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The latest quotation of Cuban centrifugals in New York, March 1, was 4⅜ cents for 96° test. This is at the rate of $87.50 per ton of 2,000 pounds. The price may not vary much from this at present, though when it does, it is more likely to advance than decline, on account of the prosperity that prevails in both Europe and America, creating a greater demand without a corresponding increase in the world's output of sugar. The deficiency in the world's stock, as compared with 1898, is nearly 300,000 tons.

Mr. Jno. E. Searles, who visited these islands some twenty years ago, and has acted as general manager and treasurer of the American Sugar Refining Co., of New York, known as the Sugar Trust, has resigned, on account of failing health, and has gone to Europe with his family, in the hope of regaining his health. He has been succeeded as treasurer of the trust by Mr. Valentine P. Snyder, vice-president of one of the New York National banks.

Among the departures for the Sandwich Islands last week was Mr. E. W. Deming. He goes there to look after several large contracts now under way, as well as a large amount of prospective work. Before leaving New Orleans he associated with him Mr. C. Robert Churchill and the latter gentleman, who can be found at 421 Hennen Bldg., will be pleased to give immediate attention to all inquiries regarding the Deming apparatus. Mr. Deming expects to be gone four or five weeks.—Louisiana Planter, Feb. 18.

That excellent monthly—The Sugar Cane—published in Manchester, England, has adopted a new name—"The International Sugar Journal." Its former title was not deemed appropriate for a monthly devoted to sugar in general, which includes beet as well as cane. It is quite probable that the beet sugar industry will soon become established on a permanent basis in England and Ireland. The experiments made with beets last year in England proved conclusively that beets can be grown there as rich as any on the continent; and if so, capital to develop this industry will not be wanting.

Among the new advertisements in this issue of the Planter, is that of the Hersey Manufacturing Co., of South Boston, Mass., calling attention to their Hersey Granulator and Cube Sugar Machine, for which they invite correspondence from the Islands. Many housekeepers here wondered why it is that we should ship our sugars all away to San Francisco and New York, and import granulated and cube sugar for domestic use, paying an exhorbitant price for them, when the domestic supply can be met at greatly reduced expense, by saving transportation and other charges incurred both ways.

The orange crop of Florida, which was destroyed a few years ago by the frost, will this year be nearly one-half what it formerly was. The orange trees were, as it were, swept out of sight in one night, and the labor of years was demolished. The young orange trees, since planted, are now fairly developing, and from this time on will increase in bearing capacity until the average will be reached again. The disaster to the orange trees, however, has proved to be a boon to that State. The cultivation of other fruits, as well as of early vegetables, has now become established, so that hereafter the failure of one crop will not mean the failure of all.

The editor of the Planters' Monthly acknowledges the receipt, from the under secretary for mines and agriculture of New South Wales, of the Annual Report on Agriculture and Forestry, to the Legislative Assembly of New South Wales. It is a folio pamphlet of 63 pages, and contains the transactions for the year 1898 on the industrial progress of that colony. Considerable space is devoted to forestry and fruits, including the orange, which is there attacked by a disease termed "melanose." The pamphlet, however, makes no reference to the sugar cane industry, which is now under a cloud, owing to the free trade policy of the present government.

An important article of special interest to coffee growers, will be found in this issue of the Planter. The same subject was referred to in the Planter of April, 1898, but the present notice is from a circular received from the U. S. Department of Agriculture in Washington. If the same disease has appeared in any part of the group, no time should be lost in efforts to check and, if possible, eradicate it. Should it once get started and commence spreading, it would be a very difficult task to stop its progress. In several of the districts of Central America, where it is now, many of the estates have been rendered almost worthless. This seems to be a different disease from that which destroyed the coffee industry in Ceylon.

SUGAR AS FOOD.—Experiments in athletic tests have demonstrated that a considerable proportion of sugar in food gives staying qualities to men. The official surgeons of the European powers have recommended to their governments allowances of liberal sugar rations, the claim being made that sugar in food and drink gives vigor and vitality to the men. The United States commissary at Santiago, reported that the troops who had their allowance of coffee and sugar were more vigorous than those who were compelled to go without it; this condition, however, was probably due more to the effect of the coffee than the sugar. The coast natives of Central America frequently choose to make a full meal of a pound of brown sugar dissolved in water. Upon such diet they will do hard work.—Journal of Agriculture.

Among the items of news brought by the last mail was that of the death of Henry A. Brown of Westport, Mass. He had been known for many years as a sugar expert, whose opinion was frequently sought by congressmen and officials in Washington, when discussing the tariff rates on sugar. He was for years a bitter opponent of Hawaiian annexation but during the past two years modified his views, and supported annexation, having based his later opinion on a clear study of the question. Recent issues of this Monthly have reprinted his views. He took the ground, which we have always expressed, that the United States, on account of its rapid growth, will for many years, require the importation of foreign cane sugar, and that the American beet sugar interest could not suffer from any importations from Hawaii. In this he was correct, and in modifying his views, showed that he was an honorable and far-sighted politician.

Gray's Sugar Statistical says that it is evident that the small two and five-pound packages for granulated sugars have come to stay. They were introduced by the new Arbuckle Refinery, and from the start proved a very taking card, and the demand for them has been on the increase every month. Other refineries, which have been waiting developments, are now convinced that they must fall into line and provide packages, or they will soon be side-tracked by their new and more progressive rivals. In our opinion, in less than twelve months, the bulk of the retail trade in America and Europe will be done with these new and very handy packages, which save a wonderful deal of labor, waste and loss to the sugar buyers, who were always complaining of poor wrappers and loss of sugar. To the poor, they are a perfect god-send, and the Arbuckles deserve credit for their really genuine Yankee enterprise.

Prof. Whitney, of the U. S. Agricultural Bureau, says that the history of the western soils of America will make one of the most interesting chapters in the world's history of agriculture. Although these soils, excepting the Red River and desert districts mentioned, have only from one-fifth to one-half of the annual rainfall received by the territory east of the Mississippi River (that is, from seven to twenty inches), they seldom, if ever, suffer from drouth.

In the Mohave and Nevada deserts the annual rainfall averages about five inches, but beneath the alkali crusts the soil is always moist, a fact which the scientists have as yet been unable to explain. In fact, little is yet known of the power of the soils to hold water. As artesian wells show water in all these districts, from forty to two hundred feet below the surface, it is considered possible that there is a slow and continuous movement of water upward from the artesian sources, which are beyond the influence of local climate.

U. S. Sugar Statistics in 1898.—The total consumption of sugar, foreign and domestic, in the entire country, including the Pacific Coast, in 1898 was 2,047,344 tons, against 2,071,413 tons in 1897, a decrease of 24,069 tons, or say 1.16 per cent decrease, says Willett & Gray's Circular. The consumption of 1898 consisted of 317,447 tons of domestic cane sugar, 33,960 tons of domestic beet sugar, 5,000 tons maple, 300 tons sorghum, 1,700 tons molasses sugar, a total of 358,407 tons domestic production,. and a total of 1,638,937 tons of foreign production.

"The domestic beet sugar industry of the United States shows some very notable features, which are quite surprising when considered from some points of view. The result of the campaign in tons is below last year, but the gain in factories built and proposed is quite important. The object lesson of a few well-managed factories paying 20 per cent dividends to stockholders and dividing $200,000 among farmers near by, as in Utah, is having a wonderful effect upon both capitalists and farmers in neighboring States and localities, and the year 1899 bids fair to see much greater activity and advance in this industry, regardless of any objection or fears from without. The industry itself is expected to be strong enough in its position, politically or otherwise, by the time that any important action may be required."

FUTURE OF DOMESTIC SUGAR.—The activity displayed in the extensive promotion of the beet sugar industry in the United States calls for more than passing notice. Reorganization of existing corporations are being made and the stocks being dealt in on the street in anticipation of regular listing on the exchanges later on. It is perhaps well to call attention to the changing sentiment in favor of the safety of beet sugar investments by capitalists. It has been thought that the acquisition of Porto Rico, Cuba and the Philippines would count against this industry, but it now begins to be more evident from the progress of the discussion on the confirmation of the treaty that it will be many years yet before sugars are admitted free of duty from these countries, except as to Porto Rico. Even if the duties were removed from sugar imported from Cuba and the Philippines, still it must be expected that export duties or production taxes on sugar would need to be assessed in those islands to pay the expenses of the local government. This would enhance the cost and prove to be some protection, at least, to the sugar production at home. In the meantime the progress of the home sugar industries will cause them to become an important factor in all tariff legislation.—Willett & Gray's Circular.

The attention of planters is called to the exceedingly interesting report of the discussion of seedling and other canes at a meeting of the Louisiana Sugar Planters' Association, reprinted in this issue. Dr. Stubbs' remarks at this meeting, giving the results of his close study of seedling and other canes, and what constitutes their value for sugar, are presented with a clearness and force that carry conviction, and that must be of service to every planter. There can be no doubt that sugar cane is capable of improvement, and this does not consist solely in its size nor in the number of stalks to the hill, but in the sugar contents. He shows the causes of the failure of the crop in Louisiana the past year, which early in the autumn gave promise of a heavy yield, but later rains, cold and frosts destroyed the earlier hopes of the planters. The Doctor is confident that some of the new seedlings received from Demerara will prove to be a valuable acquisition in Louisiana. Here in Hawaii, however, we need no better cane than our favorite Lahaina; but great care should be taken to guard against its degeneration; and this can best be done by reserving seed from the best or healthiest fields; and where better seed can be secured by purchase from a neighboring plantation, this should be done. In short, no efforts should be spared to obtain the very best seed, even at considerable cost. And under no circumstances should poor or doubtful seed be taken for this purpose. Louisiana and Demerara planters have many drawbacks to contend with, as shown in the Doctor's remarks, that planters do not have here; still, there is much to learn from the narrative of their experiences in the same line of industry. Their efforts to secure new and better varieties of cane will doubtless result to the advantage of the cane industry everywhere.

Beet Sugar in California.—Little more than 17,000 tons of sugar were produced in California during the last year. This is about half the production of 1897 and less than a quarter of what was expected early in this season. The falling off was caused almost entirely by the long drought which prevailed during the entire winter. The sugar beet growers of California depend altogether upon the winter rains, which are generally very heavy, to thoroughly saturate the soil and put it in condition for sprouting while it is sufficiently moist for germination. Moreover, as there is very little irrigation and scarcely any rain during the summer, the beets secure their moisture for the remainder of their growth from the moisture-bearing propensity of the soil. This moisture seems to come from the drainage of the mountains, which are saturated during the winter, and from which the water filters away during the summer. As there were no winter rains last year, the seed which was planted early did not germinate properly, and after the middle of February growers postponed sowing until rain should come. Thus a little sowing was done each time a light shower occurred, but the acreage was very small up to the end of April. About two inches of rain fell about the first of May, which is about normal for that season, and considerable acreage was then sown. As usual, the rest of the summer passed with scarcely any rain. Many acres of beets dried up, and the area showing a good stand rapidly diminished all through the summer. The factories started toward the end of August and ran for about 70 days. While the beets showed a slightly higher sugar content than usual, they were very small and dried up, and often so hard that difficulty was experienced in slicing and working them. General rain fell about the first of October, and was welcomed by all as the forerunner of a rainy fall, which would freshen and soften the beets, and perhaps save many acres, even at that late day. But the rain did not continue, and only light isolated showers occurred during the rest of the campaign. After the end of the campaign two or three heavy rainstorms fell during December, but until January 1st the outlook was still rather gloomy. However, on New Year's a heavy storm started and continued for two weeks with little interruption. Everything is now looking most promising and a large yield of about 70,000 tons of sugar may be expected next year. The unfortunate conditions have not been wholly without value, however, and it is safe to say that California will never be caught again without sufficient irrigation to prevent a recurrence of the present situation.—Willet & Gray's Circular.

