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The latest quotation of Cuban centrifugals of 96° test in New York, June 9, was 4¾ cents, with frequent changes every day. Prices in Europe were relatively higher on same dates. The deficiency of stocks, as compared with same date last year, is 323,000 tons.

The persistent drouth we are now experiencing in Louisiana is a source of some anxiety, although the cane is standing the lack of moisture remarkably well. A continuation of these dry conditions for another week or ten days, however, will render the situation serious to a certain extent, although sugar cane has a remarkable power of recuperation from drouth.—La. Planter.

Sarah Grand never uttered more practical words than the following, which every business man should cut out and paste in his memorandum book: "Just do a thing and don't talk about it. This is the grandest secret of success in all enterprises. Talk means discussion; discussion means irritation; irritation means opposition; and opposition hindrance always, whether you are right or wrong."

An exchange states that owners of United States patents or designs and of trade-marks, prints or labels registered in the United States Patent Office can now have their rights extended so as to include the territory subject to military government by the United States forces. An order recently issued by the governmental authorities provides for such extension

upon the owner of the patent, design, trade-mark, print or design, or certificate of registration, with the Governor General of the island wherein such protection is desired.

The commercial prospects of the country, resulting from Mr. McKinley's Administration are brighter than at any previous period in our history. Our money standard has been placed upon a confirmed basis, and there is no possibility of its being upset. Gold is predominant, and there is plenty of money in circulation. The present conditions of the country are excellent, and the Republican party, under the leadership of Mr. McKinley, has gained prestige, admiration, and respect in Europe, and has become solidified throughout the United States. Distinctly Mr. McKinley will be the Republican candidate, and as surely he will be elected.—Am. Grocer.

An interesting experiment and one that may be pregnant with much value to the sugar cane industry, is about to be tried in Trinidad. An ozone manufacturing firm have applied ozone to beet and found that it has increased the yield of sugar crystals by 30 per cent. The firm now desires to be allowed to erect a plant at a sugar factory in Trinidad to try the experiment with cane, and they will carry it on entirely at their own cost. The matter was brought up at a meeting of the Agricultural Society and several planters present intimated their willingness to allow the ozone manufacturers to try the experiment at their respective factories.—Demerara Argosy.

The apples which Queen Victoria eats grow in New York State. It was Lady Randolph Churchill who introduced the Spitzenberg apple to Her Majesty just 12 years ago, and since their supply is sent yearly to Windsor. These apples, by the way, are highly polished, each is wrapped in vari-colored tissue paper, and the barrels are painted in parallel stripes of red and green and glossily burnished, while around and inside the top of the barrels apple blossoms and leaves are realistically painted. On the head of each barrel is stencilled the address: "To the Under Steward of the House, Windsor Castle, England."

Porto Rico, which now belongs to the United States, is a very productive island, of 3,530 square miles, not so large as Hawaii, nor so mountainous, but with much more arable land.

The highest of the hills rise to only about 3,600 feet above the sea. It is extremely well watered, having over 1,200 streams well adapted to developing electric power. It has produced annual crops of over 200,000 tons of sugar, and over 6,000,000 pounds of coffee, with large quantities of tobacco. The population is said to be over half a million, of mixed negro and Spanish blood. Under American auspices, and aided with American capital, Porto Rico will increase its products very rapidly, and may become an outlet for the surplus colored population of the Southern States.

In a report of the Committee on Diseases and Insects in Florida, which we find in the Florida Agriculturist, the following well-merited compliment occurs, referring to the work of Prof. Koebele, who is employed by the Hawaiian Sugar Planters' Association and the Hawaiian Government:

"Pruning and destruction of trees, sprays and fumigation were powerless in California to control or hinder its spread, and the forlorn hope of sending Koebele to Australia to discover natural enemies, the introduction of Vedalia, the almost total destruction in a short time of the scale so that the Vedalia also for want of food became almost extinct, forms one of of the brightest chapters in American mychology. In fact the natural enemies, whether insect, fungoid or bacterial, are the only safe and economical means of fighting the insect pests of fruit trees."

In a recent issue of the Louisiana Planter, the following reference is made to co-operate sugar planting in that State: "It gives us great pleasure to be able at any time to chronicle the success of our colored population as agriculturists. So many are lacking in ambition or that thrift which enables them to establish themselves in business, that when we hear of one we like to chronicle the fact. We have often taken pleasure in mentioning that Lofty Briggs, a colored sugar planter in Vermillion parish, was a bright example in that direction. For nearly twenty years, now, he and his family have successfully and profitably cultivated cane, and they are respected by all their neighbors for their industry, honesty and good citizenship generally. In the parish of St. Mary there is another prosperous colored planter, in the person of Moses Alexander. He owns the Amelia Hope plantation on Bayou Cypremort, and, as usual, has a good crop, embracing 60 acres of plant

cane, 45 in stubble and 65 of corn. Last season he made 330,000 lbs. of sugar. Let others follow this example. The central sugar factories afford them the opportunity.

The locust has not yet appeared in Hawaii. In the Western United States, and in some European countries it is in some years very destructive to growing grain, corn and vegetables, while in South Africa and in South America it feeds on sugar cane, and all kinds of vegetation. In the Argentine Republic, (South America), they have discovered a valuable enemy to the locust, in the beetle called the Champi. The American Consul at Rosario, Argentine Republic, writes: "The Champi is the most effective locust-egg destroyer that we have. He is a dirty blackish beetle, the larger species being a little more than one inch long by half an inch, and must be looked for closely where locusts are laying their eggs, or his presence may not be discovered. These beetles belong to the genus Trox of the family Scarabaeidae. The eggs of the locusts are covered with a frothy exudation, that soon becomes strong-smelling, and attracts the beetles, who devour them." It is possible that locusts may some day be found here, and it will be well to remember where their enemy is to be found. They are among the most destructive insects known.

In Paraguay, (South America), the grasshoppers are almost as destructive of growing crops as are the locusts. We have the grasshoppers here now in Honolulu, and though they are not as yet numerous, they are likely to increase, if efforts to check them are not made. In Paraguay they use a mixture of caustic soda, arsenic and sugar or molasses. When sprinkled on the leaves of plants infested, which they eat, it kills them. This is a slow and tedious remedy..

It is probable that Italian laborers will soon be introduced to work on sugar plantations. Thousands of them are each year taken over to the United States in gangs or colonies, under agreement to work on low wages in mines or factories. They are generally in charge of a head man, who provides food and other necessaries, as agreed on. As they speak a foreign language, it becomes necessary to have such a spokesman, wherever they go. The people from the north of Italy are those generally preferred, and they differ very much from the inhabitants of Southern Italy, who are said to be unruly, lawless, and difficult to control. As to food, all Italians are fond

of macaroni, which is considered their staple, as bread is ours, and rice that of Chinese and Japanese. When the material is obtainable, they make it themselves. Their food is more expensive than that of Chinese or Japanese. But if facilities are afforded them to grow vegetables, they will raise for themselves much of what they require, in the matter of food. The success of any effort to introduce Italians or any Europeans will depend very largely on the person who has charge of the colony, who should be able to speak both English and Italian, in order to enable him to understand any matters complained of by the laborers, and report at once to the manager.

It is the opinion of some of our oldest planters that Hawaii can prosper without contracts embodying the penal clause. More than half the laborers now employed on plantations are free laborers, and as soon as the annexation of this group to the United States is confirmed by Congress, all labor regulations of the Republic must necessarily apply to Hawaii.

The following items are from Sugar Beet:

The working of first grade syrups by a new process appears destined to lead to satisfactory results. These syrups are diluted with first carbonatation juices or with the sweet water from filter presses and combined with 3 per cent lime. These syrups are mixed with fresh syrups from triple effect until the purity corresponds to a given standard, this is grained in a special pan. It is claimed that the lime has, under these circumstances, a special epurating effect and that the purity coefficient after graining is 63. A mixture of the mass thus obtained with 1-6 syrup from evaporating apparatus gives a syrup having a purity of 86, from which may be obtained high-grade sugar.

We note in one of our exchanges a correspondence showing how good drinking water may be determined by the use of sugar. The idea was first called to notice many years ago by numerous savants. We, however, quote data relating to the renewing of a series of experiments familiar to most sugar chemists. In 150 c. c. of water to be examined is dissolved 0.5 gram of sugar crystals, the flask containing same is closed and exposed to the sun at a temperature of 80° F. In a few days certain surface changes will be visible. Evidently boiling does away with any organic changes and there need be no laboratory test to show this.

A letter written to the New York Journal by Hon. James

Wilson may be of interest to our readers: "The dairy farmer of the United States is going to be a great factor in the future. * * * We have learned the secret of Denmark's butter and cheese keeping so well in tropical climates. * * * We send our butter to China and it cannot compete with the butter of Denmark. Why? Because it won't keep. There is a splendid market in the Orient, but we are shut out of it practically because our butter will not stand exportation to that sort of climate. * * * Danish dairymen feed their cattle with the same substance as the waste of our beet-sugar factories. * * * If we raise sugar beets and feed the waste of the factories to the dairy cows, we will make our butter just as good in the tropics as that of Denmark."

Herbert F. Oxnard denies that the beet-sugar factories of which his brother is president have been sold to a beet-sugar trust. "The facts in the case are these: About a month ago four factories, situated at Chino, Hueneme, Grand Island and Norfolk, the last two in Nebraska, were consolidated into one organization There was no sale of properties, but the capital stock was placed at $5,000,000 preferred and $15,000,000 common, of which not all was issued. The only feature about the deal is that two large banking firms of New York have just been taken into the concern. The name of the new corporation is the American Beet-Sugar Company, and it is not a beet-sugar trust. Henry Oxnard was president of the four factories, and is now president of the combined plants."

The statement which has been lately published, that neither the beet sugar interest of the United States nor the Sugar Trust combination, including the Louisiana planters, will, at the coming or any future session of Congress, antagonize the sugar interest of Hawaii, but will join with the Hawaiian planters to have a discrimating tariff put upon sugar imported into the United States from Cuba and other colonies lately acquired during the recent war with Spain—will, if confirmed, be gratifying news to all interested in the advancement and success of Hawaii. Most of the planters here, as well as those interested in the advancement of this industry are Americans, fully in sympathy with the success of both the beet and cane industries of the mother country. Ours is a very different relationship to that of the territories lately acquired from Spain. These will require to go through a period of tutelage, absolutely necessary to fit them for entrance, and for the enjoyment of

those privileges which are the birthright of all Americans, whether born on American soil or on Hawaii. Whether the policy referred to has yet been adopted or not, it is a wise one, and in the end will result to the advantage of the mother country, and be an object lesson to any that may seek admission to the American Union.

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BEET SUGAR AND WESTON'S CENTRIFUGALS.

The rapid growth of beet sugar interest in the United States is frequently referred to in our exchanges. There are now eighteen factories ready for work in various sections of the Republic, about one-half of them, as regards capacity, being located in the Pacific States, including Utah, which has now two. There are also twelve factories now in process of erection, making a total of thirty beet factories in the United States, all of which will be in operation during the year 1900. Some of these are quite small. Two of the California factories —the Spreckel's at Salinas, and that of the Oxnard Company at Oxnard, are very large and complete establishments, each being capable of turning out thirty to forty thousand tons of sugar annually, provided the beets can be had. As this crop, like the grain and fruit crops in that State, is dependent on a regular supply of water, either from showers or by irrigation from artesian wells or mountain streams, the amount of sugar obtainable from this source must remain uncertain, until reliable irrigation supply, needed to supplement the rainfall, can be provided. Other crops in lower California,—grain as well as fruits, are all dependent on the rainfall, where irrigation is not to be had, and in some years, like 1898, the failure of both grain and fruits has been very disastrous. In our trip to Southern California, last year, it was a sad sight to witness the effects of the drought, not only on the beet fields, but on the grain and fruit fields, some of which were abandoned, and the trees cut down to make way for hay and grain crops.

