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NEW YORK SUGAR MARKET.—Willett & Gray Report.—Raws.—April 25.—A fair amount of raw sugars for sale, in the absence of the largest buyer from the market, enabled the independent refiners to obtain supplies at 1-16c. per lb. reduction, bringing the quotation for Centrifugals at 4 3-8c. for 96 deg. test. The weekly receipts were reduced to 29,857 tons, against 50,411 tons last week, and 34,686 tons for the corresponding week of last year. Meltings increased 3,000 tons, and will be larger as the fruit season approaches. All the sugars available will be required about as fast as offered for some time to come. Europe is rather above the parity of our markets, and likely to remain so, as they are strengthening during our weakness.

There has been no change in the quotations or conditions of the refined market at the East. A decline of 10c. per 100 lbs. was made at San Francisco, but not followed here. The only concession is the shading of a few grades of softs for round lots.

SUGAR IN WALL STREET.—The week has shown lively movements in sugar stock, both down and up, equal almost to its palmiest speculative days. The low point this week was $101 1-4, and the high point $118 1-4, closing at $118 1-8, with transactions of 557,378 shares.

Willett & Gray's Statistical says: "A large portion of the Java crop is being diverted elsewhere, and this is likely to continue throughout the year. China and Japan need heavy supplies to meet the deficiency in the Philippine crop, and India will also probably draw largely on Java, in consequence of the immense fall-short in its own sugar crop."

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THE WORLD'S CONSUMPTION OF SUGAR.

Each year public attention is called, in the commercial papers, to the steady increase in the production of sugar, the

last European beet crop having been about 400,000 tons more than that of the previous year. Some argue from this that the world's market may in time be overstocked, and the article become a drug. When it was announced that the European beet crop would exceed five millions of tons, as it has, the prediction was made that the price might drop to such a figure as to discourage both beet and cane growers, and lead them to abandon their cultivation. The crop has been harvested, and has yielded the predicted increase, yet the price has not been lowered, and instead of there being a surplus in the beet crop of forty or fifty thousand tons, as compared with the previous crop, no greater surplus for export has been found, while the price in Europe remains firm, creating a doubt in the minds of many as to the actual figures of the crop. Sufficient allowance had not been made for the steady increase in the consumption by the local European population. Probably millions use sugar daily now in Europe as a necessary article of food, who formerly regarded it only as a luxury. The large beet crop of Europe will only meet the growing demand of the local population.

Russia alone has a population of about one hundred millions, and although a large portion of the people are but little better than half civilized, yet as they advance in civilization they will acquire a taste for a luxury which will soon become a necessity. So with other European nations; they will all gradually demand sugar, first as a luxury and later as a necessary food. In this way the large sugar crops of Europe will be needed for her own people, while America will require and consume all the cane and beet sugars that can be manufactured within her boundaries. This home demand will call for all the beet and cane sugar that can be produced in her domain during the next twenty, and perhaps fifty, years.

Just now we find the cost of some staple products and many manufactured articles steadily increasing, and some wonder why the price of sugar does not advance with them. For instance, copper, iron, lumber and articles made from them, as also coal, have appreciated in value because of the extraordinary demand for manufacture in all kinds of work in which these staples are required.

The area of sugar beet cultivation is constantly increasing, but it only keeps pace with the demand for the staple. Consequently the price of sugar remains as it has been, notwithstanding the largely increased consumption. The cost of production is about the same for the two kinds of sugar, ton

for ton. So also with the yield per acre. The quality and richness of beets, however, is increasing each year, by the selection or perhaps skillful cultivation of the plants for mothers to serve as seed producers. In this Europeans have shown much skill, and met with success. Formerly, forty years ago, but one ton of sugar to the acre of beets or cane was considered a fair yield. This, however, has been steadily increased by the selection of choice plants, called mother beets, for producing seeds, till now some few varieties yield two tons, and one variety is said to have yielded three tons of sugar to the acre. This shows the success that attends skillful cultivation. Cane planters must follow the same careful methods in selecting the best seeds, and in preparing their fields, as do truck gardeners and beet growers, where it can be done. The rivalry is bound to be sharp, but patience and intelligent work will secure a rich reward, and the cane planter will hold his own, whether it be in Hawaii, Louisiana, the West Indies or elsewhere.

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DR. MAXWELL'S RESIGNATION.

The resignation of Dr. Maxwell, who has been in the service of the Hawaiian Sugar Planters' Association and of the Government for the past five years, has been announced, and he will leave for Queensland during the coming autumn, having accepted a position under the Queensland Government similar to that which he has held here. The sugar industry of that colony has for several years been in a very demoralized condition, and it will need most heroic measures on the part of the Colonial Government to redeem the industry from the very low condition into which it has lapsed. If any man can do it, Dr. Maxwell can, provided the sugar planters and the Colonial Government co-operate vigorously in carrying out the plan on which he proposes to operate. Dr. Maxwell arrived here April 2, 1895, and during his term of service has most unquestionably been the means of greatly improving the methods employed in cane cultivation and sugar manufacture, and has succeeded in raising the standard of work both in the field and in the sugar house, and consequently the outcome of the crop for each season. Hawaii may now be fairly ranked among the first of cane sugar countries, equalled only, perhaps, by Java. He has studied the capabilities of the group more thoroughly than any person who has ever been here, and his report to the United States Government, now being prepared, will probably furnish the fullest and most reliable data relative

to the agricultural capabilities of Hawaii that have yet been compiled. Dr. Maxwell will leave for his new field of service some time during the coming autumn.

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THE ARTESIAN WATER SUPPLY.

It is much to be regretted that any of our new sugar enterprises should be compelled from unforeseen circumstances to abandon efforts to open new fields for domestic industry, as has been the case with the "American" and "Kamalo" sugar companies, located on Molokai. The only cause that has led to this result is the lack of water for irrigation purposes. Molokai has an abundance of arable land, but no streams. Wells were sunk in different localities which gave excellent fresh water, and capitalists were encouraged to venture in the new enterprise, confident of success. But later on the water in these artesian wells became too brackish for cane cultivation, and the work on the American Plantation had to be abandoned.

It would seem possible from this that what has happened on Molokai may in future decades be repeated on our other islands, where artesian wells now supply abundant fresh water. The freshness of artesian water depends largely on the abundance of the rainfall which supplies the subterranean reservoirs. For this reason all of our wells should by law be placed under strict surveillance, and no new wells be permitted to be bored except after full investigation, and by special license by the Government, accompanied with such restrictions as may be deemed necessary for the protection of the whole artesian interest. If the subterranean reservoirs on Oahu should once be overtapped, causing a decrease in older wells, the warning must be immediately heeded, and a prompt and peremptory halt called, forbidding any new wells being opened. The average annual rainfall on Oahu may be an ample supply for the wells now in use, provided all water running to waste from them is rigidly stopped, but there must be a point when Nature will suddenly step in and shut down on all alike, and this may be nearer than any of us now think.

This underground storage is a mine of wealth provided by an all-wise Creator, and is too precious to be tampered with as though it were a mere toy designed for the pleasure and profit of those who are fortunate enough to receive the handsome incomes now derived from it. Let us cautiously surround it with whatever restrictions may be deemed necessary to preserve its value unimpaired for future generations.

THE PLAGUE, FIRE AND INSURANCE.

After an embargo of over four months, the quarantine on account of the bubonic plague in Honolulu has been ended, and all restrictions on trade and travel have been removed. When we state that the plague on this island of Oahu has been confined to the city, the benefit of the quarantine will be seen. Of the 71 cases, 61 were fatal, and a majority of these were Chinese. The property destroyed by order of the Government could not have amounted to over $200,000, while that caused accidentally by a high wind may exceed five times that sum. How far the liability of the Government is involved in this additional loss remains to be decided by the courts. Some compromise will probably be made, or at least should be. If, however, it should be refused, it will become a serious question whether insurance of local property should not be undertaken by companies organized and controlled here. There are very few cities where fires occur less frequently, or the amount of property destroyed by fire is less, than on these islands. No better field for the investment of local capital can be found than in the establishment of home insurance companies, whose field would embrace the whole group. The amount now invested in sugar mills and buildings connected with them, to say nothing of the large annual increase in dwellings, steamships, cargoes, etc., furnishes a field which ought to be controlled by local capital. The subject is one which should be discussed and fully examined by those who are familiar with it and the amounts which are now annually sent away, and which should be kept here.

This is a matter in which sugar planters and capitalists are directly interested. If taken hold of in earnest, it would give employment to many.

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A TRIUMPH IN SUGAR MAKING.

The fact that sugar of standard quality can be made from beets regardless of the purity of the juices, is one that has been prior to this year a disputed point. Those who are familiar with the work of the last campaign at the factory in Chino, however, know it to be a verity. This result is the outcome of the technical efforts of Superintendent J. McCoy Williams.

To the scientific sugar world this means an increased yield, as the success of working lower products into first quality of granulated sugar has not been accomplished before in the

States, and possibly such success for a whole campaign without making part of the syrups into raw sugar, is unknown in the sugar world. By this means a factory operates without unknown losses, and may still place on the market direct granulated sugar, all of a superior grade. The yield is naturally the best per 100 pounds of sugar, as the products crystallize well at the start, leaving but little crystalline properties in the last syrup for the Steffens process to extract, which enters finally with the fresh juice from the beet. The process of granulation is accomplished in one boiling, under Mr. Williams' process, as the juices are especially prepared to mix with the syrups. In the perfection of this mixture during crystallization, a uniform grain of sugar is obtained. This shortens the process over the usual way, from one to two boilings.

We take pleasure in congratulating Mr. Williams, an American superintendent, on having perfected this new system of treating the juices in process, which, we learn, differs technically in many details from any ever before used. Mr. Williams is a liberal thinker, active in all departments and especially popular among the workingmen, who highly esteem his fair treatment. Those who are thrown with him may hear him say, when referring to the campaign, "If it were not for the interest the men took, this would not have been done." He never wishes to detract credit from his fellow co-operators. The secret of success lies in perfect control of the details of the work, closely followed by the truly interested workingman. Mr. Williams' geniality has won for him respect. The "Champion" is in a fair way to hear outside opinion, and upon further inquiries finds it had all the more reason to say in recent issues, "This ends, in some respects, the most remarkable campaign Chino or any other sugar factory ever had." The factory employees will be glad to welcome Mr. Williams back from his Eastern trip.—Chino Champion.

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ANNEXED AT LAST.

The welcome news of the final annexation of Hawaii to the United States was received by the last mail from San Francisco. It has been a long struggle to accomplish this political change, dating from the advent of Elisha H. Allen in 1850, and advocated by most of the American officials stationed in Honolulu from that time till now. That these islands should naturally be a part of the United States, if annexed to any power, has been often admitted by European

diplomatists and by all well informed public men of any nationality. That they will also prosper in a larger degree by this union than in any other way is also clear to every reasonable person. President McKinley has acted wisely in selecting Hawaiian citizens to fill the more important positions in the first Territorial Government, as it will tend greatly to inspire confidence with the native Hawaiians in the new order of things, and remove every cause for distrust on their part.