IMPROVING CANE SEED.

More attention is now being paid than ever before by agriculturists to improvement of the seeds selected or reserved for the next crop, whether it be for grain, fruit trees, vegetables, sugar beets or cane, as experience clearly shows that the gain in quantity or the profit from superior quality is increased in a vastly greater ratio than the outlay made to secure it. The same results have been found to follow in the one line as much as in the other.

A writer in a recent issue of the Queensland Sugar Journal, referring to this improvement in seed, by selection of the best variety, says, "as cane growers and sugar manufacturers, we must confess that we have not improved our plants or manufacture to at all compare favorably with our German cousins, who by the selection of roots for seed, have more than doubled the saccharine contents of the beet during the last 25 years and we can't claim the same for cane, although in the West Indies and elsewhere, considerable attention has been given to propagating more profitable varieties. One propagated by Mr. Jenman, Botanist, Georgetown, Demerara, British Guiana, is very favorably commented upon, and with all the trouble and expense of hard labor there, the planters assert that this cane will pull them through all their troubles. 'Caledonian Queen' is the name of this cane; it is said to be a heavy cropper, good ratooner, and carrying 23 per cent of crystallizable sugar, low in fruit sugar, and about 45 per cent ash. This cane may assist us out of our troubles, and if you could only impress on the farmers that it is tons of sugar per acre we want to give us a price for our cane and not tons of cane, we might agree to growing only the best varieties of cane."

Can any of our readers inform us whether this new variety is growing on these islands, and if so, where ? It should not be confounded with the "Yellow Caledonia," which is quite common.—Editor Planters' Monthly.

Regarding the care taken to improve the beet seed in Germany, the following remarks from the American Consul at Magdeburg, Germany, will be read with interest:

"First class sugar factories of Europe buy none but the very best seed, grown from high-grade individual 'mother' beets, to distribute among beet growers; thus not only maintaining the standard of their sugar beets as to quality and quantity, but also putting themselves in a position to compete in all the markets of the world. The first-class seed is sold and delivered by the growers on board cars in the Prussian province of Saxony, at from 8 to 10 cents per pound, which is a moderate price, considering the fact that it takes at least four years to get it into the market. There is also a second-class seed offered for sale in this country, at from 5 to 6 cents per pound. This is commonly called the 'Nachzachtsamen,' being a seed not produced from the mother beets, but from the first-class seed mentioned above. This inferior grade, however, is not used by first-class sugar men in Germany, France, Holland and Belgium, but most of it goes to Austria, Russia, and the United States. And this is the reason why I deem it my duty to call attention to the importance of getting only the very best seed obtainable. In my opinion, those American growers of sugar beets who buy cheap grades of seed, make a great mistake. All kinds of seed have a natural tendency to degenerate. Even the first-class beet seed mentioned above will not bring forth beets that come up to the standard of the original or mother beet, but will show a loss of ½ to 1 per cent of sugar content. Now, the second generation of seed will degenerate more than as much again, and lose from 1 per cent to 2 per cent. This is a small amount when considered by itself, yet it is sufficient not only to turn the profits of a sugar factory into loss, but even to drive the concern to the wall."

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STORING SURPLUS MOUNTAIN WATER.

Public attention has lately been called, in local journals, to the waste of water in our mountain streams, with suggestions that if proper efforts were made, much of this water might be saved for irrigation and for generating electrical power, which is so much needed in every department of industry. These islands, however, possess very few streams which continue to flow throughout the year. Even on Hawaii, the most rainy island of the group, nearly all the streams have at times become dry, at least for short periods, and just at the season of the year when large water supplies are most needed. Dams for retaining surplus water are always expensive, when well constructed, and are rarely built strong enough to resist heavy and long continued storms and freshets. For this reason, they are deemed a risk to life and property, which ordinarily should not be assumed.

This subject of the conservation of mountain streams for the purpose of generating electric power for use in distant localities is receiving much attention in Europe, where the demand for more power is springing up in a thousand different new ways, where steam is less adapted for it. In Germany, a convention of scientists was held a few months ago, to discuss the safest and best method of utilizing the mountain water for generating electricity to be applied in some instances in cities located at a considerable distance away from the streams. The demand for such water power has been increasing so rapidly that it has created a marked increase in its value since it has been proved that it can be made available by electrical transmission for works at long distances. It was stated in the convention that "the electrical exposition of Frankfort in 1891 showed that 75 per cent of the power found at a river could be carried a distance of 110 miles. At that time the cost of the experiment was too high to make it practicable. Since then, many methods of transferring the power 20 to 30 miles have been made profitable. Inasmuch as the danger due to the movements of large volumes of water in the mountains must first be done away with, the employment of such methods has been restricted hitherto to plants where the lowest water level of the rivers was sufficient. There will be vast progress in utilizing water power as soon as this difficulty is overcome —i. e., the waters of the mountains will be utilized equally during the whole year.

"The dangers hitherto inseparable from waters in the hills can be scientifically controlled. It is necessary to construct reservoirs large and secure enough to contain easily more than the largest probable amount and to give it off in the dry seasons in the required quantities. How far such reservoirs endanger inhabitants of the valleys, is a question much more important than all those concerned with industrial or agricultural development. Only after the most careful scientific investigation by the country's best engineers, should the basins be built or the valleys dammed. The appalling accidents like the Johnstown disaster and the more recent one in France have prejudiced the public mind. Dams do not, however, burst when properly built; and to build dams properly is no harder, nor half as hard, as to swing bridges across broad spans of rivers and guarantee them against storms. Water volumes may be estimated to a maximum; winds and storms, with free play of the elements in wide areas of space, never.

"The advantages of storing up the water may be summarized as follows: Creation of a uniform water power for the factories in the valley, and inducements to increase said industries; distribution of power by electrical transmission; a higher water level in the streams, even in the warm summer months, and a decrease of their impurities; decrease in the liability of the rivers to freeze by the drawing off of comparatively warm water, as the layers of water in a reservoir are rarely less than 5° C.; improvement of the water supply for cities and irrigation of barren lands; decrease in the liability of floods and the damages done by them; decrease of the desire on the part of the inhabitants to collect in large towns; beautifying the landscapes, developing fisheries, water and ice sports, etc., and improvements of means of transportation."

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THE SUGAR INDUSTRY IN DEMERARA.

A recent issue of the Demerara Argosy contains a review of the cane industry in that colony for the year 1898. As compared with our more favored islands, it furnishes a very disheartening picture. It says: Another year of British colonial industry has closed with a case demanding redress, and still waits patiently for the British Government to perform a simple act of honesty and justice. Continental bounties, variable and unknown in quantity, like a sword of Damocles, hang over the British Colonial sugar industry threatening its existence, and paralyzing its credit and its progress. * * *

The yield of sugar obtained in Berbice was very satisfactory, considerably above the usual average, but in Demerara and Essequebo, yield during the last quarter of the year, when the bulk of the crop is reaped, was extremely disappointing—on a good many estates less than one ton 1st sugar per acre. Fortunately, the fungus disease did very little damage, and cane juice was, generally speaking, of good quality, and worked up well. On estates where crops were very short on account of heavy seasons, considerable losses will have to be met, but the majority of estates will show a moderate profit as the result of the year's working. There has been a slight increase during the year in the acreage under cane cultivation, but the exact figures are not at present available. In 1896 the acreage under cane dropped to just under 67,000 acres, and has since remained nearly stationary. There are now 60 estates in the Colony on which sugar is manufactured. The yearly reduction in acreage steadily from 1890 has ceased, and a slight yearly increase seems probable in the future. The total East Indian population in the Colony is now estimated at about 117,000, of whom 66,000 or thereabouts, are resident on the sugar estates.

Seedling Canes.—It is probable the next few years will see a considerable extension of the cultivation of the most promising varieties of seedling canes. It has been necessary to go very cautiously to work, as loss and disappointment would have resulted from the cultivation of any new variety inferior to the Bourbon. It has been asserted that the planters have taken little interest in the attempts made to secure a cane superior to the Bourbon, but these assertions are made from sheer ignorance, and want of knowledge of the facts. To secure and grow a new variety of cane is a very tedious process, and the new plant must be cultivated a year or two before any reliable conclusions can be arrived at. Some of the new seedlings show a hardiness and vitality which will probably render them valuable for cultivation, where the Bourbon does not ratoon well or shows signs of weakness. This, so far, is the chief feature in their favor. Hundreds of endeavors to establish small industries have ended in failure, and to attain success in growing fruit, coffee, cocoa, nutmegs, ground-nuts, and such like, is not the simple matter many inexperienced people seem to believe. Capital, combination, persevering industry and special training are necessary for the prosecution of any agricultural industry in this Colony.

ORANGE GROWING IN JAMAICA.

Editor Planters' Monthly:—Jamaica orange growers, since the destruction of the orange trees in Florida by freezing, a few years ago, have received some revelations regarding orange culture. Many Florida growers, discouraged by the destruction of their orange trees by frost, went over to Jamaica where they could operate without fear of a freeze; for Jamaica, of course, is far below the southernmost limit of the frost belt. When the Florida growers reached Jamaica, they found the mode of orange culture entirely different from that pursued in Florida. The system then prevalent in Jamaica was very lax and imperfect, not only with regard to cultivation but in the way in which the fruit was picked, handled and packed. These processes, all very important, were carried on in a reckless and haphazard manner, so that the Jamaica growers did not receive the full value of their crops.

In picking the fruit the Jamaican's only idea was to get the oranges off the trees, no matter how. They knocked them off with poles and shook them off the trees, letting them fall to the ground. They employed any means which would save trouble, utterly regardless of the requirements of the American market, which takes nearly all their fruit. The result was that much of the fruit was bruised and rendered unfit for export; and bruised fruit quickly contaminated the box and barrel, so that it reached the market in a very poor condition.

After the fruit was knocked and shaken from the trees, it was tossed into carts and "dumped" where it was to be thrown into the barrels and boxes for shipment. Equal recklessness was shown in the shipping of fruit. The Jamaicans knew nothing and cared nothing about equality. They remembered only that they must supply a certain number for shipment by the next steamer, and they did not trouble themselves about the quality of the fruit.

These methods did not meet the approval of the Florida growers, and they at once began to reform the industry. They take the greatest care with regard to the condition in which the fruit is shipped; and in growing, each tree receives the greatest care. Then, the fruit is hand-picked, and carefully sorted and graded. The result is that the industry has been materially improved and extended since the Americans took hold.

