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The latest quotation for sugar of 96 deg. test in New York was 3¼c. on the 5th of November.

The exports of sugar continue on a liberal scale, as several of the mills have commenced grinding earlier than usual, on account of the large crops in some districts, where the mills will have six months of steady work before them.

The drought in the Hamakua, Hawaii, district still continues, notwithstanding that abundant and very heavy rains have prevailed all over the group. This drought necessitates the early cutting of the cane in order to save a portion of the crop.

A fire, which is said to have started in the trash pile, destroyed a portion of the Pacific Sugar Mill at Kukuihaele, Hawaii. The machinery is believed to have received no great damage. The building is being rapidly replaced under the direction of Mr. Wm. Conradt of Hilo.

The inquiry has often been made of us to furnish information regarding Liberian coffee, which for some localities is said to be superior to other kinds. On page 514 will be found an account of its cultivation in India, where some varieties of coffee are grown at an elevation of 6,000 feet.

The list of officers and committees of the Planters' Labor and Supply Company is inserted on the last page of this issue, for reference. It is hoped that there will be a full attendance of all interested in sugar and other agricultural industries at the annual meeting which takes place in this city on Monday, December 4.

There is great doubt regarding the changes that will be made by the proposed revenue bill in Congress. Some think that the duty will be restored to raw sugars and the bounty abolished. But by far the larger, and perhaps best-informed, think that the bounty will remain as it is, under the belief that it is in the form of a contract, which has twelve more years to run, before it can lawfully be changed.

Attention is called to the article on "Improvement in Sugar Producing Plants" (page 511). Special efforts are now being made in various countries to improve the sugar cane, as the sugar beet is being improved by selection of the best seeds and varieties. The large increase in the saccharine quality of the beet juice, from five and six per cent., when it was first used for making sugar, to fifteen and over, as is claimed for it now, is certainly remarkable. And if this is done with beets, why may it not be done with cane ?

In the August number of this MONTHLY was a very interesting article on the cultivation of the orange. Some may have failed to notice the remarks on "inarching or grafting by approach," which will be found on page 348-9. Where one possesses a valuable fruit tree,—orange, pear, mango or other species,—and desires to increase the number of trees of the same fruit, without waiting for trees to grow up from its seeds, often disappointing the owner in the quality, this process of grafting (though somewhat difficult) generally insures a similar fruit to the tree from which the bud was taken. If the first attempt should not prove successful, subsequent ones may, as the buds are sure to grow when the work is thoroughly done, though they may be several weeks in starting.

ARTESIAN WATER.

On page 489 will be found an article from a Queensland paper, relative to the control of artesian water in that colony where many wells have been successfully bored during the past few years. It has been proposed to have a government inspector there, whose duty it shall be to supervise all these artesian wells, to prevent waste of water. The statement referred to furnishes some points which have a bearing on our own artesian system

This subject of inspection has occasionally been referred to in the newspapers here, but there has been no real scarcity of water from this source, although during one or two dry seasons, several of the wells in this city have shown a noticeable decrease in the force of the water. It is, however, possible that the time may come when regulations may be deemed necessary, to prevent waste. Generally the wells on this island are so fitted with caps that the supply is regulated to meet the demands of its owner.

There are no flowing wells on either of the islands of this group except Oahu, where the number is about 150 of all kinds, some of which, like those of the Ewa plantation supply an immense quantity during the year. So far there has been no diminution in the force of the water drawn from the Waianae basin, which is probably entirely distinct from that of Honolulu or Kona. The extent of the Waianae artesian basin must be very large, stretching from Pearl Harbor, under the Waianae range of mountains to Mokuleia plain, a distance of forty miles, and a possible width of eight or ten miles. Of the depth of the water in these subterranean basins, no means has ever been devised to ascertain or measure it.

The quantity of water discharged annually from the 23 artesian wells on the Ewa plantation is estimated at fifty millions of gallons per day when all are flowing. The wells flow about 200 days in the year, giving a total supply of water for the year of ten thousand millions of gallons. And notwithstanding this enormous output, there has been no perceptible diminution in the force of the water discharged.

From these facts one can form a faint idea of the vastness of the underground supply of water. And this on an island of 600 miles superficial area.

There are several wells in the Waimea district of Kauai furnishing fresh water, which is pumped, and used for irrigation on the sugar plantations of that district.

Recently two wells have been sunk at Kahului with success. From one of these 6000 gallons of water per minute are pumped, and from the other 2000 gallons per minute. These quantities are required to be pumped in order to allow the workmen to continue their work in completing the wells. As there are 1440 minutes in a day, it gives a daily output of 8,640,000 gallons of pure water to be added to the daily use of the plantation from the large well alone, provided the pumps work day and night.

There is no reason to doubt but that fresh water can be obtained in the same manner on any part of Wailuku common, now mostly a dreary waste, and that in years to come the whole of the isthmus from Kahului to Kalepolepo may be changed into a perennial garden.

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COFFEE BLIGHT AND ITS ENEMIES.

In a private letter received from a gentleman engaged in agriculture, we find a few paragraphs relating to coffee blight and its enemies, which will interest readers :

"An article published last year in the PLANTERS' MONTHLY suggested that the most effective way of getting rid of the coffee blight—the white aphis so called (*dactylopius destructor*)—would be in discovering and introducing some internal parasite. At that time, though the pest has world-wide distribution, it was not known to be liable to anything of the kind. You will be glad to learn that recently a Chalcid Fly has made its appearance in California and utterly destroyed the pest. The fly has been referred to as a new genus and called *Rileyii Splendens*. My information, which is from a private source, goes no further. It is, however, reliable. I am writing for full details by this next mail and expect shortly to receive a published account.

"The history of most of these parasites is remarkable, and the many instances in which they have totally destroyed insect pests, which threatened the very existence of many industries, affords one great hope that if this particular kind could be introduced into the islands the coffee industry would be relieved of its worst enemy.

"Spraying at the best is a cumbrous and costly operation; and, so far as is now known, no such phenomenal results as were achieved by *Vedalia Cardinalis*, in the fight with the cottony cushion scale, can be hoped for in the case of the *dactylopius* from any lady bird. The larger lady bird found in the islands (*ceccinella abdominalis*) is quite unequal to the task. There are two smaller undetermined species of whose habits little is known.

"The other blight which has recently made its appearance is a species of *puloinaria*, probably *camillicolla*. Though very unsightly it does not appear to do very much actual damage to coffee anyway."

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VANCOUVER AS A SUGAR MARKET.

The *Queensland Sugar Journal*, in an article showing the advantages of Canada as a sugar market, gives the following statement of the cost of shipping sugars from Brisbane to Vancouver, British Columbia, by steamer:

"The Vancouver refinery even now is looking our way for supplies. The freight from Brisbane is 30s. a ton, and the charges at this end 5s. The refiners will buy landed on their wharves, giving the New York price for raw centrifugals. This is at present 3¾ cents per lb., equal to £17 10s. per long ton, or 17s. 6d. per cwt. That is the figure offered for 96 deg. polarization and not above No. 14 Dutch standard in color. We might add that all sugars not above No. 14 D.S. are admitted free of duty. Allowances and deductions are made for sugar above and below the 96 deg. standard, respectively, viz., 3 cents per cwt. for every degree above, and 6 cents per cwt. for every degree below. Every precaution is taken to enable buyers and sellers to find a fair analysis, and payment is offered at 60 days after delivery. It seems to us that a shipment to Vancouver by way of trial would be a wise step. A factory making raws with an average net titre of 92 deg. would obtain £16 10s. per ton in Vancouver, as against £12 8s. 8d. on the wharves in the district of production in Queensland. Against this large margin of advantage have to be placed the allowance made by the Queensland company for bags, the cost of carriage to the port from which the foreign steamers sail, and freight and charges to Vancouver. These probably would amount in the aggregate to a considerable sum, but there would still appear to be sufficient advantage in selling to the Vancouver refinery to place the manufacturers of Queensland in an independent position."

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COFFEE CULTIVATION.

KAILUA, NORTH KONA, November 16th, 1893.

EDITOR PLANTERS' MONTHLY :

SIR :—As the coffee industry is being revived in real earnest in these islands, I beg to enclose copy of a pamphlet received from Mr. Hart of the Royal Botanical Gardens, Trinidad, as I feel sure the same will prove both interesting and instructive to many of the numerous readers of your much esteemed periodical. At the same time, if I may crave without encroaching too much on the valuable space in your monthly, I should like to add a few remarks as bearing on the enterprise in this country.

Perhaps it is needless for me to mention that the writer of the article attached to this letter is one who has not only had a long experience in coffee culture, but one who is also thoroughly versed in all the details of the industry and believes entirely in scientific cultivation as the only road to success.

Taking the headings in their order, it will be seen on referring to his remarks in connection with elevation, he bears out my theory as embodied in my prospectus issued some three years ago, viz., that a plantation in Kona should be set out at a much higher altitude than the bulk of the wild coffee found growing throughout the district. He makes a statement which is well known to all coffee planters, viz., the higher the altitude the better the quality of the coffee; and I may add, in this district, the larger the bean.

Nurseries.—When I first commenced operations for the company, I had to face a considerable amount of adverse criticism, waste of time, useless expenditure, etc., when coffee plants could be had by the million for the mere cost (?) of gathering, and I was dubbed by the natives at the start as the "haole pupule." The shape and appearance, however, of the trees on the company's plantation to-day speak for themselves.

It will be interesting for your readers to learn what another "haole pupule" (I trust Mr. Hart will pardon me) says in regard to nurseries.

Planting.—The distance apart of the trees adopted on this plantation is 6 x 6 feet, although a portion has been set out at 9 x 9 feet with a view of growing larger trees. From the experience already gained I feel convinced that the former will prove the most suitable of the two; in any case the limit should not exceed 7ft. 6in.

In the matter of holing, considering the rocky nature of this district, the Trinidad system of dibbling would never answer, and the plan adopted in Ceylon, viz., of digging large holes 18 x 18 x 18in. is the only one to insure a rapid and healthy growth of the young plants when set out in the clearing.

Weeding.—Mr. Hart's remarks as to the best season for weeding operations are not applicable to Kona; the very opposite being the case. From the wonderful fertility of the soil and the excessive moisture during the rainy season, especially at the higher elevations, it is next to an impossibility to make any headway in keeping down the weeds and especially Hilo grass.