The same conditions prevailed in these islands twenty or thirty years ago, when sugar cane was dependent solely on the uncertain rainfall, which in the spring and summer, was very light, and rendered the sugar industry extra hazardous. As a result of these droughts, it may be stated that, some thirty-five or forty years ago, two shares of the Lihue Sugar Co., the par value of each share being then $5,000, were sold at auction here in Honolulu, for $2,000 each, simply because the planta-

tion did not pay current expenses. This was before irrigation was introduced. The same shares could not probably be purchased now for $200,000 each. Irrigation and the later discovery of artesian or mountain water supplies changed the condition very rapidly, and rendered the cultivation of cane a reliable and profitable one. It would seem as though the same results might be secured in California, at least to a limited extent, by obtaining artesian water for the sugar beet farms.

Still the beet industry is being developed throughout the middle and northern states, and wherever grain will grow, beets will do as well. But the selection of seed, the planting, care, cultivation and harvesting can only be gained by experience. At Lehi, in Utah, it has taken the farmers ten years to learn how to grow beets that will yield the most sugar, and they are paid there now according to the saccharine value of the roots. The same rigid system has long been adopted in Europe, with the result that beets are improving from year to year, and the farmers are paid according to the sugar value of the roots.

It is stated that at least twenty-five beet sugar factories will be in operation during the present fall in the United States, and that the product will be some sixty or seventy thousand tons. Gradually the industry will expand, for there is no crop more easily grown, nor any which pays better than sugar beets, when proper care is taken with them. The growth of this industry in America during the next few years will be a marvel to those who are not familiar with current events. The Pacific slope alone will be able to produce one hundred thousand tons of beet sugar within four or five years.

The price of raw sugar in 1850 was eight to ten cents a pound, and refined or loaf sugar was fifteen to twenty cents. But it then cost four or five cents to refine sugar, whereas now the cost of refining has been reduced to below one-half cent. This reduction has been secured chiefly by the discovery of the centrifugal method of drying raw sugar, which was invented and patented by Mr. D. M. Weston, a Bostonian, in Honolulu in 1852, 3 or 4. The way in which it happened is this, and it well illustrates how great results often spring from the most trivial occurrence.

Mr. Weston was an engineer and machinist, whose shop was in the flour mill, and one day he threw a wet cloth on a wheel that was revolving rapidly in his shop, and taking it off a few minutes later, found it quite dry. A new idea struck him at

once, and in order to test it he filled a wet bag with soaking sawdust and placed it on the wheel. In a few minutes this was taken off, and on examination the bag and contents were found to be perfectly dry. These experiments were made in the presence of several gentlemen, of whom the writer, (the Editor of the Planter's Monthly) was one. Being of a practical turn of mind, it occurred to Mr. Weston that this method might be applied to the drying of sugar on our plantations, which was then left in large iron pans or trays for weeks or months, to dry by evaporation. He soon set to work making a machine for this purpose. It was made of thin sheet iron, drilled with numerous small holes, and was much smaller in size than those now made. The writer, who was at that time interested with Mr. Weston's flour mill enterprise, well remembers watching the construction of this first centrifugal or "drier" as it was then called. The molasses had to be put into it by hand, with a scoop, and the dried sugar taken out in the same way—a slow and tedious process. The original machine was tested in his shop several times, during this experimental period, and driven only at a slow speed. This first experimental centrifugal or "sugar drier," was bought by Dr. R. W. Wood, and sent to his mill at Makawao, East Maui, of which Mr. A. H. Spencer, (father of James G. Spencer of this city), was then manager, and part owner. Of its first work in a sugar mill, Captain Wilfong, in one of his reminiscences, refers in the following extract, which will be found in the Planter's Monthly, Vol. 1, page 150.

"About this time (1852) one of Mr. Weston's new centrifugals, was set up, a four-man power attached by wheel and belt. This was one of the first Mr. Weston ever made. I had it set according to directions, with a post in the ground eight feet deep, filled in with stones and cement. The spindle of the machine was inserted in the end of the post, on which the machine run, and the molasses led off to a tank below. This machine was a curiosity to native people, and sometimes a hundred or more came to see it work. The school boys would come every afternoon and run the machine till night without pay, and would dispute their turn to run it. They would make it hum."

This was the beginning of one of the most useful devices ever invented for making sugar, and which has done more to reduce its cost than any other. The credit of its invention has been disputed by others, but it unquestionably belongs to Wes-

ton only. It is now used in every sugar factory and refinery in the world, as well as in laundries, cotton and woolen factories, and in many other ways, which its inventor never dreamed of. Mr. Weston died some years since in Boston, where his widow and son still live, enjoying the fruits of his useful invention.

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THE POSSIBILITIES OF MAUI.

The extent of arable land, suitable to the cultivation of sugar cane on these islands, has long been a question, the solution of which depends in part on the amount of water obtainable, either from rainfall, streams or artesian and other wells. Formerly streams and rainfall were the only sources of supply for the growth of all kinds of vegetation. The aborigines well knew how to utilize river water for the cultivation of their chief vegetables, taro, sweet potatoes, yams, etc., and in conveying it, often in long ditches, to a great distance. Their regulations were very exacting, and though they had no written laws, the ancient customs, based on the will of the chiefs, konohikis or local agents, were regarded as the law. As foreigners came in and purchased land, the ancient water rights went with the land to the new owners.

In the early days of cane planting, the old law still prevailed, and restricted the area of cane in many places to small holdings. As this area gradually extended, and new supplies of water were needed, private rights were purchased, until the limit of cane cultivation seemed to be reached in 1880 with an annual crop of about 33,000 tons of sugar; and under then existing conditions of limited water for irrigation and with poor machinery, no man would have dared to predict that these islands would ever produce for export more than 100,000 tons of sugar. The discovery of artesian water two years prior to the above date, and its application to the sugar industry created an impetus, which still continues, with even greater force than at any previous date. The efforts that have been made to find artesian water on the other islands of our group than Oahu have demonstrated that abundant supplies of fresh water exist below the surface on each of the islands of our group, excepting perhaps Hawaii.

A recent visit to Maui convinces us that abundant supplies of fresh water exist at the base of the great mountains of that island, sufficiently pure for irrigating cane and for all purposes in the mills and plantations. Several wells have been

opened on the Spreckles plantation, with more to come. One of the finest wells on that island, visited by the writer, is on the Paia plantation, perhaps half a mile from the seashore. In digging this, the workmen found, under the surface soil, a layer of black volcanic sand, then they blasted through several feet of hard lava rock, then again a layer of black sand, followed by another of lava rock. On removing this, at a depth of only 33 feet, which had apparently been pent up for centuries, there burst out, and filled the excavation nearly to the surface—clear, sweet water, fit for man, beast or growing cane. For more than a year the supply from this fine well has not varied perceptably, though yielding ten millions of gallons daily, serving for all the uses of the plantation.

Other wells quite as valuable as this have been opened, and are now in operation along the base of this great mountain, on its western and northerly sides, and there can be no question that the supply of water for plantation purposes on Maui as on Oahu, is practically without limit. Not every effort, however, to find it is successful, but enough is known already to demonstrate that there are vast reservoirs stored under ground, ready for the use of man, whenever he may search for it. Not every effort has been successful, nor will it be, but the supply is there notwithstanding, and it remains for man's ingenuity and skill to bring it to the surface and make it available. The readers of this and other periodicals that have been edited by the writer, are aware that he maintained, so long ago as twenty-five years, that water supplies existed below the surface, as indicated by subterranean streams of fresh water seen flowing into the sea, between high and low water levels, at numerous points on each of the islands of this group. Scarcely a month passes but some new development is made, as is shown by the recent reports from Molokai and Lanai, where on the latter island, one of the finest wells has lately been opened. Hawaii has not yet responded to the diviner's rod, but even there, where Pele's fires still burn, and where some deem it impossible, hidden reservoirs may yet be tapped and brought to the surface.

On the western slopes of Mt. Haleakala of East Maui, lies the large land of Wailuku, stretching from Spreckelsville to Maalaea Bay—a distance of ten or twelve miles. It is a plain of rich alluvial soil, nearly level, and gently sloping off to the isthmus which connects East and West Maui. It has scarcely a tree or blade of grass on it; and in this denuded, desolate

condition it may have remained for centuries, washed by the annual winter rains, which dry up, almost as soon as they fall on it. The trade winds blow across this plain, and when very strong, clouds of red dust sweep over it, which the natives facetiously term "Maalaea or Kihei rain." This plain varies from fifty to four hundred feet above the sea, and belongs to the Hawaiian Commercial or Spreckles Sugar Plantation, which intends shortly to construct a new water ditch from the stream on the windward or north slope of the mountain, a distance of twenty-four miles, furnishing an ample supply to irrigate each year two or three thousand acres of the plain, which has lain uncultivated for centuries. This new land will then be able to increase the crops, and perhaps double the annual output, making good Col. Spreckels' boast that the plantation would be made to yield forty thousand tons annually. The cost of the new ditch will not be less than $240,000. This project indicates the determination of the company to make this the first sugar estate of Hawaii, as its former owners always intended it should be. It may not be generally known that the Spreckles plantation includes about ten square miles of land, a large portion of which may be termed first class sugar land, requiring only water to insure heavy crops. Wells are being opened in various localities on the lower lands, the water in which has to be pumped to the height required for irrigating. And there seems to be no limit to the amount of water obtainable from this source.

There are on Maui nine sugar mills in operation, viz: the Pioneer at Lahaina, the Wailuku, (which includes the Waikapu and Waihee estates), the Hawaiian Commercial, Paia, Haiku, Hana, Hamoa, Kipahulu and Olowalu, with two new estates in prospect—Kihei and Nahiku. The Maui crop of 1899, for each of the factories in operation, will show an increase over that of the previous year, while the Pioneer of Lahaina may double its last year's output. This factory has, during the past year, been made practically new, having a nine-roller mill of the latest pattern, engines, boilers, vacuum pans, evaporators, etc. Not a vestige of the old works remains. In addition, three wells have been sunk on the premises, and will soon be supplied with powerful engines raising water not only for the mill, but for irrigating new cane fields near by. Here, as in nearly all the sugar factories of this group, little or no coal is used, the trash from the mill, supplying all the fuel, with heaps to spare. In this and other mills, many new devi-

ces, some originating from the ingenuity of the employees, will be noticed—all tending to economize labor, fuel or space. It is doubtful whether the sugar factories of any other country can show so many improvements for the handling of cane, sugar, trash and the waste. Some are kept as neat as a lady's kitchen—quite in contrast with former times.

It may be remarked in passing, that the unanimous opinion of sugarmill men here is, that the use of the Krajewsky or the National Shredder is a very great help in various ways, by putting the cane in much better shape for the rollers to do their work, rendering the feeding of the mill more regular and even, thus reducing the strain on the rollers, which thereby become less apt to clog and break. They also serve to dispense with the men formerly required to feed the mill, and watch the cane and rollers, which were so liable to breakage. As a result, the mill works evenly and without a jar, crushing out every drop of juice in the cane, lessening the liability to heavy strain and breakage, thus securing more satisfactory work, with greater profit to all interested.

Most of the transportation on the larger estates is now done on steam railways, permanent or portable, allowing a constant extension of the cane area to new fields, some of which are ten or twelve miles from the mill. By the same means, all the sugar is conveyed to the ports of shipment. The chief factor that creates an expansion of the sugar production on Maui is the opening of new wells at various points, that are not reached by flumes. This steady increase may continue from year to year, so long as good planting area is reached by the new subterranean water supplies. The cost of raising water to an elevation of three or four hundred feet above sea level will be the main factor in determining the limit of expansion of our sugar industry. At Kaanapali, the water is raised now to over four hundred feet, and with satisfactory results. The point beyond which it will not pay to elevate the water for irrigation has not yet been reached.