The appointment of Mr. Dole by President McKinley to be the first Governor of Hawaii, reflects credit on the good judgment of the President, and meets the wishes of an almost unanimous majority of the people of Hawaii, including both natives and foreigners. The fact that he has administered the office of President for seven years with satisfaction to resident foreigners, as well as to the native population, and is familiar with the local customs and institutions, and that all have the fullest confidence in him, naturally point to him as the fittest person to steer the Hawaiian territorial craft during the first few years of its voyage on the stream that may eventually lead us to statehood.

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"California," says a recent visitor from the East, on his return from a short visit to that State, "has a great future. The extension of American commerce with Japan, China, the Philippines and Siberia, is stimulating commercial enterprises all along the Pacific coast. Railway extension in Siberia and China is opening up vast territory, having an immense population, which will become free consumers of American products; and California is most favorably situated to command a large share of the commerce. Then add to these newly acquired advantages the wonderful natural resources of the State, and it warrants an optimistic view of its future. The discovery and development of oil-producing territory in Southern California is one of the most marked of recent features." In this expansion of trade and agriculture Hawaii is sure to share and reap a benefit.

We have received from the author, Wm. L. Barr, of 149 William street, Brooklyn, N. Y., several pamphlets treating on the manufacture of sugar, including extraction, concentration, crystallization, etc., with illustrations of the latest machinery employed. For those engaged in sugar boiling, the pamphlet will be very serviceable. It is printed in English and Spanish, and can be seen at the Planters' Association rooms.

ASIATIC IMMIGRATION.

The immigration of Japanese and Chinese to Hawaii having been stopped, the tide has turned to the north, and large numbers are now crossing the Pacific by way of Vancouver. Of course it is for the interest of the steamship owners to encourage this immigration, which, as it reaches the mainland, disperses to the North, the East and the South, and in a few days the wily immigrants, by a change of clothes and the assistance of confederates who have preceded them, are scattered among the hills and forests, where they remain till they find employment and become settlers, at very scanty wages. There are now in Hawaii more Asiatics than are required for labor in all kinds of work, and in consequence there will be a disposition on the part of the unemployed to create dissatisfaction among those employed. For the present, at least, compromise settlements of disputes and demands seem to be the wisest course to pursue; the time may come when the authorities may be compelled to interfere in order to prevent destruction of property and to secure the punishment of those instigating incendiary acts.

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WHERE SUGAR IS PRODUCED.

Figures just compiled by the statistical bureau show a remarkable transfer of sugar production from tropical plantations to temperate farms. It appears that 95 per cent. of the sugar crop of the world was in 1840 supplied by sugar cane, a tropical product, and 5 per cent. from beets, a product of the temperate zone; while in 1899 but 34 per cent. of the world's sugar supply was from cane and 66 per cent. from beets. How much of this is due to the disappearance of slave labor, which existed in all cane-producing territory at the beginning of the period under review, is left to the consideration of economists and sociologists. The total cane sugar crop of the world is given at 2,862,000 tons, while the sugar importations of the United States in the calendar year 1899 were 1,664,170 tons, so that if all the cane sugar product of the world in 1899 were massed together and the local consumption of the countries of production deducted, the remainder would more than equal the importations of the United States alone in that year. It is not to be understood from this statement, however, that the United States does in fact import all the world's surplus of this sugar. On the contrary, our consumption of beet sugar is steadily increasing, and was in the fiscal year 1899 greater than that of any pre-

ceding year in our history, with the single exception of 1897, when the imports were abnormal by reason of expected changes in the tariff law. The total imports of beet sugar in the fiscal year 1899 were 723,336,252 pounds out of a grand total of 3,517,950,689 pounds, so that beet sugar, having captured the markets of Europe, is now supplying one-fifth of the imports into the United States, despite the proximity to the United States of so large a proportion of the cane sugar producing territory of the world.—Wichita, Mich., Price Current.

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WEST INDIAN SUGAR CONFERENCE FOR 1900.

By recent mails we have received copies of the "West Indian Bulletin," a new publication, issued at Bridgetown, Barbadoes, and devoted chiefly to sugar and other branches of tropical agriculture, and issued under the patronage of Dr. D. Morris, Imperial Commissioner of Agriculture for the West Indies. The monthly promises to become a valuable addition to sugar cane literature, judging from the list of those engaged in the agricultural department in the six or eight islands embraced in the British West Indian Colonies, the names of forty officers being published in the list as so employed, some of whom have long been known as leading writers in sugar cane literature.

The conference opened with an address from the president, Dr. Morris, from which we quote quite freely a few paragraphs relative to one of their best canes, showing the lines on which the West Indian experts are working in their efforts to improve the sugar cane:

"New seedling canes continue to be raised in most colonies. Their merits, so far as known, are fully given in Reports issued locally. The Barbadoes Seedling No. 147, prominently referred to at the last Conference, has fully maintained its position in this island, and after six years' experience is regarded by planters as a most valuable variety. Under favorable conditions of soil and climate, the amount of available sugar contained in it at Barbadoes is at the rate of 3 1-2 tons of sugar per acre. As illustrating what the planters think of this cane, I quote the following from the fortnightly summary of the Barbados Agricultural Reporter, December 23, 1899:—'The ups and downs of this season's rainfall has

enabled us to study more closely the behavior of the new varieties under the stress of the continued dry weather. So far it certainly appears that in the matter of endurance, as well as in many other good points, B. 147 clearly takes the lead. Where planted with other varieties the contrast is strongly in its favor. A midland planter, who is a very close observer, found in a mixed field of White Transparent and B. 147, that the latter had, on the average, about double the number of stout canes to the hole—no small advantage when we consider the sugariness of the new variety—for the difference may be measured by many tons of sugar. B. 147 has, too, 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 we saw lately cut for plants, was remarkably free from the common cane-borer, of which it was very difficult to find even a single specimen.' There are other promising canes, such as the Demerara cane (D. 145), which, after experimental trials extending over five years, has twice shown results surpassing even those of B. 147. It is apparently very susceptible to drought. About twelve varieties in all are under experimental trial on plots of several acres, distributed over the island, under the ordinary conditions of estate cultivation. In addition there are several varieties taken up by private planters. The Bourbon cane, until a few years ago almost exclusively cultivated here, has now been discarded in favor of new varieties. In addition to raising new varieties from seed, experiments are in hand with canes raised as the result of 'bud variation' or sport. A striking instance of this mode of variation in a red-ribbon cane was obtained last year. A drawing of the original cane, as also of the sport derived from it, is shown today. Also of canes grown from the latter. According to Professor Harrison, 'the best seedling varieties at Demerara have been obtained from the red-ribbon cane.' This indicates a special susceptibility of variation in this cane both in seedlings as well as in sports.

"In every sugar-producing country great importance is attached to improving the quality of the particular plant yielding sugar. In European countries, the amount of sugar yielded by the beet has been nearly doubled within a comparatively short period. Until within the last ten years, nothing had been done on similar lines to improve the quality of the sugar cane. This work was only possible when, by a fortu-

nate circumstance, the power of the sugar cane to produce fertile seed was fully realized. This occurred almost simultaneously in the East and West Indies—in Java and Barbados. This island is, therefore, to be congratulated, no less than those personally connected with it, in having been among the first to grasp the practical bearing of this fact. The point now is to utilize to the utmost the capabilities of the cane in this direction and endeavor to place it in an equally favorable position as the beet. The experiments so far carried on, though on a limited scale, have been most encouraging. We have results from Java, the Hawaiian Islands and Louisiana, all confirming those obtained in the West Indies. I have recently cited those obtained in British Guiana. I would now draw attention to a seedling cane obtained in Barbados of a most promising character. (Dr. Morris here exhibited a bunch of fine canes that had previously been brought in and placed in the upper part of the hall.) It was raised at Dodds Botanical Station, and is known as Barbados, (or shortly) B. 147. I quote from a letter written by Mr. Bovell (who raised this cane) as follows:—'This cane has been under cultivation here for the past five years, and it has during that time given an average yield of nearly half a ton of valuable sugar per acre over the "Caledonian Queen," which comes next, and more than three-quarters of a ton more than the "Bourbon." All the planters who have tried it speak favorably of it, and I have no hesitation in recommending planters in the black soil districts to plant this year about a third of their estate with it.'

"Mr. Bovell adds the following comparative statement of the average results for five years obtained at Dodds with the seedling cane, B. No. 147, and certain other canes usually cultivated in Barbados:

Name of Cane.	Sucrose per Imperial Gallon lbs.	Glucose per Imperial Gallon lbs.	Average available Sugar per A. lbs.
Seedling No. 147..	1.794	.114	7,190
Caledonian Queen.	1.980	.041	6,137
Rappoe..	1.922	.041	5,929
Naga B.....	1.937	.051	5,894
Bourbon...	1.775	.086	5,210
White Transp'n't..	1.804	.086	5,275

The best proof of the value attached to this cane B. 147 is the keen demand which has arisen for it amongst the planters themselves. Several fields of it exist in different parts of the

island, and it is reported as having actually yielded as high as three tons per acre. This year about 200 acres will be established on one group of estates.

REDUCING COST OF CULTIVATION.—Side by side with the raising of new canes and the cheapened and improved manufacture of sugar, we have to consider the reduction of the cost of cultivation. For instance, at present, it is estimated that the system of manuring adopted at Barbados costs at the rate of £6 per acre per annum. Whether this large expenditure is absolutely necessary can only be decided after careful and exhaustive experiment. Efforts in that direction are now being made. It may be possible, but it is not yet proved, that a good deal of the artificial manure now applied to the land is not really effective in producing a corresponding extra yield of sugar. Similarly with the costly system of pen manuring now employed. A re-examination of the value of green manuring as an economical means of fertilizing cane lands, deserves careful consideration.

"It has long been known that the fertility of arable land was greatly increased by occasionally growing leguminous crops, such as beans and peas. The practice has already been followed in the West Indies. Since Hellreigel discovered a few years ago the scientific explanation of the part played by leguminous crops in fixing the free nitrogen of the air, the subject has assumed great importance. It is possible, by using exactly the right plants and treating them in the most advantageous manner, that we shall find in green manuring a means of enriching cane soils at a comparatively small cost. Mr. Bovell will read a paper, which I trust will lead to a useful discussion on the subject. There will also be shown numerous specimens of leguminous plants, with nodules and tubercles attached to their roots and a slide showing the microscopic organisms inhabiting them having the power of fixing atmospheric nitrogen and thus enriching the soil. The cost of cultivation may also be reduced by increased attention to rotation and catch crops, thus growing to a larger extent than at present the foodstuffs and supplies imported from other countries.

The following extract from a paper read by Mr. Bovell shows the diseases that cane has to contend with in the West Indies:

"For nearly two centuries the sugar canes in the West Indies have at certain periods been subject to various animal and vegetable pests, for we find from Schomburgk's History

of Barbados that as far back as 1518 the island of Hispaniola, or Hayti, as it is now called, was almost abandoned in consequence of an ant, which in that and in the two succeeding years overran the island, devouring all vegetation. About 1760 they showed themselves in Barbados, and caused such devastation that it was deliberated whether the island, formerly so flourishing, should not be deserted. In 1763 they were found in Martinique, and in 1770 in Grenada. So great was the destruction which they wrought, that in 1776 the Government of Martinique offered a reward of a million of their currency for a remedy against the plague; and the Legislature of Grenada £20,000 for the same object, but all attempts to get rid of them proved unavailing, until the hurricane of 1780 effected what man had been unable to accomplish. In 1814 they again made their appearance in Barbados, but did not long continue to do much damage. From then on, until the latter half of the last decade, the canes in the West Indies seemed to have been singularly free from any pests, with the exception of the moth borer.

