PART TWO.

PART TWO.

THE ADAPTABILITY OF THE EVERGLADES FOR THE GROWTH OF SUGAR CANE.

Sugar Cane—Where Found.

IN order to determine the conditions under which sugar cane can be grown most advantageously we have but to study the soil and climatology of the localities in which it flourishes in a natural state, or in which it is most successfully cultivated.

Writers and travelers tell us that sugar cane is found in practically all the low moist lands in both hemispheres extending about thirty-five degrees both north and south of the equator. From this we see that its natural habitat is a warm climate, having a mean temperature ranging from seventy to ninety degrees, with an abundance of moisture and sunshine. It seems to thrive best in low lands swept by a moist sea breeze. For commercial use cane is most extensively grown in British India, Cuba, Java, Hawaii, Louisiana and Texas.

Climatic Conditions Necessary.

Although sugar cane is a tropical plant, it will withstand about 30 degrees F. for a few hours without serious injury, but it will not endure extreme or continued cold. In the countries where sugar cane is grown most success-

fully (without irrigation), the average annual rainfall is about sixty inches. In the sugar districts of Cuba it is 56 inches; in Porto Rico 77 inches, and in Louisiana 58 inches. Large crops of cane are grown in Guinea and other countries with a rainfall of upwards of 100 inches, but it remains green at maturity and is low in sugar content.

Where the annual average rainfall is much below sixty inches, as in the Hawaiian Islands, irrigation is necessary to produce a maximum yield. From careful experiments it has been ascertained that each ton of cane produced in Louisiana evaporates through its foliage about 150 tons of water. The only way in which the sugar content is extracted from the soil and deposited in the stalk is by the evaporation of water through the foliage. However fertile or rich in plant food the soil may be, it cannot yield a profitable crop of sugar cane unless the necessary amount of water is available at all times. Not only must the requisite quantity of water be provided, but it must be distributed throughout the season as required by the growth of the plant. Too much at one time and not enough at another is a serious detriment.

During the months of March, April and May, while the cane plant is small, it cannot evaporate as much water per day as during the months of June, July and August, when the stalks are large and the foliage more dense. In order that the cane may ripen properly and yield a large quantity of sugar, but little moisture is required in October and November. A

dry season is also advantageous during the winter months, while the cane is being cut and hauled out of the field, but a certain amount of moisture is necessary during these months to sprout the plant cane and keep the stubble in good condition. From these facts it appears that a dry winter, followed by a comparatively dry spring, then a wet, hot summer with a high degree of humidity, followed by a dry fall, are the ideal conditions for the growth of sugar cane, producing a large yield of sugar. In Hawaii and other places, where the annual rainfall is deficient, cane is most successfully grown by irrigation. This does not signify that the requirements or essential conditions cited above are in any way changed or modified; it simply means that the exact amount of water required by the cane is supplied as needed.

The average of fifteen tests made under identical conditions at the Hawaiian Experiment Station, giving the total amount of water received by two crops for the season of 1897 and 1898, 1898 and 1899 (a period of seventeen months each), is as follows:

Crop Period.	Rainfall.	Irrigation.	Water Per Acre.	Yield Sugar Per Acre.	Water Required to Produce 1 lb. of Sugar.
1897-98....	46.56	48.00	2,567,682	25,755	865
1898-99....	26.01	77.00	2,797,133	27,133	859

*The author states that no single rainfall exceeded one inch, and no more than one inch of water was applied at any single irrigation.

By withholding the water at the end of the growing season, where irrigation is practiced, the cane is ripened naturally and the sugar content is much greater than it otherwise would be. In fact, the ideal condition for growing any crop is that in which the grower is able to control the amount of moisture in the soil. When there is too much he must be able to promptly remove the excess; when there is too little to supply the deficiency. Where these conditions exist, or can be secured, a maximum crop may be produced each year with a degree of certainty that makes agriculture profitable.

Essentials for Profitable Cane Culture.

