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The sugar market in New York at the latest date was very strong, Cuban Centrifugals of 96 test being quoted at $3.56. At the same time the price of beets in London was on the decline, under the influence of favorable reports from the growing beet crop.

The annual meeting of the Planters' Labor and Supply Company will be held on Monday, Nov. 14. It is desirable that there be a full attendance, as matters of general interest will probably be brought before the meeting. The list of committees will be found on the last page of the August number of this year. A circular has been issued by the Secretary calling the attention of members to the committee reports assigned for the current year.

A correspondent in one of our local papers asks whether cotton planted on the windward side of our islands does well. The cotton tree or shrub is a delicate plant, and thrives best where it has the least wind. Cotton fibre is improved when grown in proximity to the sea, and the best sea-island cotton raised on these islands in years past was grown on the lee sides near the shore, some of its fibres measuring four or five inches in length, and as strong as any of the Georgia sea-island cotton. Kona on Hawaii, Honuaula and Kaupo on

Maui, and Kaunakakai produced the finest and strongest fibre raised on these islands, and it sold in New York at two dollars a pound during the civil war.

In commenting on Prof. Hilgard's letter published in the August number of this MONTHLY, the *Manchester Sugar Cane* says: "We cannot quite consider the above letter conclusive, and in face of the constant practice of using cane "tops" for seed in other cane growing countries where no complaint is made of any general reduction in the yield obtained, we adhere to our opinion that a qualified expert who will collect statistics, examine carefully into all the various opinions expressed, and make experiments and analyses with assistance of experiment fields and proper laboratory equipments, is the man to settle the question satisfactorily."

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INFRINGEMENT ON A HAWAIIAN PATENT.

EDITOR PLANTER'S MONTHLY:

SIR:—*The Louisiana Planter and Sugar Manufacturer* of September 10th, 1892, contains a letter from Paris by Mr. George Dureau in which the writer refers to a patent being granted to Mr. A. Fontaine, manager of the Sermaize sugar house, Marne, for improvements in heating juice and evaporating it.

The improvements mentioned as patented infringe in a direct and wholesale manner on patents granted me in 1888 and 1889, in most of the important sugar producing countries throughout the world—France included. And as it might interest some of your subscribers who are interested in eliminating the item of coal expense from the cost of manufacturing sugar by the diffusion process, I would thank you to insert the following extract from the above mentioned letter and after it the part of my patent specification and claims bearing on the subject in question.

ALEX. YOUNG.

(Extract from a Letter to Louisiana Planter, Sept. 10.)

Recently the attention of inventors has been called in a special manner to the improvements for the reduction of the

cost of steam or fuel in sugar manufacture. A patent has been granted to Mr. A. Fontaine, manager of the Sermaize sugar house, Marne, for improvements in heating juice and evaporating it. Mr. Fontaine adds a fourth pan to the ordinary triple effect, and in this the juice is heated in thin films by coils in which superheated steam at 135 deg. C. circulates. To obtain this superheated or reheated steam the vapor from the boiling juice and the exhaust steam is passed through a heater placed in the bottom of the boiler chimney.

There the furnace gas, retaining a temperature of about 450 deg. centigrade, readily heats the exhaust steam and vapor to 135 deg. In their turn the vapor from the fourth pan, owing to its high temperature, heats the triple effect. I can't now go into details, and it suffices to say that by this system Mr. Fontaine secures an economy of live steam in various apparatuses, and that according to his calculations it amounts to 3 fr. per ton of beets worked, or $15,000 for a sugar house working 25,000 tons of beets per season.

George Dureau.

(Extract from Alex. Young's U. S. Patent Specification.)

"A good method of utilizing my graduated compound steam boiler, in evaporating of liquids, is illustrated in plates V. and VI. in which, it is shown combined with an ordinary triple effect. In this instance the exhaust steam from any steam user is superheated in compartment C. of the superheater, and passes to the first cell of the triple effect, where it does duty in boiling the liquid contained in that cell. The vapor rising from the liquid boiled in the first cell, is superheated in compartment G. of the superheater, and does duty in boiling the liquid contained in the second cell. The vapor rising from the liquid boiled in the second cell, is superheated in compartment J. of the superheater, and does duty in boiling the liquid contained in the third cell, whence it passes to the condenser, and to the vacuum pump in the usual manner. The superheating of different grades of vapor may be continued through any number of cells and superheaters, or, the exhaust steam from the heating pipes or drums, of each cell of multiple effect may be re-superheated as many times

as there are cells in the apparatus, by having a sufficient number of compartments in superheater for that purpose, and instead of using the vapor from the boiling liquid, the exhaust from heating pipes, or drums, of each cell of multiple effect would simply pass through a compartment of superheater to the heating surface of the following cell, and so on throughout all the cells of apparatus; consecutively; whilst the vapor rising from the boiling liquid in all the cells, in common, would go to the condenser; in which case the vacuum in all the cells may be alike."

"12th. I claim the method herein described, of superheating the steam or vapor rising from one pan, or cell, of a multiple effect evaporator before said steam enters the next pan, or cell, of said evaporator."

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POOR ROADS AND HIGH FREIGHTS.

During the past few months frequent articles have appeared in local papers urging the making of good roads and landings as the best encouragement that can be afforded for peopling the islands with an industrious class of small farmers. The high cost of transportation on land and sea appears to be among the greatest drawbacks to the development of minor industries. It is always so in newly settled countries, but it would seem to be about time that good roads and cheap freights were provided here in Hawaii, which has been under responsible and intelligent government for more than forty years.

We have lately received several letters touching on this topic of poor roads and high sea freights, and from them we make two extracts, to show under what disabilities farmers here are laboring. A gentleman on Maui, engaged in growing potatoes, writes:

"Dear Sir:—I am shipping a small lot of potatoes to-day, a sample of about 22 acres which I have grown this year, and I have good reason to believe their keeping qualities, if properly matured in the ground, are equal, if not superior to any imported. I have imported several varieties for planting, some of which have turned out superior to any I have seen grown in the country, while some have not been a success.

I am growing them in Kula, and have a haul of some twenty miles to Kahului, over—well, I might say—no road at all for about eight miles of the distance, with the additional disadvantage of extremely high rent for the land I cultivate. Yet, with moderately good roads the people of Honolulu would never have to send a dollar out of the country for potatoes, provided they are willing to pay 1¼ cents a pound laid on their wharf for the class of potatoes I send. I believe freights can be had between San Francisco and Honolulu for about $2.00 per ton, while it costs the producer in Kula $15.00 per ton to land his potatoes in Honolulu, viz.: $5.00 inter-island steamer freight, and $10.00 for hauling twenty miles to Kahului over an abominable road. With intelligent cultivators, good roads, moderate inter-island freights, and liberal-minded land owners, we might be exporting, in a few years, what to-day the country is not supposed capable of producing."

Another correspondent writes:

"It is discouraging to raise vegetables and fruits and then have no market for them, or find that the freight charges on island steamers eat up the whole realization. Last year I sent to Honolulu sixteen sacks of cabbage (rice sacks), each sack contained from four to six heads of cabbage; they were sold at auction for five cents per head, realizing four dollars for the lot. I afterwards saw the freight bill, and it was 25 cents per bag, total *four dollars.* I concluded it did not pay to ship any more. I think the papers should draw public attention to the frightful freight charges: For instance, the usual charge for carrying a box of bread is 50 cents, but if you eat the bread and ship the same box back to Honolulu with young pigs in it, (say six), the charge will be 25 cents per head, or $1.50 for the box; or if you put 12 chickens in it, the freight will be one dollar. The freight on wool is six dollars per ton to Honolulu—distance only a few hours run. The same wool is taken to San Francisco, 2100 miles, for FIVE DOLLARS per ton. There is no question but what these islands could supply very many things to the Pacific Coast if the island freight charges were reasonable. Our uplands will raise anything that is raised in California, and that too on lands that here are now used for pasture only and worth not more than five

dollars per acre. The same lands in California would be worth $500.00 per acre, for fruit culture."

Recently two gentlmen of ample means, engaged in coffee culture in Guatemala, visited this place and also various sections of the group to ascertain whether there was an openning for an enterprise in coffee culture on a large scale, to be backed by incorporated companies, with ample capital. They found the soil and climate all they could wish—in fact the best that exist anywhere. But the difficulty of obtaining land either on long lease or fee simple, and the roadless condition of the best coffee districts in the group had evidently a disappointing influence.

It affords pleasure to notice that the Legislature is disposed to make liberal appropriations for new roads in some of these outer districts. If the ways and means can now be provided to carry out these wise plans, it will help to attract capital and farmers from abroad to locate here, adding their means and their muscle to swell the aggregate of the nation's productive capacity.

A hundred thousand dollars spent annually by the Government in opening new roads and landings and improving old ones on the Island of Hawaii alone, will undoubtedly bring farmers to inspect, locate and invest there in coffee, tea, orange or other industries, adding to the capital of the country annually more than the sum spent by Government in its public improvements, and increasing the income from taxes each year. There is a class of men of means, who prefer a mild climate such as is ours, who will migrate hither and invest largely, if they find the conditions favor their living with comfort and a fair profit from their investments. These are the men we want as settlers, and among the thousands of tourists expected to arrive during the next twelve or fifteen months, a few score may be induced to make this their home if they discover a spirit of progress and liberality on the part of the Government, and a readiness to do its share in opening up the avenues of industry and travel, so that settlers be not handicapped with obstacles and costs which should not be allowed to exist.

To such public work, very voter and tax-payer will say amen.

THE WAIANAE PLANTATION, OAHU.

Editor Planters' Monthly:

The Waianae Company's Plantation comprises the Lualualei, Waianae and Makaha lands. The Waianae Valley contains some of the richest lands found on this Island, a portion of which, the past year, yielded $8\frac{3}{4}$ tons of sugar per acre There are about 250 acres under cultivation in this valley, the fields ranging in size from 10 to 40 acres, though latterly the fields have been considerably enlarged. They are somewhat difficult to cultivate, and it is only by hard work and good management that it is possible to work them to profit. The cane here is in fine condition, and will yield five to six tons per acre.