Jamaica, a remarkably fertile island, is very backward, which the people constantly deplore. But they content themselves with petitioning the Secretary of State for the Colonies, in London, and drawing up and adopting resolutions, instead of improving upon their antiquated and half-barbarian methods of agriculture. All the up-to-date methods used in the island today are the result of American capital and enterprise. Her banana industry is the greatest in the world; but it was originated, fostered and is controlled by a single great American company.

ALLAN ERIC.

Boston, Feb., 1899.

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THE RELATIVE SENSIBILITY OF PLANTS TO ACIDITY IN SOILS.

(By Walter Maxwell, Director and Chief Chemist, Hawaiian Experiment Station.)

The degree of acidity in soils is relative, and is largely controlled by climatic conditions. In temperate zones, due to the more moderate means in temperature and rainfall, this matter of acidity does not necessarily engage as much attention in agricultural considerations. In subtropical and tropical conditions, in which the writer is engaged, and where the mean annual temperature is over 21° C., and the yearly rainfall varies between twenty inches on the leeward side of the islands, and 200 inches (17.5 feet) on the windward uplands, the matter of soil acidity demands primary and careful consideration.

Our observations were made not only in order to obtain precise knowledge concerning the relative sensibility of various plants, and families of plants, to acid conditions, but also to indicate that the errors and confusion at present existing concerning the forms in which plants assimilate nitrogen, may be in part due to this behavior of plants in relation to acidity.

In another publication[1] we selected, among others, as an example, a tropical wood fern, which was growing in conditions of extreme soil acidity, such as the sugar-cane could not exist in. We used the analysis of this fern, the green leaves of which contained four-tenths per cent nitrogen, to

[1]Reports of the Hawaiian Experiment Station, 1896.

show that "one of the two theories must be wrong, and that the nitrifying organisms in soils can carry on the nitrification of organic nitrogen in acid media, or that the fern must take up nitrogen in a non-nitrified form."

The conditions of the situation have obliged us to make examinations, the results of which show that certain common agricultural varieties of plants live and thrive in soils where others totally fail; and that the success or failure of the respective varieties can be due to the inability of given plants to withstand a degree of soil acidity in which other plants reach a considerable and even normal growth; and may be quite independent of the mode and elements of plant nutrition.

The experiments which furnished the given data were arranged and conducted as follows: Two tubs having a diameter of twenty-four inches, and a depth of twenty inches, and perforated bottoms, which were covered with linen cloth, were each filled with 120 pounds of air-dried soil of moderate fertility, having a neutral behavior towards acid and alkaline tests. These tubs were placed in tin pans which were six inches deep, the perforated bottoms of the tubs being raised four inches above the bottoms of the tin pans. The tin pans were filled with water up to the level of the perforated bottoms, and the water was kept up to that level until the soil in the tubs had absorbed moisture to saturation, the water absorbed being 48.2 per cent on the water-free weight of the soil. To tub No. 1 enough citric acid was added to make the whole volume of water absorbed a one-tenth per cent solution. To tub No. 2 citric acid was added to make the absorbed water a one-fiftieth per cent. solution. In each of the tubs seventeen varieties of seeds were planted, these being planted in a circle, and equal distances apart. The seeds germinated quickly, were up within four days, and had a healthy appearance. After the plants were up, and one inch high, the mode of applying the acid was changed. When the acid was applied in the water absorbed by capillarity from the tin pans, it was not equally distributed through the mass of the soil, but was more or less fixed by the bases in the soil at the bottom of the tubs, and did not reach the plants. Therefore the acid was dissolved in water and applied around the plants at the surface. This was controlled by determining the loss of water from the tubs by evaporation, and replacing the lost water, with the weight of citric acid dissolved in it necessary to bring up the whole volume of water in the tubs to one-tenth per cent and one-fiftieth per cent solutions respectively. This was repeated every fourth day, the acid solution being applied by our field assistant, E. G. Clarke, with a pipette, and in strictly equal quantities to each plant. With this detailed description of the mode of applying the citric acid to the tubs, the results may be given, which are found in the following tables:

A. CRUCIFERA.

(Tub No. 1. Strength of Acid one-tenth per cent.)

Name of plant.	Planted.	Up.	Failed.	Development.
Black mustard......	May 27	May 29	June 15	Three inches high
White mustard.....	"	" 29	" 15	"
Beet	"	" 31	" 11	"
Mangel wurzel......	"	" 31	" 11	"
Rape...............	"	" 30	" 17	"
Carrot	"	June 3	" 17	Four "

(Tub No. 2. Strength of Acid one-fiftieth per cent.)

Name of plant.	Planted.	Up.	Failed.	Development.
Black mustard......	May 27	May 29	June 15	Three inches high
White mustard	"	" 29	" 11	"
Beet...............	"	" 31	" 11	"
Mangel wurzel	"	" 31	" 11	"
Rape...............	"	" 30	" 11	"
Carrot.............	"	June 3	" 17	Five "

B. LEGUMINOSAE.

(Tub No. 1. Strength of Acid one-tenth per cent.)

Name of plant.	Planted.	Up	Failed.	Development.
White lupine	May 27	May 30	July 16	1 foot high
Cow bean	"	" 30	Aug. 31	7 feet 2 inches long (No seed)
Windsor bean.......	"	June 3	Aug. 12	3 feet long
Winter vetch.......	"	May 31	July 9	2 feet long
Crimson clover.....	"	" 30	June 17	3 inches high
Alfalfa	"	" 29	" 15	3 inches high

(Tub No. 2. Strength of Acid one-fiftieth per cent.)

Name of plants.	Planted.	Up.	Failed.	Development.
White lupine	May 27	May 30	July 21	1 foot 2 inches long
Cow bean...........	"	" 30	Aug. 30	6 feet long (no seed)
Windsor bean.......	"	June 3	" 12	3 feet long
Winter vetch	"	May 31	" 4	3 feet long
Crimson clover.....	"	" 30	June 17	3 inches high
Alfalfa............	"	" 29	" 11	3 inches high

C. GRAMINAE.

(Tub No. 1. Strength of Acid one-tenth per cent.)

Name of plants.	Planted.	Up.	Result.	Development.
Pearl millet	May 27	May 30	Matured	4 feet 1 inch long and formed seed
Wheat	"	"	Failed	1 foot 3 inches high
Maize	"	"		3 feet 6 inches high Formed flowers, but no seed
Oats	"	"	Failed	8 inches high
Barley	"	"	Failed	8 inches high

(Tub No. 2. Strength of Acid one-fiftieth per cent.)

Name of plant.	Planted.	Up.	Result.	Development.
Pearl millet........	May 27	May 30	Matured	5 feet 4 inches high and formed seed
Wheat.............	"	"	Failed	1 foot 2 inches high
Maize	"	"		1 foot 2 inches high Formed flowers, but no seed
Oats................	"	"	Failed	6 inches high
Barley..............	"	"	Failed	11 inches high

The crucifers succumbed almost immediately to the action of the acid, the one-fiftieth solution acting almost as effectually as the one-tenth solution. This behavior of the crucifers under artificial treatment with citric acid corresponds to certain general observations upon the growing of root crops in non-aerated and sour lands.

The lupine, bean, and vetch struggled hard and long against the acid action, but none of these fully matured, or formed seed. The crimson clover and alfalfa succumbed as rapidly as the crucifers, showing that the clovers cannot bear an acid soil, and explaining one cause of the extreme "hunger" of the clovers for lime.

The graminae showed a very variable behavior in relation to the acid. The wheat, barley, and oats failed almost completely, although none of these actually died. The maize grew well, had a strong and deep green colored blade and reached a moderate size, forming a full blossom, but no seed. The pearl millet distinguished itself from all other varieties. Its growth was steady and quite normal, as compared with a plat of millet growing a field near by, which it actually exceeded in development, reaching five feet five inches in height. Five large heads matured, which contained a finer grade of seed than was originally planted. A special test was made with the millet, in which the plant was treated every fourth day with a one per cent. solution of citric acid. This strength of solution kept the young plant, which was three inches high, at a standstill for three weeks. After that time the plant appeared to accommodate itself to the intense acidity, began a further growth, and was two feet high when the experiment was stopped. (A photograph was taken of this example.)

Considering the relation of these observations to common findings in the field, it may be said that maize is being planted with some success in our upland, acid soils, and millet will now be tried. The effects of acidity upon the crucifers and certain legumes, have been noted in soils notably less sour than most of the upland soils of these islands. The Director and Agriculturalist of the Rhode Island (U. S.) Experiment Station, Professor Flagg, in a communication concerning a sample of soil sent to the laboratories of the writer, says: "We found all this soil acid when tested with litmus paper; so much so that timothy and clover, barley, beets, spinach, lettuce, and a few other plants, failed to thrive without the use of air-slaked lime to correct the acidity."

These observations, which are only a part of extensive investigations that will be published shortly, show the extreme difference in degree of sensibility of the various agricultural plants to soil acidity. They also indicate with what ease a failure in growth of one plant can be attributed to some trouble in plant nutrition, when it may be wholly due to the inability of the plant to bear the acidity of the soil, which is illustrated, as has been shown, by the power of other plants to thrive in the same medium.

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METHODS AND SOLVENTS FOR ESTIMATING THE ELEMENTS OF PLANT FOOD PROBABLY AVAILABLE IN SOILS.

(By Walter Maxwell, Director and Chief Chemist, Hawaiian Experiment Station.)

In framing a method, and in the selection of solvents for estimating the proportion of plant food probably available in soils, it appears necessary to be wholly guided by a precise observance of the agencies by means of which the insoluble soil materials are being daily changed by the processes of nature in the field, into forms in which they can be used by growing plants.

The processes by which the food elements are prepared in nature are altogether chemico-physiological; and for this reason the problem cannot be primarily considered from an analytical standpoint.