Too much stress cannot be laid on the advantage of using only such fertilizers as the soil demands. This can only be ascertained by careful analysis; and in this important study, the work of the Honolulu laboratory, under Dr. Maxwell's supervision, is doing good service. While riding in company with the manager of one of the Maui plantations, a very marked difference was noticed in the appearance of the cane, on each side of the roadway, both apparently of the same age. One

had the bright glossy appearance of healthy growth. The other had a sallow, hungry look. On inquiring we learned that both fields were planted at the same time, and had received the same cultivation and water. One had been well fertilized with the food it needed; the other had not been fertilized, owing to a short supply, which was daily expected. A more striking object lesson, showing the value of judicious fertilizing could not be desired. The difference in the yield of these two large areas of cane, both having received the same cultivation and watering, had they been left to grow to maturity, would have been not less than two or three tons per acre. This tells forcibly on a field of five hundred acres. Successful planters have learned that cane like draft animals must be well fed with nourishing food, and that the nourishment which one crop takes from the soil must be replaced for the succeeding crop. The contrast which the fields of to-day show, when compared with those of twenty years ago, is so great, that there can be no doubt that the increase in the production is mainly owing to more thorough cultivation and better mill work, the same fields now yielding double the amount of sugar they then did.

The labor question is still a perplexing one, as all the larger plantations require more men, to say nothing of the eight or ten new plantations, which will call for several thousands more, if all the present plans are carried out. In some localities, no doubt, colonies of white laborers as well as Asiatics can be located, which, with special privileges, or assistance afforded to them at the start, will prove advantageous to both the planters as well as the colonists. Could machinery be invented to perform part of the heavy work, such as planting, hoeing, stripping, topping and cutting the cane, as well as loading it on cars following close behind the cutters, it would save a vast amount of hard work, many laborers and animals, just as the steam gang plows are doing to-day. It is the firm belief of the writer that these improvements will be accomplished in the early years of the twentieth century.

H. M. W.

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A firm in Scotland is engaged in the manufacture of artificial stone, which is, it is claimed, quite the equal of the natural product in durability, hardness and in its ability to stand weather tests. The ingredients are principally lime and sand, with water at a very high temperature.

SUGAR PROSPECTS IN HAWAII.

There has been less activity in the sugar stock market in Hawaii during the past month, and but one large sugar corporation has been floated—the "McBryde Sugar Company," with a capital of $3,500,000, and privilege to increase to $10,000,000. The estate is located on the southerly side of Kauai, extending from Koloa to the Hanapepe river, which separates it from the well-known Makaweli sugar estate. It absorbs the Eleele Plantation, the McBryde estate and the Koloa Agricultural Company's estate—altogether about 20,000 acres, a considerable portion of which is good sugar land. With the exception of the Hawaiian Commercial Company's estate on Maui, this embraces the largest extent of any sugar estate on these islands. On page 336 of this issue, will be noticed the latest transactions in Hawaiian sugar stocks to the 12th inst. Owing to the new and very superior machinery which has been introduced during the past twelve months, and the impetus that has been given to this industry, the output for 1899 will exceed estimates heretofore made, and will probably be not less than 260,000 tons. The capacity of some of our mills has been nearly doubled, and awaits only the ripening of growing cane to show in 1900, a still greater yield of the finest sugar produced anywhere.

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SECRETARY WILSON AND SOUTHERN PRODUCTS.

The following advice, given by the U. S. Secretary of Agriculture, Hon. Henry Wilson, at a recent meeting in New Orleans, is equally applicable to Hawaii, and will be read with interest here. Where reference is made to negroes it will apply equally well to Hawaiians.

"The South has marked advantages over the North with regard to production. It has more heat and moisture, the two great factors of production, and if the cotton-grower is to diversify his crops he must use those natural advantages. The dairy cow would succeed admirably in the South, so would the mutton sheep, but before either is generally introduced something for them to eat must be provided. The winters in the South are mild, grasses, grains and legumes can be sown in the fall, grow abundantly through the winter, upon which the dairy cow and the mutton sheep may thrive and produce. This was one of the first propositions to which I gave attention and

concerning which I made wide inquiry. Experiments have demonstrated that alfalfa, Italian rye grass, rape, the clovers, vetches, etc., will grow vigorously in the South and furnish abundant forage for domestic animals. At the present time, under the reign of cotton, one rides hour by hour throughout the South and sees nothing of this kind growing. When they are grown the farmer is ready for the brood animals—the mare, the cow, the ewe, and the sow. I discussed the question publicly and privately with leading Southern people of the advisability of turning much of the labor of the South in this direction so as to diversify labor and take advantage of the natural opportunities offered by Southern conditions. There is a divided sentiment regarding the diversification of labor. A good many contend that the labor of the South, the colored man, will not and cannot successfully be turned in this direction. Others admit that this can be successfully done. It can only be accomplished, however, in my opinion, by the intelligent, educated men of the South taking hold of their laborers and teaching them. Along agricultural lines very few people are as intelligent as they should be. A man can be successful in a profession and yet know very little about furnishing feed for the dairy cow or taking care of her milk. The greatest hope we have is that the experiment stations are gradually educating a class of young men who can take the colored man by the hand and show him how and when to plant these forage plants. Then teach him how to care for the dairy cow, the brood mare, and the mutton sheep.

"The South can prepare the spring lamb much earlier than the North, and Americans are learning to eat mutton because mutton rather than wool sheep are being propagated at present, and as more good mutton is offered the American will eat more of it. The South can produce this product just as easily as it can produce strawberries. The Southern landowner understands horse-raising. He understands how to rear and train the saddle horse, something not understood by people generally. There is always a greater demand for saddle horses than is supplied. The world wants carriage horses, it wants draft horses, it wants good roadsters. The Southerner is ready now to lead in this production, and if he would use the labor at his disposal along this line it would be profitable both to the employer and the employed. We know far more about horses than we know about sheep and cows. Early spring chickens, the broilers, can be produced down there, because they have milder winters and milder springs, and the Northern market can be supplied, but should it become overstocked we can send this product abroad in the refrigerator compartments of our steamships."

The South has reached the point in agriculture reached by the North a few years ago, when corn was so abundant it was used for fuel. With the advent of diversified farming, with the dairy and stock interests prominent come prosperity.

THE SUGAR CANE AND ITS CULTIVATION.

We have received, says the Louisiana Planter, a handsomely bound copy of a work recently published by Wilh. Kruger, Ph. D., superintendent of the Bacteriological Division of the Agricultural and Chemical Experiment Station, Halle, A. S., Schallehu & Wollbruck, publishers, Madgeburg and Vienna, price 30 M. The book is entitled "The Sugar Cane and its Cultivation, with Particular Regard to the Conditions and Investigations in Java." The contents of this book indicate its character. It opens by giving the general literature upon sugar-cane, and also mentions the institutions giving instruction in the culture and manufacture of sugar-cane and its products. Among these the author mentions the Louisiana Sugar Experiment Station, and the Audubon Sugar School of the State University at Baton Rouge. He also mentions this paper as one of the weekly periodicals giving valuable information in regard to the culture and manufacture of sugar cane and its products.

The first chapter discusses the position of sugar-cane in the plant system, giving a large number of species with numerous varieties; and while we regard the discussion of these numerous species as being more scientific than practical yet it is interesting and instructive to see the manner in which it has been done. The second chapter treats of the structure, developement and physiology of the cane and gives a clear insight into the manner in which cane grows and develops. The third chapter discusses the habitat of sugar-cane, and the cultivated varieties derived from the wild kind. The fourth chapter gives a history of the cane and its preparation into sugar from the earliest times down to the present day. The fifth chapter deals exclusively with the history and cultivation of the sugar-cane in Java. In this chapter we find a discussion of the varieties, so-called, of the cultivated cane and those grown in different countries of the world, and at the same time those found adapted to the seasons in Java. The seventh chapter gives the chemical composition of the sugar-cane, with different kinds of fertilizers. The eighth chapter discusses the requisite climate conditions, and the ninth chapter the soils best adapted for cane cultivation. The tenth chapter gives the cultivation and preparation of the soil. Chapter eleven is devoted to the fertilization of

cane as practiced in different parts of the world with experiments with different kinds of fertilizers. The rotation of crops is treated extensively in the twelfth chapter; while the selection and handling of seed cane constitute the subject matter of chapter 13. The proper methods of planting and cultivation, are subjects for the fourteenth and fifteenth chapters; while the enemies and diseases of the sugar-cane form the subject of the extensive chapter sixteen. Harvesting the cane, the tonnage, the cost of cultivating it, the cost of manufacturing cane-sugar and the world's production of sugar and list of sugar-producing countries, are treated of in the concluding chapters. The book is extremely full of information, and is well written.

In the first chapter we find twelve distinct species, giving Saccharum Officinarum, one to which we have been in the habit of referring in the canes cultivated in this country. He claims it was not found wild, its original habitat being Cochin China, Malay Archipelago or Bengal, and they have separate varieties of these species. Of the canes cultivated in Java he thinks that they belong to the following species, Saccharum Spontaneum (L), Saccharum Soltwedeli (Kobus), and Saccharum Officinarum (L). He says that canes closely related to the cultivated canes of the country are found even in the Pacific Islands, while their original home was doubtless in the region of the Ganges delta. He further gives the history of the cultivation of the cane and the simple methods originally pursued of preparing sugar, and claims that in the early stages the fermentation of the juices and the preparation of effervescing beverages were more the object of the producers of cane than the production of sugar therefrom. He alludes to a knowledge of sugar-cane by the ancient Greeks, Romans, Phoenicians, Egyptians and Jews. He traces the growth of sugar-cane and sugar in Persia, and claims that it was at one time largely used as a medicine by Persian physicians. He also follows its developments in Arabia, Egypt, and its general distribution into Africa and Europe, Babylon, Cairo, Nubia, Morocco, Italy, Sicily, Andalusia, Granada, Valencia, Madagascar, Sokotra, Zanzibar, Bourbon, etc. He traces sugar-cane and sugar during the middle ages of Europe and then takes up its cultivation in Asia, China, Japan and the Archipelagos, then its cultivation in Manila, Formosa, Cochin China, Java, and Hawaii. He

then follows it into the New World, and claims Columbus brought it from the Canaries to St. Domingo, Cuba, Mexico, South America and Paraguay.

The history of the cane in Java is an interesting one. It was first introduced by the government in partnership with the natives. The first vacuum was introduced into Java at Probolinggo in 1836, and an experiment station was founded in West Java in 1886, one year after the establishment of the one in Louisiana. Another was established in East Java in 1887. In 1893 there was formed a syndicate of the sugar manufacturers of Java.

In describing the so-called varieties, he gives different methods of variation, color, size and form of internodes, nodes and the formation of eyes, smooth or hairy stalks, form, buds, etc., botanical characteristics of flower, stalks and blossoms, suckering, chemical constitution, and then with these characteristics he differentiates them into the varieties found throughout the world. The varieties most cultivated in Java are the Cheribon, Djapara, Tangerang, Lozier, Red Fiji, and in the West Indies, Bourbon, in Porto Rico the Crystallina, in Brazil the Cayanna and Otaheite, and in Louisiana the Red Ribbon and Purple, in Mauritius and Reunion, the Bourbon, Bamboo, Mackay and Lozier, in Australia the Bourbon, and in the Sandwich Islands the Lahaina and Rose Bamboo. The chemical constituents of the cane are given in detail.