Pruning.—With regard to the height of the trees, we are of the same opinion. The company's trees at 6 x 6 feet have been topped at four feet while those wider apart will be topped at six feet, which brings the uppermost pair of primaries within the reach of even a Japanese laborer. Any tree allowed to grow higher than this is only a waste of sap, as the crop could not be gathered without injury to the branches.

Anyone riding through the district during harvest time can see this forcibly demonstrated in trees ranging from ten to fifteen feet in height, bent and broken down in all directions. The balance of his remarks on pruning are in accord with mine, as can be seen on referring to my article on "Coffee Culture," which appeared in the PLANTERS' MONTHLY of November, 1891. As I mentioned at the time it is quite an art, and I may add it is only to be acquired by practical experience and not from a book, as no two trees are alike.

Manuring.—In Ceylon, in order to secure a crop, this work had to be performed regularly once a year, and was a most expensive operation. In my opinion it will be a long time before such a work will be necessary in that district.

Harvesting and Curing.—Mr. Hart's remarks under this heading deal minutely with every detail in the curing of the crop, and are summed up in my article already referred to. All the machinery to be employed by the Hawaiian Coffee & Tea Co. will be imported direct from Messrs. John Gordon & Co. in order that the crop may be cured in such a manner as to place it in the market in the best possible shape.

It is the intention of the company to try exported coffees with a view of producing perhaps a superior grade of coffee, even to that now existing in Kona, and which has established quite a reputation for itself abroad. Already Liberian, Peruvian, Guatemala and Bolivian have been planted, but owing to the inferiority of the seed the experiment was not very successful. I am at present corresponding with parties in Jamaica and Nicaragua for a small consignment of seed, which produces a very superior grade of coffee, as quotations from sales in the London market can testify.

Trusting that the foregoing remarks may prove of some interest and apologizing for having taken up so much of your valuable space.

I remain, sir, yours faithfully,

CHAS. D. MILLER.

[The length of the pamphlet accompanying the above (20 pages) precludes its appearance in this number, but it will be inserted in the next issue possibly.]

CORRESPONDENCE AND SELECTIONS.

CONTROL OF ARTESIAN WATER.

[Correspondence of the Queenslander.]

Kindly allow me a little space on the subject of the uncontrolled flow of artesian water, the Government Hydraulic Engineer's report on which appeared in your columns lately. That the flow should be regulated I grant, as the source of the supply is as yet unknown; but what is to be understood by the term "waste," and what are the powers to be given to inspectors? for I presume it will be necessary to have inspectors should any legislation be enacted in the matter? Mr. Henderson appears to advocate State control over all artesian bores in the colony. That this is not always an unalloyed blessing may be gathered from the Barcaldine experience, where the Divisional Board were forced to put down a bore alongside the Government well, as that water was not allowed to flow even temporarily to give relief to stock at a time of unusual drought. And what is meant by the expression that no person should have the right to bring to the surface more water than he can properly use? Is the water to be supplied to the stock in troughs as they come in for it? If so a man would have to be at every well. When a large supply like a million gallons is struck it would probably suffice for the stock in half a district, but they cannot come in to the one spot, and it is only by allowing the water to flow that a larger number are able to benefit by it. If the bores are to be shut down, so that the flow may not extend any distance, and the squatter is to be forced to sink a fresh well lower down the creek, it will not be hard to show that there is more danger of waste of the underground supply from two or more bores than from one, as the inspector cannot be always on the spot to see the control exercised.

I would point out to Mr. Henderson that the great requisite on our drought-stricken Western plains is water, and that our great object is to enable stock to get a drink without having to drag their weary frames miles across a desert plain, as in the present disastrous drought. In wet seasons check the flow by all means, but in dry weather it would be absurd to expect owners to shut down their bores.

I am under the impression that the supply of some of the American bores has been found to lessen owing to the great number that were put down within a small area. Our bores at the present time are too far apart for any immediate danger, and settlement on these drought-stricken Western plains is not likely to be sufficiently close to endanger their flow for years to come. Might it not be a safeguard to enact that none but small-sized casing, say 4in. or even less, be allowed to tap the water-bearing stratum below, for in certain districts it will soon be accurately known at what depth water is to be obtained.—I am, sir, etc.,

JOHN D. WIENHOLT.

Warenda, 3rd July.

Sir,—I am a civil engineer and one of the pioneer machine well-borers of Australia, with an American and some fifteen years' practical experience of boring for water, mostly in Queensland. I need not tell you that I have studied the question of an underground water supply—both artesian and that from moderate depths—very closely, theoretically and practically, for in the interior country, where I have passed most of my time, from the Darling Downs to the Gulf of Carpentaria, I had little else of importance to do. I may also say that in a series of letters I wrote to the *Brisbane Courier* in May, 1883, and by a pamphlet published in Brisbane in 1882 on "Artesian wells as a means of water supply for country districts," I advocated, as strongly as I could, obtaining that artesian water supply which has become within the last few years so generally availed of.

I have read with great interest a letter by Mr. J. Burkitt, of Maxwelton, in the *Queenslander* of 15th instant on the subject. Mr. Burkitt takes a generous optimistic view of the quantity of those supplies and their permanence, and alludes to the last report of the Department of Water Supply, in which the Hydraulic Engineer seems to be somewhat doubtful of both. The engineer says, however, that whilst he is aware that the views he has expressed meet with the approval of some artesian well-owners and many intelligent Queenslanders, others equally intelligent and who are also interested in the subject hold contrary opinions, for which, although he does not agree with them, he entertains very great respect, and that in making the foregone remarks he was not unmindful that he was traversing ground exposed to some doubt and discussion, and that he sees no reason why the subject should be avoided. This I take to be a very considerate and liberal position for the Hydraulic Engineer to take up. As a member of the leading civil engineering association in the world, the Institution of Civil Engineers, London (it is to be regretted that there is not yet a similar arena of discussion in Queensland), the Hydraulic Engineer knows that there is nothing lost by fair discussion, and that although all theories and opinions cannot be right, those of the public directly interested are placed in a position by the publicity afforded by the public Press in these discussions of fairly judging between them.

In the pamphlet I speak of, published in 1882, was the following, which I submit still holds good: "The geological formation of artesian basins varies in different localities, but, broadly speaking, the lower impermeable or primary bed rock consists either of silurian metamorphic, or granite rocks. The newer formations which fill in the basin, or trough, are various in character. Cretaceous or upper mezoic rocks overlie the palæozoic rocks or miocene, or middle tertiary formations. The bed rocks are practically impervious to the escape of water in large quantities, but in all the newer formations there exist cavernous spaces through which water can readily percolate, and it is in these newer formations that search for artesian water will prove successful. The Australian continent may be described as a huge basin, the edge of which consists of an elevated coast range. The interior of this almost entirely consists of and is filled in by the newer formations, the isolated ranges being peaks protruding through them, consisting of the older or bed-rock formations alone. During ages of time the action of flowing water from the coast range and from the secondary ranges of the interior has been producing constant changes in removing the denuded surface, making valley-like depressions in the surface, through which the excavated material has been carried and deposited at lower levels. By this means the great central basin has been formed, and of this there is ample evidence visible in the interior in the mud plains, in the river channels, and in frequent remains met with of what geologists call desert sandstone. Denudations of still older formations have been planed off down to the vast granite masses that everywhere form the foundation of the Australian continent.

"In this great embracing basin are interior and local ones lying, as before stated, between the outcrop of the impermeable rocks, in which the true artesian water will be obtained. Allowing for evaporation and the quantity of water passing down the surface rivers and creeks of this colony, that passing away underground, after the basins have been surcharged, must be enormous, the great tropical rainfall in the North, the rapidly absorbing nature of the soil over vast tracts, the short rivers or creeks, which eventually lose their water by soakage, all tend to show that a very large percentage of the water passes underground to the ocean. The strata from which good results will also doubtless be obtained are those alluvial beds of sand and gravel which are in the leading valleys and extend to very considerable depths, covering the sites of ancient watercourses. It is also probable that the great plains of the interior may contain tertiary beds of great thickness in which an abundant supply of water could be obtained." (This has been amply proved since the date of the pamphlet alluded to, 1882.) "Wells have been made through clay and marl, when a plentiful supply of water has been obtained. In some localities a limestone formation exists overlying sandstone. This formation would be very likely to afford large supplies of water by means of wells, as the rain from the surface of these generally flat and sandy districts percolates through porous beds of sandy clays, gravel, and sand down to the limestone beneath."

Your correspondent, Mr. Burkitt, in discussing the theory presented by the Hydraulic Engineer, that the inlet of artesian water is confined to a length of 1600 miles, with an average width of only about an eighth of a mile, asks—"What becomes of the drainage from the great extent of country lying between the sandstone outcrop and the top of the Dividing Range to the east ? and further says that the course of the outcrop being from north to south, and the fall of the country from east to west, the drainage must find its way to the line of the former, when it is probably disposed of as follows :—First, by flowing over the outcrop on to the impervious cretaceous shale, thus being practically lost, so far as artesian water supply is concerned. Secondly, by direct soakage into the sandstone strata against which it is projected, and by percolation under the sandstone and through the softer palæozoic rocks, ultimately being forced into the superincumbent sandstone strata by hydrostatic and thermal pressure."