The Makaha lands are also very rich; one field of 100 acres will easily yield six to seven tons of sugar per acre. It is a magnificent field of cane, well cultivated, and will compare with any other field of its size in the Hawaiian Islands. There are only about 200 acres under cultivation, on account of the limited supply of water, and 40 acres of this is irrigated from a surface well.

Lualualei Valley is at present mostly in rattoons. There are about 300 acres under cultivation. This whole field is in good condition, but would be better if more water were obtainable.

The mill is one of the best on this Island, and contains all the latest improvements, including a five-roller mill, tripple effect, two vacuum pans, one automatic vacuum cleaner, and Young's patent condenser. They claim to have the best mud presses made, with all other improvements, and time and steam saving devices used in any mill. This mill is very conveniently arranged and the system of handling the juice is about the best I have seen. The tripple effect here is cleaned every night. To accomplish this, the juice is taken from the effect to be cleaned into the vacuum pan at night, and run out again in the morning. The juice is never boiled down of a Saturday night. The last effect is emptied into the tanks, and the first two effects taken up into the vacuum pan. By adopting this system the men all leave the mill by

five o'clock instead of 12 o'clock midnight as is usually the case. They make 50 to 56 clarifiers a day, and all the work is done by half-past five o'clock, notwithstanding they make but one grade of sugar here. The Nos. 2 and 3 sugars are diluted with water and boiled separately. This is claimed to be an advantage over mixing these sugars in the juice. The average polarization is 97 degrees, and the average density of the diluted juice, 6 B.

There is an improved washing machine for cleaning bags or filter cloths, made of iron with four compartments which washes 30 filter-press cloths at a time. This machine will, in two hours, wash all the filter cloths needed for a week.

The water from the last two effects, of the tripple effect, is pumped back to the maceration mill. This makes another saving in steam and fuel. The condensed water from clarifiers and vacuum pans passes through the juice heater before going to the *hot well.* This raises the temperature about 15 to 20 degrees.

The mill is supplied with a number of extras, including two full sets of boilers, two extra rollers, extra gears, and a number of extras for steam plows. There are also three locomotives, 14 miles of stationary track and 2½ miles of movable track. Special mention should be made of the railroad system adopted here. Much of the land is almost inaccessible, still nothing but the locomotive and cars are used in transportation.

The new steel flume in use at Lualualei is the best I have seen. It is 15x24 in., 14,000 ft. long, has expansion joints every 500 feet, and is substantially made and tight as a drum.

Everything about the plantation is kept in good condition, as are also the mill, outhouses, fences, roads, tracks, and running gear of all kinds.

The quarters for the workmen are well looked after, and the homes of the mechanics are about the prettiest ever seen on the Islands. They are entirely surrounded by ornamental shade trees, and the gardens are one mass of beautiful flowers.

The pastures for animals are well stocked with algaroba trees which afford them shade and food, and shelter them from the scorching rays of the sun in one of the hottest valleys on this Island. G. O.

CORRESPONDENCE AND SELECTIONS.

THE SEED CANE QUESTION.—DEGENERATION FROM LACK OF PROPER PLANT NUTRITION.

EDITOR PLANTERS' MONTHLY:

In the closing passages of Mr. Moore's last letter in PLANTERS' MONTHLY regarding cane degeneration are these words: "The above result can better be brought about through a station for experimenting on cane and sugar in the hands of educated scientific men."

Now if ever we have an experimental station for cane, it will be because the planters individually will realize its value and be prepared to have it conducted on a sound basis and under a management of their own choosing. I am satisfied that the Government will never do anything of the kind. Before this desirable time arrives we may add somewhat to the elucidation of this matter perhaps from our own experience, or our knowledge of the experience of others.

In Professor Krueger's Berichte der Versuchsstation fur Zuckerrohr in West Java, for 1890, there is a very excellent chapter on the degeneration and atarism of sugar cane.

Dr. Kruger, before discussing the question of seed from cuttings of different parts of the cane, makes the remark that frequently the word degeneration is but a convenient term for our ignorance of an unwelcome developement in the plant. and further that emphasis ought to be laid on the fact that exhaustion of the soil from continued planting can be definitely noted and reasoned about, while degeneration of the plant is somewhat conjectural, yet not distinctly deniable, for we find uncultivated plants as well as those well cared for, in soil possessing all the properties of plant nutrition, sometimes exhibiting symptoms of weakness and senility. Neither can we consider weakness in cultivated plants, a reaction from the tension of high farming back to a more natural mode of life.

Mr. H. Lose of Honolulu has translated the greater part of the following. There is not an English translation of Dr. Krueger's work and its German is certainly not holiday reading.

H. M.

(Translated from the German, in Professor Krueger's Reports of Experiment Station for Sugar-Cane in West Java, expressly for Planters' Monthly.)

"Besides those men of experience who speak of a general degeneration of the cane by reason of propagation from seedlings, there are others who believe the causes of the "Sereh" lies in the fact that unripe tops have been used for a long time back and ask that seedlings of the ripe part of the sugar cane be planted.

"It is known that not only in Java but also in all countries where cane is planted to any extent, cane tops have been used for a long time for seedlings, whereas others utilize the lower rooty part of the cane and but few use the stalks in their entirety when in ripe condition.

"The results in the countries first referred to, do not show that the choice of seedlings has had a bad effect for while other conditions may have contributed to the success of the sugar industry in these countries, it cannot be denied that they are among the most productive of sugar and that the yield has increased from year to year.

"It is not to be credited for an instant that the selection of the tops from a plant so long under cultivation as the sugar cane, is purely accidental, on the contrary the advantage of that portion of the cane for seed, over other parts of the plant is based on good grounds and also supported by experience.

"In order to obtain good seed, the age and formation of the so called eyes must be first considered, as on these depend the entire germinating power. Looking at a matured and well developed stick of cane, we find that the joints from the base to the top decrease in length. The longest joints form during the time the cane has its most rapid growth. Considering the initial forming of the cane, we must know that these eyes which are produced while the cane is growing most quickly are least perfect. Ask any gardener which eyes he prefers for improving inoculation and copulation and the answer will be, *never* those that have grown rapidly but those, the growth of which has been slow.

"Secondly that those eyes which are oldest are most liable to suffer from insects and dryness. The lowest eyes of the cane make an exception to the above fact and are better

adapted for seedlings, being covered by soil and protected from retarding, outside influences. Comparative experiments on a large scale and not merely vegetable garden demonstrations show that the germinating power of the eyes of ripe cane when used as seed, increases in proportion to their nearness to the top.

"The joints of the red variety (Cheri bou Cane) should be used only as long as the color shows distinctly. It is not always true that the percentage of productiveness as seed is dependant entirely upon the seed, but that the energy of germination, that is to say, the time which is required for proper germination is a vital factor. As the vitality of the eyes in the seedling depends largely upon age, it will be observed by planting the seed, taken from various heights of the stalk, by themselves that the lower the joints were procured the smaller will be the ultimate percentage of productiveness and the slower the sprouting and growth of the seed.

"Necessity demands that as far as possible, we obtain fit material for planting, and hence, the older the seed, the greater the quantity required to produce the same growth. If the various kinds of seedlings were kept separate, which should be the rule for all planting, the sprouting energy could be easily determined. The large number of stalks of cane to the stool which is claimed to be the result of planting seed taken from the lower joints does not equal the results otherwise obtained. If we would improve in the cultivation of sugar cane, we must endeavor to obtain an even growth to maturity. When practicable, seedlings with four to six eyes should be used, and seed having below or above these numbers should be rejected.

"Should it be necessary however to increase the quantity of seedlings for want of good material, they may be taken from joints towards the lower end provided the cane is healthy, whereas should the cane have disease it is better to secure the upper parts. In both instances a careful distinction should be made however when planting the seedlings.

"Although for ordinary purposes, the use of the very topmost part of the cane for seed should be avoided, it may be necessary owing to disease to obtain seed from somewhat beyond the height suitable for the purpose. Experiments with

seedlings from diseased cane show almost without exception that the disease increases with the age of the seedling.

"Not only the time of germination and the position of the individual eyes on the cane stick play important parts in elucidating the question of the best seed, but conditions of an anatomical-physiological nature are to be reasoned with, for they are all important and have to be considered as first essential in our choice of seed as described.

"It is well known that every plant strives to maintain its kind through sprouts, dispersion of seed, unfolding of eyes or by throwing out runners, and these are accompanied with reserve food stuff containers, or the bud itself, is so furnished that the new germ may the more readily maintain its struggle for life until its organs of nutrition are in a condition to lay hold of its food from the outer world.

"Now, all green plants require as nourishing agents, in organic matter such as carbonic acid, water and the various salts of the soil besides the reserve material of different character suiting the kind of plant. In these are organic salts and nitrogenous material which in the process of growth becomes changed in various ways.

"What are the conditions with reference to sugar cane? The germ consists of the eye and as reserve stuff containers, the joints of the cane are to be considered. Cultivation requires to produce a cane which contains as much as possible of pure juice, that is, a juice which, besides water and sugar, contains but few salts and mephitic matter.

"When cane sugar was first cultivated, it did not contain a high percentage of juice—not more than young cane or young parts of old cane do now; or the condition respecting quality of the juice was at least but equivalent as has been demonstrated by experimenting for hundreds of years with different varieties of cane, which were but little cultivated at first and gradually improved. As is generally known, the older the joints, the purer and richer will be the juice. The younger the cane, and if the joints of old cane are young, the less sugar and less pure will be the juice. These facts have been proven by examinations as shown in another chapter. The cells of the older joints are full of juice in which cane sugar is the chief ingredient, while the cells of

young cane or the young joints of old cane have less juice, and the cane sugar therein dissolved with other nitrogenous matters (protoplas matische,) nitrogenous composition. The sugar (non-nitrogenous) gives way, therefore, as the nitrogenous matter is present. Where substances nitrogenous and non-nitrogenous are equally or both necessary, and their respective proportions to one another for the development of the young plant include the answer to which part of the cane we should give preference when choosing seed." Dr. Krueger answers this question in larger letters than the current text, "We should cut those parts of the cane where the eyes are most capable of life, and where an equal distribution of nitrogenous and non-nitrogenous material is apparent in them."

"Now, whether one will use the tops of the ripe cane, or whole lengths of young, especially grown for seed is in our opinion a local matter, for one or the other means has, at all events, nothing to do with the "Sereh" disease, and cannot without proof (which we have been trying for years past to obtain by comparative experiments) say whether it matters or not with reference to the degeneration of the cane."