However, about that time fungoid diseases began to show themselves amongst the canes, not only in Barbados and the other West Indian Islands, but in almost every sugar-producing country in the world.

At the present time the insect and fungoid pests known to be attacking the canes in the West Indies are:

(a) The Moth Borer—Diatroea saccharalis.
(b) The Rind Fungus—Trichosphaeria sacchari.
(c) The Root Fungus—Colletotrichum falcatum.
(d) White Blight—One of the Dactylopieae—probably Dactylopius calceolariae.
(e) Black Blight. A disease apparently caused by the fungus growing on the excretion voided by Dilpliax saccharivora.

The shot borer, Xyleborus perforans, and the lady-bird borer, Sphenophorus sacchari, are found on decaying canes, but so far the preponderance of evidence with regard to these tends to show that they are saprophytic, not parasitic. Consequently, we may, for the purposes of this paper, take no further notice of them.

Of the foregoing pests, the moth borer has been known for many years, and was first described by the Revd. Lansdown Guilding at St. Vincent in 1828.

Prof. Bovell also remarks: "The difference between the Bourbon and Caledonian Queen is very marked, as they are

quite close together, only a small drain about two feet wide dividing the two fields. In the one with the Caledonian Queen it is almost impossible to pass through on foot, while in the other with Bourbon, one can ride between the rows without the horse injuring the canes."

Prof. Harrison, speaking of experiments with seedling canes, says: "This is probably the most promising line of experimentation to be carried on. It is important to ascertain from which of the older varieties the most promising seedlings are obtainable, and to use them as parents. Unfortunately the ease with which fertile seed is produced by many of the new varieties is so great compared with that of the more valuable of the older varieties that it appeals to us; therefore much more attention is being given to raising seedlings from new varieties than from the older canes. Our belief is that valuable varieties are more likely to be obtained from the striped kinds than from others, the striped ones showing a remarkable range of variation among their offspring. So much has been written and said about seedling canes and their selection in accordance with certain characters that it is not necessary for us to add anything more.

"In our opinion too much stress is being laid by some writers on the advantage of canes having a short period of growth; we believe that weight of cane per acre and consequent weight of sugar will only certainly and regularly be obtained by canes having a relatively long term of vigorous growth. We have very grave doubts if, on the large scale, the exceptionally sweet but small cane of short growth will hold its own against canes of medium to fairly high saccharine strength of longer period of growth. The latter, as far as our experience goes, are the more promising."

The following paragraphs are from Prof. Albuquerque's report:

"The discovery that the sugar cane produces fertile seed, from which can be reared canes of the most varied size, habit and richness of juice, has opened to cane growers all the potentialities of the wonderful means of variation embodied in the fertilization of the oosphere or the fusion of two different cells. The researches of Messrs. Harrison and Jenman, more than any others, have been directed to investigate the relations between the mother parent cane and its seedling progeny, which all ideas and conclusions on the subject of heredity compel us to believe must exist between the qualities of parents and their offspring; and these researches have shown

relations of an important kind. They have shown that, as a rule, "the average size of the (mother) variety" * * * "closely governs" (with exceptions) "the size of the offspring" that the same may be stated in regard to color; but the sugar contents of the juice, glucose ratio and quotient of purity, present in the offspring very wide variation on both sides of the mother variety, so that, to quote their words, a "seedling from the Mani cane" * * * "is equally likely to contain only 1 pound sucrose per gallon in its juice as against 1.7, about what the parent variety averages, whilst it may contain 1.9 pounds;" and they tell us "to obtain canes richer in sugar than the Bourbon and other old established varieties we are compelled to proceed purely on experimental lines by selecting the finest seedlings of a few appreciated varieties, and, from among them, picking out, after a few years' study of them both as plants and rattoons, those which give the greatest yield of cane of the highest saccharine strength and purity." It would appear, therefore, from these researches, that the size (and color) of seedling canes varies to a moderate extent on either side of the mother variety, and that, in order to improve the cane in the latter respects, we must trust to repeated trial to give us the canes we seek for. * * *

It will be obvious to every worker interested in the question of improving the sugar cane, that at present there is no existing cane which combines all the characters, and in the degrees which are desirable from the point of view of the sugar producer. The first and foremost are, heavy tonnage of cane per acre, and richness in sugar: and I suggest that by fertilizing a large number of arrows of some heavy tonnage variety (as rich in sugar as we can find such a variety) with pollen from some variety very rich in sugar (and of as heavy a tonnage as we can find such a variety), we ought to be rewarded with at least some seedlings possessing a larger than ordinary measure of both characters. Other characters that we would seek to incorporate as far as consistent with the above would be early power in the tops, resistive power to fungoid and insect attacks, pure as well as rich juice, good milling properties, etc.

PRESIDENT MORRIS.—The first business proposed to be taken this afternoon is to consider the present position of efforts to supply Central Factories to the smaller sugar islands (especially Barbados and Antigua) that are not already possessed of means for manufacturing sugar of a high quality, and at a cost that will enable them to compete successfully in the markets of the world. Until this problem is satisfac-

torily solved, the efforts of the Imperial Department of Agriculture to be of service to these islands will be seriously crippled. I regard it as of fundamental importance that these sugar islands should be provided with Central Factories, otherwise any benefits arising from raising new varieties of canes and generally improving the cultivation will be neutralized by the loss in the process of manufacture. This loss is estimated at from 30 to 40 per cent. It is impossible for any industry to succeed where such a loss is sustained.

Further, the sugar produced is of an inferior kind, and is suited to one market, and that a precarious one. Just now West Indian sugar of high quality, owing to the effect of countervailing duties in the United States, realizes about 30d per ton more than last year. Unfortunately, the low-grade sugars, such as muscovado, largely produced in these islands, do not fully share in the benefit. This supplies another argument in favor of Central Factories. It must also be remembered that the United States market may not always be open to us. We have it on the authority of a Cabinet Minister, the present Secretary of the United States Department of Agriculture, that owing to the phenomenal expansion of the beet industry, "there is abundant encouragement to lead us to conclude that our country will within a few years produce what sugar it requires." If muscovado sugar cannot compete in a protected market like that now existing in the United States, it is certain that it must fail in any market where it would come into open competition with beet sugar. It is probable also that all the cane sugar produced in Porto Rico (about 100,000 tons annually), as also the enormously large quantity likely to be produced in Cuba (before the war this amounted to about 1,000,000 tons) will all be shipped to the United States.

Since this time last year you will have noticed that a considerable amount of valuable information has been brought together, but that information only deepens our conviction as to the necessity for immediate and decisive action in regard to Central Factories. I confess that I am not in a position—and I believe no man living is in a position—to suggest any industry that would immediately take the place of sugar in Barbados, Antigua and St. Kitts-Nevis. If these islands are to prosper at all, it must be by means of the sugar industry. There is hope for other colonies, for they can profitably grow coffee, cacao, limes, arrowroot, fruit, etc., and thus supplement their sugar industries. For the islands I have mentioned there is none.

UTILIZATION OF EXHAUST STEAM.

Efficiency of Steam Engines Increased More than One-half.

Considerable comment has been aroused in all parts of Germany of the surprising results attained by Prof. E. Josse, of the Royal Technical High School, at Charlottenburg, with the use of exhaust steam for the generation of power. As is well known, the ordinary simple high pressure engine, which, after passing steam through one cylinder, discharges it into the air, utilizes hardly more than five per cent. of the value of the fuel consumed under its boiler. The compound engine, in which the steam, after passing successively through two, three or more cylinders, is condensed, and the warm water of condensation restored to the boiler, utilizes under favorable conditions twelve to thirteen per cent. of the fuel energy, and there the economy appears to have stopped.

The new principle involved in the Josse form of engine has made possible a return of power for fuel consumed which has heretofore been entirely impossible in steam engines. Already a large company has been formed in Berlin for exploiting the new principle and three of the largest electrical works in the city are expected soon to install engines of this type.

A complete and what appears to be an accurate non-technical description of the experimental engine employed at Charlottenburg has been transmitted to the State Department by United States Consul-General Frank H. Mason, of Berlin. From this report it appears that the process is the joint discovery of Mr. G. Behrend, a Hamburg engineer, and Dr. Zimmermann, of Ludwigshafen; and, although first patented in 1889, it has only recently been matured and its application perfected by the employment of an auxiliary engine, which, utilizing the heat contained in the exhaust steam, gains as high as 56 per cent. additional motive power without increasing the expenditure of fuel. The principle and process involved are simple and Mr. Mason describes them as follows:

It is plain that, with all progress which has hitherto been made in steam-engine practice through higher pressures, superheated steam, economical cut-offs, or successive, cylinders there is always an important and inevitable loss of heat energy when the steam, having done its work, is discharged into the open air or changed back to water by contact with cold water in a condenser. When the exhaust is into the open air, the steam has a temperature of about 100° Celsius

(212° F.): when it passes into a condenser, the steam has a temperature of 60° to 70° Celsius (140° to 160° F.), according to the vacuum. The corresponding latent heat of steam, given up upon change of form from steam to hot water, has hitherto to run to waste in the condensing or cooling water, or in the air. Messrs. Behrend and Zimmermann attacked the problem of utilizing this wasted caloric by employing it to create a new supply of steam by evaporating some liquid which has a lower boiling point than water, and for this purpose they chose, after many experiments, sulphurous acid, which is not only cheap and easily obtained, but has the further advantage of a viscous consistency and lubricates the inner working surfaces of the machinery without corroding them. Their demonstrations, although not practically conclusive, were so promising that Professor Josse, as a technical authority on this subject, took up the problem, and, after several months of highly satisfactory laboratory experiment, caused to be constructed and connected with an ordinary working steam engine of the compound type an additional condenser and auxiliary engine, the power of which could be exactly measured.

The engine employed in these experiments was an ordinary compound steam engine with a stroke of 500 milimetres (19.69 inches) and a speed of 41.5 revolutions per minute. In the engine, as altered for the new process, the exhaust steam is made to pass from the low pressure cylinder into a surface condenser, called the "vaporizer." In this vaporizer or condenser, the cooling medium used, instead of water, is liquid sulphurous acid, which has a boiling point so low that it is immediately decomposed by the heat of the exhaust steam, whereby the sulphur dioxide gas is liberated, which passes over into the cylinder of an auxiliary engine, where its work is done as in an ordinary steam engine. The auxiliary cylinder has a diameter of 300 milimetres (11.81 inches) and a stroke of 500 milimetres, with a speed of 77 revolutions per minute.

After passing through this cylinder, the sulphurous vapor enters the surface condenser, around the tubes of which cold water flows as in an ordinary steam plant. Here the sulphurous vapor is condensed to liquid and is forced by a pump back into the vaporizer, where it begins its cycle again, the same sulphur dioxide being used over and over again indefinitely. There are, therefore, in fact, two condensers, the first serving, as it were, as a boiler or steam generator for the auxiliary engine; and this boiler, instead of being fired by coal, obtains all

its heat from the exhaust of an ordinary steam engine, and instead of converting water into steam, evaporates a liquid which is much more volatile, i. e., has a far lower boiling point.

