky, a long dark smoky stripe on the middle of membrane, three or four nervures of the latter smoky at apex. Length with wings 6¼ mill.

Short-winged female. Tegmina reaching only to base of fifth segment, tegmina without the smoky markings of the long-winged form, the neuration similar but shortened.

*Since the above description was sent to press I have bred many males of this parasite. These have not the peculiar characters seen in the thorax and legs of the female, and seem very similar to the Hawaiian *Labeo*, so that I have some suspicion that the latter will prove to be the male of *Gonatopus*.

The following table will distinguish the known cane leaf-hoppers, except *pelphax saccharivora* of the West Indies, of which I have no description to hand. Only the long-winged forms are considered. The characters are partly taken from Kruger's work on sugar-cane:

A. Front wings twice as long as the hind ones; hind tibae without long spur.....*Phenice maculosa* (Java, India.)
AA. Front wings not twice as long as the hind ones; hind tibae with long spur.
B. Front wings of a uniform brown color.....
.....*Eumetopina Krugeri* (Java, Borneo.)
BB. Front wings not uniformly brown.
C. Wings much longer than the hind body.....
.....*Perkinsiella Saccharicida* (Australia, Hawaii.)
CC. Wings not much longer than the hind body.....
.....*Dicranotropis vastatrix* (Java)

———:o:———

REPORT OF COMMITTEE ON HANDLING AND TRANSPORTATION OF CANE.

October 18th, 1904.

To the Trustees and Members of the Hawaiian Sugar Planters' Association.

Gentlemen: Since the inception of the sugar industry in these Islands the Handling and Transportation of Cane has been one of its principal problems. The first consideration under this head is to deliver sufficient cane at the factory "to keep the mill going." The second consideration is the reduction of cost of whatever system may be used to obtain the first.

Thus each district has, after years of experiment, about settled to its satisfaction the system or combination of systems best suited to its needs. Hilo and Eastern Kohala has its flumes, Eastern Hamakua its trolleys, Paauhau its gravity road, Kohala its combination of wagons and traction engines, and Oahu, Maui and Kauai their extensive railroad systems. It is probably a fair inference to say that, for some time to come, there will be probably little change in the transportation systems now used.

The problem is to perfect, reduce the labor of, and economize those systems. In short, the problem has almost ceased

to be one of transportation and is now one of handling cane; that is to say the picking the cane from the field and the placing of it in its conveyor, whether that conveyor be flume, trolley, railroad car or anything else.

In the earlier history of the sugar business labor was fairly plentiful. It is not so now in some portions of the Territory. And there is no assurance but that later on these conditions may be worse instead of better. Further than this, loading cane by hand is extremely hard work.

For the purpose of this paper, we will classify the different systems under their different heads, give their cost and give descriptions of both the "Wilson-Webster" and the "Gregg" loading machines which, as far as your committee is aware, are the only loading machines on the market. We have no new ideas of our own to lay before you, and can only place at your disposal the information obtained through the kindness of the various managers who replied to the circular of the committee concerning their work, and to whom the committee extends its thanks. It is to be regretted that more replies were not sent to the circulars forwarded, so that more complete data could be given. The Island of Maui was particularly negligent in this respect.

By far the largest portion of the crop of these Islands is handled by means of the system of railroads and portable track. Flumes rank next in importance. These are, in turn, followed by those who have adopted a combination of several systems. The trolley is made use of in Hamakua and a portion of Hilo, and, to a small extent, the traction engine in Kohala.

Herewith are the schedules compiled from the data given:

Schedule No. 1—Railroads	18	Plantations
Scehdule No. 2—Flumes	7	"
Schedule No. 3—Combinations of systems, Trolley, Traction Engine	7	"
A total of	32	Plantations

giving the total cost per ton of delivering cane, after being cut, on the carrier.

Schedule No. 4, showing condensed summary, by Islands, of the various subdivisions of the work.

The averages for railroad work in Schedule No. 4 are not the same as in Schedule No. 1, for the reason that several plantations gave replies in lump sums and their data could not be made available in subdividing the cost under different heads.

And this brings up the question of the absolute necessity for some uniform basis for arriving at cost. One plantation flumes its cane for 26.99 cents per ton of cane, and another

for 43.88 cents. Again one estate places its cane on the carrier by rail at 29.30 cents, and another for 50.30 cents. Surely, in these extreme instances, there are radical differences in the accounting. On the whole, perhaps, the data are fairly accurate, but when a report is being made up the glaring differences are discouraging.

Contrary to the opinion expressed hitherto, fluming, as a means of transportation, shows up rather well. The average of the seven fluming platations is 38.01 cents, and of the 18 railroading plantations 43.31 cents. On the other hand it should be remembered that, in every instance given in this report, the weight of cane has been estimated on flumed plantations. How accurate that estimate is we are unable to say. The average cost per ton for handling and transporting cane of the 32 plantations that made reply is 40.89 cents.

It is fair to assume, we think, that, taking different localities, different lands, and different temperatures, etc., into consideration each plantation gets as much work out of its men as it can. If there are any differences they may be attributed to the systems employed. And right here it may be pertinent to remark that on at least those plantations using porable track and railroad, there will be no great economy effected until a radical change is made from the method now generally employed of loading cane by manual labor. For this reason, your committee has given considerable space to the loading machines of Wilson-Webster and Gregg. These, we think, are a distinct advance.

The "consummation devoutly to be wished," however, is the machine which will pick the cane from the field and place it on cars. If that can be done the solution of our labor difficulties in one line, at least, will be accomplished.

This Association is therefore urged to appropriate a liberal sum to be expended with that end in view.

There are inserted in this report the following letters, or descriptions, of cane handling and transporting systems or devices, as follows:

Exhibit 'A."—Letter from Paauhau Sugar Plantation Co., concerning Gravity System.

Exhibit "B."—Letter from Mr. John Hind, Hawi Plantation, giving cost of handling and hauling by Traction Engine.

Exhibit "C."—Communication from Mr. A. A. Wilson, giving description and cuts of Wilson-Webster Cane Loader, together with an estimate of cost of loading with same.

Exhibit "D."—Communication from the Gregg Co., Ltd., with cuts of Gregg's Cane-Loading Machine, description of its manner of working, its merits, and of its working supervised by Mr. Gregg at the Ewa Plantation.

EXHIBIT "A."

"Paauhau Sugar Plantation Company.

"Honokaa, Hawaii, T. H., Sept. 15th, 1904.

"Mr. Geo. F. Renton, Manager Ewa Plantation Co., Oahu.

"*Dear Sir*: In further reply to your favor of the 2nd inst., we beg to say that we have answered the questions on the circular you forwarded, relating to the handling and transporting of cane, in as far as they are applicable to the work on Paauhau.

"As to your request regarding expense and methods of running our gravity railroad system, we might give you the following particulars:

"The cane, when cut, is loaded on mule wagons by manual labor. This expense is about 13c. per ton of cane. It is then carted to the loading station on gravity railroad. The expense of this cartage varies with the distance covered, but might average 21c. per ton of cane. Seven men and three mules are required at each derrick for hoisting the cane out of the wagons into the cars and dispatching same. Where the gravity meets the main railroad track, two men and two mules are needed to handle the cars. Thus the cost on the gravity would figure out about 5c. per ton of cane. From this point the trains of cane are taken in care of locomotives.

"Wire cables on double line gravities are used here, the loaded cars going down at the same time that the empty cars are being drawn up, the speed being controlled by means of pulleys supplied with brakes at the loading stations.

"We hope you will find this sufficiently descriptive of cane transportation, as carried on at Paauhau.

"Yours truly,

"PAAUHAU SUGAR PLANTATION CO.,

"Per H. GLASS."

EXHIBIT "B."

"Hawi Mill and Plantation.

"Kohala, Hawaii, Sept. 15, 1904.

"Mr. Geo. F. Renton, Chairman, Committee on Handling and Transportation of Cane, Hawaiian Sugar Planters' Association, Ewa, Oahu.

"*Dear Sir*:—In reply to yours 8th inst., requesting a statement of the cost per ton of cane from the time of its being cut to delivery at mill by traction engines, beg to submit the following figures:

Labor—Engineers and firemen	.02½
Fuel for traction engines	.05
Supplies for traction engines	.00¾
Repairs for traction engines	.01½
Repairs roads	.00½
Repairs wagons	.02¼
Labor loading cane by hand	.12
Overseers' salaries, loading	.01¾
Labor, teamsters in field	.01½
Stable expense, animals hauling in field	.02½
Ladders and loading planks	.00¼
Total	.30½

"These are average figures under all ordinary weather conditions, hauling a distance of about 1½ miles from field to mill.

"The mill yards expenses at the old Hawi Mill, when hauling cane by traction engines, is 6 cents per ton of cane.

"Enclosed herewith please find statement of cost of transporting cane by wagons and carts.

"Yours truly,

"(Signed.) JNO. HIND."

EXHIBIT "C."

"Honolulu, T. H., Sept. 19, 1904.

"Mr. Geo. F. Renton, Manager Ewa Plantation Company, Ewa, Oahu.

"*Dear Sir*: The Wilson-Webster cane loader was invented in the summer of 1902, and the first machine was built and operated at Waialua, Oahu, during the latter part of this year,

and the beginning of 1903. Further trials were made at Ewa, Oahu, during February, March and April, 1904.

"The experience thus gained by operating the machine in the field, led from one improvement to another, and the present design is the result. The original machine weighed 7 tons, while those designed for Ewa will weigh approximately 5 tons. To suit conditions existing at different plantations, however, it will be necessary to alter the design somewhat, at the same time retaining the salient features. For example, where the crop is light, the slings would be made smaller, and two bundles would be drawn in and hoisted at one time. Where the land is rough and hilly, a lighter design of machine, requiring less men to operate, is necessary.

"For description, mode of operation, see circular. The life of the machine, with proper usage, should be not less than 15 years. As practically no wood is used in construction, the machine is indestructible by fire.

"The machine does not require picked men, and even the weakest men and women may be employed. By its use, the cars are loaded compactly, drawing cane from a distance of 150 feet each side of the track, so that less portable track has to be laid than with hand loading, thus effecting a saving in the cost of this item. The average per man, is 7½ tons, loaded on cars per day with the machine, while 5 tons per man, hand-loading is a high average attained only by Contract System."

"Where machinery is used to do any class of work there is never any shortage of labor. Even were the cost of loading by the machine no cheaper, it would still be good policy for plantations to use the machine, for the effect produced on the laborers employed. In my opinion, however, the machine will save at least 10c. in cost of loading. A crew to operate machine should consist of 19 men, as follows:

"Two to operate the drum-clutch levers.
"Two to tend the hauling in cables.
"Two to tend the hoisting cables.
"One to place loads on car.
"Ten to pile cane in bundling racks.
"One extra man to move cars, etc.
"One driver and team of mules.

"In making comparisons with hand loading, however, the driver and team of mules should not be charged against machine, as the team is used to deliver loaded cars on main line, as in the case of hand loading.

"Experience has proven, that the bundling can be contracted at 6c. per ton, and that by the cutters piling directly into the bundling racks, a further saving can be accomplished. In the writer's opinion, the machine can be made to load 200 tons per day of ten hours, and at a cost of 14c. per ton. In all trials

the machine has been operated by day work gangs, and piling done under a disadvantage, owing to a shortage of slings.

"Very respectfully,

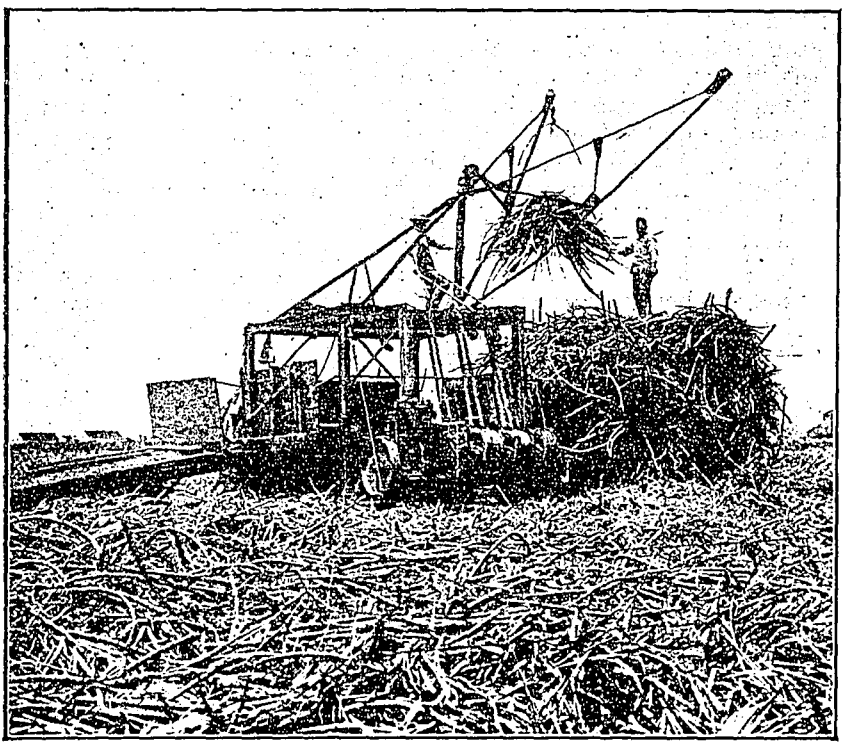
"(Signed) A. A. WILSON."

Dic. A. A. W.

THE WILSON-WEBSTER CANE LOADER.

The Wilson-Webster cane loader is mounted on trucks, to run on the main and portable tracks, and is arranged to permit of empty cars being hauled up an inclined track, over the platform, passing through the frame work of the machine, and down a similar inclined track on the opposite side. This feature of the machine always leaves the main and portable tracks clear, so that seed cane or portable tracks on cars may be drawn over them.

It is provided with six cable drums, any one of which may be connected at will of operator, by means of friction clutehcs



WILSON-WEBSTER CANE LOADER.

to their shafts, which is driven by a thirteen (13) horse power gasoline engine. Two of these drums are used for hoisting purposes, and four for drawing in cane from a distance. On top of the frame work are two jib-cranes for the hoisting cables.

The mode of operation is as follows: The machine is run over the main track to the field being harvested, and hauled out by mules onto the portable track, convenient to the cane to be loaded. The brakes are then set, the inclined tracks are placed in position, over which the cars to be loaded are hauled, until all but one have passed through the frame of the machine, the last car being left on the inclined track under the jib-cranes. The laborers pile the cane into bundling racks which are made of such dimensions as to hold about 500 or 600 lbs. of cane. Patent slings constructed of 5-16" wire rope, with pipe spreader are previously laid on the ground along side the racks and are drawn around the bundles and securely locked. The rack is then taken off by separating the parts. The crane hoisting cables are now used to pick up all the bundles reasonably near the machine and raise them to a suitable height to swing clear of the car. The jib cranes are so arranged as to swing automatically to the center of the car, the man on the car placing them where desired. By withdrawing the bolts on the spreader of the sling by a tap on their handles, after the bundle is in place, the load is instantly detached and the sling withdrawn. This method insures compact and well filled cars. While this is being done the second jib crane is hoisting a second bundle; these operations are repeated until the car is loaded, whereupon the car is pulled toward the main track and an empty car run through the machine to the loading position. The hauling cables at the same time are being run out and used to draw the bundles from a distance, to where they may be reached by the crane cables. The machine and cars may be moved by power from the machine; but a span of mules are found more desirable.

EXHIBIT "D."

"The Gregg Company, Limited.

"Honolulu, Hawaii, October 10, 1904.

"Ewa Plantation Co.,

Mr. G. F. Renton, Manager, Ewa, Oahu.

Gentlemen: We enclose herewith description and photographs taken of Gregg cane loading machine while at work

on your plantation. Thanking you to incorporate this with your report to be given to the Hawaiian Sugar Planters' Association, we beg to remain,

"Very truly yours,

"THE GREGG COMPANY, LTD.,
"(Signed.) C. M. LOVSTED."

"The Gregg Company, Ltd.
"Honolulu, Hawaii, October 10, 1904.

"The principle of the machine is as follows:

"The cane is picked up by hand, and thrown into a sled, shaped like the ribs of a boat. The boat weighs 200 pounds and holds 800 pounds of cane. The boat is then drawn by a team of mules to the side of the machine which is mounted on wheels and stands alongside of and parallel to the railroad track. It is operated by a gasoline engine. The machine picks the boat up, and dumps the cane into the car, returning the boat to the ground, whence it is hauled back to the field by the mule team, left there to be filled, and a boat which has meanwhile been filled is in turn drawn to the machine."

"The Gregg Company, Ltd.,
"Honolulu, Hawaii, March 17, 1903.

"The Gregg cane loader, used in an experimental way on Ewa Plantation, gave the following results on preliminary tests:

"March 4th. With ordinary stake cars, commenced 7:30 a. m. Quit 4 p. m. (1 hour noon).

13 men.
2 teams.

15 at 7½=112½ hours at 7½c. per hour.....$ 8.43
8 gallons of gasoline at 30c..... 2.40

$10.83

16 cars loaded. Total cane weight 53 tons.
Average cost per ton 20 4-10c.

"February 23rd. The machine was used on 10 flaring side cars constructed temporarily for this test. This test was not made for time, but for the purpose only of ascertaining how the cane would load on such a car and the quantity each car would hold as a fair working load. Four of the cars contained over four tons each; the balance a little less. Figuring the time on same as above test, March 4th, showed the cost of loading these 10 cars to be 16 7-10c. per ton."

"March 10th. With ordinary stake cars.
23 men.
3 teams.

26 at 2½ hours=65 hours at 7½c. per hour.....$4.88
2½ gallons of gasoline at 30c. per gallon..... .75

$5.63

40 tons of cane loaded.
Average cost per ton—14c.

From our experience in loading the one hundred and forty cars on six different fields, under varying conditions, I am confident one of our machines, improved according to our experience, equipped with a properly proportioned force of men and teams will load 200 tons of cane per day of 10 hours. For this quantity the crew should consist of:

16 men loading the boats.
3 teams hauling boats.
2 men on machine.
1 team hauling cars.
10 gallons of gasolene.

"The advantage over the present hand method may be stated as follows:

"1st.—Saving of from 30% to 50% of the number of men.

"2nd.—Saving of from 10% to 50% of cost of loading, according to the efficiency of plantation management.

"3rd.—Saving of half the present amount of portable track used.

"4th.—Cane loaded free from trash.

"5th.—Cane loaded closer to the cutters, thus saving loss by cane becoming sour by exposure.

"This last point can be made of more or less importance according to the attention given to it, but I am confident our machine can be worked much closer to the cutters than the hand loaders work when in large gangs as at present. I have no doubt that, with proper attention to this phase of the machine, nearly, if not quite, its entire cost can be saved in one season."

"The following extract from an article written for the 'Planters' Monthly,' by Dr. Maxwell, in November, 1896, emphasizes this point.

" 'A great loss of sugar can occur between the field and the mill if the period, between cutting and grinding, exceed a given length of time. The rate of loss is largely controlled by the sucrose content of the cane and the temperature of the air. In Louisiana, in the month of December, we personally found the loss, by letting the cane lie after cutting, to be 1

per cent. per day of the total sugar for the first five days. We have obtained some data bearing on this question under the conditions obtaining with us. While controlling other investigations at the Waianae Plantation, Mr. Crawley made some observations upon the rate of fermentation, and loss of sucrose in cut cane, which are given as follows:

Cane.	Sucrose in juice per cent.	Purity per cent.	Loss of total sugar per cent.
Fresh canes	19.9	86.9	....
One day old	18.5	83.3	7.2
Five days old	14.77	69.7	25.7

"These observations were made on very ripe and rich cane, with high air temperature prevailing. They are very generally confirmed by observations made by Mr. Otto Schmidt at Kekaha, in 1895. Mr. Schmidt reports to us as follows:

Cane	Sucrose in juice per cent.	Purity per cent.	Glucose Ratio per cent.	Loss of total sugar per cent.
Fresh canes	17.21	82.2	2.90	....
Two days old	16.16	80.0	12.40	6.1
Four days old	14.42	72.5	24.70	16.2

"The loss was greater than these figures show; since a notable loss of weight essentially took place in the cane that laid four days, Mr. Crawley found this loss to be 11 per cent. on cane which laid five days.

"6th.—The use of any kind of labor.

"It is a well known fact that only the stoutest, healthiest Japanese are willing to or can perform the laborious work of carrying the cane on their backs to the car over rough ground and after that up the narrow plank to a height of 11 to 13 feet above the ground—the height they have to load the cars to give satisfaction.

"With our system, the only time the cane is touched by hand is throwing it into the boats. It is not necessary to do any walking, as the cane within reaching distance around the boat will fill it (800 lbs.) It is not necessary to carry any bundles. The individual stalks of cane are picked up, thus keeping it free from trash. Any class of labor will do this work in preference to most plantation employment.

"I estimated the ordinary working capacity of those filling the boats to be: Four men four minutes per boat of 800 lbs. This is below rather than above results which should be expected. We have noticed four men working by the day load a boat in 2½ minutes when they did not know they were being watched. As a test a young Portuguese loaded a boat full in five minutes. This would be at the rate of four men one boat in 1¼ minutes."

"It requires one minute to unhitch the team, elevate, discharge and return the boat by the machine and hitch the team to it

again. To keep a machine working at this rate for 10 hours would load 240 tons of cane, and would require—

"16 men throwing cane in boats.

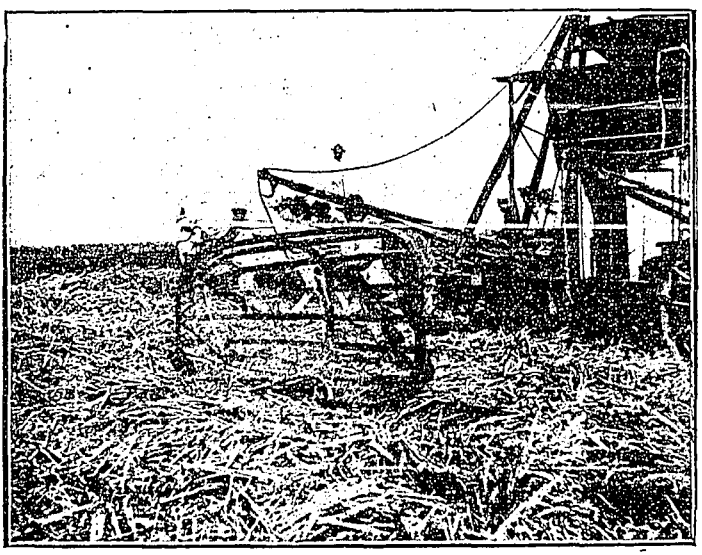
"3 teams hauling, ordinary distance.

"3 other men.

"1 team handling cars.

"The above list of men and teams is the same as given on page 2, the maximum capacity of which is 240 tons, but is there estimated at 200 tons to allow for some delays."

Mr. C. C. Kennedy wrote of a machine, in use at the Waiakea Plantation, in his last report on our subject. Your committee



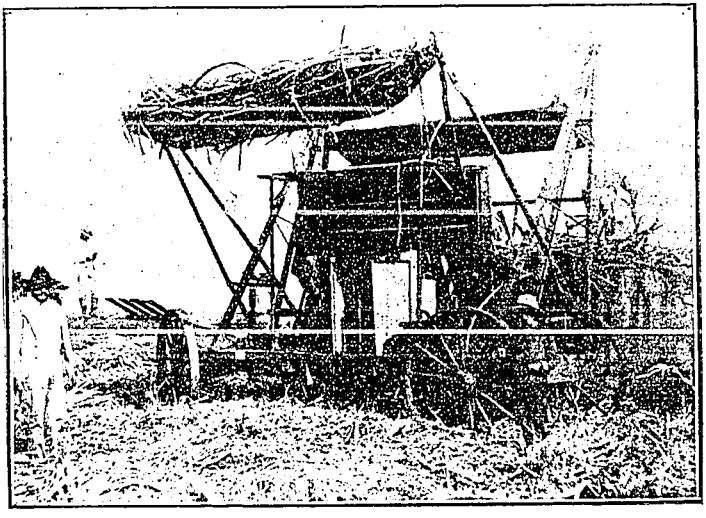
asked him for a description of his device, but no answer was returned, owing, probably, to his absence from the Territory.