The solvent agents operating in nature's processes are, in addition to water, the acids moving in the sap of living organisms, and being emitted through the membranes of their roots, the chief one, so far as our present knowledge goes, being carbonic acid; and, more important, the acids which result from the decay of vegetable matter upon and within the soil. The acids that are formed when plants, roots, and fruits decay are the simple organic acids,—carbon acids; and the amido acids,—carbo-nitrogen acids. Consequently, the acids in living, and produced by dying, plant organisms are carbon acids, with or without nitrogen. In the complete decay of vegetable matter, however, these organic acids are resolved into ultimate mineral bodies; the carbon into carbonic acid, and the nitrogen of the amido acids into nitric acid or nitrogen, the simple forms in which these were primarily taken from the air to build up the plant organism. Consequently, the amounts of carbon and of nitrogen contained in the composition of plant organisms are respectively the measure of the relative amounts of simple carbon acids and of amido acids that can be produced in vegetable decay; and of the amounts of carbonic acid and nitric acid that finally result from that decay, and which act as solvent agents upon the soil. The minute amount of sulphuric acid, and the still more minute portion of phosphoric acid, that are formed from the sulphur in the nucleins, and the phosphorus in the phospho-glycerides (lecithines), are unnoticed in these considerations. Also the basic action of the amidogen group (NH^2) contained in the amido acids, which has been indicated in our investigations, is reserved for notice until a statement of results in detail is made. In the absence of elementary determinations of carbon in the composite structure of plants, these estimations having been confined to constituent bodies some other mode has to be used for arriving at an estimation of the proportion of that element contained in plant organisms; and, at the same time, of the relative proportion of nitrogen. This is done by ascertaining the amount of the constituents of plant organisms that are composed of carbonaceous bodies not containing nitrogen, and the proportion of these bodies that do contain nitrogen. The carbonaceous bodies free from nitrogen are the so-called nitrogen-free extract matters, the fiber, and, for the present purpose, are added the fats. The bodies containing nitrogen are collectively considered as proteids. The relative amounts of these non-nitrogenous and nitrogenous constituents found in a broadly representative series of agricultural growths are set forth in the following table:

Kinds of growths.	No of examples.	Proteids.	Fiber.	Nitrogen-free extract matter.	Fats.
		Per cent.	Per cent.	Per cent.	Per cent.
1 Legumes and cereals.	32	8.0	27.6	51.0	3.1
2 Roots and bulbs . . .	14	13.9	10.5	64.5	3.1
3 Grain and other seeds	45	12.9	2.3	79.5	4.4
Means..........	91	11.6	13.5	65.2	3.5

If the third series (the seeds) should not be included in the average, for the reason that the grain and seeds are not allowed to return directly to the soil, the means will remain nearly the same, since the large proportion of the extract matters in seeds is offset by the small amount of fiber. These data show that in the 91 examples of vegetable growths we have:

	Per cent.
Nitrogen-free carbonaceous bodies	92.2
Nitrogenous carbonaceous bodies	11.6

The nitrogen-free carbonaceous bodies, including the small amount of fats, may be considered as bodies containing six atoms or parts of carbon ($C^6H^{10}O^5$). The proteids, in which the elementary analysis finds sixteen per cent of nitrogen, with fifty-four per cent of carbon, are bodies in which, according to the relative atomic weights, about three parts of carbon are associated with one part of nitrogen. The relation of the carbon and nitrogen present in those organisms, then, may be expressed thus:

			Parts of carbon.
Nitrogen-free carbonaceous bodies....	82.2 per cent.	× 6 =	493.2
Nitrogenous carbonaceous bodies ...	11.6 "	× 3 =	34.8
			528.0

			Parts of nitrogen.
Nitrogenous carbonaceous bodies	11.6 per cent.	× 1 =	11.6

These data show that in the composition of the plants, roots, and seeds stated there are forty-five parts of carbon to one part of nitrogen. Therefore, in the decomposition of those organisms there must finally be produced forty-five parts of carbon dioxide and one part of nitric acid.

Nitric acid is a more immediately active solvent than carbonic acid, and will dissolve soil material rapidly while its action lasts. The duration and measure of its action, however, are fixed by the quantity, and can extend only to the point of neutralization with the bases it acts upon, which is the case with the carbonic acid. Moreover, nitric acid is a monatomic acid, whilst carbonic acid is a diatomic acid; which thus doubles the solvent power of the forty-five parts of carbon, and lowers the possible action of the one part of nitric acid to only one-ninetieth part of that of carbonic acid, providing both acids exercise their action on the soil bases to neutralization.

These considerations have appeared to the writer to constitute the nature of any method, and the character of any solvent whose action can approximately compare with the processes operating in the field. Their reasonable nature has been amply endorsed in a course of work in which methods were adopted, from which mineral acids were excluded, and simple carbon acids and amido acids were exclusively used as solvents. The results, which form only a part of a broad investigation which is being carried on of Hawaiian soils, and which have been obtained with the aid of the associated labors of our first assistant chemist, J. T. Crawley, and C. F. Eckart, second assistant chemist, will be publishel in later issues of this Journal.

Laboratory of the Hawaiian Sugar Planters' Association.

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HON. JOHN DIMOND'S VIEWS ON THE EFFECT OF THE ANNEXATION OF HAWAII AND CUBA.

Hawaii has already been annexed and is presumed now to be one of the territories of the United States. Some rather strange conditions prevail there, conditions very much at variance with those that prevail in the other territories and in the states of our Union. The sugar industry is the dominant industry in Hawaii, and it is based almost entirely upon a system of contract or forced labor. When some 23 years ago the reciprocity treaty with Hawaii was adopted the production of sugar there was but one-fifth of what it is now. The free importation of this sugar into the markets of the United States, the fertile soils and tropical climate of the islands, and the opportunities possessed by the planters there of contracting for labor and thus producing their sugars with a forced, or semi-slave labor, gave rise to the enormous development of the sugar industry there which has so seriously disconcerted us in Louisiana and led to ever recurring remonstrances on our part to the national legislature against the continuance of this unjust reciprocity treaty. With Hawaii finally acquired by the United States and the American flag floating from all of its public buildings, it remains now to be seen whether or not the genius of the free institutions of the United States will prevail in Hawaii, whether or not forced labor laws will be abrogated and the natives there, under their tropical skies, be left to work or play as their own will suggests. Any way, we should say that we have felt in the past the severe competition of these Hawaiian sugars brought into Louisiana and in competition with Louisiana sugars produced under laws which deny the forced labor contracts.

Our next acquisition is that of Porto Rico. The acquisition of Porto Rico may be looked upon largely from a military point of view. The island is a mountainous one and while it produces a considerable amount of sugar and a considerable amount of coffee, yet, as compared with the total consumption of the United States these quantities are but insignificant and their competition with similar products within the limits of the old Union cannot have any very injurious effect.

When we come to consider the Island of Cuba, however, the situation is very different. A large part of the Island of Cuba is a vast plain, underlain with coral rock, a land of great fertility and of extraordinary resources in many directions. Cuba lies so near to the United States that even under Spanish domination, American enterprise largely affected most of her industrial undertakings. Thousands of Cubans made their summer homes in the Northern States, and thousands of Americans their winter homes in Cuba, and the intimate relations thus established have added largely to the popular demand for the termination of Spanish arbitrary rule in Cuba. If Cuba be treated as an independent state, or if the government there be carried on as a protectorate, or in some manner separate and apart from the methods that prevail with the states of our Union, then perhaps Cuba may develop enormously and at the same time not seriously injure the Southern States of the Union. If, however, Cuba becomes as thoroughly merged into the Union as Hawaii, if it should be granted all the territorial rights such as have been granted to the other territories of the Union, then it would seem to be but a question of time as to when the sugar planters of Louisiana, Texas and Florida would look back to their lost industry, just as the wheat farmers of the valley of the Genesee look backward now to their famed production of fifty years ago. We know that Cuba stands pre-eminent as a possible producer of sugar from sugar cane; that Cuban tobacco commands the markets of the world, owing to the excellence of its quality, and that cotton can be produced in Cuba as readily as in Florida, while the whole list of early vegetables with which the Southern States now flood the Northern markets during their off season, can be produced even more successfully in Cuba and reach the markets of the North with equal rapidity and equal cheapness.

The final factor in the problem that has been presented for our consideration at present is that of the Philippines. We have here a vast territory that even under Spanish misrule has produced more sugar than Louisiana has until within the last few years, and a country capable of enormous development, provided that it became to the interests of the American people to foster such development. Scarcely any comparison, however, can be made between the Philippines and Cuba. Cuba is at our doors, but a few hours' sail from the southern limits of Florida, quickly accessible from every port on the Atlantic coast, an island partly Americanized at present, wherein millions of dollars of American capital are already at work and have been working for years; where the advantages of modern machinery are thoroughly understood and where only a good and stable government is necessary for the doubling or tripling of the crops of the country. If we omit the consideration of Hawaii from the question that is presented to us because we have already had a reciprocity treaty with that country for over twenty years, if we omit Porto Rico from consideration because of its comparative smallness and the military features of its occupation, if we omit the Philippines because of the magnitude of the problem there presented, the great distance of these islands from the United States, the uncertainty of the ratification of the treaty covering their cession, we shall then have only Cuba as the difficult problem before us for a solution, and based upon the data hereinbefore referred to and the argument advanced, I believe that every thinking man who is identified with the industrial development of the Southern States will admit that the transfer of that island to the United States will seriously injure all of the competing products of the Southern States, owing to the greater climatic advantages possessed by Cuba for such production, to the great fertility of the soils and to their adaptation for the production of every crop that is now produced in the Southern States of our Union.

There is one feature of this subject that has not yet been much discussed, and yet it may be a very important one in the final development of these tropical countries. Nature is so prodigal in the tropics, there is such a luxurious growth of all vegetable matter, that the natives find that they can live with almost no effort. A few bananas will supply their daily wants, clothing is almost unnecessary, and hence there is nothing to compel efforts for self preservation as in the countries at the North. After the termination of slavery in the British West Indies, it was found that the leading industries were practically destroyed, the freedmen had no particular necessity for working, while their wants were small and so readily supplied without effort. The landed proprietors had severe laws against vagrancy, against petty thieving &c., but still life was so easy there that one or two days' work in the week would keep the negroes fairly well supplied with all actual necessities. The sugar industry of Jamaica was almost destroyed. It so happened that Barbados, a very small island, was very thickly populated, being in fact one of the most thickly populated countries in the globe. Here the negroes had but little chance of living, as there were no wild or unoccupied lands to go to. Barbados, therefore, retained its conspicuity as a sugar producing island up to recent years. In the Island of Trinidad and in British Guiana, the impossibility of maintaining the sugar industry without some control of the labor, led even the British Government to permit the importation of coolies under long contracts, which they were forced to maintain by law, thus constituting a forced, semi-slave system. There are even now in British Guiana and in Trinidad constant efforts making to secure increased importations of immigrants from the East Indies. A like system of contract labor prevails in Australia, the islands of the South Seas being carefully canvassed for Kanaka laborers who are carried to Queensland and New South Wales under long contracts, where they are utilized in the leading industries.

It is not very probable that the American people after having freed themselves from the system of slavery that prevailed before the Civil War, will now at the beginning of the twentieth century inaugurate any system of contract, or semi-slave labor. The revolt of the laborers of this country against the free importation of the Chinese was an indication of the popular feeling in this direction. The American people do not seem to want to introduce any large amount of foreign or cheap labor and to this desire on their part, we must look largely for the prevention of such injury to the products of the Southern States as would otherwise result from the annexation to the Federal Union of these various countries. If the Island of Cuba could secure a sufficient amount of labor, its productions could be increased five-fold within a few years. Labor, however, has always been difficult to secure there, and we are inclined to believe that while the competition of Cuba with the Southern States of the Union may in the end be very severe, yet such competition at present is somewhat remote, and that our safest course is to go right along, and and to do the best that we can to meet the difficulties of the hour when they come.—Louisiana Planter.

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SEEDLING AND OTHER SUGAR CANES.

(Discussion at a meeting of the Louisiana Sugar Planters' Association, January 12th, 1899. Judge Emile Rost in the chair and Mr. Dykers at the desk.)