In the long series of recorded tests with the plant, the following results were attained:

The steam engine is of the compound type, of good, modern construction, and being given a steady load, developed 34 indicated horse power, with a consumption of 8.6 kilograms (18.96 pounds) of steam per indicated horse power hour. The auxiliary machine working with sulphurous vapor indicated 19 horse power—that is, an increase of 56 per cent., and yielding, instead of 1 horse power, 1.56 horse power for the same steam consumption and reducing the steam consumption from 8.6 kilograms to 5.5 kilograms (from 18.96 to 12.13 pounds) per indicated horse power.

The experiments showed on the average that for every 15 kilograms (33.169 pounds) of steam passing through the main engine, 1 horse power could be gained in the auxiliary machine. Applied, therefore, to an ordinary single cylinder steam engine, exhausting into the air at high temperature, the percentage of power saved by this new device would be very much higher than the economy reached in these experiments, which, as has been shown, were made with a highly improved compound engine. From the average of these experiments, it may be broadly stated that, given a fairly economical compound engine, using 7½ kilograms (16.5 pounds) of steam per indicated horse power hour, half an indicated horse power could be produced in the auxiliary machine for every indicated horse power developed in the main engine.

The expense of this improvement is practically all in the construction cost of the vaporizer, condenser and auxiliary engine itself, and its economy may be realized from the fact that the exhaust steam from a 2,000 horse power central station engine should furnish power to drive an additional 1,000 horse power engine, which can be connected as an extra cylinder to the steam engine or run independently, and this increase by 50 per cent. the power developed without adding a pound to the quantity of fuel consumed.—Manufacturer.

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The shipments of sugar, of the current year's crop, from these islands, to December 31, amounted to 82,442 short tons, showing a large decrease from the shipments of the previous year, caused by the plague. The entire crop will exceed that of 1899.

NOTES ON CRYSTALLIZATION.

From Fock's Introduction to Chemical Chrystallography.

The empirical law governing crystallization may be stated in the following terms: When a substance separates from a solution in the crystalline form owing to withdrawal of the solvent, the crystals are the more irregular in shape, in proportion as the separation occurs with greater rapidity, in proportion as the solvent is more viscid, and in proportion as the substance is less soluble. (Lehmann.)

During the growth of a crystal the mother liquid or solution in which it grows must be to a certain limited extent supersaturated, and, the effect of the crystal's growth being to attenuate the solution in its immediate neighborhood, this condition of supersaturation has, in order to allow of further growth, to be maintained by diffusion from some more distant portion of the solution, or the attenuation may be counteracted by evaporating the surplus solvent, as happens when masse-cuite is boiled in a vacuum pan.

Since the solubility of most substances is less at low than higher temperatures, crystallization may generally be looked for on cooling a saturated solution, the condition of supersaturation necessary for crystal growth being maintained, and attenuation counteracted, by the solvent capacity of the solution diminishing as the temperature falls. The latent heat of crystallization given off on change of state from liquid to solid during crystal growth in a cooling solution, retards the rate of cooling, increases the strength of the diffusion currents amongst the crystals, and to a certain extent assists in counteracting attenuation by evaporation. The principle has been often enunciated, that complete immobility is necessary to the formation of good crystals, and that all shaking should be avoided as much as possible. This rule is, however, of only limited application. Wulff showed that it is not the motion of the solution per se which acts injuriously during the process of crystallization, but only a subsidiary action which accompanies the movement. During evaporation and cooling slowly, layers of different temperatures and different concentrations are formed in a crystallizing solution; the heat liberated by the separation of solids also contributes towards this result. Under these conditions any agitation will cause the various liquid strata to mix directly, instead of being mixed by the slower process of diffusion; further, a super-saturation

will set in, in all those cases in which a rise of temperature of the solutions is accompanied by a more than proportional increase in the solubility of the dissolved substance. This latter is indeed usually the case, and agitation consequently occasions a sudden separation of the substance, preventing the formation of good crystals. If, however, these layers of different temperatures and concentrations are never allowed to form in the solution, movement has no injurious effect. In the process of sugar boiling the solution is undoubtedly in a state of violent agitation, yet the most beautiful crystals frequently separate, and Wulff moreover states that better and more regularly developed crystals are deposited from agitated solutions than from those kept at rest. In order that shaking should be without injurious effect, the following conditions must therefore be fulfilled:

(1) The motion must be continuous, because during pauses layers of different temperatures and different concentrations would begin to form, and, on recommencing the agitation, partial super-saturation would set in and rapid crystallization would become possible.

(2) The motion must be of such a kind that the growing crystals are continually washed into different positions, otherwise structural anomalies might easily make their appearance.

If, therefore, the formation of a crystalline meal which exercises so injurious effect on the formation of well developed individual crystals is to be prevented, the decrease in the amount of the substance held in solution caused by cooling or by evaporation must be brought about slowly, when all the separating material will be taken up regularly and normally by the crystals present. In the ordinary course of boiling a sugar solution to grain in a vacuum pan, the solution is first concentrated to that degree of super-saturation allowing the sugar to crystallize out of it. These crystals grow at the expense of the remaining sugar in the boiling solution, the continuous agitation of the crystals by ebullition placing them under the best conditions to facilitate their growth, while at the same time the evaporation counteracts the attenuation of the solution and maintains the necessary degree of super-saturation.

When a masse-cuite consisting of sugar crystals and the super-saturated mother liquid from which they crystallized out and grew in during boiling, is cured hot, and the mother liquor separated, with the mother liquor is removed its crystallizable sugar content at the temperature at which separation took place. Whereas, had the masse-cuite been allowed

to cool slowly under conditions favorable to crystal growth, the crystals would have continued to grow from the sugar present in the mother liquor, the consequent attenuation of this being counteracted and super-saturation maintained by the diminution of the solvent power of the mother liquor due to the gradual lowering of its temperature, instead of by the evaporation which takes place in the vacuum pan, the result being a gain in the weight of sugar obtained, with a corresponding diminution of the crystallizable sugar contents of the mother liquor. From Herzfeld's recent determinations and his recalculation of Flourens' data regarding the solubility of pure sugar in water at different temperatures, the quantity of sugar that would crystallize out from a saturated solution on account of the altered saturation point consequent on altered temperature can be ascertained, it being noted that the calculation must be based on the water content and not on the volume of the solution. Thus, taking a saturated mother liquor consisting of pure sugar and water at 71% C., say 160% F., cooled down to 15% C., say 59% F., the sugar content at the higher temperature would be 76.43% and water content 23.57%, or 3.24 units of sugar held in solution by each unit of water; on cooling to the lower temperature the sugar content would fall to 66.33%, with a water content of 33.67, or 1.97 units of sugar held in solution by each unit of water. Assuming no loss of water during the cooling, 3.24—1.97=1.27 units of sugar per unit of water contained by the mother liquor at the higher temperature will crystallize out while cooling to the lower temperature, showing the importance of reducing as much as possible the water content of the mother liquor. Or, stating the figures differently, from every 100 lbs. of the mother liquor at the higher temperature, 29.9 lbs. of sugar would crystallize out of cooling. Herzfeld, while specifically stating that his figures are only correct as far as solutions of pure sugar and water are concerned, adds: "For more or less impure solutions other conditions hold, but for the almost pure solutions commonly handled they will be found not inaccurate." The solution at the lower temperature remaining saturated, the sugar crystallizing out may be taken as representing the gain theoretically obtainable by utilizing the aggregative power of the crystals during the cooling of the mother liquor.

On the other hand, from consideration of the foregoing it will be seen that to cool a first masse-cuite down rapidly in the hope that as the whole mass soon becomes solid more sugar

will be obtained, is a mistake. During rapid cooling the crystals are at once placed under conditions which prevent their further growth with about as much certainty as when the masse-cuite is cured hot from the vacuum pan. Since the density and the viscosity of the mother liquor, increasing as cooling progresses, soon prevent its circulation between and around the crystals, and the precipitation of small sugar crystals will take place owing to the solvent capacity of the mother liquor diminishing rapidly with its fall in temperature, a small proportion of this precipitated meal sugar will attach itself to the l arger crystals present in the masse-cuite, but the greater portion of these small crystals will remain merely entangled amongst the larger ones and escape during cold curing. To facilitate the subsequent cold curing of such a mass and cleanse the larger crystals, water in some form and quantity is usually employed, which has unavoidedly a certain solvent effect on both small and large crystals, diminishing yield and increasing crystallizable sugar content of the so-called molasses.

The immediately preceding remarks apply more particularly to cases when first masse-cuite is cured cold after comparatively quick cooling in small crystallizers or "Kasten," in which it is allowed to set hard. When first masse-cuite is allowed to cool down in large coolers having, as usually constructed, a limited radiating surface for their capacity, the rate of cooling is reduced, and to that extent the continuation of the growth of the crystals is favored, the latent heat given off during such growth assisting in the prolongation of the cooling. At the same time it must be remembered that, the crystals remaining stationary, there are only the diffusion currents produced by their own growth, impeded by the resistance met with in circulating through the mass, to counteract the local attenuation of mother liquor. Consequently, crystal growth can be but slow, and before much is effected the mass will become a hard compound of semi-solid mother liquor, crystals, and precipitated meal sugar, very similar to that produced by more rapid cooling. When low masse-cuite is struck "blank" into large coolers, although the conditions are somewhat more favorable to crystallization than in the case of rich masse-cuites, owing to the composition of the lower mother liquor rendering its progress slower and more gradual, it will be seen that as the crystals first separating from the super-saturated mother liquor attain appreciable weight, they will gravitate to the bottom of the cooler, where, remaining at rest, their growth is,

for reasons already given, slow, and further interfered with by the deposit on them owing to fall of temperature, of successive crops of different sized crystals from the supernatant mother liquor. These conditions are only partially favorable to the exhaustion of the sugar content of the mother liquor, in such a form as to minimise after-loss in curing and secure the theoretical yield in cured sugar. In connection with the crystallization of low sugar solutions in large tanks where the radiating surface is small, it is interesting to note that it is by no means a rare occurrence in refineries, when a liquor of somewhat too high a quality has accidentally been boiled blank and correspondingly rapid crystallization has taken place, to find that the heat given off during crystallization has raised the interior of the mass to so high a temperature as to partially caramelize it. In the other direction, a low masse-cuite may have its density so rapidly increased by cooling as to prevent crystallization taking place without re-heating and subsequent gradual cooling, a method of treatment which has been utilized to retard crystallization taking place in residual molasses reboiled in order to produce treacle or syrup for table use.

In addition to the general laws affecting crystallization already touched upon, the following will repay consideration:— Although the generally accepted statement as to crystals not taking up during their growth, even in impure solutions, other than their own constituents, may be sufficiently accurate for all practical purposes as far as regards the substance actually crystallizing out, that is to say, the intimate particles of which the crystals are built up, it cannot be so as regards the total bulk of the individual crystals, each of which contains occluded in the interstices between the particles referred to, its interstitial content of the mother liquor in which it grew. Each crystal also carries with it a surface coating of the mother liquor, the amount of which depends upon the conditions under which separation took place. If this surface coating be removed by washing with a solvent, the crystals will be found to have a tint corresponding to that of the mother liquor, which no further washing will alter except to the extent of the reduction of the apparent depth of the tint due to the loss in bulk of the crystals by the action of the so lvent. It may also be remarked that the fact of the absorption of coloring matter by crystals, is utilized in the manufacture of sugar candy, as, when yellow or dark brown candies are required, glucose or uncrystallizable sugar is added to the liquor, or a liquor con-

taining a certain proportion of glucose is employed, which under the temperature conditions to which it is exposed produces a colored mother liquor from which are obtained crystals of the required color. From the above it may be fairly assumed that the smaller the crystals obtained from a solution consistent with sufficient bulk to withstand surface cleansing, the purer will be the solution made from them, a deduction borne out by Maumene's remarks as to the mistake sometimes made in selecting sugar candy in large crystals as the best source of chemically pure sugar.

