CONTENTS.

Sugar Plantations, Cane Growers and Sugar Mills.

ISLAND AND NAME.		MANAGER.	POST OFFICE.
OAHU.			
Apokaa Sugar Co.	*	G. F. Renton	Ewa
Ewa Plantation Co.	*	G. F. Renton	Ewa
Waianae Co.	***	Fred Meyer	Waianae
Waialua Agricultural Co.	*	W. W. Goodale	Waialua
Kahuku Plantation Co.	x*	Andrew Adams	Kahuku
Waimanalo Sugar Co.	**	G. Chalmers.	Waimanalo
Oahu Sugar Co.	x	E. K. Bull	Waipahu
Honolulu Plantation Co.	**	J. A. Low	Aiea
Laie Plantation	x*	S. E. Wooley	Laie
MAUI.			
Olowalu Co.	**	Geo. Gibb	Lahaina
Pioneer Mill Co.	x	L. Barkhausen	Lahaina
Wailuku Sugar Co.	**x	C. B. Wells	Wailuku
Hawaiian Commercial & Sug. Co.	x*	H. P. Baldwin	Puunene
Maui Agricultural Co		H. A. Baldwin	Paia
Kipahulu Sugar Co.	x	A. Gross	Kipahulu
Kihei Plantation Co.	x*	James Scott	Kihei
HAWAII.			
Paauhau Sugar Plantation Co.	**	Jas. Gibb	Hamakua
Hamakua Mill Co.	*x	A. Lidgate	Paauilo
Kukaiau Plantation	x	J. M. Horner	Kukaiau
Kukaiau Mill Co.	*x	E. Madden	Paauilo
Ookala Sugar Co.	**x	W. G. Walker	Ookala
Laupahoehoe Sugar Co.	*x	C. McLennan	Papaaloa
Hakalau Plantation	**	J. M. Ross	Hakalau
Honomu Sugar Co.	**x	Wm. Pullar	Honomu
Pepeekeo Sugar Co.	**x	Jas. Webster	Pepeekeo
Onomea Sugar Co.	**x	J. T. Moir	Hilo
Hilo Sugar Co.	**	J. A. Scott	Hilo
Hawaii Mill Co.	x	W. H. Campbell	Hilo
Waiakea Mill Co.	*x	C. C. Kennedy	Hilo
Hawaiian Agricultural Co.	**x	Wm. G. Ogg	Pahala
Hutchinson Sugar Plantation Co.	**	Carl Wolters	Naalehu
Union Mill Co.	*x	H. H. Renton	Kohala
Kohala Sugar Co.	*	E. E. Olding	Kohala
Pacific Sugar Mill	x**	D. Forbes	Kukuihaele
Honokaa Sugar Co.	x**	K. S. Gjerdrum	Honokaa
Olaa Sugar Co.	xx	J. Watt	Olaa
Puna Sugar Co.			Kapoho
Halawa Plantation	x*x	T. S. Kay	Kohala
Hawi Mill & Plantation	‡‡	John Hind	Kohala
Puako Plantation	‡‡	W. L. Vredenburg	S. Kohala
Niulii Sugar Mill and Plantation	*x	Robt Hall	Kohala
Puakea Plantation	*x	H. R. Bryant	Kohala
KAUAI.			
Kilauea Sugar Plantation Co.	**	A. Moore	Kilauea
Gay & Robinson	x*x	Gay & Robinson	Makaweli
Makee Sugar Co.		G. H. Fairchild	Kealia
Grove Farm Plantation	x	Ed. Broadbent	Lihue
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Koloa Sugar Co.	x	F. McLane	Koloa
McBryde Sugar Co.	*x	W. Stodart	Eleele
Hawaiian Sugar Co.	x*	B. D. Baldwin	Makaweli
Waimea Sugar Mill Co.	*	J. Fassoth	Waimea
Kekaha Sugar Co.	x	H. P. Faye	Kekaha

KEY.	HONOLULU AGENTS.	
*	Castle & Cooke	(5)
**	W. G. Irwin & Co.	(8)
***	J. M. Dowsett	(1)
x	H. Hackfeld & Co.	(9)
*x	T. H. Davies & Co.	(8)
**x	C. Brewer & Co.	(6)
x*	Alexander & Baldwin	(6)
x**	F. A. Schaefer & Co.	(2)
x*x	H. Waterhouse Trust Co.	(2)
‡‡	Hind, Rolph & Co.	(2)
xx	Bishop & Co.	(1)

THE HAWAIIAN PLANTERS' MONTHLY

PUBLISHED FOR THE

HAWAIIAN SUGAR PLANTERS' ASSOCIATION.

Vol. XXV.] HONOLULU, JAN. 15, 1906. [No. 1.

WEATHER AND CROP.

Low temperatures prevailed during the early part of the month, but the last week was warm and mean temperature for the month approximated the normal. In most sections of the group rain was plentiful.

The kona storm in the middle period of the month did considerable damage to the cane in Maui and Hawaii.

Young cane made little growth during the first half of the month, owing to the generally cool and cloudy weather, especially in the Hilo and Kohala districts.

Conditions during the entire month with the exception of the period covered by the heavy storm during the third week were generally favorable for the ripening of the 1906 crop and the harvesting thereof.

All plantations are now in full operation on the new crop, harvesting and grinding continuing uninterruptedly.

SEEDLING CANES AT THE EXPERIMENT STATION.

The Experiment Station has this season attained remarkable results in the propagation of canes from seed. At the present time there are upwards of five thousand young plants, in various stages of growth, many of which are far enough advanced to plant out in the field. The results are all the more gratifying, because these plants all germinated from seed gathered at the Station from this season's tassels; whereas, in the experiments conducted last year, all of the plants that survived were from imported seed.

That the weather and climatic conditions during this season were most favorable to the full development of the cane tassels, is shown by the large proportion of seed that germinated. All varieties of cane at the station are represented, including even some Hawaiian canes; these canes have been propagated from cuttings for so many years that it was believed the seeds were no longer fertile, and the germination of such seeds is an indication of the great success which has followed the experiments.

Among the various varieties the Demerara seedling canes are well represented and form the largest percentage; there are over 500 seedling from Lahaina cane, 700 from Yellow Bamboo, 120 from Ko Kea; other canes represented are Barbados No. 306, Striped Tip, Gee Gow, Tiboo Merd, White Mexican, Queensland Nos. 1, 4, 5 and 8a, Mexican Bamboo, Striped Singapore, La. Purple, Altamattie and Rappoe.

The first systematic experiments in the propagation of cane seedlings here were inaugurated at the Station in 1904, in the hope of securing some new and improved varieties,—Island and imported seeds both being planted. The seed from the Island canes, with a single exception, failed to germinate, but very good results were obtained from the seeds imported from the West Indies, a total of about 280 plants surviving and being set out. With this experiment a total of thirty-four per cent. of the young plants reached a sufficient size to be set out in the ground.

The non-germination of the Hawaiian grown seed during the first experiment was attributed largely to the unfavorable climatic conditions, as the very stormy weather during the tasseling period destroyed the tassels and scattered the seed.

These experiments in the propagation of seedling canes are still, of course, in their initial stage, and the great desideratum for some time to come, will be to obtain seedlings, and no attempt at cross-breeding or hybridizing can be made until the value of the various seedlings already obtained is ascertained.

From among the seedlings, however, it is almost certain that new and improved varieties will develop, and such results will determine the future work along these lines.

We believe that the raising of seedling canes is by far the most important agricultural work yet undertaken at the Station, as well as the most interesting, not only from the experiments themselves, but in the great possibilities involved. It is impossible to refrain from speculating upon the great benefit and gain which would follow from the development of a variety that would, under similar conditions of soil, climate and cultivation produce a yield of sugar fifteen or twenty per cent. higher than any of our known canes; such a variety would be clear and unadulterated gain to the planter. Or again, imagine a cane that would be capable of resisting the attacks of the leaf-hopper, or the various cane diseases which have caused so much loss. It is in the line of improved varieties of cane that will produce larger yields of sugar, or that are resistant to insect pests and diseases, that we must, in the future, look to for gains in production. Our soils are now fairly well understood, cultivation and manufacture have reached a high state of development, and while improvements will continually be made in all branches of the industry, no extensive increase in tonnage can be expected from any such means.

SUGAR PRICES FOR MONTH ENDING JANUARY 15, 1906.

	Centrifugals.	Beets.
December 15, 1905	8.375c.	8s 1½d.
December 22, 1905	3.625c.	8s. 1½d.
December 29, 1905	3.625c.	8s. 1½d.
January 5, 1906	3.705c.	8s. 2¼d.
January 12, 1906	3.67c.	8s. 2¼d.

Czarnikow, Macdougall & Co., under date of January 19, report as follows:

"The market for raw sugars has this week experienced the lull which usually follows a few days of considerable transactions, and the indifference of buyers, coupled with the increased offerings of Cubas, Porto Ricos and San Domingos for February-March shipment, has compelled sellers to make concessions in price in order to bring about the small amount of business done.

"These concessions amounted to 1-16c. on Cubas for January shipment and to ⅛c. on stored Centrifugals reducing quotations for the former to 2¼c. c. f., basis 96° and for the latter to 3⅝c., basis 96°.

"These prices could probably still be obtained for sugars in the same position, as ready supplies are not yet plentiful, but there are no more January Cubas for sale, and the remnant of the stored Centrifugals is not likely to come on the market until after the pressure of Cubas and other West India crops is over.

"For February-March Cubas, the last price, 2¼c. c. f., is asked, but all refiners are holding off, some of them owing to being well supplied for February, and others in the expectation that present prices will not be maintained after Cuban and Porto Rican production is in full swing. For the present sellers are firm and are refraining from pressing their sugars on an unwilling market.

"European beet markets have been dull and their tendency has been downwards, although the decline for the week in present crop is only ¾d. and next crop is unchanged. Our private cables of date give the European visible supplies as 3,856,000 tons, as compared with 2,658,306 tons at same dates a year ago. The world's visibles are given as 4,035,000 tons, as against 2,830,-236 tons a year ago, showing an increase for the year of 1,204,-764 tons. As prompt beets were selling on this date a year ago at 16s. 3d. f. o. b., and today cannot be quoted at over 8s. 4d. f. o. b., the enormous increase in supply has been pretty fully discounted in the decline in price. The New York spot market a year ago for cane sugars was 5¼c., as against 3⅝c. today—a decline of 1⅝c. per pound, or 7s 6d. per cwt.

"Mr. F. O. Licht has announced this week that he now estimates the present European beet crop at 6,930,000 tons. This is 55,000 tons over his previous estimate and 2,217,024 tons over last year's total production of 4,712,976 tons.

"The House of Representatives has passed the Tariff Bill reducing the duty on sugars from the Philippines to 25 per cent. of the Dingley rates. The bill has now to go to the Senate where, according to all accounts, it will have a thorny path. The present rate of duty (75 per cent. of the Dingley rates) on Philippines, is on No. 1 Iloilos, 88°, 1.05375c., and on Iloilos Assorted, 84°, .94875c. If the bill passes, the duties will be reduced to .35125c. and .31625c. The full duties on non-privileged sugars of same test are 88°, 1.405c., 84°, 1.265c."