"In case one will want fields for the exclusive cultivation of plant cane seed, which, with our normal condition here, we cannot consider wise, we would give special warning not to have the cane older than five to six months.

"To cut up whole lengths of ripe cane for seed would neither be economical nor scientific. As an example let it be said that neither the large, mealy, nor the small starchy potatoes are best adapted for seed, but that under the same conditions the medium sized potato should have the preference. Careful and scientific experiments have proven these facts beyond dispute.

"Let us see what the selection of seed has to do with improving the cane. Although it is said that to weigh cane by means of a polarimeter, has no bearing thereon, yet on beets, potatoes, etc., we think it has. The theory is that seeds from rich juiced cane have produced poor, and those from poor juiced cane, a rich juiced crop. But how is this proven? Have proper examinations been made? No. For several crops may have been compared, but atmospheric influences have been ignored, or results have been obtained under

various conditions of the soil, or sticks of various ages have been used, and these differences have not been taken into consideration, consequently the question: Does rich cane produce richer successions than a poor quality, will not be answered by the above method of investigation?

"To arrive at any definite conclusions, all the conditions of climate, soil, age of seed, etc., must be taken into account, and experiments, within these lines, will we believe show different results from those obtained by a cursory investigation in which these influences are not considered. Choose a certain quantity of cane of even age, inspect the lower part thereof as to its contents of sugar, make a proper distinction of the seedlings which contain poor and rich juice, and cultivate them separately under as similar conditions as possible, continue this through several generations, and good results perhaps may be gained with the assistance of good average analysis.

"Should there be no power of transmission in the seedlings by what means then has the rich cane of to-day been obtained? Which under the most unfavorable conditions has given proof of its generating power? Nothing will be gained by this means for several years, and it would be foolish to commence experiments with any other expectation, for with cane as in other matters, patience and time are required."

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HOME INDUSTRIES.—HONOLULU SALT WORKS.

There are quite a number of salt works in operation on this Island, (Oahu,) and as the process of manufacture is not generally known a brief description may be of interest.

Salt, sodic chloride, or common salt is the product left when sea-water is evaporated.

Sea salt crystalizes in colorless, transparent, antyrous crystals belonging to the esometric system. This mineral occurs very abundantly in nature both in the solid state as rock salt, and is held in solution in sea-water, saltlakes, saltsprings, etc. The entire quantity of salt in the ocean is estimated at 3,000,000 cubic miles, and 5,000,000 tons is said to be used in Europe every year. Very little is known of the origin of

rock salt. Some of it was doubtless produced by the drying up of large bodies of sea-water when shut off from the ocean, but how the great quantities were formed, is only a matter of conjecture and probably a solution to the mystery will never be found.

"The salt of the ocean has undoubtedly resulted from the chemical changes which have taken place between the elements that constitute the earths crust during former geological epochs. Water of the ocean contains on an average 33.8 parts of salt in 1,000 of which 26.8 in 1,000 is common salt, and its specific gravity is 2.1 to 2.257."

There are various methods in use for the evaporation of the water, and these are known as the kettle, pan and steam process. Here, however, we see nothing but the solar process, the heat of the sun doing all the evaporation.

At Kakaako, just south of the city, is situated the best salt works in the district. E. O. Hall & Son are Agents. These works are a credit to Honolulu, and show what enterprise and energy when combined with intelligence and application can do.

These salt works are laid out systematically and beautifully and one is surprised with the regularity and evident perfection of every arrangement and of every process in connection with it. One would suppose that a skilled mason with a trowel, stones and cement, had been used in constructing these works, and still nothing of the kind was used. The soil here is of a clay or loamy substance, and can be worked into any shape or form, and seems to be formed by nature for this very purpose. These works are quite extensive covering about eight acres, and comprising at present fifty-six sets of ponds, seven ponds to a set.

On each side of the works there are canals which extend to the ocean. These canals supply the storage ponds, which latter again supply the evaporating ponds, from which the water runs into the strike ponds, where the crystals are formed. The salt water passes along gradually from pond to pond, and takes usually a week to reach the strike pond. In this way the water gets denser and denser until it is saturated with a very dense of solution of salt, when it crystalizes rapidly. The water in the strike ponds is not more than 1½

inches deep, the two adjoining ponds, a little deeper the next a little deeper and so on.

These ponds are connected with each other by troughs and wooden pipes. These troughs are well made, and twice tarred before being put in place. The strike ponds are also protected from the wind with good substantial fences, the object of this is to keep the water as still as possible.

In the process of crystalization the sun does all the work, the water however has to be agitated at intervals to settle the crystals which have formed on the top of the water, like a thin crust of ice.

There are nearly sixty strike ponds and they each take off a strike every seven to fourteen days, according to the weather, the amount of salt per strike is on an average 850 pounds for each pond. The strike ponds are arranged parallel with each other with their tributary or auxilary ponds between. There are convenient roads, paths, etc., for the transportation of the salt, and good substantial store-houses for storing the same.

The water used is pure and clean and comes always from the direction of Waikiki. The salt manufactured here is fine grain, white and clean, and looks as good as any of the best salt imported.

The salt is handled with care, and thoroughly dried before being put on the market. The only piece of machinery noticed here is a genuine Chinese pump, made by hand, and is very simple in construction, but at the same time will throw more water than any other pump devised by white men.

The labor on the Salt Farm is all done by Chinese, as no other class of labor has ever given satisfaction, though Hawaiians and Portugese have been employed. The evaporating season commences about April of each year, and lasts six or seven months. No salt can be made in rainy weather.

About five men are employed during the season, and two during the winter season, merely to keep the pond in order and make necessary improvements.

The Company has built a substantial house for the workmen, and two store-houses to keep salt in between seasons. The Kakaako salt is more in demand than any other home-made salt and the Company readily dispose of all they have been able to make. G. O.

CANE DISEASE FROM BAD CULTIVATION.

[Queensland Sugar Journal—August.]

Mr. E. de P. O'Kelly, reporting to the New South Wales Department of Agriculture on the "Sugar-cane disease" on the Richmond and Clarence Rivers (N.S.W.) states emphatically that there is no real disease, such as Sereh, prevalent. Insects are doing some damage, but not sufficient to cause alarm. Having detailed the best way to deal with the pest, Mr. O'Kelly goes on to say that the so-called disease on the Clarence was simply the dying, from natural causes, of the cane. The cane had set for arrowing and then been checked by climatic influences. It had matured at twelve months and was dying away at fourteen and sixteen. Healthy ratoons came up from the stools of the affected canes. Further the unhealthy condition of certain canes is traced to the use for plants of "cane that had set for arrowing." Mr. O'Kelly says: "In one paddock of 17 acres, where "sets" had been taken from different canes—viz.: some that had "arrowed" and some that had *not*, the result was very marked; those planted from "arrowed" sets having a very unhealthy appearance, and the others looking healthy and strong. A more striking example presented itself in the case of two ten acre blocks adjoining each other. One had been planted from "sets" taken from cane which had set for "arrowing," and was in a very unhealthy condition; the other field, on the contrary, which had been planted at the same time, but from "sets" taken from a field of young plant cane, which had *not* "arrowed," was looking remarkably well, and gave promise of a heavy crop. Both these fields of cane were subject to the same conditions of soil and cultivation, and were four months old plant cane of Mauritius Ribbon. These facts point strongly to one conclusion—viz.: that this unhealthy development has been brought about by planting "sets" from "arrowed" cane, or cane which had set for "arrowing," or which was in an otherwise unhealthy condition.

I found amongst the generality of farmers an utter want of care and discrimination in the selection of their plants. The importance of this cannot be too strongly impressed upon them. Nothing but the most healthy plants should be select-

ed, and I would strongly recommend that no plants should be taken from any but plant-cane of not over twelve months old." Referring generally to cultivation Mr. O'Kelly says: "The usual mode of cultivation practised by the farmers is capable of much improvement. After the work of felling, lopping, and burning off has been carried out, they plant their "sets" leaving the operation of "stumping" to be accomplished after the first crop has been taken off, thus giving the stumps two years in which to decay and die. During the first eight or nine months the cane receives a fair amount of attention, and is kept free of weeds; but after this, beyond being "trashed" twice or more, usually only once, just before cutting, it is practically allowed to take care of itself.

"After the first crop has been taken off, the stumps having dried away, the soil is ploughed and worked up, and as long as the horses can get into the cane, it is kept clean, and fairly well cultivated. The plant cane is usually cut at two years old, the first ratoon at twelve months, and the second ratoon at two years. In many cases the farmers continue cropping from the same "stools" of cane, till they find their crop utterly fails, when they plough up and replant. I am glad to see, however, that amongst the more careful and intelligent farmers this system is falling into disuse. After cutting the second ratoon, the "stools" should be ploughed up and the field replanted, or, better still, be green manured, and allowed to lie fallow for at least twelve months. Many farmers have told me that they have grown cane on the same land for upwards of 24 to 30 years, giving the soil no rest beyond rotating every five years with a crop of maize. Now, it is a generally accepted fact that maize is one of the most exhausting of crops, it being very rich in magnesia, potash, and phosphoric acid, and as the prevailing prices for some time past have been far from remunerative, it is hoped that farmers will turn their attention to a more suitable and profitable crop. That the districts through which I passed are naturally very fertile, there can be no doubt, and the climate and rainfall are all favorable to the growth of the sugar-cane, and I have no hesitation in saying that I have never seen more luxuriant growth or heavier crops than on some newly established farms, and others of longer standing on which care and intel-

ligent cultivation have been exercised. But I may say, at the same time, that on other farms, where cane has been grown continuously for years on the same land without either rotation of crops, application of manures, or even a rest, the cane has exhibited marked signs of deterioration, and a very unhealthy appearance, and there is no doubt in these cases that the soil is suffering from exhaustion, and is undergoing this process as every crop is removed from it. It is true that the soil in these districts is subject to periodical enrichment by the deposits left by floods, and it is a common thing to hear farmers say that in consequence of these floods their land will never be exhausted. Notwithstanding this assertion a chemical analysis would show that a proportionate amount of certain elements necessary to the normal growth of the cane was wanting, and the fact that the cane becomes the victim of disease without any apparent cause, practically demonstrates that fact to the sceptical.

