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SUGAR PRICES FOR MONTH ENDING FEBRUARY 14, 1908.

	Centrifugals	Beets
January 10, 1908	3.90c	9s 10½d
January 17, 1908	3.89c	9s 10½d
January 24, 1908	3.77c	9s 10½d
January 31, 1908	3.75c	9s 10½d
February 7, 1908	3.75c	9s 11¼d
February 14, 1908	3.67c	9s 9¾d

We take the following from Willett & Gray's "Weekly Statistical" of the 23rd and 30th of January:

January 23:

There seems to be no question but that the making of the sugar crop in Cuba is being interfered with on several estates by the frequent recurrence of rainy days, compelling the estates to stop for the time being. Several cables to this effect are at hand daily.

This being so, it is an argument for better prices, but on the contrary, there is seemingly a constantly weakening disposition with sellers.

They manage things quite differently in Europe, where they have just harvested a beet crop of some 6,575,000 tons, and yet the markets show little pressure to sell, even with a parity of 4.06c. per 100 lbs., with Cuba at 3.80c. and Louisiana at 3.44c.

There is no doubt that the network of sugar exchanges, affording facilities for dealings in futures, has much to do with sustaining the European markets.

Louisiana, with a small crop of cane sugar to market, goes even below the depth of Cuba prices, last sales being made at 3 7-16c. per lb., or .62c. below the European parity.

There is something the matter with the methods of marketing all sugar crops with the exception of the beet crops of Europe. What is it, and what is the remedy?

It is not that all the Louisiana and Cuba sugars that can be raised will not be wanted for consumption of the campaign year; it is because all of their crops are not wanted as fast as made, which seems to be the method used for their disposal, leading to an oversupply at this season and resulting in an undersupply later on.

A method of judicious selling would give these crops a much better outturn of profits to the producers, as they are fully protected by the high parity of Europe, the only competing market.

Regarding business in this market, the trend has been slowly downward, with moderate sales making at each 1-32c. decline.

At the end of last week quotations were 3.92c. for spots and 2 9-16c. c. & f. for January or prompt shipment, equal to same parity; while today's quotations are 2 7-16c., basis 96°—say 3.80c. for prompt and January, and 2.41c. for February shipment, equal to 3.77c., showing 1-16c. per lb. decline for all positions.

There are moderate amounts for sale at these quotations, but buyers are holding off looking for lower prices, probably 2⅜c. c. & f., equal to 3.73 c. duty paid.

San Domingos for January-first half February shipment were sold during the week at 2.163c. c. & f., equal to 3.86c.

Receipts at the six ports of Cuba continue comparatively small, 15,000 tons, while the number of factories are increasing rapidly, there being 122 grinding, against 85 last week. Our regular cable gives no mention of rainy weather, the rains reported at the different estates being only local.

Philippine Bill in Ways and Means Committee.—Secretary Taft appeared before the Committee on Monday and stated that he would be willing that 300,000 tons sugar from the Philippines should be admitted annually into the United States on a twenty-five per cent. rate of the Dingley tariff, until the expiration of the Treaty of Paris (August, 1909), and after that up to the same amount free of duty, though he believed the crop had never reached 300,000 tons, and he did not believe that the crop will increase materially, as hemp is more profitable, but, nevertheless, he believed that the planters should be granted relief.

The probabilities are that the House of Representatives will pass the bill as it comes from the Committee, but the Senate will probably argue upon it.

Some of the sugar men are said to have expressed willingness to compromise with Secretary Taft.

January 30:

The spot market has been irregular during the week. The opening quotation was 3.80c.; declined to 3.77c.; advanced to 3.80c., and closed at 3.75c. This latter quotation is 34c. per 100 lbs. below Europe.

March shipment from Cuba, however, were sold at 2⅜c. c. & f., 96° test, equal to 3.73c. per lb. duty paid (36c. per 100 lbs. below European parity), and the tendency continues downward under expected increased receipts pressing upon the market for prompt sale.

From latest observation on the island we revise our estimate of Cuba crop to extent of a maximum of 1,200,000 tons and a minimum of 1,100,000 tons.

At the close there are free sellers of March shipment at 2⅜c. c. & f., 96° test, with buyers showing marked indifference in expectation of further decline.

Java sugars have been offered during the week, for June-August shipment, at 10s. 6d. c. & f., equal 4.02c. duty paid, 96° test.

European beet sugar quotations have improved for the week from 9s. 9¾d. to 9s. 11¼d., with a quiet closing.

Mail advices from Europe state that Mr. Otto Licht is foreshadowing a decrease in the sowings of Germany and Austria of 5 to 6 per cent. This probability of such a serious shortage of supplies for next season has been received with incredulity generally in the European markets and consequently has had little effect.

Inland navigation on the Continent is still closed by ice and supplies of foreign sugars are somewhat curtailed.

Under date of January 17 Czarnikow, Macdougall & Co. report the sale of a cargo of raw sugar at 4.10c. which price, when cabled here, created considerable interest. They state:

An exceptional transaction took place this week which had no bearing on prices here or elsewhere. A Java cargo of 5,620 tons, belonging to European operators and stored in beginning of December, has been bought by one of our refiners on private terms, said to be 4.10c. According to common report, these buyers had contracted for 5,000 tons Cubas for first half January shipment, which sellers have not been able to forward within contract period. The Javas being the only stored sugars in Importers' hands, and nothing else being available for buyers' immediate wants, the purchase was made, although the price said to have been paid is .20c. above current quotations. On the strength of this sale, several cargoes of Javas stored in United Kingdom were offered in this market at an equivalent price, but were not wanted.

The delays and interruptions to grinding in Cuba have affected early January shipments, and have caused a moderate

scarcity here; but this can only be of short duration, as Cuban shipments in the last half of January will be considerable, and during some months thereafter will be more than ample. As grinding was late in being started and has been interfered with by rains, good weather will be needed during the rest of the season to take off the crop. Conditions might arise to make the Cuban output a good deal less than the estimates, while there appears to be no possibility of anything arising to make the output exceed the estimates. In any case, the United States must draw on Java or Europe and pay the world's price for part of its summer supplies, and the quantity to be drawn will depend on the Cuban output; hence it is that the Cuban crop will control the world's market situation during the later months of the campaign, and its progress will be watched with the greatest interest.

SUGAR REVIEW FOR 1907

Willett & Gray have published for 1907 their usual annual statement of the sugar business of the United States. Some of the statistics are very interesting.

The figures show the consumption of sugar, 2,993,979 tons, an increase of 129,966 tons from 1906, or 4.538 per cent. increase, against an increase of 231,797 tons, or 8.606 per cent. for the preceding year, against 4.479 per cent. average yearly increase for 26 years.

The total consumption of sugar on which full duty was paid was 355,297 tons, and of sugar on which a concession of duty was allowed was 1,351,100 tons, and of sugar on which no duty was paid was 1,287,582 tons.

Cuba contributed 1,340,400 tons; Hawaiian Islands, 418,102 tons; Porto Rico, 212,853 tons; Philippine Islands, 10,700 tons; Domestic Cane, 264,968 tons; Domestic Beet, 375,410 tons; Maple Sugar, 10,000 tons, and Molasses Sugar, 6,249 tons.

The total consumption of refined sugar in 1907 was 2,843,928 tons, of which the American Sugar Refining Co. manufactured 1,401,061 tons, or 49.27 per cent., against 51.03 per cent. in 1906 and 52.89 per cent. in 1905.

The independent refiners manufactured 1,064,827 tons, or 37.44 per cent., against 37.38 per cent. in 1906 and 37.48 per cent. in 1905.

The Domestic Beet Sugar factories contributed 375,358 tons, or 13.19 per cent., against 10.87 per cent. in 1906 and 8.79 per cent. in 1905.

The Hawaiian Cane factories contributed 1,674 tons, or .06 per cent., against .61 per cent. in 1906 and .69 per cent. in 1905.

Foreign refined supplied 1,008 tons, or .04 per cent., against .11 per cent. in 1906 and 15 per cent. in 1905.

The average difference between Raw and Refined in 1907 was .893c. per lb., against .829c. per lb. in 1906 and .978c. in 1905.

For the year 1908 the average for Raws, under the outlook of supply and demand, should be higher than in 1907.

Consumption per capita is 77.54 lbs. in 1907, 76.1 lbs. in 1906, 70.5 lbs. in 1905, 75.3 lbs. in 1904, 70.9 lbs. in 1903, 72.8 lbs. in 1902, 69.7 lbs. in 1901, 66.6 lbs. in 1900, 61.0 lbs. in 1899, 60.3 lbs, in 1898, 63.5 lbs. in 1897, 60.9 lbs. in 1896, 64.23 lbs. in 1895, 66.64 lbs. in 1894, 63.83 lbs. in 1893, 63.76 lbs. in 1892, 67.46 lbs. in 1891, 54.56 lbs. in 1890, 52.64 lbs. in 1889, 54.23 lbs. in 1888, 53.11 lbs. in 1887, 52.55 lbs. in 1886, 49.95 lbs. in 1885, and 51 lbs. in 1884.

RECAPITULATION OF CONSUMPTION OF SUGAR IN THE UNITED STATES.

	1907. Tons.	1906. Tons.	1905. Tons.
Total consumption of sugar in United States	2,993,979	2,864,013	2,632,216
Compared with preceding year—Increase	129,966	231,797	* 134,946
Compared with preceding year—Increase	4.538	8.806	* 4.876
Consumption consisted of:			
Domestic Cane (Louisiana and Texas)	264,968	267,947	334,522
Domestic Beet	375,410	300,317	220,722
Maple	10,000	6,000	9,000
Molasses Sugar	6,249	8,150	11,880
Total Domestic	656,627	582,414	576,124
Hawaii (Cane)	418,102	343,857	376,497
Porto Rico (Cane)	212,853	193,978	124,928
Philippine Islands (Cane)	10,700	41,900	14,673
Cuba (Cane)	1,340,400	1,165,994	1,101,611
Total on which tariff concession allowed	1,982,055	1,745,729	1,617,709
Total foreign on which full duty assessed	355,297	535,870	438,383

CENTRIFUGALS.—Average price per pound for 1907, 3.756c.; 1906, 3.686c.; 1905, 4.278c.; 1904, 3.974c.; 1903, 3.72c.; 1902, 3.542c.; 1901, 4.047c.; 1900, 4.566c.; 1899, 4.419c.; 1898, 4.235c.

DUTIES.—Since July, 1897, the full duty on sugar has been 1.685c. per pound for 96° test. Since December 27, 1903, sugar imported from Cuba has been allowed a concession of 20 per cent. and assessed 1.348c. per pound duty, 96° test. Sugar from Hawaii and Porto Rico pays no duty. Sugar from the Philippines has 25 per cent. reduction from full duty rates and the average grade produced there of 84° test pays .949c. per pound less .022c. per pound export duty collected on shipments from the Islands. All other sugars than the above imported into the United States in 1907 paid duty of 1.685c. per pound for 96° test basis. Duties for 1908 will be collected as above.

NOTES.

CANE-BORER PARASITE.—Recent cable advices from F. A. Muir, an entomologist of the Experiment Station of the Hawaiian Sugar Planters' Association, dated at Macassar, in Larat, brings the welcome news that he has found a parasite of the cane-borer (*sphnophorus obscurus*). If the efforts which will be made to introduce this parasite here prove successful, another chapter will be added to the list of achievements of the Station.