Mr. F. O. Licht, in his monthly report, dated January 16, states:

"Underneath, we present our present reckoning for the probable European Beet sugar produce of this year, laying, however, stress on the fact that reliable estimates cannot be given at present and that we may be liable at any time to make any necessary alterations in these figures:

	1905-06. Tons.	1905-04. Tons.	1903-04. Tons.	1902-03. Tons.
Germany	2,400,000	1,598,164	1,927,681	1,762,461
Austria	1,510,000	889,373	1,167,959	1,057,692
France	1,075,000	622,422	804,308	833,210
Belgium	330,000	176,466	209,811	224,090
Holland	205,000	136,551	123,551	102,411
Total	5,520,000	3,422,976	4,226,945	3,979,864
Russia	1,000,000	950,000	1,206,907	1,256,311
Other Countries	410,000	340,000	441,116	325,082
Total	6,930,000	4,712,976	5,881,333	5,561,257

"According to this, the campaign 1905-06, may reckon on an increase of about 2,217,000 tons against its predecessor, meanwhile the figures already mentioned,—for 1905-06 are only for the time."

EXPORTS OF TRINIDAD.

It is stated in the *Annual Report* on Trinidad for 1904-5 that the year's sugar crop was a very short one, in consequence of a dry season. Owing, however, to good prices, the total value of the sugar exports show a large increase over that of the previous year's crop. It is satisfactory to observe that there has been increased activity in sugar cultivation, and there seems no doubt that sugar will continue to hold its own.

MONTHLY SUGAR PRICES FOR THE PAST SIX YEARS.

With the present quotation of 3.67 cents a pound for sugar in New York it may be interesting to compare the prices of centrifugals, 96 degrees polarization, from 1900 to 1905 inclusive. Up to August, 1904, the figures given below are official from statistics of the Department of Commerce and Labor, being "wholesale monthly prices," and from that time on they are derived from the telegraphic reports. Each quotation is in cents per pound and for the first Thursday of the month:

1900—	January 4	4.25
	February 1	4.44
	March 1	4.38
	April 5	4.38
	May 3	4.47
	June 7	4.63
	July 5	4.75
	August 2	4.88
	September 6	4.94
	October 4	4.91
	November 1	4.88
	December 6	4.44
1901—	January 3	4.38
	February 7	4.25
	March 7	4.06
	April 4	—
	May 2	4.25
	June 6	4.25
	July 3	4.25
	August 1	4.16
	September 5	3.75
	October 3	3.75
	November 7	3.75
	Decmber 5	3.75
1902—	January 2	3.63
	February 6	3.69
	March 6	3.38
	April 3	3.62½
	May 1	3.50
	June 5	3.44
	July 3	3.37½
	August 7	3.40
	September 4	3.41
	October 2	3.50
	November 6	3.62½
	December 4	3.94
1903—	January 1	3.87½
	February 5	3.62½
	March 5	3.78
	April 2	3.56
	May 7	3.69
	June 4	3.59
	July 2	3.56
	August 6	3.72
	September 3	3.87½
	October 1	3.91
	November 5	3.81
	December 3	3.69
1904—	January 7	3.47
	February 4	3.35
	March 3	3.44
	April 7	3.67
	May 5	3.73
	June 2	3.95
	July 7	3.94
	August 4	4.06¼
	September 1	4.25½
	October 6	4.25½
	November 3	4.37½
	December 1	4.65
1905—	January 5	4.90
	February 2	5.24
	March 2	5.15
	April 6	4.94
	May 4	4.61¾
	June 1	4.37½
	July 6	4.25
	August 3	4.06¼
	September 7	4.00
	October 5	3.61
	November 2	3.50
	Decmber 7	3.56½

The last December quotation is the lowest of the six years. Five and 24-100 cents per pound on February 2, 1905, is the highest price, and three and 35-100 cents on February 4, 1904, the lowest in the table.

The average price for six years 1900-1905, on the first Thursday of each month, was 4.0369 cents.

IMPROVEMENTS IN MANUFACTURE IN 1905.

For many years the history of the sugar industry in this country as given in the annual reports of various committees appointed by the Hawaiian Sugar Planters' Association has been marked by individual (and more or less isolated) efforts at improvement, but during the year 1904 the various results obtained were brought together in a comprehensive statement submitted at the annual meeting of the Association held in November, 1904.

This statement showed that a large proportion of the sugar factories in this country realized the need of scientific methods, and had to a great extent adopted them; a few places are still run in the old haphazard way, but some of the large factories are exceedingly well organized and manufacturing operations are carried on in a most thorough manner. Of the total pure sugar in the cane, a well equipped Hawaiian factory, carefully managed and under a proper system of control, will recover from 84% to 88% as pure sugar.

This result is not equal to that obtained in beet sugar factories, but the difference between the rivals (beet and cane) is gradually being reduced and cane is creeping up, slowly but surely, and the time is not far distant when the recovery of pure sugar from cane will equal, if it does not surpass, its competitor in the world's supply.

To further this desirable end, efforts have been made in the past to get all of the sugar factories to render statements in comparative form. Absolute comparison has not yet been obtained, owing to differences of opinion in essential matters, but combined statements have been made during the crop now almost completed, which, while not being as perfect as could be desired, have proved of great value, and show clearly that united effort is needed to raise the general average of factory work.

Fortified with the results already obtained, it seems likely that the near future will see factory work in this country carried out on a uniform basis; and, with the information thus obtained passed to the common fund and properly applied, average improvements will without doubt result.

A few years ago the combined 9-roller mill for crushing the cane was deemed the best; it has lately been proven that multiple crushing carried further by the addition of another set, making a 12-roller mill, produces better average results, and several of these will be in operation for next crop.

The improvements in extraction processes are being balanced by improvements in other branches of manufacture, losses of time and fuel in boiling operations are being minimized; losses of sugar in waste molasses and other residues are being attacked, and in some instances excellent results are being obtained.

In fine the future of the industry in this country as far as manufacture is concerned is clear; the disturbing element in the industry being the question of labor to produce the necessary raw material for our mills to work upon.

Respectfully submitted,

J. N. S. Williams, *M. I. Mech. E.*

Assistant Manager for Machinery and Manufacture, H. C. & S. Co.

RAISING PEDIGREE SUGAR CANES.

The first announcement respecting the possibility of raising seedling sugar canes in the West Indies was made at various times in Barbados between 1859 and 1888. A similar announcement was made in Java in 1887. Since that time seedling varieties have been raised which are capable of resisting the attacks of disease which destroyed the older forms, as well as increasing the yield of sugar. Several experiment plots were maintained in the West Indies from 1888 to 1898, and the success of the results thus obtained must be very gratifying to those who were engaged in the work, for the seedling canes raised by Mr. Bovell and Professor Harrison in Barbados, by Mr. Jenman and Professor Harrison in British Guiana, and by Mr. Hart in Trinidad are now well known in most of the sugar-producing countries of the world.

The earlier method adopted for producing improved seedling canes was by means of a careful selection of casually produced seedlings. The identity of seedlings was derived from the seed-bearing parent only. A further step was raising seedlings from canes planted in alternate rows so that the pollen-bearing parent might be identified as well as the seed-bearing parent. Experiments in this direction were carefully carried on in Java, Barbados, and British Guiana.

By means of a system of rigorous selection both in the field and in the laboratory several good varieties have been raised, but a large percentage of the seedlings produced, as was to be expected, have proved to be worthless. In any case, it took several years before a seedling cane was sufficiently tested under varying conditions to deserve to be recommended to planters, and even then it was left to the planter himself to make a final selection of those which were likely to be suitable for his purposes, as a seedling cane might give very good results in certain soils, or in a wet or dry season, while proving an utter failure in others.

The latter method of attempting to secure cross-fertilization between known varieties referred to above was carried out in

Java and elsewhere by carefully selecting two varieties known to arrow at the same time and planting them in adjacent plots. By these means it was hoped that one variety would be crossed by the other. In some cases this no doubt took place. Another step was the bagging of the arrows some time before they reached maturity. On the ripening of the pollen, the contents of one bag were shaken into the bags of another variety, which was to be the female parent. As some of the seedlings were suspected of having been produced by pollination *inter se,* some uncertainty still remained as to the parentage of the resultant seedlings.

An important step in advance was made in the hybridization of the sugar cane, when it was found that certain varieties did not produce fertile pollen, while their pistil was normal; whereas other canes produced a very large amount of normal pollen. Taking advantage of this, the Imperial Department of Agriculture in 1902 started artificial cross-pollination, by means of which the flowers of one variety were emasculated while still young, and then pollen was transferred from another variety by means of a camel's hair brush. Owing to the minute character of the flowers of the sugar cane, this was a difficult process, especially as it had to be carried out while the operator stood on a temporary platform 10 to 12 feet high. This experiment was, however, successfully carried out by Mr. L. Lewton-Brain, B.A., F.L.S., (now Assistant Director of Vegetable Pathology, Hawaiian Sugar Planters' Association) in November, 1904, when he was Mycologist on the staff of the Imperial Department of Agriculture for the West Indies. He worked with some of the best of the Barbados varieties and obtained five seedlings, which proved that the raising of hybrid sugar canes by artificial cross-fertilization was practicable. The resulting seedlings are the first raised in the West Indies whose parentage on both sides is a matter of certainty. They are being carefully propagated, and instructive results are expected to follow. The method adopted by Mr. Lewton-Brain is fully described in the *West Indian Bulletin* (Vol. V, pp. 362-3).

In view of the success of this work, it was decided last year to make systematic attempts, on a larger scale. The work was entrusted to Mr. F. A. Stockdale, B.A., Mycologist on the staff of the Imperial Department of Agriculture. Owing to fluctuating variations in some of the new seedlings, only those which had stood stringent tests on a large scale, for a considerable time, were used in the experiments. That is, an attempt was made to raise pedigree seedlings from selected varieties only. Of these, B. 147 and B. 208 were considered the best, and over 400 spikelets of these two varieties were emasculated and pollinated. Three sound canes were chosen in the varieties to be used, and at least a dozen spikelets in each arrow were operated upon. Crossing was then made in two directions, the pollen parent in one cross being used as the seed parent in the other cross; in other words, one variety was utilized as the female parent in one cross and as the male parent in the other cross.

In all, over 600 spikelets were emasculated and artificially pollinated last year, and it is hoped that the results obtained may be such as will, before long, fully carry out the objects in view. A concise account is being kept of the crosses performed, and next year it is hoped that a series of investigations into the cytology of the sugar cane will be carried on, with the view of determining exactly the right age for pollination, as well as overcoming many of the mechanical difficulties that have hitherto been met with.

If the results of the new method of breeding sugar canes described above are still further extended during the next few years, and the lines so successfully adopted by Messrs. Garton and others in raising new varieties of wheat and oats in England are closely followed, the prospects of the sugar industry in these colonies should be still further improved. There are now no good reasons why we should not be in a position to produce pedigree sugar canes as well as pedigree wheat and oats.—Ag. News.

BEET SUGAR.

OUTPUT FOR THE YEAR IN EUROPE.

According to the following report on the production of beet sugar in Europe, Consul Diederich, of Bremen, thinks that this year's output is to surpass all hitherto recorded except 1901-2. The crop of beets will be far beyond that of last year in quantity, though the quality will be lower. The consul writes:

The great interest as to Europe's sugar-beet crop in 1905 is shown in many reviews now being published on the subject. The beets are being harvested everywhere and hauled to the factories, where the work of slicing them has begun. The cool and wet weather of the past weeks was not of a kind to improve the quality or the ripening of the beets; but while the crop lacks in quality it abounds in quantity. Last year 17 tons of beets were harvested per acre, whereas an average of about 23 tons is expected this year. From all accounts it will also be found that the individual beets are much larger than last year and that their average weight will exceed former figures, but their sugar content will not run very high, being only 15 per cent, against 16.01 per cent in 1904 and 15.46 per cent in 1903. However, large beets or roots of fair polarization always give better results than a high polarizing beet of small size. So while some of the sanguine estimates already put forward as to the outcome of the sugar crop of this year may not be realized, it is safe to say that all previous records of beet-sugar production in Europe will be surpassed, with the exception possibly of the year 1901-2, when it reached 6,722,051 tons. At any rate, there will be more sugar produced than can be used by consumers, and the final stocks at the end of the year, on September 1, 1906, will again be far over 1,000,000 tons. Naturally all estimates of the new crop at this writing (October 24) can only be preliminary and approximate. The following table will show such estimates, as made by Messrs. Otto Licht and Gieseker, the German and Belgian experts, and by the "Zentralblatt," of Magdeburg.