The methods of treating masse-cuite and the apparatus employed to obtain a greater yield of cured sugar from the concentrated juice are now so numerous as to put any attempt at description, or even enumeration of them here, quite beyond the scope of these notes. Attention, however, may be drawn to one of these systems as presenting several interesting features. The system referred to consists in feeding the boiling masse-cuite for a considerable period prior to its being struck from the vacuum pan, with molasses or mother liquor, from a previous strike, cleared of small crystals by heat, instead of with the concentrated juice, and when the pan is full its contents are struck into closed coolers or crystallizers connected with the condenser of the vacuum pan, in which the masse-cuite is mechanically stirred in vacuo for 16 or 24 hours, within which time it is found to cool down sufficiently by radiation, assisted only by the slight evaporation which takes place, to give satisfactory results. Under the conditions obtaining in the coolers, the mother liquor in the masse-cuite for some time after entering them increases in density, due to loss of heat by radiation, concentration produced by sensible heat of mass, and latent heat given off during the growth of the crystals exceeding attenuation produced by it. This increase in density is corrected by feeding the masse-cuite with molasses, as was the case while boiling, which keeps it in a perfectly free and open condition, allows of crystal growth, and facilitates its discharge to the centrifugals, which is effected by closing connection to condenser and applying compressed air to the surface of the masse-cuite. Although this process is said to give satisfactory results, the practice of returning molasses to the vacuum pan and coolers, causing crystal growth to take place in an increasingly impure mother liquor, is theoretically objectionable, since, as has been already noted, the growth so made will be less pure than that otherwise obtained from

the concentrated juice, and consequently the employment of molasses in the manner referred to should be restricted to cases where the object in view is the production of raw sugars for refining. In such cases, and since it appears to be so far impracticable to secure all the obtainable sugar from the juice at one operation by this method of treatment, without providing the exhausted coolers with heating surface or virtually making them into vacuum pans, it has been found preferable to employ additional slow boiling vacuum pans of special construction, wherein the aggregative power of crystals in motion can be utilized to reduce the crystallized sugar-content of the mother liquor from the cooled first masse-cuite. In these pans the treatment can be continued for such periods as required, during which saturation is maintained by slow evaporation, and the crystals kept in movement by stirrers. In practice, a portion of the mother liquor to be treated having been brought to suitable temperature and density in a slow boiling vacuum pan, sufficient first sugar crystals are added to form an artificial masse-cuite with which to commence operations, which is fed with the surplus mother liquor till the pan is full, when the resulting masse-cuite is allowed to cool gradually, the movement of the crystals being continued, as was the case with the first masse-cuite when in the coolers, and the cooled second masse-cuite transferred to centrifugals in a similar manner. By this double treatment, practically all the sugar obtainable by crystallization should be secured in the shape of raw sugar. When, however, market conditions require the production of the finest sample of crystals obtainable, they should be separated from the mother liquor as soon as possible after the masse-cuite is discharged from the vacuum pan, while the mother liquor is still hot, its viscosity lowest, and the surface cleaning of the crystals most easily effected. Many methods, the choice of which depends chiefly on commercial considerations, may be adopted for the recovery of the crystallizable sugar contained by the rich mother liquor separated when masse-cuite is cured hot, as described above, amongst which the following one is suggested:—A portion of the mother liquor from the first masse-cuite having been boiled to grain, the resulting masse-cuite would be transferred to one of the slow boiling vacuum pans, previously described, in which treatment could be sufficiently prolonged to allow of the crystals it contained exhausting within the practicable limits not only their accompanying mother liquor,

but also any remaining surplus from the first masse-cuite. The sugar obtained by this second treatment would, in the case under consideration, be dissolved and re-crystallized, by which means the whole of the sugar in the juice extractable by simple crystallization should be obtained in the form of high-grade sugar with very ordinary apparatus. Re-crystallization, if properly conducted, implies the expenditure of very little fuel, seeing that the evaporation need be but small.—International Sugar Journal.

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INSECT PROBLEMS.

By Prof. C. L. Marlatt, Washington, D. C.

The last few years have given practical demonstration of the possibilities in applied entomology, and the subject is now being put to a more general and thorough test perhaps than ever before. The inciting cause has been, and is, the San Jose scale, which has aroused the interest and attention not only of entomologists, but of the general public throughout the world, more than any other insect problem which has arisen since the beginning of history. Never before have fears been created over so much of the earth's surface about a single insect, and never has so much and diversified national legislation on an insect matter resulted. At no previous time also have more earnest and widespread efforts been made to prevent the spread of an insect pest or to exterminate it where it had secured a foothold.

What has all this excitement, agitation and work demonstrated? Have we actually prevented the further spread of this scale insect? Have we accomplished by our artificial efforts in any degree its extermination? In other words, what are the practical results of the vast amount of work done and money expended?

In the same vein we may ask ourselves: Has any important insect pest been exterminated? Does not the locust still flourish, and is not the cankerworm still a burden? Are not all the insect plagues of our forefathers to the remotest times still with us? The commendable industry lately shown in some quarters in delving into the writings of the ancients in their reference to insect pests emphasizes the fact that many of the insects with which we contend nowadays were familiar to the very oldest writers.

In our efforts to control the normal and perhaps inevitable

course of nature in any particular instance, as, for example, in our attempt to prevent the further spread and effect the extermination of the San Jose scale and other similarly well-established introduced pests, are we not merely repeating and putting into effect the boast of the courtiers of King Canute that at his command the tide would roll back; and are we not, like that good old king, though unwittingly, giving a practical demonstration of our own impotence by having the tide of failure roll up around our bodies?

In the foregoing introductory remarks the writer may seem to have asked questions which he cannot answer, and to have stated problems the solution of which he cannot give. Whether this be true remains to be demonstrated, but in his present mood he feels like voicing his doubts as to the practicability of much of our present effort and indulging in heresies perhaps; but if the interrogatories are vain and the doubts unjustified, they will at least not have been harmful, and may stimulate the presentation of the real truth.

To explain my intention in advance, I shall make a plea, as a solution of the insect problem, for the *laisser-faire* policy in such large matters or continental or world concerns as seem to me to be beyond practicable reach by human agencies, and I shall counsel active efforts at control and prevention in such smaller and more local fields as promise adequate results. In other words, I shall attempt to separate the work in applied entomology that is practicable and profitable from work that is impracticable and unprofitable, and so benefit the former by preventing needless waste of effort.

If one could view the earth from a sufficient distance or at an elevation, as the bird sees it flying in mid-air, a condition of perfect nature would be impressed. The vegetation covering valleys and hills would seem unbroken, and all the slight abnormalities which are visible on close inspection would disappear. Only the stable conditions of a balanced nature would be visible. The stability, or the balance between animal and plant life, is evidenced by the very existence of both animals and plants, and in undisturbed nature a healthful condition of both plants and animals is the common and notable rule. One sees forests and sturdy, giant trees which have stood as they stand today for more than a thousand years. One may drive over hundreds of miles of unbroken prairies and not find a single spot within its covering of perfect sod. In other words, without multiplying illustration, it

is evident that, in the broad view, nature is quite capable of taking care of herself, and that plants and animals have long existed and will continue so to exist without the efforts of man to protect and save either.

Much of the damage by insects which we note and herald is unusual and isolated. The occurrence of an insect in destructive numbers is witnessed, a bulletin or report is distributed, and the information thus gained is repeated in other publications for years, perhaps, while, in point of fact, the repetition of such injury may be long in coming. Even under natural conditions of virgin prairie and forest one occasionally notes instances of isolated damage. Professor Cockerell has called my attention to a notable case. The plant *Atriplex canescens* covers the country in unbroken square miles for vast areas in the Southwest, and normally presents a healthy, vigorous aspect, free from attacks of scale insects. In this area, however, one plant has been discovered literally covered with a scale insect, *Ariococcus neglectus*. Continuing the same idea, anyone who has made an effort to collect the long list of injurious insects which figure in our reports as attacking different cultivated plants knows that it takes many years of careful search to collect anyhere near a complete series, and that instances the special damage by most of the hundreds of injurious species, so called, are of very rare occurrence.

In the matter of control of injurious insects, I think also we are rather apt to overestimate the actual effort made. It is undoubtedly true that, as a general rule, in this country, and still more so abroad, no steps are taken by the ordinary farmer, fruit raiser, or trucker to destroy or prevent the presence of noxious insects. Yet I believe it to be true as a rule that such farmer or trucker is successful if he cultivates well, selects his varieties intelligently, and makes a careful study of the marketing of his products.

Professional economic entomologists are practically limited to our own generation, but insects destructive to cultivated plants are not of recent origin, nor are the conditions which are supposed to be so favorable to unusual multiplication of injurious species characteristic only of modern methods of culture. From the time man first began to till the soil and practice the arts of agriculture and horticulture, have special plants been grown in masses together, often two or three only, over whole provinces or countries to the exclusion of everything else, and such special cultures have been going on un-

interruptedly for two or three thousand years in many places, as witness the olive orchards of southern Spain, Italy, and Syria, and the culture of the grape and the citrus fruits in different parts of the Old World. Instead of being despoiled by insects, as might be supposed in accordance with modern ideas, the cultures cited are as successful today, if not more so, than at any time in the past, and in fact are often much freer from insect damage than recent plantings in newer parts of the world, and this in spite of the fact that, as a rule, nowhere are any special steps taken to control or prevent insect depredations.

Coming to our own times, fruit raising is just as successful in California, Italy, and Spain today as it was before the growth of commerce introduced into each of these countries many new insects. Not one of us, also, can recall a time when he suffered for the lack of the necessaries or the luxuries of life on account of insects. We have the San Jose scale, the Hessian fly, the imported cabbage worm, and fifty other pests from abroad; we have such important native pests as the Colorado potato beetle and the chinch bug; yet the production of crops particularly affected by these insects proceeds with little apparent check therefrom. Occasionally an individual will suffer severely, but as a rule it will be found that it is the result of his own neglect or ignorance, and whenever there has been an absence or scarcity of any particular vegetable, fruit, or other product of the soil, the cause as a rule has not been the insect enemies, but some other adverse condition much more universal and fundamental.

The writer grew up in the great western corn and wheat belt, the home and headquarters of the chinch bug, and the first region to be visited by the Colorado potato beetle, and early afflicted also by the Hessian fly, and yet in twenty years' experience a farm was never known to be completely devastated by any of these pests. Two or three times the Rocky Mountain locusts ate up every green thing, and the drought often impoverished the farmer, but the insects named above were never responsible for more than local or partial damage to a crop.