Chair: At the December meeting, Prof. Stubbs sent down a very complete collection of sample sugar canes from the sugar experiment station. The samples have been here all this time; they are not as fresh in appearance as they were when first sent here; but Prof. Stubbs is here this evening, and the association will be glad to have him speak about them and tell us which represents the best cane—which represents the present and especially which represents the future.

Prof. Stubbs: I sent these canes down a little over a month ago, with no intention, however, of making a speech on the subject. I sent one hundred different varieties more to attract the attention of the planters to the varieties of canes that are grown in different parts of the country than anything else. They have been collected from nearly every sugar country on the globe. We have about eighty varieties here that represent the old canes that have been grown for years in these places. Some come from the Pacific islands, some from the Atlantic islands which we have been discussing tonight, some from the Philippines, and one or two directly from, or near, Manila. However, I may dismiss this subject by saying that none of the foreign canes have become sufficiently acclimated for our purposes; they are all, to a certain extent, inferior to our locally grown purple and striped cane; and in this connection I might say that our purple cane is nothing more or less than an off-shoot from our striped; that has been demonstrated at the sugar experiment station. We have the greatest trouble to keep striped cane as striped cane —the stripes disappear, even to the point of obliteration.

Col. Zenor: I am glad to hear you express that.

Prof. Stubbs: I have lived long enough to controvert a great many things I formerly believed, and I am modest enough to acknowledge my wrong when I find it out. We have no permanent striped canes. For instance, I have four canes here to which I would call your attention; they are all originally from the same stalk but are now four distinct varieties from the standpoint of color. One is perfectly green, which I named "Soniat" because I got the cane originally from Mr. Soniat. It was a bastard stalk; one-half red, and the other half white. I took that stalk and planted it eight or nine years ago, and have since made four distinct kinds from it; one is green, one is light striped, one is dark striped, and the other is a deep purple. These permanent canes come from what is called the bud variation. Now I want to dismiss all these foreign canes as being of no value in this state—they will not compare with our home canes, but before going further I want to call your attention to the manner in which the beet has been brought up to its present high state as a sugar producing plant.

Chair: Let me ask you one question, professor, before you pass to that. You spoke just now about bud variation; the chair would like to ask you whether the different varieties that have been produced from one stalk are not due to hybridization.

Prof. Stubbs: Not without seed, it is utterly impossible. The seminal organs of the canes are always in the flower, around the flower, and it is only by mixing the bristles of one flower with the bristles of the other that hybridization takes place. As the canes are planted apart there is no disposition to mix. If these canes should all change, if they should all turn purple, or striped, or white, that would not be hybridization—it would be simply a change in color due to the climate or soil—something of that kind. The striped cane is not a constant one and has a tendency to grow to a hardy variety here. We have unquestionable evidence of this which was published some time ago.

Mr. Coiron, who first introduced striped cane into this state, getting it from Savannah by schooner loads, planted it at St. Sophie in 1825. He brought no purple canes that he knew of—they were all striped—and from those striped canes we have today the entire purple cane fields of Louisiana, and it is a question of the survival of the fittest. This striped cane has generated two kinds—one white, the other purple. The purple became the hardiest of the two, as is seen in the stubble and in the plant; and today nearly the entire cane fields of Louisiana are purple, notwithstanding they were first striped when introduced.

Dismissing that part, Mr. President, which you alluded to just now, and going into the question of the future, which as our friend Mr. Miller said just now looms up as possibly in the future, enabling us to make sugar a little cheaper than at present, I want to go back and take up the history of the beet for a few moments. During the days of Napoleon the beet was an insignificant sugar plant containing only 3 per cent sugar. But the beet has a power of reproducing and of making seed. We have a patch at the station which was put down in the last few months—they are winter beets which came from France; they were planted in October and will be ready for the mill in January and February. They are of good size. If we are successful and find that they are rich in sugar we will simply let that beet stand. The beet has been brought up from the insignificant 3 per cent just mentioned to somewhere about 19 per cent of sugar; but we have gone to 22.3 on samples, and by constant efforts the growers have got the sugar in the beet up to a high percentage. If you do not do this, the beet will soon degenerate and go back to the original beet.

Six, eight or ten years ago, Profs. Bovell and Harrison, chemists in Barbados found some canes, twenty-five or thirty growing together, that were blooming, and they thought they would see whether or not they could get some fertile seed from the lot. In order that they might not lose the opportunity, they swept the ground carefully on the leeward side of the cane so that all seed blown out by the wind would find a suitable soil in which to lodge. In a short while, to their very great surprise, they found the whole soil springing up with grass-like fibres—very small and diminutive; it reminds you more of spring, or June, grass. They placed these plants into little pots, and in that way they soon got fifty or more little pots of these canes. They nursed them until they became full grown canes. As you all know, in the West Indies the cane stools very enormously—as high as twenty-five or thirty stalks from one stooling. They took these stalks, nursed all that had an increased content of sugar over the normal canes of that country, and in that way they reserved 500—giving them numbers from 1 to 100 and began to grow them systematically; at the same time they began to send this seed and these cuttings all over the world—to all the sugar countries. I, in the meanwhile, received, I reckon, thirty or forty of these new seedlings, and we have been propagating them for the last year. We found three of them that possessed a great merit—one of prominent merit, No. 74 it is styled by them, and by us retained. This number 74 averaged, for the last four years, 1½ per cent above every cane we had. This year I distributed five or six tons of this to the planters in this state. This year, by a stalk analysis, we did not have any cane equal to it.

If I recollect correctly, there was 13½ per cent sucrose for that cane, while our purple and striped and Lapice, grown side by side, only averaged between 9 and 12. This one, No. 74, this year, by stalk analysis gave us 13½ per cent.

Now another point I want to illustrate is this. We are experimenting every day with seedlings. Just as soon as we find a cane that is prominently rich, we plant it. I can give you some seedlings, and let you plant them; but out of five hundred plants you will hardly get more than one good one. It will take about six or eight months to sprout—they grow very slowly and look like grass. In fact you would cut them out, or plow them up for spring grass. I want to say this, gentlemen, that the best thing for the sugar cane industry now rests almost exclusively upon our home cane by means of selection from seedlings. Now, I have gone so far as to prove No. 74 and 95—I have planted from these canes and they are now tested. We have gotten three generations from the first, and for each successive year we believe they will become richer. I also believe the time is not far distant when we will have new varieties of cane that will contain a considerable quantity of richness over the present cane—this is the last hope of improving sugar cane. We have tried fertilizer of various kinds to increase the tonnage but I doubt if any man has yet found a fertilizer that can put sugar in the cane and at the same time maintain the tonnage. Now we have tried different varieties of cane—we have even gone to the expense of tile draining—which is very costly—we have gone from early spring planting to early fall; yet we have not succeeded in getting what is called maximum sugar with maximum tonnage; but we have approximately, done better with these seedlings than with anything else; we believe it possible that these seedlings, under proper selection and propagation after a while will give canes sufficiently rich, without diminishing the tonnage, that will answer our purposes, and assist in re-establishing the cane out of which sugar shall be made. Now we have means by which we can continue to select for fifty or seventy-five years hence; it has taken seventy-five years for the beet to get where it is. In fifty or seventy-five years we can hope to have sugar cane containing as much richness, or more, than the best beet of today.

Col. Zenor: There is one thing that we have thought of a great deal; we have been very seriously impressed with the phenomenal or abnormal condition of sugar cane this year. I believe the whole association would like to hear your views on this—either the phenomenal or abnormal condition of the cane this year—it was something extraordinary.

Prof. Stubbs: I don't think there was anything abnormal about it. Take the history of sugar cane in various countries —in British Guiana, in Demerara they very rarely grow cane with over 12 per cent—it runs from 12 to 15 per cent. Again in other islands, where it is dry, or where they have a cessation of rainfall, you will find they get 18, 17, 16 and sometimes as high as 20 per cent. Demerara suffers through heavy rainfall and the canes are gorged with moisture. Where this takes place they are always low in sugar, in ripeness. In other words the cane has two cells—the vascular and the sugar cell—the vascular cell that contains only sap—water on its passage from the roots through the cane to the leaves. Whenever these vascular tissues become gorged with water, it dilutes the sugar in the cane. When this takes place, you will always find the sugar content low—your juices low and watery, just as though you had grown the cane in Demerara. This year we had Demerara weather. After the drought was broken in July, it rained incessantly, almost in torrents—we had some twenty inches of rainfall. We went into the season with the ground saturated with moisture, and from that rainfall, without any period of dryness, we had a severe cold which checked the growth and killed the cane. This excessive amount of moisture just gorged the cane. We always pray for dry weather during September and cool nights in October which is always beneficial to the cane.

Col. Zenor: I would like to ask the professor what was the result of his yield this year.

Prof. Stubbs: A small fraction under last year—70 per cent of last year; I made a calculation the other day. Last year our cane ran from 11 to 13; this year most of it only reached 9 and 10 per cent sucrose in the juice.

Col. Zenor: Another thing that seemed to be the experience of a large number of planters—I don't know whether it was universal—and that was this: they found the bagasse did not make fuel as it usually does. It did not give the heat.

Prof. Stubbs: I will explain that in a moment. Increased sugar content carries with it always increased fibre content, and increased fibre content and increased sugar content are parallel. Just as soon as you give me your sugar content, I can predict the fibre content. When your sugar is low, your fibre is low; and when your fibre is low you get less extraction relatively with this diluted juice, and when it goes into the furnace, you have this extra amount of water to evaporate.

Hon. Henry McCall: You have not as much carbon.

Prof. Stubbs: Where cane gives 20 per cent sugar, you will find 14 per cent of fibre.

Chair: What is normal?

Prof. Stubbs: From 8 to 10.

Wherever you find the sugar content high, you will find the fibre high.

Chair: If I understand you rightly, the cause of the failure of the cane this year was due to the distribution of moisture and no cessation of the rainfall up to the time of the freeze.

Prof. Stubbs: In other words, the cane has not ripened a particle. Cane this year, in November and December, resembled our usual analysis made in August and September. We have gotten just as good results in the field in August and September as in December this year. We are not dry yet. Our cane was killed with the ground thoroughly saturated with water. When you remember that the roots of the cane were buried in soil holding fifty per cent of water, and little sunshine, and you simply pumped that water out from the soil through the cane, you can readily see why the results were so poor. We went from midsummer's drenching showers to winter's freeze, and cut our canes in the midst of the freeze with all that water.

Chair. I would like to ask whether this condition of things will likely affect the stubble or seed cane.

Prof. Stubbs: I think it will likely affect the growth in this way, I don't think the stubble is hurt yet. It has not been cold enough. While we have had very heavy rains, with no dry weather (our mornings are almost rainy), and the cane in the ground—if we had a favorably opportunity to windrow our seed, so that we could put it away in good condition, draining and covering well, everything is propitious for keeping it. The trouble has been with the weather—we cannot get the dirt dry enough. I want to say this, I don't know whether it has been the experience of all planters or not; but I have not had enough dry weather to burn the trash on the ground.

Col. Richard McCall: Have these seedlings a tendency to fall down?