"As there seems a disinclination on the part of the farmers to renovate their land with artificial manure, on account principally of the initial expense, and also an uncertainty as to the results, I would strongly recommend that a system of green manuring should be tried. It is an inexpensive, and at the same time a most effectual method of keeping up the fertility of the soil. For this purpose I would recommend the cow-pea, pigeon-pea, or some other leguminous plants, such as lucerne, peas, or beans, and others, such as indigo or maize, which should be sown broadcast, two or three bushels per acre being used for the purpose, and ploughed in green immediately before planting the cane. I have seen maize very successfully used for this purpose. It is also a good plan to plant one or other of these leguminous plants between the rows, when the canes are just planted, or the ratoons are just "springing," and when they are in a green and succulent stage, to cut them down, and laying them neatly between the cane rows, turn the soil over them with the plough. "The benefits of green manuring are: (1.) It adds humus, *i. e.*, vegetable matter, which makes clay soil crumbly, and gives sandy soil more body. (2.) It makes the soil warmer, and lets in the air, to increase chemical action. (3.) It generates carbonic acid gas, which renders plant food more assimilable.

(4.) Supplies the soil with large quantities of nitrogen, a very precious plant food, made especially so because it is used in large amounts by plants, which is apt to be lost by leaching through the soil as nitric acid, or by escaping into the air from the manure heap in the form of ammonia, and for the reason that it is the most costly plant food in the market." As a means of destroying insects I would recommend the burning off of the field after the crop has been removed. This system I find is pretty generally in vogue amongst the cane-farmers. There are some who claim that the practice is wrong: but I have seen it done for years with no ill effect, and as long as discrimination is used not to burn off in very dry weather the advantages to be gained, when weighed with the disadvantages, are more than sufficient to justify the practice of burning off."

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AMERICAN SUGAR INTERESTS.

[New York Sun.]

There have appeared recently in the *American Agriculturist* a number of articles on the sugar industries of the world and the possibility of increasing the output of the product in the United States. From the data collected by men who may be looked upon each as an expert in this special province of inquiry, we learn the aggregate amount of the world's annual consumption of sugar, the chief causes of its supply, and the causes of the expulsion of cane sugar by beet sugar from the European markets. We also find set forth the results of experiments showing the adaptability of a large section of this country to the cultivation of the sugar beet and the exceptional value of such a crop to the producers.

It appears that for the year ending July 1, 1890, the total production of sugar in the world was 5,158,928 tons. Of this aggregate the European beet contributed 3,169,642 tons, leaving 1,989,286 to be credited to the tropical cane. Of cane sugar, 598,214 tons came from the Spanish West Indies; from the other West Indian Islands and Guiana came 350,892; from Brazil and Peru, 160,714; from Louisiana 111,606; from Hawaii 107,142, while 660,714 came from the East Indies and Africa. It is well known that the West Indies are the chief

purveyors of the American market, and that the bulk of their product can not be sold elsewhere, the beet sugar having supplanted it among European consumers. Of the sugar imported into the United States in 1890, some 43 per cent. came from Cuba and Porto Rico, 13 from the British West Indies, 4 from Brazil and other countries on the American continent, 11 from Hawaii, and 11 from the East Indies; the remaining 18 per cent. is referable to importations of beet sugar from Europe. The cane industry is, it seems, declining everywhere outside of the West Indies under the pressure of low prices; and even the West Indian planters have been forced to reduce greatly the cost of manufacture, to introduce improved mechanical processes, and to abandon estates so distant from ports of shipment as to involve high rates of transportation.

The United States consumed in 1891, 1,885,994 tons of sugar, or 363,263 more than in the previous year. Of this amount only some 250,000 tons were of domestic growth, the bounties offered by the government not having as yet very largely stimulated the growth of sugar in the Uuited States. Mr. Charles E. Buckland, however, the author of one of the articles in question, has no doubt that a material increase in the domestic output will soon be observed. The area in the southern States adapted to the cultivation of the sugar cane is, he says, more extensive than is commonly supposed. Especially is this true of Florida, where there are large tracts of land as well suited to the cane as the Hawaiian plantations. There is, moreover, a vast section of the United States where sugar beets of exceptional richness can be grown. Some experiments recently made in Nebraska show an average yield of over twenty tons of beets per acre, with a saccharine content of about 13.5 per cent.

The sugar beet area is mainly confined to the northern part of the country, the elevated plateaus of Utah and Colorado, the coast valleys of California, and the States of Oregon and Washington. It is true, nevertheless, that beets of exceptional richness have been grown further south, especially in the Shenandoah Valley. The reasons for expecting at an early day a signal expansion of the domestic sugar industry are that under the stimulus of a bounty system practical

measures have been taken to encourage the growth of the sugar beet. Thus three large beet sugar factories are in California; there are two in Nebraska and one in Utah, and companies have been organised in several other Western States.

According to the writers of whom we are speaking, there is no more lucrative crop than the sugar beet. We are told that an average yield per acre is from fifteen to thirty tons of beets, which the farmer can sell at $5 per ton. At the minimum rate of yield just mentioned, his returns would be $75 per acre; and the cost of raising the crop, including the seed and delivery at the factory, does not, we are assured, exceed $40. If this estimate is trustworthy, it would certainly be difficult for the farmer to use his land to better advantage than in raising sugar beets. This crop, moreover, does not impoverish the soil, provided it be raised only in alternate years, wheat being sown in the interval. It should be noted that the sugar beet, to be merchantable should not weigh more than one to one and a half pounds.

Large beets are worthless to the manufacturer, because they contain a superabundance of water and but little sugar. An obvious gain from growing beets in the vicinity of a sugar factory is that the farmer is sure of his money within a week of delivery, and that his returns are subject to no deduction for freight and commissions. That, influenced by such considerations, farmers, even in the Eastern States, are beginning to look with some favor on the cultivation of the sugar beet, is indicated by the efforts to establish the industry in Onondaga county, New York.

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THE SUGAR INDUSTRY.

[From Demerara Argosy.]

At a time when a succession of unfavorable seasons has diminished the quantity of canes in the field and lowered the saccharine density of the juice, and when the great staple product of the colony has to engage in the battle of competition with the sugar factories of the wide world, some of them subsidised by Government bounties, and to face in one of the two chief markets for West Indian crystals, the exactions of

that modern monstrosity in commerce a "trust" which unifies the buyers of a certain product and fixes the price at which it shall be bought, it should not be a matter for surprise that the profits of a sugar estate in British Guiana are not providing quite a princely income for the owner, or giving extra encouragement to men with money to invest some of it in sugar property. The times are somewhat tight, it must be admitted, but no more so than they have been on several previous occasions during the past thirty years of the colony's history, and not to be compared with the awful experience of the '40s when nothing but the courage, tenacity and bigheartedness of certain men who owned sugar estates in those days kept the flickering light of the colony's industry from going out altogether.

Unfavorable although the seasons have been since 1890, we can assert on unquestionable authority and fearless of contradiction that many estates in this land have nevertheless cleared a profit, larger or smaller, every year. Some estates have not; and here and there a financial closure has had to be put in force by those who are helping the inpecunious owners with money to meet the current expenditure; but those instances have been very few and cannot be held accountable for the extraordinary distrust with which landed property as well as local stock and shares, is being regarded in the mother country at present, even by those who ought to be the last to depreciate, or to speak or act so as to depreciate, the value of colonial possessions.

There can be no question that the proposed abandonment of one of the largest sugar estates in this land, or in any other British colony, the principal owners of which are reported to be wealthy, has had a good deal to do with creating and maintaining the want of confidence to which we refer. People who do not know the circumstances which have brought about the crisis in the affairs of the plantation referred to, naturally enough argue that if this estate, more favorably situated than any other in British Guiana and owned by rich men, cannot be made to pay and is a source of annual loss to its owners, it would be madness to expect a return upon money spent upon any other of the colony's sugar estates; and consequently when a plantation is offered for

sale, there is no "outside" capitalist to be found ready to invest in it. It happens that the colony is unfortunate enough to have amongst its prominent landed proprietors men who are in the position "to make their loss" as they phrase it, by cropping their estate and dismantling it, whenever the mood seizes them, and who having other means to live upon, do not consider that the interests of the sugar industry as a whole have any call upon them;—their own interests being the limit of their consideration, although in matters of Immigration, Water Supply and others, the sugar planters of the colony are all closely allied by a partnership under which, morally if not legally, consideration for the welfare of one another is obligatory.

To illustrate our contention, let us take a suppositious case the points in which shall not be overstated. A man owns an estate which for a long series of years previous to—say 1890, gave him a handsome income, sometimes five, six or more thousands of pounds and never less than two or three,—this upon a property the market value of which in goodish times might be placed at from £25,000 to £30,000. His success as a proprietor would have been impossible without the co-operation of his brother planters in obtaining labor from abroad under a carefully organized system the expensive machinery of which can only be kept in motion by the combined efforts of the planters as a body.

A year comes when the accounts of his estate do not show a profit; another year probably makes a call upon the money the years of plenty had provided; there is no reason to fear that the years of profitable working are never to return, but the proprietor, regardless of all but himself, never thinking of the increased burden he is throwing upon those who helped him to get the labor supply by which the profits of his estate were rendered possible, gives way to feelings that are not too harshly described as cowardly and selfish, and from his comfortable quarters in the old country (for the renegade is never a resident-proprietor) issues the order that the fields must be cropt, the machinery sold, the manager and staff turned adrift, the houses of the hundreds of laborers sold for what they will fetch, and the poor people themselves, many of whom have no other home than the estate, driven off to find

another home where they can, with as little compunction on the part of the absentee proprietor as if they were a drove of pigs.

If the financial prospect of sugar estates were hopeless, the policy of the retreating rats would be regarded as self-preservative; but we are glad to know that the real planters of the colony, the men who own estates and look after them, themselves, have no sympathy with the pessimists, and regard any tightening of the market rates, or reduction of the crop by untimely rain or drought as only a reason for practising more rigid economy in field and factory, improving their agriculture and adding the best they can afford to their plant of machinery. They feel they can, by growing good canes, crushing them well, defecating and evaporating the juice with the splendid apparatus modern science has fabricated, make crystals at a cost that will leave a margin of profit even if prices are low; and they are not superstitious enough to suppose, because two seasons in succession are wetter than they could wish that the forces of nature have entered into a feud against them.