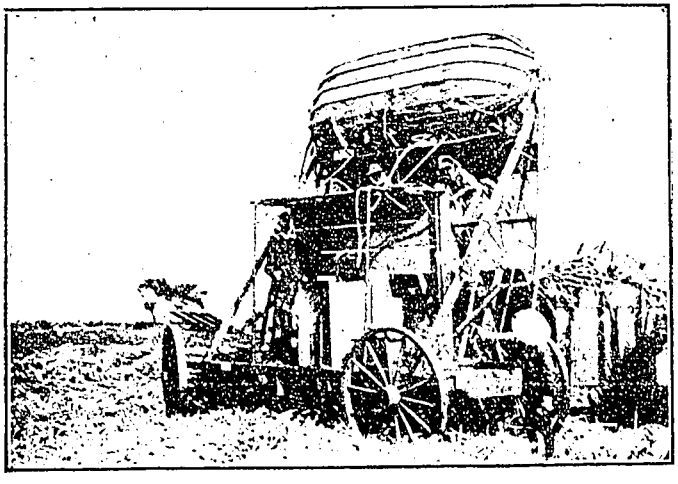
Both the Wilson-Webster cane loader and the Gregg cane-loading machine were tried by the Ewa Plantation on Oahu, the former for several months in 1904, the latter for a few weeks in 1903. The Wilson-Webster loader was also in use at the plantation of the Waialua Agricultural Co. during the entire grinding season of 1903.

The following figures are taken from these tests made by Ewa Plantation Co.:

TEST OF WILSON-WEBSTER CANE LOADER APRIL 7, 1904, AT EWA PLANTATION IN FIELD I—*E.*

Machine commenced loading 6:35 a. m.
Machine finished loading 5:15 p. m.
One-half hour stop for lunch.
Actual working time of machine men, 10 hrs. 10 minutes.
Actual working time of loading machine exclusive of delay in piling bundles and 1 moving of machine is 8 hrs. 26 minutes.





Shortest time loading 1 car, 7 minutes.
Longest time loading 1 car, 15 minutes.
Average time loading 1 car, 11¼ minutes.
Largest number of bundles in 1 car=20.
Smallest number of bundles in 1 car=10.
Average number of bundles in 1 car=14.
Average weight of 1 bundle, 474½ lbs. cane.
Machine moved once during day. Time taken in moving 15 minutes.

Machine loaded cane from both sides, a distance of 150 feet on 1 side, and a distance of 132 feet on 1 side.

Machine was not kept to capacity during the latter half of day owing to insufficient piling men.

Average time loading 1st 25 cars = 10.68 minutes.
Average time loading last 20 cars = 11.95 minutes.
Loading actual time 8 hrs. 26 minutes=5⅓ cars per hour.
Men actual time 10 hrs. 10 minutes=4½ cars per hour.

Performance of men piling in slings 2,262 lbs. cane per hour. 13 men worked each 10 hrs. 10 minutes and loaded each 22,998 lbs. cane during the day.

CARS LOADED.

45 cars—Gross weight		473,080 lbs.
Tare of cars	168,780	
Tare of leaves	5,325	174,105 "
45 cars=per car 3 tons..	644 lbs.	298,975 lbs. net

ESTIMATE OF COST OF OPERATING.

1	Japanese	—lever man loading	$ 1.25
1	"	lever man hauling in	1.25
1	"	in car placing	1.00
4	"	holding guys and pulling out cables .85	3.40
13	"	piling in slings, .80	10.40
20 men at estimated cost of			$17.30
Add oil packing, etc., say			.40
Add gasoline 10 gals. at 23c			2.30
Total estimated operating cost			$20.00 per day

According to Mr. A. A. Wilson 1 machine with equipment complete hauling in wire ropes and 100 slings with pipe holders= $3,000.

$3,000 at 8 per cent. on investment	$240.00	per annum
Repairs on machine	210.00	" "
Depreciation life, say 12 yrs	250.00	" "
Total say	$700.00	" "

Estimate of 160 days' work in grinding season gives cost of Machine per day=$ 4.37.

149.5 tons loaded.

Cost of machine per day $4.37	2.923c. per ton of cane
Cost of labor per day $20.00	13.377c. per ton of cane
Total	16.3c. per ton.

TEST OF THE GREGG LOADING MACHINE MARCH 10, 1903, AT EWA PLANTATION IN FIELD 24—*D.*

Time of test—2 hours, 38 minutes, 30 seconds.
Shorest time loading 1 car, 6 minutes, 30 seconds.
Longest time loading 1 car, 13 minutes.
Average time loading 1 car, 8 minutes, 48 seconds.
Smallest number of boats 1 car, 5.
Largest number of boats 1 car, 7.
Average number of boats 1 car, 6 1-9.
Average weight of 1 boat, 729.5 lbs.
Machine was not moved during test.
Performance of men piling in boats 3,210 lbs. per hour.

CARS LOADED.

18 cars at 4,458.3 lbs. per car. 80,250 lbs. net.

ESTIMATE OF COST OF OPERATION.

Assuming that one man will place 14½ tons of cane in boats in 9 hours and machine will load 136 tons cane in 9 hours:

There will be required for 1 machine.

9.4	men piling in boats, .80	$7.52
3	teams, 6 mules, to drag boats, .50	3.00
4	teamsters, .90	3.60
1	engine driver	1.25
2	helpers to aid at hooks, .85	1.70
16.4	men and 4 mules at	$17.07
	Add oil, packing gasoline, etc	2.50
	Total	$19.57

According to Mr. W. C. Gregg 1 loading machine with 10 boats equipment complete=$2,350.00.

$2,350 at 8 per cent. on investment	$188.00
Repairs on machine (estimate)	210.00
Depreciation life say 12 years	195.50
Total say	$593.50

Estimate of 160 days' work in grinding season gives cost of machine per day $3.71.

Estimated 136 tons cane loaded per day.

cost of machine per day, $3.71= 2.72c. per ton of cane
Cost of labor per day, 19.57=14.31 per ton of cane

Total . . . . . 17.03 per ton of cane

The principal point to which your attention is drawn is the favorable comparison that either of these machines make with present loading rates. The tests themselves were neither exhaustive nor altogether thorough. You are not asked to pin your faith to the estimates. They are not even to be taken as an absolutely accurate comparison of the two loading machines. The writer of this paper, who made the tests, is of the opinion that there is not so much to choose between them in the way of cost of actually loading cane on cars. Each has points of superiority over the other, and each can be greatly improved as the designers themselves admit. But the Wilson-Webster loader has two things especially that are in its favor:

(1) It is a substantially built machine.

(2) It draws its loads in by wire and thus eliminates the necessity of having a large number of teams in the harvesting field.

It may be said, however, that there does not seem any insuperable difficulty to the utilization on the Gregg machine of a wire rope to pull in its boats and thus, also, dispense with the teams.

The committee does not wish to enter into a detailed consideration or comparison of these two really meritorious machines. Both Mr. A. A. Wilson and the Gregg Co. have very kindly furnished descriptions and claims for their respective designs, which are attached to and form portions of this report.

From these the reader may draw his own conclusions.

There are several points to be made in favor of loading machines as against manual labor which one might overlook.

(1) It was stated early in this paper that the principal thing to be done after cutting the cane was to keep the mill supplied. Do we all do this? If we do it now by manual labor, have we any assurance that it can be done by manual labor a year or two hence? And even if we have the assurance that it can be performed two years hence by manual labor, have we the further assurance that it will not cost a great deal more?

By way of illustration, your attention is drawn to the fact that on the Island of Oahu, while the rate paid for loading cane by manual labor by contract was 16½ cents per ton of cane, four, at least, of the large plantations, representing an output of at least 90,000 tons sugar, were unable to keep their mills fully supplied. Had machines been in their fields which would have enabled them to keep their mills running to their full capacity, it would

have saved them money, even if their machine had cost more to load than contract loading.

(2) In the two tests given herewith at Ewa, the canes were loaded clean; there were no scattered canes. The gleaning alone remained. Now the writer is certain that on the tests made the cost of gleaning was not more than 2 cents per ton of cane loaded. If this be added to the cost of loading cane by say the Wilson-Webster loader, as shown at Ewa Plantation on Oahu, we have 18.5 cents per ton of cane representing cost of removing same from field and placing on cars.

Let us now see what it costs by manual labor for loading canes on the same basis. The following figures are taken from replies kindly forwarded to the chairman of your committee by the managers of the various Islands. From the tables given, it will be found that the cost of loading cane, loading scattered cane and gleaning by system of portable track and railroad is:

Plantations on Oahu,		average	22.24	cents	per ton	of cane
"	" Kauai,	"	20.24	"	"	"
"	" Maui,	"	18.50	"	"	"
"	" Hawaii,	"	18.69	"	"	"

There is apparently a respectable margin in favor of loading by machine loader. Your committee is, however, inclined to believe that, possibly, the plantations on Maui and Hawaii have not put down all that might be charged to loading as have those on Oahu and Kauai. Moreover, the figures given for Oahu and Kauai represent thirteen estates as against four estates on Maui and Hawaii. From these figures it may safely be assumed that, after all, loading by manual labor is not always as profitable as appears on the surface. And if we are loading for say 17 cents a ton by contract it is generally 17 cents, and something more.

(3) Loading machines do not go on a strike, neither do they require a picked body of men to lift the cane from the ground to the top of the car. The machine does the lifting, and in either the Wilson-Webster or the Gregg loader any one, even a boy, can place the cane in slings or in the "boat" sled. And they not only do not require picked men, but they require less men, picked or otherwise, which is always a marked advantage.

Both of the tests referred to were carried out on the Ewa Plantation, whose flat lands gave very favorable opportunity to the machines. In a hilly country like results might not have been realized. Under these latter conditions it will be necessary to have loaders to suit local requirements. The point that your committee wishes to emphasize is merely this:—the necessity for abolishing, as far as as possible, the heavy labor of handling and loading cane, and the necessity that each plantation meet its own requirements in this line.

Waiakea Plantation has its loading machines which, from all acounts, are giving satisfaction. Kukaiau Plantation has improved its trolley system to suit its needs. Ewa Plantation Co.

has ordered three of the Wilson-Webster loaders for use in 1905. Honolulu Plantation Co. has, we understand, tried several machine loaders and is at work on another.

Evidently the plantations appreciate the situation.

In conclusion, your committee wishes to apologize for the scant scope of this paper. It will be enough if a perusal of its figures and statements brings about a discussion which will tend towards a full and instructive discussion of the subject by plantation managers, and a fuller and more instructive report for next year.

GEORGE F. RENTON, Chairman;
C. C. KENNEDY,
JOHN M. HORNER,
GEO. CHALMERS,
H. P. FAYE,
D. C. LINDSAY,

Committee on Handling and Transportation of Cane.

Paauilo, Hamakua, Oct. 26th, 1904.

Mr. Geo. F. Renton, Ewa, Oahu, Chairman on Hauling & Transportation of Cane.

Dear Sir:—Persuant to your request, I take pleasure in submitting the following detailed description of the Cable System in use at Kukaiau, and some other places.

The "Horner Cable Transmission System" is especially adapted in a rolling or hilly country, as it is dependent upon gravitation. It can be operated on any grade above 4%.

This system has been applied with particular advantage on the Kukaiau and Ookala Plantations, as well as some others, where the nature of the ground is uneven, and where, in former years, the cane was transported by wagons.

Previous to the introduction of this system upon the Kakaiau Plantation, there had been constructed some 25 miles of wagon roads throughout the various cane fields. The cane was hauled over these roads by teams at a very heavy cost, and it was owing to this high cost of transportation, that much good cane land remained unavailable, until the introduction of this Cable System, since which time the area of the plantation has been materially increased.

The cables are suitably anchored at both ends, and having spans varying, according to the contour of the country, from 100 feet to 1,800 feet.

The size of the trolley wheel varies according to the grade. The steeper the grade, the smaller the wheel; and the lower the grade, the larger the diameter of the wheel must be. There is a Spiral Spring above or on top of the cross arm of each support. This has an eye-bolt through it, which extends down through a

suitable hole in the cross-arm. In the center of the support, to the lower end of this eye-bolt, under the cross-arm, is attached a drop-holder and sheave, which supports the cable. This makes a flexible antifrictional support, and relieves any jar or bump of the passing loaded trolleys, while the cable is prevented from leaving the sheave support, by reason of the clip holding cable to sheaves at supports.

At the present time there are four permanent lines at Kukaiau, leading from the mill to the various parts of the plantation. The longest one of these is 3¾ miles. In this distance are two transfers or switches, where the trolleys with their loads run from one wire to another.

The cost of handling cane by this system is gradually being reduced. The past year the cost of handling cane, including bundling, loading onto wagons, transporting to mill, a distance (average) of two miles, including the labor for constructing the lines and moving the portable lines from one field to another, was 58c per ton. It requires 9 tons, estimated, of cane to make one ton of sugar at Kukaiau; so to transport enough cane for one ton of sugar it costs us $5.22, as against $7.62 by wagons, a reduction of $2.40 per ton of sugar.

On plantations where inaccessibility and lack of water for fluming exist, this transmission system should occupy an important position. It is also a valuable acquisition in connection with "railroads," where the contour of the country is such that portable tracks cannot be used to advantage; as, for instance, on some plantations they have a permanent track running from the mill through the lower part of the plantation. Cane is hauled from the upper fields to this railroad in wagons. On these places the cane could be delivered into the cars at a less cost by this cable system.

We use a bundling machine for compressing the cane into suitable bundles; it is a simple, light, circular steel frame, hinged at the bottom. When open, and before placing cane in it, the chain sling is laid in the bottom. Then the cane is put into the machine until the same is full. The sides of the machine are then brought together by a lever until the cane is pressed tight. The sling is then fastened, and machine removed. Bundles average about 300 pounds in weight.

After cane is bundled it is loaded onto low wagons by an especially constructed, light, portable loader. This loader is propelled from the rear by two animals; wagons are driven between the rows of bundles, and in front of the loading machine, which picks up the bundles and places them onto the wagons.

The force required to operate this loader is 3 men and 3 animals, as follows: One driver for the 2 animals that push the machine about the fields; one man and horse to lift the bundles from the ground and put them onto the wagons. The work of lifting the bundles, also works the boom automatically, so that

as soon as the bundle is free of the ground, it at once starts for the wagon through the automatic movement of the boom. A third man is required to hook the end of the rope into the ring of the slings which are used for bundling the cane. This outfit handles 125 tons of cane in 10 hours.

After the wagons are loaded they are driven to wire-loading station, (this station is changed from time to time as may be needed) where a hoisting machine, consisting of mast, short arm and block with tackle is arranged on a suitable sled. The lower block is attached to wherever necessary, so the wire may be lowered and trolleys hooked on. Then the wire is raised until the bundle is free of the wagon, when it is released, and it runs to the terminal. Hoisting machine is worked by one boy and a horse.

One of the most important advantages of this system is that any one using it is absolutely independent of the weather, for it works equally well either in wet or dry weather. In this respect it is next to the flume. The original cost of the equipment for a mile of cable is much less than a mile of flume.

Respectfully submitted,

(Signed) A. HORNER.

———:o:———

REPORT OF COMMITTEE ON MANUFACTURE.

To the Members of the Hawaiian Sugar Planters' Association.

Gentlemen:—Your committee appointed to consider and report upon the Manufacture of Sugar as carried out in this country beg to submit the following:

Object of this Report: Is to discover the true standing of the art of making sugar in these Islands; to criticize the defects if any; and to make such recommendations for future work that the performance of the various factories and systems of operation may be readily comparable one with the other, so that real improvements in manufacturing processes may be adopted with the least expense and in the shortest time by all able to do so.

Obviously the first step was to obtain accurate information as to the methods used in the several sugar houses, and to this end your committee sent out to every plantation manager in these Islands a list of questions pertaining to Manu-

facture of Sugar; it is highly gratifying to be able to say that from 48 plantations operating their own factories to which the list of questions were sent your committee has received 38 replies, all of them fairly complete, thus giving an opportunity to make a report on the condition of the industry in this country that is accurate.

As these lists of questions were sent out at the beginning of the year 1904 the replies in great measure refer to crops up to and including crop of 1903; a few changes have been made since the conclusion of the 1903 crop so that this report dealing with the conditions under which our staple export is manufactured must be considered as not on the whole including work on the crop harvested this year.

The following is an abstract of the individual replies to the lists of questions sent out to the several plantations. The replies have been (for purposes of comparison) graded into classes A, B, and C, in the following manner:

Those factories which showed a fairly complete system of control of manufacture are classed "A." Those factories showing a partial system of control of manufacture are classed "B." Those factories showing no special system of control, excepting ordinary care and vigilance, are classed "C."

In the A class there are 12 factories.

In the B class there are 14 factories.

In the C class there are 12 factories, making a total of 38.

No attempt has been made to classify every reply, which would be uninteresting even if possible, but on the contrary the endeavor is to put averages before your Association in such form that fairly true comparisons between different classes of work may be readily made.

QUESTIONS ON MANUFACTURE OF SUGAR SUBMITTED TO PLANTATION MANAGERS.

WEIGHTS.

Cane—Do you weigh your cane?

How often do you test for accuracy the cane scales and by what method?

Do you make allowances for dirt and field trash brought in with the cane, and if so, how do you find the amount to be deducted?

Juice—Do you weigh, or measure the mixed diluted juice from the mills before clarifying, and if so by what method and what checks have you to ensure reasonable accuracy?

Sugar—After the sugar bags are filled and weighed, have you any system of checking the weights of the bags?

How do the San Francisco or New York weights of your sugars compare with the shipping weights?

WORK.

Extraction—How do you extract the juice from the cane?
What percentage of the sugar in the cane do you obtain in the extracted juice?
How do you determine this?
Clarification—What system of clarification do you use?
Do you apply lime to the cold juice, or after it is heated?
Do you use re-agents other than lime?
How much lime do you use per ton of sugar made?
Do you use intermittent or continuous settlers?
Do you filter your juices?
Have you any special treatment for settlings and scums before filtration?
To what percentage of sugar do you exhaust the filter press cake, and is this done by single or double pressing?
Evaporation—Do you concentrate the clarified juice in double, triple or quadruple effect evaporators?
What is the average density of your syrup?
Do you have much trouble in keeping the evaporators clean?
Do you use coal, or other fuel as auxiliary to the bagasse, and if so, please state the value of such fuel per ton of sugar made during the crop?
Graining—To what density do you boil the 1st massecuites?
To what density do you boil the 2nd massecuites?
To what density do you boil the low grades?
What is your recovery of dry sugar from 1st massecuites?
What is your recovery of dry sugar from 2nd massecuites?
What is your recovery of dry sugar from low grades?
Do you wash No. 1 sugars in the centrifugals?
Do you wash No. 2 sugars in the centrifugals?
What is the average polarization and purity of No. 1 molasses?
What is the average polarization and purity of No. 2 molasses?
What is the average polarization and purity of low grade?
Do you use a dryer, or cooler of any kind to pass the shipping sugars through, before bagging?
What percentage of moisture is there in your shipping sugars?
What is the average polarization of your No. 1 sugars?
How does the San Francisco or New York polarization of your sugars compare with the shipping polarizations?
Have you any special method of treating No. 2, No. 3 and low-grade molasses?

If so, please write a brief description of same?
Do you make more than one grade of sugar for shipping?
If not, do you remelt the No. 2, or draw into the vacuum pan dry?
Do you use crystallizers for No. 1 or No. 2, or only for low grade sugars?
What is your opinion as to the relative merit of crystallizers, and open cooler cars, or tanks?
What is the average polarization and purity of your waste molasses? (Apparent purity and direct polarization.)
How much in pounds or gallons per ton of cane or sugar, does your waste molasses amount to in an average crop?
What do you do with the waste molasses?

Sugar House Control—Do you employ a chemist,
Have you a system whereby leaks and losses of sugar in the course of manufacture can be at once detected and stopped?
What is the basis of your control, the sugar in the cane ground, or the sugar in the juice sent into the boiling house?
Do you have a system of daily reports for sugar house work?
Do you exchange results with others?

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TABLE SHOWING CLASSIFICATION OF FACTORIES.

	A	B	C
Method of testing cane scales—			
U. S. Standard weights	3	1	
Against another scale	2	5	1
Balancing scale beam	6	5	4
Weight of cane—			
All cane weighed.	10	6	5
Part of cane weighed	1	6	
No cane weighed.	1	2	7
Allowance for dirt and field trash—			
Made by actual weight	7	5	1
Made by estimation	2	1	2
No allowance made	3	8	9

Method of extraction—			
Diffusion process.	1		
12 roller mill and crusher	1		
9 roller mill and crusher	6	5	1
9 roller mill no crusher	4	5	4
Other arrangements of mill...		4	7
Extraction obtained % sugar on sugar in cane—			
Diffusion process.	96.7 %—97.2%		
12 roller mill and crusher	95. %—96. %		
9 roller mill and crusher	92.75%—95.6%	88.9 %—93.0%	93.5%
9 roller mill no crusher	92.0 %—94.0%	89.05%—93.0%	90.0 %—92.0%
Other arrangements of mill...		90.0 %—93.0%	85.32%—91.0%
Juice weights—			
Extracted juice weighed	2	1	
Extracted juice measured	8	10	5
Extracted juice calculated	2	3	7
Clarification—			
Super heat and continuous tanks	2	2	
Super heat and intermittent tanks	2	2	1
Boiling point and continuous tanks			3
Boiling point and intermittent tanks	7	10	7
Chemicals other than lime used..	Phos. acid in one mill only	Pros. acid in one mill only	
Filtration—			
Filter presses single pressing....	5	12	9
Sugar in press cake	5 %—9%	5%—10%	6 %—7%
Single pressing and lixiviation..	2	1	
Sugar in press cake	1½%—2%		
Filter presses double pressing.	4	1	3
Sugar in press cake	1 %—4%	.2%—1 %	1½%—3%
Sand filters or bag filters	4	3	1

Massecuites—			
% water in massecuites	10%— 6%	8%— 4%	Unknown
Treated in crystallizers	2	none	none
Dried direct from pans	10	14	all
Recovery of No. 1 sugar	57%—66%	55%—63%	unknown
No. of factories knowing this...	all	two	none
2nd Massecuites—			
% water in massecuites	10%— 3%	9%—6%	Unknown
Treated in crystallizers	7	1	none
Treated in cooler cars	2	7	all
Dried direct from pans	2	6	"
Recovery of No. 2 sugar	40%—55%	54%	unknown
No. of factories knowing this...	all	one	none
Low grades—			
% water in massecuites	12%— 6%	11%— 7%	Unknown
Treated in crystallizers	1	none	none
Treated in cooler cars	2	none	"
Treated in large tanks	9	14	all
Recovery in low grade sugar	7.5%—30%	20%—25%	unknown
No. of factories knowing this...	all	two	none
Shipping sugars—			
One grade.....	4	6	5
Two grades.....	8	8	7
Second remelted..	7	10	7
Seconds taken back dry.....	5	4	5
Average polarization of sugars..	97.4%	97.5%	97.5%
Treatment of sugar—			
Hersey driers.....	2		1
Moisture in sugars	.35%— .5%		Unknown
Elevators and fans	3	4	1
Moisture in sugars	.35%—1.0%	.4%— .9%	.5%—.6%
Sugar bagged from machines	7	10	10
Moisture in sugars	.7%—1.5%	.6%—1.2%	.6%—1.%

Loss in weight at market lb. per bag—			
Hersey driers.....	no loss or gain		gain in weight
Elevators and fans	¼ to ½ lb per bag	½ to ¾ lb per bag	1 lb per bag
Sugar bagged from machines	½ to 1 lb per bag	½ to 1 lb per bag	¾ to 1½ lb per bag
Polarization on marketing	slight gain	slight gain	small loss
Waste molasses—			
Average gallons per ton cane....	3.7	3.25	3 to 7.45
Average purity....	37.7%	27%— to 48%	31% to 46%
No. of factories knowing this...	all	6	2
Auxiliary fuel in value per ton of sugar—			
Mills using diffusion process....	$1.56		
12 roller mill and crusher	none		
9 roller mill and crusher	none to .66 cts.	very little	none
9 roller mill and crusher	none	none to .60 cts.	none
Other arrangements of mill...		none	none to .50 cts.
Use made of waste molasses—			
Burnt as fuel....	4	1	
Fed to animals...	9	11	9
Used as fertilizer.	8	5	2
Thrown away.....	2	4	5
Sugar house control—			
Employing professional chemists.	11	6	
Employing amateur chemists...	1	3	
Not employing chemists		5	12
Basis of control—			
Sugar in cane....	5	4	
Sugar in extracted juice	7	8	No control

Improvements in the processes of Manufacture of Sugar have been few, (improvements in milling and extraction have been taken up by the Committee on Machinery).

Taking up the subjects in order:

Clarification: Superheat clarification is now used in few factories only, most of the sugar houses formerly using superheat having reverted to the plan of liming the juice cold, bringing up the same to boiling point in closed heaters and

settling out the impurities in small tanks and decanting off the clear juices.

A few factories are using sand or bag filters for passing the clear juice through before evaporation.

Scums: The great majority of factories use filter presses for one pressing only, leaving the press cake containing from 5% to 10% of sugar.