With the exception, perhaps, of the leaf-hopper, the cane-borer has caused more direct loss to the sugar planters of Hawaii than any other pest or disease. Not only in Hawaii, but in Fiji great losses have occurred from this pest. Although a great deal of money has been spent in the past in attempting to control the borer by gathering them in the fields and by the planting of harder varieties of cane, up to the time that Muir began his travels, no systematic effort had been made to secure a parasite of the borer.

The cane-borer of these Islands is known to exist in many localities and is found in Queensland, Fiji, North Guinea, Tahiti, and in probably many of the Islands of the Pacific. It is the larva of the borer that does such great damage. The female beetle deposits its egg usually beneath the rind of the cane, an eighth of an inch or less. When the larva emerges and begins to feed, it proceeds to work its way into the inner tissues of the cane stalk and invariably takes an upward direction. It is a voracious feeder and grows rapidly. As the larva tunnels its way, large quantities of food material are defecated and block this passage. Although a large percentage of this sawdust-like material has passed through the digestive system of the larva, a great deal of the plant tissue has been merely masticated in order to express the juice. Having come fully fed the larva approaches the rind, eating out a well defined hole sufficiently large to enable it, when a beetle, to escape.

Not only is the loss large from the immense amount of cane that is destroyed by the larva itself, but the stalk is so weakened that it takes very little to break it and bring it down.

The plantations in the dry, hot sections are not bothered with the pest to the same extent as those in the wet districts where the borer thrives.

The commonest method of controlling the pest has been by gathering the beetles by hand, this work being usually done by the women and children, who are paid so much per hundred borers. Another method of destruction, which has been adopted from Fiji, is that of bait. This consists of split sticks of cane, which are placed in small heaps around the infested fields. The borer is readily attracted to fermenting cane and by this means large quantities are obtained.

On some plantations burning the fields previous to cutting is resorted to, resulting in the destruction of immense numbers of adult beetles.

Mr. Muir's account of his travels in the Far East in search of a parasite of the cane-borer, including his journey into interior parts of China, Malay Peninsula, Borneo and the neighboring Islands of the Pacific, are of great interest and an account of his latest travels in Borneo will be found in this issue.

IMMIGRATION.—Compelled to suspend its efforts to bring Europeans direct to Hawaii, the Board of Immigration is planning to take advantage of the opportunities offered by the Division of Information of the Bureau of Immigration to obtain some of the immigrants coming into the United States through the Atlantic ports. Whether the Board will be successful in inducing any immigrants to resume their journey and eventually land in Hawaii, is a question that can only be solved by actual trial. On first consideration it would seem that the scheme can only be a failure: the total lack of knowledge of Hawaii on the part of practically all of such immigrants, and the long distance to travel, would seem to be features that would prevent any desirable persons from coming here. On the other hand it is argued that the climatic conditions of Hawaii, enabling one to work throughout the year, the assurance of continuous employment for a man and all of his family of workable age, at a fair wage, and, if he seeks work on a plantation, with perquisities in the nature of house, water, fuel and medical attendance, should go far toward attracting a class of good agricultural laborers.

The Division of Information of the Bureau of Immigration whose coöperation has been secured in this attempt, is a new departure, and was established under the amended immigration law of February, 1907. It is made the duty of the division to promote a beneficial distribution of aliens admitted into the United States, among the several States and Territories desiring immigration and it will be the endeavor to prevent the newcomers from settling down in the cities and increasing the congestion of the population where they are not needed, and to distribute them

throughout the country, particularly on the farms and in the small towns where their labor is needed.

The Division is in charge of T. V. Powderly, former chief of the Bureau of Immigration. Thus far, the greatest demands for labor have come from the northwest country and the south, the latter section being in need of farm laborers and factory hands, the total orders for laborers reaching about two hundred thousand.

BEET SUGARS IN KOREA. A British consular report from Korea states that prospects for beet culture in that country are bright. The Japan-Korea Sugar Milling Company has made extensive experiments, and a yield per acre of 12 tons of beets with 10 per cent. of sugar is assured. The company will partly raise its own beets, furnishing farmers (Japanese and Koreans) with seed to supply the rest and giving them instruction in beet cultivation, In return the farmer gets 50 per cent. of the yield.

NITRATE PRODUCTION IN SOUTH AMERICA. Consul Alfred A. Winslow, of Valparaiso, states that from 1830 until 1907 the nitrate fields of Peru and Chile have produced 36,443,327 tons of nitrate, valued at $1,112,728,765 United States gold. He adds:

About two-fifths of this was produced during the last ten years. There has been much said about the exhaustion of the nitrate mines or beds, but from the best information obtainable they are good for two hundred or three hundred years, even at double the production, which is about 2,000,000 tons per year. Fully one-half the production has been net profit, but a new process has been invented that will do for the nitrate business what the cyanide process did for the gold production. Heretofore from 9 to 10 per cent. has been left in the waste, but with the new process it is claimed that there will not be a loss of 2 per cent. and at a less cost of production than by the old method. Even the waste or tailings can be worked with a great profit.

BRAZILIAN IMMIGRATION PROPAGANDA. Deputy Consul-General Joseph J. Slechta, of Rio de Janeiro, advises that official commissioners have been selected for the purpose of turning a larger share of European emigration toward Brazil, concerning which he adds:

The headquarters of the commission are to be in Paris, with a commissioner in the capitals of Germany, Italy, Spain and Austria. In the near future this organization is to be extended to provide for agencies in each of the more important sea ports of the countries mentioned. The inducements to be offered by the Brazilian Federal and various State governments are only to agricultural immigrants. Those will be given preference who are prepared to settle with their families on the farms provided in the so-called nucleus colonies. To all such prospective immigrants who are not otherwise objectionable, free transportation will be

furnished from the port of embarkation. It is intended that these commissioners shall arrange for the publication of propaganda and advertising matter in the various European countries where they are located.

Advices from the State of Rio Grande do Sul indicate that extensive preparations are being made for taking care of a large number of immigrants, one colony in that State having 200 farms ready for occupation. In the State of Minas, Geraes and Sao Paulo several colonies have been formed. In the former State the authorities have made large purchases of agricultural machinery from American concerns for distribution to settlers.

SUGAR INDUSTRY IN NEW SOUTH WALES. In spite of the heavy bounties that have been paid to sugar growers in New South Wales (£263,917 since 1903-4), figures given in the Melbourne *Journal of Commerce* indicate that the area devoted to the cultivation of the cane crop is decreasing rather than extending In 1903-4, the cane sugar area was 24,579 acres. This has decreased to 20,601 acres in the present year, and a further decline is expected for 1907-8.

About 90 per cent. of the acreage is tilled by white labor, and the remainder by black. The shrinkage is most apparent in the white labor sugar area, although it is noteworthy that, notwithstanding the diminution of 26½ per cent. in the cane sugar acreage worked by white labor, the output of sugar from this area has increased from 19,236 tons in 1903-4 to 22,000 tons in 1906-7.

This falling off in the acreage devoted to sugar cultivation is, to a large extent, attributed to the superior attractions of dairy farming.

PHILIPPINE TARIFF LEGISLATION.

It is asserted by the *Far Eastern Review* that the Philippine Tariff Bill will be brought before the present session of Congress in a modified form, permitting the introduction of duty free sugar to the amount of four hundred thousand tons, and it is confidently stated that the bill will pass without opposition.

We are not so sure that this is so. The prospect is that the Philippine bill will not be pressed for passage at the first session of the Sixtieth Congress. It is understood that Secretary Taft is disappointed to find that public sentiment has not rallied to the support of his measure, and he is not disposed to carry so heavy a handicap for the presidential nomination. It is the talk in Washington that the Philippine bill will be allowed to sleep until after election.

The *American Economist* has the following to say on "Some Aspects of the Philippine Tariff Question":

"How many among the sentimental advocates of Free-Trade with the Philippines understand the exact Tariff relations between those islands and the United States? Very few, we venture to say, are aware of the fact that every dollar of Tariff duties collected upon Philippine products entering the United States is covered back into the Philippine treasury and used for the maintenance of the Philippine government; also that the export duties collected at Philippine ports on products shipped to the United States are paid back to the exporters; also that products of the United States entering the Philippines pay the same rates of duty as those which are paid upon products of other countries exported to the Philippines. Yet these are the facts.

"Under the act of Congress of March 8, 1902, duties collected in the United States upon imports from the Philippine Islands and returned to the Philippine government have been as follows:

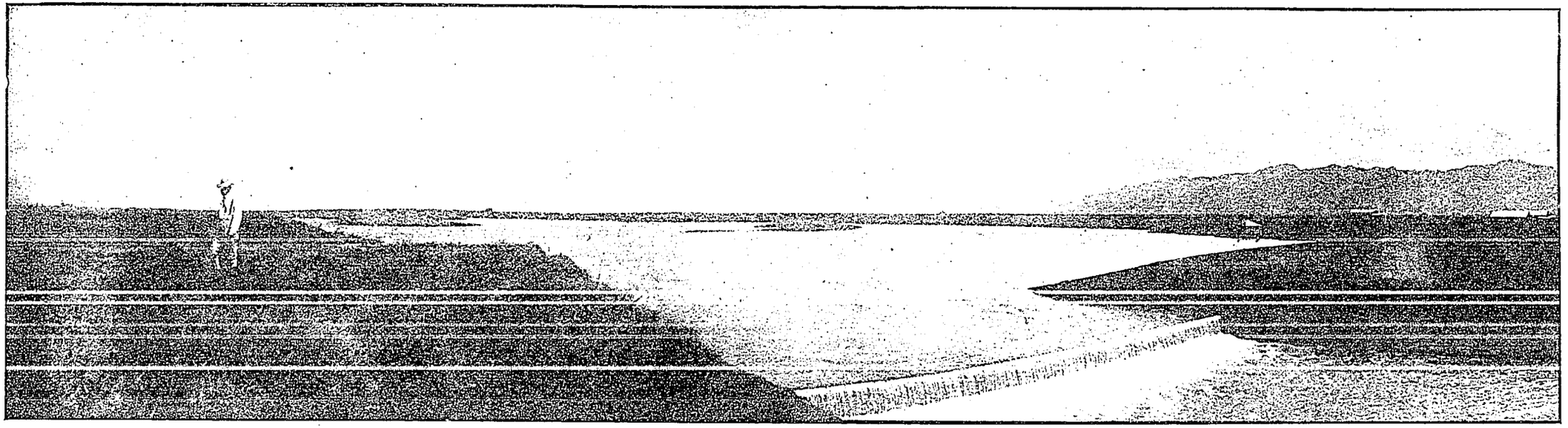
Year.	Pesos (50 cents).
1903	146,436.58
1904	1,265,809.72
1905	1,096,539.28
1906	834,952.40
1907	1,633,974.06
Total pesos	4,977,712.14
Total dollars	$2,988,856.07

"Export duties collected in the Philippine Islands upon products going to the United States, and subject to refund under the act of March 8, 1902, have been as follows:

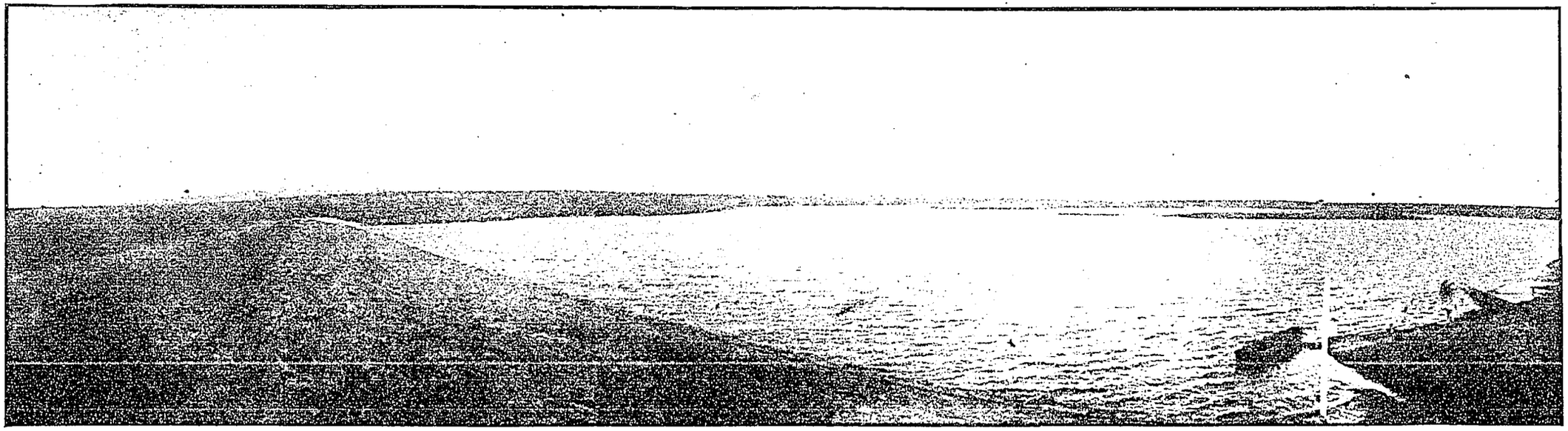
Year.	Pesos (50 cents).
*Mar. 8, 1902, to Dec. 31, 1902	153,863.96
*July 1, 1902, to June 30, 1903	1,047,848.20
July 1, 1903, to June 30, 1904	905,956.70
July 1, 1904, to June 30, 1905	973,402.06
July 1, 1905, to June 30, 1906	868,428.02
July 1, 1906, to June 30, 1907	1,692,491.95

"It will thus be seen that the Philippine producer has fared far better than has the American consumer of Philippine products. If the Philippine producer pays the Tariff (which Free-Traders deny), he pays it into the Philippine treasury for the support of his own government, besides receiving back any export duty he may pay upon articles (such as hemp, indigo, copra, etc.), which enter the United States free of duty. Tariff duties collected in

*Refunds from July 1, 1902, to Dec 31, 1902, have been covered in twice.



VIEW OF THE WAHIAWA RESERVOIR LOOKING UP FROM THE DAM AT THE SPILLWAY END—80 FEET 6 INCHES OF WATER—DEPTH OF WATER OVER SPILLWAY 6 INCHES—AUGUST 19TH, 1907.



VIEW OF THE WAHIAWA RESERVOIR LOOKING UP FROM THE DAM AT THE OTHER END OF THE DAM MAY BE SEEN A PART OF THE SPILLWAY—80 FEET 6 INCHES OF WATER—AUGUST 19TH, 1907

the Philippines on articles from the United States also go into the Philippine treasury. But if the American consumer is the one who pays the Tariff on imports of sugar, tobacco, etc., from the Philippines, he pays his money into the Philippine treasury. Whichever way you look at it, the Filipino is not so badly treated after all.

"But, it is urged, the Filipino would get more for his sugar, tobacco and rice if he could sell them in the United States free of duty. He might and he might not. It would depend some on the quantities marketed in this country and upon the prices which the Sugar Trust and the Tobacco Trust were willing to pay for raw sugar and tobacco. If the quantities were great enough to influence market values in this country—as they most certainly would be in time under Free-Trade—then the American producers of sugar and tobacco would get less for their products.

"So it turns out that there is more than one side to the Philippine Tariff question. There is the American farmer's side. No political party has ever flourished for any great length of time that failed to consider the American farmer's side of any question."

THE WAHIAWA DAM AND RESERVOIR.

In the middle of last summer, after a period of heavy rains in the mountains, the water in the Wahiawa reservoir of the Waialua Agricultural Company, reached its greatest height and for the first time overflowed through the spillway. The cuts here shown were taken from photographs made at the time.

The Wahiawa dam was built across the Kaukonahua stream and impounds the waters of that stream. It is of the rock fill and earth type with a watertight plank bulkhead set in concrete, and a concrete cutoff wall across the stream to a depth of about 40 feet below the original level of the stream. The dam is about 100 feet above the level of the stream, 420 feet in depth, 400 feet across the top and contains 141,000 cubic yards of earth, 26,000 cubic yards of stone and 108,000 feet of 2x12 selected and well seasoned redwood in the bulkhead. It is intended to hold water to a depth of 80 feet.

The overflowed area at that depth will be over 700 acres and the capacity of the reservoir 2,500,000,000 gallons.

It is estimated that this reservoir will fill four times per annum, thereby impounding 10,000,000,000 gallons of water annually.

While it was under construction the waters of the stream were carried off through the permanent outlet pipe, 48 inches in diameter and 1,300 feet long, and through three tunnels 700 feet long, 8 feet in diameter and 8 feet high. The timbers of these tunnels required over 300,000 feet of lumber.

The rock used in the dam was brought from the Waianae mountains, five miles away. This required a railroad line with equipment of locomotive and 60 cars.

The earth for the fill was brought by sluicing the earth into position with a stream of water. This required all the earth on twelve acres of land to a depth of eight feet.

The preliminary work upon the tunnel and stripping the base of the stream was commenced early in 1904, and the actual construction of the dam about one year later.

During the winter months heavy rains fall on the Koolau mountains and the slopes forming the watershed of Kaukonahua stream. The dam will save much of the flood water that would otherwise run into the sea.

The Waialua plantation has used this mountain water for many years for irrigation, but it had no means of storing large quantities; ditches with a daily capacity of about 40,000,000 gallons were built and are now in use, making the water available for irrigating over 4,000 acres of cane. The object of the new dam, however, is not only to store water for continual irrigation of the 4,000 acres now in cane, but to provide water for a large additional area extending from the upper line of the present cultivated area to the 725 foot level.

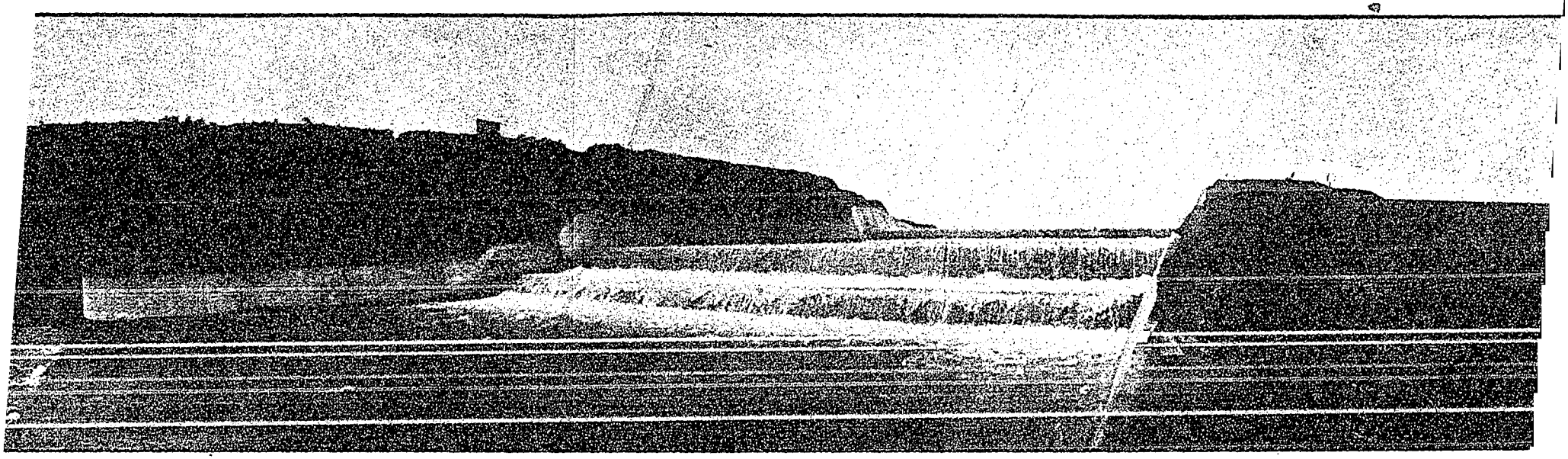
ENTOMOLOGICAL NOTES.

MUIR'S REPORT OF TRAVELS IN BORNEO IN SEARCH OF CANE-BORER PARASITES.

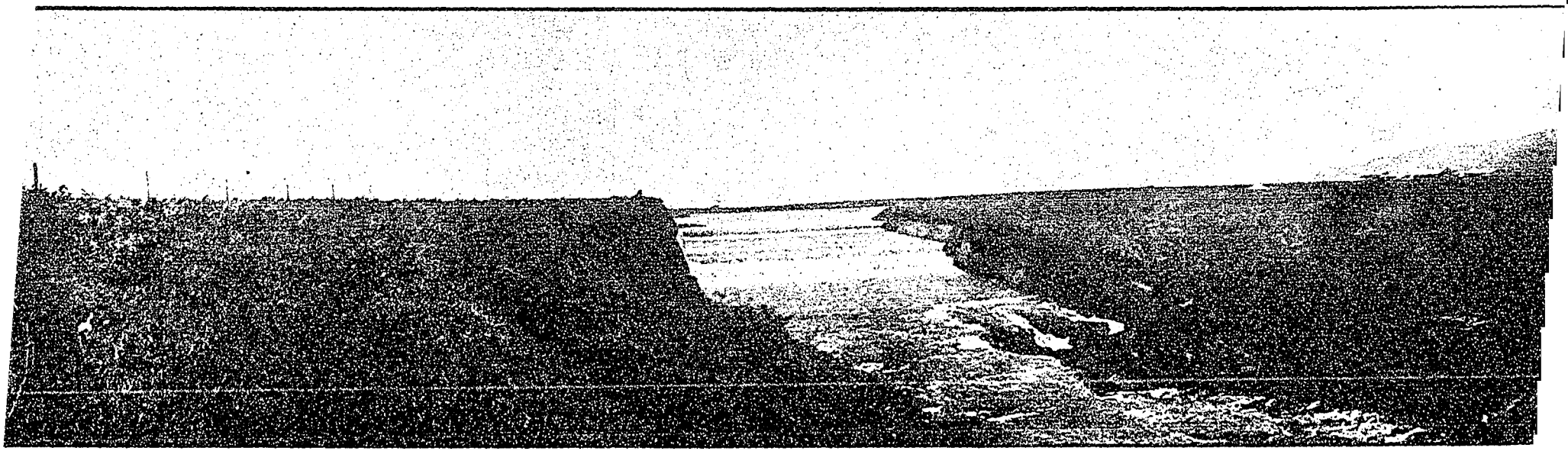
The stories of a scientist are not usually written in a form that attracts the general public. As a usual thing the searcher after greater knowledge is so deeply engaged in his scientific task that he does not think to jot down the incidents along the way.

An exception to the rule are the letters of Fred. K. Muir, assistant entomologist of the Hawaiian Sugar Planters' Experiment Station, who for some time past has been traveling in the Far East in search of a parasite of the cane-borer, and has recently cabled that he has discovered the object of his search.