A close theoretical and practical study of this whole subject of artesian water supply has led me to reason upon it as follows :—The crust of the earth has been disrupted and upheaved, producing fissures or chasms of unknown extent, form, and direction, which have become filled in in many cases with strata of a more or less porous (water-bearing) nature. An enormously wide and extended area of country also consists of successive layers of the same aqueous water-bearing rocks. If the great bulk of the accumulated rainfall of centuries—ay, of ages of time—in the interior of this country had not found its way underground to its lowest level—the bed of the ocean—unseen and unrecorded, the interior of this continent would long ago have been a mere swamp. The paucity of surface river channels to carry the rain water away, the peculiarly porous, absorbent nature of the soil in the great plains of the interior, all warrant us, even after a deduction is made for evaporation (some 10 per cent. per annum only of the yearly rainfall), in assuring ourselves that vast quantities of water are stored up underground in porous (water-bearing) strata (it must be borne in mind that all rocks, except the bed rocks—silurian, metamorphic or granite—are pervious under certain conditions of pressure from large adjacent accumulations of water), the overflow from which is passing without cessation along the porous water-bearing strata, with their connecting fissures and channels, to its final, lowest level, the bed of the ocean. The water-bearing basins of this country must really be enormous, extending as they do from South Australia and New South Wales to the Gulf of Carpentaria with a varying breadth of many hundred miles; and with all due respect to the opinions of others, it is, I submit, hard to believe, after a very close study of the subject for a great number of years, that a mere few hundreds of bores, with a 6in. discharge, can curtail the permanent supplies; nor do I for one moment believe that very many thousands of similar undertakings would trench in a detrimental manner upon the enormous supplies which are, if we so will it, at our disposal.—I am, sir, etc.,

W. G. Cox, C.E.

Brisbane, 24th July.

On this question "Spinefix" writes from Western Queensland to the *Pastoralists' Review*:

I beg to lay before you some cogent reasons why the foolish and mistaken policy advocated by some people with regard to enforcing the screwing down of all the bores should not be adopted by colonial legislatures, as action of this nature would be most detrimental to all the colonies and effectually check all future enterprise in this direction. The effect of putting private bores under Government control, and regulating the supply, would be an intolerable nuisance to the plucky Government tenant who has, after heavy expenditure, been lucky enough to strike the artesian supply, and would create an increase in that already too large body of men, *i.e.*, the "Government stroke" inspectors, who loaf on the Government and help to absorb our yearly diminishing public income by drawing salaries for doing little or nothing. The effect of screwing down and absolutely stopping the flow of bores has proved in many cases disastrous to the bore, forcing the water between the casing and the earth and running the supply away underground in various directions; in some cases the water has made its appearance a long distance from the bore site. It is needless to remark that this literally ruins the bore.

It is self-evident that, in the far Western parts of Queensland, where there is little or no water, and the rainfall is very light, no sane man would go to the expense of experimenting in sinking a bore unless he was free to run the water from paddock to paddock down natural watercourses, if he struck a good supply. To get a good supply of artesian water at any spot, say, fifty miles from the edge of the large cretaceous area of Western Queensland, means sinking from 2000ft. to 4000ft., at a cost of from £3000 to £10,000, with the chance of having to abandon the bore before completion, either from encountering strata, such as quicksand, or some other formation that blocked further operations, or from his failure to strike artesian water at all. Take, however, the case of a man who spends £5000 to £6000 to sink a bore 3250ft., which result would be a marked success, and cheap work, too; say, he gets a supply of 1,000,000 gallons per twenty-four hours—sufficient to run one of our dry Western watercourses twenty-five miles, and water paddocks capable of carrying 70,000 sheep—what would be the feelings of this man if his bore was immediately taken possession of by a Government turncock, who informed him that he was going to screw it down and regulate the supply, probably, also, insisting on the water being confined to one place in a paddock. The result of this action would be that the bore would be of no more use to the squatter than a well or dam in a large paddock to which all the sheep would draw, thus utterly perishing all the grass within a radius of say five miles of the bore site in a time of real drought. In other words, in order to induce squatters to spend large sums of money in boring and watering immense tracts of the driest country in Australia, it is absolutely essential that they are allowed to run the water to their stock from paddock to paddock, or they will achieve no adequate result in any way proportionate to the immense expenditure that is necessary to develop the country, for it must be borne in mind that dams and wells are practically useless in this class of country, the former invariably silting up in a very few years, and the latter only striking water at immense depths if at all. I would also point out that the result of allowing the bore water to flow along the course of our shallow Western creeks has another distinct advantage that should not be lost sight of—namely, that in times of drought a great quantity of fresh green feed is produced, and this feed can be increased by blocking the watercourse here and there and allowing the water to irrigate adjoining flats. I saw this forcibly demonstrated during the late drought, and it is wonderful how the sheep benefited by depasturing on the green feed thus provided for them in patches scattered here and there on vast dried-up plains.

Another very forcible argument against this proposed tampering with the bores is the fact that, so far, it is absolutely patent that there is no diminution in the flow from any bore unless the bore has been injured by screwing down, as before explained, or was not faithfully sunk and tubed, in which latter case some falling in of the surrounding earth may have stopped the flow, and this defect is as a rule easily rectified. Bearing this fact in mind, it is apparent that stopping the flow of a bore by screwing it down is not only a useless expenditure, but an act fraught with much danger to the permanence of the bore. In the last report issued by the Hydraulic Engineer from Brisbane he throws out a very good suggestion with regard to ascertaining whether the flow from any bore increases or diminishes in volume from year to year —his plan is very simple, and merely entails the boxing of the channel that receives the overflow from the bore for a few yards—by measuring the width and depth of the water flowing through this open drain the number of gallons per twenty-four hours can be easily calculated, and any diminution of the flow detected. If at the end of a year it is proved that the flow remains the same, it is foolish to check the supply, and thereby endanger the efficacy of the bore. It is, therefore, to be hoped that every one who bores will resort to the use of this simple means of accurately gauging and watching the overflow. Arguments are freely made use of with regard to the falling off of the artesian supply from American bores. These, however, are in no way applicable to Australia, as the geological formation of the two continents are absolutely different. In Australia it is believed by geological scientists that the supply of water is inexhaustible, the area of the cretaceous formation being of immense extent, and the sandstone underlying this, supplying the water, being fed by the sandstone country comprising the rest of our enormous continent.

Although my remarks apply to bores in general, there is a certain justification for Government action in controlling the flow from bores sunk by aid of public funds, which bores are used for the supply of water to townships, travelling stock, etc., and in such cases it is absolutely necessary to exact some payment. Still, as I pointed out before, this "shutting down" is attended with great danger to the bore, and may result in the ultimate loss of the water supply. Still, private individuals must pay for water supplied them from bores sunk with Government money, and the only way to arrive at the amount to be paid is by screwing down the bore and chancing results. It would, however, be worse than madness to apply such restriction to private bores.

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DROUGHTS.

[Tropical Agriculturist.]

A drought is generally taken to mean in agriculture a want of rain. This condition is a very common one in the Eastern tropics, and is attended with special disaster in rice-growing districts. The want of rain is frequently given as a cause for the failure of the paddy crop, while from the fact that grass and other short-rooted fodder crops are easily killed out during severe droughts, the prolonged absence of rain has a most important bearing on the management of the stock. On a recent visit to India we found that the severe drought that prevailed in the Southern districts during the first part of the year was the means of greatly reducing the number of cattle in those parts. On enquiry we learnt that the owners of stock, driven to their wits' end in the fruitless attempt to keep their animals from starvation point, were compelled as a *dernier resort* to part with them for one-fifth and less than a fifth of their values either for the butcher or to be removed to less drought-stricken districts. We have since read of how even English stockowners have been compelled to part with their animals to the butcher during the late unusual drought that prevailed in England; while in France a similar condition of affairs drove farmers to look for fodder in the trees of the forest, whose nutritive qualities Necessity has brought to light. Indeed the apparently general drought that lately prevailed compelled the natives of some parts of India to find sustenance in mango kernels and mhow flowers.

Professor Warington, the well-known agricultural chemist, had seized the opportunity when farmers in England were sorely troubled for lack of rain to deliver a homily on "drought," in its scientific aspects, and it would be worth our while to ponder over what he has said on the subject.

In agricultural text-books statements will be found as to the power of certain soils to maintain a moderate degree of moisture, even in the absence of rain. We are told that clay and humus are hygroscopic, especially the latter; that is, that when they have been perfectly dried, and are placed in moist air, they absorb a certain amount of water. The true hygroscopic action is, however, very limited even under favorable circumstances, and the amount of moisture thus obtained would be quite insufficient for plant nutrition, save in the case of the small growths of some of the lower organisms. The condensation of moisture from the atmosphere may. however, become considerable when changes of temperature intervene, and water is deposited in the soil as dew, and this is undoubtedly a powerful agent in renewing the moisture of the surface soil. The soil being cooled by night radiation, the moisture of the atmosphere is condensed, not only upon it but within it if the soil has undergone a proper tillage; and the plants, which in the evening appeared limp are in the morning again fresh and vigorous. The water thus condensed at the surface may not in all cases be derived from the air; the vapour of water rising from a moist subsoil may be condensed at the cold surface; but for this to take place after drought has long continued, a soil of very open texture would be required. In the case of gravels, this supply of water vapour from below is very important. For the condensation of water from the air to be of really practical effect, it is of course essential that the air should be sufficiently moist, and this condition generally fails when a drought has long continued. Land in the neighborhood of the sea possesses considerable advantages in this respect, and crops in such localities suffer distinctly less in time of drought. As already mentioned, the amount of condensation in a soil depends greatly on its being in a porous state, the result of good tillage.

The amelioration brought about by atmospheric moisture can be looked on only as a mitigation of drought; for any considerable supply of water in the absence of rain we must look to the stores already in the soil. Much depends on the distance of the water level below the surface; if this distance is only a few feet, crops should suffer but little in time of drought. Where, as is generally the case, the water level in the soil is at a considerable depth, the supply of water at the surface must depend (1) on the power of raising water by capillary attraction possessed by the subsoil: (2) on the water-holding power of the soil and subsoil; (3) on the amount of evaporation taking place at the surface.

The height to which water can be raised by capillary attraction depends on the narrowness of the passages through which it rises; the narrower, however, become the passages, the slower becomes the rate of ascent, so that a practical limit to the action of capillarity is soon reached. The action of capillarity in bringing water to the surface from a considerable distance beneath is much smaller than is commonly supposed. When the surface soil is far above the water level its water-holding power is determined by the amount retained on the surface of its particles. in its pores, and in the finer capillary tubes; the wider tubes are all empty. Humus has a far greater power of holding water than either clay or sand, being far more porous in its nature. According to Schlœsing, some extremely fine sands, containing no cementing material, exceed clay in their power of retaining water. Such fine sands, resembling silt, constitute some of the most fertile soils, especially when of a good depth. Much may be done to increase the water-holding power of heavy soils by deep tillage and subsequent pulverising of the soil; also by increasing the proportion of humus by the use of farmyard manure or other means.