PRELIMINARY ESTIMATES.

Preliminary estimates just published by the International Union for Sugar Statistics, comprising all the sugar factories in Germany, France, and other countries, put the results approximately as follows:

Country.	Beets (1905-6) Tons	Sugar (1905-6) Tons
Germany	14,760,500	2,114,900
Austria-Hungary	9,014,000	1,325,000
France	7,977,300	970,200
Belgium	2,375,000	316,800
Holland	1,370,000	189,100
Russia	7,745,690	1,007,100
Sweden	827,200	117,700
Denmark	510,000	63,750

These figures show a great advance over former years, ranging from 20 to 98 per cent. as to the amount of beets and from 8 to 85 per cent. as to quantity of sugar.

TOTAL VISIBLE SUPPLY.

As to the cane-sugar crops now growing in Cuba and other countries, they also give promise of a material increase over last year. According to the best information, we may look for about 5,200,000 tons of cane sugar. Therefore, taking these estimates, which are the most conservative, as a basis, we may consider the question of supply and demand for the coming year, or campaign, by noting the facts and figures in the following instructive table. The visible supply is that in sight September 1.

Description.	1905-6 Tons	1904-5 Tons	1903-4 Tons	1902-3 Tons	1901-2 Tons
Visible supply	1,661,000	1,969,000	2,353,000	2,239,000	1,221,000
Beet	6,400,000	4,700,000	5,859,000	5,572,000	6,722,000
Cane	5,200,000	4,629,000	4,584,000	4,297,000	4,109,000
Total	13,261,000	11,298,000	12,796,000	12,108,000	12,052,000
Surplus		1,661,000	1,969,000	2,353,000	2,239,000
Consumption		9,637,000	10,827,000	9,755,000	9,813,000

The consumption of sugar during the past campaign, ended August 31, was the smallest in many years. How to account for this is an open question. It is claimed by some that the Brussels convention, which abolished the bounties, made sugar dearer than it otherwise would have been and checked consumption. This, in my opinion, is erroneous. The bounties had stimulated the European sugar industry to such a degree that, in 1901, it produced fully two-thirds of the world's supply of sugar. Had the bounties continued this condition of affairs would have been greatly aggravated and the world would have become still more dependent on the European beet crop for its sugar. That we are still greatly dependent is seen from the fact that when a year ago it was found that there would be 1,000,000 tons less of beet sugar a wild speculation developed and prices rose out of bounds, causing a large decrease in consumption; and when this year it became known that there would be another bumper crop the market collapsed, and very low prices now prevail. The very object of the Brussels convention is not to stimulate speculation, but to prevent these fluctuations in the market and to bring about a condition of things that will determine the price of sugar by its cost of production and by nothing else. This final result will be attained, but the process requires time.

REDUCED CONSUMPTION.

Another interesting item connected with the beet-sugar question is furnished by Consul Harris, of Mannheim. He calls attention to the reduced consumption in Europe, giving figures for the years 1903, 1904 and 1905. He writes:

The consumption of sugar in the countries adhering to the Brussels Sugar Convention for the years ending June 30, 1905 and 1904, are given as follows:

Country.	1904-5 Tons	1903-4 Tons	Decrease Tons
France	542,314	699,030	157,716
Germany	968,856	1,018,673	58,817
Austria-Hungary	445,016	503,962	58,946
Belgium	67,676	85,431	17,755

United Kingdom	1,533,773	1,566,869	33,096
Holland	90,173	88,355	*a* 1,818
Total	3,641,808	3,962,320	*b* 320,512

a Increase. *b* Decrease.

The year 1903-4 showed a gain in the countries named of 781,999 tons over the year 1902-3, or 24.5 per cent, while the year 1904-5 showed a gain of 461,487 tons over that of 1902-3, or a gain of 14.5 per cent.

SUGAR BEETS IN CANADA.

Consul Ifft, of Chatham, Ontario, makes the following report on the growth of sugar beets in the peninsula of Ontario:

The farmers of the peninsula of Ontario will receive more than $600,000 for their sugar-beet crop this fall. This represents the price paid the farmers for this year's crop, which totals about 155,000 tons—the product of about 15,000 acres planted in beets last spring. This shows an average yield of more than 10 tons to the acre, and so protable has the crop been that the acreage will undoubtedly be greatly increased next year. In some favored sections the yield has run from 15 to 20 tons per acre, and while the beets are on the whole smaller than the average they test as high as from 14 to 17 per cent. The product of about 2,000 acres of this crop, and some of the very best of it, has been bought by the American beet-sugar manufacturers and the beets are now being shipped to the factory at Marine City, Mich., as fast as they can be loaded. In all about 30,000 tons of sugar beets will be sent to the United States from the peninsula of Ontario this fall. Buyers for the American manufacturers are paying $4 per ton for the beets on the river banks or at the railway stations; delivered at the factory on the American side they cost about $5.25 made up of the original $4, the 25 per cent duty, and the transportation charges—which average about $1 per ton.

The balance of the Ontario crop, about 130,000 tons, is being sent to the factories at Wallaceburg and Berlin, the only beet-sugar plants in operation in Canada this year. Two other factories in Ontario were abandoned last year mainly because of unfortunate locations. The factory at Dresden was moved to Janesville, Wis., and the factory at Wiarton was closed through litigation and is idle.

A new beet-sugar factory is now in course of erection at Whitby, on Lake Ontario, but will not be ready for this season. Next season will probably see other plants located on the Canadian side, although the American manufacturers in Michigan are making a vigorous fight for a reduction in the duty on Canadian beets.

GUMMING OF THE SUGAR CANE.

(With Original Illustrations in the Text.)

By N. A. Cobb.

PART I. DESCRIPTION OF THE DISEASE.

FIRST DISCOVERY OF THE DISEASE. ITS NATURE.

Gumming is a disease of the sugar cane that was first carefully investigated in the State of New South Wales, Australia, in the early nineties. The original reports of the investigations were more or less fully reprinted in various parts of the English-speaking world and were translated into foreign languages, and in consequence the disease, one of the earlier plant diseases having a specific microbe assigned as its cause, became widely known in a literary way. The interest thus aroused led to its identification in other parts of the world, where it had proved its injurious character.

It is in fact a disease of a very insidious nature, and one that usually attains a dangerous character before it is recognized. It is capable of doing a great deal of damage if left to itself, but fortunately its ravages are within our control by means of comparatively inexpensive precautions. The main point therefore is for the sugar-planter to learn to know the symptoms of the disease, so as to recognize it in its early stages. The malady is so obscure in its onset that the most common loss is the falling off in yield that accompanies the beginning of an attack. For that reason it is desirable to place before our planters accurate colored illustrations of the most characteristic features.

STRUCTURE OF THE CANE-STALK.

To understand the fungus and microbe diseases of the sugar-cane it is necessary to know something of the structure of the cane plant, and for that purpose it is best to have recourse to the plant itself.

Strip the leaves from a one-year-old cane plant. Sugar-cane is a grass, and from place to place on the solid stem occur joints or nodes from which the leaves grow. The internodes, or spaces between the nodes, will be found on the average to grow shorter and shorter as the leaves are successively removed from the bottom upwards, until near the top the distance from node to node is not more than a quarter of an inch. Above this the young white leaves will be seen wrapped closely together in a long and slender cone (Fig. 1). Later on this slender cone will contain the inflorescence, which when mature forms a panicle of plume like that of many smaller grasses, and produces seed on a scale proportionate to the relatively gigantic size of the cane plant. The term "arrow" is used by cane-growers to designate both the slender white sheath and the panicle itself, thus: "the cane has arrowed" (flowered); "the frost has injured the arrow" (the growing point of the cane, whether inflorescence or not); "a borer has got into the base of the arrow," the "base of the arrow" meaning the top of the stalk, where the internodes are short, about A, Fig. 1. This even when there is not a trace of inflorescence to be seen. It is necessary to be careful that the sense in which the word arrow is used is perfectly plain, though both the above usages appear to be correct.

Slice the cane in various ways in order to get an idea of the internal structure of the plant. First, to obtain as thin a transverse slice as possible, make a smooth surface by cutting squarely across the stalk, and then take off a slice no thicker than a sheet of paper. By holding this up against a strong light, it will be seen to have a spotted appearance, the spots toward the edge being smaller

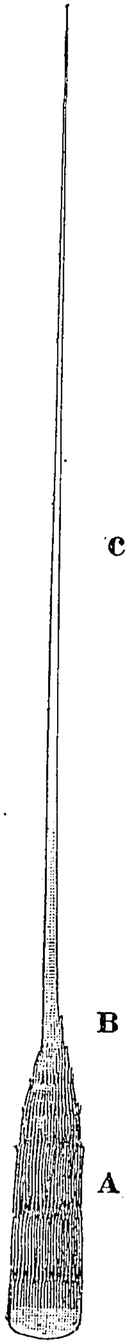

FIG. 1. Arrow of cane after removal of the upper leaves. The long slender spike contains the youngest leaves rolled up into a compact and much elongated cone, at the centre of which is the "embryo" of the future inflorescence: A, top of the stalk; B, base of the arrow; C, the arrow, or rather the topmost leaves wrapped into a narrow cone.

The cavity containing offensive matter of microbic origin, to be spoken of later on, is usually located between A and B.

and very close together (Fig. 2). There are from 1000 to 2000 of these "spots." Look carefully at one of the larger spots near the middle of the slice, holding the slice squarely before the eye. With ordinarily good eyesight at least two minute holes will be plainly seen in the spot, running squarely through it. Of course if the slice is not held exactly square, that is at right angles to the line of sight, the holes will not be visible. It goes without saying that a pocket lens will reveal these holes much more plainly.

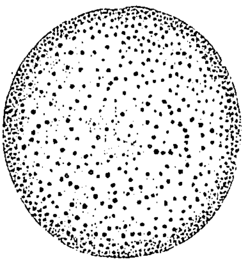

FIG. 2. Section through the upper portion of a healthy cane-stalk, natural size, as seen against the sky, showing cross-sections of the fibres as dark spots. One of the spots in this figure is shown highly magnified in Fig. 3. It will be noted that the fibres or fibro-vascular bundles are much more numerous near the surface of the stalk. This arrangement gives strength to the stalk. The sugar-bearing cells are more abundant toward the centre of the stalk.

If a piece of cane which has been rotted by the weather be now procured and broken open, much of the soft part will be found to have disappeared, and the fibres which remain may be seen to advantage. It will now be clear that the "spots" which appeared in the slice of cane (Fig. 2) were really cross-sections of fibres. Hence the holes which are seen in each spot must indicate holes or channels through it, of which two are larger than the others.