This may appear to some of our leaders as a decidedly optimistic picture of the planter's condition at the present day, but we have not penned it with any intention to misrepresent, for no good could come of that. Referring to the report of the Colonial Company, Limited, that was submitted to the shareholders a few weeks past, we find the amplest corroboration of what we have here stated. In his speech in submitting the report the chairman stated that in the previous year the company had lost £19,450 by their muscovado estates and made £19,400 by their vacuum pan estates. They had arranged to manufacture all their canes into crystallised sugar (as do nearly all the estates in this colony) and there was a certainty that the next year would show a profit. During the past seven years their vacuum pan estates had made money every year, and in 1891, a year of exceptionally unfavorable weather, crystallised sugar was made at a profit which represented £3 6s. 8d. on every acre of canes that had been cut. We have to add that the company's estates in Demerara are all in excellent order and managed with as much care and unceasing economy as if they belonged to keen-eyed

resident proprietors, and that the chairman's opinion that a vacuum pan estate would continue to pay notwithstanding bad seasons and low markets is that entertained by all the resident proprietors whose estates are in thorough working order. There is no real ground for the funk that has seized those absentee proprietors to whom we have referred and it is right our readers beyond the colony should know the true position of our staple industry. The few renegades who are deserting the ranks, were never at any time true sugar planters, although they owned and benefited by sugar plantations. The planters who are in the colony managing their own affairs are as full of fight as ever, be the enemy, rain or drought, the sea, the trust, the McKinley tariff, or any other financial or fiscal iniquity. They are determined to make their estates pay in the future as they have paid in the past, and to maintain the colony's position as one of the recognized first class sugar centres of the empire.

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AN EXPERIMENTAL SUGAR STATION.

The following letter, though not written for publication, possesses so much importance and is of such general interest, that its publication cannot fail to serve the interests of sugar planters primarily, and also of the whole country. The suggestions made refer to a policy which is being adopted in every beet and cane growing country, and must eventually be adopted here :

Kohala, Hawaii, Oct. 6th, 1892.

H. M. Whitney, Esq., Dear Sir :—Although not a subscriber to the Planters' Monthly, the numbers which come here for Kohala Sugar Co., are turned over to me, and I have read them with much pleasure for the past year. I hope then you will pardon my bringing to your notice a matter which is I think of great importance to the planters of this country.

As the sugar industry stands at present, and in view of the efforts being made by the U. S. Government to place both beet and sorghum sugar on a sure footing, it does not require a gift of prophecy to foresee that in a short time sugar cane

will be, to use a slang phrase, "not in it." I think that the only thing that will save the Hawaiian planters is just such thorough scientific work as has been done in connection with beet sugar, and to that end the establishment of an experimental station is necessary and that without further delay.

Would not the establishment of such a station come within the province of the Planters' Labor and Supply Co.? The planters would have to support the station even if it were established by the government; and it seems to me direct control would be much more satisfactory than through the medium of a political machine.

Below are a few of the things which an experimental station might undertake:

1. Cane Growing: (a) Attempt to increase the sugar content of cane either by originating new varieties, cultivation or variation in fertilizing agents. (b) Determine whether deterioration of the quality of cane is taking place, to what extent and its cause. (c) Study the effect of different fertilizing agents on the non-sugar in the cane, and consequently on the yield of molasses.

2. Soils: (a) Study soil exhaustion in its relation to cane growing; how to prevent and remedy it. (b) Determine the extent to which varying mechanical conditions of the soil affect the yield of cane and sugar. (c) Determine the fertilizers best adapted to various soils or varieties of cane.

3. Fertilizers: (a) Analyse all fertilizers sold to planters, and so check all fraud in this business.

4. Chemistry of Cane: (a) Determine the condition in which food material is most easily assimilated by cane. (b) Study the solids not sugar, their chemical composition and relation to sugar production in the plant.

5. Mill work: (a) Attempt to improve mill work and lessen the loss in manufacture. (b) Study the waste products of the mill with a view to their economical utilization.

As a chemist I have no hesitation in saying that the chemistry of sugar cane is an almost unexplored field, and that there is renown for the chemist who has the opportunity to explore it, and I think, money for the planter as a result of such exploration.

I do not write this for publication, it might look like two words for the chemist and one for the planter, but I do not hesitate to say that I would like nothing better than such work as I have outlined above.

Without going into details, I may say, that a station could be started and kept running for a sum which, divided among the planters of the Islands, would not be a drop in a bucket.

I am yours sincerely,

EDMUND C. SHOREY,
Chemist.

Kohala District, Hawaii.

INDIAN COOLIES.

Whatever information can be furnished regarding these laborers is always acceptable, and for this reason the following will be interesting. The first is a note accompanying his communication, and is dated as below. The writer spent several years on these islands, but requests that his name be not published in connection with his communication. Had he given more data regarding the cost of these laborers in Ceylon, his article would have possessed more value:

Nahalme Tea Estate, Kelany Valley, Ceylon, Aug. 15th, 1892.

Dear Sir :—I enclose you a letter upon the Tamil Cooly of India, which you have entirely at your disposal, the waste basket is perhaps the most suitable place for it. As I state I was a sugar planter in Hawaii, and know the Japanese and Chinese laborers well, and now it has been my luck to know the Tamil as I am on the above tea estate where we employ between 550 and 700 coolies all the year round. I could not speak too well of the Tamil as a laborer, as he is the salvation of the country. Without the Tamil cooly, Ceylon would be nowhere. The soil of the country is not to be compared with that of Hawaii, and sugar planting was a failure on that account and so was coffee, but tea which is doing well, is a hardier sort of plant than coffee, and its roots go further down in the subsoil. The Hilo district of Hawaii would be very suitable for the culture of tea and coffee—all that belt of wood between the top of the plantations and the foot of Mauna Kea and Mauna Loa ; but to grow tea you would require about a cooly to the acre, which would not pay at the high rate of wages in Hawaii. Yours truly,

* * *

THE TAMIL COOLY.

Editor Planters' Monthly :

Sir :—Would you kindly allow me a small space in your paper for a few remarks on the above subject, which may be of some interest to planters and other employers of labor in Hawaii. As a former resident in Hawaii, and being employed for some time on a plantation, enables me to know a little

about the bad state of the labor. It is a well known fact that no kind of labor can beat that of the Tamils of South India; wherever they have been taken they have proved to be the best and cheapest labor. A great many coolies have been taken from India to different parts of the world recently. Ceylon being so close as it is to India has always an abundant supply of coolies, of which the tea enterprise employs something over 150,000. Then the various other products such as coffee, cocoa, cinnamon, cinchona, cocoanuts, etc., require many more laborers.

The Tamil cooly is to be found abundantly in the Straits Settlements, (Malay Peninsular) on the Coffee and Sugar plantations there, also in Sumatra and Borneo. Of late a great many have gone to South Africa, Mauritius and a few to Queensland and the Fiji Islands. In Ceylon a good cooly gets at the rate of six pence (6d.) a day, but of course in these other countries a little more is given as they are generally contracted for a certain time at a certain rate. The method of procuring coolies in Ceylon is through a Kangany (headman) who has got a few coolies and who will leave the coolies with you as a security for an advance of cash which he takes over to India and collects as many coolies as he has got cash to bring back with him. After bringing back these coolies the Kangany turns them out to work and he looks after the work for which he draws a commission of four cents a day upon each cooly. By this commission which is taken off the coolies' pay, encouragement is given to the Kangany to turn out his coolies regularly.

Another very good arrangement is the issuing out of rice to coolies, by this you have a great power over the coolies, who entirely live on rice and depend upon it. If there is lots of work which is required to be done, all you have got to do is to tell the coolies that no rice will be issued under six days work; at the end of the week the check roll is looked over and rice issued to all coolies of five or six days work and an order for the amount given to the Kangany who goes to the district rice store and draws his amount of rice for his coolies that wrought the stated amount of work. The keeping back of rice has a wonderful effect upon a cooly, the mere fact of fining a cooly by giving half a name or no name or a Rupee

has little effect; but if you tell him that the next offence his rice will be cancelled, it is looked at in quite a different light. To be short of rice for the following week weighs heavy in Ramsamy's mind, but the thought of a Rupee or two less at pay day, which is perhaps two or three months distant, matters nothing at all.

Those who have had the experience of looking after Japanese laborers know how little good is obtained by fining, but if their rice was at stake much more power would be obtained over them. The common run of coolies from India do not lay themselves out for saving up a little money and running away back in about three years as is the case with the Japanese who have to finish their three years contract, and then if enough money for a passage back, away they go. At the instigation of the "Ceylon Tea Plantation Company," an investigation was made in the interior of India a few months ago to ascertain if there were lots of coolies available, when it was found that large districts full of people were to be had only at a little more expense bringing them to the seaport. As it is and has been, coolies have all been taken from as near Triticorin or Madras as possible, and consequently these districts are getting scarce, but as it is proved that there are plenty in the back-ground, there is little to fear for a scarcity of the Tamil cooly. Yours truly,

Ocha.

Ceylon, October 15, 1892.

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PROPER METHOD OF APPLYING COMMERCIAL FERTILIZERS.

A Paper read by Prof. W. C. Stubbs before the Monthly Meeting of the La. Sugar Planters' Association, Thursday, July 14, 1892.

[Louisiana Sugar-Bowl.]

Commercial fertilizers consist chiefly of one or more ingredients, viz: Nitrogen (the chief element of ammonia), phosphoric acid and potash. Intelligent and thoughtful planters and farmers are frequently asking the question: Under what conditions can we most profitably use commercial fertilizers? It is universally conceded that fertilizers

should be used whenever crops are grown which do not attain their maximum on account of a deficiency in the soil of one or more of the above ingredients. But the deficiency of plant food is not always the cause of small yields. An excess or deficiency of water may, in this climate, be the main trouble. Drainage or irrigation may be the corrective factor needed. Impervious clays, with a wealth of fertilizing ingredients, frequently check luxuriant growth by impeding root development.