The next important point to be borne in mind is the loss of water from the soil by evaporation. All soils when saturated with water lose by evaporation at an equal rate, but when partially dry, evaporation proceeds more rapidly in a coarse soil than in one consisting of fine particles. Here again the advantage of good tillage is apparent. The greatest amount of evaporation takes place when the soil is occupied by a crop in full vigor of growth.

The object of the farmer in a time of drought is that the crop shall have the full benefit of the water still in the soil, and that as little as possible shall be lost by surface evaporation. Much may be done to attain this result. By shallow surface cultivation, leaving in a loose state a couple of inches of the surface soil, the evaporation of water is greatly hindered. When the soil remains solid any loss of water at the surface is replaced from beneath, and so the loss becomes continuous; but after the surface soil has been stirred, it dries without again absorbing water from below, while it effectually protects the lower soil from the action of sun and wind. The mulching employed by gardeners, and the application of cocoanut fibre, are still more effective plans for preventing useless evaporation from the soil.

A Veterinary authority treats of the effects of drought on animal health in an article in a late number of the *North British Agriculturist*. He states that a scant and diminishing supply of water, which threatens many parts of the country, affects in many ways the well-being and life alike of man and beast. As essentials for animal life, next after continuous supplies of fresh air, come frequent supplies of pure water. The bodies of domestic animals contain nearly 60 per cent. of water, which is not only a necessary constituent of every tissue, but is requisite for digestion, absorption and nutrition; for the regulation of animal temperature; for the solution and washing out of waste products. From air passages, skin, kidneys and bowels, fluid matters are almost continuously excreted, and the loss thus sustained must be made good by the ingestion of water or watery food. During such hot weather as has been recently experienced, the skin secretions are greatly augmented, necessitating increased recuperation of fluid matters. Horses at work during hot summer weather and living on mixed diet, will take daily 15 to 25 gallons of water, while cattle will drink even more; and sheep, although popularly believed to be independent of water, when the air and food are dry, consume 2 to 3 gallons daily.

A restricted water supply seriously interferes with thriving. The thirsty animal will not eat, no matter how tempting the food may be. So long as strength remains, it moves restlessly about; the mouth and throat are dry, and the tongue usually swollen and protruded; febrile symptoms supervene; and, where privation of water is absolute, exhaustion and death occur in a few days. Occasional, or even, continued, shortage of the fluid nutriment does not always produce notable immediate effects. The hair or wool may be observed to be dry and harsh, the animal does not grow or gain weight, the bowels are usually torpid, the urine may be high colored and concentrated, and hence will irritate the excretory passages. Unless, however, the restriction is of short duration, more serious and permanent mischief results, especially in young cattle and sheep. The animals become gradually more thriftless, there is gastro-intestinal derangement, the skin is scurfy, the mucous membranes pallid, frequently jaundiced. Change of food, good nursing, and medicinal treatment in such cases are seldom of much avail. The patient pines, and perhaps six months after the mischief has been done dies, and the chief morbid condition discovered is a shrunk, hardened, fibroid liver.

Protracted drought not only affects the quantity, but also the quality, of the water supply. In a densely-populated country, the risks of sewage contamination are greatly increased. As rivers, streams, springs and pools rapidly evaporate under the solar heat, and are freely absorbed by the dry-baked soil, the water is apt to contain a large percentage of impurities, notably of injurious organic and organised materials. It is thus that springs, wells, and more especially pools, particularly if they have no fresh stream constantly passing through them, become dangerous sources of drinking water. Such contaminated water produces diarrhœa, often of a serious, sometimes of a fatal, choleraic type. Not infrequently such supplies become deadly from admixture with anthrax virus, and the increase of such cases recently reported from various localities may probably be thus accounted for. Many instances are on record of pools, which for years had with impunity been used for watering the stock of the farm, becoming during dry seasons so impregnated with putrefaction products that fatal anthrax occurred, not only in cattle drinking therefrom, but in the horses, hogs, sheep and even in the poultry.

When any particular variety of food fails, others may usually be substituted for it; but there is no substitute for water. Practically, there is also but one source of it, namely, the clouds. Notwithstanding American projects, neither electrical nor other methods will coerce them to part with their contents. The best must, accordingly, be made of available supplies. In view of dry seasons like the present, live stock farms must be better furnished with such a prime necessary. An adequate permanent supply must be got, even if the cost be considerable. Streams and springs must be more carefully and economically utilised. Loss and waste must be guarded against.

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AGRICULTURAL MACHINERY AT THE WORLD'S FAIR.

[CORRESPONDENCE OF QUEENSLANDER.]

No country can dispute with the United States of America the title of holding foremost rank in the invention of labor-saving appliances for agricultural work in the out-turn of such manufactured appliances, and in their intelligent application on every farm, large and small, throughout the length and breadth of the land. The enormous number of firms engaged in the production of agricultural machinery, and the bewildering multiplicity of their devices, are revealed by a visit to the annex of the Agricultural Hall at the Chicago Exhibition devoted specially to this department. When it is explained that this annex is 550 feet long by 300 feet broad, and covers close upon four acres of ground, that each individual exhibiting firm has a space of only forty-five feet by twenty feet, and that every square yard of the great floor is occupied, an idea may be conveyed to those who do not visit the Fair of the magnitude of the display. Additional interest and value are secured by a large proportion of the exhibits being in motion, the action of harvesters, cultivators, hay presses, feed cutters, seed drills, threshing machines, water elevators, agricultural engines, etc., etc., thereby being illustrated so far as can be without the performance of actual work on the field or in the farmyard.

An observer would have to spend weeks among the agricultural implements at the Fair before he could hope to investigate the special advantages claimed for the thousands of machines displayed, and a newspaper writer would have to secure à monopoly of space for a whole month before he could describe each and everything of interest to be seen. No brief review, therefore, can be anything like exhaustive, and I can only hope to spot points some of which may be new to colonial farmers. Perhaps the most striking general feature of the show is the extension of the use of steel in the manufacture of agricultural machinery. Heavy and cumbrous wooden boxes, bars, and other parts are everywhere being displaced by the light and durable metal compound, some of the harvesters shown having hardly a piece of wood used in their fabrication. Another point is the very general return to the type of harvester known as the "low down." This type is not new, but early in the history of these appliances was discarded, by reason of certain mechanical difficulties, in favor of the bigger machine, which was found to handle the grain more conveniently. In answer to the demand, however, for a handy, practical two-horse harvester, the mechanical difficulties standing in the way of application of the "low down" principle have now been fully overcome, and almost every firm of exhibitors concentràte their attention in displaying machines of this class. In the matter of corn cultivation, a change has recently come about in favor of shallow sowing, this principle being now taught in all the American agricultural colleges. Accordingly, there are quite a number of new corn cultivators which claim to meet the requirements of the altered system. Another feature is the extension in the use of adjustments, whereby, as in the case of an up-to-date sewing machine, a single frame of an implement may be used for half-a-score of purposes, such as sowing, applying fertilizers, rolling, harrowing, pulverising, cultivating, and cutting down.

Of harvesters, to which agriculturists in new countries owe almost everything, it is almost unnecessary to write, as all the famous patterns are known throughout the colonies. It is less than fifty years since the first really practical reaper was built, and it is forty-five years since the first reaper factory was established in America. It is true that in Great Britain during the first quarter of the century several attempts had been made to produce harvesting machines, but nothing was developed that had sufficient merit to find favor with British agriculturists, and apparently all efforts of the kind on that side of the ocean had been abandoned when during the "thirties" the experimental machines of Hussey and M'Cormick began to attract attention in America. It was in 1845 that Cyrus H. M'Cormick succeeded in getting his machine manufactured. It was a crude affair that he brought to the Globe Works at Brockport, New York State. There was no driver's seat, and the man who raked off walked beside the platform. The gearing was imperfect, and the sickle was but a thin straight strip of steel, serrated reversely on the front edge every four inches or five of its length, and liable to be clogged at the slightest provocation. Yet, though so coarse, immature, and imperfect, it was a machine with which it was possible to cut grain when the conditions were all favorable. Various trials, however, suggested various improvements. It was cut down a little here, strengthened a little there, and generally brought into better form. The raker sat astride a saddle provided for him in the rear of the gearing, and used an ordinary hand rake; but the driver rode a horse or walked, for still there was no seat. In the result, 100 reapers were built for the harvest of 1846—the first quantity of harvesters ever put upon the market and sold. Since that date hundreds of improvements have been made, and it is interesting at the Chicago Fair to look upon one of the first reapers made close upon half a century ago, and contrast it with the beautiful machines of steel that are being manufactured to-day, and are shown in many rival forms at the great World's Exposition.

One novelty in harvesters may be mentioned. It is a small compact machine adapted for virgin land that has been sown with wheat without being ploughed. It has very high driving wheels very wide apart, and the cutter bar is controlled by the foot instead of by the hand, so as to give the driver full control of his horses in rough country. The bar is thereby raised to pass all obstructions. The machine is uncommonly strong and handy, and is eminently suited to the wants of pioneer farmers in new country.

Haying implements of many kinds play an important part in the exhibition. Owing to the cost and distances of transport, hay presses are coming into very general use in America. Quite a large number are shown, worked either by hand lever power, horse power, or belt power transmitted from an engine. By all of these the hay is compressed so that from 150 pounds to 175 pounds is put into neat compact bales of such dimensions as seventeen inches by twenty inches by thirty-six inches. The machine is taken out right into the fields, and as rapidly as hay can be fed to it the whole harvest is converted into bales. The advantages for transport and storage are obvious, and the hay loses none of its good qualities by the process of compression. Indeed, the fodder preserves its goodness and sweetness for a longer time when compressed than when stored in the ordinary loose manner. This fact, it may be mentioned, is appreciated by the heads of the Indian Army, in which compressed hay, originally introduced with a view to overcoming one of the gravest military problems in India—namely, that of transport, is now in universal use. The subsidiary advantage is claimed for the hay presses that they can also be applied to a variety of purposes, such as baling wool, hops, rags, etc., so that they are an exceedingly handy machine to have upon a farm.