Let us investigate these fibres and find out their function. Split the piece of rotten cane. The fibres do not stop at the joints, but pass up or down through the stalk, sending off branches at every node or joint. The nodes thus become a very solid and intricate mass of fibres, but after a little trouble it will be found that, starting at a node, there are but four directions taken by the fibres. They may go: 1. To the leaf of that node. 2. To the bud of that node. 3. To a root from that node. 4. To another fibre.

It thus appears that the whole plant is supplied with tubular fibres which extend even to the buds, leaves, and roots. The cane plant has then a complete system for the circulation of the "sap," and these tough but hollow fibres contain the larger vessels. The water taken up by the rootlets is thus sent all over the plant, and the nourishment made by the leaves in the sunlight is in the same way returned for use wherever it is needed. It is quite clear that these vessels must be of the greatest importance to the plant, and worthy of the most careful study. By making a microscopical examination of a very thin slice of healthy cane, it will be seen that the fibres are by no means so simple as they

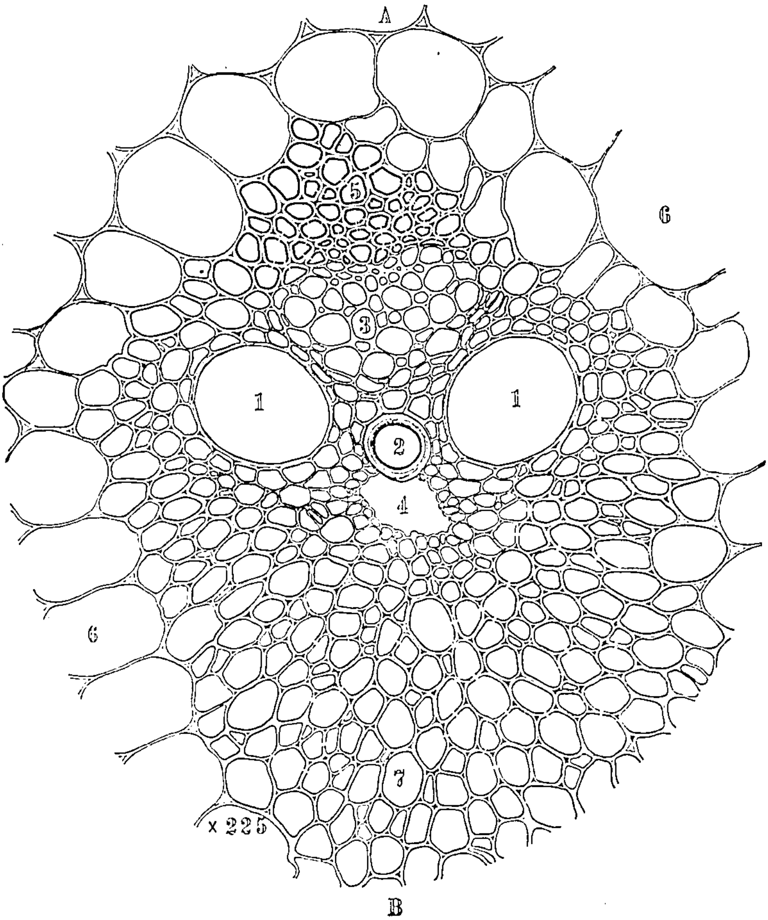

FIG. 3. Cross-section of a fibro-vascular bundle of seeding cane. The fibre was taken from near the top of an eight months' old seedling, and was not yet fully lignified. 1, 1, the two large ducts with unbordered pits; 2, an annular vessel; 3, one of the seive tubes, among which may be seen the smaller companion cells of the bast; 4, intercellular air space; 5 (and 7), sclerenchyma; 6, parenchyma, or sugar-bearing tissue; 7, sclerenchyma. A, outer side of the fibre; B, the inner side of the fibre.

appear under the ordinary examination. Besides the two comparatively large vessels there are other smaller vessels, called annular vessels (Fig. 3). The thick and woody walls of these vessels and cells make the fibres strong and durable, and, as noted, they do not decay as quickly as the softer parts of the stalk. These fibres are the main constituent of bagasse.

The softer tissues are seen on microscopical examination to consist of cells with thin walls, containing among other things cane sugar in solution, and are, from the commercial standpoint, the most important part of the plant. Fig. 4 shows a few cells from a perfectly healthy seedling cane, and as not ten minutes were allowed to elapse after it was harvested before the sketch was made, the figure may be taken as actually showing the living cells in their natural state.

We may thus enumerate the different parts of which these cells are made up. There are: 1. The cell wall. 2. The nucleus. 3. The nucleolus. 4. The protoplasmic network. 5. The interstices of the protoplasmic network.

The *cell well* encloses each cell and separates it from the surrounding cells and from the air, for few plant tissues are devoid of air-spaces among the cells. Air is necessary to them and is always present. The cell wall is thin in proportion to the size of the cell. The main portion of its substance is called celluloise.

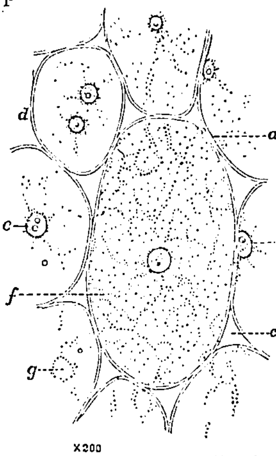

FIG. 4. A few cells from the sugar-bearing tissue of a healthy seedling cane; a, cell wall; b, nucleus; c, intercellular space containing air; d, a cell containing two nuclei, i. e., caught in mitosis: e, a nucleus containing two nucleoli; f, protoplasmic network.

A *nucleus* exists in each cell, and is usually, but not always, located near the centre. It is the centre of activity in the cell. In cell division the nucleus leads off, after which the whole cell soon becomes divided into two parts. The cell *d*, Fig. 4, is in process of division. The nucleus had already divided and the whole cell would soon have followed suit.

The *nucleolus* is a smaller body usually residing in the nucleus.

The *protoplasmic network* extends throughout the cell. The nucleus is enmeshed in it. It is composed of granular matter, which also lines the cell wall, and in a general way is termed protoplasm. This wonderful substance is always in motion. The granular particles show this movment plainly. They are often to be seen flowing slowly along and rolling over one another. This may be clearly seen with a powerful microscope, (Fig. 4).

The interstices of the protoplasmic network are filled with cell-sap holding sugar and various other matters in solution.

These few notes on the structure of cane will be found of some assistance in understanding the nature of the gumming disease as described in the following pages.

HOW TO RECOGNIZE THE DISEASE.

To a casual observer a crop of cane that is already considerably infested may appear to be in fair condition. It is only when the canes are examined microscopically that the disease is detected, unless indeed it be suspected as the result of its low sugar content, when tested chemically. The symptoms vary from those of this inconspicuous nature to those of the crop so severely smitten that the majority of its stools are in a dying condition.

Attention is usually first attracted to the disease at the stage when a few stools in the crop are seen to have one or more stalks with dead tops. In such instances the base of the arrow will be found to be decayed. An examination of this part of the stalk will disclose one or more cavities, often of considerable size and more or less filled with a somewhat malodorous matter of the consistency of pus. About these cavities the tissue is dark in color, being red, brown or black, though sometimes the color is lighter than this, and indeed in some cases may be altogether lacking. In all cases however these tissues are completely filled with slimy and offensive looking matter.

The inroads of grubs sometimes bear considerable resemblance to these cavities at the top of the stalk, but they may be distinguished from those due to gumming by the presence in them of the castings of the grubs.

Stalks of cane that have died at the top from the gumming of the tissues, as just described, sometimes shoot from buds lower down, as they do in the case of other "top diseases."

THE APPEARANCE OF THE GUM.

A further examination of a stalk that has become diseased in the manner just described will disclose other very characteristic symptoms. If a very sharp knife be used to cut the stalk into segments it will be found that the cut made in this smooth way tends to "bleed." The liquid substance that slowly oozes out from the cut-off ends of the fibres has a yellow color and as a

FIG. 5. Stool of gummed cane; a, a, a, are diseased stalks, the dry leaves of which are shown at b, b, b; inside the top of the stalk at c will be found a cavity containing offensive-looking matter; some of the stalks in this stool are not badly diseased and still present a somewhat normal appearance.

rule has about the consistency of honey, which it resembles in general appearance, though not in taste. After a few minutes tiny drops of this gummy matter may often be plainly seen, though in other instances it is only after some hours that the outflow can be substantiated. Sometimes the gum is transparent, sometimes it is more or less opaque. This feature depends on the stage reached by the disease. At the upper part of a stalk the gum is likely to ooze out faster than lower down.

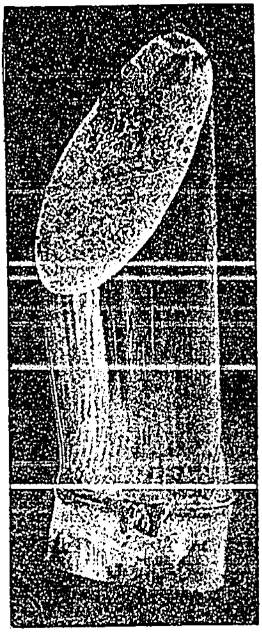

FIG. 6. Cutting from gummed cane. The gum has oozed out and formed into drops on the surface of the cutting. This outflow takes place in from 5 minutes to 24 hours. In bad cases the gum oozes out very promptly, but in less-marked cases it may flow only slowly. The flow is particularly favored if the sections are kept in a moist, shady place, as when they are covered with wet sacking. The preparation of cuttings in this manner constitutes the best test for the discovery of gumming in sugar cane. The gum is usually yellow in color. It is only in very marked cases that it will ooze out in such quantities as are shown in this illustration.

In marked cases of the disease, after an hour or so, these droplets of gum attain such a size that they run together and form larger drops. This fact is utilized in the inspection of cuttings to avoid planting the disease. So abundant is this exudation in some cases that if a score or more of the cuttings be placed under a cover where the evaporation is checked, one may collect from their ends after 24 hours an ounce or more of the gum. This gum contains the microbes causing the disease, and it is worthy of note that if the gum be dried, its vitality is preserved for some time, and if the dried gum be moistened it may be used experimentally to transmit the disease to other cane plants.

When the gum dries on the ends of the stalks, as for instance when cuttings of gummed cane are allowed to become dry, it forms bright yellow stains on the light colored tissue of the interior of the cane. More rarely the gum oozes out in such a thick state that it forms short threads similar to those of Rind Disease, only much shorter. Such eruptions give rise to what has been described as "a yellow mossy appearance" on the ends of the cuttings. This is because the gum issues in a state so nearly dry that it fails to form into droplets in the usual manner.

The symptoms just described are those to be observed in a marked case of the disease, but an equal amount of gum may sometimes be found in stalks that have not yet died at the top, and which still appear to be at least fairly healthy. If, for instance, an apparently sound stalk be removed from a stool that contains stalks dead at the top through gumming, it will often, on being cut in the manner described, exhibit very much the same symptoms as the lower part of the more severely smitten stalk. The offensive-looking cavities at the top of the stalk will be lacking, but otherwise the symptoms will be very similar. This is not necessarily the case, however, for it is possible to find in one and the same stool badly diseased stalks and stalks that *appear* at least to be quite sound. However, when such apparently sound stalks examined microscopically it is not uncommon to find traces of the disease.

All these symptoms of the disease can be seen at the carriers of the sugar mill when it is crushing gummed cane, for the cut ends of the stalks exhibit all the colorations just described as being produced by the oozing forth of the gum-like substance produced by the growth of the microbe causing the disease. Apart from these symptoms it is not difficult to detect gummed stalks by their altered color. Such stalks generally take on an over-ripe appearance, their greens and yellows becoming yellow and orange, while their purple or blackish tints tend to become reddish. Certain parts of sound cane usually present a waxy bloom, but this appearance is more or less lacking on gummed cane.