Prof. Stubbs: Not at all, sir. On the contrary, last year we had quite a blow; our home canes went down and those stood up as straight as they could stand. All of these foreign canes have a tendency to stand up and resist the blows. The roots are larger, and penetrate the ground deeper, hence resist the wind with a great deal more ease than our home canes. Our home canes go down of their own weight; and if you will notice it, you will find that most of these canes are usually straight.

Col. Richard McCall: I got from you some years ago a cane that was tremendous. I took it home and planted it carefully in my garden; and this year I planted five acres of it—I thought with five acres I would have a test. The cane gave me thirty-five tons to the acre; the sucrose was very low—5.20, I think it was, solids not sugar with half sucrose. These canes stood up through the blows as straight as an arrow; you could see them two miles away. There was not a bend in it.

Prof. Stubbs: I had some of that cane growing in the hot house; it was only two years old. At the time I gave Mr. McCall the sample he admired it very much—it was an enormous cane, the joints were larger than my arm and some of the stalks weighed twenty pounds.

Nothing further coming before the meeting for discussion, the meeting then adjourned.

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SPRAYING FOR FUNGOID DISEASES.

It is four years since there was published, in Farmers' Bulletin No. 7 (U. S. Department of Agriculture), a summary of the more important methods of combating some of the destructive diseases of fruits. During this time many improvements have been made in the work, and for this and other reasons it seems desirable to now bring together, in brief, practical form, our present knowledge on the subject. The question as to whether it will pay to spray has long since been answered in the affirmative, so it is not necessary at this time to enter upon any argument in regard to this phase of the subject. It is furthermore not necessary to go into detail as to the relation of spraying to hygiene. Suffice it to say that if the work is properly done no danger whatever to health need be apprehended.

Fungicides or Remedies for Plant Diseases. During the past four years numerous solutions, powders, etc., have been tested, with a view of determining their value as economical, effective, and practical preventatives of fungous parasites. While a number of these preparations have given promise of value, none have been found which fill so many requirements as bordeaux mixture and the ammoniacal solution of copper carbonate. Of the two preparations, bordeaux mixture has long been recognized as possessing the most valuable qualities, and it is probably more generally used today than all other fungicides combined. The chief points in its favor are: (1) Its thorough effectiveness as a fungicide, (2) its cheapness, (3) its safety from a hygienic standpoint, (4) its harmlessness to the sprayed plant, and (5) its beneficial effects on plants other than those resulting from the mere prevention of the attacks of parasites.

So far as we are at present concerned, therefore, it is necessary to consider only the two fungicides in question, setting forth the recent improvements made in preparing and using them.

Bordeaux Mixture.—All things considered, it is believed that the best results will be obtained from the use of what is known as the 50-gallon formula of this preparation. This contains:

Water	50 gallons
Copper sulphate	6 pounds
Unslacked lime	4 pounds

It has been found that the method of combining the ingredients has an important bearing on both the chemical composition any physical structure of the mixture. For example, if the copper sulphate is dissolved in a small quantity of water and the lime milk diluted to a limited extent only, there results, when the materials are brought together, a thick mixture, having strikingly different characters from one made by pouring together weak solutions of lime and copper sulphate. It is true, furthermore, that if the copper sulphate solution and lime milk are poured together while the latter or both are warm, different effects are obtained than if both solutions are cool at the moment of mixing. Where the mixture has been properly made there is scarcely any settling after an hour, while the improperly made mixture has settled more than half.

Briefly, the best results have been obtained from the use of the bordeaux mixture made in accordance with the following directions: In a barrel or other suitable vessel place 25 gallons of water. Weigh out 6 pounds of copper sulphate, then tie the same in a piece of coarse gunny sack and suspend it just beneath the surface of the water. By tying the bag to a stick laid across the top of the barrel no further attention will be required. In another vessel slack 4 pounds of lime, using care in order to obtain a smooth paste, free from grit and small lumps. To accomplish this it is best to place the lime in an ordinary water pail and add only a small quantity of water at first, say a quart or a quart and a half. When the lime begins to crack and crumble and the water to disappear add another quart or more, exercising care that the lime at no time gets too dry. Toward the last considerable water will be required, but if added carefully and slowly a perfectly smooth paste will be obtained, provided, of course, the lime is of good quality. When the lime is slacked add sufficient water to the paste to bring the whole up to 25 gallons. When the copper sulphate is entirely dissolved and the lime is cool, pour the lime milk and copper sulphate solution slowly together into a barrel holding 50 gallons. The milk of lime should be thoroughly stirred, before pouring. The method described insures good mixing, but to complete this work the barrel of liquid should receive a final stirring, for at least three minutes, with a broad wooden paddle.

It is now necessary to determine whether the mixture is perfect—that is, if it will be safe to apply it to tender foliage. To accomplish this, two simple tests may be used. First, insert the blade of a penknife in the mixture, allowing it to remain there for at least one minute. If metallic copper forms on the blade, or, in other words, if the polished surface of the steel assumes the color of copper plate, the mixture is unsafe and more lime must be added. If, on the other hand, the blade of the knife remains unchanged, it is safe to conclude that the mixture is as perfect as it can be made. As an additional test, however, some of the mixture may be poured into an old plate or saucer, and while held between the eyes and the light the breath should be gently blown upon the liquid for at least half a minute. If the mixture is properly made, a thin pellicle, looking like oil on water, will begin to form on the surface of the liquid. If no pellicle forms, more milk of lime should be added.

The foregoing directions apply to cases where small quantities of the mixture are needed for more or less immediate use. If spraying is to be done upon a large scale, it will be found much more convenient and economical in every way to prepare what are known as stock solutions of both the copper and lime. To prepare a stock solution of copper sulphate, procure a barrel holding 50 gallons. Weigh out 100 pounds of copper sulphate, and after tying it in a sack suspend it so that it will hang as near the top of the barrel as possible. Fill the barrel with water, and in two or three days the copper will be dissolved. Now remove the sack and add enough water to bring the solution again up to the 50-gallon mark, previously made on the barrel. It will be understood, of course, that this second adding of water is merely to replace the space previously occupied by the sack and the crystals of copper sulphate. Each gallon of the solution thus made will contain 2 pounds of copper sulphate, and, under all ordinary conditions of temperature, there will be no material recrystallization, so that the stock preparation may be kept indefinitely.

Stock lime may be prepared in much the same way as the copper sulphate solution. Procure a barrel holding 50 gallons, making a mark to indicate the 50-gallon point. Weigh out 100 pounds of fresh lime, place it in the barrel and slack it. When slacked, add sufficient water to bring the whole mass up to 50 gallons. Each gallon of this preparation contains, after thorough stirring, 2 pounds of lime.

When it is desired to make bordeaux mixture of the 50-gallon formula it is only necessary to measure out 3 gallons of the stock copper solution, and, after thorough stirring, 2 gallons of the stock lime; dilute each to 25 gallons, mix, stir, and test as already described. One test will be sufficient in this case. In other words, it will not be necessary to test each lot of bordeaux mixture made from the stock preparations, provided the first lot is perfect and no change is made in the quantities of the materials used. Special care should be taken to see that the lime milk is stirred thoroughly each time before applying. As a final precaution it will be well to keep both the stock copper sulphate and the stock lime tightly covered.

Ammoniacal Solution of Copper Carbonate.—This preparation as now generally used, contains—

Water	45 gallons
Strong aqua ammonia	3 pints
Copper cvarbonate	5 ounces

The copper carbonate is first made into a thin paste by adding a pint and a half of water. The ammonia water is then slowly added, and if of the proper strength, i. e., 26 degrees, a clear, deep-blue solution is obtained, which does not become cloudy when diluted to 45 gallons.

The ammoniacal solution of copper carbonate being a clear liquid, its presence on the leaves, fruit, and other parts of the treated plants is not so noticeable as where the preparations containing lime are used.

In case it is desired to keep the strong solution as a stock preparation, the bottle or jug in which it is placed should be tightly corked.

Applying Fungicides.—To obtain the best results from the use of a fungicide, it is necessary that it should reach all parts of the plant subject to the attacks of the fungous parasites. Many devices for accomplishing this object have been put on the market in the past three or four years. All these fall within three principal groups, namely, knapsack pumps, hand pumps, and horse-power sprayers. The knapsack pumps are designed especially for low growing crops, such as grapes, nursery stock, etc. The hand-power pumps can be used in a great number of ways, and if strong and durable are probably the most useful of all the various styles of apparatus. The horse-power sprayers are designed to be drawn by one or more horses and operated by the same means. All these machines must be provided with nozzles that will furnish a mist-like spray and at the same time be easy to clean of any obstruction that may clog the necessarily small opening. There is no form of nozzle that so well fills these requirements as the Vermorel, which is now sold with nearly all spraying outfits.

Where good labor is cheap and the crop is mainly grapes and low growing plants, the knapsack form of sprayer will probably be found as economical as any apparatus. For orchard work, however, more powerful machinery will be required. Probably the most satisfactory form of apparatus for this kind of work consists of a strong force pump, mounted upon a barrel or hogshead, or probably upon a water-tight box wagon bed. If mounted on a barrel or hogshead, arrangements will, of course, have to be made to conveniently draw these through the orchards. The horse-power sprayers are nearly all complicated and comparatively expensive; moreover, they can not be used satisfactorily under as many different conditions as the hand pumps mounted on suitable reservoirs. They may be dismissed, therefore, with the statement that it is only in exceptional cases, as, for example, in case of an orchard of several hundred acres on level ground, that it will pay to use them.

With reference to the cost of the several kinds of apparatus mentioned, it may be said that good knapsack pumps, complete in every detail, may now be obtained at from $10 to $12 each. The cost of a first-class orchard outfit, such as already described and figured, should not exceed $25 or $30. Some kinds, in fact, may be rigged up even for $10 or $12. The horse-power sprayers cost all the way from $25 to $125 each.

There are many farmers and others who grow a miscellaneous line of fruits, such as grapes, pears, apples, etc.; in such cases it is desirable to have an inexpensive and effective apparatus that will answer for the various crops. Such an apparatus is shown in Fig. 5. As will be seen, it consists of a small force pump provided with a long piece of discharge hose and a cyclone nozzle. The whole outfit can be purchased and put together for $5, and it will be found in every way superior to the many forms of syringes on the market. The pump is strong and durable, and although small it will throw a solid stream, the size of a lead pencil, for more than 30 feet. It may be used for trees of all kinds, as well as for vines and low-growing crops.

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DANGER OF INTRODUCING A CENTRAL AMERICAN COFFEE DISEASE INTO HAWAII.

(United States Department of Agriculture, Division of Vegetable Physiology and Pathology.)

The interest evident in Hawaii in the introduction of Guatemalan coffee for cultivation calls for a word of caution as to the danger of introducing a very destructive disease of the coffee plant prevalent in Mexico, Central America and South America. Cooke described two small parasitic fungi, *Stilbum flavidum* and *Sphœrella coffeicola*, growing on coffee leaves sent him from Venezuela, and believes them to be the cause of the disease known as Mancha de hierro or Candelillo, which attacks the leaves of the coffee plant in that country. In 1892 Prof. Nicholas Saenz, of the National University of Columbia, published a pamphlet on coffee culture and in it described at some length the disease in question. He speaks of it as a "disastrous malady, which has caused and is now causing great loss to growers." The affected plants, he says, present a number of round or oval dingy yellow spots on the branches, fruits, and especially on the foliage, he having counted as many as seventy of these spots on a single leaf.