Any number of hay rakes are shown, also a variety of hay tedders, a machine which follows the mower and tosses the hay about, leaving it open to the air and sun warmth, and therefore causing it to mature rapidly. A side delivery hay rake is a novelty. It sweeps the cut grass out to the sides, gives it a long lay on the patch instead of a cross lay, teds the hay, has no forks to drag up dirt, and easily passes over all obstructions. A hay loader is shown in operation. It is used to put any kind of hay or grain, loose or in cocks, on to the wagon, and the machine is easily hitched to an ordinary hay wagon without special preparation. A light steel rake collects the hay in front of the wheels, making a bunch automatically, which a light revolving rake in the rear lifts into carriers, whereby it is taken up smoothly without threshing or pushing. While moving up the carriers, the bundle is narrowed from eight feet at the bottom to four feet at the top, where it is delivered on the load in a compact forkful. These forkfuls come up as fast as two men can arrange them on the load, and the motion of the wagon does not interfere with the men putting on a load in a few minutes. Next to the horse rake there can be little doubt that no implement used in hay-making is more useful or saving of money than the loader. It affords facility for securing hay, which under the old style of hand labor would be damaged in showery weather. The saving of actual labor in pitching hay on the wagon in the meadow is very great, the pitching by hand being the slowest and hardest part of hay-making. But the saving of labor is not the greatest saving made; this lies in the securing of hay when ready for the barn or stack before it is damaged by rain. If a farmer has twelve loads cured ready for the barn, and can by hand secure but half of it during the day, the other half must remain and take the chance of getting wet, and may be utterly ruined before the weather allows of its being secured. With the aid of the loader the same help that drew in the six loads would have secured the whole twelve, thereby saving six loads. Such are the claims advanced for the hay-loader, which is in extensive use throughout the United States.

Numerous varieties of feed grain and fertilizer drills are on exhibition. In these steel frames are almost universally used, and the machines are light and elegant. The use of double hoppers enables the phosphates—the use of which is so important in old wheat country—and the seed to be put in the ground at the same time, and light trailing chains smooth the soil over the drill. The machines can be adjusted so as to sow the seed and distribute the fertilizer in drills, in hills, or broadcast. For all kinds of sowing the amount of seed and fertilizer can be regulated to a nicety, and the regulators, which fix the proportions at four pecks, three and a half pecks, and so on to the acre, are marvels of effective simplicity. The mere turning over a plate enables the machine to be used for fine grains, such as wheat, or coarse seed, such as maize or beans. So nice is the adjustment of parts that in the case of one machine I saw it sows a single grain at the same moment in fourteen parallel drills. The old system of weights is abandoned, and instead strong adjustable springs regulate the fraction of an inch the depth to which the seed is sown. Every little bit of these truly wonderful machines is patented, and there is the keenest rivalry among the competing firms engaged in their manufacture. One firm has glass cups for the phosphates and another firm porcelain-lined cups, both subjects of distinct patents, and equally superior to the old iron boxes which the acids in the phosphates caused to corrode and wear out. Altogether these drill seeders are beautiful works of mechanical genius and patience. Quite a number of them are in the market, and their cost in America is about $75. To illustrate the use of adjustments, I may mention one machine of this class that in its first form sows broadcast and covers all kinds of grain and fertilizers. In its second form, and by the simplest of changes, the fertilizer is used without the grain seeder. By removing certain other parts the farmer has a harrow and cultivator for spreading earth around the tender shoots of corn, beans, potatoes, or any crop planted in rows any width apart. A further simple change gives a bean harvester, which uproots the crop and causes it to fall in bundles, harvesting from twelve to eighteen acres per day. Another adjustment enables cornstalks to be cut, chopped up, and returned to the soil as a fertilizer, the ground thus being cleared for future cultivation. The total cost of this machine, with its various parts, is $142.

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CALIFORNIA IRRIGATION.

[Correspondence Independent.]

A gentleman who was visiting California a few years since remarked: "Water is the only thing that is scarce in this great State of magnificent promises, mighty performances and unlimited resources."

Less observing tourists, who have only seen the copious showers and week-long rain storms of a California winter, or have witnessed the overloaded rivers and flooded plains, have naturally inferred that water was adequate to every purpose, and a plentiful supply was assured for grain fields, fruit orchards and vineyards for one season at least.

But when the rainless period of the year arrives, and the winds cause rapid evaporation, the smaller streams quickly cease to flow, and grain, vegetables and orchards begin to suffer. In some portions of the State vegetation would perish entirely were if not for water artificially applied to the parched earth. Therefore a California orchardist who would see his trees dressed in green, his oranges in gold, and his grapes in purple, should know that his thirsty trees and vines are well supplied with water, which is their very lifeblood.

In former years irrigation was practiced on a small scale by means of common wells, or artesian wells, owned by individuals or local corporations. This system is a convenience, because a well-owner can use water when he desires, and is independent of a large company which would make him wait his turn to use the ditch belonging to them.

It has been asserted that the great advance in population and wealth of Los Angeles, San Diego, Fresno and other towns of Southern California, has been greatly due to the present system of irrigation. Thousands of acres which have long laid dormant have been changed from dried-up plains and hillsides into fruitful orchards and vineyards by means of irrigation.

According to the Census Bulletin, California has nearly one thousand more artesian wells than any other State or Territory mentioned. San Diego County is reported as having sixty flowing wells, with an average flow of 112 gallons per minute. Los Angeles County has 627, and Orange County 649 artesian wells, the latter being the largest number in one county in the State. The deepest well in Orange County is reported to be 600 feet, and the most shallow but 20 feet in depth.

The Bakersfield Echo says, that in several instances it has been proved that there is artesian water under that whole valley, and it may be secured by boring down 100 feet. In some cases these wells have been drilled for domestic use, and for the purpose of watering stock, the surplus water being used for irrigation. In Nevada County immense reservoirs are found near the mountain summits. These artificial ponds were originally constructed for hydraulic mining purposes, but when hydraulic mining was forbidden by the courts, the water became available for other purposes. Some mining reservoirs were very expensive. The capacity of one of the largest, the Yuba Company's, is 1,800,000,000 cubic feet, according to a reliable statement. One has a dam 100 feet in height, and a waste dam of 50 feet. The Eureka Lake reservoir covers an area of 337 acres. The expensive ditches connecting with lakes were sometimes from fifty to one hundred and fifty miles in length. Much of this water is now available for agricultural purposes.

There are several very large storage reservoirs in the southern portion of the State, chiefly used for irrigation purposes. The first one constructed in San Bernardino County was a grand success, and it waters a vast extent of territory. The average rainfall in that country for January, there the wettest month of the year, is said to be but a little over three inches. The rainfall in Grass Valley, in Nevada County, for the same month in various years, is recorded as over ten, fifteen and nineteen inches, and only one year in thirteen seasons has the fall of water been recorded as but 3.05 inches for January.

The formation of irrigation districts, under the so-called "Wright law," has caused great progress in the growth of irrigation, as well as in the increase of fruit orchards. In order to obtain the necessary capital, the benefited lands are bonded. An election is held, bonds to a certain amount are approved for a certain number of acres, and the court passes upon the validity of the proceedings. There are said to be thirty or more such districts in this State. Vast tracts of land have greatly increased in value within these districts, and a vast improvement has been made in changing the face of Nature from dry, unfruitful land into green, fruitful orchards. Several Supreme Court decisions uphold the legality of the irrigation bonds of at least some of these districts. The Coyamaca and the Sweetwater reservoirs in San Diego County are pronounced as being very successful.

When these immense storage reservoirs are opened this event is usually celebrated by the people of the section, or district, by great rejoicings; for this opening marks an epoch in the growth and development of the surrounding country. When the Perris system was opened in Southern California, more than a year ago, a special train ran from Los Angeles, stopping at intermediate stations for passengers and a brass band, and the ten carloads of people were met by another brass band at Perris, and a local reception committee took the visitors to a magnificent dinner prepared by the Perris Valley ladies. After dinner brief addresses were made, the visitors were shown the surrounding country in carriages, and a grand ball closed the celebration.

The Perris system brought "under ditch" 30,000 acres of fine grain and fruit land. The water is brought from Bear Valley, a distance of forty miles. The cost of the system was $442,000. The water is carried through pipes, tunnels and canals from the valley. It has been proposed to make a display at the World's Fair of the progress of California in irrigation. Models of wood, earthen and iron flumes might be of great interest to persons unaccustomed to them, and it is believed that Eastern agriculturists might learn valuable lessons from such an exhibit.

There is a large growth of individual interest in irrigation since the subject has been better understood, and since irrigation works have proved so successful. Available springs are used more than formerly, windmills for forcing water from wells are very common, and artesian wells have added millions of dollars to the wealth of the State. The natural flow of water is being saved by means of pipes and cisterns. In some places tunnels have been run under the bed of streams to catch the underflow that it might be used for orchards or vineyards.

In many portions of California a farmer must not only know how to plow and sow his fields, but how to irrigate to the best advantage. In some places water is turned upon the land in a continuous stream; in other sections iron pipes are used having a stop-cock at points where the fluid is most needed. It is said that an average irrigated California farm seldom exceeds thirty or forty acres, although there are many much larger. Ditch water is sometimes objected to because it is liable to carry the seeds of weeds, etc., upon the fruit land. Well-water is colder, sometimes too cold for vegetation when the weather is very warm, but it leaves no deleterious seeds behind.

Those who loan money upon land feel more security if there is a plenty of water for irrigation at hand. It is stated that some loan organizations refuse to loan money unless orchards are irrigated. Much satisfaction was expressed in regard to President Harrison's message after visiting the arid regions of California last year. He recommended timely legislation in regard to the water supply furnished by streams in California. He doubtless saw the great need of preserving the forests that cover the watersheds of the State. "Without our forests, without our farms" has often been repeated by agriculturists. A denuded mountain forest, that has previously preserved the deep snow, may result in floods in winter and great drought in summer.

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IMPROVEMENT IN SUGAR-PRODUCING PLANTS.

[LOUISIANA PLANTER.]

Youmans has said: "Progress moves in waves; ideas belong to eras." Certainly this seems now to be true in improvement of the sugar-producing plants—sugar cane, sugar beets and sorghum.

In each of these lines new facts have been recently discovered, old ideas have been questioned and former opinions have been reversed.