Dr. W. C. Stubbs, a recognized authority on sugar cane, says: "It may be asserted most positively that the conditions best suited to sugar cane are: (1) Fertile soil, (2) necessary conditions of temperature; (3) an abundant water supply, either naturally or through irrigation, so that it may be applied in ample quantities only when needed, and withheld when the cane has attained growth so that the process of maturation may take place." (See "Cultivation of Sugar Cane," by Wm. C. Stubbs, page 30).

Everglade Soil.

We will now examine briefly the natural features of the Everglades, and see to what extent the necessary conditions for the growth of sugar cane exists or can be readily secured.

The principal part of the Everglades lies be-

tween the 25th and 27th parallels of north latitude, being well in the limits of the sugar belt. The surface elevation ranges from six to twenty feet above sea level. The entire area is exposed to damp, moist winds, with a high degree of humidity during the summer months. There is an abundant supply of water for irrigation at all times. No intelligent agriculturist, who has ever examined the soil of the Everglades, questions its fertility. It is a bed of muck from two to fourteen feet deep underlain with a rotten limestone. A great many samples of soil from different parts of the Everglades have been analyzed by a number of competent chemists and the results obtained are practically the same throughout the entire area. Around the margin of the lake, and in other places where the land is driest, the muck is more thoroughly decomposed, and is in better condition for plant growth, but it possesses no elements of plant food not found in other parts of the Everglades.

Two representative samples taken from the interior west of Pompano, and examined for lime, potash and phosphoric acid and nitrogen by the Bureau of Soils, U. S. Department of Agriculture, Washington, D. C., show the following results:

TABLE OF ANALYSIS.

	Sample 1.	Sample 2.
Lime	2.25 per cent.	2.21 per cent.
Potash	.15 " "	.08 " "
Phosphoric acid	.19 " "	.19 " "
Nitrogen	3.16 " "	2.58 " "

From hundreds of samples of soil taken from various sections of the sugar district of Louis-

iana, Dr. Stubbs says the average analysis will be about as follows:

Lime	.50 per cent.
Potash	.40 per cent.
Phosphoric Acid	.10 per cent.
Nitrogen	.10 per cent.

Dr. Walter Maxwell, Director of the Experiment Station of Honolulu, gives the following mean result of nearly one hundred analyses from that locality:

TABLE OF DR. MAXWELL'S ANALYSES.

Island.	Lime Per Cent.	Potas Per Cent.	Phos. Acid Per Cent.	Nitrogen Per Cent.
Oahu	.38	.342	.207	.176
Kauai	.418	.309	.187	.227
Maui	.396	.357	.270	.388
Hawaii	.185	.346	.513	.540

These analyses are given to show the similarity of the soil in the Everglades to that of well-known sugar-producing sections. The writer does not believe that a soil analysis alone is conclusive proof of the productivity of any soil. Certain conditions of aeration and moisture are absolutely essential to render the plant food found in the soil available for the growth of the plant. In many places the yield of certain crops is materially increased by an application of potash or phosphoric acid, when an analysis of the soil shows the existence of a much larger quantity of these elements in the soil than is required for the growth and perfection of the crop being cultivated.

The old adage—"The proof of the pudding is in the eating"—is quite applicable in determin-

ing what a certain soil will produce. A real practical demonstration is a much safer guide than any laboratory analysis that can be made in determining whether a soil will or will not produce certain crops.

Although the Everglades as an entirety are not sufficiently drained for cultivation, there are certain limited areas partially drained where field demonstrations have been made. On the bank of Rita river, one mile south of Lake Okeechobee, sugar cane was grown quite successfully for a number of years with very little cultivation and without fertilizer of any kind. The writer inspected this patch of cane three different years and found a most remarkable growth. The stalks were large and heavy and yielded a profitable crop of syrup.

At the present time there is a patch of cane on the bank of south canal, five miles south of the lake, that was planted last April. This cane has made a good growth, and demonstrates conclusively the adaptability of the soil and climate for this crop. On the canal five miles from Miami is another field of cane, which I had photographed Nov. 15, 1912. (See plate X.) In this instance the saw grass was burned off the land, a furrow opened and the seed cane laid in and covered. I am informed this cane was not cultivated and no fertilizer of any kind was used. In the same locality the owner tells me he harvested forty tons of cane per acre last year.