Soils which puddle with every shower will, unless carefully and quickly stirred, work disaster to the plant. Stagnant water, at or near the surface, prevents aeration and the healthy development of nitrification, and thus sometimes causes our most fertile soils to be unproductive. Humus, an ingredient almost imperatively needed in this climate, for maximum production, is frequently sadly needed. Local climatic conditions, temporarily existing, may make or mar bright prospects. It should, therefore, be emphatically asserted that before commercial fertilizers can be made to produce their full effect every physical and climatic deffect should be ameliorated.

A cursory glance over many of our fields will show that our crops need physical and cultural amelioration far more than commercial manures. Irrigation, drainage, deeper ploughing, better cultivation, harrowing, hoeing, rotation of crops, incorporation of vegetable matter, etc., are far more frequently needed upon the alluvial lands of South Louisiana than the application of cotton seed meal, acid phosphate or tankage. Establish first these ameliorating conditions and then practice liberal manuring; remembering that every improvement in the physical qualities of a soil increases its capacity for absorbing large quantities of fertilizers, and transmitting them into maximum crops. Excellent soil culture, with favorable seasons, means an enormous conversion of plant food into crops.

Therefore, wherever the largest crops are produced there will be the heaviest demand for manures. Rich soils, properly tilled, can always appropriate successfully heavy applications of fertilizers, while poor soils must be fed with great caution. It is, then, the duty of every planter to first perfect

all the other conditions of heavy plant growth before calling to his aid the use of commercial fertilizers. When these are accomplished, there will be a demand for the latter—not a demand to satisfy hunger, but one to grow and fatten.

The swine raiser in the West first perfects the conditions of digestion before giving his pig all that he will eat. His object is to transform larger amounts of plant food into fat and muscle within the animal's frame than is required for simple maintenance, and this he accomplishes by carefully compounding a ration known to be both palatable and digestible. In successful stock raising, animals known to possess intensive powers of assimilating plant food are first selected and then supplied with specially prepared food in great abundance.

So, too, in farming, soils in the best physical conditions should be planted with crops known to possess enormous capacity for absorbing fertilizers, and these should be stimulated to a most intensive assimilation of plant food by a liberal application of suitable manures. The richer the soil, "cetera paribus," the more liberally does it respond to fertilizers. Per contra, poor soils under favorable conditions frequently yield satisfactory results with commercial manures.

Fertilizers frequently overcome unfavorable surroundings by giving a larger and deeper root development in early growth, enabling the plant to withstand a subsequent drought. With us they frequently cause an early shading of the ground, thus preventing "surface baking," and permit an early "lay by" to our crop.

These brief remarks will show the importance of preparing the soil for the reception and assimilation of fertilizers, and the next question is how can they be best applied. It is easy to tell which of the three ingredients of plant food is needed by our soils to grow large crops. Nitrogen and phosphoric acid seem to be universally needed, while potash in any form has given us no increased returns upon any crop. This fact, established by experimental test, is corroborated by chemical analysis and the abundant growth of a class of plants known to be large potash consumers, viz: cow peas, white clover, etc. Our fertilizers should then consist of nitrogen and phosphoric acid. A discussion of the qualities of each will throw some light upon their mode of application.

Nitrogen, the most costly ingredient of fertilizers, should be applied with care and economy, since an excess may cause abnormal development of vegetation and produce in the sugar cane a low sucrose content. Residues not used by the crop during the growing season may be leached beyond recovery by the rains of winter. At best this substance is fugitive. Yesterday it was in the atmosphere as free nitrogen; to-day, chained in chemical bonds, is a denizen of the soil; to-morrow it may be washed into the ocean through our ditches, canals and rivers, and there furnish food for fishes; or pass into plant economy, serving the wonderful function of forming the protoplasms of cells, millions of which exist in every cultivated plant, forming what Haekel has aptly called a "cell republic."

These fugitive properties strongly suggest the propriety of never applying nitrogen until it is needed by the plant, and every attempt at storing away a surplus of it in the soil is uneconomical and irrational. Experiments have shown that, under the best conditions, plants can utilize only about two-thirds of the nitrogen supplied to the soil as manure. The tendency of all nitrogenous manures is downward in the soil, and hence a rational system requires it to be kept as near the surface as possible for the welfare of the plant. On account of the above properties, nitrogen compounds, particularly its mineral forms, are frequently applied on the surface of the growing crop.

The agricultural properties of phosphoric acid are almost the reverse of those of nitrogen. It is the conservative element of fertilizers. It can be stored up in a soil, remaining for years almost in the same place in which it is applied. It does not leach or volatilize, but enters into insoluble forms soon after it is applied to the soils, to be dissolved only when needed by the plant, through the acid secretions of its minute and almost ubiquitous rootlets.

A surplus of this ingredient is needed to produce, under average conditions, maximum crops. Too large a surplus is, however, not economical or rational, and may sometimes be injurious. This is particularly true of soluble phosphates, the form recommended for immediate results. This form is preferable to all others, where fertilizing the crop is prac-

ticed rather than fertilizing the land. For, although this form sooner or later after application becomes insoluble, before becoming so it is largely diffused through the upper layers of the soil by virtue of its initial velocity due to solubility in water.

With all other forms, fineness of division and careful incorporation with the soil are essential to successful results. Phosphoric acid hastens the maturity of plants, particularly in the absence of nitrogen. It is said to have a quickening effect on all the vital functions of the plant, causing it to prematurely ripen and die. This ripening process is but a cessation of the activity in the manufacture of vegetable material and the transference of these ready-made products through the leaves and stalks to the fruit. The presence of a surplus of nitrogen prevents or rather retards this cessation of activities by prolonging and enlarging growth. From the above it would seem that soluble phosphates may be applied nearer the surface than the other forms.

Potash, though needed by very few soils (if any) in Louisiana, can be cheaply supplied through some of the German salts. All forms of potash produce their best results when applied some time before the growing of the crop which they are intended to benefit. Kainit is rich in common salt, the binding effect of which, on a soil, is well known. Frequently an application of this salt upon very light soils is productive of great good, even where potash is not needed. The power of these soils in retaining moisture is thus enchanced. On stiff soils for the same reason, they may prove detrimental. Potash does not leach, but becomes fixed as soon as applied to the soil. Hence it should never be applied on the surface, but incorporated with the soil at the depth required by most of the roots of the plant.

Now we come to the question itself: Proper application of commercial fertilizers?

To answer this question properly, the stations under my charge have been making field experiments with various crops for many years. We have propounded the following questions: 1. Shall our fertilizers be distributed broadcast, or in the drill? 2. What depth shall we apply them? 3. Shall the different ingredients be applied separately, or com-

bined? 4. Shall we make one or more applications to a crop? These experiments under cane, corn and cotton, are being continued, but our results, so far, strongly indicate the following:

Upon cultivated crops, growing through our long summers, that a proper distribution of the fertilizer in the drill is most probable. This distribution, within somewhat restricted limits, should be thorough and complete. Fertilizing broadcast has developed extra weeds and grasses which require labor and time to eradicate, and moreover has failed in every instance to grow as large a crop as the same amount properly distributed in the drill.

Fertilizers have been applied at all depths from the surface to nine inches below, and the testimony is strongly in favor of that depth at which the roots can live and thrive in an ordinary season. This depth has been found to be about two or three inches below the surface. Separate applications of the different ingredients have been repeatedly made—in conformity to their known diffusive capacities—as already described.

Potash and phosphoric acid have been applied separately and combined at depths varying from two to nine inches, while nitrogen, on account of its very diffusible nature, has been applied on the surface and at varying depths, combined and separately.

Phosphoric acid and potash have invariably responded best at depths of two to four inches—while nitrogen has varied with the seasons—in wet seasons, applied alone and on the surface it has responded best. In dry seasons, by virtue of the capillary moisture drawing it to the surface, it has done best applied at depths of two to three inches. In such seasons it has been successfully applied combined with the other ingredients. It may therefore be assumed from our experience that, in the average of seasons it is best to apply all the ingredients together and at the depth of two to three inches.

One, two and three applications of commercial fertilizers have been made upon these staple crops of corn, cane and cotton. Here, too, our results have been controlled largely by the seasons, and, as was to be expected, by the character

of the crop. Cotton with a long, deep tap root seems to have the power of arresting the downward tendency of the nitrogen, given in one application at the time of planting. It is also planted much later than either corn or cane, and more quickly springs into vigorous growth.

Cane and corn are, on the contrary, fibrous rooted, and the tendency of growth in the roots of these plants is in lateral directions rather than downward. Hence they have been frequently benefited by two or more applications, especially upon loose sandy soils and in every wet weather. Upon loamy or clayey soils the tendency to leach is not so great; and hence, with an average of years upon these soils, not much will be lost by one application given at planting or during the early growth of the cane.

Summing up our results and applying them to cane, we would advise using a mixture of nitrogen and phosphoric acid, both in highly available forms, upon both plant cane and stubble. With the fall plant, a portion, at least, of the fertilizer should be applied at the time of planting, and the rest in the late spring, when suckering begins. We have used a full ration in the fall with success. With spring plant there is but little use of division. In applying fertilizers before planting, pains should be taken to see that it was evenly distributed throughout the furrow and well mixed with the soil—simultaneously with the sprout of the cane and the nodular rootlets, which supply the young shoot until the latter develops roots of its own.

Readily available fertilizers in close proximity are seized with avidity by these rootlets, and larger and more vigorous shoots are developed. The crop is pushed in its infancy, and an early "lay by" so essential to large sugar content is assured. When fertilizers are applied to the growing plant cane or stubble, it has been found that scattering the fertilizer across the row "from the bar furrow on one side to the bar furrow on the other side" has produced better results than depositing it in the open furrow on each side of the cane.

The custom of depositing it by machinery on both sides of the cane in rolls or drills is objectionable. An improvement might easily be made by adjusting at the end of each spout a

contrivance by which the fertilizers might be distributed in the furrow. Stubbles should not be fertilized too much before the cane is large enough to shoot out its own roots, since the roots of last year are inactive and there are no undeveloped nodal rootlets. In applying fertilizers to the growing cane, stubble or plant, the side furrows should not be over two to four inches deep. If deeper than this, a one-horse plow can be used advantageously in partially filling the furrows.