It should be noted that all the symptoms of gumming are less pronounced when they occur on ratoon cane than when they occur on plant cane.

The symptoms described in the foregoing paragraphs are those of crops that reach a stage suitable for crushing. Of course the plants may not reach that stage, and in that case the symptoms are of a different nature. When cuttings from gummed cane are planted the shoots sometimes fail to appear above ground, but this is only in the most severe cases. It more often happens that the cuttings sprout, but make a tardy growth such that at the end of a year healthy crops of the same age are twice or three times the height. This state of affairs is shown in the illustrations on pages 16 and 29. Not seldom the crop is an even more pronounced failure than that shown.

PART II. LATEST INVESTIGATIONS OF GUMMING.

In recent years the gumming disease has attracted the attention of noted bacteriologists, and it has been investigated again and again.

Mr. Greig-Smith, Bacteriologist to the Linnaean Society of New South Wales, has given it attention. At a still later date the disease was investigated by Dr. Erwin Smith of the Department of Agriculture at Washington. Inasmuch as Dr. Smith mentions and to some extent describes the conclusions of Mr. Greig-Smith, and as I intend to include a translation of Dr. Smith's paper I will not here go further into Mr. Greig-

Smith's paper than to say that it differs from Dr. Smith's in the absence of any records of attempts at transmitting the disease by the inoculation of healthy canes. Mr. Greig-Smith's conclusions, reached in his usual careful manner, are fully confirmed by those of Dr. Smith.

Dr. Smith's report of his experiments appeared in the "Central blatt für Bacteriologie, Parasitenkunde und Infektionskrankheiten" from which I translate somewhat freely as follows:

"ON THE CAUSE OF COBB'S DISEASE OF THE SUGAR CANE."

By Erwin F. Smith.

In 1893 Cobb published in Australia a very interesting communication concerning a so-called "gumming disease" of sugar cane, which prevailed for some years in the vicinity of the Clarence River, and in other cane-growing districts of Australia. Cobb ascribed this disease to a bacterium. The prominent symptoms were a dwarfed growth, with rotting of the arrow or pith of the cane, and also, and this latter was constant, the occurrence of an abundance of yellow gum in the fibres of the stem. The bacteria were examined microscopically, and pictured; but not cultivated to any great extent: nor were they well characterized. Cobb proposed for the species the name *Bacillus vascularum*. He made some puncture inoculations on cane stems with yellow gum that had been taken from diseased stems, but no inoculations with pure cultures in the usual sense of the term. The results of the inoculations had not been secured at the time of writing.

In 1895 Cobb published the results of these inoculations as follows: They were conducted upon seven cane stalks which were selected on account of their healthy appearance, although they were standing in a region where the disease was very common. Unfortunately this garden plat was so far removed from Sydney that the inoculated stalks were not further observed for an entire year. They were then cut and forwarded to Cobb. One stalk had long since died; another was nearly dead and it could not be said with certainty what had been the cause of death. All the other stalks of cane, inoculated as well as those not inoculated,* were infested with the gumming disease. Concerning the other cane stalks in the same garden, nothing is said and no description is given of the symptoms during the course of the year.

In consequence, plant pathologists have expressed the opinion that the aetiology of this cane disease had not been fully cleared up. Some hold the opinion that the bacteria were only a saprophytic phenomenon of a subordinate nature; others are of the

* This is not quite accurate. Some at least of the uninoculated stalks never became infested. N. A. C.

opinion that perhaps the disease was of a purely bacterial nature, but that the fact was not well established. For instance, Krüger writes in his work: "Das Zuckerrohr und seine Kultur."

"Zwar ist durch Reinkulturen und Infektionen die Ursache diesen Krankheit noch nicht unzweifelhaft erbracht, doch ist es sehr wahrscheinlich, das obige Krankheit dem Angriffe der genannten Bakterien zuzuschreiben ist."

In 1902 Greig-Smith published, also in Australia, an article concerning the gumming-disease of sugar cane. He cultivated the organism in a pure condition and described its growth upon several culture media, but says nothing of infection experiments. His investigations were, for the most part, qualitative chemical tests concerning the nature and origin of the gum. From its reactions, which, for the most part, were the same as that of bacterial gum he bred in pure culture in agar-agar, he held it to be proved that the gum in diseased cane stalks must be of bacterial origin and that in consequence this disease could not be other than of bacterial origin.

I do not know whether any one else, the author excepted, has bred this sugar cane disease in pure culture since the publication of Cobb's papers.

My own investigations began in 1901, but the first experiments miscarried. The cane stalks were very long in transit (5 months) and although much typical yellow gum was to be seen in the fibres, and with the aid of the microscope was recognizable as composed of bacteria, all these were dead. Cultures from it gave no result, or only scattered white and red colonies of saprophytic bacteria. From the copious yellow gum I unfortunately could obtain no yellow colonies. The cane stalk was so old, shrunken, and browned, that nothing else could have been expected.

In 1902 I received a second shipment of diseased cane stalks from Australia, through the kindness of the New South Wales Ministry of Agriculture. These stalks came through quicker, were sealed at the end with sealing wax, and on examination proved to be much fresher than the first shipment. When they were cut, a quantity of yellow gum exuded slowly from the fibres in drops and was, as the microscope showed, composed of millions of bacteria, (nothing but bacteria could be found in the yellow fibres of the stalks). The stalks were two feet long, four to five centimetres in diameter and contained hundreds of fibres filled with yellow gum. Other fibres, especially those near the margin, were reddish to brownish, and in this part I found a mycelium, which, on being cultivated, produced a long-beaked Sphaeronema. Consequently I could not regard the red pigment with certainty as a symptom of the gumming disease, and I thought no more about it; but, as will be seen later on, this was not exactly correct. The mycelium itself was apparently a phenomenon of entirely subordinate character.

It was very easy, observing the well-known precautions, to isolate a yellow organism from out the yellow gum in really pure cultures. Plate cultures from two cane stalks, of which one (I) was much fresher than the other (IV) were prepared. On that prepared from Plate IV colonies of mould, and of white and orange bacteria occurred. Upon the plate prepared from I, there was little else than Cobb's organism to be found, only scattered colonies of other bacteria. The inoculations were in consequence made from the yellow colonies from the cane stalk (I). These yellow colonies were numerous and uniform. In the Petri-dishes, there were no mycelial colonies and no reddish bacteria to be seen. The microscopical morphology, as well as the plate cultures, were entirely in harmony. Everything pointed to only a single yellow organism derived from the gummed fibres. This organism was a yellow short-jointed motile schizomycete characterized by a polar flagellum, which I assigned to the genus *Pseudomonas* under the name *Pseudomonas vascularum* (Cobb).* The motile condition shows up much more clearly in young cultures than in old, or than if the bacteria are derived from vascular bundles. This restricted motility appears, however, in many other species of bacteria.

As I now possessed an excess of pure cultures, I tested the cultural peculiarities of the organism as described by Greig-Smith. These were quite correctly described by Greig-Smith. All doubts that I had on hand regarding the same bacteria were dispelled by these studies. It was the same bacteria that Greig-Smith had described. I was therefore obliged to consider that it could be no other than that which Cobb had described in 1893-1895.

The next question, and the most interesting, as well from an economical as from a pathological standpoint, was this: Could I, with these organisms, produce the gumming disease in sugar cane? Were Cobb's declarations correct, as it seemed, or were they erroneous guesses like so many other pronouncements in matters pathological?

Fortunately I had at this time sound cane plants of four varieties in the green-house, which had newly come from plantations in Southern Georgia. These had been grown in the green-house for three months from healthy cuttings and were in good condition, about four feet high with many leaves. The possibility of establishing infection by means of these organisms could therefore be tested through inoculations.

The inoculations were conducted by means of needle punctures on two leaves of each plant at a point about one to two feet from the stem. Each leaf received twenty to thirty minute needle punctures on an area of about four square centimeters, but no injection. Only two plants were punctured on

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* At a later date Dr. Smith referred this microbe to the genus Bacterium, subdivision Pseudomonas. N. A. C.

the stem, at about two feet from the ground; the results from these, however, presented no peculiarities. The inoculations were made with yellow gum from three potato cultures, which were five sub-cultures removed from the plate colonies. Up to night-fall, as is my custom, I protected the inoculated leaves from light with clean paper, but the needle punctures were not shut off from the air, which indeed they could not have been. A semi-tropical temperature was maintained in the green house and the plants grew rapidly.

During the first week after the inoculation no symptoms could be noted, i. e., the needle punctures themselves had not produced any. Many leaves were also punctured with sterile needles, indeed with many more punctures than the inoculated ones, but with no particular result, as was to be expected. About three weeks after the inoculation, white streaks were to be seen on the inoculated leaves, which soon became spotted with reddish or brownish flecks and stripes. These stripes had their origin in the inoculated parts of the leaf and grew slowly backward as well as forward. For some weeks, nothing more was to be seen except that the white streaks appeared on other leaves, and, somewhat later, reddish to brownish streaks appeared, accompanied by a shrinkage of the learf parenchyma in stripes. At this time the dwarfing of the growth commenced and in the end it became very noticeable. The row of inoculated plants remained much smaller than the uninoculated. After about three months, the inoculated leaves, as well as other large leaves, shrivelled up and the terminal bud became infested with a bacte-

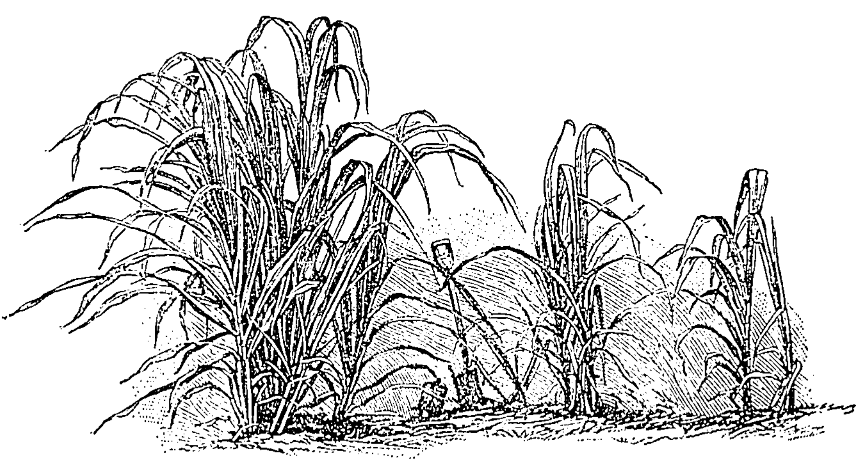

FIG. 7. Three stools of Australian cane grown from selected sets or cuttings. The stool on the left was grown from a healthy cutting; that on the right from a badly gummed cutting, while that in the centre grew from a moderately gummed cutting. This figure is accurately reproduced from a photograph. The stools grew side by side as shown and were all of the same age. The figure illustrates remarkably well the differences in growth due wholly to the influence of the disease.

rial rot. At this time not all the leaves were dead, and the well-developed part of the stalk remained green and to outward appearance sound. Moreover, sprouts and roots started from the base of some specimens.

About twelve plants of the variety "Common Green Cane" were inoculated, and all sooner or later showed these symptoms.

When the first symptoms were noticeable, I sectioned some of the inoculated leaves, and with the microscope could easily demonstrate the presence of the bacteria in the vessels for a distance of some 18 cms. upward. This was thirty days after the inoculation.