On the Fellsmere Farms, near Sebastian, 80 miles north of the Everglades, they are grow-

ing sugar cane quite successfully. (See plate XII.)

On St. Cloud plantation, near Kissimmee, Fla., on land exactly like the Everglades so far as can be determined, as high as sixty-three tons of cane per acre was grown and manufactured into sugar, yielding 12,600 pounds per acre.

These demonstrations show most conclusively that the soil of the Everglades is suited to the growth of sugar cane. It is richer in lime and nitrogen than the cane lands in Louisiana and the Hawaiian Islands, and has about the same amount of phosphoric acid as these lands, but is slightly deficient in potash.

Temperature.

The conditions of temperature in the Everglades are about all that can be desired for the growth of sugar cane. The summers are long and hot, while the winter months have just enough cool weather to ripen the cane. Frosts are of rare occurrence, and when they do occur cause but little injury.

The following table gives the mean annual, highest and lowest temperature at Jupiter and Fort Myers, 1898-1906:

Year.	Jupiter.			Fort Myers.		
	Annual Mean Temperature.	Highest During the Year.	Lowest During the Year.	Annual Mean Temperature.	Highest During the Year.	Lowest During the Year.
1898	73.7	91	31	72.6	94	28
1899	74.4	93	28	73.1	93	28
1900	74.3	93	31	72.3	92	34
1901	72.6	92	38	70.3	94	32
1902	74.4	96	38	72.2	94	31
1903	74.1	96	36	71.8	94	35
1904	73.8	94	39	....	94	34
1905	74.6	94	24	73.5	94	27
1906	73.7	91	30	72.4	92	31

These stations are both north of the body of the Everglades, and, no doubt, show from three to four degrees lower temperature than would be registered south of Lake Okeechobee.

The following table gives the mean annual, highest and lowest temperature at the sugar experiment station at New Orleans, La., for ten years, 1888-1896:

TEMPERATURE—SUGAR EXPERIMENT STATION—NEW ORLEANS, LOUISIANA.

Year.	Mean Annual Temperature.	Highest. During Year.	Lowest. During Year.
1887	70.3	99	72
1888	70.2	98	27
1889	70.1	96	30
1890	69.98	95	32
1891	68.20	98	29
1892	67.70	99	21
1893	68.40	99	28
1894	68.05	99	19
1895	68.43	98	15
1896	68.76	98	24

An inspection of these tables shows that the mean annual, and also the minimum, temperature is higher in the Everglades than in the sugar district of Louisiana. Cold waves are not so frequent and are of shorter duration. On account of this immunity from cold, sugar cane in the Everglades has a longer season in which to grow and ripen than in Louisiana and is consequently much richer in sucrose. In Louisiana the grinding season commences about the third week in October and is completed on most plantations by December 31. This is necessary in order to save the crop before the cold weather, which usually comes in January or February. This short period in which the crop must be handled entails a great loss to the sugar planter.

When the grinding season commences the cane is immature, and the yield of sugar per ton is much less than after the first of December, when the cane is fully ripe. On the other hand, if the grinding is not finished before a severe freeze comes, a much greater loss is sustained.

This drawback will not be encountered in the Everglades. The harvesting need not commence until December, giving the cane ample time to mature, and it can continue without loss until March or April. This advantage alone represents a handsome profit in favor of the cane grower in the Everglades.

Rainfall and Water Supply.

The next essential to be considered is that of precipitation and water supply. On this condition depends largely the success or failure of

sugar cane culture in any country. Sugar cane cannot be grown successfully, and manufactured at a profit, unless the proper quantity of water is supplied to the cane at the right time. If this cannot be provided naturally it must be supplied artificially. If there is too much rain at one period adequate provision must be made by drainage to remove the excess promptly. If there is likely to be a deficiency at any season of the year, provision must be made to supply it by irrigation.