Mr. Muir has been literally traveling in the wilds of Borneo. In his letters to the officers of the Experiment Station he has devoted considerable space to a description of the country through which he has been moving. Extracts from one of these letters are given herewith. It tells of a few of the extraordinary hardships a man encounters when he gives himself over to en enthusiastic study of science. The letter referred to is as follows:



VIEW OF THE SPILLWAY OF THE WAHIAWA RESERVOIR—AUGUST 19TH, 1907. 6 INCHES OF WATER FLOWING OVER SPILLWAY—SPILLWAY 125 FEET WIDE.



VIEW OF THE SPILLWAY AND DAM OF THE WAHIAWA RESERVOIR—AUGUST 19TH, 1907—6 INCHES OF WATER FLOWING OVER SPILLWAY.

I left Batavia on the 21st July, by S. S. Altong, and landed in Pontianak on the morning of the 24th.

I was very fortunate in meeting two Englishmen on board, Messrs. White and Girdlestone, both residents of West Borneo. Through their kindness and hospitality I was enabled to visit two very different localities. The former is manager of the Tanadina Co., and lives at Teloc Ayer, a small island situated in the lower part of the Kapoeas delta; the latter has mining concessions at Moewong, in the Mempawah district, about seventy miles north of Pontianak.

Owing to the shallowness of the water on the bar large boats cannot enter the main branch of the river, but have to take a more southerly entrance, and steam for nine hours through winding channels, and enter the main stream a little above Pontianak. For the first two hours the sides of the channel are lined with nepa palms, forming a thick even wall; as you continue on the nepa thins out and various species of mangrove appear, and, where the land is a foot or two high, the banks are covered with lowland forest trees. The whole aspect is very tropical, especially where the rattans shoot their graceful tops above the trees.

Pontianak was a Chinese town before the Dutch came to the country, and most of the inhabitants are still Chinese, through whose hands most of the trade passes. Copra oil is the chief product, there being two mills for the manufacture of this product.

The town is situated on the western side of the river on low swampy ground, a most unsuitable site; the roads are all reclaimed ground, and so is the ground that a few of the houses stand on, the majority being built on wooden piles, and have a couple of feet of water under them at high tide. The town is intersected by numerous ditches along which natives move in small canoes at high tide. I was surprised to hear that such a situation was healthy. During my stay I was never troubled by mosquitoes, but I was informed that at times they are exceedlingly bad.

At the back of the town the Chinese have cleared a good deal of ground, and grow various market garden products. Sugar cane is also grown in fair quantities for market and making into sugar. The cane is crushed in stone mills, and boiled in open pans in the same primitive manner as in China. On the eastern side of the river some of the forest has been cleared and a small rubber plantation started.

All the land around here is low, and belongs to the delta formation. The soil consists of a soft forest peat six to ten feet thick when first cleared of trees, but it soon sinks when exposed to rain and cultivated. The water drained from this peat land is of the color of strong tea. After heavy rains the river Kapoeas is strongly colored by this peat water, and the sago washed with it acquires a dirty color. It is not unhealthy to drink.

As I wished to visit some of the native villages on the delta, and to search among the pandanus and other swamp loving plants, I

accepted an invitation from Mr. White to visit Teloc Ayer, and went down in his steam launch. We started at 6 p. m., and arrived about 7 a. m. the next morning.

The river by night had a very different aspect than when I went up by day. The night was very dark, and innumerable fireflies illuminated the vegetation along the banks. In some places thousands had congregated together, and all kept time in the pulsation of their light; in other places a cloud of them would move rapidly up and down the bank, at one time bunching all together, and then trailing off like the tail of a comet. The larvae of these beetles are very interesting creatures, some attaining three inches in length. All that I took inhabited old trees and rotten wood, where they prey upon other insects. One that I kept alive in Java entered the runs, and fed on the larvae, of beetle borers. They do not devour their prey, but suck their juices, a process their mouth is specially adapted for. The mandibles are long and pointed, with a groove down the center, the mouth is closed below by a greatly developed hypopharynx (?), and the maxillary palps large and used for grasping its prey. The antennae are thick, reminding one of the eyestalks of a snail, and are capable of being withdrawn into the head. The head is also capable of being withdrawn into the pronotum. Few of these larvae have been reared and identified; one that I bred had fully winged male and female, and the mouth parts, although greatly reduced, were very like the larval forms. Each segment of the body bore a lateral process, articulated at the base.

The delta formed by the Kapoeas, Landak, and some smaller rivers, is of large extent; the land is low and flat, with innumerable channels cutting it up into small islands; mangrove is the chief tree, especially in the lower parts of the delta. A few isolated hills, of a sandstone formation, with occasional quartz veins running through it, stand out from the general flatness of the country. These hills are covered with large forest trees different from those of the surrounding swamp.

Teloc Ayer is such a hill, forming a crescent, looking east. The forest along the shore, between the points of the crescent, has been cleared, and the factory built near the beach. A stream of good water comes down from the hills and supplies the factory. This stream has given the name to the island (Teloc, bay—Ayer, water), native boats having made this a place of call for getting fresh water.

The majority of the "cutch" (catechu) manufactured here was shipped to America, but a recently imposed heavy duty has closed this market. Should the customs duties ever be abolished, or lowered, in favor of the Philippines, this industry would be very profitable there.

Mr. White's home is situated on the northern point of the crescent, and looks toward the east. From it one gets a fine view of the surrounding country. The tops of the mangrove trees form

a flat, green surface, cut up by channels; where the light green of the Nepa palm growing along its edge. On a clear day one can distinguish the Sockadana hills some fifty miles away. This flat view may have charms for a visitor, but becomes a monotonous sight to those few Europeans living there.

One of the few forms of excitement here is keeping chickens, not that this in itself is very exciting, but when you go to get your breakfast eggs and find a fifteen-foot python curled up in your hen house, lazily digesting two or three of your chickens, it adds to the excitement, if not to the profit, of poultry raising. We caught one such in Mr. White's hen house while I was there. My boy got its head through a slip knot and dragged it down to the factory, where it was skinned and tanned. Its intestines, like so many snakes in this part of the world, was full of parasitic worms.

I found a few clumps of sugar cane growing near the factory, on which I took a species of leaf-hopper and its attendant egg parasites. These insects I found wherever I went in West Borneo. These parasites are the main factors keeping this hopper in check, and appear to be very efficient.

Before leaving Java I had obtained the services of a native collector who had worked a long time for the Buitenzorg Museum. I soon recognized the value of his services, as between 11 a. m. and 4 p. m. I generally found the heat too great to do much field work.

I spent twelve days in this district, and then returned to Pontianak. Here I met Mr. A. J. Simons, an Englishman, with whom I traveled from Singapore to Batavia. He invited me to visit him at Sockadana, situated on the coast to the south, but having just returned from a similar locality, I considered it best to get inland, so I accepted an invitation to visit Mr. Girdlestone at Moewong. To reach this place is a three days' journey, the first by canoe, and then two days' walk.

Having procured letters, through the kindness of the Assistant Resident of Pontianak, to the Captains of the Chinese Kampongs through which I had to pass, I started at 5 p. m., so as to benefit by the tide.

My canoe was about 40 inches wide, and about 18 feet long, covered with a bamboo frame, thatched with palm leaves, except at the bow and stern, where the two natives, who formed the crew, sat and paddled. After stowing away my baggage there was little room left for myself and boy.

The first few miles our course lay eastward, along the Landak river, then we turned off into the Mandor river, and proceeded north.

The banks are low and covered with lowland forest trees; pandanus grows abundantly along the edges, in many places forming a solid wall seven or eight feet thick. About nine o'clock a thunderstorm came on, and my men tied up under the shelter of

such a wall. These rivers are said to be full of "crocks," but I only saw one. It would be inconvenient to be upset in such a place, as one might have to swim a mile or more to find a landing place; to get through the pandanus to the bank would be almost impossible.

I was greatly surprised not to be troubled by mosquitoes in such a situation; in Fiji, whenever I passed a night upon the river, I was nearly driven mad. During the day we were all troubled by several species of Tabanidae, or "Dyak flies," as they are called locally. These flies are exceedingly numerous, and follow the boat for miles. One large specimen, with a very decided clip out of its wing, flew round the boat for four hours, occasionally settling on one or the other to feed. There is very little cattle (disease) in this part of Borneo, and I did not hear of any severe plague among them, but a few months before my visit an epidemic killed off the majority of the dogs in this district. No doubt trypanosome would be very quickly carried through the country by these Tabanid flies.

In the rainy season one can go up to Mandor by boat, but at this time of the year the water is so low that one cannot go past Koeping; even to reach that point the crew had to get out on several occasions and push the canoe over sand banks. In the higher part of the river the trees often meet over the river. Old fallen tree trunks block the stream, and masses of pandanus and other water plants form islands, only leaving small passages through which to navigate the canoe.

We did not reach Koeping till 11 a. m., and then I had to wait for an hour and a half before I could get a couple of Chinese coolies to carry my bags to Mandor, about twelve miles farther on. Koeping consists of about four houses, where half a dozen Chinamen live. The road between this place and Mandor is good, and runs through fairly old forest, parallel to the river; in the shade of the forest the ground is covered with moss, and the atmosphere is cool and damp.

The great number of "stick-insects" (phasmids) and the scarcity of butterflies was very noticeable.

Mandor is a Chinese village consisting of one long street. Travelers arriving here and wishing to get coolies to go up country or a boat to go down the river are charged exorbitant rates, and as there is no one else to go to, you have to pay. Fortunately I had letters from the Assistant President, and so had less trouble than I otherwise would have had, but I had to pay more than a righteous charge. I spent the night here, and started at day break for Karagnan.

Soon after leaving Mandor the country becomes hilly, and large timbers disappear. In all this part of Borneo one only finds primitives forest on a few isolated tops of mountains, where the Dyake, partly out of superstition, have not burnt it. The same thing is mentioned by Dr. A. W. Nienwenhuis in his journey

through Borneo. The Dyak method of agriculture is responsible for this. Near the end of the dry season they clear a piece of ground by burning the trees, and then sow their rice, which comes up with the rains. After one crop of rice has been taken from the soil the spot is abandoned and not used again for six or seven years. Although the Dyaks are very few in number, yet succeeding generations have cleared the country of large timber. Borneo possesses many valuable trees, some on account of their resins, others for building or cabinet making; properly conserved, the forests would be much more valuable than the miserable crops of rice raised on the cleared spots.

The Chinese were in this district washing for gold long before Europeans. The extent of their workings is marvelous, and cannot be believed unless seen. For miles the whole face of the country has been changed by diggings and sluices, and whole hills have been "washed" away.

About 11 a. m. we reached a small Chinese village situated on the Mempawah river, which is fairly large here, and has to be crossed in a boat. Soon after this the road becomes bad, and is only a track through the brush a great deal of the way. At half past three I arrived at Garagnan, two hours earlier than I expected. I stopped the night at this small Chinese village and started early in the morning.

As the road passes through so many streams, I decided to walk in pajamas and shoes. By this means I enjoyed many a pleasant bath with little trouble.

A Dyak bridge is not at all a nice thing to negotiate. Sometimes it consists of a tree trunk thrown across the stream; sometimes a few bamboos lashed together into a bundle, with a rattan stretcher as a hand rail. The bridge sways always from side to side, but should you try to steady yourself by aid of the hand rail your fall is inevitable. Personally, I prefer to wade.

Sugar cane grew in patches around all of the villages, and in many spots in the bush, probably the sites of old Kampongs. I made many halts on the way to examine these patches, but found no traces of beetle-borers.