Under the preparation of soil for cane culture he emphasizes drainage, good roads, and mentions the fact that steam plowing is largely in vogue in Java; tile draining is not practicable, while irrigation is performed in some parts of the Island with success. He gives the manurial constituents of sugar-cane and the fertilizer found adapted to the same, and gives the natural sources of fertilizers in Java, viz: peanut oil cake, bat guano, residues from indigo factories, leguminous crops. He also discusses the methods of applying fertilizers, the benefits derived therefrom, and when to apply them, with quantities per acre. He gives the following as an excellent rotation for the sugar-cane in Java—sugar-cane, leguminous crop, rice, leguminous crop, rice, sugar-cane.

He further discusses seedlings and the method of their selection, how to germinate the seed and the successful method of cultivating the seedlings. He also refers to the method of

planting the bottom, middle and tops of ordinary cane, width of rows, quantity of seed-cane per acre, depth of planting, and care and cultivation during the growth, laying by the cane, protection against external damage, winds, animals, etc. Removal of trash from the cane, and influence of light in ripening the cane are all thoroughly discussed. Among the enemies of the cane he mentions rats and cattle, and of diseases those chiefly of the fungus order of plant life. Under the head of harvesting cane he discusses the ripeness of the cane, how it shall be cut, cost of cultivation, cost of producing sugar, and the world's production of sugar. The book is extremely valuable, is written in German, handsomely bound, and excellently illustrated with colored plates.

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HAWAIIAN PLANTS AND PESTS.

By Geo. Compere, in California Cultivator.

It is not generally known that all the tropical trees and shrubbery and flowering plants, as well as all citrus and other fruit trees have been imported to the islands from all parts of the globe, as none of them are indigenous. And, with the importation of these trees and plants, there also came insect pests from all parts of the world, as there was no system of inspection carried on. The consequence was, the islands were soon over-run with pests, and their presence soon noticed by their work in destroying many of the valuable shade and ornamental trees, and it became utterly impossible for the planters to raise the citrus and coffee trees successfully any longer; in fact, most of the shrubs and coffee trees at one time were so badly infested by a mealy bug, Dactylopius vastator, Mask, that their destruction seemed imminent, notwithstanding the fact that the planters were fighting these pests with the most effective weapons at hand, and at great cost, and when they found that they were not making any headway on the pests, they at last gave up in disgust.

Then they began to think that it might be worth trying Prof. Koebele's plan to delegate this work of destroying the various pests to beneficial insects, and they secured his services, giving him a good salary and all his traveling expenses, one-half being paid by the Hawaiian Government and the other by the Planters' Association. When Prof. Koebele began his work, there were sixty species of scale insects to be found on the island, and among them some of the most de-

structive known, such as the purple scale, Mytilaspis citricola, Packard; long scale, Mytilaspis gloverii, Packard; mining scale, Chionaspis biclavis, Coms; white scale, Icerya purchasi, Maskell; Aspidiotus longsipina, Morgan; Lecaniun acuminatum, Signoret; L. longulum, Linnaeus; L. nigrum, Nietner; L. tessellatum, Signoret; Parlatoria zizyphi, Lucas; Dactylopius chalceolariae, Maskell; D. adonidum, Linnaeus; D. ceriferus, Newstead; D. vastator, Mask; and about forty-five other species of scale pests that are more or less destructive. But relief came with the introduction of the beneficial insects, and plantations that were a great expense to their owners under the old method of fighting the pests with artificial means, are now a source of great revenue to them, and none of the various scale insects that were once such pests are considered such any longer, they all being kept in check by the various parasites introduced, the only scale prevalent on the islands at this time being what is called the wax scale, Ceroplastus rubens, Mask; this one is not very injurious compared to other scale.

Of the various parasites introduced by Prof. Koebele on to the islands and the most valuable to the planters, was the lady-bird Chryptolaemus montrouriezi, Mulstant, that rid the plantations of one of the most pernicious coccids ever met with, Dactylopius vastator, Mask. This lady-bird was introduced from Australia. Chilocorus circumdatus, Gyllh, was introduced from Hong Kong, China. This one rid the citrus trees of the purple scale, and Orcus chalybeus, Boisd, has rid the citrus trees of Parlatoria zizyphi, Lucas. Vedalia cardinalis, Mulstant, has checked the spread of the white scale; Rhizobius ventralis, Erichson, has rid the islands of the various Lecanidaes; Platyomus lividigaster, Mulstant, and Coccinella rapanta, Thum, destroy all of the various Aphis or plant lice, while Scymnus punctum keep the Red Spider, Tetranychus telarius, in check.

But there are some other very serious pests on the islands that have not yet been subdued by parasites, and probably never will, owing to their nature. What is known on the islands as the Japanese beetle, Adoretus umbrosus, Var, that was probably introduced there from Japan and more than likely in the soil coming from there with the numerous plants imported from there to the islands.

The larvae of this beetle lives in the soil, and does much damage to the roots of plants, resembling very closely the

white grubs or larvae of the June bugs or May beetles, Lachnosteran rugosa, Melsh, that occur throughout this State, and to which species they belong, as the beetle is a night flying insect, only becoming active after the few insect-feeding birds have gone to rest, and there is nothing to molest them, and not even a single mole to feed upon the larvae, so they breed by the millions.

These beetles have voracious appetites and their food plants are too many to be enumerated. After the roses were gone the beetles paid their attention to various other plants and trees on the islands, and but few remain entirely free from their attacks, even the eucalyptus and orange trees being defoliated by them; the accompanying cut being an illustration of the larvae and beetles showing their work upon eucalyptus robusta, and orange leaves.

Another very serious and disgusting pest is what is known on the islands as the melon or cucumber flies. These flies appear at all seasons of the year; they pierce the melon or or cucumber and deposit their eggs in the puncture; these soon hatch into minute footless white grubs or maggots. Their presence is soon noticed in the cucumber by a small yellow spot where the puncture was made, and I have counted and removed one hundred and sixteen of these maggots of three different sizes from one large cucumber that had been punctured in three different places. The maggots eat out the entire insides of the melons and cucumbers, leaving nothing but the seeds and outside skins, and very few of the vegetable growers make any attempt at growing melon or cucumbers now, owing to the ravages of this pest.

The foregoing is but a brief sketch of some of the most dangerous pests of the islands, and which California fruit growers and farmers will have to guard against. It need hardly be said that the State Board of Horticulture, by its efficient quarantine guardian Alexander Craw, is keeping a watchful eye on all importations of products from these Islands as well as from elsewhere, as is shown by the recent destruction, by Mr. Craw, of a large shipment of cucumbers from Hawaii.

As to the Chilocorus circumdatus with which my recent mission to Hawaii was principally connected, I hope at sometime in the near future to make a report. It is sufficient however to say now, that their work on the Islands more than bears out the statements made concerning them.

As to the outlook of the Islands for the intending settlers: I do not think any man not possessed of ample capital, can expect to succeed, as lacking that, he will have to come into competition with the cheap Japanese and Chinese labor which, to say the least, would be exceedingly distasteful if not ruinous. Of course there are some who will succeed in the face of almost any odds, but my advice would be to stay at home. As an enjoyable trip there is probably none that will compare with the voyage to these Islands, but when it comes to residence that's another thing, and the old original United States, especially Southern California, is good enough for me.

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AGRICULTURE OF THE SUGAR CANE.

(Continued from February Number, Page 82.)

(From Jamaica Bulletin.)

By an adoption of the above suggestion, it is believed that in a few years valuable information to general cane culture would be obtained. (5)

(5) A study of the varieties of the sugar-cane is of paramount importance, for by careful selections canes may be obtained suitable for cultivation under various conditions of soil and climate. Equally important is a knowledge of the behaviour of different varieties in relation to fungoid diseases.

Many of the West Indian Islands have suffered most severe loss in recent years from fungoid parasites in their cane. In some of these islands it has been demonstrated that there is a marked difference in the manner in which the varieties are attacked. This question has formed the subject of investigations in Barbados and Antigua, where it has been shown that while some varieties readily succumb to fungoid attack, others are remarkably resistant. Whether this immunity will be maintained in spite of the constant exposure to infection, consequent upon the fact of their being propagated in infected fields, remains to be seen. So far, however, the selection of varieties would appear to constitute the most effective method of combating fungoid attacks; by growing the most hardy varieties, rejecting these as soon as it appears that they show signs of breaking down and substituting others, attacks of such fungi as Trichospheria sacchari, the rind fungus, may perhaps be overcome.

So far Jamaica appears to have escaped any serious fungoid attack of its sugar canes. This is possibly due to the fact that several varieties are cultivated, while at the same time there are but few Bourbon canes amongst them. It will be well for Jamaica planters to be on the alert to check any outbreak should such occur, and this check will probably be best secured by an immediate change of the variety of cane under cultivation. As a preventative measure it is very desirable that a careful study of as many useful varieties as can be collected should be made at the Botanic Stations, these experiments will serve a double purpose by first leading to a knowledge of the saccharine richness and yield of the different varieties and secondly a knowledge of their freedom from or liability to fungoid and other parasites. An attempt is now being made to study this subject in a more systematic manner and it is hoped that in a short time there may be presented to planters information compiled from local experiments bearing upon this important side of the sugar question.—F. W.

Composition of Cane.

Analyses show that every ton of cane delivered at the mill removes from the soil 9.4 pounds albuminoids, or 1.5 pounds nitrogen, and 12.2 pounds of ash. This ash would contain 2.17 pounds potash, 1.48 pounds phosphoric acid, and .8 pounds of lime. In Louisiana the proportion of tops and leaves to cane is about one to three. Therefore every three tons of mill canes will give one ton of tops and leaves. One ton of tops and leaves will remove 35.80 pounds of albuminoids, or 5.7 pounds nitrogen, and 68.8 pounds ash. Since every ton of cane has about one-third of a ton of tops and leaves, there will be required for the growth of a ton of cane, exclusive of roots, and including tops and leaves 21.3 pounds of albuminoids, or 3.4 pounds nitrogen, and 34 pounds ash. When the cane is harvested, the trash (tops and leaves) is left on the ground and usually burnt. In burning, the ash or mineral matter is restored to the soil, but the nitrogen is dissipated into the air. Therefore, to one burning hi strash, there is withdrawn from the soil with every ton of cane 34 pounds nitrogen, 2.17 pounds potash, 1.48 pounds phosphoric acid and 8 pounds of lime. There is a saving of 1.9 pounds nitrogen, by burying the trash to each ton of cane made, equal to the nitrogen in 27 pounds of cotton seed meal. From the above it will be seen that the quantities of elements usually supplied in commercial fertilizers are assimilated and utilized by the cane in relatively small quantities when compared with others staple crops. The excessive weight, however, of a crop of cane grown on a given area causes the total absolute quantities of the ingredients referred to, to more nearly approximate those removed from the soil from other plants.

Forty tons of cane per acre is not unusual. This amount would require 136 pounds of nitrogen if the trash was burnt, or 60 pounds if trash was turned under, 87 pounds potash, and 59 pounds phosphoric acid.

The above quantities of nitrogen would be represented by 1943 and 856 pounds cotton seed meal.

It would require over 700 pounds kaimt to supply the potash and nearly 400 pounds of a 15 per cent. acid phosphate to furnish the phosphoric acid, if none were furnished by the soil.

Burning of Cane Trash.

Shall we then burn our trash or shall it be turned over? Chemically there is a loss of nitrogen for each ton of cane

harvested, by burning, equivalent to that contained in 27 pounds of cotton seed meal. On a field averaging 30, 20 or 10 tons per acre, there will thus be lost an equivalent of nitrogen contained in 710, 540 and 270 pounds cotton seed meal—a loss which would be serious in any other agricultural industry, Why, then, do we burn? The following reasons are given:—The cane borer, which at times becomes so abundant as to seriously injure the cane, is practically held in check by burning the tops in the trash, which contain the worms, thus destroying thousands annually. If a cessation of planting cane on the part of every planter in the State could be simultaneously practised for one year, and no cane saved for seed wherein the worms could hibernate, and all the trash everywhere burned, it is believed the borer would be exterminated in Louisiana. Since it is extremely rare that any are found in the stubble left after cutting down the stalks, and if by chance any should be so found, the cold of our average winters and the heat from the burning trash would destroy them.