A few years ago Messrs. Harrison and Bovell questioned the accepted idea that sugar cane never produced fertile seeds, and they revolutionized accepted theories by proving that new varieties can be produced from sugar cane seed, thus opening a new way for the improvement of sugar cane.

A little later Prof. Nowoczek questioned the accepted idea that beets could be produced only from seed. He proved that it was possible to produce 116 superior beets from a single selected beet, without seed.

Still more recently, at Calumet plantation, the accepted idea that plants which are propagated by buds only, cannot be improved by selection of the best for planting, seems to have been successfully questioned. It was found that there are decided differences in values for sugar manufacture in canes of the same variety in the same rows, and an effort was made to determine whether the poorer produced as good canes as the better. Existing theories and all practice had long decided that sugar cane could not be improved, because it is propagated by buds and not by seed.

In recent years the Department of Agriculture has attempted the improvement of sorghum canes by introducing new varieties, and also by selecting seed from the best canes, following closely the methods which were used in improving the sugar beet. As could have been foretold when, as in this case, there was a multitude of untried varieties by crossing, and privilege of selecting seed from the best canes, where, as in this case, no selection for sugar making purpose had ever before been attempted, improvement in the quality of the canes was easy and rapid.

It seems singular that millions of sugar cane growers should have been ignorant so long of the fact that sugar cane does produce fertile seeds in favoring circumstances.

It seems singular that millions of sugar beet growers never knew that a remarkably rich beet could be rapidly multiplied by cuttings.

It seems singular that the belief should so long have been held that one sugar cane was as good for planting as any other cane of the same variety.

And it seems singular that sorghum which came to this country from barbarian countries forty years ago has waited until now for the first attempt at improvement by selection of seed.

In reference to sugar cane the opinions which have been held, until recently, by scientific horticulturists everywhere were well expressed by Mr. D. Morris, assistant director of the Royal Botanic Gardens, at Kew, the largest establishment of the kind, in an address before the London Chamber of Commerce in 1888.

"It is well known that the sugar cane does not produce seed, and hence it is impossible to improve it by processes which have been so beneficial to other plants. If sugar cane was capable of being improved by experimental processes, like those which have improved the beet, this would be one of the most effective means of benefiting the industry."

It is remarkable that Darwin, Morris, and other scientific men urge planters to keep keen watch for marked variations in type, which very rarely occur, and to plant them so as to produce new varieties, while they offer no advice in regard to selecting the best, which always occur, in order to improve the variety. The theory seems to be that extravagant variations in type will be truly propagated, while it is useless to attempt to propagate differences in quality of juice.

The facts seem to be that the germ of a bud and the germ of a seed have almost absolute identity of character, both produce varying plants, the bud varying less than the seed, because entirely free from the disturbing influence of foreign pollen, but the variations, in both cases, are inheritable. Sir H. Holland said: "The real subject of surprise is not that a quality should be inherited, but that any ever fail to be inherited." By planting the best the superior variations are preserved, the inferior are rejected, and the superior variations are accumulated, added together, until a superior variety is formed—*Omnes, Græci, Arabes et Latini in eo consentiunt*, as Ranchin states it.

A leading agricultural paper, commenting upon the experimental work at Calumet with sugar cane, says: "The method of improving plants propagated by bud by selecting buds from the best plants may be used with advantage in other lines. For instance, the Ben Davis is a handsome, showy apple, more largely planted in the West than any other variety, but it is inferior in flavor. It is observed there are considerable differences in the flavor of the fruit, and by selecting buds for the propagation from the trees which excel, an improved variety of this otherwise superior fruit may be formed." If correct, this method opens a way to the improvement of many plants which have been neglected hitherto.

In this connection it would be of interest to know whether buds separated from sugar canes, as Prof. Nowoczek separates buds from beets, would produce normal canes, or change the form as is said to be the case with beet buds.

It would also be of interest to know whether graft hybrids could be produced by transfer of bud from cane of one variety to cane of another variety.

It is for us to learn facts; the results, greater or less, will, follow the facts. Men have been helped and have been hindered by theories, and they who upset an accepted but incorrect theory, by experiment, do mankind a service.

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LIBERIAN COFFEE CULTIVATION IN TAVOY.

The following report has been written by Mr. J. T. Watson, Tavoy, to the Director of the Department of Land Records and Agriculture, Burma:

The investor in coffee land for the purpose of planting Liberian coffee has several choices in Burma. The superiority of forest land over *chenas*, especially if they are recent, is very marked at low elevation, this system of cultivation having very poor results on soil exposed to the hot sun and heavy rains of the plains. On the hills rich forest lands that have a free soil are much to be preferred. Much land of this description is to be found in Burma in all the districts in Lower Burma, and forest land should be selected in any case. The soil for Liberian coffee cannot be too rich, but it must be deep and friable. Shallow soil, especially if mixed with quartz and gravel, will not grow good Liberian coffee, but a sandy loam friable to a good depth; this is of great importance, and in selecting soil one must take the trouble to inspect the nature of the soil down to a depth of two feet at least, and, if found friable at this depth, it recommends itself. Stiff marsh or clay land should also be avoided. All land that might be water-logged, *i.e.*, retain water for a long time, should be also avoided and friable land insisted on with a natural slope to drain itself. As to lay of land, this should be undulating and not too steep, as Liberian coffee is a *tree* that should not be exposed to wind, and shaded ground well protected at the base of our many mountains is perfection for the cultivation of Liberian variety. The steep land at the higher elevations would be suitable for *Coffee Arabica* and tea. Exposure to wind is a certain drawback to the cultivation of this variety, as it is to any other planted product, but its ill-effects are comparatively small, if the land is selected with care, and the wind must be very exceptionally bad, if other conditions which I have formerly pointed out are favourable.

The best climate is undoubtedly that of the wet portion of Lower Burma. (I am here speaking of what I know, as I have only been once up in Upper Burma, and I cannot say what might not be possibly attained in Upper Burma in those great mountain ranges which have all the appearance of a country that would be perfection itself for the cultivation of the coffee plant and other valuable products, such as tea, cocoa, pepper, and rubber, and by appearance from what I have attained here Liberian coffee ought some day to be the king of products in Burma.) A rainfall of 100 inches is sufficient for Liberian coffee, but for all that 200 inches in the Tavoy district seems to be in its favor, if the ground is well drained; this must be attended to strictly, as no coffee will stand what is termed *wet feet*; standing water in the soil rots the roots. Elevation, where aspect and exposure are favourable, from sea-level up to 2000 feet, each elevation having its own advantages, but the higher we go the greater the necessity for good soil and shelter from wind.

Shade is most important in the cultivation of Liberian coffee until the tree once gets a good hold of the ground. In forest this can be done by only removing the small trees and scrub at first, planting at the same time as the coffee valuable trees for shade (trees that are sub-soil feeders), such as jack and the san tree, *Albizzia stipulata*, and Medeloa (*Albizzia etata*), San (*Albizzia stipulata*), Hiris or siris (*Præru* or *Sirisu*), Fatikoia (*Marginata odoratessiam*). All these trees are found in Burma and the Forest Department might be asked to secure seed of some and supply to intending planters. The jack tree is my favourite tree, and it can be turned to account to grow the pepper *vine* upon it at the same time.

When the shade trees grow up the jungle trees left for the purpose of temporary shade can be gradually cut down and removed, or allowed to rot on the ground for manure. Rotten timber mixed with the weeds and surface soil and quicklime makes a splendid manure for the coffee trees, nothing better, barring cattle-dung.

The size of the estates depends on the means of the planter. But I should recommend blocks of land to be taken out from 200 acres up to 4000 acres; to those intending to form a company every encouragement ought to be given.

Seed ought to be selected from matured trees; this is an important point; and the seed should be thoroughly ripe and selected from the most robust trees that are well formed, as Liberian coffee is inclined to what is termed "sport," *i.e.*, you will find trees that do not cover ground well and get as it were spindley and do not throw out branches from the stem near the ground; those trees should be avoided in selecting the ripe cherry. Seed for planting into nurseries should never be dried in the sun; the sun's power destroys the germ, the life of the seed. Seed ought to be all dried for seed purposes under shade and never allowed to heat or ferment, and it ought to be kept in an open space to allow air to pass, but shaded from the sun's rays, and I prefer to cure seed in this manner with the husk on the bean, not as parchment. Should the seed be wanted for seed purposes when ripe, then by all means remove the husk and put in the seed at once to the ground without drying. This is a sound and sure plan to put into boxes or prepared beds. As to the best method of germinating seed there are many opinions. I have been most successful in the germinating of Liberian coffee seed between coir mats simply. The seed is laid in a layer on a coir mat, care being taken that the layer is a single one, and on it another mat is placed. If kept damp, but not wet, the seed will germinate freely and can be readily picked out. This method has the advantage of cleanliness. Another plan is to put the seed after the husk has been removed into coconut fibre dust into boxes, a layer of seed and a layer of coconut fibre until the box is full, and put a piece of wood in the centre of the box so that you can draw ont and put in your hand to inspect how germinating progresses. This is a good sound plan and generally safe. The fibre must only be kept damp and not wet. The same method may be carried out with charcoal where experience is wanting, as if too wet the charcoal takes in the extra moisture, and gives it out again, when the bean or germ requires it; any of these three methods I fully recommend.