Toward noon the road become more rugged and the ascent steeper, as we follow up the Mempawah river between Pandang and Sekeh mountains. We passed several Dyak villages, built on platforms raised on wooden piles four to five feet above the ground, with a notched trunk of a tree for steps to reach it. The stench that rises from the mud and filth that accumulate below is abominable. A "village" generally consists of one such platform, with one building divided off into compartments, with one larger general compartment for cooking, etc. The size of a village is estimated by the number of doors. Sometimes the road passes through a Dyak village, and then one must climb up the notched tree trunk, pass through the village, and down the other side.

A steep climb up the side of the Moewong mountain brought me to my destination about four o'clock, where a bath and a drink put me in a frame of mind to appreciate the view which lay stretched out in front of me.

The mountains form a circle, with a break towards the south-east. On the eastern side of the break rises Mount Sekeh, about 3,000 feet, on the western side, Mount Pandang, a little over 3,000 feet; Moewong, about 2,700 feet, is in the center. The Mempawah river rises within this circle of mountains, and passes between Sekeh and Pandang. The sides of the mountains are covered with fine old trees, thickly covered with orchids and climbing plants. My friend's house is situated about 1,500 feet up the mountain side of Moewong. Even at this slight elevation there is a distinct difference in climate; the evenings and nights are cool, and one must sleep under a blanket. During the day one can walk around and collect without real discomfort. From his balcony one look between Pandang and Sekeh, over the Landak district, which stretches out like a map, ranges of hills stretching in all directions. In the early morning, before the sun has dispersed the mists in the lowlands, it looks like a sea dotted with islands.

In this spot I spent two weeks, and would willingly have spent two years. It is a rich entomological field, where an entomologist could spend a life time. I took several species allied to our cane borer, but not our species. I found Hysterids and Hydrophilids at work on several of the larvae, but got no direct parasites; but as both eggs and larvae were exceedingly scarce I could get little material. A whole day's search would only result in a few eggs or two or three larvae. A large patch of cane was growing near a Dyak Kampong at the bottom of Moewong, but I found no borers attacking it. Cane-hopper and its parasites were also present, but not in numbers.

The gold mine they are at present working is on the eastern face of Moewong, and the mill is situated about 300 feet below the house. Good copper ore exists at Pandang, but has not yet been worked. Dutch Borneo has been unfortunate in its mining, not so much on account of the nature of the ore, for a lot of it runs from one to one and a half ounces to the ton, but on account of mismanagement and want of capital. Were all the mining rights in West Borneo amalgamated, they could be run much more economically and profitably.

I was surprised to find that the Dyaks possessed a knowledge of metallurgy. Not only can they recognize metal bearing ore, but they understand the process of baking, and extracting the metal. The Chinese only work alluvial gold, so I do not think they can have learnt from them. The temper of their steel is of a high quality, and a good "head cutting" knife is reported capable of cutting through an iron bar; they are also cleverly inlaid with brass, and sometimes with gold. As far as I observed the only

heads they were keen on getting were Queen Wilhelm's stamped on a silver coin.

The day before I left we had heavy rains, which made the roads bad and all the streams swollen. Leeches, which were bad before, were now much worse, and my coolies had to be continually stopping to clear their legs of them.

On my way down the river I made several stoppages to examine the pandanus for a species of cane-borer, but without success.

I left Pontianak on September 8th, by S. S. Alting for Batavia, from whence I proceeded for Buitenzorg, to get together another lot of Histerids and Hydrophilids for shipment.

EVAPORATOR SCALE.

*By S. S. Peck.

During recent years, much work has been accomplished by chemists engaged in research work in establishing the solubility of salts in water, in solutions of other salts, and in water with insoluble bodies held in suspension. The general result of these investigations has been, with few exceptions, to establish the fact that the solubility of an electrolyte in an aqueous solution of another electrolyte containing a common ion is depressed, the difference in each case depending on the temperature and concentration of the solvent, the mass relation between the solute and solvent, and also the time necessary to produce a condition of saturation. Amongst other lines of chemical research, agricultural chemistry has received considerable assistance in the solution of some of its problems from the investigations of Warrington, Cameron, Seidell, Bell, and many others, on the solubility of the various phosphates of lime, alumina and iron, as well as that of the sulphate of calcium, in water under different conditions of temperature, time and concentration, and in solutions of salts both with and without a common ion. The predominating constituents in evaporator scale are, in addition to organic matter and silica, the sulphate and phosphate of calcium. With a view of ascertaining whether the results of the investigations mentioned would be of value in lessening the amount of scale formed in or on the tubes of the effects in the mills of Hawaii, the work of this Bulletin was undertaken. While the results offer no precise solution to this problem, they explain some of the phenomena of scale formation and may contain considerable of interest to other investigators, practical and theoretical, of this question; perhaps giving them a clue which will lead to the dis-

[*Experiment Station of the Hawaiian Sugar Planters' Association.]

covery of a successful method of treating the juice of the cane which will inhibit to some extent the formation of scale during evaporation.

SCALE IN OTHER COUNTRIES.

As should be expected, there is a great difference in the composition of the incrustations found in the different bodies of an effect. Analyses of scales by H. Pellet, and given in Deerr's "Sugar and the Sugar Cane," are as follows:

TABLE I.

	First Body	Second Body	Third Body
Water and Organic Matter.....	29.80	26.70	18.60
Silica	.40	23.40	69.80
Iron and Alumina	3.80	9.98	2.80
Lime	46.30	25.80	6.80
Magnesia	1.36	.81	1.08
Phosphoric Acid	17.10	11.70	trace
Sulphuric Acid	.00	.00	trace
Copper	trace	trace	trace
Undetermined	1.24	1.61	.92

For the purpose of comparison, the percentage composition of the mineral portion of the scales has been calculated.

TABLE II.

	First Body	Second Body	Third Body
Silica	.57	31.92	85.75
Iron and Alumina	5.41	13.61	3.44
Lime	65.95	35.20	8.35
Magnesia	1.94	1.11	1.33
Phosphoric Acid	24.36	15.96	trace
Sulphuric Acid	.00	.00	trace
Undetermined	1.77	2.20	1.13

A marked difference exists between these scales and those from Hawaii, especially noticeable being the entire absence of sulphuric acid in the first two bodies and a mere trace in the last, a condition which obtains in none of the samples which were analyzed in this Station, with perhaps the exception of scale number 1 (see page 12, table VII), which is from a third effect, and resembles very closely in both its organic and mineral composition the third body scale reported above. Unfortunately we were not furnished with samples of scale from the first bodies of the effect in this instance, and therefore do not know whether the same uniformity of composition exists with respect to these deposits or not. There is a great increase in the amount of silica from the first to the last body, a phenomenon which is exhibited also in local scales, which can be seen by reference to table VII.

In Java, the composition of scale has received considerable attention from Mr. Prinsen Geerligs. In his work on "Cane Sugar and the Process of its Manufacture in Java," he gives the following analyses of scales from a quadruple effect:

TABLE III.

	First Vessel	Second Vessel	Third Vessel	Fourth Vessel
Phosphate of Lime.....	57.85	56.98	15.02	7.49
Sulphate of Lime.....	2.02	1.92	.54	1.65
Carbonate of Lime.....	3.25	4.68	19.55	9.93
Silicate of Lime.....	7.86	13.31	.71	7.02
Oxalate of Lime.....	....	....	11.32	11.27
Iron Oxide	2.03	1.53	2.31	2.58
Combustible Matter	20.37	13.41	11.04	5.08
Silica	7.79	7.43	39.26	54.34

These scales show the same increase of silica, and corresponding decrease of phosphoric acid from the first to the last body as do most of the local scales.

In the International Sugar Journal, 1906, there appeared an article by the same writer and H. Tervooren on scale in evaporators, in which analyses are given of scales originating with juices which had been clarified by defecation with minimum lime, with much lime and subsequent saturation with sulphurous acid, by double and single carbonation, and finally by combined defecation, carbonation, and sulphitation. The figures of the ordinary defecation and single carbonation are presented in tables IV and V as being those which have some relation to the investigations undertaken in this laboratory, and as bearing on some of the conclusions, regarding the presence of phosphoric acid in the scale, reached by the Java chemists.

TABLE IV.

SCALE FROM DEFECATION WITH MINIMUM LIME.

	First Body	Second Body	Third Body	Fourth Body
Loss on Incineration.....	22.28	25.97	31.62	39.91
Silica	5.64	14.26	41.75	18.45
Phosphoric Acid	29.25	22.12	9.83	2.70
Sulphuric Acid	1.90	2.31	.45	.26
Iron Oxide	1.47	2.20	.76	1.69
Alumina	.30	.39	.13	.81
Lime	39.13	31.96	13.97	23.42
Nitrogen	.13	.31	.13	.27
Percentage Composition of Mineral Matter.				
Silica	7.26	19.47	62.42	38.98
Iron and Alumina.....	2.28	3.53	1.33	5.28
Lime	50.37	43.64	20.88	49.48
Phosphoric Acid	37.64	30.20	14.69	5.71
Sulphuric Acid	2.45	3.16	.68	.55

TABLE V.

SCALE FROM SINGLE CARBONATION.

	First Body	Second Body	Third Body
Loss on Incineration.....	34.58	40.63	42.25
Silica	24.91	38.99	14.22
Phosphoric Acid	.42	.00	.00
Sulphuric Acid	.38	.00	.00
Iron Oxide	16.32	11.71	4.72
Alumina	.86	.44	.00
Lime	12.81	4.31	21.47
Nitrogen	.41	.17	.13
Percentage Composition of Mineral Matter.			
Silica	44.72	70.32	35.19
Iron and Alumina	30.84	21.91	11.68
Lime	23.00	7.77	53.13
Phosphoric Acid	.42	.00	.00
Sulphuric Acid	.69	.00	.00

The scales formed during the evaporation of juices defecated with lime correspond to many of the scales in our mills as respects the high content of phosphoric acid and increasing amounts of silica deposited in the latter vessels. Those which have been carbonated show an almost entire absence of both phosphoric and sulphuric acids, and from a comparison of these results amongst themselves and compared also with scums from defecation and carbonation filter-presses, the authors have derived interesting conclusions which we quote at length:

> "The figures show that the incrustations in the first "body contained the suspended particles (in the clarified "juice), while the incrustations deposited in the vessels "where the juice is already more concentrated, were dis- "solved in the clarified juice. According to Pellet and "other authors, the lime contained in calcium aluminate "or silicate is gradually liberated during the heating of "their solution in juice, leaving insoluble alumina and "silica, which latter is to be found in well-nigh every "incrustation. * * * We ascertained as a result of "special investigations that calcium phosphate is very "sparingly soluble in saccharine liquids, and no more "soluble in an acid medium than a neutral or alkaline "one, so that only very little calcium phosphate can be "deposited from a real solution. When, however, the "scales in the first vessels contain much of the salt, it is "proof that the calcium phosphate has not been present "in a dissolved state, but gelatinous and in suspension. "The fact is further confirmed by the knowledge that the "juice from carbonation, which is filtered in presses and "not merely clarified by subsiding, does not contain ap- "preciable quantities of calcium phosphate."

In an earlier article on molasses in the same periodical, Mr. Prinsen Geerligs also remarks that

> "the phosphates of clarified cane juice do not occur in "solution, but in suspension, and in cases, as in carbona- "tion juices, where a thorough filtration of the juice is "possible, they are more apt to be removed than in the "majority of cases, where nine-tenths of the juice is not "filtered at all, but only clarified by subsiding. The same "thing is true for silica; in the list we find almost total "absence of this body in carbonation molasses, while the "defecation molasses contains more silica which has es- "caped the clarification at the outset of manufacture."