Again, our stubbles are liable to be killed during our winters. It has been clearly demonstrated that this danger is greatly enhanced by excessive moisture, and the latter is frequently produced during our winters, if the trash as permitted to remain on the ground or turned under with a plough. Burning trash off the stubble immediately after the cane is harvested, leaves the cane rows clear of vegetable matter and enables them to shed freely the water falling upon them, and if proper drainage has been established, the entire field will remain practically dry during our wettest winters and the stubble will rarely be injured even by excessive cold. Experimnts in burning the trash off immediately after harvest have so conclusivly demonstrated the wisdom of the act, that almost every planter in the States seizes the first dry spell after his cane is cut to fire his fields. If the trash be left on the ground it will absorb and retain a large amount of moisture in the spring and thus retard the sprounting of the stubbles. Burnt fields always give earlier stubble stands.

Leaving the trash on the field is also a great obstacle to the proper cultivation of the ensuing stubble crop. A crop of thirty tons of cane will leave ten tons of a light porous trash, which during the winter and spring will absorb large quantities of water, and which, decomposing very slowly, will prevent the successful running of ploughs and cultivators. It is

claimed by observant managers that the increase in the stubble crop, due to a more excellent cultivation rendered possible by burning the trash, will alone more than compensate for the fertilizing ingredients lost in burning. These are the main reasons for burning, and an experience of twelve years enables the writer to pronounce them sound and valid. The loss of vegetable matter by burning, is willingly, knowingly, but rigidly sustained to prevent subsequent losses of a far more serious nature.(°)

VARIATION IN COMPOSITION OF DIFFERENT PARTS OF THE STALK.

Canes vary in composition, not only with age, in different countries and on different soils, and under different climatic conditions on the same soils in the same country, but also among themselves. Individual stalks rarely ever give exactly the same composition. This will be more fully discussed under the chapter on "suckers," when it will be shown that in harvesting a clump of canes, no two will be found of exactly the same age, and therefore variable in composition.

Even individual canes have not the same composition throughout their length. It is well known to every planter that the butt of a cane is the sweetest part of the stalk, and that its sweetness decreases as you ascend, until finally the extreme upper part is almost devoid of sugar.

(°) Burning the Trash.—The question whether trash should be burned or no, has been most keenly debated. Dr. Stubbs gives excellent reasons for pursuing his practice under the conditions prevailing in Louisiana where it would appear the gains far outweigh the losses. It seems quite open to question whether under the conditions prevailing in Jamaica the gains would equal the losses. Some observers maintain that comparatively little check is given to the ordinary moth borer (Diatroea saccharalis) by burning the trash tops. In Louisiana with its winter it is highly desirable to prevent the chilling which would result from leaving a water soaked layer of trash covering a field during a winter, when the temperature for brief interval may fall as low as freezing point. This difficulty does not confront the Jamaica planter, who for the most part will find his trash of value as a covering to his fields, a covering which will conserve moisture and prevent the injurious action of the direct heat of the tropical sun upon his soil or his young plants.

Again not only does burning involve the loss of the nitrogen contained in the trash, but it involves also the loss of the organic matter which by decay forms humus, a substance of great value in soils, beneficiently modifying the relation of the soil towards water, rendering stiff close toils more easily drained and worked and causing light sandy soils to retain moisture more efficiently. From this point of view, under tropical conditions, burning probably entails considerable loss, particularly if carried on systematically year after year. It is admitted true that a heavy covering of trash is in some degree troublesome when plowing the fields, but this difficulty has been overcome by the methods in vogue amongst West Indian planters.—F. W.

So apparent is this to the taste, that chemical analysis is not needed to convince even the "small boy" who chews the cane. Yet time and again has the chemist verified this fact by analysis. He has shown that the sucrose is most abundant in the lower portion of the cane with a minimum of glucose. That the former decreases and the latter increases as you ascend the stalk, until finally in the upper white joints the glucose absolutely predominates. This suggests the wisdom, when only sugar is desired, of lowering the knives in the field and removing the in mature upper joints, which from their composition are bound to be melasegenic in the sugar house and perhaps restrain from crystallization otherwise available sugar. Again the nodes and internodes of a stalk of cane vary in composition even when taken from the same part of the stalk. The following analysis of the nodes and internodes of twenty stalks of purple canes with normal eyes, will show the variation:

	Brix.	Sucrose.	Glucose	Slids not sugar.	Fibre.
Nodes 15.94		12.6	0.13	3.21	16.5
Internodes 17.4		15.5	0.94	.96	8.00

The nodes vary from the internodes, not only in the total nitrogen content, but also in the form of nitrogen present. The nodes containing .1829 per cent. of total nitrogen, of which .1778 albuminoids, and .005 amides; while the internodes have only .0817 per cent. of total nitrogen, of which .0559 are albuminoids, and .0258 amides. It will thus be seen that the nodes carry much larger amounts of solids not sugar, fibre and nitrogenous matters, while the internodes are richer in sucrose and glucose. This explains why the juices from the different mills in our sugar houses vary in composition, and that the juice from the first mills is purer and more easily worked than that from the other mills. The first mill extracts juice mainly from the internodes, which are softer than the nodes. The second and third mills crush the nodes and extract from them the impurities given above, and the more powerful the expression the more impure the juices obtained. Attached to every node is an eye or a bud, destined to become a future plant. Around this eye is stored the food for its future use, and in this respect the nodes resemble the seeds of flowering plants with the sucrose and glucose of the internodes as a further food reserve.

The excess of gums, mucilages, albuminoid and fibre in the node, is therefore intended as food material for the young plant until it shall become large enough to obtain its own food, and these substances are formed in the node during the process of ripening by the condensation of the simple molecules into more complex and less soluble forms of gums and mucilages, and by the union of amides and glucoses in the presence of sulphur compounds, to form albuminoids. As the bud developes, the albuminoids are converted into soluble amides and glucoses, and the gums, mucilages and fibre, in soluble carbohydrates (glucose or dextrose), which furnish the food for the young plant until it can draw its own sustenance from the soil. In case this storehouse should be exhausted before the plant is capable of self-support, it can draw on the reservoir of sucrose, glucose or nitrogenous matter stored in the internodes, as shown by the experiments of Prof. Ross. The action of ferments during germination will readily produce the above tranformations and may even convert a part of the fibre into soluble carbohydrates, thus rendering a portion of his substance available for plant food. The following is the conclusion of a series of investigations made by Dr. J. L. Beeson in the laboratory of this Station.

"To recapitulate: It has been found in the course of this investigation that the juice of the nodes of the cane is quite different from that of the internodes, containing markedly less reducing sugars, more 'solids not sugar,' and more allu minoids bodies; that the 'fibre' of the nodes contains more albuminoids, more insoluble carbohydrate not sugar, which readily pass into reducing sugars; that as the cane deteriorates, reducing sugars are formed more rapidly in the nodes than in the internodes. In our opinion these facts can be best explained by the hypothesis previously stated, namely that the physiological function of the node in the cane is similar to that of the seeds in the case of flowering plants—to store food in the region of the eye for the use of the young plant before it has taken sufficient hold of the earth to draw sustenance from the atmosphere and soil. The hypothesis further confirmed by the fact the isolated nodes of the cane when planted will germinatd and grow to maturity.

"As already shown, there is a marked difference in the purity coefficient of the juices from the nodes and internodes. That from the nodes gives an average of 81 per cent. purity,

while that from the internode an average of 89 per cent. approximo. If a machine could be devised by which the nodes could be separated from the internodes so as to work the juices separately, it would doubtless be profitable. Since the nodes in the samples analysed constitutde about 14 to 16 per cent. of the whole weight of the cane, it would be a great loss to throw them away. Since the nodes show a much lower purity co-efficient, many short joints on the stalk decrease the purity of the juice of the whole cane."

Preparation of Land Planting, etc.

Once in three years a restorative crop is interjected between the cane crops. The rotation being as follows:—First year, plant cane, second year, stubble cane, third year, corn and cow peas. No system of rotation is complete without a leguminous crop, and among the leguminous crops the cow pea occupies the front rank as a rapid soil restorer, frequently accumulating in a few months over 100 pounds nitrogen per acre. An examination of the roots of the cow pea vine during rapid growth will reveal large quantities of wart-like tubercules which when crushed and portion examined under the microscopic will reveal countless thousands of bacteria, peculiar to this plant living in symbiotic union with its host. Nothing can supplant the cow pea in the short rotation adopted by the sugar planter. Cow peas perform many valuable functions. By their deep roots and immense foliage they pump up from great depths and evaporate large quantities of water, and thus placing the soil in a condition relative to moisture most favorable to nitrification. They intensely shade the ground, thus protecting the nitrogen ferments from the destructive influences of direct sunlight, and enabling them to work directly up the surface. Their tap roots are pumping, along with water, soluble plant food from great depths.

But the chief virtue lies in its extraordinary power of utilizing the free nitrogen of the air. Therefore it is used once in three years to restore the nitrogen exhausted by two crops of cane.

Sometimes second year stubble is carried, and then the pea crop is every fourth year. A few planters practice a continuous growing of cane, and in doing so plant peas in the old stubble and cut the latter early for seed cane, and bury the pea vines for the coming plant cane.

A crop of corn is planted, and when it reaches the height of a few feet, it is laid by and simultaneously sown with cow peas, using one to three bushels per acre, of the Clay, Unknown, or Black varieties. Early in the summer the corn is gathered, and sometimes the pea vines made into hay for the stock of the plantations. In either event, the soil, with or without the pea vines, is turned under with four, six, or eight horse plows in August, or early in September, and the cane planted in October.

Ordinarily, the root residues of the pea vines give enough nitrogen for the ensuing plant cane, and many planters positively assert on his account that it makes no different to future crops whether they are removed or turned under, but carefully conducted experiments on this station show that when turned under there was an average increase of 7.42 tons of cane per acre, extending through plant and stubble, over soil treated similarly, with vines removed for hay. Yet where there is stock to be fed, it is wise to utilize the vines as hay and restore the manure from the stables to the soil.

Up to date, the work of inverting the corn stalks and pea vines has been performed by large turning plows with steel discs, for cutting the vines, attached in front. These plows are difficult to handle and frequently get choked, making the operation a slow, tedious, and expensive one. Recently the disc plows have been placed on the market and one of them has been successfully used by the station for such work.

It has on our soil buried successfully pea vines that were waist high and very thick, plowing to the depth of ten inches and cutting a furrow 15 inches wide. It was drawn by three heavy mules and showed on the dynamometer a pull of 500 to 550 pounds. It was managed entirely by one hand, who rode on the plow. There was no choking and no stopping to clean the plow . Nearly three acres per day can be plowed with this implement. For flushing land it has no equal, and the draught is much lighter than with the four-horse plow usually used, and the work performed more satisfactory, there being no compression of the soil at the bottom of the plow, caused by the shear and landside of the turn-plow.

After the land is flushed, it should be bedded with two-horse plow into high rows, five to seven feet wide and the middles carefully plowed out. The quarter-drains should also be cleaned. It is thus ready for planting late in September or

early in October, the time at which fall planting is done. When ready to plant, the rows are open with a double mould board plow and two or more running stalks are deposited in this open furrow and covered by a disc cultivator, plow, or by hoes. Fall planted cane is always covered deeper than that planted in the spring, in order to protect it against the cold of our (Florida) winters. The open furrow in which the cane is deposited should be above the level of the middles between the rows, and the latter should be at least six inches above the bottoms of the quarter drains. Thus planted and maintained during the winter, there will be no trouble from either excessive cold or moisture.(7)

(7) The method of working here recommended is one which may be advantageously followed in Jamaica; the intervention of a leguminous crop to be turned in as a green dressing is wise provision, as is fully explained; in these islands not only will the cow pea serve this purpose, though perhaps it will prove as useful as any other, but the Gungo, No Eye Pea, or Pigeon Pea (Cajanus indicus) and Woolly Pyroe (Phaseolus Mungo) and Bengal bean (Dolichos Lablab) are also employed to advantage; indeed, it may be safely asserted that the success with which the cultivation of sugar was carried on, until recent years, in the Colony of St. Kitts was largely due to the wise manner in which the Gungo Pea or Pigeon Pea was employed for green dressing.