In other words, the normal healthfulness and balance which we have found in wild nature applies in the long run also to nature as influenced and partly controlled by man. It is the exception, not the rule, even with cultivated plants, that the damage is overwhelming and disastrous.

In taking this broader view, one is not only impressed with, but convinced of, the stability, permanence, and repose of nature in the long run. The course of life is even, and the necessary antitoxin is furnished when needed. The balance

may move a little up and down, the pendulum swing more or less widely from side to side, or the line of record may be a jagged one, but the average will be the normal right line which pictures simply nature's method.

Time does not offer to consider the means by which this balance is preserved, and many of the influences at work are obscure and beyond our easy finding out. Briefly noting some of the more evident influences which operate to check undue increase of insects, disease plays a very important role; also any unfavorable climatic and seasonal condition, as note the result of the severe winter of 1898-99, and the effect of the occasional exceptional heat of the dry summers of California and Southern Spain. Probably less important than the influences just mentioned is the action of parasitic and natural enemies, and least important of all, the puny efforts of man. From the side of the host plants the chief influences are the weeding out of the nonresistant and weaker individuals and those growing under unsuitable conditions, and the development of increased vigor and power of resistance in the stronger ones.

I have endeavored to show the self-curative and self-preservative action of living organisms in the long run. On a close inspection, especially of what concerns us personally and directly, many little ills appear, not, however, especially antagonistic to the workings of the general law indicated. These in our field of applied entomology are the local abundance from time to time of this or that injurious insect. There may be an outbreak in some limited section or in spots here and there of the army worm, the Hessian fly, the chinch bug, some species or other of locust, a scale insect, or some wood borer; or we may be temporarily annoyed by a plague of fleas or ants or flies. To correct such disturbances a knowledge of the habits, life histories, natural enemies and parasites, and of remedies is desirable; and in the control or prevention of such local annoyances intelligent effort finds an immediate practical and satisfactory outcome. In such work also the economic entomologist finds a legitimate and serviceable field for his activities. Nevertheless, the results gained, however locally valuable, affect little if any the normal course of events in the larger sense.

Every now and then, however, we are brought face to face with a disturbed balance of a more general nature, the most striking examples of which are in the new insect enemies

which come from time to time, and which in new situations and under strange surrounding conditions multiply excessively, and assume an economic importance which for the moment obscures all older like troubles. So universally true is it that the newcomer will prove more destructive than the old familiar pests; that this is looked upon as a fixed principle, like the law of gravity. A good illustration of this is seen in the recent very valuable book by Mr. E. E. Green on the insects of Ceylon. Referring to the insects occurring on that island, he takes the position that excessive damage by an insect is a proof of its foreign origin. He says that all the troublesome insects of Ceylon are introduced species, and that not a single undoubtedly native species has attacted any notice as a pest. Out of twenty-six species of Chionaspis, for example, occurring on the island, three only are injurious, and these are introduced species. In this country our experiences have been more varied, and we probably would not go to the same extreme, but the history of insect introductions and migrations here and elsewhere certainly indicate the truth of the general principle.

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PROFIT OR LOSS IN REFINING SUGAR.

The question of profit or loss in refining sugar is attracting particular attention just now, and lends special significance to the evidence of the various refiners before the Industrial Commission, a digest of which evidence has been prepared for the Commission by Mr. E. Dana Durand.

According to current quotations for sugar there is a difference in favor of refined sugar of 63.75 cents per hundred pounds. That is to say, with 96 test centrifugal (the standard) raw sugar selling in the open market at 4.3125 cents per pound, if the refiners are obtaining their full net price of 4.95 cents per pound for granulated they have a surplus of 63¾ cents per hundred pounds, out of which to pay all expenses of refining. It is not considered probable, however, that they are receiving the full net price for granulated sugar, as trade discounts for prompt cash, etc., would necessarily creep into any calculation based on "list" prices.

It is therefore evident that the difference between the cost of raw and refined is in fact nearer 50 cents a hundred pounds than 63¾. Even at the lower figure the refiners are not selling at a loss, if the sworn testimony of the refiners themselves is to be believed, for it must be taken for granted that as com-

petent business men the refiners in their estimates must have given proper consideration to fixed charges, depreciation of plant and the numerous other items that readily suggest themselves.

According to Mr. Durand's digest of the sugar testimony Arbuckle Brothers think that they can stand the losses if a company selling 90 per cent. of the total product is losing on the entire amount, and they are in business to stay. Offers for purchase of their refinery have been made by outside parties, but there have been no conferences with the American Company directly. Arbuckle Bros. have markets in various parts of the country depending on freight rates.

While no minutely specific statements were made by the witnesses as to the cost of production, the general consensus of evidence goes to show that the margin necessary between raw and refined to secure any profit is from 50 to 60 cents, and the presumption is that when it falls below 50 cents refiners are not being a profitable business. This margin includes the cost of refining proper and also the loss of weight in refining.

Mr. Jarvie made the above as a general statement, but refused to state the precise cost of refining in his own establishment.

MR. HAVEMEYER'S ESTIMATE OF COST.

The cost of refining, Mr. Havemeyer pointed out, is not the same as the margin between 96 degrees raw sugar and granulated. The commercial value of a degree of sugar is 6 cents per 100 pounds, so that from the margin 24 cents per 100 pounds must be deducted. "There has never been any cost of refining that I have ever been acquainted with less than one-half cent a pound." When the margin is only 50 cents per 100 pounds, it is a "fair inference" that refiners are running at a loss. Dividends could hardly be paid from profits resulting from such margins, but the witness refuses to state the source from which his company now pays 12 per cent. dividends, when the margin is below 50 cents. "We may borrow it." He also referred to existing conditions as ruinous. With the margin at 75 cents "it is beneficial * * * there is no great damage done then," but not unless everything is working in concentrated form and in the very best manner.

Mr. Doscher declares that his refinery has been unable to make any profit from refining at the existing margins of from 32 to 51 cents, but he had expected to be able to make "a nice profit" if the margin of between 70 and 97 cents, which existed

before his refinery was established, could be maintained. He is not clear as to details of cost or the methods of figuring loss of weight from refining. He believes 93 pounds of refined sugar from 100 pounds of raw sugar a better estimate than 92. From the same quantity of raw sugar about 2 gallons of syrup, worth about 12 cents a gallon, are obtained. Because of the risk of the sugar business the witness thinks a refinery should earn from 12 to 20 per cent. yearly on its cost.

Mr. Jas. H. Post, of B. H. Howell, Son & Co., agents of the Mollenhauer refineries, submitted the following estimate, prepared by the general manager of the National Sugar Refining Company. This shows that the cost of refining, including the revenue tax of 4.799 cents per 100 pounds, amounts to about 35 cents, while the loss of weight in refining amounts to 28 cents; total, 63 cents, as the necessary margin. The cost has not substantially changed within five years. Large refineries, such as those of Havemeyer & Elder, with 12,000 barrels capacity, and Spreckels, with 8,000, could probably produce at from 3 to 5 cents less. Centrifugal sugars contain of—

Pure sugar, about	per cent	96
Impurities, about	per cent	3
Water, about	per cent	1
		100
The loss in refining is about, of sugar, per cent		1
Leaving of pure sugar available, per cent		95
Of this we get of—		
Granulated and yellow sugars, equal to, pounds		92½
Syrup, pounds		2½
The sugar is combined with an equal weight of impurities, making about, pounds		5
Taking value of granulated at 5.375 cents gross, or 5.08 cents net, and syrup at 2 cents per pound, we have equal to—		
91½ pounds granulated at 5.08 cents		$4.699
2½ pounds sugar in syrup, at 4 cents		.10
		4.799
Less		.348
		4.451

Expenses to be deducted—		
Brokerage, about ½ per cent.		
Gov. revenue tax, ¼ per cent.		$0.04799
Office expenses, ¼ per cent.		.10
Packages		
Wages, fuel, bone black		.20
Repairs and sundries		
		.348
Granulated, say	$5.08	
Results	4.45	
Cost, say	.63	

Mr. Atkins, who sold his refinery to the American Sugar Refining Company about twelve years ago, states that at that time the cost of refining sugar was estimated at about one-half cent per pound. If the combination has succeeded in reducing this by 25 per cent. it would be doing exceedingly well. Besides the bare cost of refining, labor, fuel, char, etc., account must be taken of the cost of packages, insurance of goods, interest on borrowed money to conduct the business, etc. The witness thinks that the American Sugar Refining Company is producing as cheaply as it is possible to do, and doubts whether any competitor could suceed against it.

CAPITALIZATION AND VALUE OF REFINERIES.

To understand the cost of refining and the profits of the sugar combination, it is further necessary to consider the cost of refineries and the relation to the existing capitalization of the trust—$75,000,000. Several witnesses testified that the cost of a refinery sufficient to produce 3,000 barrels per day would be somewhere between $1,500,000 and $2,500,000, including the cost of ground. This, of course, has no reference to the value of the plants already erected, including good will, etc.; nor does it take into account the running capital necessary to conduct business.

Mr. Havemeyer testifies that the capital of the trust when first formed was $50,000,000. The capital stock of the various companies which entered the trust was given by Mr. Searles before the New York Trust Committee at $6,590,000. But their capital had little to do with their assets or real value. Some of them were worth $15,000,000 or $20,000,000, and were capitalized at $300,000. A committee of appraisement fixed the

respective values, taking plant, location, trade-marks, status of business and all considerations into account. The witness believes the trust is now capitalized at much less than its real value. He knows of no better estimate of what a thing is worth than what people are willing to pay for it in cash. The cost of building refineries for an output of 45,000 barrels per day would be perhaps $30,000,000 to $35,000,000, but the brand of Havemeyer & Elder would bring as much alone. The value of brands and good will must not be overlooked. The various plants were bought at what they could be obtained for. On its being pointed out that most of them were losing money and worthless under conditions then existing, the witness said that they were "not worthless under the conditions that were about to prevail." If a refiner feels that his plant is worth $1,000,000 to him, he may offer it to the trust for $2,000,000, and it may be accepted because more money can be made by buying the plant than by leaving it out. It is fair for consumers to pay dividends on good will—fair, indeed, to get out of them all you can.

Mr. Doscher believes a good refinery will cost about $2 per pound of daily capacity. Aside from land, a refinery of 1,000,000 pounds (3,000 barrels) capacity could probably be built for about $1,500,000, but not for $1,000,000. Refineries must be built on water fronts, which are expensive. The ground for the witness' refinery is worth probably $300,000. Mr. Doscher owned the Brooklyn refinery at the time of the formation of the trust. He received for it $3,000,000 in trust certificates, which was, he thinks, not more than its value. The North River refinery took cash instead of an offer of double the amount in trust certificates.

Mr. Havemeyer, in reply to a question as to the possibility of building refineries of 3,000 barrels capacity at $1,500,000 each, maintains that the man who made that statement would want to make about 50 per cent. on his stock. He does not believe such a thing could be done.

Mr. Jarvie estimates the cost of an up-to-date refinery of 3,000 barrels daily capacity at $2,000,000 exclusive of "real estate."