Three factories only use single pressing and washing the cake with water in the press, reducing the sugar in the cake to from 1½% to 2% of sugar.

Eight factories use double pressing, in which process a double battery of presses is required, the cake from the first battery being crushed with water to a stiff mud and put through a second battery, by which means the final content of sugar in the press cake is reduced to from 1% to 4%.

Undoubtedly the best and cheapest method of exhausting the press cake is single pressing and lixiviation, or washing with water, which is also used exclusively in beet factories, but in the majority of cases the filter presses in use are not properly designed for this system of work, and the cost of installation of the proper kind of presses is so great in comparison with the gain to be made, that little progress has been made in this direction.

Evaporation: There is nothing new to report upon in this direction; most factories use triple effect standard machines, some factories use quadruple effect machines, some of the vertical or standard type, some film evaporators of the Lillie system, and others of different makes.

All classes of evaporators foul up more or less and there does not seem to be any reason to believe that one type is better or worse than another type in this respect, the cost of keeping these apparatus clean depends considerably upon the quality of the juice in operation and the care bestowed upon the weekly cleaning by the men in charge of such work.

All factories aim to concentrate the syrups to the highest point obtainable; the figure varies from 48% Brix. to 60% Brix.

Boiling to Grain: There is little uniformity in the boiling of the first massecuites, the percentage of water left in the masse being reported at from 10% to 4%. The after treatment varies considerably: two factories use crystallizers for No. 1 sugar, the remainder dry the first massecuites hot, direct from the pans. Comparatively few factories have control over the work of making No. 1 sugar, since out of 38 factories only 14 know what the recovery of dry sugar on the weight of the first massecuites is and these vary amongst themselves from 55% to 66%.

Second Massecuites: Are in 8 cases treated in crystallizers, in 9 cases treated in cooler cars and in 9 cases dried hot direct from the vacuum pans. Only 13 factories know

the result of boiling second massecuites and the recoveries vary from 40% to 55%.

Low Grades: One factory only (using the Java process) treats low grade massecuites in crystallizers, two factories treat them in cooler cars, and the remainder treat low grade massecuites in large tanks or cisterns.

Fourteen factories know what the weight of low grade sugar per 100 lbs. of this low grade massecuite is, and the recoveries vary from 7.5% to 30%, depending naturally upon the quality of the goods worked up.

*Waste Molasses*s The resulting waste molasses from the working up of low grade massecuites is as variable as the methods of working it up.

The A class factories turn out waste molasses at 3.7 gallons per ton of cane of an average purity of 37.7%. B class factories produce waste molasses at 3.25 gallons per ton of cane of a purity varying from 27% to 48%. In the C class only two factories know anything about this work and they turn out waste molasses from 3 to 7.45 gallons per ton of cane of a purity from 31% to 46%.

The uses to which the waste molasses is put pertains to the work of the Committee on By-Products, but it will be seen from the tabulated returns that nearly all the factories make some use of the waste, either for fuel, fertilizer or stock feed, and in addition some small quantity is shipped to San Francisco. Those factories making use of the waste molasses divide it amongst the animals and the fields and some few burn the bulk of it; comparatively few factories waste the whole of this refuse.

Shipping Sugars: The grade of No. 1 sugars turned out by all the factories is remarkably uniform, averaging 97.5% polarization.

Fifteen factories make one grade of sugar for shipment. Twenty-three factories make more than one grade of sugar. Drying apparatus for taking the moisture out of the shipping sugars have been introduced in three cases, the moisture in the shipping sugars from these machines varies slightly from .35% to .5% with no loss or gain in weight at market.

Eight factories use elevators and fans for cooling the No. 1 sugars before bagging and the moisture in these sugars varies from .35% to 1% with a slight loss in weight of the sugar at market.

Twenty-seven factories bag their No. 1 sugars direct from the centrifugal machines; these sugars contain when bagged from .6% to 1.5% moisture and lose in weight at market from ½ lb. to 1½ lbs. per bag.

In many cases there seems to be a very slight gain in polarization on arriving at market, with the exception of the

class C factories, one of which reports a loss, one a gain, the rest do not know.

A study of above shows that if sugars are washed in the centrifugals (which is done in only a few cases now) drying apparatus for removing the moisture from the dried sugar becomes a necessity. In all other cases the keeping qualities of the sugars seem to be improved by cooling them and breaking up the lumps of sugars leaving the centrifugal machines before bagging.

Auxiliary Fuel: Many of the factories sending in replies to your committee do not use any fuel whatever excepting that furnished by the cane.

Several do use more or less fuel, varying from 10 cents in value per ton of sugar made to 66 cents per ton. Diffusion process uses fuel to the value of $1.56 per ton sugar.

This is undoubtedly caused in those factories that are fitted up with powerful evaporators, etc., by the number of boilings the low grade molasses is subjected to, and possibly also to irregular deliveries of cane for whatever reason. Evaporating apparatus too small, or not kept clean will account for this use of auxiliary fuel, and there are certain kinds of cane which furnish a bagasse that is of poor quality for fuel purposes. Given regular deliveries of cane of fair quality and a rational system of work in the sugar house, with ample and clean boilers, evaporators, and vacuum pans there does not appear to be any reason why, even with maceration to the extent of 30 gallons of water per 100 gallons of original juice, a sugar house in this country should not run through its crop without the use of auxiliary fuel.

Improvements in Manufacture: During the past season this Association entered into arrangements with a gentleman from Java to come to this country and instruct certain factory operators in what is known as the "Java Process" of boiling sugar.

In brief terms this process consists in reducing the material operated upon to a certain standard purity or set of purities so planned that a large proportion of the No. 1 molasses is worked with the syrups resulting from the cane juice, and boiling so as to produce a class of goods that by treatment in the centrifugal machines will result in a shipping sugar of sufficiently high grade to send to market.

Crystallizers are used for No. 1 sugars. These sugars are washed in the centrifugal machines with water, which wash water is kept separate from the first molasses. The sugars after drying in the machines are passed through driers and granulators.

The first molasses is then brought to a standard purity by

mixture with lower grades, is boiled and put into crystallizers, treated, dried and washed, granulated and mixed with the sugars resulting from the first boiling, the whole product being shipped as No. 1 sugar, the resulting molasses from the second boiling being waste generally.

The length of time under operation for the first boiling, including crystallization is about eighteen hours; and for the second boiling, including crystallization is about 48 hours, so that in, say three days' time, the whole of the available sugar in the cane ground is in bags and the waste molasses is out of the mill.

It goes without saying that this is a most satisfactory method of operation for those factories that are arranged for doing this work properly, but the process requires for its successful operation more crystallizers and more centrifugals than are ordinarily used and the waste molasses runs somewhat higher in sugar and purity, while in actual quantity there seems to be somewhat less molasses produced per ton of cane ground, so that the actual loss of sugar in the waste molasses may be even less by the use of the "Java Process" than by the common method. The process is now in successful and satisfactory operation at Waialua, Oahu, which factory in its original design lent itself better than almost any other factory in the country to the application of this method.

There is one point about the Java process that can be adopted by any factory without cost for new machinery, and that is the plan of boiling to standard purities, and your committee recommends that this be studied over by every factory manager in the Territory, as the plan promises well for an increase of No. 1 sugar at the first boiling and a reduction of the losses in the waste molasses.

It will be noted in the foregoing that no attempt has been made to compare results in yields of sugar or in cost of production; before such comparisons can be made a uniform basis for statement should be adopted.

As an illustration of this necessity the following may be noted:

Of the 28 factories weighing cane only 4 use U. S. standard weights for proving the accuracy of their weighing apparatus. The other factories use various schemes for checking the accuracy of the scales. Ten factories do not weigh cane.

Allowances for dirt and field trash are made by some and not by others, and those that make deductions vary in the method of obtaining the figures: some weigh a sample car every day, some once a week and some estimate by looks only.

The mixed juice from the mills taken into manufacture is weighed by some, measured by some, and calculated by others.

With such differences of method at the beginning of manufacture it is not surprising that some factories will state that

they obtain 66 lbs. of No. 1 sugar from 100 lbs. of first masse-cuites while others get only 55 lbs., the fact being that very few really know what they obtain.

It can be truly stated that there are very few sugar factories in this Territory that can compare in the system of control, with average beet factories in any part of the world, and as the beet sugar factories have made such strides in the past few years it is surely incumbent upon this Association to suggest the adoption of similar methods whereby accurate knowledge of what is going on in the manufacture of our staple product be obtained.

It therefore seems to your committee that it is highly desirable that a standard method of stating results be adopted and that reports be sent in annually to this Association on this basis; such reports could then be tabulated and used in determining the value of different methods of manufacturing sugar, and the value of the improvements that are continually coming forward.

This does not mean that precisely the same method of obtaining these results should be followed in all instances. Your committee believes that the individuality of the various managers and factory operators should be preserved, because without individuality effort to improve is stifled.

At the annual meeting of this Association in November, 1902, an effort was made to establish a standard method of sugar house control and the Association of Hawaiian Sugar Chemists was requested to take the matter up. A "Provisional" method for the determination of the extraction of sugar from cane was brought out and issued shortly after the commencement of the grinding season, crop 1903, but proved defective and was abandoned after that crop, and another set of "Provisional" methods was adopted later on in that year just before grinding crop 1904.

As far as your committee can ascertain these last methods are not accepted as final, as can be seen by the fact that while the "Provisional" methods of 1903 recommend that the sugar in the cane be adopted as the basis of sugar house control, out of 12 factories having a fairly complete system of control of manufacture, seven take the sugar in the extracted juice as the basis, doubtless for excellent reasons.

For the benefit of the industry as a whole, your committee suggests as a first serious move towards uniformity in stating results, that a special committee of this Association be appointed to confer with the gentlemen composing the Hawaiian Chemists' Association to the end that a system for stating sugar house results be evolved that shall be simple, that shall not cause extra outlay of money and that shall give the essential figures; so that if necessary, comparative reports of the

performance of various factories made up on the same basis could be rendered.

Your committee begs to thank those gentlemen who answered so promptly and fully the questions sent them and hopes that in the future the same measure of interest may be taken in this vital subject.

Respectfully submitted,

(Sgd.) J. N. S. WILLIAMS, Chairman;
" T. CLIVE DAVIES,
" AUG. AHRENS,
" G. H. FAIRCHILD,
" K. S. GJERDRUM,
Committee on Manufacture.

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REPORT OF COMMITTEE ON MACHINERY.

To the President and Members,
Hawaiian Sugar Planters' Association.

Gentlemen:—We beg to present herewith the report of your Committee on Machinery.

Prior to the commencement of the 1904 grinding season and during the past year, the following installations of new machinery have been made on the several estates mentioned:

HAWI PLANTATION—Has erected a complete new factory. The buildings and all staging for carrying the machinery throughout are of steel construction, the principal machinery installations being as follows:

The crushing plant consists of a 9-roller mill with 30x54 rollers, with hydraulics applied to the top rollers; the 3 mills being driven by one Hamilton-Corliss engine with the usual arrangements of gearing.

The steam generating plant consists of four 6x18-foot horizontal tubular boilers complete with trash conveyor from mill to boiler room, with automatic feeders to the furnaces.

The clarifying apparatus consists of a heater and settling tanks. The heater consists of two vertical bodies with the necessary heating surface in same through which the liquor passes on its way to the settlers, where it is heated to the proper temperature for clarification. These heaters are open at the top and permit of cleaning while in operation.

The evaporator is a standard triple effect of 4,200 square feet heating surface of the central circulating tube type.

One 8-foot vacuum pan is at present installed with the new machinery, but the staging is designed for a second pan.

The cooler system, as adopted by Mr. Hind, is a novel one, consisting of large tanks so arranged in 2 lines that the molasses strikes from the pans can be delivered direct into the tanks, and, later, the massacuitte can be transferred to the mixer without any manual labor, provision having been made for this in the design of the building. The mill is equipped with a Hersey dryer, with all elevators, and altogether the plant is a very complete and modern installation, being designed for an output of 40 tons of sugar per 24 hours.

HILO SUGAR COMPANY—Have enlarged their evaporator, which is a standard triple effect of 5,600 square feet. A new boiler plant has also been installed, consisting of one of their present 6x20-foot boilers and three new 7x20-foot tubular boilers with self-supporting stack 90 inches in diameter and 120 feet high.

PAAUHAU PLANTATION—Have installed a complete 9-roller mill with rollers 32x66 and several minor improvements throughout the factory in connection with the same.

KAHUKU PLANTATION—At the end of the last grinding season a 9-roller mill with 34x72 rollers was installed with a Wick's Cane Unloader and a Krajewski Crusher. In conjunction with this new mill a complete steel elevator and conveyor to the boiler room were installed with the necessary chutes, gates and feeders for automatically feeding the bagasse to the six boilers.

Four crystallizers were also supplied for the boiling house on account of a lack of cooler capacity, it being decided by the management that the crystallizers were less expensive than additional buildings with floor space for coolers and the necessary car capacity.

HONOLULU PLANTATION—An additional large pumping station in the Waimalu Gulch, consisting of two triple expansion flywheel pumps, each of a capacity of 7,000,000 gallons per 24 hours at a maximum height of 450 feet, has been erected and is now in operation.

OAHU PLANTATION—Have converted their 9-roller mill into a 12-roller plant, the operation of which for the past year has been very satisfactory, increasing the capacity of mill, and a higher extraction than formerly being obtained with a smaller amount of maceration water.

KOLOA PLANTATION—Have converted their 2-roller mill into a 3-roller plant, driven by the original gearing.

KILAUEA SUGAR COMPANY—Have replaced their old 3-roller mill by a new 32x60 3-roller mill operated by the original engine and gearing.

NEW MACHINERY.

The following new machinery installations are either contracted for or are in contemplation for the following year:

LIHUE—The Lihue crushing plant is being re-constructed, utilizing the present two 34x78 3-roller mills which will be driven by a new gearing and engine to be operated as a 6-roller mill. In addition a complete new 34x78 3-roller mill will be installed, to be operated in conjunction with the present 3-roller mill, making a total of 12 rollers; an overhead steel traveling crane spanning the whole of this machinery will be included with these improvements.

MAKAWELI PLANTATION—Contracts have been awarded for a complete 12-roller milling plant and a Krajewski crusher with rollers 34x78. This machinery will be driven by two Hamilton-Corliss engines, one engine driving six rollers and one engine six rollers and a crusher. In addition to this machinery the diffusion plant now in operation will be dispensed with and space utilized for the clarification system, settling tanks and filter presses. A complete bagasse conveyor will be installed for feed-feeders.

KEKAHA SUGAR COMPANY—A complete central condensation ing the boilers in connection with the existing automatic bagasse plant consisting of a compound condenser and a high speed dry air pump will be installed. One of the vacuum pans will be re-constructed with a low pressure coil system and numerous other improvements will be made which will add very much to the efficiency of the boiling house.

PACIFIC SUGAR MILL—A number of improvements and additions will be made in this factory, consisting of the installation of an additional triple effect evaporator to be operated in conjunction with the present apparatus. A 2-roller mill will also be placed in front of the present 9-roller plant as a crusher, and the vacuum condensing apparatus throughout the boiling house will be remodelled and a central condensation system installed.

We have endeavored to gather such data as will be of interest, and, at our request, the following contributions have been submitted:

1st. Paper by Jas. Scott, on *Fuel Oil.*

2nd. Paper by C. Hedeman, on *Juice Weighing Machinery.*

3rd. Paper by J. N. S. Williams, on *Extraction of Sugar from Cane.*

4th. Paper by C. Hedemann, on *Progress in Milling.*

5th. Paper by Max Lorenz, on *Central Condensation in Sugar Houses.*

Respectfully submitted,

C. HEDEMANN,
Chairman.

FUEL OIL.

Kihei, Maui, T. H., August 26th, 1904

C. Hedemann, Esq., Chairman Committee on Machinery, Hawaiian Sugar Planters' Association, Honolulu.

Dear Sir:—In laying before you the following data on Coal versus Fuel Oil, also the observations made on the latter, which I trust you may find of assistance in framing your report for the annual meeting, I wish to call your attention to the following:

In making a comparison between Coal and Liquid Fuel, I shall figure coal at its cost approximately landed at the furnaces previous to the introduction of oil in October, 1902, and while the oil fuel will show a greater saving over coal than should actually be credited to it, owing to minor changes and alterations of an economical nature having been made in the steam plants and pumps at our different pumping stations since the introduction of oil, the value of which I am unable to estimate, the comparison therefore in saving is an approximate one only, though sufficiently large, to prove beyond a doubt the economy and benefits of its introduction.

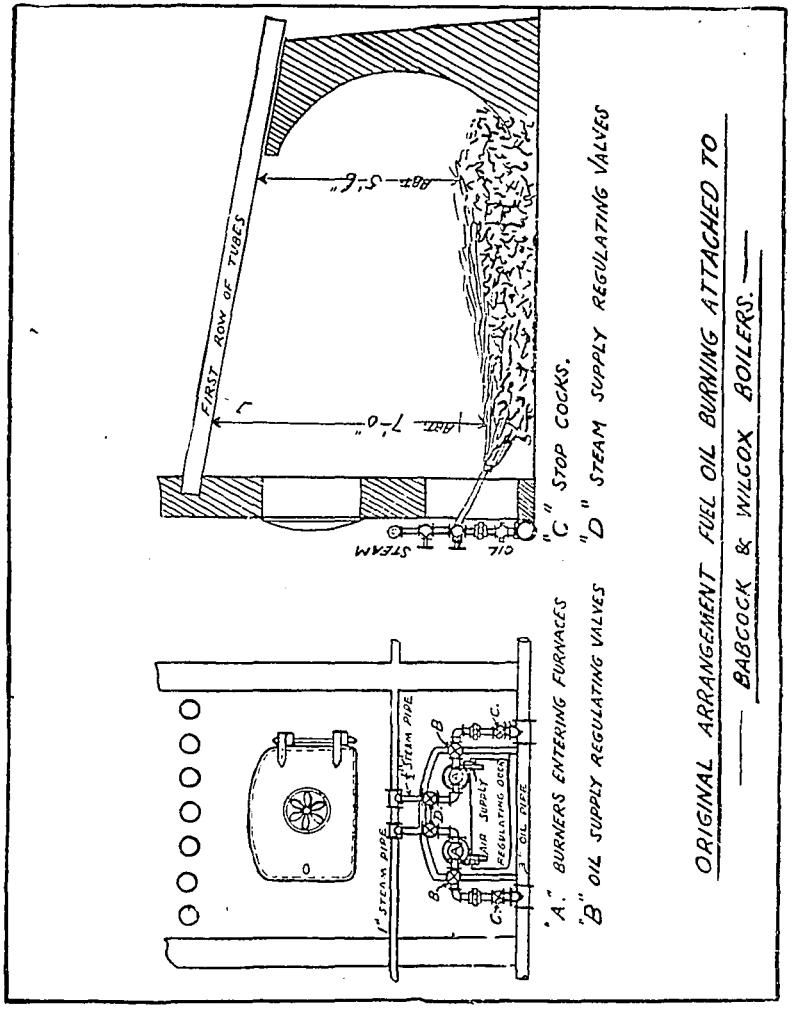
FUEL OIL was introduced to the furnaces of boilers at the three pumping plants of the Kihei Plantation Co. the latter end of 1902, since which date a very large saving has been effected by its use over that of coal, not alone in material but in labor.

The difficulties at first experienced in the handling of this new fuel, were many, principal amongst which being, the burning out of tubes, and the collapsing of fire brick walls of furnaces, the loss of time in removing tubes, and the building up of new walls, which work could not be started upon before 24-36 hours after shutting off the fuel supply, owing to the intense heat of brick work.

On changing the furnaces from coal to oil burning, originally, nothing but the grate bars and bearers were removed, and a target of loose fire bricks laid down edgeways on the ash pit floor about three feet distant from the point of burners, of which there were two of the "Palmer" type to each furnace, these entering the original coal firing doors and angled downwards in the direction of the target; after a season's run in this shape and experiencing the above-mentioned difficulties, a change was made in the furnaces and burners, and with excellent results.

The changes made consisted of putting one burner only of the McLean & Picard type to each furnace, through the same door as previously but pointing more directly to ash pit floor, which we filled in with loose brick bats to a height of 3 feet 2 inches below bottom row of tubes at front end, gradually sloping to a height of 2 feet 6 inches below tubes at back end of furnace, thus giving

the rebounding flame a better spreading effect over the lower row of tubes. To protect the masoned side walls of furnace from crumbling out under the fierce heat, we built up on each side a dry fire brick wall, keeping bottom of these walls a few inches nearer the center of furnace, and gradually battering out until the top row of bricks came in contact with the original side walls, and

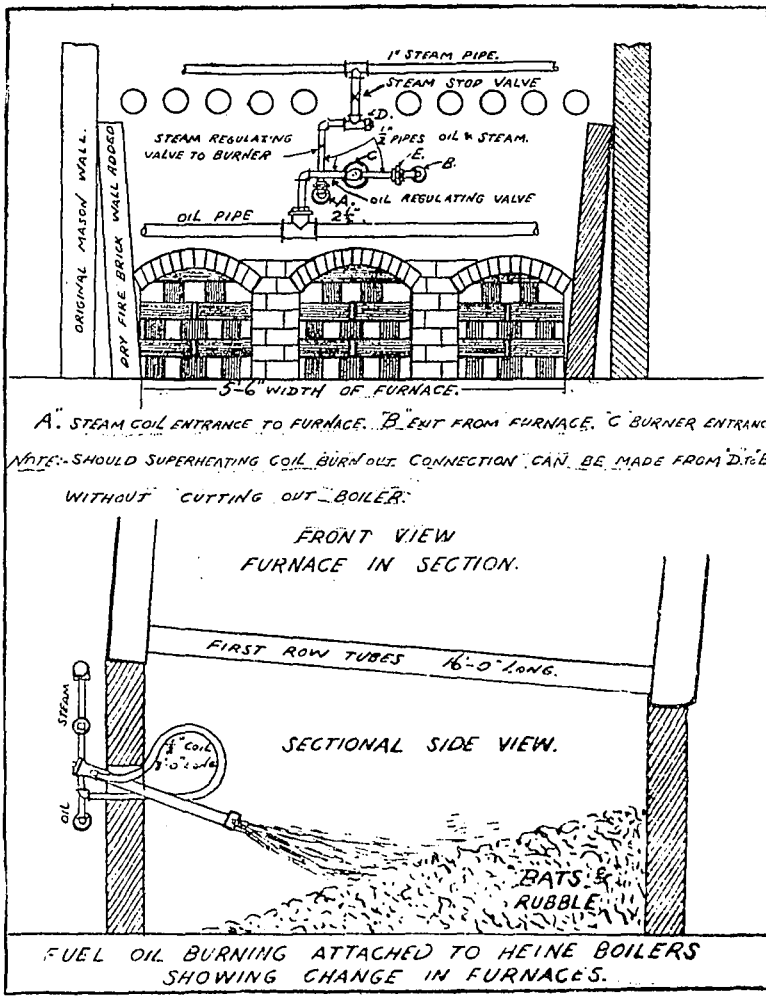


directly below the lower row of boiler tubes. The front of furnaces were also bricked up in the same way, with exception of the ash pit floors, which were left pigeon-holed for the admission of the requisite amount of air. This change made the fire room very comfortable, where previously it was so hot, that the fireman when manipulating the burners, required a protection over his face, and even the floor of the boiler room in proximity to the

furnace fronts, became hot enough to burn through ordinary shoes.

The naked hand can now be put anywhere within an inch or two of the outside of furnaces without any uncomfortable feeling of heat.

Since starting up this season early in May, and since the latter



changes were completed, there has been a continuous run without the necessity of stopping for repairs to furnaces or burners in any way, and which are apparently in as good order to-day as when started.

For comparative purposes, the following calculations are based upon the actual work done by the pumps at both stations, during

the month of July, and during which month there was no stop day or night appreciable to effect the comparison.

PUMPING STATION NO. 1.

Water delivered 225 ft. elev.: 6,001,600 gal., average per 24 hours
Water delivered 295 ft. elev.: 5,640,192 gal., average per 24 hours

Oil fuel consumed for this work avge. p. 24 hrs. 75 bbls.
@ $1.44 .....=$108.00
Coal fuel required for same in 1902=42,560 lbs. @
$9.00 p. 2,240 lbs.....= 171.00

Difference .....=$ 63.00

Or a saving in favor of oil of 36.84% or 3.94 bbls. fuel oil= 2,240 pounds coal.

PUMPING STATION NO. 3.