The element of plant food which is most completely removed from the soil by the cultivation and manufacture of sugar is nitrogen, which is also the most expensive ingredient of artificial manures or fertilizers, this element is largely restored by a judicious system of green dressing with leguminous crops. The practice is by no means a new one; it was known and followed by the Romans, and Virgil refers to it in his Georgics. Of late years a great impetus has been given to the practice of green dressing by means of leguminous crops, owing to the discovery of the manner in which they assimilate atmospheric nitrogen and thus accumulate in the soil for the use of subsequent crops. Not only do green dressings add to the store of nitrogen in the soil, but they improve the physical condition and texture of the soil in a marvelous manner, aiding the draining of stiff clays and increasing the water-holding power of light sandy soils. In addition to this, the use of a green dressing does much to assist in keeping down grass and troublesome weeds. There are very few soils that will not be materially improved by the use of green dressing.

The planting of a corn crop a little before the cow peas or other plant used for green dressing, as suggested by Dr. Stubbs, is an obvious advantage; by this means, corn for the use of the stock is obtained while the training stems of the leguminous plants finding some support, tend to form a denser, thicker mass, thus increasing the amount of vegetable matter to be ultimately plowed in.

This use of green dressing commends itself not only to those who cultivate sugar cane, but will prove of the greatest use in the cultivation of bananas, cocoa, coffee, limes, oranges, while in growing ginger it will probably prove an adjunct of the first importance as maintaining the necessary fertility of the soil and at the same time adding to the store of humus and nitrogen.

The use of a fertilizer containing potash and phosphates (without nitrogen) will often result in a great increase in the growth of the leguminous crop, and it would seem desirable to add those ingredients of the artificial manure to the leguminous crop rather than to raise the green dressing and then apply the potash and phosphates to the plant canes.—F. W.

COCOA PLANTING IN SAMOA.

A report on cocoa planting in Samoa has been received at the Foreign Office from H. M. Consul at Apia. In an introduction to the report, the Consul states that it would seem, assuming the price of cocoa not to fall radically and no cocoa disease to arise, both of which events seem unlikely to occur, that a potential commercial future has at length arisen for the Samoa group, after years of depression owing to the fall in the price of copra and the apparent unsuitability of the climate for other cultivations, such as rice, sugar, tea or cotton.

Small capitalists (£500 to £2000) going to Samoa and purchasing or leasing land for the purpose of cocoa planting, would stand a good chance of making a fair income after the first three or four years—provided that they either possess a practical knowledge of tropical planting or will take advice from those in Samoa who have experience in the matter.

Cocoa was first experimentally grown in Samoa by "Die Deutsche Handels und Plantagen Gesellschaft der Sudsee Inseln zu Hamburg" on one of their plantations near Apia. In 1892 a favorable report on the quality of the bean was received from Germany. In 1893-4 a large number of seeds were distributed among the Samoans, and a few small plantations were started by some of the more enterprising of the British and other foreign residents, which are now coming into bearing. The number of small plantations are rapidly increasing and the amount of land at present bearing cocoa trees is estimated to be 75 acres.

The most encouraging reports continue to be received from Hamburg, San Francisco and Sydney regarding the quality of the Samoan cocoa, the price varying between £60 and £80 per ton. An English planter in this island has an agreement with the German firm to cut and take all his cocoa, he paying freight to market and receiving two-thirds of proceeds, and the firm one-third, but it is stated that this arrangement has not as yet been extended to others. However, there need be no difficulty as to drying and preparing the cocoa for market, as another planter who prepared his own in a rough manner received 16 cents (about 8d) per lb. in San Francisco, whereas the cocoa prepared by the German firm realized 18 cents (about 9d) per lb in Hamburg. The expense of fitting up, drying and preparing rooms would not be great if divided amongst

several planters. Small plantations are to be preferred, at all events at present, to large ones as in the former personal supervision can be given, and the initial and working expenses are of course a mere fraction of what a large plantation would entail.

A small plantation of 6 acres holds about 1200 trees, and these in the third year produce about 140,000 pods, and it is apparent that, even with the liberal allowance of 15 pods to the pound of marketable bean, each tree would produce from 6 to 8 pounds of prepared cocoa bean per annum. The trees begin paying in the third and fourth years after planting, and are in full yield after the fifth. Apparently there is practically no age limit to the bearing of a cocoa tree. The two heaviest cuttings are in April and September, and between times there are cuttings about every three weeks. The full grown pods, the immature one, and the blossom may all be seen on the same tree.

The best and cheapest way of preparing bush land for cocoa growing is to thin out the undergrowth but to leave the trees standing so as to afford shade to the young plant. The cost of clearing and planting ought not to exceed £4 per acre. The young plants are raised in small cocoanut baskets filled with earth in well shaded nurseries and planted out; or the seeds are planted in holes well covered with topsoil, 15 by 15 apart, and when the cocoa trees have attained two years' growth, banana trees are planted between the rows of cocoa, the shade trees are ring-barked, and when dead are felled and allowed to rot in situ. It is surprising to see how very little damage—in fact practically none—is done to the plantation by the fall of these trees.

The cocoa tree seems to be able to bear an extraordinary amount of rough usage in Samoa. When the trees are about three years old the banana trees are cut down and rooted up. The tree with a single trunk is not considered desirable in Samoa, and by allowing two or three main stems to grow and training the laterals to branch out well a comparatively low bush is obtained, which does not attain the height to which the cocoa tree is allowed to grow elsewhere, and consequently is not so much damaged by hurricanes, and produces a larger crop of pods than the other variety.

The kinds of cocoa planted in Samoa were Caracas and Forastero, but as usually happens by hybridization, a distinct kind has been produced, partaking of the best qualities of

each variety. The Samoan cocoa is prepared in the Ceylon manner and is especially well adapted for confectionery purposes.

It is advisable not to prune the trees, as this entails stunting them in Samoa. In fact the golden rule for would-be planters in Samoa is not to follow any rule blindly, however well established, but to adapt the general rules of cocoa planting to the special factors out here, and not to try and make Samoan nature follow scientific rules, but vice versa. The cost of land near Apia is about from £1 10s to £3 per acre if purchased from whites, and about 4s to 8s per acre if leased from the natives on a 20 or 40 years' lease. The soil is rocky and volcanic, and well adapted for cocoa.

Although labor in large masses is practically unobtainable in these islands and the native Samoan is by no means an energetic and hard-working laborer, yet sufficient floating labor for small plantations is to be had. The price is about 24s to 35s a month per laborer, his food costing about 16s per head a month. One man ought to be able to look after six acres of well grown cocoa in the dry season, but two are required during the wet season from December to May.

In Samoa the cocoa is a robust, hardy tree, growing luxuriantly, and yielding abundant crops with but trifling cultivation.—Cultivator.

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THE VELVET BEAN.

A few words about the velvet bean as a source of forage as well as a renovator of the soil be very opportune, and I would suggest to those who are unaware of the value of this bean to try a small patch of it and just watch the result. Those who have already grown the bean will bear me out when I say that we have nothing in its own line to equal it. It is a great forage producer, and the grain, both in the green and dry state, is equal to anything grown for food for any stock, and it is not too much to say that everything that walks on four feet is fond of it.

The velvet bean grows and makes a fair crop where cowpeas would scarcely germinate the seed. It is an excellent improver of the soil in that it is the best nitrogen gather among all the known legumes. Its foliage is so dense that it shades the land completely during our hot days of summer, and by shedding the leaves nearest the ground, it forms a mulch that

conserves the ordinary moisture in the soil. In short, we have in the velvet bean what the Southern farmer has so long been looking for, that is, something that will produce a good profitable crop and at the same time help to put backbone into the poor sandy soils of the South.

I have said that it will make a fair crop on land too poor for cow peas, but it will repay its grower for a little commercial fertilizer applied to the soil previous to planting time. Some farmers are sanguine enough to think that there will come a time when commercial fertilizers might be entirely dispensed with. There is no indication that will ever come; in fact, the tendency is rather the other way, as every year sees a marked increase in the fertilizers used, and every broad-minded, observing farmer knows that for every dollar thus invested he gets back ten and sometimes twenty, according to the intelligence and wisdom exercised in the selection of the proper kind of fertilizer and the method and time of application.

Like every other crop, the velvet bean has a preference, if we may use the term, for a certain kind of food which is best suited to its requirements and which enables it to return the most profitable crops. It wants a fertilizer analyzing high in phosphoric acid and potash. Being a natural nitrogen gatherer, it does not require any nitrogen fed to it in the shape of fertilizers. If we cannot get a fertilizer containing no nitrogen, the best way to get over the difficulty is to buy our phosphate and muriate of potash, and prepare our own fertilizer, bringing the analysis as near as possible to ten per cent. potash and seven to eight per cent. phosphoric acid. Four to six hundred pounds of this per acre, broadcasted and mixed in the soil a short time before planting will pay for itself at least twenty-fold. On poor, worn-out soils it is best to drill in the fertilizer and plant the bean in the drill after it has had a good rain on it.

In preparing the land for this crop the best method in my experience has been to run off furrows about five feet apart and drop a bean every ten to fifteen inches; this will give a good stand, and as the crop is a long season one it should be planted as early in the season as possible. Some time in late June or July make a very thin sowing of Giant beggar weed in the water furrow this will spring up quickly and be ready just in time for the bean to climb all over it (for the latter undoubtedly does best when it has something on which to climb.) If the bean has been planted early in April, which is really

the proper time, a thin sowing of fodder corn in the water furrow in June will answer the purpose as well as beggar weed. This combination will give an exceptionally heavy forage crop, ready to cut in early September, and it will make a good second crop after that which can be allowed to remain in the ground and be plowed under in the winter to improve the soil and restore its fertility.

If simply grown as a soil renovator it can be planted four feet apart and every two feet in the furrow and allowed to remain where it grows. If wanted for pasture for stock or hog feed, beggar weed, millet, or anything of that kind planted along with it, will prove a decided benefit, as in itself it is somewhat laxative at first in its effect on stock, and other forage mixed with it helps to counteract this effect somewhat.

In cutting to cure for forage is where the real trouble is encountered, as its growth is so enormous, and if it is growing on anything the tangle of vegetation is such that it is a hard matter to get at it well. If cut in the forenoon, after the dew has dried off, and hauled to the barn without delay and spread over poles (I use my tobacco barn for the purpose), it cures excellently and makes the finest cattle forage I ever saw, and I feel confident that it only needs a proper trial by every Southern farmer to secure its general adoption all through the Southern States.

I do not think the velvet bean can be grown north of Kentucky successfully. A friend in Kentucky grew some of it last summer and he reports an extraordinary growth of vine but no grain, the season being too short for it to form seed. He grew it in a field adjoining the turnpike road where a telegraph line ran along. The vines went through the fence and climbed to the very top of the telegraph poles, showing that Kentucky soil is well adapted for the vines at any rate.

C. K. McQuarrie.

Florida Ag.

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FERTILIZATION OF THE COFFEE FLOWER.

A good many planters who will recognize the above initials know that I am keen on the crossing of coffee. Wishing them and others to be equally keen in a work which may eventually lead to the advantage of the whole planting community, I venture to offer a few hints as to how the details of the crossing may be put in motion. The process of fertilization, if confined

to individuals of the same species, will only result in producing "varieties" of the individuals concerned. But when it is extended to different species of the same genus, then an intermediate class of plants called "hybrids" are produced.