The formation of nursery beds is a matter which need not engage our attention much here. Sloping ground should be chosen, with water above it if possible, but in any case close at hand. The beds should be made about four feet wide to facilitate sowing, weeding, etc., and should be raised above the paths between them in the usual way so as to allow superfluous moisture to run off readily. The soil of the nursery should not be dug too deeply, otherwise the tap roots of the plant will reach an inordinate length before they are put out and be most difficult to deal with, but it should be thoroughly pulverised and cleared of all stones and roots. Soil with a good proportion of clay in it is better than what is gravelly as it enbles the plant to be removed with earth round the roots. Soil in nurseries should be rich; it does not answer practically to make them in poor soil. As regards the distance apart at which the seeds should be planted, much depends on the class of plants and the length of time they are intended to remain in the nursery; 2½ to 3 inches apart is the most satisfactory distance. I would recommend all such nurseries to be shaded until the plant get up at least four or five inches and has six or eight leaves. Out of the rains they should be shaded right throughout the dry season here and, when the rains are well set in, the shade should be gradually removed to allow the stem or collar of the plant to harden. The importance of watering nurseries in a liberal manner during the dry weather cannot, I think, be overrated. They should be watered thoroughly after the sun is well down, say, 4:30 or 5 p.m. I object to watering in the morning for the reason that the sun is so powerful that it burns the leaves in a manner, if the water is not brushed off the leaves. No plant in fact ought to be watered in the morning in India, a great mistake which few understand. * * * *

Now that I have made things clear how this variety can be planted with success in Burma, and also proved that it is to be a lasting and standing product of value. I am able to state what can be done to bring it into bearing. It can be planted fairly well at the cost of R120 per acre, and brought into bearing for R350 with care, if all that I have pointed out here is properly attended to, and bear in mind that it thrives best not beyond the voice of man, that it must have daily attention for its protection from cattle and it must not be knocked about, but tended to with care. After it comes into bearing see what a good mine it is to be. I have pointed out already that I have individual trees bearing ½ cwt. husk or cherry coffee per tree. Now if we will take it at Burmese measure you will understand this better. Say one basket per tree, and to take this at 8 viss per tree of husk or cherry coffee. Another thing must not be lost sight of here, *i.e.*, that the Liberian coffee contains far more percentage of husk than the Arabian, or we will call it Ceylon coffee. I point out this not to mislead any one in this important point, which has again and again been misunderstood even by expert planters who have not had experience in the manipulation of this product. Now we will take, instead of 8 viss to the tree, only 1 viss. Mind I am now speaking of clean coffee or rice coffee prepared for the shop or London market, *i.e.*, say that 8 viss of husk only produce 1 viss clean coffee. Now 1 viss of clean coffee brings at the present moment in Tavoy R2-8-0 per viss. Now we will take the lowest percentage of trees per acre leaving allowance for shade trees and roads and drains, etc., say, 600 trees per acre. See what this will bring in yearly, or again, to put it at the very lowest, put it at ½ viss per tree of clean coffee and value it at R2 per viss, and again see what this will bring in per acre of cultivated coffee. This is about the lowest average and is the lowest amount which I have put down for information to the Government of India, which has been called for from me. I put down the very lowest, namely, 896 pounds or 8 cwt. per acre. At the present moment clean coffee in London is selling at over 120 shillings, or, say, £6 sterling per cwt. See what this will come to per acre, £48 sterling. I need not say more on this point as the very lowest average recommends itself.

We will now take £48, or say R600, allowing the rupee to revert to the value of 1s. 8d. Now R600 will allow an expenditure of R300 per acre, and this amount on an estate of 400 acres much could be done to bring this variety into even greater perfection and allow expenditure on building roads, drains, dams, tools, machinery of all necessary sorts for irrigation purposes, much can be done here by irrigation in the dry season. I have proved this, and this amount should allow a liberal amount for cultivation, such as manuring with cattle manure and compost, making new cattle sheds and roads for cart traffic, and the purchase of pigs and cattle. Pigs could be fed on jack fruit and poonack from the rice-mills, such as paddy-dust, and after this liberal all wance the planter would have a profit at the very least of R300 per acre yearly. I do not recommend the Ceylon coffee, *i.e.*, *Coffee Arabica* to be planted below an elevation of at the very least 2,000 feet, and it will succeed much better at 3,000 or 4,000 feet elevation. I planted 14 acres here; it gave a maiden crop and went out, *i.e.*, died right out.

You will see by this report that where the cultivation of Liberian coffee stops Ceylon coffee begins. From 2,000 up to 6,000 ft. Ceylon coffee can be grown with this variety, but I do not consider the conditions in Burma yet ripe for this valuable cultivation. Should planters wish to embark in this cultivation, let them do so by all means, but at their own risk. I do not recommend it for the reasons, first, of dread of the leaf disease; it I think must have a time of rest for this evil to leave the coffee or work itself out by ultimate death of the trees where it exists. Where it does not exist it will again flourish and pay well in this country, but the local Government ought not to recommend it as the time has not come as yet to recommend its cultivation again on a large scale.

Besides, the present existing circumstances in this great country do not afford facilities to reach elevation. Take this into consideration. Where are your roads? Nowhere. At this elevation I strongly recommend the cultivation of Liberian coffee, cocoa, cardamom, cinnamon, croton oil trees, ginger, Colombo root, sapan wood, pepper, vanilla, and all manner of fruit-bearing trees for shade purposes. And above all, next to Liberian coffee, I would strongly recommend cocoa for Burma, as the soil and conditions are suitable for its cultivation.

The local Government ought to procure fresh cocoa pods for those that would give a guarantee to cultivate the same. As I have already remarked, it can be grown side by side and interplanted with the Liberian coffee, as the great Liberian trees would answer for shade for the valuable cocoa.—*Rangoon Gazette.*

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It is an utterly low view of business which regards it as only a means of living. A man's business is his part of the world's work, his share of the great activities which render society possible. He may like it or dislike it, but it is work, and as such, requires application, self-denial, discipline.

FINEST GARDEN IN THE WORLD.

Every year upwards of a million and a half of people visit the Royal Gardens at Kew. One hundred thousand have been admitted on a Bank Holiday; 50,000 on a Sunday. But very few of the thousands who roam about its 270 acres and huge glass-houses realize the plendid work done there, and its importance to the British Empire. For 120 years Kew has taken the lead in the discovery and utilization of "economic" plants, with a view to the extension of trade, the development of our colonies, and the creation of new industries. "Economic" plants by the way, are those whose fruit, seed, fibre, sap, etc., may be turned to account. Kew has no equal, for no rival garden has half so large a sphere of usefulness. It is the centre of a hundred similar gardens in various parts of the Empire many of whose directors it has trained. All are engaged in the same work, which is something more magnificent than growing lovely flowers to delight the eyes of the visitors, or for profit. An illustration: A tanner informs the director of Kew that the supply of "gambier," an extract from the leaves and shoots of a Malayan climber, is not equal to the demand. The price has doubled two or three times. No substitute has been discovered. Then Kew goes to work. The director communicates with the Colonial Office, which instructs the Consul at Singapore to send seeds and particulars of the culture of "gambier" to Kew. This is done. The seeds are sown, and plants dispatched to such botanical centres as possess a suitable climate. Full particulars of growing and preparing for the market are published in the *Kew Bulletin*, or elsewhere. Planters and natives are put in the way of cultivating *Uncaria Gambier*, and so the output is or will be increased, to the great benefit of the trades interested and the public. Again: A trader, say on the West coast of Africa, is shown by the natives a sample of rubber new to him. It may be valuable or worthless. He does not know the plant from which it is extracted. He obtains specimen leaves and inflorescence, and sends them, with a sample of the rubber, to Kew. There the plant is identified to a manufacturer to be tested. Eventually, particulars of the plant, the manner of obtaining the rubber, and its capabilities and market value are published. Thus the trader learns whether the article is worth exporting. If it prove valuable other traders are apprised of a commodity worth seeking.

This systematic identification, testing, and propagation are going on daily. A dozen "economic" plants may be receiving attention at one time. Kew introduced to India the cinchona, from which quinine is obtained. It is constantly studying new fibrous plants, an idea of the value of which may be gathered from the price of pineapple-leaf fibre—£60 the ton. Guttas, gums, indigo, jute, coffee, cacao, and other products too numerous to mention, plant disease, insect pests, adulterants, etc., are taken in hand with a view to extension or remedy. Whenever something new is discovered an attempt is made to propagate it for cultivation in our Colonies. Should the demand for the staple product of a colony fall off, Kew is able to suggest and supply another, indirectly or otherwise.

Much of its work, though entrancing to those engaged in it, is naturally uninteresting to the general public. That cannot be said of the inquiry into the so-called "weather-plant," the "Paternoster pea," of which much nonsense has been written. Mr. Nowack, an Austrian, actually patented the plant, *Abrus precatorius* with an apparatus to enable it to fortell the weather—fog, rain, snow, and hail; earthquakes, depressions likely to cause explosions of fire damp in mines, and what not, forty-eight hours in advance, for forty miles round! Such were the claims advanced.

Kew, in conjunction with the Meteological Office, took the "Paternoster pea" in hand, demonstrating that the much-advertised "weatherplant" is not influenced by the weather, past, present or future in any way. The movements of the leaves are induced by variations of light; the downward motion supposed to presage an earthquake, is caused by an insect that punctures the stem, when the leaves drop and die. Exit the wonderful "weather-plant." The services rendered by Kew in connection with coffee have been of the greatest value. The coffee tree is a native of Abyssinia and tropical Africa. Kew has assisted to spread it over the tropical world. It has inquired into its adulteration, which is carried on to such an extent that 96,000,000 pounds of bogus coffee are said to be sold every year in the United States alone. In the Kew Museum are specimens of sham coffee-berries made of rice-flour, glucose and water, worked into a paste and shaped in a mould. Kew has endeavored to check adulteration by increasing the output of the genuine article.

The Royal Gardens are the advanced technical school. Each gardener is admitted for a two years' course, but it is necessary that he should have had experience elsewhere. He sees every kind of cultivation carried on in the establishment, attends lectures, and obtains instruction in scientific subjects connected with his profession. Kew men are in great request; the best receive valuable appointments as opportunity offers, and are to be found in every part of the world. Nearly all of them are in constant correspondence with their *alma mater*; the authorities foster it in every way.

Four periodical publications are issued from or prepared at Kew. The *Botanical Magazine* has been prepared there since 1841. The *Kew Bulletin* has been issued monthly since 1887. The *Kew Annual Report* is, as its name implies, published yearly. The first number of a new publication, a private enterprise, has just been issued. It is the *Journal of the Kew Guild*, an association of past and present Kew men.