Water delivered 350 ft. elev.: 4,908,628 gal., average per 24 hours
Water delivered 450 ft. elev.: 8,140,186 gal., average per 24 hours

Oil fuel consumed for this work, 123 bbls. @ $1.44....=$177.12
Coal fuel required for same in 1902=78,400 lbs. @
$9.00 p. 2,240 lbs.....= 315.00

Difference .....=$137.88

Or a saving in favor of oil of 43.77% or 3.57 bbls. fuel oil= 2,240 pounds coal.

NOTE.—In comparison for efficiency with Pumping Station No. 3 let it be borne in mind that the steam from the boilers of this station has to travel a distance of 450 feet before reaching the throttle valve of engines.

The introduction of California crude oil upon these Islands for use as fuel may yet be considered in its infancy, and so far as I can learn there has been no reliable data yet published, bearing upon the properties and peculiarities of this valuable Western product, such as there has been upon the product from the Eastern crude oil fields, nor yet can we consider the value and results of Eastern crude oils, and compare them with those of California. The Eastern oil having a parafin base, while the California product is from an asphaltum base.

When California crude oil was first introduced on Kihei Plantation, a careful study of the contract between the Union Oil Co. and the consumer was made, with a view to becoming acquainted with methods of guaging for temperature, amount of sand and

KIHEI PLANTATION COMPANY, LIMITED.

UNION OIL CO.'S TANK. TESTS FOR TEMPERATURES

TEST NO. 1.

DATE.	TIME.	LOCATION OF TEST.						Original Testing Point	WIND.
		No. 1	No. 2	No. 3	No. 4	No. 5	No. 6		
1904									
Jan. 15.	2:30 P.M.	79	80	80	80	82	83	81	N.E.
" 16.	7 A. M.	77	79	80	80	80	80	80	None.
"	12 M. D.	80	80	80	80	81	82	81	N.E.
"	4 P. M.	79	79	80	80	81	82	80	N.E.
" 18.	7 A. M.	75	75	75	76	76	75	76	None.
"	12 M. D.	82	81	80	80	82	83	82	N.E.
"	4:30 P. M.	82	80	80	80	81	79	79	S.W.
" 19.	7 A. M.	76	76	76	76	77	76	76	N.E. strong.
"	1 P. M.	81	80	79	80	81	82	81	N.E. very strong.
"	5 P. M.	78	81	78	78	80	80	78	" " "
" 20.	7 A. M.	76	74	75	75	75	74	76	" " "
"	1 P. M.	82	81	81	80	81	83	81	" " "
"	5 P. M.	81	81	80	81	82	84	81	N.E. light.
" 21.	7 A. M.	72	72	73	73	74	74	74	" "
"	5 P. M.	80	81	81	80	80	80	82	" "
" 22.	7 A. M.	72	73	73	73	74	73	72	None.
"	1 P. M.	82	82	83	83	84	85	84	"
"	5 P. M.	78	79	80	81	81	82	82	N.

KIHEI PLANTATION COMPANY, LIMITED.

UNION OIL CO.'S TANK. TESTS FOR TEMPERATURE AND DISPLACEMENT.

TEST NO. 2.

DATE.	TIME.	LOCATION OF TEST.						Original Testing Point	GAUGE OF TANK.
		No. 1	No. 2	No. 3	No. 4	No. 5	No. 6		
1904									
Feb. 1.	7 A. M.	72	72	73	73	71	70	71	
"	12 M. D.	82	82	81	81	82	82	82	
"	5 P. M.	79	80	81	81	82	82	82	
" 2.	7 A. M.	74	74	74	74	74	74	74	
"	12 M. D.	84	83	82	83	84	86	84	
"	5 P. M.	79	80	81	82	82	82	82	
" 3.	7 A. M.	73	74	74	74	73	73	73	
"	12 M. D.	80	80	79	79	79	81	80	
"	5 P. M.	78	78	80	80	81	82	82	
" 4.	7 A. M.	74	74	74	74	74	74	74	19 ft. 7 3/8 in. Full
"	12 M. D.	80	80	79	79	79	80	80	19 ft. 7 3/8 in. "
"	5 P. M.	80	80	80	80	81	83	82	19 ft 7 3/8 in. "
" 5.	7 A. M.	74	74	74	74	74	74	74	19 ft. 7 3/8 in. "
"	3:30 P. M.	82	83	85	85	85	86	86	19 ft. 7 3/8 in. "
" 6.	7 A. M.	75	75	74	74	75	75	75	19 ft. 7 3/8 in. Bare
"	12 M. D.	78	78	78	78	78	79	79	19 ft. 7 3/8 in. "
"	5 P. M.	79	78	78	78	78	78	80	19 ft. 7 3/8 in. "
" 8.	7 A. M.	71	72	73	73	73	73	71	19 ft. 7 13-16 in.
"	12 M. D.	76	76	77	77	77	77	77	19 ft. 7 13-16 in.
"	5 P. M.	76	76	76	76	76	76	76	19 ft. 7 13-16 in.
" 9.	7 A. M.	74	74	74	74	74	74	74	19 ft. 7 13-16 in. Bare
"	12 M. D.	82	82	83	83	84	85	84	19 ft. 7 13-16 in. "
"	5 P. M.	78	79	79	79	80	81	81	19 ft. 7 13-16 in. "
" 12.	7 A. M.	74	74	74	74	74	74	74	19 ft. 8 1/4 in.
"	1 P. M.	78	78	78	77	77	78	78	19 ft. 8 1/4 in.
"	4 P. M.	78	78	78	78	78	79	78	19 ft. 8 1/4 in.

NOTE—The difference in Gauge of Tank between the 6th and 8th and 9th and 12th was due to rain leaking into tank through roof, and on which dates we made no tests.

UNION OIL COMPANY'S TANK.

TEST FOR TEMPERATURE AND DISPLACEMENT.

TEST NO. 3.

DATE AND TIME.	LOCATION OF TEST.						Original Testing Point	GAUGE OF TANK.	WIND
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6			
Feb. 18, 1904.									
8:30 A. M.	75	74	75	75	75	74	74 deg. F	19 ft. 8¾ in.	.....
1:30 P. M	82	83	84	81	82	81	85 deg. F	19 ft. 8¾ in.	S.W. light
4:30 P. M.	79	79	79	79	79	78	79 deg. F	19 ft. 8¾ in.	S. strong

19 ft. 8¾ in.=36124.5626 Bbls. @ 74 deg. F. | 74 deg. F | =35871.6907 bbls. @ 60°
19 ft. 8¾ in.=36124.5626 " @ 85 deg. F. | 85 deg. F | =35673.0056 " @ 60°
19 ft. 8¾ in.=36124.5626 " @ 79 deg. F. | 79 deg. F | =35781.3793 " @ 60°

CALCULATING FROM TEMPERATURES—TAKEN AT ORIGINAL TESTING POINT THE:

Difference between 8:30 A. M. and 1:30 P. M.=Plus 198.69 Bbls. @ 60 deg.
" " 1:30 P. M. and 4:30 P. M.=Minus 90.32 " @ 60 deg.

A difference of 198.69 Bbls. @ 60 deg. F. would mean a displacement in tank of approximately 1 15-16 in.

Official measurement of tank being:
First 2 inches in depth=34.9675 Bbls. per ¼ in.
Above 2 " " =38.1734 " per ¼ in.
For each degree over 60 deg. F. deduct 1-20th of 1 per cent.

water contained in the oil, also guaging for deliveries to consumer, and gravity tests. The oil being bought and paid for on a basis of 60° F. with a deduction of 1-20th of 1% for each degree over 60° F.

For storage of oil, the oil company had a tank 115 feet diameter by 30 feet deep, erected on the beach as near the landing or ships' anchorage as circumstances would permit, having a capacity of approximately 55,000 barrels of 42 U. S. gallons each, and into which oil vessels could discharge their cargoes by pipe line. This tank being measured by the official U. S. Gauger.

In order to gauge the amount of oil delivered into the tank from vessels, and the amount withdrawn for plantation tanks, a point on roof of tank was selected by the oil company agreeable to the consumer, which should thereafter be considered as the official point at which to take all gauge readings of deliveries into or out of tank. Another opening on roof of tank was selected as being satisfactory to both parties at which tests for temperature were to be made, position of which you will notice on sketch of roof plan attached herewith, and upon which I shall further write, later on.

Not long after the consumer began withdrawals from the oil company's tank, it was noticed between times of withdrawal that a certain amount of shrinkage was taking place in the body of oil stored, which caused a thorough investigation as to a probable cause of this shrinkage, as it had been claimed by the oil company, the evaporation from the oil was so little as to be almost nothing. No leak in tank, pipe line, or valves being found, a daily record of gauge reading and temperature was started with the discovery that a daily loss of about 4 barrels @ 60° F. was taking place, by evaporation or some unknown causes, from a total storage amount of approximately 35,000 barrels.

On making our findings known to the oil company we were informed that our temperature tests could not be correct, and that our thermometer was faulty. The method of taking temperatures up to this time, was by withdrawing a sample from as near half way between the surface of the oil in the tank and bottom of tank as could be gauged at the point agreed upon, then by immersing the thermometer into the sample and the temperature reading taken. In order to get at as true and correct a knowledge of the actual temperature of the oil in this tank, or as near such as possible, I had six holes cut in the roof of the tank, beginning at a point on the northeast side and continuing in a straight line to the other side of tank, following the prevalent direction of Kihei winds. On the roof plan of tank, you will note I have marked the holes beginning with No. 1 on the northeast side which will guide you in following out copies of tests for temperature and displacement which I will enclose. I also had a new thermometer ordered of the maximum-minimum type and which could be

lowered into the body of oil, thus getting a registered record of the temperature taken. Test No. 1 merely gives the temperature taken in the oil at the different openings on roof of tank, and part of test No. 2 the same, but beginning with the test of February 4th at 7 a. m., you will note the gaugé of oil in tank was also included, and it is upon this I wish to draw your particular attention.

You will note at a glance that on each date the displacement was taken, the measurement of oil in the tank was the same, while the variation in temperature was considerable, showing the apparent phoenomenon that there was no increase in expansion due to increase in temperature.

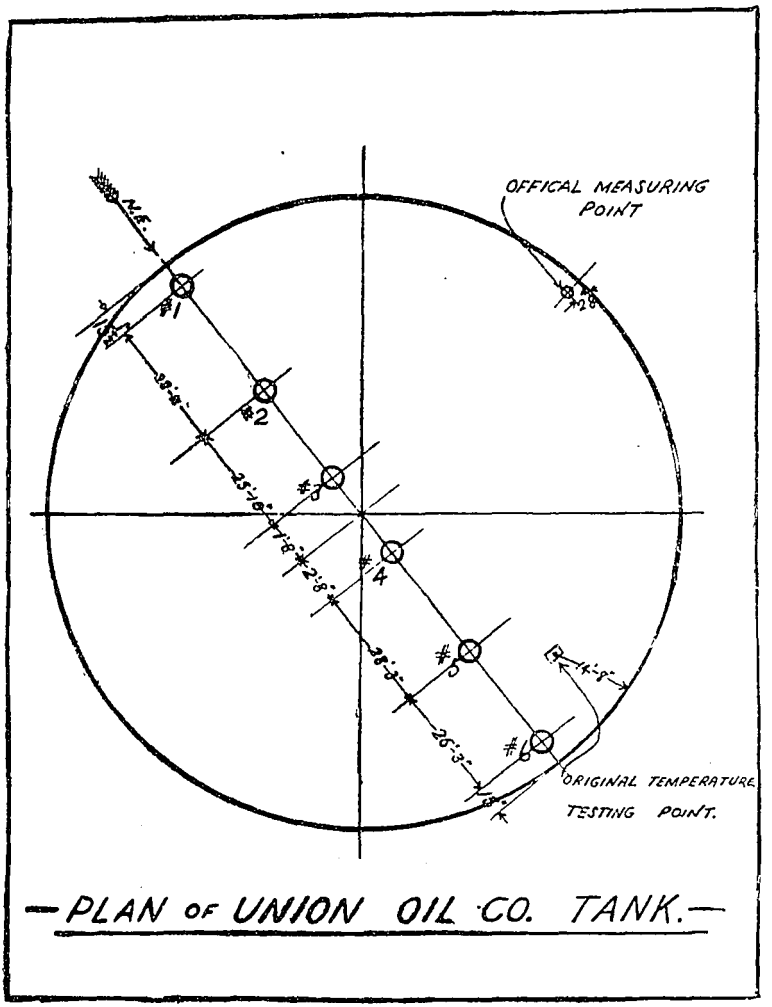
I will take for example the gauge reading of February 9th on test sheet No. 2, taken at original point at the different times during same day, thus:

7 a. m. 19 ft. 7 13-16 in. @ 74° F.=35,729.5 bbls. @ 60° F.
12 m. d. 19 ft. 7 13-16 in. @ 84° F.=35,549.6 bbls. @ 60° F.
5 p. m. 19 ft. 7 13-16 in. @ 81° F.=35,603.6 bbls. @ 60° F.

In other words there was 179.9 bbls. at 60° less oil in the tank at 12 noon than at 7 a. m., same day, and at 5 p. m. 54 bbls. more oil in tank, than at noon. The difference being due to the same measurement but different temperatures.

After many days testing, and with the same result as above, a day was set aside for an official test being made, with the Oil Company's representative present, a copy of which I enclose herewith and call test No. 3. This was made on February 18th, 1904, in company with the Oil Company's representative, our Pump Station No. 1 engineer, and myself. This test was made thorough in every respect, where there was the slightest difference of opinion in a reading for temperature or amount of oil, the test was repeated until all three were satisfied with the accuracy of such, furthermore the temperature readings were taken at as near as could be measured, half way between the surface of the oil of the tank and the bottom of same. The results of the test speak for themselves. While I am willing to admit that these tests for temperature may not represent the actual true average temperature of the oil in the tank at the different times tested, I am positive they are as near correct as can be taken with a thermometer. To get the actual true temperature of such a body of liquid stored in such a large tank, the liquid should be in motion, which of course is out of the question, in our case, but the average test taken from the six different openings in roof of tank we consider sufficient for our purposes. In the smaller plantation tanks of which there are three, one at each Pumping Station, the largest having a capacity of 5,000 barrels, we find practically the same results, as in the Oil Company's tank, so far as the same tri-daily measurement with a variable temperature is concerned.

That the temperature readings of the oil stored in this large tank during all of the tests made are correct and which cover many days, I am satisfied beyond a reasonable doubt. That the same cubic content of oil at say 74° F. can be stored in the same space as an oil of 85° F., is in my mind impossible. Wherein



—PLAN OF UNION OIL CO. TANK.—

then is the cause of the apparent phenomenon? For, unless there be absolutely no change in temperature in the oil throughout the day of 24 hours, which in the face of our findings here, seems absurd, in such case the body of oil would remain the same, less what goes off by evaporation. Can it be possible that no change in temperature takes place in the oil stored in this large tank during the 24 hours of the day, under a respective change of

average temperature such as we have here, and which I quote from record of temperatures taken in the shade throughout the year 1903, beginning with January, 16 deg. F., 17 deg. F., 16 deg. F., 17 deg. F., 20 deg. F., 18 deg. F., 18 deg. F., 18 deg. F., 17 deg. F., 15 deg. F., 15 deg. F. The expansion of this steel tank by calculation from the higher temperatures of the atmosphere as against the lower temperature of the contents of the tank, is so little that it is not worth while taking into consideration.

In showing the value and application of our findings I would again refer you to our test No. 3. Here you will find at 8:30 a. m. with the measurement and temperature reduced to barrels at 60° F. the tank contained 35,871.69 barrels and again at 1:30 p. m. to contain 35,673.00 barrels at 60° F.; again at 4:30 p. m. the tank contained 35,781.37 barrels at 60° F., or 198.68 barrels at 60° F. less oil in the tank at 1:30 p. m. than at 8:30 a. m., same date, and yet in three hours later, we find the tank contains 35,781.37 barrels at 60° F., or 90.31 barrels at 60° F. less only at 4:30 p. m than at 6 a. m. This you will agree is absurd, yet clearly shows the true result of our findings.

Now for example we wish to draw oil from the large tank at 8:30 a. m. and gauge the tank as above, and say for example we finish drawing off the oil at noon, when we again gauge the tank finding the temperature has increased from 74° F. to 85° F., the consumer would lose or have to pay for 11-20ths of 1% more than would be the case had the oil remained at the same temperature at noon, as it was 8:30 a. m., or, unless the oil had increased in body by expansion at above ratio during time of withdrawal, which according to all our past findings, it has not; on the other hand the case would be reversed were the consumer to start taking delivery at the time of day when the content of tank was hottest, and measure for displacement and temperature at time the oil in tank was coolest.

In taking up this subject in the manner I have done, I am perfectly conscious I have laid myself open for much criticism and perhaps ridicule from some of those interested in the sale of oil, but as I am in a position to give ocular demonstration of the facts herein contained, and can verify every test I have made, I sincerely trust the outcome of this paper may in some way educate or enlighten those who are in the same position as myself, on the subject of the peculiarities of this valuable commercial product.

I remain, yours very truly,

(Signed) JAMES SCOTT.

JUICE-WEIGHING MACHINERY.

The construction of a reliable machine for automatically weighing the juice on its way from the crushing rolls to the boiling house is one that has been given a great deal of thought and study in all sugar-producing countries.

A number of machines have been brought out from time to time, none of which have stood the test of continuous use. Many of these "juice weighers" have been very elaborately designed and constructed, but after a short life some weak spot is developed in the mechanism that renders the results inaccurate and consequently of no value.

In the construction of the weigher, as shown in the photograph herewith, it has been the aim of the writer to develop one that can be easily cleaned and kept in proper condition, and also one that will accurately weigh the liquor passing through same, and in addition be automatic in its action, so as not to require the services of an attendant.

The picture herewith illustrates the general appearance of our juice weigher, consisting of an iron frame carrying the weighing apparatus, and in addition supported on top of four columns is a regulating tank, fitted with a float and valve, so as to prevent any large quantity of juice that may come in excess of the actual capacity of the machine, and so prevent overflowing.

The weighing of the juice is performed by the alternate filling and emptying and consequent tipping of the weighing trough from one side to the other, this trough being divided into two compartments by a partition in the middle. Secured to each side of the tipping trough is an iron pipe into which a certain quantity of quicksilver is placed, this amount being just sufficient to balance the opposite trough when filled to its capacity. Simultaneously with the tipping, the quicksilver flows to the end of the trough which is being emptied, and, in the meantime, the opposite end of the weigher is being filled for a similar operation. There are no valves that require power to move, or that can become jammed. On the side of the frame is shown the mechanism which changes the direction of the continuous flowing liquor from one side of the trough to the other, which is of the simplest construction.

A counter in connection with the tipping trough registers the number of tips, and after the machine has been calibrated by the actual weighing of the juice, the capacity or quantity can readily be computed. Underneath the tipping trough and in connection with same are fitted air cushion cylinders which

prevent any jar to the trough in tipping. The capacity of the weigher shown is 7500 gallons per hour, this being the largest size machine that we have constructed.

Respectfully submitted,

C. HEDEMANN.

EXTRACTION OF SUGAR FROM CANE.

To the Committee on Machinery, H. S. P. A.,
C. Hedemann, Esq.

Gentlemen:—Believing that the question of the extraction of sugar from cane, involving the constant attention of engineers and adjustment of heavy machinery, is one to be taken up by your committee, I herewith beg to hand you the following study of the subject:

Extraction in relation to sugar manufacture as understood in these Islands, is that proportion of the total sugar in the cane which is obtained by milling or other methods.

It is usually expressed in percentages of the whole, thus 92% extraction means that 92 pounds of pure sugar have been obtained in the raw juice out of every 100 pounds of pure sugar present in the cane.

Obviously the correct amount of sugar in the cane must be known, as well as the correct amount extracted, if the correct percentage of extraction is required.

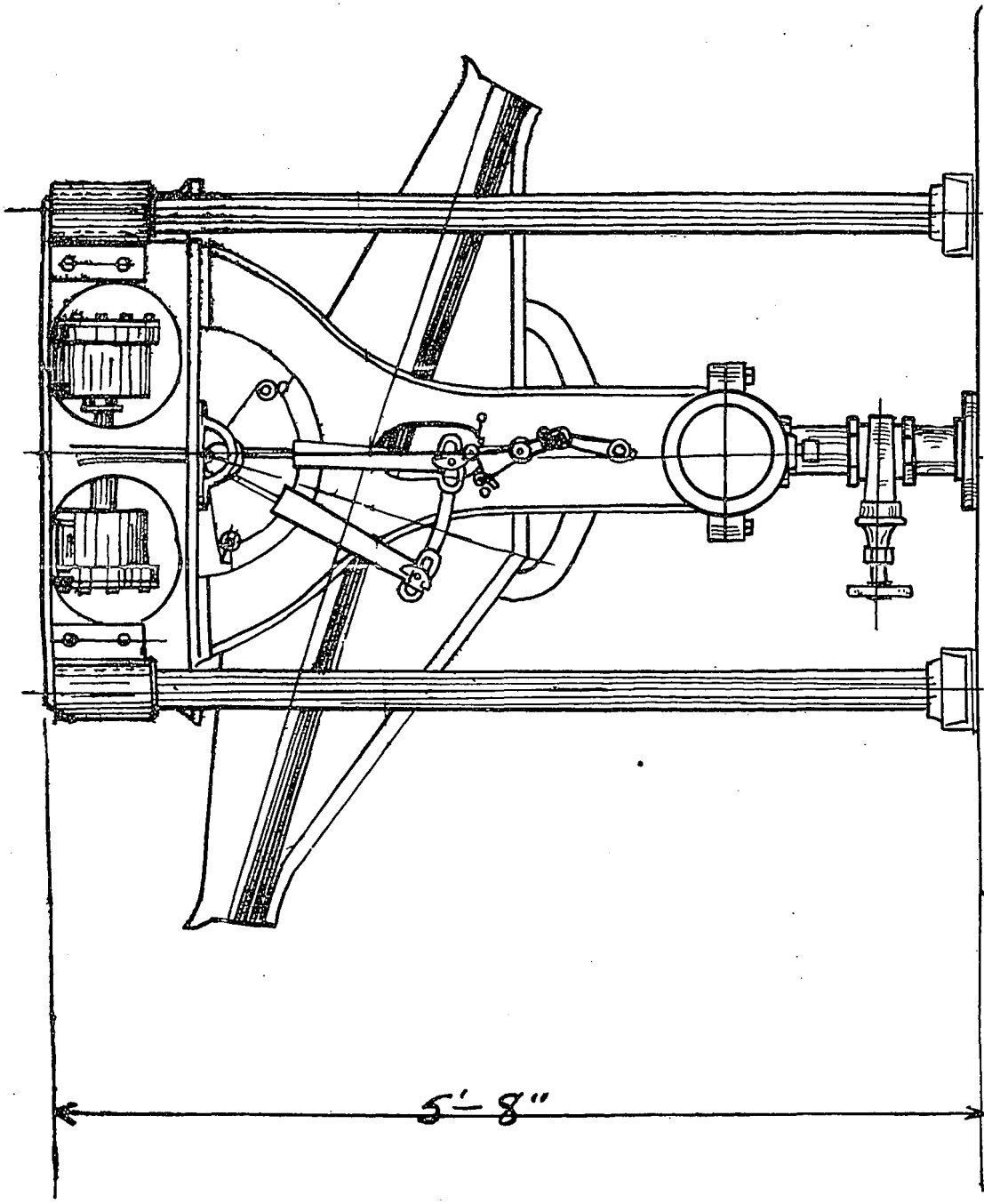
To determine the sugar in the cane accurately is one of the most difficult problems in sugar house management, and it is probable that no two sugar houses in this country adopt precisely the same method.

Without going too much into wearisome detail it can be said that there are three main methods of getting at a figure which represents the sugar in cane.

1st.—Direct determination by sampling and analyzing the cane itself.

2nd.—Measuring or weighing the extracted juice and determining the sugar therein by analysis, and calculating from analysis the amount of sugar lost in the cane refuse leaving the mills, the combined figures representing sugar in cane.

3rd.—Analyzing the cane refuse for the sugar content, calculating the amount of juice extracted, and the sugar therein from the weight of cane, and the analysis of the various juices delivered


5'-8"

by the mills; the combined figures again representing sugar in cane.

Other methods are numerous but are combinations or adaptations of the above principal systems.

Direct determination of sugar in cane is by far the most accurate method, by so carry it out properly involves considerable expense for apparatus, such as sampling mills; and the sampling of the cane would have to be done on an elaborate scale to ensure accuracy.

All other methods are open to objections, and are admittedly approximations only; some nearer to the truth than others, but still all of them lending to that uncertainty which is one of the greatest obstacles to real progress and improvement.