Effects of the Disease.—The plants in good soil show but little damage at first and may pass through the winter and the dry, hot season almost unchanged, but when the first rains come on even the most vigorous suffer greatly, losing most of their leaves and fruit, so that the harvest is therefore much reduced. Not all the diseased leaves fall, however. Sometimes in case of mild attacks the spots fall away, leaving holes in the leaf. Spots on the berries always appear on the upper side, and the berries that do not fall frequently show a portion of the pericarp dead and simply a network of dead fibrous tissue. "Sometimes the diseased part extends as far as the seeds, which then are retarded in their development, as is shown by their wrinkled surface." Even strong trees require at least three years to recover from an attack of the Mancha.

The disease almost invariably begins in the upper or colder parts of a plantation. Professor Saenz further states that "the development of the disease is favored by long rainy seasons, accompanied by a relatively low temperature;" and again, that "in order to start a coffee plantation where there is least risk of its suffering the ravages of the Mancha a locality should be selected whose temperature is 23 degrees C. or above, because it is observed that at the lower temperatures the fungus develops rapidly."

THE DISEASE IN GUATEMALA.—In 1893 Sr. Adolfo Tonduz, of the Costa Rica National Physico-Geographical Institute, made a preliminary report on the Mancha, and with this report sent out dried leaves showing the disease. He found in Costa Rica that it caused the droppin of great numbers of the berries from some trees.

In 1897 W. J. Forsyth wrote two short accounts of this malady (determined by Mr. J. B. Ellis from specimens sent to the Smithsonian Institution in 1894) as it exists in northwestern Guatemala (Tumbador District) and southwestern Mexico (Soconusco in Chiapas). He says:

"When I first went to Guatemala—March, 1883—the coffee showed a magnificence and a luxuriance of growth and redundancy of foliage that I had hitherto been a stranger to. From 8 to 12 pounds of coffee was not unfrequently picked off single trees. But in the early nineties I noticed a great change, particularly in Soconuso and the district in Guatemala called Tumbador, which immediately adjoins Soconusco. The coffee trees seemed to have lost their great and exhuberant vigor. Their luxuriant foliage was decidedly lessened, and in their stead an unhealthy, sickly appearance had taken its place. The leaves were more scattered on the ground than in their proper place on the trees. The young wood especially appeared weak and was withered and black looking from the ends leading toward the trunk."

In recent letters to this Division and to the Division of Entomology Mr. E. P. Dieseldorff, a prominent coffee planter of Coban, Central Guatemala, expressed alarm at the extension of this disease about Coban. In a letter dated December 16, 1897, he writes: "I am no longer afraid of the scales, but more seriously of the coffee-leaf disease, which has increased alarmingly and is doing damage to many plantations—about $100,-000 worth every year;" and again, "I find that lately the coffee-leaf disease has increased alarmingly, so crops of many estates have been greatly decreased." On January 3, 1898, he wrote: "Having been saved from Dactylopius, the coffee plantations in the north of Coban are now seriously threatened by the coffee-leaf disease, called Candelillo, or Viruela, and I am very much troubled by it. I noticed its appearance some eight years ago, and since then it has assumed alarming proportions." He concludes by saying: "I believe the best would be to start planting tea, which has been taken up by Ceylon planters when coffee failed there on account of similar reasons." Samples of the diseased leaves received from Mr. Dieseldorff have shown the disease to be identical with that studied by Tonduz in Costa Rica and Saenz in Colombia.

The leaves attacked by this Mancha or Candelillo disease show dead, yellowish gray spots, from one-eighth to three-eighths of an inch in diameter, on both sides. On the upper side slender threads rise, each from one-fiftieth to one-twenty-sixth of an inch in length, bearing on the upper end a little globose head of spores. This is the fungus called *Stilbum flavidum* Cke., and is, as the name denotes, a clear yellow.

Special Danger to Hawaii.—In the Hawaiian Planters' Monthly, 1897, there appears the following item:

"A fine specimen of coffee grown from Guatemala seed was received at this office," says the Hilo Tribune, "from Mr. J. M. Horner's plantation at Kukaiau, from a four-year-old tree, which had upon the one primary received nearly nine hundred well-developed coffee cherries, and there were forty such primaries on the same tree—fully three-quarters of a pound to the primary. Some of these primaries, Mr. Horner informs us, had one thousand cherries. He says he will have twenty-five tons of coffee this year, and were all his trees from Guatemala seed he would have sixty tons from his plantation instead of thirty. This is the way he replies to the difference and selection of seed. Side by side the Guatemala and wild coffee trees are growing, and the former produce eight times the amount of the latter. The growth of the wood is in favor of Guatemala by long odds."

The writer has been informed that considerable coffee seed has been imported into Hawaii from Guatemala in the past, and that some young plants have been brought in.

It is obvious that such reports as that published in the Hawaiian Planters' Monthly and elsewhere regarding the superiority of Guatemalan over Hawaiian coffee is likely to lead to a considerable importation of seed and possibly of young plants into Hawaii from Guatemala, and in this way the Mancha disease may be introduced.

Hawaiian weather records for 1894 and 1895 give the rainfall in many parts of the Island of Hawaii near where the coffee is grown as very heavy—from 150 to 200 inches or more annually. The temperature records are reported for three points near the coffee plantations, and at all three the mean temperature for every month in the year is below 75 degrees. This is the temperature below which the disease is said by Professor Saenz to spread rapidly.

Necessity of Inspection.—Now, in view of Professor Saenz's statements as to the disease being favored by rainy weather and by temperatures below 75 degrees F., there is grave danger of its spreading and doing damage if introduced into the islands, while from Forsyth's and Dieseldorff's statements it appears that it exists in at least two regions of Guatemala.

The safest course would be to prohibit the importation into Hawaii of all seeds or young plants from South America, Central America, and Mexico. Should this be impracticable, it would certainly be advisable to have all plants and seeds imported rigidly examined by an expert, who would have power to destroy those affected. At the same time it would be well to guard against the introduction of the other coffee-leaf disease, called *Hemileia vastatrix*, which has brought about the almost total destruction or abandonment of the coffee plantations of Ceylon, causing the production to decline from 1,000,000 cwt. eighteen to twenty years ago to 50,000 cwt. in 1896, and in southern India causing it to decline from 450,000 cwt. to 240,000 cwt. This disease, the worst enemy of coffee culture known, is very difficult and in many cases impossible to remedy. It exists in many places in southern Asia, in Ceylon, Sumatra, Java, the Fiji Islands, the Islands of Reunion, and in east Africa. All importations from these points of plants or seeds of coffee or of other plants of related genera, particularly the cape jasmines, or gardenias, and vanguerias, is in the highest degree dangerous and should be prohibited.

A disease caused by a nematôde worm (*Meloidogyne exigua* Goldi) does very great damage to the coffee in Brazil and might well be guarded against also.

The Mancha and the Coffee Market.—Because of the Hemileia disease Mr. J. Ferguson, editor of the Tropical

Agriculturist and Ceylon Observer, says: "It will be a long time, however, before such an enterprise or any other enterprise at present within British territory, can seriously affect the coffee market, and I see no early prospect in any other quarter of an over-production of coffee." At that time Mr. Ferguson probably had no cognizance of the serious diseases above described, which threaten the coffee industry of Central America and Mexico. Indeed he cites these very countries as having from their constantly increasing production kept the markets supplied while the production was declining in the East Indies.

It is then probable that the coffee industry of Hawaii will be greatly developed in the future, provided these almost irremediable diseases and pests are prevented from reaching the islands.

WALTER T. SWINGLE,
Special Agent, Division of Vegetable Physiology and Pathology.

Approved:
JAMES WILSON, Secretary.
Washington, D. C., July 26, 1898.

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CUBA AS A SUGAR PRODUCING COUNTRY.

Cuba in normal times may be said to be one of the most favored countries of the world for the economical production of sugar. The condition of affairs greatly burdens the sugar industry, owing to the necessity of protecting the estates, the loss of cane through incendiary fires, and the difficulty at all times of getting enough hauled to the works to use them to their full capacity.

Under normal conditions the contrast between the Cuban industry and that of the West Indian Islands, or any American sugar-producing country, is remarkable. The total sugar crop of any other island is equal only to the output of three or four of the largest Cuban manufactories, and with the exception of Demerara all these countries show considerable inferiority to Cuba in methods of manufacture, and in the class of machinery in use. The neglect of the other West Indian planters to advance with the times is the main cause of this this lack of prosperity at the present moment. Of the other cane-sugar countries of the world Java is the only one which comes within 50 per cent of the amount of sugar produced annually in Cuba in normal times, and Java and the Hawaiian Islands are the only ones which are generally advanced in the process of manufacture.

Until a very recent date the manufacture of sugar and the growing of the cane in Cuba were extremely profitable undertakings, and the reason for their prosperity may be stated as—

1. The excellence of the climate and the fertility of the soil, which allow of large crops of good cane. The rainfall, about 50 inches, is so distributed that irrigation is not a necessity, though it would in many cases be advisable.

2. The great movement toward the centralization of the estates which took place in the early eighties; planters having understood the value of large sugar houses, and overcome their difficulties in this way.

3. The proximity of the United States, affording as it does a cash market for the sugar.

It is a matter of surprise to many with experience in other sugar-producing countries that even with the above advantages, the Cuban crop should have reached the great amount of 1,000,000 tons, for while elsewhere the sugar industry is fostered by bounties, as Europe and the United States, or by special treaty with the country where the sugar is sold, as in the Hawaiian Islands, in Cuba the growth of production is hindered by direct taxation, and by enormous duties on the various necessaries of manufacture. Besides this the want of ordinary roads and bridges is severely felt at times. Further, the freight charges on railroads and coasting steamers are excessively high.

The Cuban grinding season lasts from about December 1 until the spring rains begin about May 15. During this time very little rain falls, and the crop may be harvested without damaging the roots of the cane—a very important consideration where land will continue to yield well from eight to twenty-five years without replanting. The crops vary from 40,000 to 120,000 arrobas per caballeria, or from twelve to fifty tons per acre, and the cane contains from 13 per cent sugar in December up to 18 per cent in March and April. The manufacturer's aim is, therefore, to begin as late as possible in order to profit by the ripening of the cane. Very little manuring has been tried yet, and in a few places only is there any well conducted cleaning of the fields in the dead season, or proper ploughing before planting. Old wooden plows prevail in many districts. No irrigation works of any account exist, and no trials of any scientific value have yet been made to determine the kind of cane best suited to the soil and climate. In fact, the natural agricultural advantages of the country have been relied on up to now, and have been found sufficient to insure large profits. Most of the cane is transported to the sugar houses by narrow-gauge roads built for this purpose, and are often from 10 to 40 miles in extent, and connecting with the main lines. Transport by means of flumes or canals is not known. The cost of producing sugar in Cuba may be said to be an unknown quantity in respect to the great bulk of the estates, owing to their lack of commercial organization, but it may be said that a great many can make sugar of 96 deg. for about 2½c. per pound at the sugar house, and that a few can do it for less. The great factors in the cost of production in any sugar house are:

1. Cost and quality of cane or value of sugar in the cane.
2. Daily capacity of sugar house.
3. Price of labor and method of manufacture.