SCALE FROM EVAPORATORS IN HAWAII.

During the season of 1907, in response to requests from this Station, twenty-nine samples of scale, representing twelve mills, were supplied for analysis. The results are tabulated in tables VI and VII, the mills being designated by letters for future reference.

TABLE VI.

ANALYSES OF HAWAIIAN SCALES.

Mill	Body	Organic Matter	Mineral Matter	Nitrogen	Carbonic Oxide	Fat Wax, etc
A	Third	30.24	69.76	.73	.00	*
B	"	29.36	70.64	.27	.32	*
C	"	25.49	74.51	.17	.00	*
D	"	22.41	77.59	.10	.04	.22
"	"	20.21	79.79	.16	.00	*
E	Fourth	25.82	74.18	.26	1.14	*
"	Third	42.18	57.82	.90	.00	*
F	First	16.57	83.43	.23	1.46	*
"	Second	29.41	70.59	.44	1.37	*
"	Third	23.20	76.80	.26	1.71	*
"	Fourth	44.15	55.85	.25	1.84	*
G	First	23.99	76.01	.53	1.45	.33
"	Second	28.62	71.38	.52	1.36	.26
"	Third	26.52	73.48	.36	1.33	.41
"	Fourth	37.00	63.00	.34	.55	*
H	First	28.95	71.05	.47	.23	*
"	Second	32.40	67.60	.51	.46	*
"	Third	30.76	69.24	.39	.48	.49
"	Fourth	41.25	58.75	.19	1.25	.60
I	First	34.53	65.47	.78	.79	*
"	Second	29.75	70.25	.62	1.05	*
"	Third	53.48	46.52	.84	.28	*
"	Fourth	54.01	45.99	.29	.50	.22
J	First	35.61	64.39	.31	.00	*
"	Second	50.15	49.85	.46	.56	*
"	First	25.52	74.48	.44	.00	*
"	Second	28.71	71.29	.47	.15	*
"	Third	26.35	73.65	.47	.05	*

* Not determined.

TABLE VII.

ANALYSES OF MINERAL MATTER OF SCALES.

Mill	Body	Silica	Iron and Aluminum Oxides	Lime	Magnesia	Phosphoric Acid	Sulphuric Acid
A	Third	87.41	.91	10.75	.10	trace	.88
B	"	.53	.23	45.34	.08	6.23	47.38
C	"	1.21	.45	39.35	3.40	2.82	52.10
D	"	3.54	.33	43.08	.26	1.10	51.45
"	"	6.17	.28	44.47	.46	1.22	46.02
E	Fourth	11.45	.85	42.71	1.79	1.47	41.64
"	Third	4.23	2.21	53.01	4.30	31.91	3.71
F	First	5.91	1.45	48.33	3.79	38.62	1.60
"	Second	10.43	2.18	44.94	3.37	32.22	6.08
"	Third	11.64	1.03	47.57	2.49	35.04	1.53
"	Fourth	31.20	4.06	33.47	4.74	15.90	10.34
G	First	16.88	4.19	43.08	3.56	29.70	2.07
"	Second	17.48	3.84	40.03	7.12	28.65	2.08
"	Third	17.07	3.76	42.94	3.19	29.54	2.97
"	Fourth	52.51	3.05	25.24	2.55	9.43	6.70
H	First	.38	3.15	46.98	2.83	43.94	3.12
"	Second	.36	3.42	51.44	2.51	40.00	1.79
"	Third	2.22	3.39	49.97	2.62	39.31	1.78
"	Fourth	7.33	1.00	46.48	4.23	38.62	1.86
I	First	1.36	2.28	51.22	4.52	37.64	2.22
"	Second	5.80	2.45	51.65	3.20	33.77	3.00
"	Third	3.57	2.52	58.37	1.60	28.59	5.08
"	Fourth	24.65	.77	61.95	1.22	8.00	3.44
J	First	17.08	2.32	44.59	.75	8.98	26.60
"	Second	40.86	3.48	47.06	2.99	4.20	1.74
"	First	4.04	2.75	47.95	4.86	38.14	2.11
"	Second	8.31	1.44	44.02	4.12	39.29	2.54
"	Third	36.31	.84	31.87	2.94	25.71	2.74

Some of the samples of scale were accompanied by information regarding method of clarification, etc., which is herewith presented in condensed form.

Mill "B." Standard effects; open pan clarification; low grade sugars mixed with clarified juice, then settled out and taken through the effects; press juice used for remelting low grade sugars; no sand filters; variety of cane mainly Yellow Caledonia.

Mill "D." Standard effects; superheater; low grade sugars not reclarified; press juice goes directly into the triple effects; no sand filters; Lahaina cane; scale found in the third body only. At the time the sample was taken, the effects had not been cleaned for one month, and scale was particularly heavy because juice of exceptionally low purity had been evaporated during this period. Scale is present in such quantities in a measure because of the density to which the juice is evaporated, namely, in the neighborhood of 65° Brix. The effect of scale is somewhat counteracted by the fact that lime is added only to neutrality.

Mill "F." Lillie quadruple effects; superheater and intermediate settlers; juice limed to neutrality, no clarifying agent other than lime employed; sand filters used; press juice mixes with clear juice from the settlers as it enters the sand filters; remelted low grade sugars reclarified; Lahaina cane; considerable trouble with scale formerly when the juice used to be sulphured; evaporators boiled out once a week with soda-ash and afterwards with muriatic acid; also use "Evaporator Compound" in place of soda with good effect.

Mill "H." Lillie quadruple effect; alkaline clarification with lime only; closed heaters and intermittent settlers; sugars not remelted; press juice mixed with mill juice; Lahaina cane; scale formed principally in first and fourth bodies, that in first body being much harder than that in fourth; very little scale in second and third bodies.

Mill "I." Standard effects; lime to neutrality; superheaters and intermittent settling tanks; no sand filters; press juice run into effect supply tanks; remelts not clarified; Lahaina cane.

Mill "J." Lillie and standard effects (the first two in the tables are from the standard, and the other three from the Lillie); clarified with lime only; superheater; no intermittent settlers; no sand filters; remelted low grade sugars not reclarified; press juice returned into first juice; Yellow Caledonia cane.

The scales were all scraped from the tubes previous to any treatment by soda or acid. Some of them contained considerable copper, indicating in a measure the difficulty which was experienced in removing the incrustations, the amount varying from nothing in those scales consisting principally of sulphate of cal-

cium to 13.51% in the scale from the third effect in Mill "E." The analyses presented are all calculated to copper-free basis.

The deposits can be generally classified as silicate, sulphate, and phosphate scales. The silicate and sulphate scales were of a white or light gray color, and in thin sheets or laminae. The others of a black to dark gray those from the latter bodies being much lighter than those from the first.

SILICATE SCALES.

As with the scales reported by Pellet and Prinsen Geerligs, the percentage of silica increases from the third to the last body. These scales, especially when principally aluminum silicate, are hard and smooth and offer an immense resistance to heat transmission, it having been estimated that they possess a hundred times less conducting power than brass. The silica comes not only from the juice itself, but also frequently from the lime used in clarification. It has been proposed, in order to eliminate this danger of contaminating the juice with this unwelcome substance, to slake the lime, using considerable water, allow it to settle, and decant and discard the supernatant liquid. Claasen criticises this method, calling attention to the fact that

> "most varieties of lime contain scarcely any impurities "which are soluble in water, and of such only the salts "of the alkalies are worth considering, for those con- "stituents of lime which are difficultly soluble in "water, or dissolve very slowly, such as, for instance, "silicate of lime and alumina, will never be satisfactorily "removed, for the simple reason that they are much more "soluble in sugar solution than they are in pure water."

Experiments conducted to show the solubility of ferric oxide, alumina, and silica contained in quick-lime when in hot sugar solution show that as soon as the alkalinity was lowered to between 0.15 and 0.07, the percentages of lime and alumina were also less. The solubility of silicic acid, however, remained nearly constant at variable alkalinities. These deposits resist the action of acids, but are partly dissolved by the action of boiling soda solution. Sometimes this fails to remove it, and mechanical scraping must be resorted to.

SULPHATE SCALES.

The list of scales contains six which consist principally of sulphate of calcium. The sulphuric acid comes entirely from the juices of the cane, no sulphurous acid being used in the clarification; the extent to which it is present must depend on the character of the soil, the nature of the fertilizers applied, or the property of the cane or of different varieties of cane in absorbing the sulphuric acid radical from the soil. However, a study of

the analyses of soils from the districts represented reveals no marked difference in their respective contents of sulphuric acid. From fertilizers, they all receive approximately the same amounts of soluble sulphates; sulphate of ammonia, sulphate of potash, and sulphate of calcium in superphosphates, being always present. The fact that some scales are formed with mineral matter consisting principally of sulphate of calcium may be due to two causes, 1st, that the style of evaporators used, whether submerged tube or film, affects the nature of the incrustation deposited; or, 2nd, that in certain districts, canes, of the same or different variety, have a greater selective power for the sulphuric acid radical than in others; for given the same amount of sulphuric anhydride in the juices as they enter the effects, it would be supposed from the very nature of the changing solubility of calcium sulphate, that the incrustation in the last body would be largely composed of that salt. A certain increase is indeed to be seen; thus, in Mill "F" the percentage of sulphuric acid increases from 1.60 per cent. in the first to 10.34 per cent. in the fourth body, and in Mill "G" from 2.07 per cent. to 6.70 per cent. On the other hand, in Mills "H" and "I" there is no appreciable difference. Two years ago a scale was analyzed which came from Mill "B," and also a deposit from molasses from the same source, with results as follows:

	Scale	Molasses Deposit
Silica	.17	2.11
Lime	42.87	41.65
Magnesia	.60	.25
Phosphoric Acid	9.48	4.00
Sulphuric Acid	41.76	49.55

It will be seen that the composition of the scale in this instance is practically constant, and not due to any seasonal accident or peculiarity of the juices.

SOLUBILITY OF SULPHATE OF CALCIUM IN PURE SOLUTIONS.

Sulphate of calcium, which is anhydrous gypsum, is more soluble in cold water than in hot. The results as published by different investigators vary greatly owing to the tendency of the salt to form supersaturated solutions. The maximum concentration exists at about 37.5° Centigrade (99.5° Fahrenheit), when a liter contains 2.15 grams, decreasing to 1.798 grams at boiling

temperature. The presence of other salts affects the solubility differently, those containing a common ion decreasing, and those not containing a common ion increasing it. According to Droeze, a liter of a solution containing four grams potassium chloride will dissolve 2.32 grams at 21° C., while with the concentration increased to 80 grams of the chloride per liter, 5.84 grams are dissolved. Sugar likewise affects the solubility. In 1866 Sostmann gave results showing that a 67 per cent. solution of sugar would contain 4.94 grams of the sulphate in a liter. Later researches have given results quite to the contrary. G. Bruhns (Centr. Zuckerindustrie) shows that the solubility decreases instead of increases with the concentration of the sugar during evaporation and boiling, and that both with neutral and alkaline juices, a separation of gypsum in after products must take place. Stolle has also published a table from which the following figures are taken:

TABLE VIII.

SOLUBILITY OF SULPHATE OF CALCIUM IN SUGAR SOLUTIONS AT DIFFERENT TEMPERATURES.