The true value of any method of analysis lies in the comparative figures it produces, but in order to gain comparisons worth anything the same method of analysis must be used crop after crop, as it is clear that any radical change in method will vitiate all comparative results between crops, or between portions of the same crop. The actual results produced by the various kinds of machinery employed vary within wide limits.

The richness of the cane worked up by the different factories varies greatly, and this very naturally has a marked influence on the figures representing the percentage of extraction, as it is clear that while a process may with ease extract 94% from cane containing 350 pounds of sugar per ton, that same process might be very hard pressed to get 92% out of cane containing only 250 pounds of sugar per ton.

The following table comparing the results of various processes and combinations of machinery is based not upon the percentage of sugar extracted, but upon the *pounds* of *sugar* per *unit* of *fibre* per ton of cane, *lost* in the refuse, because it is evident that fibre in cane by reason of capillary attraction must exert some influence in holding back sugar; that this is true is well known, although it is doubtful if it has ever been expressed in exact terms.

The figures are taken from various reports, some published and some obtained from private sources.

Process.	Cane worked up per 24 hrs.	Lbs. sugar lost in bagasse p. ton cane	Lbs. fibre in cane p. ton cane	Lbs. sugar lost p. lbs. fibre
Diffusion	700- 750 tons	9.8	226	.0433
12-roller mill, crusher, and 20% maceration	1150-1350 "	14.2	227.6	.0619
9-R. M., crusher, and 30 - 40% maceration	750- 900 "	12.7	229.4	.0549
9-R. M., crusher, and 15 - 25% maceration	1100-1200 "	20.9	230.4	.0907

From this it will be seen that diffusion comes first, 9-roller mills with slow crushing and heavy maceration second, 12-roller mills with fast crushing and moderate maceration a close third, and ordinary work with a 9-roller mill away behind in the race for efficiency. Were this all there is to be known, the questions could be settled on the above figures, as there can be no argument in favor of machinery that losses 20.9 pounds of sugar per ton of cane, when precisely the same machinery operated in a different manner loses only 12.7 pounds of sugar per ton of cane; but unfortunately this is not the case as the following table shows such discrepancies in final results that further investigation is clearly necessary.

Comparison of average results in marketable sugar obtained by seven 9-roller mills and crushers during crop 1903:

	1	2	3	4	5	6	7
Fibre in cane, %	11.44	11.50	11.38	11.63	12.17	10.93	11.60
Pol. 1st mill juice %	17.69	16.89	16.70	17.38	17.68	16.42	18.06
Sugar in cane, %	15.05	14.17	13.61	14.93	15.49	14.03	15.32
Apparent dilution %	36.64	36.81	20.38	12.80	14.40	12.05	23.35
Extraction of sugar, %	95.62	95.65	93.61	92.89	92.79	91.92	93.08
Sugar in bagasse, %	2.95	2.54	3.71	4.64	4.42	4.91	4.44
Total losses, %	11.97	11.36	12.47	13.52	13.60	14.91	12.34
Tons cane p. ton sugar	7.37	7.76	8.14	7.48	7.27	8.10	7.14

The results above tabulated do not include the figure from diffusion works nor yet those resulting from the use of a 12-roller mill.

An inspection of the figures will show that No. 1 with an extraction of sugar 95.62% and a total loss in manufacture of 11.97% requires 7.37 tons of cane to produce one ton of marketable sugar; No. 5 with 92.79% extraction and a total loss in manufacture of 13.6% actually requires only 7.27 tons of cane to produce the same amount; while an examination of the quality of the cane as shown by the polarization of the first mill juice and the fibre shows that of the two No. 5 had the poorer cane; although the reported sugar in cane was for No. 1 15.05% and for No. 5 15.49%. Compare No. 7 and No. 5; No. 7 had a richer first mill juice and less fibre, and yet the reported sugar in the cane is less than in No. 5, being 15.32% for the one and 15.49% for the other. The same discrepancies exist between No. 3 and No. 6. No. 3 with a richer first mill juice and con-

siderably less loss in manufacture than No. 6 requires 8.14 tons of cane to produce 1 ton of marketable sugar, while No. 6 requires 8.1 tons of cane to do the same work, and so on.

Thess discrepancies can only arise from one of two things, either (a) the polarization of the first mill juice is no criterion whatever of the quality of the cane as regards sugar content, and therefore should not be used in any calculations; or (b) the methods adopted by the various mills for determining these losses produce results that differ materially.

If the quality of the juice in the cane, as shown by the polarization of first mill juice, is subject to wide variations, as may be the case, it is of the greatest importance that it should be generally known, together with the conditions, (whether soil, climate, season or fertilization), that govern such variations; but if the differences above shown are due in whole or in part to mere methods of calculation the remedy is obvious, meanwhile considerable uncertainty exists as to the direction in which improvements in extraction are possible.

(Signed) J. N. S. WILLIAMS.

Puunene Mill, Sept. 15, 1904.

PROGRESS IN MILLING.

During the past ten years there has been great progress made in milling or crushing of cane in our sugar houses, due principally to the introduction of powerful 9-roller mills with hydraulic pressure regulators in conjunction with shredders or crushers of different types for preliminary preparation of cane for the mills.

The process of maceration has also been greatly improved with the aim of reducing to a minimum the amount of water for maceration and, consequently, a saving of steam or fuel in the process of evaporating or concentrating the juice.

With the object, therefore, of comparing the results of the past three years, including the season of 1904, the writer, through the courtesy of the managers of the different plantations, was enabled to get such reports as would bear on this subject, and has had the enclosed table constructed, showing the advancement made in the years mentioned.

Columns 1 and 2 show the result in extraction from mills of small size, and, consequently, light construction.

Column 5 also shows similar results for the years 1902 and 1903, in which the milling plant consisted of a crusher with one 3-roller and two 2-roller mills, while 1904 shows the results from a powerful 34x72 9-roller mill and crusher.

In column 5 the fibre contents of the cane in 1902 and 1903 is shown to be 10½% and 11% respectively; and in 1904 the

fibre contents were 12.6%. The extraction in 1904 was over 94% of the total sucrose in the cane, with a dilution of 20.4%, while in 1903 the extraction was 92%, with 29.7% dilution, and in 1902, 89.8% extraction with 10.8% dilution; again the moisture in the bagasse with the 9-roller mill was 42.7% while with the 7-roller mill it was 47.7%.

I have incidentally called attention to this particular case showing the results that are obtained with the powerful mills in comparison with the type of mill which were our standard ten years ago.

The last column under the heading of average shows the average results for each season of the three years work, extraction being increased from 92% to 93.7%, the extraction on the weight of the cane being increased from 80% in 1902 to nearly 82% in 1904, while the sucrose in the bagasse has been reduced from 1.11% in 1902 to an average of .88 of 1% in 1904.

The above results show the excellence of the work now being done in our crushing plants, and the close attention that is being paid to this branch of our milling work, and reflects great credit on the engineers in charge for the uniform improvement that is being made in this direction.

It is well known at the present time that our mills are being strained to the utmost in every direction. Ample proof of this is shown in the straining of returner bars, King bolts, etc. It is also now necessary in our large milling plants to provide the main mill bearings with water jackets, so that a continuous circulation of cooling water can be applied, so as to insure cool running.

There are many other features of this table that will be found of interest to the sugar planters, showing that we are not lagging in this important part of our industry.

Respectfully submitted,

C. HEDEMANN.

CENTRAL CONDENSATION IN SUGAR HOUSES.

Sept. 28, 1904.

Mr. C. Hedemann, Chairman Committee on Machinery, Hawaiian Sugar Planters' Association, Honolulu, T. H.

Dear Sir:—Replying to your communication requesting that I prepare a paper on central condensation in sugar houses, to be presented at the next annual meeting of the

Sugar Planters' Association, this paper to contain such data as will be of interest to the sugar planters here.

In response, I beg to say that while such a central condensation plant is now in course of erection at the Kekaha Sugar Company's factory in Hawaii, it will not be completed in sufficient time to present any data covering the results. However, I am pleased to hand you the following remarks on central condensation which may be of interest.

CENTRAL CONDENSATION—The system of central condensation has been adopted for many years in nearly all of the large beet-sugar factories of Europe, either with a central condenser and vacuum pumps or with an independent condenser at the different pans and evaporators and a central vacuum pump or system of pumps, depending on the size of the factory. As is well known in all beet sugar factories, coal or other fuel is used for the generation of steam and power, being a large item in the operating expense account, which, of course, is quite contrary to the conditions which exist in cane-sugar countries, where the bagasse in most cases, as in Hawaii, supply all the fuel necessary for the operation of the factory; and, as a consequence, the beet sugar factories are straining every effort to gain the highest results with the limited amount of fuel. For this reason the condensation system in the beet factory has been brought to the highest point of efficiency, while the same cannot be said of the cane sugar house. The conditions existing at Kekaha at the present time are such as obtains in most all of our sugar houses in which a vacuum of not exceeding 24 inches or 25 inches is the average for the evaporator and a maximum of 26 inches and perhaps 27 inches for the vacuum pans. In addition each vacuum pan or evaporator has its own direct-acting vacuum pump, of which there are half a dozen in the Kekaha Boiling House. These, as is well known, are most wasteful in the use of steam, as well as being inefficient in regard to the vacuum obtained in comparison with the modern vacuum apparatus in use abroad.

Another desideratum in the modern beet factory is to reduce the number of independent steam cylinders to a minimum. As a consequence, for example, we will find the pumping arrangement of quadruple effect will consist of one steam cylinder operating four, six, or more, pump cylinders for removing water of condensation, or circulating liquor in connection with the apparatus, while in our sugar houses a multitude of independent steam pumps of all sizes and capacities, with steam supply and exhaust pipe lines running through the house, all of which are wasteful of steam as well as being expensive and troublesome in the up-keep.

In some of the more modern factories in Europe steam cylinders are eliminated and electric motors are used wher-

ever possible, thus dispensing with small steam pumps and engines, as well as objectionable pipe lines, and the whole operated by a central electric plant. An example of this can be seen in the Salinas Beet Sugar Factory, where the boiler feed pumps even are operated electrically.

The aim at Kekaha is to eliminate all small independent pumps for whatever purpose, and to install a central condenser to which are connected all the pans and evaporators in the house with a specially designed vapor gate to each pan, which is water-sealed, so as to be absolutely tight. This will permit the several pans being cut out or put in communication with the condensation apparatus at will.

There will be one dry vacuum pump of special design having ample capacity for the whole system so that a vacuum of not less than 28 inches can b e carried in the central condenser continuously. This air pump is driven direct from the tail-rod of an automatic cut-off fly-wheel, the engine at the speed of 75-100 revolutions per minute, as may be desired. As there is no water used in the interior of the pump for sealing or filling up the dead space, as in the ordinary vacuum pump, the speed at which this may be operated can be anything within reason that may be desired without affecting the efficiency. The main suction and discharge valve, which is embodied in one valve only on the air cylinder, is mechanically operated and similar to the slide or Corliss valves of ordinary engines, no fibre or rubber valves being used in the construction of same, the pistons being fitted with cast iron packing rings; and, as a consequence, this pump can be operated continuously without the renewals and constant attention required in the present air pumps, everything being metallic.

RESULTS TO BE OBTAINED—The next important point is the results we expect to obtain.

FIRST—With a vacuum of not less than 28 inches in the factory with this system we expect to do all the evaporation in the houses with 75% of the steam now used.

SECOND—With our new reconstructed vacuum pan we expect to do all the boiling with exhaust steam, using no live steam in any instance.

THIRD—With the surplus fuel it is the intention of the Kekaha Sugar Co. to establish a central electric power station in conjunction with the factory's boiling house so that all of the irrigation pumps on the estate can be driven electrically from this station, the electric generator engines to be operated either high-pressure or condensing as may be desired, thus making it possible to utilize the exhaust steam from this machinery in the sugar house for evaporating purposes if desired.

This plan is especially feasible at Kekaha, for the reason that the grinding continues practically throughout the year.

Respectfully, MAX LORENZ,

Consulting Engineer H. Hackfeld & Co.

———:o:———

REPORT OF COMMITTEE ON UTILIZATION OF BY-PRODUCTS.

E. D. TENNEY, ESQ., *President Hawaiian Sugar Planters' Association, Honolulu, Oahu.*

Dear Sir:—Your Committee on the "Utilization of By-Products" herewith hands you their report. You will remember that last year's committee made a very full report so that we have little more to do than to go over the same ground.

We consider the by-products upon a plantation to include, Waste Molasses, Stable Manure, Bagasse, Press Cake, Ashes, Cane Tops, etc., left in the fields after harvesting, and will consider each in order in this report.

WASTE MOLASSES. This "by-product" while still a "waste product" upon some plantations is rapidly becoming a valuable commodity, and the main point to be considered is "are we getting the best results from it considered from a financial standpoint." Some plantations are feeding it to their working stock at the rate of from 3 to 15 pounds per day, others are burning it in their furnaces mixed with the bagasse, or by means of the "Anderson" or other atomizing burner and in some instances it is being applied directly to the soil as a fertilizer.

As a FEED FOR MULES OR STOCK there is no longer any question about its being a valuable and harmless feed. There is already considerable literature from different reliable sources within the United States and foreign countries proving that it is a valuable food and without bad effects when fed properly. Feeding properly means to protect the molasses from an excess of water diluting it to a point where fermentation might develop were the mixture allowed to stand some time during hot weather. One of the most recent articles upon molasses as a food for animals is the one which appeared in the "Louisiana Planter," April 19th, 1904, entitled "Results of Scientific Feeding of Plantation Mules" by Walter Godchaux. Those who are still doubtful of the value or safety in feeding molasses to their live stock should read this article.

Assuming that a ten thousand ton plantation requires 150 head of mules or horses, and that each mule will eat a gallon of

molasses a day, then during the year 54,750 gallons of waste molasses will be used as feed.

Ordinarily not less than 25 U. S. gallons of molasses are produced for each ton of sugar made in a well equipped factory, or 250,000 gallons per year from a 10,000 ton factory; of this hardly a fourth would be consumed as feed by the working stock. If it is not practicable to feed all of the molasses, (and it is most valuable as a feed as we will show later on), the next best scheme is to burn it in the furnaces, and we believe the best results are obtained when the molasses is finely atomized and combustion takes place before the potash in the molasses can combine with the silica in the trash and form a mass of clinker and glass that will clog the grate bars.

Results at Ewa, McBryde, Maui Agricultural, and the Makee Sugar Co.'s plantations prove that molasses has a fuel value relative to coal in the ratio of about one to four; 250,000 gallons of molasses will weigh about 1625 tons and its fuel value would be equal to, say, 406 tons of coal, worth say $4,000.00; after burning the molasses the valuable by-product potash is left. Authorities claim that 35% of average waste molasses ash is potash; 1625 tons of molasses will yield 9% of its weight in ash or, say, 146 tons of ash, and 35% of this is potash in carbonate form; 51 tons of potash is worth about $100.00 a ton, or say $5,000.00.

From the foregoing we find that the waste molasses from a ten thousand ton plantation when burned in the furnaces is worth as fuel and fertilizer about $9,000.00. Are we getting this from it?

We will now consider the value of waste molasses as a food for stock. On the Makee Sugar Co.'s plantation for the last 20 years molasses has been fed to mules at the rate of 3 to 5 pounds per head per day. Tanks of molasses have been kept in the paddocks where not only the working oxen could drink it at will, but also fine racing stock. When the molasses was fed to milking cows it was found that the milk from them tasted of molasses which, while being bad for household use, might be advantageous for young sucking calves whose mothers were feeding on poor pastures.

Since the first of this year they have fed their working stock at the rate of from ten to fifteen pounds of molasses per day and have reduced the amount of grain from 16 and 18 pounds to 6 and 8 pounds.

For years they had fed the following ration:

5 pounds bran	at say .01⅘ cents a pound...=	.09 cents
12 pounds barley	at say .01½ cents a pound...=	.16 cents
3 pounds molasses		
35 to 50 pounds of chopped cane tops.		
Cost of grain per day.....		.25 cents

Since the first of the year they have fed the following ration:

6 to 8 pounds barley at .01½ cents pound.....= .12 cents
35 to 50 pounds of cane tops mixed with 10 to 15 pounds of molasses

Cost of grain ..... .12 cents

From the foregoing figures it is evident that a gallon of molasses is worth at least ten cents when used as a feed for stock, and as the manure from the animals is properly preserved, cured and applied to the soil there is an additional value as all of the potash contained in the molasses is recovered in the manure.

Assuming that a ten thousand ton plantation making 250,000 gallons of molasses per year could feed all of that molasses to the stock and utilize the manure on their field then the value would be as follows:

250,000 gallons at .10 =.....$25,000
51 tons of potash recovered in the manure..... 5,000

$30,000

Bran is not necessary as a food for working animals when molasses is fed at the rate of from 10 to 15 gallons per day, but an occasional "bran mash" when required is very good for the animals.

In changing from a strict grain to a molasses diet, where animals have never been accustomed to molasses, it is best to withdraw the grain gradually and substitute the molasses. It is also best to give as much "dry matter" such as grass, cane tops, etc., as the animal will eat and mix the molasses thoroughly with it.

Keeping the animal's hair short is another advantage both in hot and cold weather. A long coat of hair holds rain and perspiration to the detriment of the health and spirit of a working animal.

Mr. C. C. Kennedy on Hawaii reports on molasses as a food as follows, which corroborates the above results of the Makee Sugar Co.

The figures given below are for the month of July, 1903, when no molasses was used, and for the month of July, 1904, when molasses had become a regular part of the ration:

One gallon molasses assumed to weigh 13 pounds.

AVERAGE DAILY RATION PER ANIMAL.

	July, 1903. (No molasses)	Value at wharf.	July, 1904. (Using mola'es)	Value at wharf.
Lbs. hay	14.	.18	5.75	.075
Lbs. bran	8.5	.106	4.	.5
Lbs. barley.....	8.5	.11	5.5	.07
Lbs. molasses.....	nil	....	11.83	nil
	31	.40	27.08	.20

Saving in landed cost, 20c.

Saving in hauling weight, 4 lbs.

It can readily be seen that in landed cost this means a saving throughout the year of $7,300 for 100 mules.

The mules at Waiakea have now been on this regular ration of molasses for some time, and are in as good condition as before.

At Laupahoehoe, where the lands are steeper, it is found necessary to increase the ration of barley to keep the mules in condition for heavy plowing, etc.

The following is an extract from Farmers Bulletin No. 170, U. S. Department of Agriculture, Principles of Horse Feeding by C. W. Langworthy, Ph. D., May, 1903: "Molasses, which consists almost entirely of carbohydrates (sugars), was used as early as 1830 as a feed for horses, and has recently attracted considerable attention in this connection. When used for this purpose it is usually sprinkled on dry feed, being first diluted with water, or it is mixed with some material which absorbs it and renders it easy to handle, such as peat dust, or with some material rich in nitrogen, as dried blood. In the latter case the mixture more nearly represents a concentrated feed than the molasses alone, or molasses mixed with an absorbent material. Cane-sugar molasses is also used as a feeding stuff. It differs from beet molasses, in that it contains glucose in addition to cane sugar, and has a much smaller percentage of salts.

The number of experiments which have been reported in the last few years on the feeding value of molasses is fairly large. According to the Louisiana Station, cane-sugar molasses has been extensively used for some time locally as a feed for horses and mules, many feeders keeping mules exclusively on rice bran and molasses in addition to cowpea hay. The general custom is to feed the molasses from a large trough allowing the mules to eat it ad libitum. It is said they will consume, with apparent relish, from 8 to 12 pounds per head daily. The mules at the Louisiana Station have been fed molasses daily ad libitum for eight or ten years, and it is stated, show its good effects "in their splendid condition, lively action, and endurance of work."

When molasses, diluted with water and sprinkled over chopped hay, was fed to some army horses in Porto Rico for about five months the condition of the horses improved. Apparently, a daily ration of 35 pounds of grass and 13 to 15 pounds of molasses per 1,000 pounds live weight was sufficient to maintain a horse in good condition. It was noted that molasses possessed some disadvantages, namely, it attracted insects, notably flies and ants, stuck to the animals coat smearing his face and breast, halter strap, etc,, and caused some trouble and delay in mixing it with the other feeds.

Other tests in the United States, France, Holland, and elsewhere have been favorable to the use of molasses as a feeding stuff, and from the results of all these, it seems fair to conclude

that it can be safely fed to horses when its cost in comparison with other feeding stuffs warrants its use, a quart night and morning, diluted with water, being apparently a reasonable amount. Apart from the nutritive material molasses supplies it has a value as an appetizer and frequently renders poor hay or other feed more palatable."

Another use for waste molasses is the making of rum or alcohol, but as this subject was very thoroughly gone into by Mr. Williams last year, we do not deem it necessary to give it further attention in this report.

The making of "molasses briquettes" has been an idea of your committee but we are not in possession at this time of sufficient data and information to make a satisfactory report.

Upon most plantations the conservation of the forests means lack of "camp fuel" which is becoming a serious and expensive matter. Many places are obliged to supply their laborers with coal. It stands to reason that the laborers cannot burn the coal as economically as can the plantation in their specially constructed furnaces. If it were possible to make from bagasse and molasses a small readily portable and friable briquette there might be a substantial reduction in the "Camp Fuel Expense." The addition of a small amount of pitch, tar and coal dust might make a cheap and efficient fuel for use in the camps.

The application of waste molasses directly to the soil is certainly not economic, its real value is due to the presence of potash and this can be obtained just as well after the molasses has either given up its heat as a fuel, or its nutriment as a food for stock.

STABLE MANURE.—On many plantations not enough attention and care are directed to the proper preservation and curing of stable manure and its application to soils sorely in need of organic matter or humus.

Any text book on Scientific Agriculture gives full instruction as to the preservation and treatment of stable manure, etc., and also its financial value.

Farmers' Bulletin No. 21, U. S. Department Agriculture, on "Barnyard Manure" is well worth reading as it contains directions for preserving manure. Upon the shallow over-cropped soils of these Islands no chemical fertilizer is able to produce the results obtainable from the application of properly cured compost of stable manure, etc. We believe this "waste product" is less appreciated than any other. Rich virgin soils can be worked for some time and made to respond handsomely to chemical fertilizers, but a day comes when the organic matter has become so exhausted that no chemical fertilizer can produce the results of earlier years simply because the humus or organic matter is not there to aid the chemical fertilizer to accomplish the expected results.

As a matter of fact in some soils the chemical fertilizer is practically inert or lost owing to the poor physical condition of

the soil on account of the lack of humus or organic matter, which has been burnt and cropped out.

Not a pound of humus-making material should be allowed to go to waste upon a plantation and yet but few of us are doing all that we should, either because we rely too much upon the easily bought chemical fertilizer, or from lack of labor, postpone the day when we will commence to conserve scientifically the valuable by-products that are about a plantation which should go into the compost heap.

Plantations which have been cropping their lands for years and have shallow side hill soils, etc., to contend with find that a good compost will give results that will show for months where the best chemical fertilizer will do but little more than turn the leaves a good color. There is nothing left in these soils to hold a chemical fertilizer, or furnish a medium for its proper action.

We all know the value of humus, its ability to retain a higher temperature in the soil and its importance as furnishing a medium for the action of high grade chemical fertilizer, but we have not been forced by economy to conserve and make it upon the plantation at a much less cost per ton than we pay for the high grade fertilizer which often disappoints us in soils not suitable for its application.

BAGASSE.—The very best use for this product up to the present time has been and is the burning of same in the furnaces where it generates the power to extract and make the sugar.

The ashes should be kept under cover until applied to the field on account of the value of the potash contained therein.

Any excess of bagasse should be applied to the old fields where in time it will supply organic matter to the soil, improving its physical condition.

MUD PRESS CAKE.—Every plantation seems to be alive to the benefits of this by-product as a fertilizer. There are different ways of applying it to the land many of which were originated for the purpose of economic handling rather than with a view to obtaining the best results as a fertilizer. The sooner the press cake is applied to and mixed with the soil the better, as then the nitrogen contained is not lost; if this cannot be done then enough super phosphate should be applied the same as with manure to fix the nitrogen.

The personal observation of one of your committee is to the effect that where the press cake is applied to fallow fields and plowed in at the rate of from 2 to 4 tons per acre the growth of cane is much better both in color and size of stalk. Upon a small piece of land that was used as a dumping station for the subsequent distribution of the press cake for one season only and amounting to about one acre, when plowed and planted had cane at four months further advanced than cane on land not so treated had at six months, and at the present time the difference in growth and color is as marked as is the cane upon virgin and

over-cropped land. The presence of the lime and organic matter is mainly responsible for this result.