In closing this hastily written paper, permit me to felicitate the sugar planter upon his good fortune of having within his reach two unfailing sources of nitrogen, cow peas and cotton seed meal. The former are now being sought by the entire sugar world. The station has recently by request sent samples to Australia and Mauritius.

It has been shown beyond cavil that the cow pea has enormous capacity of abstracting and appropriating large quanties of nitrogen from the air. Examine the roots of this plant, and you will find it full of nodules. In these nodules are myriads of bacteria which, while they take away the juices of the plant, yet restore one hundred fold. This living together, technically called "symbiosis," is now a common property of all legumes, and among the latter, your cow pea is emphatically the prince.

These bacteria accomplished the difficult task of transforming the free nitrogen of the air into vegetable albuminoids, and the decay of the pea transfers the latter to the succeeding crop. It has been found by the station that a crop of cow peas, grown broadcast and turned under, conveyed to each acre of land an amount of nitrogen equal to 900 pounds cotton seed meal. No wonder the world covets our great nitrogen gatherer.

To our neighboring cotton planters are we indebted for our cotton seed meal. Residing near the great cotton mart of the world, where every product of this wonderful plant is battered from first hands, you get the benefit of wholesale prices without the freights. You are thus enabled to procure nitrogen at prices varying from 12 to 14 cents per pound, while the commercial prices elsewhere prevailing rarely fall below 19 cents.

This substance contains, besides, 3 per cent. phosphoric acid and 2 per cent. potash, and when suitably mixed with acid phosphate and potash salts gives a fertilizer adaptable to every crop upon every soil.

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THE FACTS ABOUT RAIN-MAKING.

GEORGE E. CURTIS, METEOROLOGIST TO THE RECENT GOVERNMENT RAIN-MAKING EXPEDITION.

[ENGINEERING MAGAZINE, NEW YORK, JULY.]

The recent experiments by the Government to produce rain by explosions have received a degree of popular attention seldom accorded to Government scientific undertakings. Throughout the south-western portion of the country, where rain is the one thing needful, the operations excited a profound interest, and awakened lively anticipations of success; and when it was announced that rain had been produced, the news was received with very general acceptance over the entire country. Since the return of the expedition, not only has this interest not abated, but in some Western States it has been increased by the formation of artificial-rain companies, which are contracting with communities to do the public watering at a stated price per acre. These indirect results now give the matter a new importance, and it is not merely to rebut a theory, but to correct a prevailing misconception as to fact, that a specific account should be given of the experiments, of the conditions under which they were made and of the rainfall which attended them, accompanied by a critical judgment of their relation to each other.

[Here follows a detailed account of the firing, with particulars of the state of the weather, and of the rainfall during the experiments.]

The different parts of this detailed account may now be gathered into the following summary:

1. A smart shower on the afternoon of August 10; was preceded on the evening of August 9 by two shots of rackarock to test the powder.

2. Shots were fired on August 12, 14 and 15 without effect.

3. Explosions of rackarock and dynamite were executed on the 16th, 17th, 18th and 20th, when storm-clouds were in

sight, sometimes before and sometimes after the sprinkling had commenced. The rainfall was measurable on one day only, when it amounted to 0.02 inch.

4. On August 22 a fine mist, due to a severe norther, was preceded on the 21st by an explosion of 156 lbs. of rackarock.

5. The explosions of the 25th were followed by rain on the 26th, when the Weather Bureau had predicted local showers for this region. This case is put forward as the strongest evidence of the success of the experiments. But it fails to afford the primary condition of a crucial test, for at the time the experiments were made, the natural conditions antecedent to and productive of a thunder-storm prevailed.

Moreover, August is the beginning of the rainy season in North-west Texas, and although rain in measurable quantity fell on two days, only at the C ranch where the experiments were made, there were nine days when measurable rain fell at one or more stations.

Examined in detail, with all the attendant circumstances, it is evident that the experiments have utterly failed to demonstrate that explosions can develop a storm, or can produce a measurable rain, and they have been not only unsuccessful in result, but meagre and trivial in themselves. After the conclusion of these experiments, two members of the party continued operations at El Paso, and at a point near San Diego, Texas. The explosions are said to have been on a more extended scale. But a careful study of the report of these operations and the attendant weather fails, however, to assure me that the results were any more conclusive.

But while, for all practical results, the explosions at Midland were a failure, they afforded one fact of scientific interest. In several instances, when a dense, threatening cloud was overhead, a sharp, detonating explosion was followed, after an interval of twenty or thirty seconds, by a spatter of rain, or, if it was already sprinkling, the blast was followed by a noticeable momentary increase of the drops. This result occurred a sufficient number of times to indicate that the phenomenon was a real result of the explosions. But this is not what the experiments were designed to accomplish. It was supposed that rain might be produced in measurable quantity whenever and wherever needed. The Government

appropriation has been expended, and we are no nearer the desired result than before. The mere waste of the $9,000 is a trifle, but the misconceptions to which the reported successes have given rise render the matter very serious.

Charlatans and sharpers have not been slow to seize the opportunity. Artificial-rain companies have sprung up, and are now busily engaged in defrauding the farmers of the semi-arid States by contracting to produce rain, and by selling "rights" to use their various methods. In South Dakota the subject has become one of the vital questions of the day.

This aftermath of the rain-making experiments serves as an excellent warning. For the honor and good name of the Government and of science, it would be well if we had seen the last appropriation to produce rain by bombarding the heavens, and the last expedition which should mislead the people by sending out premature and sensational reports.

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COFFEE LEAF DISEASE IN JAVA.

[The Queenslander.]

In view of the extension of coffee planting in the North the following account of Dr. Burck's method of treating the leaf disease in Java, read before the committee of the Natal Botanic Gardens recently by the curator, will interest many of our readers :—

The disease is well known to be due to a fungus termed Hemilia vastatrix, which appears in the form of yellow or orange colored spots on the upper side of the leaves, while on the under side they are covered with a fine orange powder. This powder consists of spores, or seeds, of the fungus, which are easily brushed off. If this is done, however, by the next day the spot is covered again with another layer of spores. This can be repeated several days before the fungus is exhausted.

Professor Marshal Ward has estimated that each sick spot can produce 180,000 spores in a day, and can continue this production for from seven to eleven weeks, and as there are often sixty or seventy spots on one leaf the number of spores produced in a coffee plantation at all affected by the disease is something enormous. The spores are carried away by the

winds, and scattered far and wide. All those that fall upon a coffee leaf and find there the requisite conditions of existence will develop the disease in that leaf. If they fall upon the trunk of a tree, or upon the ground, or upon the leaves of other plants, or even upon the upper side of a coffee leaf, they perish. The conditions necessary for germination of the spores are water, air, and more or less complete darkness. For the further stages it is requisite that it fall upon the under side of a coffee leaf, for on the upper side are none of the stomata by which alone it can penetrate to the interior of the leaf. These observations are not without practical interest, for the injurious effect of sunlight upon the spores explains to us the fact well known to planters, that the leaves of the upper branches of untopped trees are seldom attacked so badly as to affect the ripening of the fruit. It is better, therefore, on the whole not to top the trees, and in the plantations where the trees have already been topped for some years it is better to shoot them up again.

The spores will not germinate in air however damp it be; they require fluid water, so that the leaf can only be affected when it is covered with drops of dew or rain. In a number of trails the spores germinated after two hours and twenty minutes, and a few hours afterwards there were tubes long enough to enter the stomata. Sometimes the operation took a long time; but whenever the spores were alive the tube was in full growth after five or six hours.

On examining a coffee bush in the morning after a rainy night it will be seen that the old leaves are nearly all quite dry, but the freshly unfolded leaves, soft and pale-green, still retain on both sides some drops. This is due to their possessing still some of the sticky bud resin, which has prevented the fall of the drops. From this it appears that the young leaves alone can be attacked by the disease, and this is absolutely correct. On each branch the yellow spots first appear on the third pair of leaves, counting the bud as the first pair, for the second pair, though probably affected, does not show the spot for a month, by which time the next pair of leaves has been unfolded, and a new bud is formed. This, then, is the appearance of a branch; the bud is not affected; the next pair is affected, but not visibly; the third pair shows yellow

spots; the fourth and lower pairs are more affected, not only by the primary but also by the secondary spots. Much importance attaches to this observation, for it reduces the treatment of the whole plant for the disease to the treatment of a single pair of leaves upon each branch. If the primitive spots are destroyed on the third pair of leaves the leaf is safe from further infection. The danger from secondary attacks, the real cause of the fall of the leaf, is thereby removed, and the chance of a renewed attack on the treated leaf is but small, as the leaves soon pass out of the stage in which, owing to the persistence of the bud resin, the rain drops do not run of.

Many planters cannot get rid of the idea that the disease can do no harm on virgin soil, or on ground that has been well worked and manured. This is, however, is quite erroneous. A badly nourished plant possesses, it is true, little power of resistance when attacked, but the hypothesis that a well-nourished individual under favorable conditions is less, or not at all, liable to attack is certainly untenable. Experiment has shown that predisposition to disease or incapacity for receiving it alike does not exist. Liability to sickness is quite independent of the soil, altitude, or condition of life of the plant. It was as destructive in the well-manured and carefully cultivated gardens of private planters as in the abandoned plantations of the poorer cultivators, in virgin soil and in ground long under cultivation. All sorts and varieties, cultivated in the East Indies or introduced from Brazil, and all the species in cultivation are equally liable to the attacks, nor has a single plant been found that absolutely resists disease. Bushes which planters have affirmed to be disease-proof have always taken the disease when inoculated, and become sick in the usual period.

ERADICATION OF THE DISEASE.