Per Cent. Sugar	Grams of Calcium Sulphate in 1000 grams solution.		
	30° C. (86° F.)	50° C. (122° F.)	70° C. (158° F.)
0	....	1.733	1.655
10	2.045	1.733	1.576
20	1.811	1.421	1.421
42	1.031	.777	.856
55	....	.505	.369

A series of experiments was made in this laboratory for the purpose of determining the solubility of calcium sulphate in sugar solutions under conditions approximating those existing during the clarification of juices; also, for comparison, in solutions without sugar and at room temperature. For this purpose, a strength of sugar solution of 13 per cent. sucrose was adopted, this being the average of the mixed juices in our mills; and of potassium chloride, a solution containing 2.50 grams to the litre, this being about the average content of this salt in Island juices. The solubility was determined at room and boiling temperature. According to Goldammer, water is fully saturated with calcium sulphate by shaking it with the finely divided substance for five minutes. However, it was thought safer to allow the contact to last for thirty minutes. Two grams of chemically

pure calcium sulphate were placed in 250 cubic centimeters of distilled water free of carbonic oxide, and in solutions of sugar and potassium chloride, and shaken at frequent intervals during half an hour. Other equal portions were submitted to similar treatment with boiling water, the flasks being connected with reflux condensers, so as to permit of no loss by evaporation.

TABLE IX.

SOLUBILITY OF CALCIUM SULPHATE IN AQUEOUS SOLUTIONS.

Solvent.	Grams Calcium Sulphate per Liter.	
	27° C.	100° C.
Water	2.100	1.792
Water and Potassium Chloride..	2.538	2.212
Water and Sugar	1.789	1.465
Water, Pot. Chloride and Sugar..	2.171	1.883

This table shows that the solubility is raised by the presence of potassium chloride, and depressed by heat or sucrose under every condition, and in nearly the same proportions.

In table XIV will be found analyses of juices showing their content of sulphuric acid, the average of the clarified juices being 1.461 grams per liter. This acid radical is combined principally with potassium and magnesium as their sulphates, and to a lesser extent with calcium as sulphate of calcium. Cameron and Breazeale (Journal of Physical Chemistry) have shown that calcium sulphate is less soluble in solutions of potassium and magnesium sulphates than in water, the solubility decreasing with the concentration of the solvent salts. But potassium chloride is also present in the juices, and the solubility of the calcium sulphate is greater in its solutions than in water, increasing proportionately with the amount of the chloride present. We have then an explanation of a two-fold action taking place in the evaporators,—the tendency of the calcium sulphate to be thrown out of solution, due to the increasing concentration of the sucrose and the sulphates of potassium and magnesium, counteracted slightly by the increasing solubility of the gypsum in the more concentrated potassium chloride solution. Unfortunately, the rate of solution is greatly inferior to that of precipitation, and sulphate deposits or scales result.

A juice clarified in the laboratory with a slight excess of lime contained 0.339 grams of calcium sulphate per liter. An ef-

fect, then, which takes care of 600,000 gallons of juice of a similar composition a week would have 769.95 kilograms of this substance passing through it. If this juice, originating with 13.48 per cent. sucrose, were evaporated to 55 per cent. sucrose, there would result 118,176 gallons, which, from table VIII, would, at 158° F. be saturated with 165.07 kilograms of the lime sulphate, leaving 604.9 kilograms to be precipitated, either as a deposit from the syrup or after products, or as incrustation on the various tubes, principally on those of the last vessel. If the syrup leaves the last body with 42 per cent. sucrose, there would result 166,184 gallons, which at the same temperature would contain 538.5 kilograms of sulphate of calcium, leaving 231.45 kilograms to be deposited. In other words, the greater the concentration, the larger will be the amount of lime sulphate liable to be deposited as scale; an increase of eight per cent. in evaporation increasing the amount of scale-forming deposit by 161.3 per cent. Of course, not all of the sulphate of calcium that is rendered insoluble is deposited on the tubes, a large part settling out later in the syrup tanks, and also from the molasses subsequent to blowing up. Of that portion forming scale, a small proportion will be found in the first bodies, but the greater portion in the last, since the tendency to form incrustation will be greatly augmented by the greater viscosity and consequent slower movement of the syrup. That such an increase in sulphate scale does result from a higher concentration of the juice is evidenced by the experience of Mill "D." The figures given above are no great exaggeration of possible conditions. A scale similar to one of the samples received and a thirty-second of an inch in thickness distributed evenly over the tubes of an effect having 1,000 square feet evaporating surface, will weigh 199,735 grams, and with a content of 57 per cent. calcium sulphate will contain 113,849 grams of that salt; while if of double this thickness, it will weigh twice this amount, or 227,798 grams.

It is noticeable that all the sulphate scales originate in vessels of the submerged tube type. However, not all of this type give a sulphate scale, as Mill "I" has a vertical effect. Unfortunately we have received but one set of samples from a mill where both styles of evaporation are in use, viz: Mill "J." Here the exceptional condition is presented of a scale from the first body containing a greater percentage of sulphuric acid than that from the second. Nevertheless, the first body of this vertical effect produces a scale with ten times as much of this radical as does any of the bodies of the Lillie. No positive explanation can be offered at this time of this phenomenon, but it is doubtless due either to the different compositions of the respective juices, or their more rapid circulation in the film evaporators, not offering time for the scaly deposit of calcium sulphate to adhere.

REMOVAL OF SULPHATE SCALE.

Gypsum can be dissolved by the action of dilute muriatic acid only after long continued boiling, a condition which is not favorable for the long life of the metal containers, although a mixture of the acid with five times its volume of water will not affect copper or brass if it does not consist of more than fifty per cent. zinc. Zinc itself and iron, however, are quickly dissolved. The solubility of gypsum in dilute hydrochloric acid at boiling temperature is as follows:

Grams Hydrochloric per liter	Grams Calcium Sulphate per liter
.77	11.209
3.06	31.780
6.12	46.902

The better plan, however, is to boil with a dilute solution of sodium carbonate, which has the two-fold action of disintegrating the scale by dissolving the fats and loosening up the other organic matter, and of converting the calcium sulphate into calcium carbonate, which is readily dissolved by weak muriatic acid.

Lime sulphate is also more soluble in a solution of common salt than in water, one containing 20 per cent. sodium chloride dissolving 8.23 grams per liter at 20° C. A rise in temperature lowers the solubility until at 100° C. only 2.5 grams remain in solution. It is also soluble in many other salts, as ammonium sulphate and sodium thiosulphate. An endeavor has been made to use these compounds in removing this incrustation from rum stills, but without any success.*

Lime as sulphate can be removed from the juices before evaporation partially by sodium carbonate, whereby sodium sulphate and the more innocuous calcium carbonate result; or almost completely by treatment with barium salts. Neither of these methods is to be recommended, the latter especially on account of the poisonous nature of barium compounds.

PHOSPHATE SCALES.

The balance of the scales are composed principally of lime phosphate. The solubility of the different phosphates of lime has received extended study. That of tri-calcic phosphate, the insoluble form in which it is precipitated from the juice during defecation, has been greatly complicated by the fact that a true

* A. Urich. International Sugar Journal, December, 1901.

solution of this substance does not take place when it is placed in contact with water, but a partial decomposition results. The extent of this decomposition or hydrolysis varies with the relative masses of the solvent and the solute, the time of contact, temperature, and completeness of agitation. The products of the decomposition are hydroxide of calcium and free phosphoric acid, the latter going entirely into solution, the former partly, the remainder forming with the calcium phosphate left a basic phosphate. The acid radical is dissolved out in far greater proportion than the lime, so that the resulting solution always has an acid reaction.

In experiments with a pure preparation of tri-calcic phosphate, Warrington showed that after boiling it with water for three hours, the solution contained three times as much phosphoric acid as calcium, although the original contained a little more calcium than required by the formula where the relation between lime and phosphoric acid is as 1 to 0.845.

All the salts of calcium diminish the amount of phosphoric acid going into solution in water. Solutions of potassium chloride up to a certain concentration act likewise, but increase the amount of lime, the solutions, however, still having an acid reaction. Sucrose solutions dissolve the phosphate in inverse proportion to the concentration. The following is from Spencer's Handbook:

Strength of Sugar Solution.	Calcium Phosphate Grams per liter.
5 per cent.	.029
10 " "	.028
15 " "	.014
20 " "	.018
25 " "	.005

For the purpose of ascertaining the solubility of the phosphate in sugar solutions, determinations were made in this laboratory with similar solutions to those used in the determinations of the solubility of sulphate of calcium. The necessary length of contact and strength of solutions were determined by preliminary tests, the aim being to obtain concentrations which would allow exact measurements of the elements dissolved. The conditions, then, of the experiments do not pretend to entirely duplicate those obtaining in a mill. The strength of sucrose, 13 per cent., and that of potassium chloride, 0.25 per cent., are derived from the average of many juices. The time of contact was two hours, the cold solutions being shaken at frequent intervals. The boiling was conducted in flasks connected with reflux condensers.

There were four series of tests, with water alone, water and potassium chloride, water and sucrose, and water, potassium chloride and sucrose. The solubility was determined both with the phosphate alone and with calcium carbonate suspended in the solvent. Calcium carbonate was selected from the list of compounds which decrease the solubility of the phosphoric acid as being the one that it would be possible to use both economically and practically, if the results warranted it, and as further having no known injurious action on the juice. The sugar used was refined granulated, the ash being determined and proper allowance made in the calculations. The water was carbonic oxide free, and the potassium chloride and calcium carbonate chemically pure. The calcium phosphate was almost exactly correct, as the following analysis shows:

Tricalcic Phosphate	91.62 per cent.
Calcium Hydroxide	.89 " "
Moisture	7.40 " "

The following tables give the amounts of lime and phosphoric acid contained in a liter of solution. In each case the determination was made with 500 cc. of the respective solutions, an amount of the phosphate equivalent to five grams of tri-calcic phosphate, and one gram of calcium carbonate. As stated before, the conditions were exaggerated over what is found during the clarification of juices, but all determinations were carried on under exactly similar conditions, and are strictly comparable.

TABLE X.

SOLUBILITY OF PHOSPHATE OF CALCIUM IN WATER.

Temperature.	Lime Grams per Liter	Phosphoric Acid Grams per Liter	Reaction N/10 C. C. per Liter
Without Calcium Carbonate			
25° C.	.0053	.0201	3.41 Acid
100° C.	.0055	.0777	19.62 Acid
With Calcium Carbonate			
25° C.	.0342	trace	Neutral
100° C.	.0077	faint trace	Alkaline

Boiling rapidly accelerates the decomposition of the calcium phosphate into free phosphoric acid and basic lime, the former increasing over three fold, while the amount of the latter going into solution remained constant. Addition of calcium carbonate either prevented the solution of the acid, or upon its being released interacted with it forming a fresh precipitate of insoluble calcium phosphate, the amount of phosphoric acid actually in solution not being determinable by ordinary laboratory methods. There was much more lime dissolved when the carbonate was present, but upon boiling the amount was reduced to almost that of the solution without this addition.

TABLE XI.

SOLUBILITY OF PHOSPHATE OF CALCIUM IN WATER CONTAINING 0.25 PER CENT. POTASSIUM CHLORIDE.

Temperature.	Lime Grams per Liter	Phosphoric Acid Grams per Liter	Reaction N/10 C. C. per Liter
Without Calcium Carbonate			
25° C.	0.0121	0.0221	3.28 Acid
100° C.	0.0116	0.0800	18.67 Acid
With Calcium Carbonate			
25° C.	0.0427	trace	Neutral
100° C.	0.0105	faint trace	Alkaline

A decided increase of lime in solution is effected by the presence of the potassium chloride, the phosphoric acid remaining practically the same. The relative changes are the same as in the previous table.