As this may not be quite clear to all, I shall give a practical illustration. When two bushes of C. arabica are growing near to each other and flowering simultaneously, they will be observed to attract many insects of the winged class. It is a marvel where these insects come from in such numbers and at such short notice. But there they are, the whole day, hurrying to and fro from one bush to the other, until, perhaps every newly-opened flower has been visited.

Now, although these insects have been most industrious in their own interests, collecting food and building material, the chances are that they have unconsciously rendered a signal service to the coffee also, by carrying pollen from the flowers of one bush to that of the other. If they have done this inadvertently or otherwise, the insects have effected cross-fertilization to the extent of producing varieties, or new forms of the two bushes concerned. By excluding the services of the insects altogether, the same results, and even more effectual ones, can be secured by delicate manual operations. But of this further on. The difference between the fe rtilizing work of insects and that of man consists in its being promiscuous and haphazard in the one case and systematic in the other.

Now if individuals of two distinct species, such as C. arabica and C. liberica, were to blossom together in the manner described above, exactly the same activity of insect life would be observed, with, perhaps similar results, only that in this case the progeny would be more than a "variety," it would be a "hybrid." Planters know that year after year their nurseries are stocked with seedlings raised from local seed of which a small percentage appear to be new varieties, or at least different from their fellows. They know also that nature is herself responsible for such variation. If the life-history of a number of seedlings was carefully traced, it would be found that while a few differed in the form, size, and texture of the leaf, others in the size and quality of the fruit or habit of growth, the major part would be nearly identical with the prevailing variety on the estate. This is all right where the prevailing strain is good. But where the product for which a plant is cultivated shows signs of exhaustion, or has become

deficient in quality or quantity, the strain is said to have "run-down," and in all such cases too much individualism in reproduction is undesirable. It is in all probability to prevent this running down of strain or breed that nature insists on cross-fertilization.

Coffee arabica, or Arabian coffee, of which there are several well-defined local varieties known by such names as "Chick," Coorg and "Nalknad," has been almost exclusively cultivated in this country from the time the industry was started, and it is only within recent years that one or two new varieties and species have been introduced and cultivated on the estates. This fact will explain the absence of hybrids over such an extensive area, there being no material to make hybrids from. Yet, within the past few years, some hybrids have made their appearance, shortly following the introduction of Liberian coffee, a distinctly new species. And, barring the fact that two distinct species have been placed in juxtaposition to each other, the hybrids are the work of nature. But in the instances referred to, man must get the credit of having materially helped nature by providing a new species for the latter to work upon.

If he would, therefore, do more in this direction, the chances are that worn-out strains of coffee would soon be replaced by better kinds.

This leads me on to the suggestion that approved varieties and new species of coffee should be freely introduced from other countries. The field for experiment would then be much widened, as planters would have sufficient material to work upon.

The cultivated forms of coffee in different parts of the world are already so far advanced of the indigenous or wild bush that it would probably be mere waste of effort to bring the latter into experiments, the object of which is to secure further improvement in productiveness and quality. Collections of species and varieties should, therefore, be confined, in the first instance at least, to well known jats already in cultivation. These I shall leave the planter, being the best judge, to select for himself. Now supposing that some enterprising planter has already secured such a collection of coffee-bearing plants, how is he to dispose of them to the best advantage?

With one or two new species of coffee at one's disposal, and a like number of distinctly marked varieties, such as the "Maragogipe," which is an introduced variety (from Brazil) of

Coffee arabica, an experimental plot could be started on the following lines:—

(a) Situation, as regards aspect, soil, water and shade, to be the best the estate can afford. Occasional irrigation will possibly be required to induce the different bushes to blossom together, so that the possession of a perennial water-supply would be a convenience.

(b) The crossing-plot need not exceed one-eighth or at greatest one-fourth of an acre in extent, while it is possible that equal results may be obtained by working systematically on a few bushes.

(c) In planting up the crossing-plot, an equal number of healthy seedlings of the estate coffee should be thoroughly mixed with the new kinds, so that winged insects may have full play on the whole. But in addition to the general and haphazard operations performed by the insects, a few bushes should be carefully isolated for hand-fertilization. For the latter purpose a few skeleton frames covered with fine muslin would be a sufficient protection, if placed over the bushes before the flowers opened. Plant in a square plot at 6x6 feet, so that air may circulate around the bushes freely. The preliminary details which I have emphazied under the sub headings a, b and c will keep the planter employed for at least two years, or, to be strictly accurate, until a maiden crop of flowers is produced in the crossing-plot.

Then, at this latter stage, the work of fertilization will actually begin, should several distinct kinds of coffee flower simultaneously. Unprotected bushes will be pollinated through the agency of insects chiefly, while the protected ones will be self-pollinated, should no precautions be taken to prevent it. Where bushes are intended for hand-fertilization, it will be necessary in the early stages of reproductive growth to rub off a great many of the young flower buds, so that the inflorescence of an individual may be reduced to a manageable number of flowers. For that matter, the flowers could be reduced to what is borne on a single primary, or to a few clusters of the same. The necessity for this apparently ruthless treatment is contained in the fact that, during the short time the stigma is receptive of foreign pollen, the fertilizer could only pollinate a limited number of flowers with any degree of certainty. It is, therefore, wiser to make sure of getting a few crosses than to attempt a larger number indiscriminately. Let us now suppose that the operation is about to take

place.* Having provided himself with the marginally noted requisites, and selected a protected bush to become the seed-bearer, the fertilizer places himself under the protective frame and eagerly watches for the opening of the first flower. Directly the flower opens (usually early in the morning), there will be seen, slightly projecting from its delicate-white throat (tube of the corolla) a bifid or two horned stigma supported by 5-7 arrow- headed anthers on short stalks. At the time of opening, the stigma, which is seen well in advance of the anthers, glistens with a sticky substance which holds fast any powdery matter, such as pollen, that may fall on to it. What the fertilizer has to do at this stage is to dust a little foreign pollen on to it by means of his camel's-hair brush. This done, he instantly, and as deftly as possible, cuts away the 5-7 anthers behind the stigma. But as the anthers are usually closed at this early period, they could perhaps do no harm if they were left. Everything would depend on the behaviour, so to speak, of the stigma towards the new pollen by which it has been fertilized.

The process as described above has to be done with every flower until the primary or clusters of flowers reserved for crossing have been exhausted. A register is then made of the parentage on both sides, and after a day or two the bush is liberated from its protecting covering.

I have examined many coffee flowers at the moment of opening, in most cases the stigma projects in advanceof the anthers and the style lengthens rapidly. By this means the spreading horns of the stigma afford a good platform for small bees and other insects to rest upon when searching for honey. Then flitting from one stigma to another they deposit quantities of pollen, which readily adheres to their hairy limbs. Crossing operations being completed, the next step would be to select a suitable piece of land for the cultivation and trial of seedlings raised from the crossing-plot. It is in this final stage of the experiment that the exact result of cross-fertilization would become apparent, and not before.

But the operator needs to possess patience, for among 10,000 seedlings cultivated there may not be one showing real improvement in every respect.

With our limited experience in crossing, it is uncertain what

*A fine camel's-hair brush; small, sharp penknife; small sharp pair of scissors; pocket lens; flowering branch from male parent, with pollen.

would happen, although there is reason to believe that cross-fertilization would induce beneficial variation in the growth and production of coffee.

The land required for testing seedlings of mixed parentage should be of the best quality, and the cultivation should be on a liberal scale also. Area is a matter for the planter himself to decide, as it depends wholly on the extent of his operations. I do not, however, advocate large areas for mere experimental work. When the seedlings give their maiden crop, it will be seen approximately what merits they possess from a productive point of view. But other merits, which may be roughly termed constitutional, will only become apparent after a lapse of time and under different modes of treatment.

I can readily imagine that a judicious selection of the fittest would prove a most difficult task, even to an expert.

The operations discussed from the beginning until now, when the second generation has borne its first crop of fruit, covers a period of about six years. This is a long time, and some men would doubtless say "is the trouble worth the candle? especially as there is nothing to prove that much good would come out of it." In answer to such a remark, I am pretty firmly convinced that good would come out of it and have already planted up a small crossing-plot with the view of raising hybrids. The plot consists "of 130 bushes, and includes C. arabica, C. liberica and the variety—Maragogipe." A few of the bushes are already well advanced in growth, so that the first batch of crossed seedlings may fruit within five years from date. But when matured bushes can be cross-fertilized this season, the results might be known within four years, which is not very long for a young planter to wait. My object, so far, has been to explain the modus operandi of fertilization rather than to discuss side-issues bearing on its application to the genus Coffeae. But now, I may refer briefly to argumentative views on the latter question. As the coffee bush possesses a hermaphrodite flower, it may be held by some that crossing is neither possible nor desirable. But it does not follow that a flower is self-pollinated because it contains both sexes. In numerous hermaphrodite flowers the sexes attain maturity at different periods, and in all such cases self-pollination is effectually prevented. That dichogamy prevails to some extend in the coffee-flower is certain, as I have often observed stigmas in the receptive stage when the anthers had not dehisced. I am unable to

say, however, if this is a general condition, or if it only happens in occasional flowers. A flower may thus be structurally hermaphrodite and functionally unisexual. Then, the sweet-scented coffee-flower offers great attraction to insects, which is a pretty sure sign that the dispersion of pollen is favored by Nature. Indeed, the condition of the pollen is such as would adhere readily to the hairy limbs of insects. It is not of the fine powdery kind (so-called dust of flowers) that would be suspended in the air or lightly carried by the wind.

Considered, therefore, from a morphological standpoint there is little doubt but the genus Coffeae is subject to cross-fertilization, and that its flowers are entomophilous. Lastly, I wish to dispel the idea that established coffee can be influenced one way or the other by operations of crossing, the results of which are only discovered in a subsequent generation.

But it is highly necessary that the planter should strictly conserve his testing-ground, and not allow any unknown seed to be utilized for estate purposes. The golden rule in the testing or experimental ground is to destroy all inferior forms as quickly as possible.

New strains of seeds reserved for trial could be treated separately until such time as their merits are fully established. This is all I have to say on the fertilization of the coffee flower at present.—Planting Opinion.

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ORANGE-GROWING IN JAFFA.

By Reinhold Palmer, Jerusalem.

That much-prized fruit, the Jaffa orange, is now so well-known and appreciated in England that it may interest readers to learn some details of the method of its cultivation.

The name by which this variety of orange is known in England is derived from the place where it is cultivated, the growing and prosperous little town of Jaffa on the coast of Syria, so well-known to those who have visited Jerusalem, for which it is the port. Although not a native of Syria, it thrives on the sandy coast of that country better probably than anywhere else in the world, the climatic conditions—the rainless summer accompanied by heavy night-dews, and the winter without frost—being well suited to the growth and development of the fruit. But the culture must of course be supported throughout the long summer by artificial irrigation. Were it not that

water to any amount can be procured in every garden and at a moderate depth, it would be impossible to grow oranges in Jaffa. The whole neighborhood seems to cover a river of vast breadth, percolating through the sand en route to the sea. Hundreds of Persian wheels working night and day produce no sensible diminution in the supply of life-giving water.

Several varieties of the orange, such as the round Beladi, the Blood Orange, the Mandarin, &c., thrive along the coast of Syria, but the oval and almost pipless kind known as the Jaffa orange is only produced in Jaffa itself and its vicinity; and this peculiarity, according to the native gardeners, must be attributed to the quality of the brackish water used in its irrigation. Until about thirty years ago this oval form was quite unknown, when a native gardener, quite by chance, through careful attention to his trees, succeeded, much to his own astonishment no doubt, in improving his Beladi or Spanish variety of orange into the Shamuti, by which name the Jaffa kind is known in the vernacular. By selling grafts from his improved variety to other garden proprietors, he was instrumental in substituting the Shamuti for the Beladi orange throughout Jaffa. It is a remarkable fact that all attempts hitherto made at growing the oval orange elsewhere than at Jaffa have not been successful; even at Sidon and Tripoli on the Syrian coast, where the climate and soil seem precisely of the same nature as at Jaffa, all experiments in this direction have failed.