The cane in Cuba is paid for in certain percentage on its weight of "first" sugar, or the cash value of this sugar at the time of delivery of the cane. This is a very equitable and scientific arrangement, and compares favorably with anything in vogue, even in beet-sugar countries. The amount of sugar varies from 4 to 6 arrobas per 100 arrobas of cane, an arroba being equal to 25 pounds.

In respect to daily capacity, the Cuban sugar houses are in advance of those in any other country. Very many can grind 1,000 tons of cane in twenty-four hours, and not a few can do more than this. There are a few places in France and Belgium, known as "Usines Centrales," where the juice is conveyed by a system of pipes from small juice stations to a central establishment, which equals, or exceeds the Cuban houses in capacity, but elsewhere there are none so large.

The cost of labor in Cuba is not high. An ordinary laboring hand earns from $12 to $20 per month, according to the season of the work, and is fed and lodged besides. They are lodged in "baracoons," or great sheds of the most primitive kind, in which hammocks are slung, and are fed twice a day on rice, beans and beef usually, and eat their food sitting on the ground, or are furnished with rough benches or boards. The Spanish laborer expects little. Withal he is a peaceful, temperate, and hard-working man as a rule. Chinese labor is used to a considerable degree, but it is not cheaper than black or white labor. The Chinamen are all old men, formerly coolies, and as there is not any fresh immigration at present they are becoming scarcer. The cross between the Chinamen and the negroes is a good one usually, but they do not, as a rule, live much past middle age.

The black laborer in Cuba is undoubtedly a stronger man physically than the white, and very much superior in this respect, and in most others, to the Louisiana negro coming from a different part of Africa.

The methods of manufacture in Cuban sugar houses are good as regards the kind of machinery used. Immense sums have been spent in the last ten years in this direction. The mills, evaporators, vacuum pans and centrifugals are usually first class, but the general internal management of the sugar houses leaves much to be desired except in a few instances. A good deal of sugar is lost by crude methods, and in a very few places is there exercised that chemical control which has brought the best of sugar houses to their present state of perfection.

Great advances will in time be made in the control of the sugar house and the growing of the cane, and, with good administration, it is likely that Cuba will soon again become the largest cane sugar-producing country in the world.—British Consular Report.

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SOIL PHYSICS IN RELATION TO CROPS.

Prominent among physical properties of soils are color, weight, fineness of division or texture, adhesion, cohesion and relation to gases, heat, moisture and dissolved solids. The varying productiveness of a soil is due largely to the variation in these properties. Soils containing a large amount of organic matter are more or less black. The presence of large amounts of the higher oxides of iron produces a reddish color. Much sand gives a light yellow or whitish color, and certain kinds of clay produce a bluish tint. Color is considered an index to fertility; the black and red being usually the most productive.

The weight of one cubic foot of the various soils is as follows: Sand, 110 lbs; sand and clay, 96; common arable soil, 80 to 90; heavy clay, 75; vegetable mold, 70; peat, 30 to 50. Sandy loams, usually termed light, are in reality the heaviest of all, while clay, considered heavy, is lighter, bulk for bulk, than any of the others, excepting vegetable mold and peat, which are light in both senses in which the term is used. There is, on an average, about 50% by volume of empty space in soils, i. e., space containing air and water. This will vary with the state and stage of cultivation, but for undisturbed subsoil is quite constant. For a sandy soil weighing 110 lbs. per cubic foot, the volume of empty space is about 35% while for the clay weighing 75 lbs. per cubic foot it is about 55%, and of course for the peaty soil it is still greater.

Fineness of division or texture has a marked influence on the circulation and retention of plant food and the growth of plant roots, therefore an important bearing upon fertility. Mechanical analyses show a wide difference in the number of grains in a gram of various soils, and in general their agricultural value seems to increase with the fineness of division. Whitney, in his investigations of the soils of Maryland, finds that the pine barrens have about 1½ billion grains in a given weight, while the Trenton limestone soils contain 22 billion grains in the same amount. The former are among the poorest soils, while the latter are among the best. Cohesion and adhesion are properties which usually go together, and are brought most prominently to notice after rains and thaws.

Heat in relation to plant growth is important. A soil derives its heat from the sun, from the interior of the earth and from chemical action. A black surface will absorb more heat than one of any other color. Schubler, in laboratory experiments, has shown as much as seven degrees difference between light and dark colored soils. Water has such a marked influence on soil temperature that a dry, light colored soil may become considerably warmer than a moist, black one. A wet soil will be colder than a dry one for two reasons: one because from a wet one there is greater evaporation; evaporation uses heat, part of which must come from the soil; 2, the specific heat of water is from four to five times as great as that of soil, i. e., it requires four or five times the heat to raise a certain amount of water through any given temperature that would be required to raise an equal weight of soil through the same temperature. With plenty of water the temperature is more uniform, and without water, heat is of no avail as far as plant production is concerned. Experiments in Germany, England and our own country show that plants take through their roots an average of about 325 lbs. water for each pound of dry matter produced. From this we can calculate that an acre of good corn, producing four tons of dry matter, would use during its growth 1,300 tons of water, or about one barrel for each stalk.

In 1893 the total rainfall at the Illinois agricultural experiment station for the five months, May, June, July, August and September, was 1,200 tons per acre, and for the same months in 1894 it was 1,400 tons. When we remember that considerable of this was evaporated directly from the ground surface, the amount remaining for the crop was far too small, and as a result the corn crop of 1893 was very short, while that of 1894 was moderately so. In case of insufficient rainfall during the growing season, a soil should have a large capacity for water, a maximum power of retaining it, the ability to draw from considerable depth and a texture such as will permit the roots of crops to go deep. The capacity of a soil for water depends largely on its texture. The soil having the smallest particles usually has the largest amount of space to be occupied by water and the largest surface area to hold water, hence will have the maximum capacity.

The movement of water in the soil is due to two forces—gravity or the weight of water, which always tends downward, and surface tension or the contracting power of any exposed water surface, which tends to move it in any direction, according to circumstances. Surface tension is the tendency which any exposed surface has to contract to the smallest possible area. As was said before, there is on an average about 50% of empty space in soil, i. e., in a cubic foot of soil there is half a cubic foot of space which contains air and water. This space is divided up by soil grains so that the spaces between them are very small. In moist soils each grain is surrounded by a thin film of water. Where the grains come together the films are joined so there is a continuous film throughout a large mass of soil. The grains in a cubic foot of soil have on an average about 50,000 square feet of surface area, and when there is only a small amount of water in the soil, the films are very thin and present a water surface nearly equal to the surface area of the soil particles themselves. Under these conditions the tension on so large an area will support a considerable weight, and can elevate water to a considerable height above the water table. This condition is most desirable and should be secured if possible by proper drainage, cultivation, etc.—F. D. Gardner, Illinois Experiment Station.

THE NEW ORANGE.

(Remarkable Experiment by the U. S. Agricultural Department.)

Man is seeking to improve nature's work upon the orange, and it is likely that he will be able to do it. If success crowns experiments now in progress the orange will become a hardy fruit, able to grow and bear even as far north as Canada, with skin that will peel off as easily as a tangerine's, and, perhaps, devoid of the seeds that now threaten the perils of appendicitis.

Such a recreation of this luscious fruit—for that is what it would amount to—would deserve to rank with the greatest marvels of the end of the century. It would revolutionize and expand the orange-growing industry almost beyond the limit of the imagination and remove all danger from the frosts and freezes that now from year to year either blight in large degree or entirely destroy the trees and their fruit in the states where they are grown.

The freeze in the southern states in 1894 and 1895 destroyed nearly every orange tree, causing a loss upon the crop expected of nearly $5,000,000, and a damage to the industry in general that has been computed at the extraordinary figure of $75,000,000.

Since that time the U. S. Agricultural Department has been experimenting in the cross-fertilization of oranges in the hope of producing one or more varieties that will resist the attacks of frost and that will possess the other qualities not found in the fruit of today.

The practical part of the work is being conducted in a green house back of the department building, in the mall, under the constant direction and supervision of H. J. Webber and W. T. Swingle, special agents of the division of vegetable physiology and pathology.

Up to the present the experimental processes have been productive of the results expected, but the most interesting and delicate stages are yet to come. In the green house there are at least 1,000 hybrid growths from the seeds that have been crossed, and next spring many of these will be taken to the southern states and grafted on the orange trees growing there. Then at least three years must elapse before the grafted trees will begin to bear the fruit that is to be hardy, sweet, loose skinned, and perhaps seedless.

It was not until 1897 that Mr. Webber succeeded in hybridizing the orange in a way to insure the favorable result of planting or grafting. He had found, prior to the hybridizing, that the Japanese tri-foliate orange, although its fruit is small and of little value except for preserves, is deciduous, and so hardy that it can be grown without protection so far north as Philadelphia. A number of these trees had been planted in the department grounds, and, in spite of cold, had borne fruit, which, however, was so small and bitter as to be good only for preserving. It occurred to him to cross the Japanese variety with the different kinds that flourish in the south to get the hardy quality. The practical work of hybridizing then commenced, and the mature buds of the tri-foliate and of the other kinds were selected when they were nearly ready to open. The tips of the corolla were carefully pried apart until the stamens were exposed. In these flowers the anthers, or male element, are attached to the filaments by very slender threads, which are easily broken, and the simplest method of removing the stamens was to pull them off with fine-pointed forceps. This process is termed emasculation, and during it great care had to be exercised not to open the stamens and accidentally pollinate the flower.

THE POLLINATION.—After emasculating the flower, a bag of paper was passed over the twig bearing the flower and tied around the stem in such a way as to effectually exclude all insects and foreign pollen. In a few days, when the pistils had time to mature, the sacks were removed and the pistils pollinated by rubbing the stamens over them. Then the sacks were replaced and allowed to remain until fecundation took place and all danger from the action of foreign pollen was over. The seeds of the fruit resulting were taken and properly labeled, after which they were planted in the green house, where in less than two years they have grown and thrived in temperate temperature. In many cases the perfect crossing of the varieties can be observed by examining the leaves. The tri-foliate has a leaf that is small and pear-shaped, while the ordinary orange leaf is longer and larger. The hybrid that wholly unites the two has a leaf that is larger than the tri-foliate, but has the latter's chief characteristic.

If the seedlings that are grafted on the southern trees develop a fruit that cannot be killed in blossom or maturity by the winters in that section, the scientists will feel that they have been sufficiently repaid for all their efforts. Orange growing then would not be attended by the great risks which now encompass it. In addition, if a hardy orange can be produced that will live in the north and yet have the sweetness and juiciness of the southern fruit, then the work of nature will have been wholly improved by the hand and intelligence of man.—Washington Star.