TABLE XII.

SOLUBILITY OF PHOSPHATE OF CALCIUM IN WATER CONTAINING 13 PER CENT. OF SUGAR.

Temperature.	Lime Grams per Liter	Phosphoric Acid Grams per Liter	Reaction N/10 C. C. per Liter
Without Calcium Carbonate			
25° C.	0.0195	0.0192	3.31 Acid
100° C.	0.0175	0.0726	17.79 Acid
With Calcium Carbonate			
25° C.	0.0386	0.0016	Neutral
100° C.	0.0242	0.00046	Alkaline

The presence of the sucrose increased the amount of lime going into solution, while that of phosphoric acid was slightly lowered where no calcium carbonate was added. While in pure water solution, this compound reduced the amount of the phosphoric acid to a mere trace, in a sugar solution it was retained in determinable quantities. A considerable reduction in the amount, however, is obtained, a comparison between the boiled solutions in the above table showing that the one in which the calcium carbonate was present held less than 0.7 per cent. as much phosphoric acid as the one containing no carbonate.

TABLE XIII.

SOLUBILITY OF PHOSPHATE OF CALCIUM IN WATER CONTAINING 0.25 PER CENT. POTASSIUM CHLORIDE AND 13 PER CENT. SUGAR.

Temperature.	Lime Grams per Liter	Phosphoric Acid Grams per Liter	Reaction N/10 C. C. per Liter
	Without Calcium Carbonate		
25° C.	0.0222	0.0227	3.31 Acid
100° C.	0.0233	0.0716	17.55 Acid
	With Calcium Carbonate		
25° C.	0.0515	0.00207	Neutral
100° C.	0.0334	0.00095	Alkaline

The results here show a similar relation to table XI as is exhibited between tables X and XII. The phosphoric acid due to the sugar is a little higher than in table XII on account of the presence of potassium chloride, just as in table XI the phosphoric acid in the experiments untreated with calcium carbonate was greater than in the corresponding tests in table X.

It would appear, then, that under the conditions of these experiments a boiling solution containing sucrose will dissolve more phosphoric acid than one without.

Phosphoric acid exists in the juices combined with various bases, iron, alumina, lime, magnesia, and potash. On the addition of lime, lime phosphate is precipitated out of solution along with the other insoluble products of defecation, albumenoids, etc. This precipitated phosphate is in contact with the juice for a brief period, as it passes through the heater or is boiled in the defecators, and on being placed in the settling tanks goes to the bottom along with the other eliminated impurities. The condi-

tions of the experiments are consequently quite different, but it was nevertheless hoped that the presence of calcium carbonate in the juice would effect a more complete separation of insoluble lime phosphate, and a correspondingly diminished amount that would enter the evaporating apparatus. In the carbonation process much less phosphoric acid is found in the scale than in that from the defecation process. This is due, according to Prinsen Geerligs, to the fact that in the former case the juices are filtered and particles in suspension eliminated. It will be shown further on that this may be also due to the fact that such juices are always limed to excess, the alkalinity being reduced afterwards by precipitation of the lime as carbonate by means of carbonic acid gas. There is then so little of phosphates left in the juices, that the increasing concentration in the effects does not cause a precipitation and subsequent deposition of phosphate scale.

[To be continued.]

THE SUGAR INDUSTRY IN NEGROS.

In the great sugar producing year of the Philippines, the Island of Negros sent to the markets of the world nearly 134,000 tons, equal to nearly forty-five per cent. of the total crop of the Archipelago for that year.

That was in 1893. Through the employment of American and English capital the thirty years preceding 1893 showed a steady and rapid growth of the sugar industry in the Philippines.

In 1855 the total output of the islands was 6,000 tons annually. It went up to 30,000 tons within the first five years thereafter, in the next ten years to 100,000 tons and reached its highest point, 300,000 tons, in 1893.

But the years that have followed fail to show progress.

The movement has been rather retrograde. There has been ten years of war, famine, locusts, diseases among the cattle, and adverse legislation that have put Philippine sugar at a disadvantage in the markets of the world.

Yet the investigator will find that the real source of the stagnation of the past dozen years has been due, principaly, to the withdrawal of capital and the subsequent lack of that spirit of enterprise that belongs to the races of the temperate zone. The land of Negros is as rich as ever, and under proper management will yield more than ever before. The climate is as generous and the rainfall always assures the necessary amount of moisture. There are great markets close at hand in which the product of the Negros hacienda ought to find ready sale. It is not dependent upon the United States tariff.

But the spirit of enterprise is lacking. There is no money in the country. It takes a lot of money to run a sugar plantation.

The little capital that is offered, and is keeping things running, commands a price that would make the American sugar grower and farmer sit up and rub his eyes. The capitalist who backs the Negros sugar planter today shares so largely in the profits that there is nothing left for the planter to improve his methods with.

So there must be, after all, a field in the Island of Negros for a wide-awake business man who has sufficient capital to back him, and good profits for the capitalist whose custom it is to back brains.

Just think of the great market for sugar in China and Japan. They use Java sugar there now. Why? Because in Java they have central sugar mills, where the highest percentage of sugar is extracted from the cane at the lowest cost. They send centrifugals to China where it easily outclasses the raw sugar of the Philippines. Men who have studied the question carefully say that if the Philippine sugar industry was run on the same lines today as it is in Java the Philippines product would crowd that of her neighbor out of the Far Eastern field.

It is a big question, but one well worth studying, to the man who has money to invest. In the pages which follow, the writer has not attempted to discuss the matter, but merely to show what has been done and what the conditions now are on the Island of Negros.

It is not generally known that American capital played a prominent part in the development of the sugar industry in Negros and Panay. Such is the case, however. Coupled with the earliest history of sugar cane culture are found the names of Russell & Sturgis, an American firm, and Loney & Co., an English concern. These enterprising pioneers of trade in Iloilo advanced the money to the pioneers who cleaned the forests from Negros and planted the clearings in cane. It was American and English capital that purchased the mills and that fed the multitude of laborers while they planted and harvested the crop. It was under the stimulation of such enterprise that the industry experienced its wonderful growth between the years 1855 and 1893.

While sugar is the great staple of Negros, it is far from being the only source of wealth to the island. There are vast areas of grand land for abaca, coffee, rubber, corn, and tobacco, while the rice crop each year at the present time is very large. There is also a large amount of land available for cocoanut culture. At the present time there is a narrow fringe of cocoanut groves around the island, but practically no copra is shipped out. In the majority of cases, the blossoms are cut and the sap from the stems is used as a beverage (tuba). The nuts that are allowed to mature are used in the process of sugar boiling.

Coal is found in many places on Negros, and some of it is of excellent quality. None of the known beds have yet been developed. It is believed that eventually oil will be found on the island, as it is at present on the nearby island of Cebu.

Plans are now under way for the development of a vast bed of coal discovered in the vicinity of San Carlos by Mr. Jeanjaquet, a planter. Although large areas of forests rich in hard woods disappeared before the axe of the pioneer, there is still timber enough on Negros to make it an important factor in discussing the wealth of the island. At present there is one large saw mill in operation near Cadiz, in the North, where large contracts of timber for the Philippine Railway Company are being turned out.

The proposed railway, upon which operations will be commenced within a few months, will aid greatly in the development of the island. The terminal will be at Bacolod, the capital of Occidental Negros. One branch will run south to the Ilog river, a distance of about sixty miles, tapping some of the finest sugar lands, and another branch will run northward to a point not yet determined. With the advent of the railroad, a network of public highways is being planned as feeders to the railroad.

PHYSICAL FEATURES.

Negros lies very near the center of the Philippine Archipelago, latitude 9° 4′ to 11° 1′ north, longitude 123° 34′ to 122° 24′ east, occupies the southwest angle of the Visayan group, between Panay, on the northwest at a distance of from eight to twenty-nine miles, and Cebu on the east, at a distance of from three to twenty-five miles.

The greatest length of the island from north to south is 134 miles and the greatest breadth from east to west is 33 miles. The coast line measures 836 miles. The total area of the mainland is 4,839 square miles or nine square miles greater than that of the State of Connecticut.

Negros has a total population of 509,766, the greater part of whom are Visayans. The mountain regions are inhabited by Negritos or Montescas. Many of the hacenderos are foreigners, the greater part of whom are Spaniards.

A chain of mountains running from north to south, and somewhat to the east of the center, forms the backbone of the island. There are three peaks above 6,000 feet in height, the most southerly of them being Mount Canlaon (8,192 feet), an active volcano.

The peaks all lie within the northern half of the island, which comprises the province of Occidental Negros. Between the mountains and sea on the west coast there is a fairly level plain, sloping up very gradually from the sea to the foothills. This plain is from five to twenty miles wide, and extends from Cadiz Nuevo on the north to the Ilog river, a distance of over one hundred miles. Through it run scores of creeks and rivers, some of the latter being navigable by light draft boats for a distance of from two to five miles.

It is this splendid well-watered plain that has made Negros

famous as a sugar producing country. The bulk of the land within its borders is adapted to the cultivation of cane. The marshy places are utilized for the cultivation of rice. The rivers are the highways by which the hacendero ships his product to the market. The government maintains a few good roads, but they are not of much use in carrying the sugar crop. Everything goes by water. During the grinding season, the northeast monsoon is blowing, and it is most favorable to sail transportation between the west coast of Negros and the port of Iloilo. For this particular trade the lorcha was invented many years ago by an Englishman. The lorcha is flat-bottomed, two-masted and schooner-rigged; in capacity from 50 to 100 tons and very strongly built. It is designed to be beached at low tide, and is often loaded while lying high and dry between tides.

There are eight rivers on Negros that are navigable by lorchas. The greatest river is the Danao, in the north of the island. It is navigable for vessels of 10-foot draught for a distance of ten miles from its mouth, but its entrance is practically blocked for large boats at present because of a sand bar. In 1898 several small Spanish gunboats escaping from Iloilo successfully lay hidden in the Danao until peace was declared. It is one of the possibilities of the future that the Danao river bar be removed and a railway terminal established on the river where deep sea shipping may load direct. The Ilog river in the south is another important stream, but is likewise blocked by a shallow bar. Other important streams on the west coast are the Bago and Binalbagan rivers, both of which are navigable for lorchas.

Today there is but one harbor on the Island of Negros that is open to deep sea craft, and that is San Carlos.

The extreme northern part of the island has a very limited amount of sugar land, but there is fine timber there. About Escalante and through the Danao river valley the products are corn and tobacco. On the eastern slope of the mountains is the sugar producing district of San Carlos.

There is a high table land, many thousands of acres in extent, between La Castellan and Valle-hermosa, which will make excellent grazing land. The distance between the points named is about 25 miles, and within that distance there are 24 streams, most of them of the clearest and purest water. The table land is at an altitude of from 1,500 to 2,000 feet above sea level. Years ago there was a settlement known as Malaiba in the heart of this district, and the inhabitants had under cultivation a rich and beautiful valley there, but the place was burned in the insurrection of 1896 and has since been deserted.

Just south of Bacolod, and extending to the Bago river, there is a strip of land not adapted to cane culture, and now lying idle. Sr. Timoteo Unson, manager of the de la Rama haciendas on the Bago river, is experimenting here with maguey and believes that the whole tract can be planted with this fibre plant at a profit.—*Manila Daily Bulletin.*