Later, as the general symptoms developed, I sectioned all the inoculated plants one after another, and examined them in all directions. The inner symptoms were the clearest. One could not wish or secure better results from any experiment. In every stalk there were numerous vascular bundles filled with the yellow bacterial gum, which oozed out in small drops if the stem was sectioned. Everything was as Cobb had described, and as I myself had seen in the specimens received from Australia, with the exception of the absence of saprophytic bacteria which, during the six weeks' journey, had developed upon the Australian specimens. Toward the top, close to the terminal bud, where the stem tissues were soft and not well developed, the gum was not confined to the vascular bundles. Here the parenchyma was also infested, in fact was so much infested that cavities of considerable size were filled with the yellow gum. Some of these cavities contained as much as a teaspoonful of yellow gum. This gum was also to be found in some vascular bundles at the base and middle parts of the leaves not inoculated, i. e., leaves which had been infected through the agency of the vascular fibres. The inner face of many of the leaf-sheaths was also, after a few months, spotted red or brown and sticky with the outflow of bacteria. Among the inner leaves of the terminal bud this stickiness was so pronounced that the bud could not force its way through, and either took on a zig-zag course or became crumpled, whereby the terminal bud from without appeared somewhat clavate.

Examined under the microscope, this yellow gum showed millions of bacteria, but no fungus hyphae, nematodes or insects. Morphologically these bacteria were entirely the same as those which I had seen in the cane stalks which I received from Australia. Of course if the pith-rot is sufficiently advanced, other organisms such as white bacteria and fungus hypae are present, as, for instance, in the Australian stalk No. IV.

Plates flowed with agar-agar gave in Petri-dishes an abundance of pure culture of the same yellow organism which I had secured from the Australian canes, and which I had inoculated by needle punctures into my cane leaves. Plate cultures gave the same results from various altitudes on several stalks. Bacteria were collected in great masses in pure culture in the yellow fibres of the stalk. Cultivated upon potato, agar-agar, gelatine, etc., the yellow gum displayed, whether examined by the naked eye or under the microscope, the same peculiarities as the bacterial gum which was inoculated. I therefore consider the aetiology of this disease to be settled. The gumming disease of the sugar cane must be considered a purely bacterial malady whose cause is assignable to the yellow *Pseudomonas vascularum.* There can be no further doubt about it.

There is one very interesting symptom to which I have not yet called attention, nor is it mentioned by Cobb. I refer to the red fibres. We have heard a great deal about red fibres in connection with the Serch disease of the sugar-cane in Java, and in fact a red coloration is known as a subordinate oxidation phenomenon in many diseases of the sugar-cane, but I have never seen it more beautifully developed than in connection with the canes inoculated with bacteria. In the diseased plants of "Common Green Cane," which were inoculated from pure cultures, without exception numerous blood red fibres were to be seen. It was a very striking symptom of the infestation and could not be assigned to any other cause.

Whence arises this pigment in the fibres? Coloration of the fibres is not unknown in bacterial diseases. It occurs in connection with *Pseudomonas solanaccarum;* again in plants of sweet corn, whose leaves have been inoculated with *Pseudomonas Stewarti,* we notice a fibre disease with an enormous multiplication of bacteria precisely as in the case with *Pseudomonas vascularum;* but in the former case, the fibres take on a brown color, which in the first internodes, i. e., those longest in the grip of the disease, can also be observed in the parenchyma. In precisely the same manner, as it appears, under the influence of bacteria, probably working, however, upon other materials, some fibres in the sugar cane take on a red coloration. I consider this a deterioration phenomenon of the host. According to Prinsen Geerligs, there exists in the cellulose of normal sugar cane a neutral colorless material, soluble with difficulty, which in alkali takes on a yellow color and on access of air becomes red and finally brown. The nature of this substance is unknown. In such fibres, for the most part, but not always, bacteria were no longer to be found. In their places, however, formless red masses were to be seen. Red and yellow fibres were scattered through the stalk, and often the same fibre was speckled. The same thing occurs in maize when it is inoculated with *Pseudomonas Stewarti,* but in that case the yellow is mixed with brown. The red pigment was most abundant in the nodes and in the portion of the internodes close by. The coloration of the pigment in and near the nodes was noted in many cases.

In all cases there was more pigment in the upper than in the middle or lower end of the internode, but the greatest amount at the nodes, where very often many or even nearly all of the vascular bundles were red as blood. Many chemical analyses of various parts of the sugar cane have been published, but perhaps none of the varying collection of organic compounds can throw much light on this peculiar phenomena. Perhaps, however, it is connected with a greater aeration through the leaf fibres in and immediately under the nodes than above them. In cane as in maize the pigment seems not to appear in the early stages of the invasion, but to the greatest extent when the fibres have been diseased for some time. Still one cannot assume that the reddening of the fibres is a symptom peculiar to the gumming disease. It occurs in other diseases, as I myself have observed on West Indian plantations. In order to be certain in the identification, one must find the yellow bacterial gum in the vascular bundles, which is usually easy in this disease. Only in cases where it is poorly developed in resistant stalks, is there any difficulty in recognizing the disease. Perhaps the formation of the pigment is not so prominent in all varieties as it is in the "Common Green Cane."

Somewhat later under the same conditions, two other varieties of sugar cane were inoculated, namely: "Louisiana No. 74" and "Common Purple Cane," the favorite sugar cane of the United States; but with quite different results. Both varieties were very resistant to the disease. With the exception of a few clear, but restricted or slowly appearing symptoms in the inoculated leaves and on a few other leaves, there were no outward symptoms, nor did they occur in the interior of the stalk, or if so they were much less pronounced than in "Common Green Cane." As a rule, the inoculated stalks were finally somewhat dwarfed, although at the beginning they might have been the strongest.

What is the origin of immunity to this disease? or wherein lies the susceptibility? This is a very interesting and perhaps also a very complicated problem. Only a few remarks may find place here. Before I conducted the inoculations described above, I titrated the freshly expressed juice of well-grown sound stalks of all three sugar canes, which I had at hand against alkali with phenolphthalein in order to test their acidity. According to these titrations, the juice of the "Common Green Cane" showed by far the smallest degree of acidity. Also in sterilized vessels slices of the "Common Green Cane" constituted a culture medium upon which the *Pseudomonas vascularum* throve much better than on slices of the other cane varieties. All the slices were cut obliquely, placed in a small quantity of distilled water (only the underside), and during three days daily heated a few minutes in a steam sterilizer. It was this unexpected result which decided me to take the "Common Green Cane" as the first inoculation material. I considered the cane to be more susceptible than the other varieties, and so indeed it finally turned out. The other varieties were a hundred, yes, a thousand fold more resistant to needle infections with the organism. For the most part they showed only local symptoms on the inoculated leaves or stems. No symptoms were noticeable upon the other stems of the inoculated cane stool, even after many months. Some of the inoculated stalks indeed showed a dwarfed growth with secondary symptoms upon the leaves. but after six months when they came to be sliced up, for the most part there were only a few red fibres to be seen in the stems, but in two of the stems there was also a very small number of fibres with yellow gum. These red fibres occurred only in the nodes and internodes in the neighborhood of the inoculated leaf and were for the most part to be found in the well-developed stalk neither above nor below. We can tabulate these facts somewhat as follows:

VARIETY	Acidity of the Sap in Cubic Centimeters of Normal Sodium Hydrate pro. 1.	Growth of the Bacteria upon Water Sterlized Slices of the Cane	Susceptibility to the Disease
Common Green Cane..	19.00	Good	Very high
Common Purple Cane..	.....	Poor	Very low
Louisiana No. 74......	31.00	Poor	Very low

It should be here remarked that the "Common Green Cane" is the cane that is most widely cultivated for eating, which would not be the case if the sap was very acid. A sugar chemist with whom I have spoken about the matter considers that trustworthy results are not to be deduced from single stalks. According to his opinion very likely the next titration might have given another result. In order to decide the comparative acidity of the sap of various cane varieties, the test must always be made with mixed sap from numerous stalks of each variety. I say nothing against that. It may well be so. So much depends upon changeable factors,—for instance, the soil, the manure, sunshine, rain, time of the year, ripeness, location, etc. I do not know, however, whether any chemist has tested the sap of various varieties of cane with reference to their grade of acidity. From a pathological standpoint, I think that this would be a very interesting test. Many bacteria do not thrive well upon acid culture media, and often a slight excess acts as an antiseptic. Furthermore, that some varieties of sugar cane possess a higher grade of acidity in the stem than other varieties, corresponds well with many facts in plant physiology and perhaps the high susceptibility of some cane varieties to this parasite is accounted for simply by the low acidity, or a minimum of a specific counteracting acid. The immunity is very clear, whatever the explanation may be. My own infection experiments are not the only proof. Cobb had already in the year 1893 remarked the resistance of some varieties and recommended them for counteracting the disease in the plantations. During the last year he has written that in so far as his advice was followed, the disease has diminished. We have therefore the best proof that this disease is easy to overcome through the cultivation of resistant varieties. All plantation managers, who suffer from this disease, should at least give to this method a careful trial.

There remains only the question of Sereh. Is this Australian gumming disease the same as the Javanese "curse" of the sugar cane? The symptoms are for the most part very similar,—for instance, red vascular bundles, dwarfed growth, shrinking of the internodes, albinism, shooting of the buds, propagation by means of infested cuttings, club-shaped terminal buds, etc. As I have never seen Sereh, I can not say anything about it. Valeton, Janse and Krüger have considered Sereh as a bacterial disese of the vascular bundles, but I do not know whether they have seen the yellow gum in the bundles. So far as I have read, they speak only of a red gum. Von Wakker, Went and others have combatted this opinion. Went has, however, in view of his observations in the West Indies, during the last year withdrawn his former views with regard to a fungus mycelium as the cause of Sereh. It seems fairly well established that Sereh occurs not only in Java (according to Krüger also in Borneo, Mallacca and Bankai): and Cobb's disease is not confined to Australia, prevailing also in Java, Mauritius and Brazil. It would be very useful if a competent bacteriologist should make a new and thorough-going study of Sereh in Java. A disease that is so widely prevalent among sugar cane is of general interest. Possibly two or more different diseases are united under the same name, weherof one may be of bacterial origin.

Addendum. As I have been very much occupied with other affairs, this manuscript has remained on my table for a year, and in the meantime the above mentioned pure cultures have been inoculated into other plants, which are now diseased.

1st October, 1904.

This concludes Dr. Smith's article on Gumming.

IDENTITY OF THE WASHINGTON MATERIAL.

There cannot be the slightest doubt as to the identity of the organism cultivated by Dr. Smith and inoculated by him into American canes. I was absent from Australia at the time of his first shipment and though I have no doubt as to its nature I cannot speak from personal observation. The second shipment was attended to personally by myself after it had been forwarded to me by my friend, Mr. A. C. Barry, manager of the Broadwater Sugar Mill, Richmond River, who, at my request, selected the canes and forwarded the same to Sydney. They were there unpacked, and sealed up with sealing wax and repacked at my laboratory. I examined the gum. The organism was the same species as that described in 1893 and reported on subsequently as the cause of the newly discovered disease for which I proposed the name "Gumming of the Sugar Cane."

THE CAUSE OF IMMUNITY.

To me the most interesting parts of Dr. Smith's paper are his description of his examination of the juices of the canes used for inoculation purposes, his observations on the relation of the acidity thus disclosed to the immunity of the various varieties, and his suggestion that the acidity of the juice may be a factor in the marked immunity which he notes in two of the varieties he tested.