Mr. Post believes that the Mollenhauer refinery, capacity 1,150,000 pounds daily, and the National refinery, capacity 850,000, would each cost about $1,500,000 or $1,700,000, besides lands, which would cost from $250,000 to $600,000. But each refinery needs, to carry stocks of raw sugars and credits on refined sugar, about $2,000,000 running capital. The small-

est quantity of raw sugar for two such refineries would be 30,000,000 pounds—15 days' supply. This running capital, owing to short credits, could be turned over from 4 to 6 times yearly. If such a refinery had a capital stock of $2,000,000, a dividend of 20 per cent. would be only 10 per cent. on the real investment, which the witness thinks is little enough in view of the risk. A higher profit might be made, especially by fortunate purchasers of raw sugar, or vice versa.

EFFECT OF TARIFF ON RAW SUGAR.

Mr. Havemeyer declares that the present tariff of $40 per ton on raw sugar amounts to giving that much bounty to producers in Louisiana and the Hawaiian Islands, reaching about $24,000,000 annually. He implies that the cost of production is only about 2 cents per pound. He argues that producers of raw sugar, since it is an agricultural product, should be given no protection, but on being pressed does not object to giving them moderate protection. The domestic producers furnish about 25 per cent. of the raw product, and apparently, from the witness' testimony, much of it comes in competition directly with the refined products of the American Sugar Refining Company. The price of refined sugar, and the margin between it and raw sugar, are regularly depressed during the season of Louisiana output.

Mr. Atkins, an importer of raw sugar, declares that the present duty on raw sugar affords unnecessarily high protection to the domestic producer. It has been established primarily at the instance of the producers of beet sugar, and is having the effect of building up that industry, but the witness considers that this is done at an unjustifiable expense to consumers, in view of the cheapness with which sugar could be obtained, if there were no duty, from Cuba and other outside sources. The witness considers the high duty especially unjust to consumers in view of the comparatively small proportion of the raw sugar consumed in this country which is produced here. He submitted the following table, showing the sources of our sugar supply:

CONSUMPTION AND SUPPLY.

		Tons.
Consumption of sugar, U. S., 1898.....		2,047,000
Sources of supply on basis of crops of 1898-99—		
Domestic cane.....	235,000	
Domestic beet.....	44,000	
Total (protected by present tariff)....		268,000

Free foreign sugar—		
Hawaiian Islands	240,000	
Porto Rico	55,000	
Total (no duty)		295,000
To have advantage under reciprocity treaties—		
Trinidad	50,000	
Barbados	45,000	
Jamaica	37,000	
British Guiana	105,000	
Total (supposed duty, 1.35 cents)		227,000
Subject to full duty—		
Cuba	300,000	
Java	695,000	
Philippines, export	60,000	
Egypt	90,000	
Santo Domingo and other West Indies	70,000	
Brazil	165,000	
Total (duty, 1.685 cents)		1,380,000
Total		2,170,000

Owing to the small proportion which the domestic product itself bears to the total consumption, the producers of domestic sugar are able to get the full advantage of foreign product plus the duty, competition between different domestic producers having no tendency to reduce the selling price. The witness estimates that the profit or surplus price which the producers of this country and of Hawaii, and also those of the British Colonies which receive a reduction of duty gain through the tariff, at the expense of the consumer, is $22,337,910. The method of reaching this result is shown in the following table:

Domestic production, 268,000 tons, estimated average, 96 test; duty at 1.685 cents per pound, $37.74 per ton	$10,114,320
Sandwich Islands, 240,000 tons; estimated average, 95 test; duty at 1.65 cents per pound—$36.96 per ton	8,870,400

Porto Rico, 55,000 tons; estimated average, 89 test; duty at 1.44 cents per pound—$52.25 per ton....	1,773,750
Trinidad, Barbados and Jamaica, 122,000 tons; estimated average, 89 test; duty at 1.44 cents—$32.25 per ton, $3,934,500; supposed 20 per cent. rebate.....	786,900
British Guiana (Demerara), 105,000 tons; estimated average, 96 test; duty 1.685 cents—$37.74 per ton, $3,962,700; supposed 20 per cent. rebate.....	792,540
Charged consumer for benefit of producer....	$22,337,910

Beet sugar manufacturers, since their product is refined sugar, really receive a still higher protection, the total tariff upon refined sugar being $1.95 per 100 pounds. Moreover, the beet sugar factories in this country are mostly located west of the Missouri river, and their product is sold in that region, so that the cost of freight from the seacoast, amounting to about one-half a cent per pound, is an additional protection to their industry. Mr. Atkins further stated that a recent report of the Agricultural Department shows that estimates have been made abroad, in view of the possible competition of the United States in the beet sugar industry, that granulated sugar should be produced in this country from beets at 3 1-2 cents per pound. Since the selling price of refined sugar made from the imported product is as high as 5 or 5 1-2 cents, the witness considers that the protection afforded to the American producer is excessive.

The advantage of the high protection to the beet sugar industry, according to Mr. Atkins, has not so far come largely to the farmer, but has been chiefly absorbed by the manufacturer. Estimates show that the American farmers receive from $4 to $4.50 per ton for beets, while the farmers of Germany and other European countries obtain practically the same price.—New York Journal of Commerce.

THE SUGAR WAR.

That the Havemeyers and the trust might be passing as the rulers in the sugar trade was a question discussed in Wall street. An expert in the sugar trade said: "The Sugar Trust will abandon the coffee business in favor of the Arbuckles. But the coffee firm of Arbuckle Brothers will not go out of the sugar business. More likely that firm will take over the

plants of the other independent sugar refiners, and will dictate at what price the Sugar Trust may sell its product.

"The coffee business of the Sugar Trust," he continued, "has been a losing venture. Herman Sielcken, whom the trust employed at $25,000 a year to run their coffee business, has cut into the profits as piled up through the management of J. N. Jarvie, of Arbuckle Brothers, but Arbuckle Brothers had the advantage of an established trade in package coffee, and the competition has extended that trade. The firm could afford to lose, with a prospect of higher sales and bigger profits later.

"Thus the prospect seems," the expert continued, "that the Arbuckles again will have exclusive control of the package coffee business, and besides will be the leaders in the sugar trade. It looks like the passing of Havemeyers as rulers in the sugar trade."

A responsible dealer in sugar, speaking of the cut made in the margin between the price of raw and of refined sugar, said today that any discussion as to the probable action of the sugar refiners was of doubtful value just now, and that predictions as to the losses sustained by the Havemeyer refining interests and the Arbuckles were mere guesses.

"The trade in refined sugar," said the broker, "has always been guided by the price of raw sugar. It is recognized among dealers that, figuring on a basis of 100 pounds, the difference between the price of raw and the refined product ought to be at least fifty cents in order to pay for the cost of refining. When the difference is greater there is profit for the refiner, and when it falls below fifty cents there should normally be a loss in the process of manufacture.

"Now, after the cut by the Arbuckle people recently, the situation is this: The American Sugar Refining Company has a price of $4.95 per hundred on granulated sugar, while the Arbuckles are quoting the same product at $4.90. Both pay $4.44 a hundred for the raw material, so that the American company has a margin of 51 cents, while the Arbuckles' margin is only 46 cents. According to the accepted standard, the American company has a one-cent profit balance on the hundred pounds, and the Arbuckles a loss of four cents on the hundred.

"The statement made by the American company, therefore, that the business is being conducted at a loss, does not seem to be, of necessity, true; but it is evident to the most casual observer that the Arbuckles are losing on their sugar refining

business. The statement made on the street, that "John Arbuckle roasts coffee to make money and refines sugar to make trouble for the American Sugar Refining Company," seems to gain added weight by this latest move of the Arbuckles.

"For some time the advance in the price of raw sugar has been going on, and during the last two months it has jumped up at the rate of 6 1-4 cents a hundred pounds. Of course, the price of refined sugar has, in obedience to the natural law, gone up, too, but not proportionately. While raw sugar was going up at 6 1-4 cent bounds, refined went up at the rate of 5 cents a hundred pounds only. About March 19 the last rise in both occurred, when the prices, $4.95 for refined and $4.44 for raw sugar, went into effect. Predictions at this time of the future course of the market would be valueless."

The point was made by a high authority in the sugar trade that the loss figured out as the result of the Arbuckle cut is practically all on paper, as the trade is very dull now and the cut induced no new buying. It was thought that this cut was made in order to indicate to any speculative interests what they might expect if, after a purchase of the present independent refineries, any new refineries should be built.

Attention was attracted to the prospective cane sugar supply. It was stated that less than half a crop of cane sugar will be raised in Porto Rico and Cuba this year, the yield being estimated at 400,000 tons, against 1,000,000 tons in previous years from Cuba alone. Last year a small amount of cane sugar was produced in Cuba, and it is not expected that the crop will assume its old proportions even in another year.

One of the largest handlers of raw sugars said:

"There are only two buyers of raw sugars now in the market, the Arbuckle Brothers and the American Company, but the stock of raw sugars is next to nothing, and all new arrivals are quickly placed. The buying by these concerns is in anticipation of further advances in raw sugars, and as the importations increase it is probable that the raw sugars will be stored. Just now the Arbuckles are the only ones refining outside of the American Company, but in a short time, when the spring demand appears, all the refiners will have all they can do to supply the trade."—The New York Journal of Commerce.

Readers should not fail to notice the rainfall table on the last page of this May number of the Planter, showing the rainfall for sixteen years in Honolulu.

PEABERRIES AND MALE COFFEE PLANTS.

Dr. D. Tomatis, commenting on a paragraph in the Queensland Agricultural Journal on the subject of male coffee plants, writes:

"As our Government Botanist, Mr. F. M. Bailey, states the coffee plant is neither *dioecious* nor *monoecious*, but beyond doubt *hermaphrodite*, as clearly shown by the examination of its flower. Why should the abundance of peaberries fruit on a tree indicate that it is a male? Is not peaberry fruit all the same? And still more a peaberry seed germinates as readily as a bi-lobed berry. The paragraph says that the cause of peaberry fruit is not definitely known. I am surprised at this statement, as it is very easy to find the cause, which is in the poverty of the soil and the dryness of the weather after the blossoming time, as through these two causes the young fruit could not be fully formed, developed, and nourished; hence only one lobe grew, and the germ of the other became abortive and atrophied, and consequently the single lobe or grain grew in a roundish form, and the fruit, being a single-grained berry, is richer in the essential aroma. If the ground be rich, season favorable, tree well trimmed and pruned, the blossoms thinned, very few peaberries will be produced."

Reporting on the question raised in the paragraph and in the above letter, Mr. Howard Newport, Instructor in Coffee Culture, says:

PEABERRIES AND MALE COFFEE PLANTS.

in the accompanying letter on this subject, sent on to me for an expression of opinion, I fail to see where the question arises as to why the abundance of peaberries on a tree should indicate that it is a male. The amount of peaberry on a tree has nothing whatever to do with the sex of coffee.

Peaberry is the result of the failure, for some reason or other, of its fellow-germ to fructify. There are naturally in the embryo berry two cells and it would appear that under certain circumstances one of the cells, on coming in contact with the pollen, will fructify while the other will not.

That it is so is clear on examination of the peaberry where the atrophied germ is discernable, and its envelope of parchment skin, folded together, still in its place within the "pulp." The reason why the pistils should convey the pollen to one ovule and fail to fructify the other, is the point that is not thoroughly understood yet, and not the state of the tree in

which it is most liable to this condition, as your correspondent seems to think.