The last waste products to be considered are the cane tops, dry leaves, etc., left behind the harvesting gangs. The green cane tops are fed to the stock and supply the proper amount of bulk, for a well balanced ration, especially where molasses is fed, but the dry leaves and dead cane must be burned off for fear of injurious insects which we find always increase when we fail to burn off the fields after each crop is harvested, and this is one reason, as we all know, that we are short of humus which fact should compel us to make a better attempt to conserve all stable manure, etc., to make up in part for this loss.

Where the cane borer is not bad, such as upon dry plantations, they are obliged to burn off the trash as it will not rot, no machine seems to be able to cut it up fine enough to be turned under by a plow, where it can become humus.

Upon wet plantations where it will rot, failure to burn the trash seems to be followed by a large crop of the borers which do so much damage on moist, cool plantations.

Some plantations bale the dry leaves and use them for fuel to their financial advantage when the trash is in abundance.

If the foregoing report has succeeded in doing nothing more than convince the members of this Association of the value of molasses as a food for stock, or as a fuel for the furnaces, we will feel that it has been worth submitting. We claim to have produced nothing new or original, but have brought home to the Islands the proofs of the value of this product as a food and fuel by carefully conducted experiments upon our own livestock and in our own furnaces.

If the feeding of molasses will result in a saving of $3.00 per head per month for the 7,000 mules employed upon Hawaiian plantations we can see a gain of $200,000.00 a year.

The proper preservation and application to our soils of the manure from these animals should be worth in fertilizer value every year, (not counting the potash fed with the molasses and recovered in the manure), $10.00 per head, or $70,000.00 for 7,000 head of working stock.

The value of the 65,000 tons of waste molasses produced each year is worth for potash alone over $160,000.00, and its fuel value in addition is worth $150,000.00.

If we could sell it all to live stock ranches, etc., at only five cents a gallon (its value in Louisiana as a food for stock), it would be worth $500,000.00 as food, and its potash saved in the manure or compost heap another $160,000.00.

Are we, as planters, getting the full financial returns from

such a valuable "by-product," or is it, as with some, a "waste product?"

Respectfully submitted

GEO. H. FAIRCHILD.
Chairman.
T. CLIVE DAVIES,
J. N. S. WILLIAMS,
H. DEACON,
W. G. WALKER,
JAMES GIBBS,

———:o:———

Honolulu, Hawaii, Aug. 23, 1904.

Mr. J. T. Moir, Mgr. Onomea Sugar Co.,

Papaikou, Hawaii.

Dear Sir:—Samples of so-called "molasscuite" brought from you by Mr. Van Dine, gave on analysis, according to the scheme usually adopted for the analysis of fodders, the following figures:

	Dried.	Not Dried.
Moisture	15.66	26.00
Ash	7.66	7.02
Fat	0.16	0.06
Crude fibre	10.86	7.06
Protein	4.55	4.20
Nitrogen-free extract	61.11	55.66

The item nitrogen-free extract, includes all carbohydrates, that is, sucrose, glucose, gums, and digestible fibre; and these, with the protein and fat, determine the food value.

In this fodder the fat and protein are low, and if fed to

Galley Three—Planter Nov 04.. .. .. ..mhgFhe,tETAOIN

work animals, grain should be supplied to make up the deficiency in protein. In other words, it is not a balanced ration.

The material made from dried trash is more concentrated, but apart from this there is nothing to indicate any advantage in drying the trash. Previous drying may facilitate the handling of the finished material, or improve its keeping qualities, but I am not in a position to judge.

The sample of dried trash sent with other samples, con-

tained 7% moisture, but as it was in a loose cotton bag, it probably had absorbed moisture.

I would be very glad to get any figures or results relative to the feeding of this molascuite to plantation stock, and am at your service for further work along this line if you wish it.

Yours truly,

EDMUND C. SHOREY,
Chemist Hawaii Experiment Station.

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REPORPT OF COMMITTEE ON FORESTRY.

To the President and Members of
Hawaiian Sugar Planters' Association.

Gentlemen:—Since the last annual meeting of this Association the development in connection with forestry has not been as great as was then expected; but still, substantial progress has been made.

Early in the year Mr. Ralph S. Hosmer, a member of the staff of the U. S. Bureau of Forestry, was, on the recommendation of Mr. Gifford Pinchot, Chief of the Federal Forestry Bureau, appointed Superintendent of Forestry of Hawaii.

Mr. Hosmer has visited all of the Islands, studied their general characteristics, made studies of the needs of specific localities and of the conflicting claims and interests involved in connection with a number of proposed forest reserves. He has had the advantage of accompanying the Governor upon his recent trips to the several Islands, thereby achieving the double advantage of meeting most of the leading people of each Island and District, and of personally familiarizing both himself and the Governor with the character of the forestry problems to be solved.

Additional detail studies and plans for forestry reserves have been made in connection with the Districts of Hilo and North Hilo, North and South Kona and Kohala and Hamakua, Hawaii; the Districts of Makawao, Hamakua and Koolau on Maui, Ewa, Waianae and Koolauloa, on Oahu, and Hanalei and Kilauea, on Kauai.

Litigation between large land owners in Hamakua and South Kohala, has prevented the establishment of the reserve at as early a date as had been hoped for, but substan-

tial progress has been made in preparing maps and plans, with a view to securing exchanges between the Government and private land owners, and the dedication of private forest reserves, which should show good results during the coming year.

Surveys and maps of the proposed North Hilo and Hilo Reserve are nearly completed, and definite action thereon should be secured by January 1st next, or thereabouts.

The same conditions prevail on Maui, where it is hoped that before this meeting assembles, maps and plans will have been completed for a reserve in the great belt of forest extending from Makawao to Hana on the north side of the island.

The great block of Government land between Kohala and Hamakua, Hawaii, has been recommended as a reserve, and the statutory proceedings to secure that result are now being carried on. This land furnishes the chief water supply for the proposed water ditches into both Hamakua and Kohala, and it is most important that it be preserved for forest purposes.

On Oahu proceedings are under way to set apart certain Government land as a reserve in Koolauloa, and it is hoped that they will be completed within the next few days.

Preliminary plans, maps and studies have been made for reserves on both sides of the Ewa basin, and these will be pushed early next year, as with the great artesian drain on this section, and the large area irrigated thereby, it is one of the most important points to be protected in the Territory.

On Kauai maps are about completed for the Hanalei reserve, and other districts will be taken up at an early date.

There is apparent unnecessary delay in bringing the various reserve propositions to a head, but there have been many reasons for it. In the first place, it was felt to be a sound procedure for Mr. Hosmer to first visit all of the Islands and familiarize himself with the various problems presented, so that homogeneous recommendations could be made instead of action being taken at haphazard. This has naturally taken much time.

Again, it is necessary to provide surveys and maps of proposed reserves as carefully as though they were to be sold. It can readily be understood that this takes a great deal of time, as most of the work is connected with mountain and jungle country, and surveyors are not always available when wanted.

Another feature which takes time, is the negotiation with owners of private lands located within the proposed reserves. In this connection I would say that the policy of the Board of Agriculture and Forestry is to try and arrange for exchange of Government land of equal value for private land taken for

forest reserves, when the private land owner receives no direct benefit from the reserve; but when the reserve forms a water shed which directly benefits the land owner, the endeavor has been made to secure dedication of the land for forest purposes, upon conditions fair to both the owner and the Government.

This policy has met with a gratifying response from land owners, and large areas of private lands will, it is believed, soon be added to the forest reserve at nominal cost to the Government.

It is believed that the preliminary work of the past year will show good results during the next few months, and that during the coming year a great advance will be made in creating permanent forest reserves, both on public and private lands. This, of course, will depend largely upon legislative assistance, and much of the public sentiment in support of the forest reserve policy must come from the members of this Association, which support I most earnestly request.

Appended hereto is submitted correspondence between Superintendent of Forestry Hosmer and Governor Carter, which constitutes an official statement of the forestry policy of the Territorial administration, which will answer many questions which are being asked concerning the subject.

LORRIN A. THURSTON,
Chairman on Forestry.

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FORESTRY BEST UNDER GOVERNMENT CONTROL.

In the following correspondence Superintendent Hosmer submits to Governor Carter reasons why the Hawaiian system of forest reserves should be entirely under Government control, and then at the Governor's request outlines a method whereby such Government control may best be exercised for the benefit of both the Territory and private owners who surrender lands for forestry purposes. Governor Carter sets the seal of his approval to the whole scheme as proposed by the Superintendent of Forestry. The communications are here printed in full:

Oct. 29th, 1904.

Honorable George R. Carter, Governor of the Territory of Hawaii, Honolulu, T. H.

Sir:—Numerous inquiries are received by this division concerning the forest policy of the administration. It is claimed that until it is more definitely known what action is likely to

be taken, private owners are unwilling to go to the expense of preparing maps and statements in regard to surrendering their lands for forest reserves.

As it is very desirable that these matters be clearly understood, I have prepared a statement of what, from conversations and correspondence with yourself, I understand to be the attitude of the administration on the essential features of this question. If this meets with your approval, I respectfully request that you so inform me, and that you allow the correspondence to be made public.

The essential points in the forest policy of the present administration may be thus summarized:

First: For the continued welfare and development of the agricultural interests of this Territory, on which the prosperity of the country depends, it is essential that an ample water supply be assured.

Second: To accomplish this end through the protection of the watersheds and the conservation of the rainfall, forest reserves are necessary and essential.

Third: The forest reserves should include all land which cannot be economically used for purposes other than forest, as well as such other areas as are needed to protect the water supply of permanent existing industries.

Fourth: In negotiations with the Government for a proposed forest reserve, if the owner of the forest land is largely and primarily benefited by the reservation, the Government has then the right to expect most liberal terms; especially should this be the case when the available areas of Government land in that neighborhood are to be set aside for forest reserves.

Fifth: In setting apart land for forest reserves each case must be decided on its own merits.

Sixth: Under the interpretation of the Organic Act by the legal adviser of the administration, leases of public land cannot be extended, and all Government lands that are sold outright or leased must be put up at public auction.

Seventh: The administration is willing to consider exchanges of land, fee for fee, or lease for lease, but all such exchanges must be on a basis of value, not of acreage.

Eighth: It is the policy of the administration not to exchange large areas of wild land for town lots or vice versa.

Very respectfully,

(Signed) RALPH S. HOSMER,
Superintendent of Forestry.

EXECUTIVE CHAMBER, HONOLULU, HAWAII.

Oct. 31, 1904.

Ralph S. Hosmer, Superintendent of Forestry, Territory of Hawaii.

Dear Sir:—Your letter of October 29th sets forth clearly and concisely the essential points of the forestry policy of this administration, and I heartily approve of making it public.

One of the questions that has arisen is that the owners of forest land in some cases feel that under their own control they are more certain that reservations will be maintained for all time to come, and it seems to me that your board would do well to make clearer the advantages in turning such land over to the care of your bureau of the Government.

Very sincerely yours,

(Signed) G. R. CARTER, Governor.

Oct. 31st, 1904.

Honorable George R. Carter, Governor of the Territory of Hawaii, Honolulu, T. H.

Sir:—I have the honor to acknowledge your letter of this morning, relative to the forest policy of the administration.

In accordance with your suggestion, I have drawn up the following statement of some of the reasons why the Board feels that the forest reserves can be better administered under the Government than under private control.

First: It is provided by law that the direction and control of the forest reserves shall be in the hands of a trained man, a professional forester, whose sole duty it is to care for the forest interests of the Territory. It is only reasonable to expect that a man so trained and equipped is better fitted to undertake this work than are those who are not foresters by profession, and whose main interests lie in other directions.

Second: By bringing the management of the forest reserves under one central authority their administration is simplified and made vastly more effective; the carrying out of

a definite policy is made possible—a task difficult if not insurmountable where a number of diverse, not to say conflicting, interests are involved; and, by being a department of the Government, rules and regulations can be enforced, which if framed by individuals could not be made binding.

Third: A considerable part of the lands within the limits of the proposed forest reserves is now in private ownership and subject to the shifting opinions of various individuals. It is believed that the example set by the Government and the large owners in turning their forest lands into reserves, will have no small effect in causing the other owners to do likewise, thus insuring the extension of the reserves over larger areas and the protection of the forest in places where it might not otherwise be possible.

Fourth: While the forest reserves are created primarily for the protection of the important water sheds, they may, without detriment to this end, be made to serve other useful purposes as well, if properly managed under competent supervision, by a permanent staff. To meet the objection that the present owner would lose a possible source of revenue by surrendering land which could be so used, a clause could be inserted in the deeds of transfer for surrender, providing that the owner of the land receive a stated share of any revenue so derived, and reserving to him the right to extend such operations, provided always that the work be undertaken and carried on only with the approval and under the supervision of the Superintendent of Forestry. In the unlikely event of a change in the forest policy of the Territory, the private owner can fully protect himself by the insertion in the deed of a clause stipulating that if the land be subsequently used for purposes other than as a forest reserve, that it thereupon revert to its original owner. Restrictions of this character will be agreed to by the Board.

Fifth: Under Government control a permanent service can be built up, composed of men trained in forest work, who, beside being well equipped for their routine duties, could also undertake work of general, though indirect benefit, such as the planting of waste, or barren areas, which because of its character or because of requiring a considerable time for completion, is not likely to be done by individuals.

Sixth: Forestry as a national policy has been practiced for over a century in European countries. In the United States its adoption is more recent, but today it is as firmly intrenched as a policy, as it is in Europe. Within the last fifteen years a marked change of public opinion has taken place throughout the country. From being regarded as the hobby of a few visionary enthusiasts, forestry has become a definite and settled policy, not alone of the Federal Govern-

ment but also of a number of the individual States, and one which is supported by annually increasing appropriations. The present attitude in regard to forestry was well expressed by President Roosevelt, when, in his first message to Congress, he said: "The forest and water problems are perhaps the most vital internal questions of the United States." While there may be setbacks in the forestry movement, forestry as a whole is too important and vital a question to be put aside. This is perhaps even more true in Hawaii than on the mainland, because with us the most important industries are, as has already been pointed out, dependent upon the forests. There exists in this Territory a strong public sentiment for forestry, created and fostered by the leading and most influential men. With such backing the permanence of this Territory's forest policy is practically assured.

Very respectfully,

(Signed) RALPH S. HOSMER,
Superintendent of Forestry.

October 31, 1904.

Ralph S. Hosmer, Esq., Superintendent of Forestry, Territory of Hawaii.

Dear Sir:—May I acknowledge yours of even date, in which you bring out some very good reasons why the forest reserves can be better administered under Government control than under private? In this I agree with you, and I believe the publication of this correspondence will be of benefit to all.

Very sincerely yours,

(Signed) G. R. CARTER, Governor.

To Mr. L. A. Thurston,

Chairman Committee on Forestry.

The Iron-wood seems to be best adapted to districts where high winds prevail. It is a rapid grower and thrives on steep hill sides where nothing else can be profitably grown. Several rows along the margin of fields provide ample protection from winds.

Trees of ten to fifteen years' growth attain a height of thirty to forty feet and will measure from six to twelve inches diameter. The timber is very tough and of greater strength than much of the imported hard woods. To prevent cracking while seasoning, the ends should be painted with some cheap paint and a piece of board nailed over it; timber thus treated and protected from the sun works well and makes excellent wagon axles, double and single trees, etc. If these trees are planted for fence posts, they should not be placed more than eight feet apart, to prevent too vigorous branching; these trees make good fence posts while growing if the wire is not wrapped around the tree.

The United States Bureau of Forestry has conducted a series of experiment and investigation into the cheaper methods of preserving the ordinary and the inferior woods against decay, both in and out of the ground.

The results of these experiments have shown that certain preservatives, properly applied to woods naturally prone to rapid decay, will extend the life of a fence post or a railway tie almost indefinitely. The best of these are the tar oils, spirittine carbolineum, etc.; corrosive sublimate is also an excellent preservative.

In preserving fence posts, the wood to be treated must be thoroughly seasoned and dry. In the treatment by the corrosive sublimate a common wooden vat is filled with posts, which are covered with the mercurial solution of one part sublimate to 150 of water. When the posts are thoroughly soaked with the solution they are taken out and replaced with others. Thus treated they are said to resist decay for an extremely long period. Tar oil products applied to posts must be heated, and excellent results have been obtained by successive heatings and paintings of the parts to be underground. A small steel tank is used in many parts of Europe for this purpose. This tank is set in masonry in such a way that a fire can be built under it. Tar oil is poured into the tank, the posts or poles are set vertically in it, and a fire is started under it. As soon as the oil becomes thoroughly warm it penetrates into the timber for smaller or greater distances.

The cost of the treatment by one method or the other is

practically the same, about 4½ cents per cubic foot to be treated. Thus the three feet to be buried of a seven-foot post, six inches by six inches, would cost about three cents. When it is considered that a red oak or even a pine post properly treated will outlive a natural white ash, the cost of treatment is small in comparison to the saving.

As has been mentioned in report of Forester Hall, the "Mesquite or Algaroba is the principal tree forming forests near the sea level;" although these have "tremendous powers of reproduction," yet much might be done by planting out small plots of trees on waste and rocky Government lands to form distributing points for the seeds which are spread by live stock. In this way the forests would be quickly spready, hastening the reclamation of these waste areas by many years, and making them a source of revenue to the Territory.

Respectfully submitted,

E. E. OLDING,
Member of Committee.

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November 14th, 1904.

Hon. L. A. Thurston,

Chairman Forestry Committee,

Honolulu.

Dear Sir:—In reply to yours of Oct. 29th, I am ashamed to say that I had overlooked the fact that I am a member of your Committee on Forestry.

Owing to my neglect I am unable to supply you with any information as to what has been done in the way of tree planting, or the kinds of trees planted, if any—in the different localities of Hawaii. However, this important information is known and can be supplied by your Forester, Mr. Hosmer.

So far as Kohala is concerned, the same interest in tree planting is still maintained by the few—Dr. Bond of Kohala Sugar Co. and myself continue to plant trees right along. Our ravines and waste lands are now pretty well planted up, and after twelve years of constant effort, I have succeeded in establishing a healthy belt of forest along our seacoast land. What with high winds, dry weather and salt spray this effort has not been an easy task; this little planting of some ten acres has been done with the native Lauhala, and the common ironwood. The ironwood is the only hardy and satisfactory tree which we have so far found for this district.

Regarding reservation, Kohala Sugar Co., Niulii and Dr.

Wight's Estate are the only parties who have any preserved forest land. We have an area of 1800 acres, Kohala Sugar Co. has 600, Niulii about 1500, which is the only real forest reserve in this district. We view with alarm the encroachment and use of the remaining forest just above us, which is being fenced into pasture sections by adjoining ranches. Should this policy be continued and enlarged upon by the ranches in fencing the cattle into the woods, we all know what the consequence will be. This is a condition which the local Government and Mr. Hosmer should look into.

The destruction of our forests have been fourfold, the first caused by the planters, themselves, in cutting down virgin forest to extend their cane area, the second by the unwise policy of the Government in the past in opening forest lands to Homesteaders, and notwithstanding the reservation clauses in their lease or purchase, great destruction of good healthy trees has been resorted to. The third and most destructive has been and is, to a great extent, still caused by the ravages of cattle roaming at will through our forests and, as I have already said, large areas of forest land have been and are being fenced in for pastoral purposes. It certainly does not take the cattle very long when confined to a limited area to beat and trample down the ferns, vines and other underbrush, and in a very short time produce a park-like landscape, where there was a fair forest, and, most important of all—a dense undergrowth—this no longer exists, but in its place we have an ideal storm producing water-shed from which as the rain falls it runs off into the ravine with the result in most cases of a disastrous flood while the rain lasts, and when the rain ceases, so does the water supply, which, under natural conditions, would produce no damaging floods, but the rainfall would be conserved and be given off gradually. The fourth cause of forest destruction is of course natural decay and death of trees, but to an alarming extent aided by insects which in our district are doing serious damage to young and old forest trees alike. To sum up, there ought to be a law enacted to compel the sugar planters to plant five trees for every one they cut down. The Homesteader should be located in open country where there are no trees, and compelled to plant a given number, according to the acreage he takes up. The rancher and his cattle should be forever removed from all lands having the semblance of a forest left. The men of science who make a study of plant life should at once investigate and try and find a remedy to arrest this serious destruction of fine trees by insect pests, and every public spirited citizen should plant trees in ravines and waste places in their respective properties, and I would further suggest the formation of an Arbor Day Society in every district in the Islands, thereby following up the grand example set by so many of the States on the Mainland.

In connection with these crude ideas of mine I submit a strong

and able argument in favor of forest preservation delivered by that celebrated orator and thinker—Senator Depew on June 7th, 1902. Many have seen it before and to many it may be for the first time. It is such an able and valuable contribution to this important question of forest preservation that it cannot be too extensively known and published.

THOS. S. KAY.

I am, dear sir, Yours respectfully,

FOREST PRESERVATION.

Washington, June 7.—Mr. Depew, of New York, made in the Senate today a timely and convincing argument in advocacy of the Appalachian Park project. A bill has been reported to the Senate by the Committee on Forest Reserves and the Protection of Game, which proposes to expend $10,000,000 in the creation of a national forest park, to embrace about two million acres of forest lands in the States of North Carolina, South Carolina, Georgia, Alabama, Tennessee and Virginia. This great Appalachian reserve is to be maintained and administered by the federal government in order to guard the sources of the thousands of watercourses which find their way from its plateaus to the Atlantic or to the Gulf of Mexico, and thus protect the vast area of agricultural lands which these rivers enrich and fertilize. As a member of the Committee on Forest Reservations the junior Senator from New York has given much careful study to the forestry problem, and his appeal to the Senate to undertake this beneficient and national work was supported by many illustrations of the injuries suffered in older countries from a wasteful and short-sighted denudation of forest areas.

It is said by the committee reporting the bill that "it may fairly be urged that the establishment of this forest reserve in the region of the South Appalachian Mountains is a matter of great national importance, and that, owing to the peculiar conditions existing in this region, the establishment of this reserve need not necessarily be accepted as a precedent for the establishment of similar reserves elsewhere in the East."

Mr. Depew spoke in part as follows:

Nature has been so prodigal in her gifts of forests to the United States that the important question of their preservation has been neglected too long. The attacks of the settlers upon the woods for clearings and a home have been indiscriminate and wasteful in the extreme. The settlers are not to blame nor are the lumbermen. The destruction which has been going on with such frightfully increasing rapidity during the last fifty years is due to a lack of that governmental supervision in the interest of the whole people which can only come from education and ex-

perience. The lumberman wishes to realize at once upon his purchase, and as a rule vast fortunes are made in deforesting the land. Railroads are run into the woods, all the appliances of modern inventions and machinery are at work, and this magnificent inheritence is being squandered with a rapidity which is full of peril for the future.

Intelligent conservation of the forests of a country is the highest evidence of its civilization. The climate, the soil, the productive capacity of the farm, the equability of the rainfall and the beneficent flow of the streams are all dependent upon the science of forestry. We have wisely set apart already in the West forty-one national forest reserves—about forty-six million acres. One of them is already paying expenses and yielding a slight revenue.

While 46,000,000 acres of land have been rescued to the West, there has been nothing done in the East. The country had a superb property, unique in every way, unequalled for richness and rarity and for the value of its product, in the redwood forests of the Pacific Slope. Through carelessness, simply, Congress yielded to the shrewd representations of the speculator, who, under that homestead plea, which is properly so attractive to the American, secured the enactment of laws by which any settler could secure 160 acres in these forests of priceless value. Then came the harvest of the lumbermen. Each of their employes staked out 160 acres. The sailors upon the vessels that carried off their lumber were induced to make claims for their 160 acres each, and the land was then transferred to the lumber companies, until, for a mere song, this magnificent inheritance of the people fell into the hands of different corporations who are mercilessly destroying the timber.

Negligence of this kind on the part of Congress becomes almost a crime. Those wonderful woods should have been preserved, not for speculators and bogus settlers, but for the whole people of the country. They would, under scientific forest management, have been for all time to come not only self-supporting and revenue producing, they would have been more—they would have been the source of supplies of wood for all purposes for the inhabitants of the Pacific Coast. They would have been additions to the rural scenery, which in every State and country, when attractive, helps culture and civilization. They would have been the home of game, where sportsmen could have found health and pleasure. But, instead, the land will become an arid waste, the streams will dry up, and the country will lose not only one of its best possessions, but there will be inflicted incalculable damage upon a vast region which otherwise would have remained always full of happy homes and cultivated farms.

THE PROPOSED APPALACHIAN PARK.