Two plans have been invented by Dr. Burck, both of which have been attended with highly satisfactory results; one of these is a repressive, the other the preventive, method of dealing with the disease. The first of these consists of the destruction of the sick spot in the leaf. There are two forms of apparatus in use. One consists of a small bottle of concentrated sulphuric acid, through the cork of which a glass tube

passes. The coolie is supplied also with a fine needle of bamboo. The tube passes about half way down the bottle, which is filled for a quarter or one-third its length with sulphuric acid. By this arrangement there is no fear of the acid escaping if the bottle is upset. The operator dips the needle into the acid through the glass tube, and then punctures the spot with it; a very small quantity is sufficient to destroy the fungus, and the sick spot drops out of the leaf, leaving a hole where the mycelium has been at work. This little instrument has proved most successful, but it has the disadvantage that the quantity of acid cannot be regulated, and it is also liable to get upon and burn the hands of the operator. The instrument maker Hecking, at Sourabaya, invented a pair of scissors for cutting out the spots, which is now used in many plantations in preference to the acid bottle. The coolies apparently work faster with the scissors, and more easily. A little tube on the scissors receives the cut-out bits, and when filled these can be thrown into water, or otherwise destroyed, in order to prevent infection spreading. As explained above, it is the third pair of leaves which shows the attack first; the fourth, fifth, and earlier pairs are already so badly attacked that they are not worth attempting to save. The operator then cuts out or burns with the acid the spots on the third pair on each branch. It is very rarely attacked a second time, as it soon passes out of the stage in which it is most liable to attack. In a month the third pair has become the fourth, and the pair above is the third; this pair is then treated in the same manner, and so on. Thus two leaves on each branch once a month is all that require to be treated. The leaves thus treated instead of falling in eight weeks after infection remain healthy and of a good color for months, and the operation is so simple that it can be performed by children at a very low rate of pay. Two cultivators, namely, Mr. F. W. Morren, president of the Blithim Company of Coffee Planters, and manager of the estate Bantarum, near Mingi, and Mr. J. A. A. Tannay, administrator of Kayi-Sari, near the same spot, have tried the plan on a very extensive scale—that is, of 220,000 and 170,000 trees respectively—and were very satisfied with the result, and other reports were equally favorable. Mr. Morren, in answer to a circular sent round for inform-

ation, said, "It is my decided conviction that not only with me but on every private plantation the method can be applied even when the disease becomes more severe;" and Mr. Tannay supported the same opinion. Several other gardens gave good reports, but in Pasercean and Bantam the reports of the treatment were unfavorable—that is to say, it seemed to have no effect on the crops. However, it must be admitted that in some cases the disease may become so bad that this treatment is useless.

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THE CASTOR-BEAN.

Correspondence N. Y. Independent.

The cultivation of the castor-bean is not altogether an experiment in the United States. The plant was introduced into this country in 1548, and during the more than three centuries since that date has been tried in different sections of the Union, New Jersey, Virginia, North Carolina, California, Illinois, and Missouri have attempted to raise castor-beans, although the two latter have been the most successful in the experiment, St. Louis being at present the center of manufacture of castor oil for the United States. In 1877, a firm in St. Louis manufactured, from 125,000 bushels of beans, seven thousand barrels, of forty-seven gallons each, of crude castor oil. Most of the beans used at St. Louis are grown within a circle of two hundred miles or so from the city. It is estimated that Illinois and Missouri alone produce annually half a million gallons of oil.

Several years ago, it was announced that the average yearly amount of land devoted to castor-beans in California was about five hundred acres. It is said that there are comparatively few places in California that are adapted to castor-beans. The plants will, however, bring their fruit to perfection on land that is too dry for wheat. One gentleman not far from Stockton, San Joaquin County, has a plantation of eighty acres of castor-beans. This gentleman was led to make the experiment by noticing how luxuriantly some castor-beans grew that had been planted in the door-yard for ornament. Picking has now been begun on this plantation,

the picker passing down the rows with a barley-sack hung over his shoulder, and a sharp knife in his hand with which the ripe pods are cut off. After picking, the pods are taken to the drying-floor, which is merely a portion of land two hundred feet square, that has been cleaned and the earth made as compact as possible. Here the beans lie a few days, until the pods become so dry that many of them break open and the beans pop out. Those that do not break open are threshed with a flail, after which the beans are separated from the pods and are sacked and made ready for the oil-mill. The cost of seed, planting cultivation, and sacking is estimated at about $15 per acre.

The process of manufacture that has at times been used in this state, is as follows: "After being heated for an hour or so in a furnace, the beans become softened, and are then put into a large screw-press; and the oil is pressed out. This oil is then mixed with water, about half-and-half, and boiled for an hour. This boiling process serves to extract the mucilaginous matter and purify the oil. After cooling, the watery portion is drained off, and the oil is put into zinc bleaching tanks, having a capacity of from sixty to one hundred gallons. Having stood in these tanks, bleaching in the sunlight for about eight hours, the manufacture is considered finished. It is said that, from one hundred pounds of good seeds, this process will extract about five gallons of pure oil."

Castor oil is not only useful in medicine—the form in which most people are acquainted with it—but, on account of its not "gumming," is very valuable as a dressing for leather, keeping it soft and pliable. The oil is also used in the dressing of calf-skin, and the crude oil is largely employed in making morocco. In addition, castor oil is used in making soap and good shoe-blacking, and as a substitute for neat's-foot oil, and in greasing wagon-axles. It is said that in Hindustan, where the oil is very cheap and abundant, it is used largely for burning in lamps and for other domestic purposes.

The process of boiling the oil with water must not be carried too far; for, if heated much after the aqueous vapor has ceased to ascend, the oil turns brownish, and becomes peppery in taste. In France there is a process sometimes

used of obtaining castor oil by means of alcohol; but such oil is said to become rancid more quickly than that obtained by other methods.

"Cold-pressed" oil is considered the best variety, though some of the warm-pressed may be pleasanter to the taste. Pure oil is of a light yellow color. In the best French process the fresh seeds are bruised and then placed in a cold press, and the oil that results is either allowed to stand a while, so that the impurities may sink to the bottom, or else is strained to remove them. By this process, it is said that the oil, while comparatively mild, retains all its natural qualities. About three times as much seed is needed for this process as the quantity of oil expected.

The West India method that produces the brownish, irritating castor oil is to strip off the husks, bruise the seeds, and boil them in water. The oil that accumulates on the surface is skimmed off, and again boiled with water; and so carelessly is this second boiling often done that the oil becomes brown. Sometimes, also, this brown color is caused by roasting the seeds before boiling. This kind of castor oil isunfit for use as medicine.

The old method of producing castor oil by heat has been found to be so injurious to work-men, owing to the gas escaping from the heated oil, that they have been obliged to wear masks over their faces while attending to their work.

The process used in Calcutta resembles somewhat that sometimes used in the United States; the beans being shelled and crushed between rollers, and the mass of broken beans being then put into hempen cloth and placed in the hydraulic press, the after-processes of boiling with water, straining, and bleaching being much the same as in America.

The culture of the castor-bean is said to be much like that of Indian corn, the product per acre being about twenty bushels. In the castor-bean plantation mentioned in this state, the rows are four feet apart each way, and there are from one to three plants in each hill.

The plants, which may at first, early in March, be started by planting the seeds in pots kept in the greenhouse, and, as soon as all danger of frost is past, setting out in rows in the field, will produce flowers in July, or thereabouts, and the

seeds will ripen in August and September. The pods are three-celled, and each cell contains a bean. These seeds, which differ somewhat in their appearance, are like small, shining beans, with a thick, leathery skin of a grayish color, and often marked with reddish brown. A small yellowish tubercle marks one end of the bean, and from this a ridge runs up one side of the length of the bean, dividing that side into two flat surfaces. This helps to give that peculiar appearance to the seed that was the cause of the plant's receiving for its scientific name the Latin word "Ricinus," meaning "a tick," the bean having been thought to resemble that insect. In past ages, however, the castor-bean, which was known to both the Greeks and Egyptians, was called, by the former, "croton," a name that is not now applied to this genus, but to another.

Before the invention of the manufacture of castor oil, the seeds of the plant were given whole as medicine, a dangerous practice that sometimes resulted in death, owing to the acrid properties of the beans. The pomace of the beans that remains after the oil is extracted is in some places used as a manure.

In warm countries, such as the East Indies, the castor-bean becomes perennial. In such climates the plant loses its character of a shrub and grows to be quite a tree, sometimes even attaining a height of thirty feet; but, in temperate climates, it is an annual. In some portions of Europe the castor plant grows only three or four feet high. In southern Florida it attains a growth unusual in the United States. In many parts of this country and of Europe, when the plant is not cultivated for oil, it is grown for its beauty, having large, palmate-peltate leaves, sometimes measuring one or two feet in diameter. The plant has a purplish hue and belongs to the family Euphorbiaceæ, and was formerly known under the name of "palma Christi."

During favorable years in the southern portion of England the seeds will ripen, and it is said that they have been known to come to maturity as far north as Christiana in Norway. The castor-oil plant has been cultivated in the Levant, in Spain, where it attains a good growth in Provence, India, and Brazil, and it has been experimented with in Algeria for the

purpose of feeding silk-worms with its leaves. The castor-bean is said to have been originally a native of the southern portion of Asia and of northern Africa.

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TEA CULTIVATION IN INDIA.

The area under cultivation in India is increasing yearly. The total area in 1887 in Assam was 950,171 acres, against 783,982 acres in 1882. The yield of the province was 68,451,180 pounds in 1887, an increase of 10 per cent, over 1886. The province of Assam in 1887 produced nearly 75 per cent. of the whole production over India tea. The yield per acre was 385 pounds, as against 363 pounds in 1886. While the cultivation is increasing the number of tea gardens is decreasing. The tendency is to eliminate small growers, and increase the size of the tea gardens. The tendency of the cost of production is to decrease with the improved communications and methods of cultivation and manufacture. More is obtained from the soil at less cost, it is handled more cheaply and effectually, and reaches the consumer by more economical communications. The price is now lower than it ever was before, yet the planters are doing fairly well as regards profits. The explanation is that the tea can now be turned out for less than was possible a few years ago. The use of machinery of an improved character is now largely extended, while freight and cost of transport are much less. The coolies are growing older and more skilled in their work, and can do more and far better than they could when raw hands. The Indian Tea Association estimate that Assam will produce 70,975,884 pounds this year, out of a total Indian crop of 95,829,312 pounds.—*Bradstreets.*

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A dispatch from Cincinnati says that a party of capitalists from that city, Philadelphia and New York has secured possession of a tract of land along the St. Johns and Indian rivers, Florida, eighty-three miles long and from three to six miles wide. The land "is to be drained at an expense of $4,000,000," and devoted to the cultivation of sugar, "enough of which can be grown on the strip to supply all of the United States." This is "important if true."