The Kew roll of martyrs is not insignificant. Not long ago two promising young fellows went to the Niger to found and superintend Botanical Gardens for the Royal Niger Company. The climate killed both in a very short time. A brief history of the gardens may be of interest. In the reign of Charles II., Lord Capel had at Kew, somewhere near present chief entrance, a garden containing an orangery and the finest fruit-trees and flowers in England. He grew everything obtainable at that time. The garden was famous. In 1730, Frederick Prince of Wales obtained a long lease of the house and ground from the Capel family. To his widow Kew owes much of its present glory. She gave it its definite scientific form. It was then described as "that garden where every tree that has been since in Europe is at hand." George III. showed great interest in the gardens after his mother's death. During his reign the botanical, exploration, and horticultural activity at Kew had no parallel—and has not since been surpassed. No fewer than 6,746 rare exotic plants were introduced. At that time a common fuchsia, now worth 6d., fetched £5. Sir Joseph Banks, who voyaged with Captain Cook, became unofficial Director. He sent out collectors all over the world. A botanist connected with Kew accompanied Captain Cook on his third voyage. The same man, David Nelson, sailed to the South Seas in the ill-fated "Bounty" when that vessel went to introduce the bread-fruit to the West Indies, an idea which probably originated at Kew.—*Tit Bits.*

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ENTRAINMENT.

[LOUISIANA PLANTER.]

The enormous losses of sugar in process of manufacture became apparent in Louisiana when chemical control of the manufacture was first begun. As the commercial world was willing to buy and sell sugar produce on its polariscopic test, it became evident that by this same means the amount of actual sugar entering our sugar houses could be determined. As cane juice extraction was largely a matter of mechanical skill and depended upon the strength of the factory's machinery, as well as upon the engineering skill in utilizing the whole capacity of the juice extracting machinery, chemical control began with the juice extracted, determining the crystallizable sugar in the juice with as great certainty as the public weigher determines the sugar in any package passing under his scale beam.

The sugar in the raw cane juice then entered into the process of clarification, evaporation, concentration and centrifugaling, was found in more or less reduced quantities in the sugar turned out at the centrifugal machines and in the first molasses. The losses were so great as to attract and to demand attention.

The determination of the crystallizable sugar in that turned out at the machines and the determination of the crystallizable sugar in the molasses gave the same data as that used in the commercial world on which to buy and sell the world's crop of sugar.

Omitting for the present the reboiling of our molasses for the manufacture of second sugar therefrom, we may divide our process of sugar manufacture into four parts:

1. Juice extraction.
2. Juice clarification.
3. Juice evaporation and syrup production.
4. Syrup concentration and sugar production.

Omitting the consideration of the losses in juice extraction and determining the sucrose in the juice extracted and with which we begin our process, immense losses were found to occur during juice clarification. These losses reached 5 to 10 per cent. of all the sucrose found in the juice, and once satisfactorily determined led to the quick adoption of filter presses for the utilization of the scums, until now there is scarcely a sugar house in Louisiana getting a good yield that has not filter presses as necessary means to proper and economical juice clarification. There are now no washouts in our best houses; all the scums and washings go to the filter presses, and nothing but dry filter cake now comes from the cane juice. This cake or mud, reaching about 1 per cent. of the weight of the juice, would reduce the total quantity of raw material sent through the factory 1 per cent., and as filter cake ordinarily tests for sucrose nearly as high as cane juice, except in a few instances where the cakes are well washed, we have here in the process of clarification a loss of about 1 per cent. of our sugar still continuing in most of our best houses.

The juice once clarified its evaporation into syrup becomes one of the most serious incidents of our industry, during which *entrainment* occurs, resulting in losses from ½ per cent. to 12 per cent. of the whole and losses that seem thus far practically unavoidable, and to prevent which many evaporating apparatuses, many catchalls, baffle plates, slowdowns, etc., have been invented.

The determination of the sucrose in the raw juice and the deduction therefrom of the sucrose in the filter cake furnish undisputed data as to the amount of sucrose with which the process of evaporation is begun. This assumes that there will be no visible mechanical losses, such as leakages, overflows, etc., and no inversion.

If there be any of these, then to definitely determine entrainment, the sucrose in the clarified juice entering the evaporating pans must be determined.

The sucrose in the juice entering into evaporation being determined, the sucrose in the syrup discharged from the evaporating train is determined, and any difference represents the loss which may come from inversion, overflows or entrainment. Inversion is readily determinable, and in many houses is now entirely avoided. Overflows are presumed to come from carelessness, negligence, ignorance or accident, and seem to be avoidable. We are now left with the chief loss in our sugar houses after the juice extraction, and that is entrainment during evaporation, and we believe it not extravagant to assume this loss in Louisiana to-day at 5 per cent. where multiple effect evaporation is used.

Entrainment is not well understood. It is frequently confounded with mechanical overflows or with foaming up, or priming, as does dirty water in steam boilers. The familiar soap bubble is an instance of entrainment. They are so light as to float away in the open air without the vortex and suction of a vapor outlet as in our ordinary evaporating trains. Soap bubbles are made possible by the viscosity of the soapy water and the tension of their contained air. Formulæ have been furnished for soap bubble solutions, such as caustic soda, oleic acid and glycerine, to be mixed in proper proportions with water. The viscosity of the solution is all that is needed to enable the wonderful experimentation that has been had with soap bubbles.

Cane juice is always more or less viscous. You may bathe your hands in bay-rum and wipe them dry and clean; you may bathe your hands in cane juice, but they cannot be wiped dry and clean. The material is too viscous and must have its viscosity reduced by water. Cane juice in evaporation has its viscosity increased, and entrainment seems to increase with the increasing density of the syrup in process of evaporation.

Those who have observed the evaporation of cane juice in open evaporators have often seen the whole mass arise and flow over into the scum trough. This came from the application of a limited amount of heat. With more heat, violent boiling at a low level would begin.

The slow boiling seems to give full play to the viscosity of the liquid. The bubbles form, pile up on each other and overflow, while with high heat the vapor of water under high tension rises as a bubble through the mass of liquid, its surrounding thin film of viscous liquid exploding from the tension of the vapor when the bubble reaches the surface.

There is then no overflow, but the thin sides of bursted bubbles fly up into the vapor space of the apparatus and are cycloned off with the waste water. These losses are not visible to the eye, and are rarely perceptible by chemical test, because of the vast quantity of condensing water used.

They can never be entirely avoided, for as fogs float in the air, and salt sea air is felt and influences vegetation far inland, so these little globules of cane juice vapor and the particles of larger broken globules float up in our evaporating pans until they reach the fatal outlet and are carried off with the waste waters.

It is said that entrainment occurs chiefly, if not almost entirely, in the so-called syrup pan of our multiple effects, the last pan, that in which the liquid is of the highest density, of highest viscosity and requiring vapour of high tension to effect circulation and ebullition; that if we boil our syrup to but 20 or 25 deg. Beaume that we shall have less entrainment than if we boil to 30 deg.

This does seem logical, and would doubtless give us more sucrose in our syrup, less loss during evaporation by entrainment, but it would seem to leave the work to be done by the vacuum pan and to promote the losses by entrainment there. This phase of the problem has not been much worked out thus far.

It is said that in Europe the standard multiple effects are rated at but half the evaporating capacity we estimate here for a given heating surface, and their apparatuses generally have more top or vapor space than we ordinarily have.

Several of our prominent planters are now improving their present apparatus by increasing the vapor space, endeavoring by large space to enable gravity to overcome entrainment.

ANOTHER LITTLE BUG FOR THE ORANGE GROVES.

Recent dispatches from Los Angeles tell of the good work being done in the orange groves just now by the parasite *orcus chalybeus.*

It is a steel-blue lady-bird, the larvæ of which were procured from Australia by Entomologist Kœbele. The Legislature gave the State Board of Horticulture $5,000 to defray Mr. Kœbele's expenses. He sent up a lot of parasites and they have been vegetating at favored spots. It was given out recently that most of the new insect warriors were of no value and this was taken as an excuse for an attack from certain quarters on the State Board of Horticulture.

The good news that the tiny *orcus* is now leading off, following the commendable example of voracity set by the lady-bird, *vedalia cardinalis*, is a seeming vindication of the action of the State Board.

The *orcus* does not feed on every pest but seems to enjoy especially the red scale *(aspidiotus aurantiid)*, a pest that the vedalia passes by, preferring as it does the white, cottony cushion scale *(Icerya).*

Of the red scale Matthew Cooke says: "The appearance of trees infested with this pest is very striking, very much resembling those diseased from other causes, such as bad drainage, the leaf representing a mottled appearance, a light blotch around the scale contrasting with the natural green of the leaf. The branches are but little troubled, but the fruit, like the leaf, becomes completely covered with the insects. An orange tree infested with this scale gradually becomes sickly and languishes."

Concerning the work of the *orcus*, Entomologist Craw of the Board of Horticulture says:

"The unprecedented success of the *vedalia cardinalis* has caused fruit-growers and others to expect immediate and similar results from all of the new insects; but as the *orcus chalybeus* and *orcus Australasia* have only three generations, their increase will be slower; however, I feel satisfied that the final result will be equally as satisfactory as with the *Vedalia.*

Planters' Labor and Supply Company.

Incorporated March, 1882.

OFFICE—HONOLULU, HAWAIIAN ISLANDS.

ANNUAL MEETING, DECEMBER 4, 1893.

COMMITTEES OF THE PLANTERS' LABOR AND SUPPLY CO.

Appointed November, 1892.

Labor—J. B. Atherton, C. Bolte, W. W. Goodale.
Cultivation—H. Morrison, W. W. Hall, J. Renton Jr.
Machinery—J. N. S. Williams, J. Marsden, R. R. Hind.
Legislation—H. F. Glade, W. R. Castle, C. Bolte.
Reciprocity—H. P. Baldwin, C. R. Bishop, H. F. Glade.
Transportation—W. J. Lowrey, W. H. Rickard, J. N. Wright.
Manufacture—Z. S. Spalding, J. F. Hackfeld, A. Young.
Live Stock—B. F. Dillingham, W. C. Weedon, J. H. Paty.
Forestry—T. R. Walker, T. S. Kay, J. M. Horner.
Fertilizers—F. M. Swanzy, W. W. Goodale, W. G. Irwin.
Tobacco—J. Marsden, Z. S. Spalding, A. S. Wilcox.
Ramie—H. M. Whitney, W. R. Castle, C. S. Kynnersley.
Fruit Culture—L. A. Thurston, V. Knudsen, G. N. Wilcox.
Statistics—J. O. Carter, C. M. Cooke, W. O. Smith.
Coffee and Tea—W. W. Hall, J. Austin, E. C. Bond.