The Appalachian forest preserve as proposed in the pending measure is about 150 miles in length and of varying breadth. It

is from 400 to 600 feet above the sea. It runs through the States of Virginia, West Virginia, North and South Carolina, Georgia, Alabama and Tennessee. The slopes of these mountains are very steep, varying from 20 degrees at the lowest to 40 degrees. The waters which flow from the perpetual streams, fed by the perpetual springs, run on the one side to the Atlantic, and on the other to the Gulf of Mexico. The streams from this mountain forest are the tributaries of these important rivers: The James, the Roanoke, the Catawba, the Savannah, the New (Kanawha), the Tennessee, the French Broad, the Coosa, the Yankin, the Chattahoochee, the Broad, the Hiwassee, the Nolichucky, the Pigeon, the Tuckasegec, the Watauga and the Holston. The region affected by these streams is from 100 to 150 miles in width on the Atlantic side, and more than that on the other. It comprises part of the richest agricultural country in the United States. The timber in this forest is all hardwood, and is the largest body of hardwood on the North American continent. It is a museum of forest growth, embracing, on account of its location, the woods which can be grown in temperate, semi-tropical and tropical countries. There are 137 varieties, making this forest one of the most interesting in the world. The deep soil has been forming for a thousand years or more, and in its interlacing of tree roots and humus, of grass and leaves, there has been created an enormous sponge for the absorption, retention and distribution of the rainfall.

The rainfall in this region is greater than in any other part of the United States, except the North Pacific coast. It ranges from 60 to 100 inches a year. The downpour at one time during the last year was 30 inches. Where the forests are intact the water finds its way through this thick and porous soil, goes into the crevices of the rocks and into the gulches and forms springs and rivulets. Nature, always beneficent in her operation, so arranges this vast collection of the rainy season that during the rest of the year it flows out naturally and equably through the rivulets into the streams and through the streams into the rivers and waters and fertilizes half a dozen States.

The result of an attack upon this fortress created by nature for the protection and enrichment of the people is more disastrous than the sweep of an invading army of savages over a thickly populated and fertile country. They kill, they carry off captives, they burn and they destroy, but after the war the survivors return to their homes and in a few years every vestige of the ruin has disappeared. In its place there are again cities, villages and happy people. But the lumberman selects a tract of hardwood forests upon the Appalachian Mountains. The trees, young and old, big and little, surrender to the axe and the saw. Then the soil is sold to the farmer, who finds abundant harvests in its primeval richness. For about three years he gathers a remunerative and satisfactory harvest, but he sees, as the enormous rain-

fall descends, his farm gradually disappear. At the end of three years he can no longer plant crops, but for two years more, if lucky, he may be able to graze his stock. At the end of five years the rains and floods have washed clean the mountain sides, have left nothing but the bare rocks, have reduced his farm to a desert, and created a ruin which can never be repaired.

But this is not all. That farm has gone down with the torrents which have been formed by the cutting off of the protecting woods, into the streams below. It has caused them to spread over the farms of the valleys and plateaus. It has turned these peaceful waters into roaring floods, which have ploughed deep and destructive gullies through fertile fields and across grassy plains. One freshet in the Catawba river last spring, occasioned wholly by the deforesting of the mountains, swept away $1,500,000 worth of farms, buildings and stock. The damage done by the freshet of last year alone, in the large territory fed by the streams and rivers which came from these mountains, was estimated at over $18,000,000.

DESTRUCTION OF FORESTS THREATENED.

This destruction cannot be repeated many years without turning into a desert the fairest portion of our country. This process of destruction is constantly enlarging because of encroachments upon the forests on account of the growing scarcity of hardwood. The lumbermen are running light railways so as to reach the heretofore inaccessible depths. The giants of the mountains, which are 400 or 500 years of age, and many of them, seven feet in diameter and from 140 to 150 feet high, are falling in increasing numbers every month before the pitiless and ruthless invasion of the axe and the saw. In ten years the destruction will be complete, the forests will be practically gone, the protecting soil will have been washed off the hillsides, and the newspapers will be filled each year with tales of disaster to populations, to farms, to villages and to manufacturing enterprises, occasioned by unusual and extraordinary rains, and the torrents which have been formed by them and flowed down through the valleys.

It has been estimated that there is in these mountain streams 1,000,000 horsepower, which can be easily utilized. This means a saving of $30,000,000 a year in coal alone, which would otherwise have to be used for the generation of that amount of power for manufacturing purposes. But it means more. This 1,000,000 horsepower that these streams, which flow equably all the year round because of the nature of the sponge which forms the reservoir that supplies them, would create an incalculable amount of electrical power. With the successful demonstrations which have been made in California and Niagara Falls of the distance to which this energy can be transmitted, the value of these streams, kept in their original condition, to the future of these

States cannot be estimated. There are in these conditions all the elements necessary for transportation, for light and heat, for manufactures and mining, in a very large section of the United States.

The proposition in the bill is to authorize the Secretary of Agriculture, at an expense not exceeding $10,000,000, to purchase 4,000,000 acres of these forests. They are held now in large tracts of from 1,000 to 5,000 acres. They are being rapidly bought up by lumber companies at from $1.50 to $2 an acre. The owners, as I am informed, would much prefer selling them to the government than to individuals or corporations. The reason is obvious. It is estimated by the Department of Agriculture that within five years the forests would be self-sustaining, and after that a source of increasing revenue for all time to come. It is impossible for the States to undertake this work. New York, in order to protect the Hudson and Mohawk, has been purchasing a large domain through the Adirondack forests which she proposes adding to every year. This is possible, because the whole territory is within the limits of the State of New York. But in the Appalachian region one State cannot buy the forest sources of the streams, because they are in another State. The State which has the forests cannot be expected to go to the expense of protecting them in order to preserve the streams and agriculture and industries of adjoining commonwealths.

The government does much in many ways to create wealth for the people. Every river and harbor bill carries with it millions of dollars to create wealth by dredging harbors, rivers and streams. The irrigation propositions which are always before us, and some of which have passed the Senate, are also for the creation of wealth by making fertile the lands which have always lain arid. Here, however, is a proposition not for the creation of wealth, but for its preservation. This is a scheme not for many local improvements, like the $70,000,000 public buldings bill or the $70,000,000 river and harbor bill, or the innumerable other bills which we pass for localites, but it is a public and beneficent measure to keep for future generations in many States and over a large area the productive energies which nature has stored for the comfort, the living and the happiness of large populations and for the wealth of the whole country.

It differs from all other schemes of governmental aid in another way. The advantages derived by the government from the improvement of rivers and harbors is incidental and indirect. The same is true of irrigation, of public buildings and public expenditures of every kind; but in this broad and beneficent scheme the government protects its people by entering upon a business impossible for States or individuals, and which no machinery but that of the government can carry on, and which the experience of other countries has demonstrated will prove a source of perpetual revenue.

BENEFITS OF FOREST PRESERVATION.

We have been the happy possessors of such extensive forest territories that we have not yet, like other nations, felt the poverty of wood. There has not been brought home to us how dependent we are upon it for all purposes in our domestic, home and business life. It would be little short of a national calamity if we should feel acutely the loss of our wood. That this will occur, and wood become so high as to make it a luxury, is certain if this forest denudation goes on. From the cottage of the poor man and the home and outbuildings of the farmer to the highly polished woods whose artistic graining ornaments the palaces of the rich, this wise provision of nature is our necessity. We can only keep these hard woods, which every year are becoming scarcer and more costly, within reasonable reach of the demands of the people by the government entering upon this process of scientific forestry. Instead of this 150 miles of hardwood forests being destroyed, as they will be in ten years unless measures are taken for their preservation, they would under this scheme last forever, and yield annually a harvest for the uses of the people. A few corporations or individuals may accumulate in a short time large fortunes by deforesting, fortunes which will disappear in a generation or two; but wise ownership, preservation and administration by the government will give employment, property, industries and homes to multitudes for all time.

To sum up briefly, then, this is a work which only can be done by the government of the United States. It should be done by the government because it interests many States and in a large way the people of the whole country. It preserves the hardwood forests and their product for future generations. It keeps upon the hills and mountain sides the woods, whose influence upon climate, soil and rainfall is most beneficial to a vast territory. It prevents mountain torrents, which will in time, as the destruction of the forests goes on, turn a large agricultural region into a desert. It conserves for manufacturing purposes that enormous waterpower which will be utilized for a multitude of industries which will give employment to thousands and add enormously to the wealth of the country. Instead of being an expense and a drain—and it would be the best expense which the government could make if that was necessary—it will be one of those beneficent improvements which will shed blessings everywhere, and at the same time be self-sustaining and a source of everlasting revenue to the government.

At the close of Mr. Depew's remarks, Mr. Hale said that the Senate could not fail to be impressed by the great importance of the subject. He had not been aware of the extent of the land to be purchased, but he thought that some action ought to be taken on the bill at this session.

REPORT OF THE COMMITTEE ON LABOR SAVING DEVICES.

To the Members of the Hawaiian Sugar Planters' Association.

Gentlemen:—As Chairman of the Committee on Labor Saving Devices, composed of Messrs. E. K. Bull, T. S. Kay, A. Lidgate, F. B. McStocker, F. Meyer, J. N. S. Williams and the writer, I offer the following:

This committee as you are aware is a new committee added as a result of a resolution introduced by the writer, the primary object being the handling of the question of cane harvesting and cane loading machines, with power to recommend to the Trustees the outlay of moneys to assist patentees seeking aid in the construction and building of working models where exhibition models and plans impressed the committee.

The duties of the committee as appointed, however, take consideration of all apparatus and machines which may be Labor Saving Devices, yet the writer does not understand that it is within the province of this committee to recommend the outlay of moneys on all devices coming under such a title, but to the contrary on only such apparatus as cane loaders and cane cutters, or such other labor saving machines as would be of a marked benefit to the industry generally.

There will be many, one, two three, yes, as high as five men labor saving devices exhibited to a Labor Saving Device Committee for its consideration, but it would not be good business for the association to expend moneys on all such small apparatus. While for machines of a nature of cane loaders and cutters, in cases where exhibition models appear practical or feasible, it certainly would be a good business speculation as it is possible for machines of this nature to be built which will largely cut the labor occupied on such work and be a great benefit to the plantations as a whole. The fact is, if a committee was to take up all small matters, their whole time would be occupied.

Therefore where patentees who present practical mechanical ideas in the form of well devised plans, showing all details and mechanism, or better still exhibition models, and where such plans or models showing originality would appeal to a committee of plantation managers made up from the several Islands which represent every manner of work to be performed, the Association could afford to assist in finances in the building of a working machine. From the nature of the applications made to this committee it would appear that the public got the impression that your committee was ready to advance money on ideas so as to assist those who conceived of some scheme to develop a patent on the same.

The subject of Labor Saving Devices is one which is constantly before the planter, not only first in the doing away with hand labor or liberating it from one branch of the work to another, but second by cheapening of process, third a reduction of time of performance of work, and fourth by apparatus which automatically records and checks up records. Under the later three objects we are constantly introducing machinery and apparatus which are of a nature labor saving devices, but principally in the factory end of our work. What is most needed is apparatus and machines which will cut out large percentages of our hand labor, in our fields and at those classes of work where Oriental labor only will work and that reluctantly, thereby bringing up the standard of labor.

This can be done upon the advent of successful cane loaders and cane cutters for field work. The class of labor performing this work will become better paid and more varied. It is said that "Labor Saving appliances has proved the elevation of the laborer by broadening him intellectually, making his work lighter and binding him more closely to his occupation." The experience of the past year has fully impressed the planters with the necessity of apparatus for the performing of field labor. There are few of us but what realize the necessity for machinery which will reduce the laborious harvest work done by hand labor under our tropical suns during a summer season as we have just experienced.

With successful harvesting machinery there would be no wilting or faging of men in the harvest field, the work would not have to be done by contract or stint, the supervision and control would be more satisfactory, and the factory supply would be assured, throughout the whole season. While your committee has felt the importance of its work especially as to field devices it regrets to report as will be seen hereafter little or no progress.

The Labor Saving Devices which have come to your committee's notice, coming under the subject heads classified above, as in use in this country during the past season, are as follows, viz:

FOR THE FACTORY.

Wicks' cane unloader in use at Puunene, Maui, during last season's runs, being a perfect success and reducing expenses 50 per cent. over the previous run with a Gregg machine.

A machine for sewing sugar bags in use at Puunene last season being also so successful that a second one was ordered. The principal saving in this machine, however, is not in labor but in twine. The machine performing good work uses a heavy thread costing 80c. per lb., one lb. of thread sewing 500 bags of sugar while one lb. of ordinary twine costing 19 to 20c. a lb. will sew about 80 bags of sugar. The savings

possible, will more than pay for a machine in one season's run.

An overhead juice weighing Howe beam scale introduced in the Honolulu Plantation Factory last season giving perfect success, cutting the work of the chemist and insuring the accuracy of the factory balance sheets.

An electrical register of mill data introduced to the Honolulu Plantation Factory which is a tripple apparatus recording at one time and on one sheet data for a period of 24 hours, every sheet having a ruling for the minutes of each hour. It is a modified anemometer register and records juice, maceration water, and speed of mill, showing up plainly the actual hours and minutes of grinding, the regularity of juice flow, the quantities of maceration waters allowed to flow and the exact time any of the three factors, starts or stops.

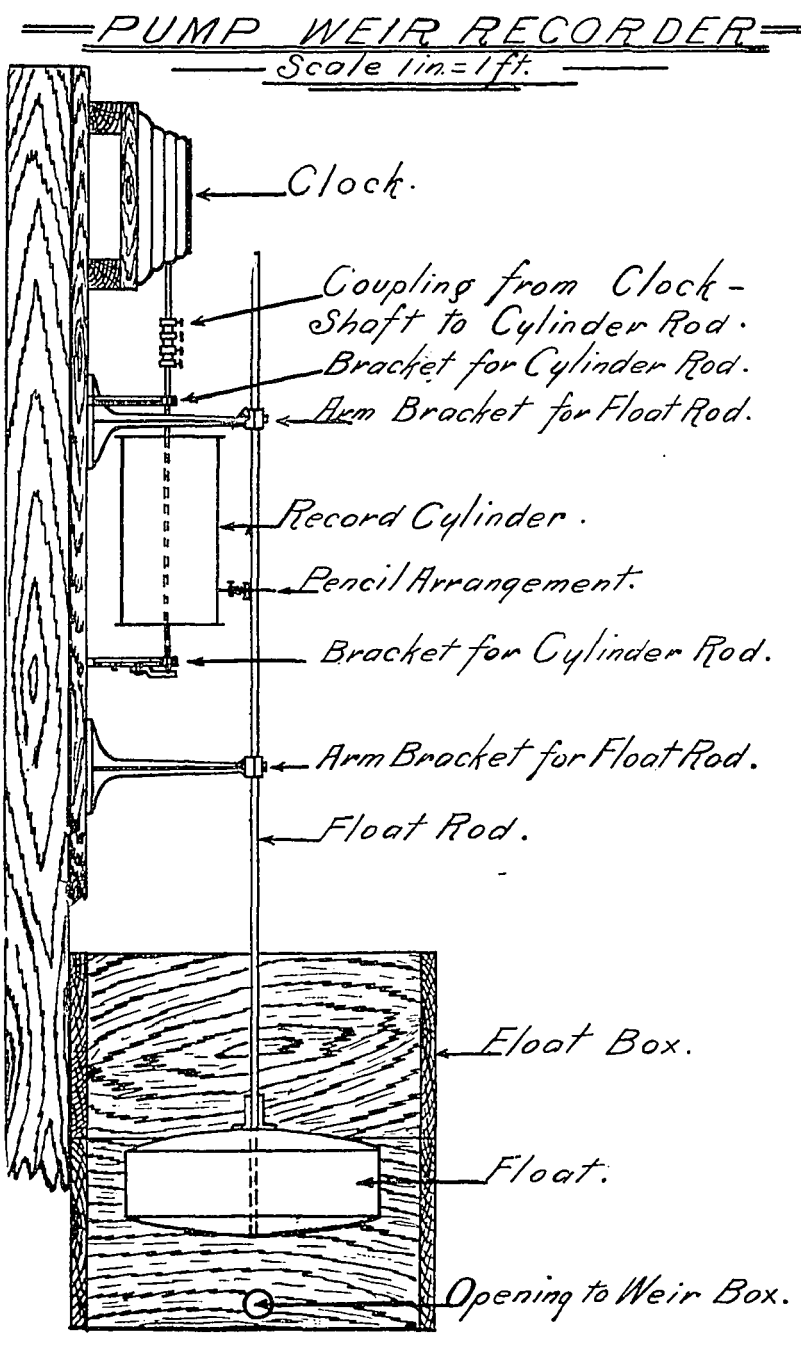
A new vacuum pump lately built by the Honolulu Iron Works constructed in connection with a duplex condensor for the purpose of forming a central condensation installation to which all vapors are conducted from three vacuum pans and two quadruple effects thus saving in labor as well as being much more efficient.

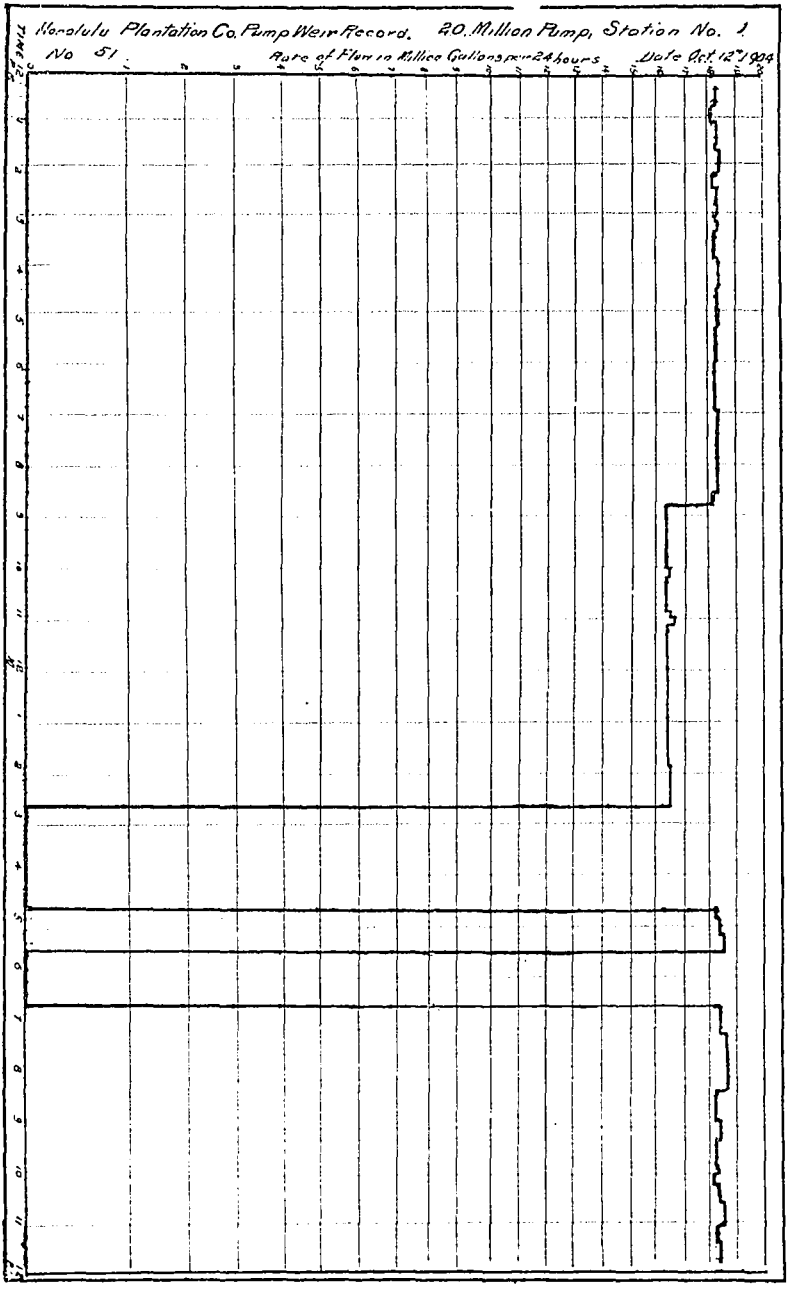
FOR FIELD DEVICES.

On folios 3 and 4 we show cuts of a simple automatic Weir Reporter introduced by Mr. Geo. J. Wagner, C. E., and placed upon the discharges of all of the high duty irrigating pumps of the Honolulu Plantation. It is a simple automatic device to determine the exact quantity of water delivered from a pump discharge or irrigating ditch and is composed of a float which carries a rod to which a pencil is attached. The pencil is so set that it comes in contact with a sheet of specially ruled paper wound around a cylinder, which is revolved once in 24 hours by a clock. As the water raises or lowers, the pencil moves the same distance making a corresponding line on the paper which being of a full scale record is the most accurate obtainable. The float is set in separate compartment connected with the weir box into which the pump or ditch discharges and sheets of paper are ruled to the size of weir in use.

The great advantage to the management of this device is the daily record obtained which gives a check upon the exact running time of the pumps and shows the least change in rate of discharge, due to such causes as low steam or poor valves, etc.

The total quantity of water discharged is calculated from these sheets and the slip of the pump determined. Thus accurate data is obtained upon which to determine the cost of


PUMP WEIR RECORDER
Scale 1in.=1ft.
Clock.
Coupling from Clock-Shaft to Cylinder Rod.
Bracket for Cylinder Rod.
Arm Bracket for Float Rod.
Record Cylinder.
Pencil Arrangement.
Bracket for Cylinder Rod.
Arm Bracket for Float Rod.
Float Rod.
Float Box.
Float.
Opening to Weir Box.


Honolulu Plantation Co. Pump Weir Record. 20 Million Pump, Station No. 1
No 51.
Rate of Flow in Million Gallons per 24 hours
Date Oct. 12th 1914

water actually delivered by the pumps at the respective discharges which can only be obtained in this manner.

The Wilson-Webster cane loader, shown on folio 7, using gasoline for generating power as shown above, introduced on the Ewa Plantation, and which is advertised as a Labor Saving Device, was fully described in the Planters' Monthly for May, 1904. As a cane loading machine it has merit. There is no originality about the machine other than the specific arrangement; it is in the nature of a crane or derrick and performs the work of hauling sling loads of cane and elevating them onto a car just as Mr. Albert Horner's device or crane wagon does which is operated by mules. Just as Mr. C. C. Kennedy's crane using gasoline for power hauls, elevates and transfers bundles of cane from the ground, wagons, sleds, to car. And also like the goose neck crane built by Jno. Fowler & Co. of Leeds, London, in 1901, for the Honolulu Plantation, cuts whereof we show hereafter, folio 8.

The slings used by the Honolulu Plantation are of the same type formerly exhibited to the Association devised by Geo. S. Garnett, being composed of two parts or sides coupled together on the bottom, which is sprung by pulling a little rope attached to a trigger, when the load is swung in position. There are no slings since devised that excel this type. It will, if made large enough, clinch and bind tightly, 2,000 lbs. of cane in such a manner as not to loose a stick while being drawn through the field. This crane has a gypsy drum attached for hauling in bundles of cane, but owing to its being low down on the car a heavy load hauls better from the boom end of the crane.

The sling loads of cane in this instance are drawn to the car and elevated by means of mule power. The crane is placed on a plantation rail car which is switched to a siding and the operator by use of gear, clutches and handle, can easily force the car along the track backwards or forwards or swivel same when raising a 1,000 lb. to 1,500 lb. bundle of cane, making a complete circle if necessary with bundle attached. A better arrangement so as to permit the crane to be steadily employed in elevating and loading of cars, is to separate the hauling-in gear and place same on a separate car, then a dozen ropes could be towed out at one time and the bundles could be hauled close to the crane from both sides of the track for a distance of 1,000 feet; or two of these power gypsy cars could be used, spread apart as in the case of steamplows pulling the ropes backward and forward onto which numerous sling-loads could be hooked and hauled to the track for the crane car; thus the empty rope going back could take back the empty slings.