The peaberry is a malformation, and generally takes place when the tree is weak or in a state of low vitality, and this condition may be brought about by unfavorable conditions of soil, climate or cultivation. A tree overbearing will produce a larger percentage of peaberry than one with a more moderate crop, even though conditions of soil and climate are as favorable as could be desired.

The shape of the malformed growth is somewhat as your correspondent states. It was thought at one time that it was the production of a special variety of coffee-bush—at any rate, by those who had to do only with the cured article, and there are many yet that still adhere to this fallacy, due chiefly to the fact of its being graded separately.

Pea-berry obtains its higher value in the market chiefly on account of the advantage of its shape in roasting. Being easier to roast uniformly, it is supposed to contain a greater percentage of caffeine or aromatic properties, but this is exexceedingly doubtful. Its presence on the tree is of doubtful advantage also. A large percentage of "P. B." grade—indicating as it does, impaired vitality—although its price is enhanced, is yet a long way short of the value of the double bean in the normal growth.

As a seed for propagation, "P. B." germinates readily, but repeated experiments have been able to show no advantage in the growth, stamina, or bearing capabilities of its production over that of the bi-lobe; nor does the plant raised from a peaberry show any special tendency to produce peaberries.

"Male" Trees.—The coffee-tree is, as is well known, hermaphrodite; it is also well known that in such cases generally the contact of pollen from another tree or blossom obtains better results than its own pollen. It may be, therefore, that the peaberry is due, to a certain extent, to continued self-fertilizing of the plant or "in-breeding."

It is supposed that the plant commonly called the "male" coffee-tree is due to this cause. However this may be among seedlings in a nursery, there is always found a small percentage of plants that appear with long narrow leaves, eyes closer together than ordinary, and a smaller and more stunted growth altogether.

In cultivating these in the field, it is found they bear very

little, although they blossom freely. (I have never yet met with one that did not bear at all.)

The flower is somewhat smaller than that of the ordinary tree, but would structurally appear to be identical. It is supposed that the want of fertility is due to some malformation of the stigma or ovules, since the pollen is perfectly fertile when applied to other blossoms.

This tendency to produce blossoms that will not fertilize, yet will fertilize others, has earned for this long leaved tree the sobriquet of "male" coffee. Whether the presence of such trees in an estate is Nature's own remedy for too long-continued course of "in-breeding," and is, therefore, of advantage, is a moot point. Generally the plant is considered useless and unnecessary (since the other trees, being hermaphrodite, can do without it), and since it bears so little, is not considered "worth its keep." It is, therefore, usually picked out and thrown away as early as it shows the tell-tale narrow long leaf in the germinating bed or nursery.—Queensland Agricultural Journal.

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AGRICULTURAL CONDITIONS IN PORTO RICO.

The special agent in charge of the section of seed and plant introduction, of the division of botany, United States Department of Agriculture, Mr. O. F. Cook, has returned from Porto Rico, and made a preliminary report to the secretary. Notwithstanding the numerous books and magazine articles which have been published, there was still very little definite information available concerning the agricultural conditions and economic plants of that island. Secretary Wilson's particular object in the present instance was to ascertain what species and varieties are now to be found there in order that the department might be able to enter upon the work of securing others likely to be of use in improving and extending the agricultural industries.

At present very little in the way of plant products is exported from Porto Rico outside of coffee, sugar, and tobacco. All other crops are designated "menores," that is "minors," and these being considered unworthy of the serious attention of the planters, the cultivation is generally left to the desultory efforts of the poorest and most ignorant of the population. As a result, there has been little attempt at the improvement of varieties either by selection or by the introduction of superior seed. Much of the fruit and vegetables sold in the markets of Porto Rican cities is of very inferior quality and quite unsuitable for export. The department will assist the

more enterprising farmers, both Americans and Porto Ricans, in experiments, which many of them have already undertaken, in order to find out what new crops suitable for our markets can be grown there.

As already pointed out in Secretary Wilson's annual report, we are paying over $200,000,000 for tropical plant products, a large part of which could be furnished by Porto Rico and the Philippines. Instead, however, of entering upon too many suggestions at once, it is desirable to settle upon a few of the more promising crops and encourage the production of these articles on a scale sufficient to give them a recognized place in commerce. For bananas, for instance, we paid in 1898 over $5,500,000, mostly to Jamaica and Central America. In Porto Rico the banana has scarcely been considered as a source of income or an article of export. It has been planted principally for shade in the coffee plantations, and as one variety was as good as another for this purpose, most of the bananas are unsaleable. The variety almost exclusively imported to the United States is not generally cultivated. As the conditions for commercial banana growing are very favorable, it may be expected that attempts in this direction will soon be made. It is necessary, however, that at least 500 acres be put under thorough cultivation, for the product of less land can hardly be marketed to advantage. Unless a company with ample capital will undertake the experiment, it can be made only through an organized effort by the landowners of some favorable locality.

The soil and climatic conditions are exceedingly diverse, so that it is probable that a wide range of products can be secured, at least for local consumption. Oranges, limes and other citrous fruits, European grapes and other semi-tropical fruits and vegetables can be produced in the drier parts of the island, while from the moister parts vanilla, cacoa, mangoes and other more strictly tropical plants can be exported. There are no localities sufficiently hot and humid for the rubber-producing plants of the Amazon valley and those of similar habitat, while the land is mostly too valuable to warrant its extensive use for others which might thrive. The potential wealth of the island may, however, be greatly increased if rubber trees can be found which can be used for shade or planted on the rocky pinnacles of the foot hills, which are now covered with tangled masses of vegetation. Some of the African rubber vines may be able to thrive in the latter situations.

As shade trees, some supposedly native rubber-bearing species of ficus have already been planted, but the amount of gum obtainable is too small to render a profit for collecting.

In the meantime, it is of great importance that the existing industries of Porto Rico be improved. Sugar lands are receiving attention from American capitalists, and large factories with the most modern facilities are being built. Coffee has been the chief product of the island, and is, perhaps, that in which the greatest expansion is possible. Over $13,000,000 worth of coffee has been exported in a single season from orto Rico in spite of the fact that methods of cultivation are of the most primitive character. Instead of seedlings grown in nurseries, those which spring up by chance in the heavily-shaded plantations are used.

These are already weak and spindling; in order to keep them alive, heavy shade is necessary, and this is continued throughout the life of the plant. This, together with the overcrowding and lack of proper care, brings the average crop down to one-third or less of what might be obtained through better methods of cultivation. There is also a large amount of land suitable for coffee c ulture, but not now planted, so that it is not unreasonable to believe that if this industry were properly developed, Porto Rico might supply at least half of the enormous quantity consumed by the United States, our imports in 1898 being valued at over $65,000,000.

There are few Americans interested in coffee-growing, and the capitalists who have canvassed Porto Rico for profitable investments have been giving little attention to the possibilities of coffee, doubtless owing to the depressed condition of the market, the result of over-production of inferior grades in Brazil and elsewhere. The superior quality of the Porto Rican article has, however, long been recognized in the European market, and there is every probability that an increasingly large amount will be required in the United States. The stock now on hand is being held at high prices, owing to the fact that the visible supply is very small, a result of the August hurricane. Higher prices in the general market are to be expected, and while it is improbable that coffee-growing under the old methods will ever be as profitable as formerly, the natural conditions are favorable for the perpetuation and extension of the industry on modern lines.

The fact that Porto Rico contains no large unoccupied areas has led some observers to represent the entire island as thickly populated. In reality, this is by no means the case,

and while a large part of the available land has been at some time under cultivation, there are many districts in which not more than 10 per cent of it is now in use, except for stock raising, which may properly be called the most popular agricultural industry at the present time.

For men without capital or experience in the industries of tropical countries there are no openings in Porto Rico; with the improvement of means of transportation, there will be much to encourage the settlement of farmers of sufficient enterprise and intelligence to carry on diversified farming, and profit by the advantageous local conditions.

Porto Rico is unique among the West Indies, or, indeed, among tropical countries generally, in the possession of a large white population capable at once of furnishing labor for carrying out local improvements and of taking part in the progress of advancing civilization. The explanation is to be found in the delightful and salubrious climate, where the European can live, work, and thrive. A more advantageous point of contact with the tropics could scarcely have been selected.—Bradstreets.

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Prof. Koebele, the well-known entomologist, who has been in the employ of the Hawaiian Government for several years, returned last month from a trip to Australia and the East Indies, where he went in search of insect enemies of some of the worst pests that we have here. He first visited Australia, then Fiji, New Zealand, Ceylon, Hongkong and Japan, in each of which countries he secured some new insect destroyers. Those gathered in Australia and sent here direct were unfortunately killed by the quarantine fumigation, a misfortune which no foresight could remedy.

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The rice crop of India, although not equal to the average, will furnish three and three-quarter million tons for export. This ought to bring the wholesale price down to three and half or four cents per pound in America for Indian rice.

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There will be a total eclipse of the Sun, May 28, total in the Mediterranean and Egypt, but not visible here.

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The bubonic plague has been entirely eradicated in these islands, solely by the prompt and heroic measures adopted by the Board of Health. For two months past there has not been a single case of it on any island of this group.

RECORD OF THE RAINFALL AT HONOLULU FOR THE PAST SIXTEEN YEARS.

From Daily Readings at the Residence of Mr. W. R. Castle. (Elevation 50 feet).

Months...	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899
January	1.07	.06	.38	5.85	.78	.87	2.00	1.19	6.50	2.57	3.08	2.38	2.20	.94	3.97	.87
February ...	1.68	.67	.94	13.04	1.98	.77	9.85	4.84	3.18	13.45	12.42	1.81	1.30	.79	7.60	3.55
March	4.06	2.96	1.63	2.24	2.25	.38	7.83	.69	.29	.75	1.51	1.46	3.11	1.20	9.66	3.73
April	3.52	5.11	1.19	2.35	2.36	.94	4.84	.88	1.60	2.22	2.25	1.01	2.40	.93	1.26	.81
May	.44	11.56	1.61	4.10	1.97	.81	1.20	.23	5.10	1.50	.10	.93	1.51	.96	.68	1.44
June	.48	2.51	.63	.95	.47	.97	.86	.43	.67	.29	.59	.90	.78	.99	2.07	.68
July	1.40	4.27	.56	.67	.15	.48	1.30	.58	.53	.28	.45	.45	.00	.81	.63	.11
August	.83	2.85	.43	1.02	4.22	1.16	1.00	.58	1.14	1.04	.08	1.41	1.33	.39	.58	1.04
September ..	.32	1.17	2.26	.95	2.80	1.81	.60	.47	.42	.91	.56	2.15	.39	2.66	.15	.35
October	4.66	.03	1.84	.44	1.31	.95	1.36	3.62	3.01	.64	1.76	.41	2.04	1.61	.52	3.70
November ..	.54	1.40	8.74	11.84	3.39	1.50	1.80	.39	.35	8.33	8.33	4.27	2.31	1.88	.50	.19
December ...	3.76	3.14	3.47	6.37	18.08	2.82	1.64	1.50	3.97	2.41	2.41	12.02	5.54	.51	.77	1.95
Totals	22.76	35.73	23.68	49.82	39.76	13.46	34.28	15.40	26.76	33.28	33.54	29.20	22.91	13.67	28.39	18.42

Average for 16 years, 28.70 inches; Maximum, Temp. 88 degrees; Minimum, 61 degrees; Average Temp. 74.49; Days rain, 104.