What may well prove to be a similar phenomenon has come under my observation, though the facts relate to another disease of cane.

In these islands the "Root Disease" of cane, to give it its popular name, shows a greater virulence in its attacks on the "Lahaina" cane and the "Rose Bamboo" cane than on the "Yellow Caledonia." This is so marked that the "Yellow Caledonia" has become the common resort of plantations where the root disease has become so prevalent as to seriously reduce the yield.

Mr. Eckart informs me that of these three varieties the juice of the "Yellow Caledonia" is by far the most acid, the other two standing far below it in this quality.

Here we have again what appears to be a correspondence between acidity and immunity. The more immune the cane, the more acid the juice.

These facts seem to be a sufficient basis for an immunity theory that takes into account the acidity of the juice *or some correlated phenomenon*, for it must not be forgotten that it is not best to assume any sort of identity between the expressed juices and the compounds existing in the living cane tissues.

Since my original tests were made the gum of the *Bacterium vascularum* has been more carefully examined by Mr. R. Greig-Smith and his results and conclusions are of so much interest as to require notice here.

The tests made by Mr. R. Greig-Smith throw much additional light on the composition of the gum produced by the growth of the *Bacterium vascularum*. His tests were made with a weak solution of the gum filtered from the microbes through porous porcelain. He says, "We must conclude that in the suspension the bacteria are inert, and for purposes of identification of the gum it is unnecessary to separate them."

The tests originally made by the writer agree in all essential respects with those made by Mr. Greig-Smith, as will be seen by comparing the following table:

	Cobb, 1892.	*Greig-Smith*, 1902.
Lime water	ppt.	ppt.
Barium hydrate	ppt.	pp.
Strontium hydrate	ppt.	Not tried
Potassium hydrate	ppt.	No reaction
Sodium	ppt.	No reaction
Alcohol	Not tried except as absolute alcohol on thick gum	pp
Lead acetate	pp.	pp.
Ferric chloride	pp.	pp.
Ferrous sulphate	No. pp.	Not tried
Barium chloride	"	No. pp.
Silver nitrate	"	No. pp.
Nitrogen content	Traces in raw gum.	3.08% in ash-free, dry substance.

The only difference of importance in the two lists is in respect to the action of potassium and sodium hydrates. My tests, which were made with large quantities of unfiltered gum, led me to regard the precipitate as a result of the addition of these chemicals. Their addition to the weak solution of the filtered gum appears to give a different result. It should also be noted that Mr. Greig-Smith obtains a voluminous precipitate on the addition of alcohol to the solution of the gum. My tests were made with absolute alcohol, and its action was tried on thick and viscid gum, with the results noted on page 31. I therefore transcribe all that Mr. Greig-Smith says with regard to the action of alcohol. His paragrph relating to the matter reads as follows:

"The precipitate obtained on the addition of alcohol to a sus- "pension of the gum or slime in water is exceedingly volumin- "ous; a precipitate which occupies a volume of about 50 c.c. "becomes, after squeezing out the dilute alcohol in a calico "strainer, a small pellet measuring about a quarter of a cc. On "precipitating the aqueous suspension three or four times with "alcohol an opalescent alcoholic solution is obtained, from "which the gum can be precipitated by small quantities of neu- "tral salts, such as sodium chloride. This fact, together with "the reactions obtained with some of the albuminoid reagents, "suggested the similarity of the gum to the mucins. That the "zoogloea slime of bacteria consists of mucin, or a substance "nearly allied to it, has already been suggested, but there are "many points of difference between the bacterial slime and the "mucins. The crude gum obtained by precipitating the cultures "with alcohol contains 6.10% of ash and 3.08% nitrogen in the "ash-free, dry substance. Repeated precipitation with alcohol, "and also filtration of the gum from the accompanying bacteria, "would undoubtedly lower this percentage. It is, therefore, "apparent that the nitrogen content alone is sufficient to distin-"guish the slime from mucin or the allied mucinoids."

Mr. Greig-Smith's tests with regard to optimum temperature lead to the conclusion that the organism thrives best at a temperature of 30 degrees C., and he suggests that this fact may have something to do with the prevalence of the disease in cold seasons. His article also contains the following suggestive paragraph:

"In view of the fact that in many bacterial diseases of plants, the microbes are found only in the vessels, and that the bacteria are very sensitive to the reaction of the contents of the vessels, it would appear that the immunity of plants disease-proof to bacterial infection may depend upon a relatively greater acidity or alkalinity of the vascular contents as compared with susceptible varieties."

He also finds that common salt acts injuriously on the microbe when cultivated on artificial media. He suggests the possibility of utilizing common salt in connection with the growth of cane on land that is subject to gumming.

The following is Mr. Greig-Smith's diagnosis of the bacterium:

BACTERIUM VASCULARUM, COBB.

Shape, &c.—The organism appears as an actively motile, short rod, and when stained and imbedded in balsam has an average measurement of 0.4:1 micromillimetres. Carbol violet followed by dilute alcohol produces the best films; fuchsin stains the gum, which usually adheres more or less to the cells; the blues stain but feebly. By using the night-blue method with the scanty growth obtained on ordinary agar the flagella can be easily stained. They are single and terminal. The bacteria are not colored by the Gram method of staining. Spores were not obtained and are probably never formed.

Relations to Oxygen and temperature:—It is a strong aerobe, and grows best at 30 degrees; at 37 degrees there is no growth.

Ordinary glucose-gelatine plate:—The colonies developed slowly. In 7 days at 22 degrees they are 1 mm. in diameter, and appear as small, raised, viscid drops. When magnified 60-fold they appear round and uniformly granular, like a thin yeast colony; the deep colonies are like those upon the surface. In 20 days the colonies reach a diameter of 4-8 mm., and look like drops of yellow bees-wax. The medium shows no sign of liquefaction, but when the colony is scraped or washed off a pit is revealed.

Ordinary gelatine plate:—The colonies grow as in the presence of glucose, but much more slowly.

Ordinary gelatine stroke:—The growth is scanty, narrow, flat, and ivory-white in color. It slowly gravitates to form a yellowish-white mass. The medium under the stroke is depressed.

Neutral cane-gelatine stroke:—There is formed a characteristic convex, deep yellow stroke, with waxy drops at intervals, and at the base. The gelatine in contact with the culture is slightly liquefied in three weeks. The color, bloom and general appearance is that of yellow wax, or of a mixture of yellow vaseline and paraffin. The "tear-drop" appearance of the stroke is characteristic.

Neutral cane-gelatine stab:—The growth forms in the upper portion of the stab only in a filiform manner, and forms a hemispherical, deep yellow nail-head. No gas bubbles are produced.

Ordinary glucose-gelatine stab:—As cane-gelatine, but neither so luxuriant nor so deeply colored. No gas formation was observed.

Ordinary gelatine stab:—Filiform growth in upper portion of stab, with small, raised, white, glistening nail-head.

Ordinary nutrient-agar stroke:—A slow-growing thin, yellowish-white glistening stroke.

Glycerine, nutrient-agar stroke:—A thin, broad, translucent white, moist, glistening growth, with turbid condensed water. The color deepens to a primrose-yellow.

Saccharose (10%)-peptone (0.1%)-agar:—A thin white fluid growth, which gravitates into the condensed water, in which there is a yellow sediment.

Potato:—A primrose-yellow, moist, glistening growth, sometimes raised and restricted, at other times flat, watery and spreading over the surface. Compared with agar or gelatine, the growth is rapid.

Carrot:—A raised, slimy, yellow growth, at first restricted, but eventually covers the surface and gravitates.

Turnips:—As on carrot.

Sugar-Cane:—No visible growth.

Nutrient bouillon:—Slightly turbid fluid, with faint indol reaction.

Nitrate bouillon:—There is no reduction of the nitrate.

Sweet wort:—No growth.

Cane-juice:—No growth.

Milk:—Unaltered; neutral reaction.

Mr. Greig-Smith closes his article with the statement that:

"Although Cobb's description is meagre, there is no doubt "that he intended the name of *Bac. vascularum* for this organism, "which he found constantly associated with the gum of affected "plants."

PART III. MICROSCOPIC FEATURES OF GUMMING.

When an internode of gummed cane is examined microscopically the growth of the microbes causing the disease is found to be confined to the fibres and indeed largely to the vessels.

The two main tubes of the fibres are found to be plugged up with gummy matter, easily recognized by its color and by the characteristic microbes. When the tissue of a piece of gummed cane is sectioned with the microtome the apertures that in a healthy piece of cane would appear empty are invariably found to be more or less occupied by this growth due to the parasite. When the disease is severe the growth is such as to completely stop the circulation natural to these vessels; when the disease is less severe the circulation may not be stopped, but it is at least seriously interfered with. Except in those cases where the tops of the cane stalk are so completely rotted that cavities are formed in the base of the arrow the gummy matter is closely confined to the sap vessels, and this fact is one of the most marked features of the disease, and one that makes a diagnosis of the disease a comparatively simple matter to the microscopist.

FIGS. 8, 9 and 10. The elements in each of these cuts were drawn from various preparations or parts of preparations. The forms did not grow contiguously as drawn.

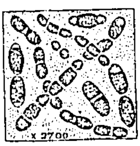

FIG. 8. **Bacterium vascularum** from sugar cane, stained with methyl violet without heat and mounted in water.

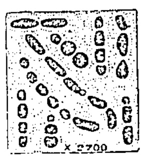

FIG. 9. **Bacterium vascularum** from a culture on agar-agar sweetened with about 5 per cent. of cane sugar, for comparison with Fig. 8.

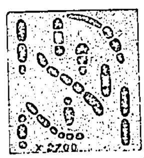

FIG. 10. **Bacterium vascularum** from sugar cane, stained with fuchsin and mounted in balsam. Compare with Fig. 8.

In first reporting upon this disease the writer used the following words: Lenses of high power show the gum to be swarming with microbes of the form known as bacilli. When the gum is fresh and yellow in appearance, the microbes are all of the one kind whose features are well shown in the adjacent illustration, Fig. 8. This microbe appears to be one not hitherto described, and I propose to call it Bacillus vascularum, in consequence of its occurrence in the vessels of the sugar cane. Each microbe has about it a small amount of gummy matter, which is the product of its growth. The gum described as issuing from the sap vessels of the cane has, therefore, two component parts, namely, microbes and a viscous gummy matter. This gummy matter appears to be a new substance, and to it I have applied the name of vasculin.

SYSTEMATIC POSITION OF THE PARASITE. INOCULATIONS.

The researches of later investigators, notably those of Mr. Greig-Smith of Sydney, New South Wales, and Dr. Erwin Smith of Washington, have assigned this microbe to the genus Bacterium, and to the genus Pseudomonas. It seems likely that the former genus will be its final resting place.

From carefully made inoculations the writer satisfied himself that this microbe was the specific cause of the disease to which he has given the name of Gumming of the Sugar-cane. This was ten years ago. Since that date the disease has been several times under investigation by competent experts and his conclusions have been corroborated.

The form of the organism is shown in the accompanying wood cuts (p. 27) and from them it may be identified so far as form and size are concerned, except that a flagellum may be demonstrated by appropriate staining. The usual methods of staining are found applicable and no special methods are required for its demonstration.. It may be readily stained with fuchsin or methyl violet. Dr. Erwin Smith has observed a restricted motility. Greig-Smith says, "actively motile."

[*To be Continued.*]

CUBA'S CROPS.

OUTLOOK FOR SUGAR AND TOBACCO.