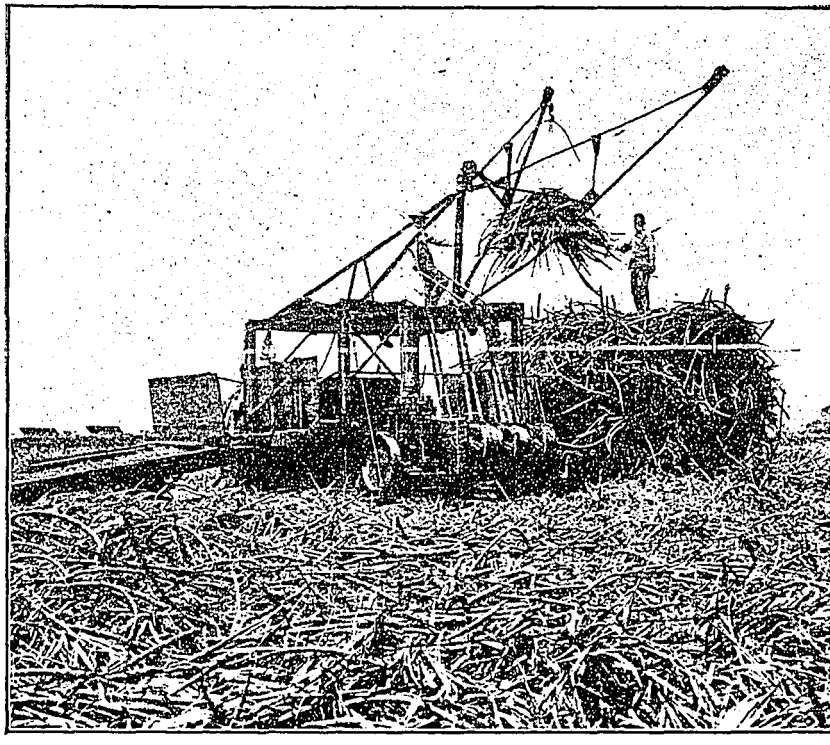
In 1901 for the basis of a report written for your Association the writer made numerous tests and gathered figures on the operation of the loading of cane both from sling loads made up on the ground and from sleds where the haul was a long distance. I then stated "being awake to the necessity of Labor Saving Devices for the harvesting of cane from our rough high lands we used a swiveling derrick hauling most of the cane by sleds from the more inconvenient places, cutting out over 80 per cent. of portable track work and reducing the manual labor 40 per cent. and increasing the mule labor 25 per cent. We proved by the method of derrick or crane a considerable cut could be made in manual labor; that on rough lands the saving was considerable, but on level or good lands little or no gain could be made in costs of loading, except in the fact that it would take some less labor; but we found a great advantage in this method of working the same, being so much easier and lighter that we could employ all classes of labor including women and children in the loading of slings and sleds, and the same being done under day wages we were enabled to do cleaner work than under the contract system. Hence a cane loader of the gib crane or derrick type by hauling its bundles to the derrick and loading with one machine, or say in separate machines, giving the crane its own work and the gypsies their work, is to be welcomed as a step forward in methods of loading cane. The writer's ideal however, is not that of a derrick or crane with gypsies, as this is no new Labor Saving Device in connection with the handling of sugar cane. Mr. Jno. M. Horner plainly showed the locomotive power which they had saved their laborers for many years past, by the use of a crane or derrick built on a wagon, in his sub-report on Transportation and Handling of Cane, in 1901.

Under this class the crane or derrick type of cane loaders are also the Mire, the Lotz and the Howard machines, all of Louisiana, which have been in use there for some time.

Cranes and derricks are machines to make labor easy; they do not deliver or free you entirely of the necessity of hand labor, but machines to materially cut the labor of loading cane must be built to pick the cane from the ground. In 1901, when writing on the subject of cane loaders, I stated that "a machine other than the derrick or crane system of a much greater labor saving efficiency would be devised," "that no machines had yet been devised or modeled which avoided the handling of cane by hand labor;" that all machines up to that time were in the nature of cranes or carriers and required the laborer to lift the cane by hand. I was then working on a machine which I secured patent on during 1902. A cut of same I show herewith on folio 11.

Upon my securing patent I learned how close I was shaving on the J. D. Martiniz automatic cane loader, who had secured his patent a few months ahead of me. See cut, folio 11.

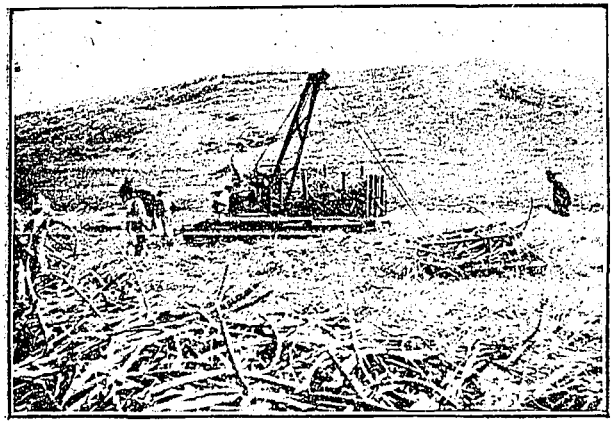
A cut whereof I am pleased to attach herewith as I learn the machine has proved that this is the ideal method of loading cane and will become truly a Labor Saving Device. Under date of September 19, 1904, Mr. J. D. Martiniz of Whitecastle, La., writes in answer to a letter from me as chairman of this committee urging him to make a proposition to the



WILSON-WEBSTER CANE LOADER.

Planters' Association whereby he would guarantee the successful working of his machine and to build and operate one here; first, in answer to certain questions which I put to him, that he is confident that the machine could be used on hilly lands, that he had loaded cane with it on lands having a fall of two inches to the foot. That he is just attaching a mechanical device for sweeping the cane into the wagons or cars when they drive along side, instead of by hand. That later on after that attachment is complete he will take the matter up with the Association.

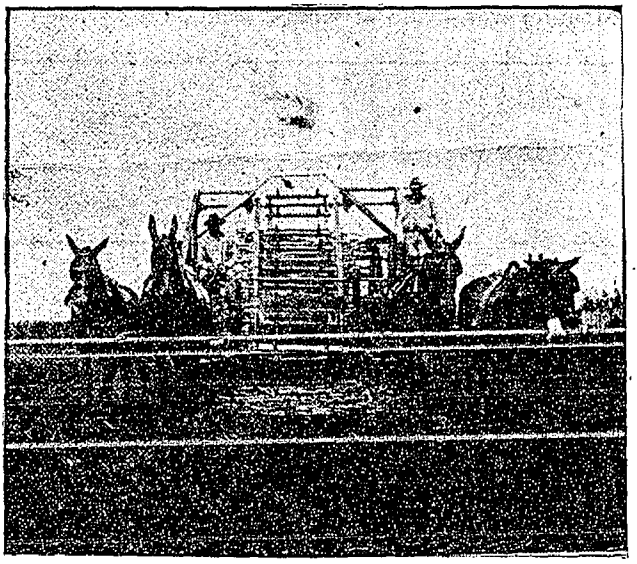
It has been stated to me by people who have seen this loader in Louisiana, that the machine will work and pick up the cane from the furrows when laid at right angles, taking it up to the table from where it is loaded into a wagon. If this is true and the machine will load on lands of a grade of two inches to the foot, it will work on any of our upland planta-



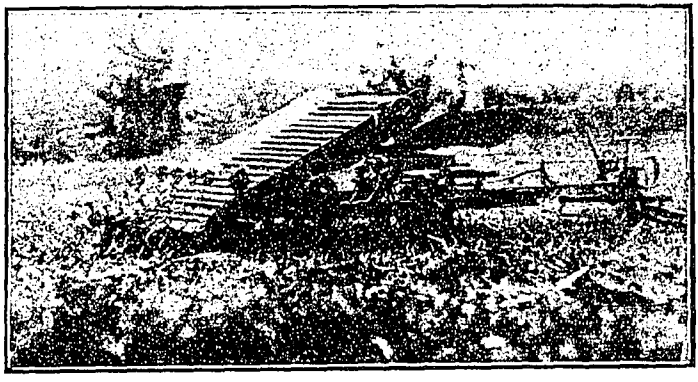
GOOSE NECK PORTABLE CRANE.

tions. With us in our deep furrows the mules would have to be worked tandem. The writer feels on behalf of this committee that now since there are so many steam cranes or derricks about the Islands which can be used for the transferring

of cane from a wagon to a car, as well as cranes and derricks worked by mule power, that the Association could afford



LOW CANE LOADER.



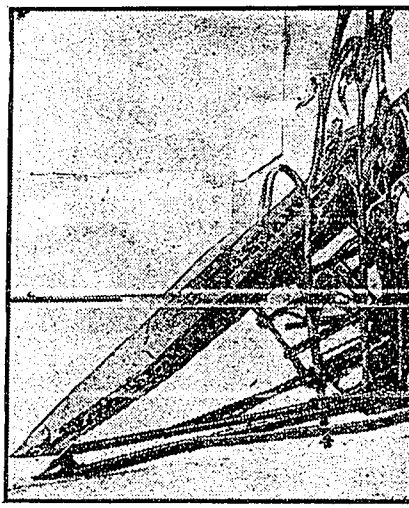
MARTINEZ CANE LOADER.

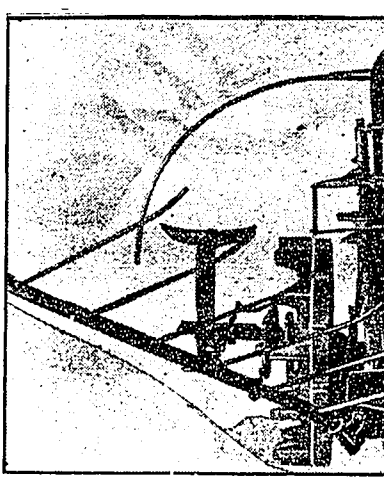
to buy an experimental machine of this type. I need not dwell upon the possibilities by the successful working of such a machine; it will be welcomed by all of us.

CANE CUTTER.

The business of your committee was not neglected. Considerable correspondence was carried on in relation to the

subject of cane cutters and loaders. interest Messrs. D. M. Osborn & C the Osborn corn cutter, in our want ters. Mention was made in your con

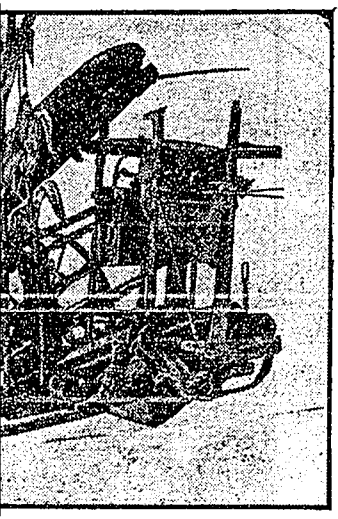


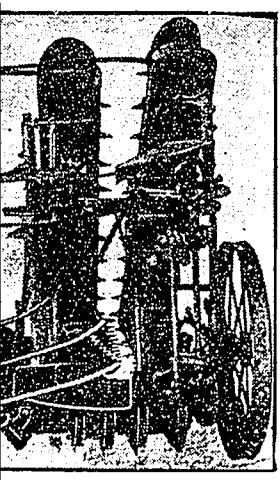


OSBORN CORN CUT

of conversation had by the writer wi is a daughtsman, diviser and constru of the fact that he had stated to the possible for them to arrange their ma

lers. An effort was made to & Co., the manufacturers of vants in the line of cane cut- committee's writings to them,





CUTTER.

r with their Mr. Moon, who nstructor of their machinery, the writer that it was quite r machine to cut cane in two

cuts, by making a double decked machine, cutting on the ground, and also five feet above the ground, providing the cane could be raised to an upright position and could be straightened up out of the snarls he had seen it in, with the high fore, or brace arms which they use for that purpose, in this manner turning the bottom cut one way and at right angles to the furrow, and the top the other way in the same manner. He stated that where cane was longer than 10 feet it could be dropped down and cut by the upper shears a second cut.

The writer stated to the Osborn people that if their machine could be arranged to do such work, such a machine would be considered a successful cane cutter, as plantations could plant in the hill instead of the furrow, as the stripping could be done before by hand, and the topping could be performed after the machine had cut it in the field. The top cut would not average more than 35 per cent. of the total and laid in that manner by itself, it would materially facilitate the separating of seed cane and cane tops from the cane by the laborers.

Messrs. Osborn & Co. answered regretting their inability to take up the experimental work with the Association along the lines suggested because of their factory being so crowded in the experimental and manufacturing departments, and because they had no man available at that time whom they could send out here.

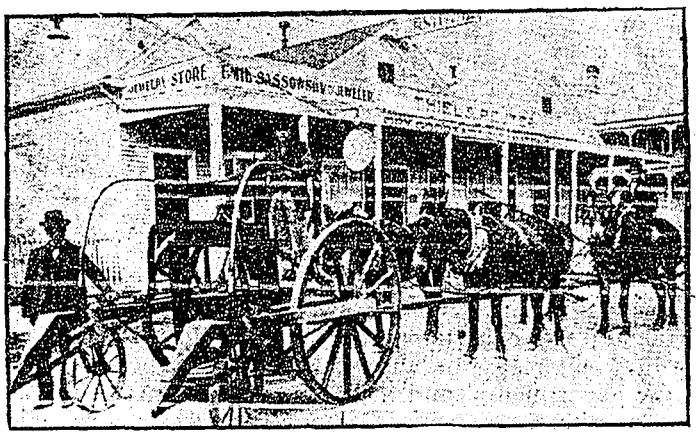
Your committee regret that they have made no progress in this matter and feel that the incoming committee should take up the matter with other of the manufacturers of corn harvesting machinery. The Osborn people only refused because of press of work. There are three or four large concerns, manufacturers of corn cutters, in the Eastern States, and if solicitation was made they might be pursuaded to take hold of the work of trying to adapt their machines to the situation. Your committee feel where engineers can devise a machine as shown in above cuts on folio 12 they surely could make some success in reconstructing it to suit our purposes; more especially as they claim furrows having a width of 5 feet apart would present many advantages to them in reconstructing their machines, as their great trouble has been due to the compact construction necessary for 2 foot furrows.

Under this, the cane cutter subject, we know of no machine yet patented which will perform work except the Gaussiran cane cutting machine here shown on folio 15, and it is not yet doing work satisfactorily.

The Gaussiran patent cane cutter consisting of disc knives cuts the cane and puts it in winrows, making only one cut at the level of the soil. This machine is only good for short upright cane.

In addition to the foregoing correspondence, your committee had applications from several persons, some of whom had patents, but most of whom had ideas and schemes.

Mr. H. W. Schmidt of Honolulu had a patent on a cutting machine which was less controlled than the Gaussiran cutter, as it allowed the cane to fall haphazard. It also was a disc cutter working on one end of a wagon, the disc being driven by a small engine on the back end of the wagon, the same



GAUSSIRAN CANE CUTTER.

being drawn back and forwards through the field. Mr. Schmidt had no exhibition model nor any detail drawings. Hereafter, folio 16, find his idea of a cane cutter which he furnished your committee when requesting that they develop his scheme.

FIELD DEVICES.

We hear of a plow devised by Mr. George Mayfield, of Puunene, for hilling up, which is in the nature of a mould-board, that has proved itself to be a source of economy, making a saving of some $2.00 per acre; and also of John A. Scott's double disc hoeing cultivator which has materially reduced the labor of cultivation of cane in the hoeing work, by loosening the soil on either side of the stool.

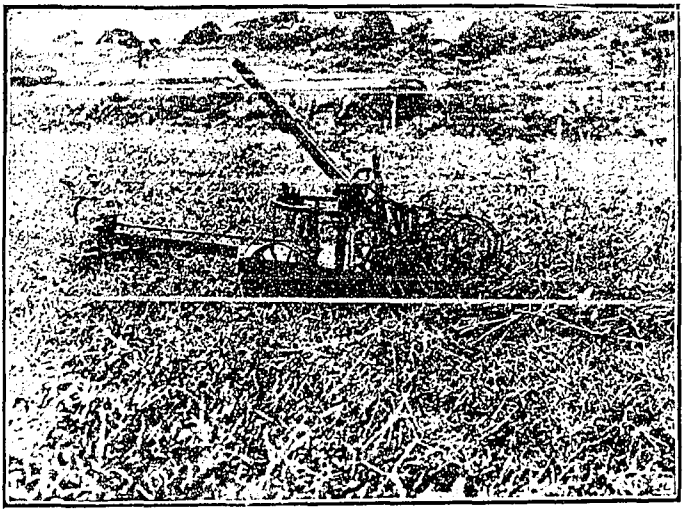
We learn of new tools devised by John A. Scott of the Hilo Sugar Co., see folio 17, and Webster & Forbes of Onomea Sugar Co., to split the stools of the Yellow Caledonia cane so they can be handled by the harrows when replowing lands, thus permitting the thorough preparation of the soil again for a further plant.

Application was made for the committee's recommendation of finances to assist John C. Searle in securing a patent on

SCHMIDT CANE CUTTING MACHINE.

) CULTIVATOR.

ideas and schemes pertaining to mills. He wrote he would secure patents on an arrangement to control the amount of maceration water applied to mills according to the position of the hydraulics, recording the revolutions the rolls had turned and weighing the bagasse according to the number of square feet of roller surface passed with full hydraulic pressure. The opinion of the committee is not known, but the writer sees no special advantage in such a device except as to the control of application of maceration water, yet if a mill is running steady then this control would not change the situation any. The other achievements which his device has is covered in



LOW'S UNSUCCESSFUL CANE LOADER.

nearly all of the mills of the Islands. The actual weight of the juice from the actual weight of the cane gives the actual weight of the bagasse.

Mr. A. Gramberg, of Kamuela P. O. writes Mr. L. A. Thurston some good ideas both on cane loader and a combined distributing wagon for laying seed cane in furrows and covering in over same at once.

He suggests a cane loader in the nature of a hay fork or hay bucker on wheels hauled by two animals. For the benefit of Mr. Gramberg, the writer begs to state that an experiment was made on a machine patented by him some two years ago on similar lines, which has failed, the machine being in the nature of a hay fork attached to a boom which was to have elevated each bundle into a wagon. See drawing, folio 18.

Mr. Gramberg writes: "I send you a sketch of a planter (see folio 20), which I know will work. The wagon (a) is to carry a

driver, seed and a boy to keep the planter in seed; (b) is a small plow with sides lengthened out to dig the trench and give room for the seed to fall; (c) of which there are two, are to cover the seed; (d) and (e) are the gearing to drop the seed and (f) is to drive the gearing and at the same time carry the machine along. You can have two machines behind a wagon to plant two rows at a time. The machines can be made to plant any distance apart by having two small plows. You can plant double rows as they do on some plantations."

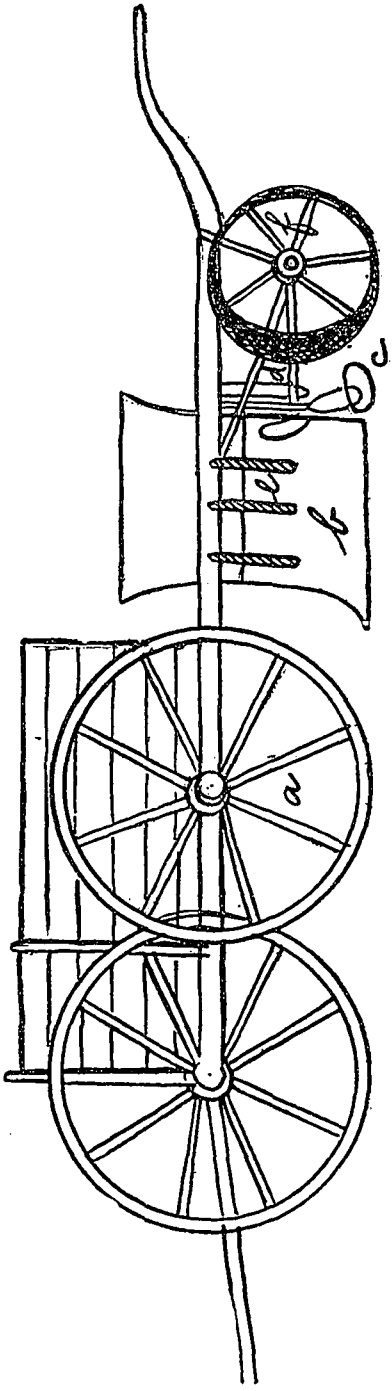
In submitting the foregoing your committee feel the importance of the work it has left unfinished and urge upon the members of the Association to encourage devisors of machines which will be complete hand Labor Saving Devices in the nature of cane loaders and cutters. The trustees have long since offered heavy rewards and bonuses for such devices, and have further through the appointment of this Committee on Labor Saving Devices offered to assist patentees with finances to develop their machines when apparently feasible.

With the co-operation of all of the members of the Association on these lines we can look forward to machines that could possibly cut down the requirements in the number of laborers in the hardest and most dreadful work on the plantations by the thousands.

Respectfully submitted,

JAMES A. LOW,

Chairman of Committee on Labor Saving Devices for 1904.



GRAMBERG'S PLANTER.

Sugar Plantations, Cane Growers and Sugar Mills.

ISLAND AND NAME.		MANAGER.	POST OFFICE.
OAHU.			
Apokaa Sugar Co.	*	G. F. Renton	Ewa
Ewa Plantation Co.	*	G. F. Renton	Ewa
Waianae Co.	***	Fred Meyer	Waianae
Waialua Agricultural Co.	°	W. W. Goodale	Waialua
Kahuku Plantation Co.	x*	Andrew Adams	Kahuku
Waimanalo Sugar Co.	**	G. Chalmers	Waimanalo
Oahu Sugar Co.	x	Aug. Ahrens	Waipahu
Honolulu Plantation Co.	**	J. A. Low	Aiea
Laie Plantation	x*x	S. E. Wooley	Laie
MAUI.			
Olowalu Co.	**	Geo. Gibb	Lahaina
Pioneer Mill Co.	x	L. Barkhausen	Lahaina
Wailuku Sugar Co.	**x	C. B. Wells	Wailuku
Hawaiian Commercial & Sug. Co.	x*	H. P. Baldwin	Puunene
Paia Plantation	x*	D C. Lindsay	Paia
Haiku Sugar Co	x*	H. A. Baldwin	Haiku
Hana Plantation	xx	E. Worthington	Hana
Kipahulu Sugar Co.	x	A. Gross	Kipahulu
Kihei Plantation Co.	x*	James Scott	Kihei
HAWAII.			
Paauhau Sugar Plantation Co.	**	Jas. Gibb	Hamakua
Hamakua Mill Co.	*x	A. Lidgate	Paauilo
Kukaiau Plantation	x	J. M. Horner	Kukaiau
Kukaiau Mill Co.	*x	E. Madden	Paauilo
Ookala Sugar Co.	**x	W. G. Walker	Ookala
Laupahoehoe Sugar Co.	*x	C. McLennan	Papaaloa
Hakalau Plantation	**	Geo. Ross	Hakalau
Honomu Sugar Co.	**x	Wm. Pullar	Honomu
Pepeekeo Sugar Co.	*x	H. Deacon	Pepeekeo
Onomea Sugar Co.	**x	J. T. Moir	Hilo
Hilo Sugar Co.	**	J. A. Scott	Hilo
Hawaii Mill Co.	x	W. von Graevemeyer	Hilo
Waiakea Mill Co.	*x	C. C. Kennedy	Hilo
Hawaiian Agricultural Co.	**x	John Sherman	Pahala
Hutchinson Sugar Plantation Co.	**	Carl Wolters	Naalehu
Union Mill Co.	*x	Jas. Renton	Kohala
Kohala Sugar Co.	*	E. E. Olding	Kohala
Pacific Sugar Mill	x**	D. Forbes	Kukuihaele
Honokaa Sugar Co.	x**	K. S. Gjerdrum	Honokaa
Kailua Sugar Co. C. J. Hutchins			Holualoa
Olaa Sugar Co. (Bishop & Co)		J. Watt	Olaa
Puna Sugar Co.	xx*	W. H. Campbell	Kapoho
Halawa Plantation	x*x	T. S. Kay	Kohala
Hawi Mill & Plantation	††	John Hind	Kohala
Puako Plantation	††	W. L. Vredenburg	S. Kohala
Niulii Sugar Mill and Plantation	*x	Robt Hall	Kohala
Puakea Plantation	*x	H. R. Bryant	Kohala
KAUAI.			
Kilauea Sugar Plantation Co.	**	A. Moore	Kilauea
Gay & Robinson	x*x	Gay & Robinson	Makaweli
Makee Sugar Co.		G. H. Fairchild	Kealia
Grove Farm Plantation	x	Ed. Broadbent	Lihue
Lihue Plantation Co.	x	F. Weber	Lihue
Koloa Sugar Co.	x	P. McLane	Koloa
McBryde Sugar Co.	*x	W. Stodart	Eleele
Hawaiian Sugar Co.	x°	B. D. Baldwin	Makaweli
Waimea Sugar Mill Co.	*	J. Fassoth	Waimea
Kekaha Sugar Co.	x	H. P. Faye	Kekaha

KEY.	HONOLULU AGENTS.	
*	Castle & Cooke	(4)
**	W. G. Irwin & Co.	(8)
***	J. M. Dowsett	(1)
x	H. Hackfeld & Co.	(9)
xx	M. S. Grinbaum & Co.	(2)
*x	T. H. Davies & Co.	(8)
**x	C. Brewer & Co.	(7)
x°	Alexander & Baldwin	(5)
x**	F. A. Schaefer & Co.	(3)
xx*	B. F. Dillingham & Co.	(1)
x*x	H. Waterhouse & Co.	(8)
††	Hind, Rolph & Co.	(1)