The method of laying out a garden in Jaffa is as follows: The land having been carefully selected and purchased—preference being always given to a red sandy soil—the owner will get in his workmen and start them on levelling and working up the ground. This is very thoroughly done; the levelling of the earth being important with a view to the future irrigating of the orange trees. The ground is in the first instance well plowed, and then with the object of effectually removing every particle of weed, the workmen use their hoes to turn up the soil to a depth of fully three feet. This expensive process is very necessary, as the presence of even the smallest root of a weed will prove injurious to the trees and be difficult to remove later on. While this work is going on the proprietor will have fixed upon the spot where the well is to be sunk, and have commenced operations. The depth at which water is found varies materially in different gardens, and ranges from about twelve to sixty feet below the surface; consequently

the cost of sinking his well is always more or less a matter of speculation to the proprietor. The deeper wells are, however, the exception and not the rule. The system of irrigating is by Persian wheels, simple in construction, cheap, quickly made and repaired; and experience has shown that they are much better adapted for the purpose intended than the steam pump. The whole of this simple machinery is quickly specified and described. A wide cog-wheel is kept going horizontally by a mule with a sweep; this turns a larger one perpendicularly, which is directly above the mouth of the well. Over this revolve two thick ropes, and upon these are fastened small wooden buckets; one side descends while the other rises carrying the buckets with them, these descending empty, those ascending full; and as they pass over the top they discharge the water into a trough which conveys it into an adjoining tank. The quantity of water discharged within the twenty-four hours depends on the speed at which the mule is kept going, and also, of course, on the depth of the well. An average-sized garden requires the constant labor of three to four mules to provide the necessary amount of water, the animals being relieved about every three hours.

The ground prepared and manured, the Persian wheel fixed, and accommodation—of the simplest kind of course—being provided for the gardener and the mules, the proprietor now proceeds to buy young lemon trees about a year old. These are meant to be used as stocks upon which the orange slips are later on grafted; and of them there is always a fair supply available in the nurseries of the older gardens. These lemon trees are now planted, under the supervision of the head-gardener, at a distance of four yards apart.

The young lemon trees will now thrive without much further attention, except that they must be carefully irrigated; this is done by a system of small masonry troughs running in all directions through the garden, and fed from the tank adjoining the well. The garden is generally divided into four equal parts, each part being irrigated within the course of two days, so that every tree receives its share of water every eighth day in rotation; and this is considered ample. A small trench is dug round each tree sufficiently large to hold its requirement of water, and as the tree grows and needs a larger supply, the trench is enlarged; the amount of water that will eventually be required must therefore be calculated on the basis of the

irrigation necessary when the trees are six years old, and may be said to have reached maturity. If the garden is a full-sized one and contains about six thousand trees, it will be necessary to sink either two wells or one well sufficiently wide to admit a double set of buckets, thus raising double the quantity of a single set in the same space of time.

During the winter months the garden is left to itself, the gardener employing his time in taking the mules to graze, thus saving the cost of feed. Irrigating commences about the end of June, and lasts till the end of October or middle of November.

The young lemon trees are allowed to grow for two summers before the orange slip is grafted upon them; this operation is performed in the autumn by the head-gardener, who is an adept at this work. After the fourth summer, calculating from the time the lemon stock was planted, a few oranges may appear on the trees; and during the following two years the whole of the expenses of a garden will, as a general rule, be covered by the sale of the orange crops.

It is generally assumed that after the fourth year a garden becomes self-supporting. After the sixth year, a garden that has been well attended to will not only pay expenses, but give a handsome return as well. The fortunate proprietor will now also have the further satisfaction of knowing that the marketable value of his property represents probably more than double the whole of his outlay. This will give an idea how profitable orange-growing in Jaffa really is to those who can afford to wait a few years for a return on capital.

Once the garden is in full bearing, the proprietor, apart from an occasional visit of supervision, has little to do beyond selling his crop of oranges, paying the expenses, and pocketing the balance.

It is difficult to calculate the exact cost of laying down a garden. The price of the land varies of course according to position and quality; then the depth of water below the surface and consequently cost of sinking the well cannot be estimated to a nicety. As a general rule, however, a garden containing six thousand young trees will cost from eleven hundred to twelve hundred pounds to lay down complete, with livestock. To this sum will have to be added five years' expenditure (during which period the garden is assumed to be unproductive) at the rate of one hundred and twenty pounds per annum, and making six hundred pounds. We have, there-

fore, a total of eighteen hundred pounds, representing the capital outlay on the garden up to the time that the trees are in full bearing. From now onwards the crop of oranges will have an annual value of from four hundred to five hundred pounds; and this will leave the proprietor, after deducting all expenses for wages, feed of live-stock, taxes, repairs, &c., a clear revenue of ten to fifteen per cent. on his total capital outlay of eighteen hundred pounds.

The risks which the Jaffa orange-grower runs, as compared with those which the grower in Florida has to face, are infinitesimal. The storms that visit the Syrian coast, although of frequent occurrence during the winter months, are not of such force as to damage the trees; in fact, it is remarkable how very small is the proportion of ripe fruit even which falls to the ground after a storm. This is no doubt due to the fact that the Jaffa orange tree is not allowed to grow larger than a good-sized shrub; and as the trees are placed only four yards apart, they afford each other very considerable protection from the force of the wind. The cactus shrubs also, forming the hedge of the garden, grow very thick and high, and give additional protection from the storms. Blizzards and frosts, which have proved so ruinous in Florida, are quite unknown in Jaffa.

Owing to the good keeping qualities of Jaffa oranges, which enables them to be shipped to distant parts, there is always a brisk demand for them, and the grower has hitherto had very little difficulty in disposing of his crops at good prices. If not exorbitant in his demands, he can almost invariably sell his fruit for a lump sum while the fruit is still green, and before the winter, with its risks of hail, &c., has set in. The shipper who purchases the fruit in this way takes over the whole of the risk of any damage that may happen to it, and he cuts the oranges from the trees whenever it suits him to do so; the contract only stipulating that the garden is to be cleared by the middle of March, as the proprietor likes to see his trees free of fruit before the new blossoms appear.

The whole of the crop of Jaffa oranges does not at the present time exceed three hundred thousand boxes of about one hundred and sixty oranges each, which is a mere trifle compared with Spanish or American crops, and about four-fifths of this quantity is at present shipped to England.

The orange-growing industry is almost entirely in the hands of natives; a few of the newer gardens are, however, owned by Germans and Frenchmen.—Chamber's Journal.

IRRIGATION OF SUGAR CANE IN QUEENSLAND.

A report has just been presented to Parliament by the Registrar-General having reference to irrigation in Queensland.

Returns have been collected upon this subject since 1891, so that information on this head is now available for seven years, and particulars respecting it will be found in the following statement:— Acres irrigated: 1891, 3869; 1892, 3840; 1893, 5287; 1894, 5846; 1895, 6447; 1896, 6395; 1897, 6647.

Thus, within the period under review, the area has very nearly doubled; the returns for 1897 comprising the largest acreage irrigated recorded in any year.

The experiences of the cultivators who availed themselves of this aid to their work, as returned on their schedules, are well nigh unanimous as to the fact that the labor and outlay incurred was amply repaid in the increased production of the soil so treated.

In 43 districts the water was artificially employed, to a greater or less extent, for purposes of agriculture. In 7 districts, the area treated exceeded 100 acres, and in 4 more it amounted to at least 50 acres.

The premier district in this respect was Ayr, where no less than 5,165 acres were irrigated, or 78 per cent. of the whole. The sources of supply and the means of elevation and distribution are most varied. Although applied industry is sometimes employed for securing the water in an artificial reservoir, yet for the most part natural sources of supply in their primitive state are relied upon, rivers, creeks, and lagoons being much more in evidence in the returns than dams, well and bores. The latter are given as sources of supply at Ayr, Barcaldine, Blackall, and St. George. As to the first named place, the supply is probably drawn from a tube well, but can hardly be from a true artesian source. Gravitation necessarily cannot often be used as the means of conveyance direct from the natural source of supply without the intervention of power to first raise the water, so as to secure a head. A great increase in the use of steam as the means of elevation is at once noticeable on comparing the returns for 1897 with those of previous years. Nearly every kind of crop grown, including vegetables and fruit, is to be found amongst the returns, but, inasmuch as Ayr contributes so large a proportion of the irrigated area, the principal object of cultivation in the district is sugar cane, that crop inevitably figures largely in the area submitted to irrigation.—Queenslander.

REPORT FOR MONTH ENDING JUNE 10, 1899, OF INCORPORATED HAWAIIAN SUGAR COMPANIES.

NAME OF INCORPORATED CO.	Authorized Capital.	Par Value, Shares	Number of Shares Authorized	Shares reported as sold past Month	Highest	Lowest	Latest Sale Reported
American S. Co. ($750,000 paid up)	$ 1,500,000	$ 100	15,000	207	$ 152	$ 150	$ 165
Ewa Plantation Co	5,000,000	20	250,000	38	399	390	395
Haiku Sugar Co	500,000	100	5 000				
Hawaiian Agricultural Co	1,000,000	100	10,000	207	300	280	300
Hawaiian Sugar Co	2,000,000	100	20,000	222	225	220	224
Hamoa Plant. Co. (not listed)	175,000	100	1,750				
Honokaa Sugar Co	2,000,000	20	100,000	540	29	27	27¼
Honomu Sugar Co	750,000	100	7,500	20	422		203
Hawaiian Com. Sugar Co*	10,000,000	100	100,000	5	115		?
Hutchinson S. Plant. Co*	2,500,000	50	50,000				
Hakalau Sugar Co*	1,000,000	100	10,000				
Hana Plantation Co*	5,000,000	100	50,000				
Kilauea Sugar Co*	2,000,000	50	40,000				
Kahuku Plantation Co	500,000	100	5,000				
Kihei Plantation Co. ($1,500,000 paid up	3,000,000	50	60,000	3695	18	15	50
Koloa Sugar Co	300,000	100	3,000				
Kipahulu Sugar Co	160,050	100	1,600				
Kona Sugar Co, ($180,000 paid up)	500,000	100	5,000	25	30		
Maunalei S Co, ($100,000 paid up)	1,000,000	100	10,000	640	15		10
McBryde Sugar Co	5,000,000	20	250,000	4840	6½	5	5
Nahiku Sugar Co	750,000	20	37,500	390	2½		
Oahu Sugar Co	2,400,000	100	24,000	572	302	290	300
Onomea Sugar Co	1,000,000	100	10,000				
Ookala Sugar Co	500,000	20	25,000	2030	24	21	24½
Olowalu Sugar Co	150,000	100	1,500	21	165	120	
Olaa Sugar Co	5,000,000	20	250,000	976	2		
Paauhau Plantation Co*	5,000,000	50	100,000				
Pacific Sugar Mill	500,000	100	5,000				
Paia Plantation Co	750,000	100	7,500				
Pepeekeo Sugar Co	750,000	100	7,500				
Pioneer Mill Co	2,000,000	100	20,000	55	330	310	310
Wailuku Sugar Co	700,000	100	7,000				
Waianae Sugar Co	300,000	100	3,000				
Waialua Agricultural Co. ($1,500,000 paid up)	3,500,000	100	35,000	147	190	180	185
Waimanalo Sugar Co	252,000	100	2,520				
Waimea Sugar Mill Co	125,000	100	1,250				

* Incorporated in California. Sales in San Francisco reported.