Consul Baehr, of Cienfuegos, reports that the sugar estates located in that district are actively preparing for grinding the new sugar crop. He writes:

On many estates new machinery has been installed in order to cope advantageously with the expected increase of cane, as the year has been in general very favorable to the plant and it is believed that the crop will be quite satisfactory. Due to the late rains, which have been very beneficial, the fields present a good appearance and the plant is growing as well as could be desired; but in some parts of the district, especially on high grounds, the plant has already begun to show the flower (guin), a sure sign of approaching maturity. In consequence some of the ingenios will have to start grinding from one to three weeks prior to others. In all "bateyas" or cleared grounds, where the buildings and machinery are located, the last preparatory steps are being taken, in order to have everything in perfect working order, and on estates where no new machinery was installed the old plants are put in first-class condition. Railway companies are preparing to handle with increased facilities the cane and later the sugar produced along their respective lines.

THE LABOR QUESTION.

A problem of the greatest importance, which has not escaped the planter's attention, and which so far has not been satisfactorily solved, at least to the satisfaction of the planters and manufacturers, is the much-talked-of labor question. For the last two years the scarcity of able field hands has been a serious drawback to the planter, and resulted in financial losses, either through the loss of a portion of the crop or through the long drawn out "winding up" of the season. Immigrants who have arrived within the last six months at the different ports of the island will to a certain extent relieve the general demand for efficient hands, but, as most of these laborers are inexperienced in field work peculiar to sugar cane or other agricultural pursuits of the island, the shortage will necessarily continue this season. These new hands will, however, all find employment at moderate wages in places on the estates where skilled labor is not essential. The general outlook for the coming season is fair, as compared with other years, so far as sugar is concerned, and if the cane keeps in its present good condition and the hopes of the planter as to prices are realized there will be no ground for complaint.

TOBACCO.

The rain has somewhat brightened the outlook of the tobacco planters. It has rained copiously in valleys and hills where this plant is mostly cultivated, and it came at the critical moment, both for the plants that were already set out and for those which are being planted at present. The resulting benefit can not be fully estimated at this moment, but it is generally believed that if there are any more such rainfalls before the end of the year the crop will be safe and will yield very good results, both in wrappers and fillers of the best quality, probably superior to last year's leaf. The fields are presenting an appearance of high exuberance of growth, and the plague of all sorts of insects, which usually attack the young plant, is conspicuous by its absence. There will be no need of replanting as all the weather conditions have so far been most favorable. If nothing extraordinary changes the present outlook, this year's tobacco crop will fully realize the planter's hope, especially if the prices will correspond to the plants' superior yield.

SUGAR IN AUSTRALIA.

PROPOSITION TO AMEND THE BOUNTY ACT.

Consul-General Bray, of Melbourne, reports that a bill is being prepared by the prime minister of Australia for presentation to Parliament, having for its object amendment of the existing bounty act. The consul-general writes:

At present there is an import duty of £6 ($29.19) per ton on sugar, and an excise rate of £3 ($14.59). To encourage the production of Australian-grown sugar by white labor, a bounty of £2 ($9.73) per ton is granted on all sugar grown by white labor, or, in other words, a rebate of $9.73 per ton on the excise rate is allowed. The ministry and a majority in Parliament are in favor of the extension of the bounty system, and desire to substitute white for colored labor. In order to do this, Parliament will be asked to increase the excise rate on sugar to £4 ($19.46) per ton and the bounty on sugar grown by white labor to £3 ($14.59) per ton, by which means that grower will be given an additional £1 ($4.86) per ton bounty, while the protection accorded to the sugar grown by colored labor against the imported sugar (of which 38,035 tons, valued at $2,020,181, were imported into the Commonwealth during 1904) will be reduced by £1 ($4.86). The white planter will, by this means, still have a protection of £5 ($24.33) per ton against the imported sugar and gain an extra £1 ($4.86) on every ton he produces, while the protection to the product of colored labor will be reduced from £3 ($14.59) to £2 ($9.73) per ton.

CLAIMS FOR BOUNTY.

The following table shows the acres registered for bonus and number of white cane growers in the State of Queensland, in which the industry is located:

District.	1902. No. of growers.	1902. No. of acres.	1905. No. of growers.	1905. No. of acres.
North	36	1,882	124	5,024
Central	519	12,333	977	28,522
Southern	617	17,814	937	30,471
Extreme south	249	4,509	643	8,589
Total	1,521	36,538	2,681	72,606

In a report to the Commonwealth Government, Doctor Maxwell, the sugar expert to the government of Queensland, remarks:

"The actual position is that after four years' operation of the bonus approximately one-third of the sugar crop of Queensland is produced by white labor. In connection with this summary result it has to be repeated that the progress has taken place almost wholly within the southern and central districts, which are the districts of densest settlement and of the more temperate climatic conditions. At this time there still remain areas which furnish two-thirds of the total sugar crop of Queensland and which are awaiting conversion from colored to white conditions of production. These remaining black sugar areas are occupied by farmers in the northern districts and by plantation owners in the southern or district of Bundaberg, and are in the hands of 750 large growers. The present schedule of bonus was based upon the cost of labor and upon other considerations existing when the legislation was enacted. With the progress of white production, white labor must continue to command a higher compensation in the form of wage and of better domestic provision for workmen. The existing measure of bonus must therefore tend to fall below, and not to exceed, the cost of substituting white for colored labor.

A QUESTION OF RACE.

"It is the possibility of failure of the present measure of bonus to meet the differences in cost between colored and white labor, which is in part confirming the larger employers of wage-earning labor in holding to the use of aliens. If the excise rate and bounty are increased, many planters in the southern and central districts will be tempted to employ none but white labor, but in the northern district the situation is otherwise. In that district settlement is sparse, and so far has not been increased by the provisions in favor of white sugar production. Neither white people prepared to settle upon the land, nor white labor ready to work at the higher rate that the bonus would provide are on the ground in the same proportionate state of readiness that obtains in the southern district. The north, it is foreseen, would have to grow sugar for some further period under the lowered protection that would follow an increase of excise, or that district would have to suspend production. Concerning the supply of the existing types of labor, it is indicated that such a supply may continue to be obtained in the north. According to the latest official returns there are in the northern district, in addition to 2,807 Kanakas, 3,917 other aliens engaged in the sugar industry. If the conceived increase of excise should induce or force white production to take the place of the remaining colored production in the southern and central districts a very considerable number of colored laborers not liable to deportation would be released and made available for use in the north. The number of aliens other than Kanakas in Queensland is 14,505."

The past sugar season in the State of Queensland, the only State in Australia in which sugar is grown, has been a very successful one. The following gives the production of the State for the past eight years:

Year.	Under cane Acres	Crushed Acres	Manufactured Tons
1897	98,641	65,432	97,916
1898	111,012	82,391	163,734
1899	110,657	79,435	123,289
1900	108,535	72,652	92,554
1901	112,031	78,160	120,858
1902	85,338	59,102	76,626
1903	111,516	60,375	91,828
1904	120,317	82,741	147,688

The crop for 1904, it will be seen, was the largest since 1898 and the second largest on record. The by-products consisted of 4,491,407 gallons of molasses and 260,289 gallons of spirits. Increased prices were obtained, being $61.04 per ton against $54.32 in 1903 on the basis of 94 per cent. sugar. The return per acre amounted to $108.67 against $77.28 in 1903, the financial return to the growers being therefore very satisfactory.

The following shows the value of the sugar exports of Queensland during the past eight years:

1897	$3,314,271	1901	$2,761,393
1898	6,438,150	1902	4,549,982
1899	5,659,788	1903	3,148,294
1900	3,257,581	1904	6,120,226

THE SUGAR INDUSTRY OF CHILE.

[From the Boletin de la Sociedad de Fomento Fabril, No. 12.]

The soil and climate of Chile indicate that the sugar industry would prosper in the republic, if properly exploited, not only to the extent of supplying the domestic needs of the nation with that important product of prime necessity, but also in such quantities as would leave a considerable surplus for export to foreign markets. The sugar beet is one of the tubers that flourishes most luxuriantly in the lands of the central zone of the republic. In addition to the natural adaptability of the soil and climate of Chile for the growth of this tuberous root, the country also possesses deposits of nitrate and guano, which are recognized to be the best and most appropriate fertilizers in the cultivation of this highly saccharine-producing tubercle

Unfortunately the cultivation of the sugar beet has not been sufficiently extended, due perhaps to circumstances foreign to the industry itself, and at the present time there are only two factories in the country capable of extracting and refining sugar from the sugar beet. One of these, situated at Guindos, has not been in operation since 1890, owing to the lack of the raw materials, caused by the failure of the proprietor thereof to continue on his plantation the cultivation of the sugar beet. The other installation is at Parral, and is owned by a corporation having a capital of 1,500,000 pesos. Until January last this factory only produced brown sugar, which it delivered to the refinery at Penco, but since the date mentioned new and adequate machinery has been introduced and the refining is now done in the establishment itself.

In 1903 the factory at Parral (Membrillo) did not produce raw sugar, inasmuch as the board of directors decided not to devote their lands to the cultivation of the sugar beet, and as sugar beets are not grown in the vicinity, the factory was without the raw material with which to work.

There are two refineries in the republic. One of these is at Vina del Mar and the other at Penco. Both belong to corporations. They use raw sugar imported from Peru, with the exception of a small quantity already mentioned, which is supplied to them by the factory at Parral (Membrillo). Raw sugar pays an import duty of 6.50 pesos per 100 kilograms. The imports of raw sugar in 1902 aggregated 41,397,378 kilograms, valued, approximately, at 4,139,738 pesos. The quantity of white or granulated sugar imported during the same period amounted to 162,395 kilograms, of an estimated value of 24,258 pesos. Sugar of the latter class is sold in the country in the form in which it is imported, and is subject to a duty of 11.40 pesos per 100 kilograms. The imports of refined sugar during the same period amounted to 1,646,930 kilograms, valued at 329,389 pesos. Refined sugar pays a duty of 14.35 pesos per 100 kilograms. The total imports of sugar in 1902 consisted of 43,206,723 kilograms, valued, approximately, at 4,493,485 pesos.

The sugar refinery at Vina del Mar has a capital of 4,667,666 pesos, gold, of a value of 18 pence. The production of this refinery for the ten years is given below:

Year	Kilograms.	Year	Kilograms.
1894	11,861,203	1899	18,968,186
1895	13,174,530	1900	20,479,093
1896	13,273,210	1901	21,096,295
1897	14,292,867	1902	24,439,964
1898	16,470,310	1903	24,285,419

The average dividends paid to the shareholders during the ten years mentioned were 10½ per cent. annually on the capital invested.

The refinery at Penco is not as old as is that of Vina del Mar. It has a capital of 3,000,000 pesos, gold, of a value of 18 pence. The production of this refinery for ten years has been as follows:

Year	Kilograms.	Year	Kilograms.
1894	4,444,428	1899	10,123,763
1895	6,311,522	1900	19,921,722
1896	7,345,970	1901	10,588,419
1897	8,957,902	1902	11,324,001
1898	10,115,360	1903	12,982,632

In 1902 and 1903 this company paid an average annual dividend to its stockholders of 9½ per cent. on the capital invested.

A recapitulation of the production of the refineries together with the imports in 1902 shows that the total consumption of sugar in the republic in 1902 aggregated 37,573,310 kilograms, or an equivalent of 11,838 grams per inhabitant, estimating the population of Chile at 3,178,783 persons, the number given in the "Statistical Synopsis" for 1903. The average price of sugar in the republic in 1902 was 43 cents per kilogram.—La. Planter.