The following tables show the monthly distribution of the rainfall at Jupiter, Kissimmee and Fort Myers. These are the nearest points to the Everglades at which reliable records have been kept for any length of time, and, no doubt, represent fairly well the rainfall in the northern part of the Everglades:

MONTHLY PRECIPITATION.

TABLE NO. 1—JUPITER.

	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	Average Monthly
March	3.26	3.58	8.20	2.30	.97	9.27	3.06	5.39	2.50	4.17
April	1.90	3.11	2.16	2.13	.97	.44	2.85	3.14	2.57	2.14
May	1.15	1.65	7.43	3.63	4.83	2.71	2.42	3.35	7.04	3.80
Total	6.31	8.34	17.79	8.06	6.77	12.42	8.33	11.88	12.11	.
June	.12	3.45	2.90	17.41	3.92	7.01	10.54	2.08	11.90	6.59
July	6.80	3.35	3.49	7.23	4.73	3.23	4.38	9.12	7.97	5.59
August	6.62	5.96	1.12	12.13	1.91	2.47	5.79	10.72	8.55	6.14
Total	13.54	12.76	7.51	36.77	10.56	12.71	20.71	21.92	28.42	.
September	3.38	11.27	7.62	9.71	6.01	15.82	8.92	10.77	8.37	9.09
October	10.89	16.66	10.11	7.08	13.74	1.81	21.49	4.26	8.31	9.37
November	1.11	.99	.73	.94	2.38	2.50	3.98	2.88	4.53	2.22
Total	15.38	28.92	18.46	17.73	22.13	20.13	34.39	17.91	21.21	
December	2.56	2.97	3.10	4.17	.71	.56	.49	15.18	.05	2.30
January	.36	4.30	3.49	8.29	.98	6.98	2.56	1.40	2.62	3.44
February	.95	4.64	2.28	1.07	4.64	4.50	2.20	1.50	6.44	3.40
Total	3.87	11.91	8.87	13.53	6.33	12.04	5.25	18.08	9.11	
Total annual	39.10	61.93	52.63	76.09	45.79	57.30	68.68	69.79	70.85	

MONTHLY PRECIPITATION.

MONTHLY PRECIPITATION.

TABLE 2—KISSIMMEE.

	1898.	1899	1900.	1901.	1902.	1903.	1904.	1905.	1906.	Average Monthly.
March	.00	1.68	6.07	3.51	1.88	5.84	.80	3.88	2.74	2.93
April	.12	3.06	3.02	3.23	1.73	.25	2.25	1.82	1.48	1.88
May	.35	1.60	5.84	2.96	.34	6.68	.51	7.17	6.77	3.58
Total	.47	6.34	14.93	9.70	3.95	12.77	3.56	12.87	10.99	
June	5.75	3.06	8.18	8.78	5.85	10.12	8.19	4.46	10.21	7.17
July	7.90	8.37	5.66	2.84	5.36	6.07	8.56	14.05	6.65	7.27
August	11.41	11.06	3.23	9.91	7.27	4.31	4.53	13.90	2.59	7.57
Total	25.06	22.49	17.07	21.53	18.48	20.50	21.28	32.41	19.45	
September	4.52	7.03	4.50	12.95	3.35	12.06	4.66	5.05	3.26	6.70
October	5.17	15.98	4.83	1.18	3.07	1.02	6.72	3.19	2.00	4.79
November	.88	.23	1.62	.67	1.15	3.56	3.15	.00	.16	1.26
Total	10.57	23.24	10.95	14.80	10.57	16.64	14.53	8.23	5.42	
December	3.02	1.60	5.09	1.35	.98	1.51	.80	9.43	.04	2.64
January	.23	5.72	4.88	.92	.19	4.76	4.16	.70	6.43	3.10
February	1.12	11.53	2.65	2.26	6.07	5.04	5.16	.91	1.49	4.02
Total	4.37	18.85	12.56	4.53	7.22	11.31	10.12	11.04	7.96	
Total Annual	40.47	70.92	55.51	50.56	40.22	61.22	49.49	64.55	43.82	

MONTHLY PRECIPITATION.

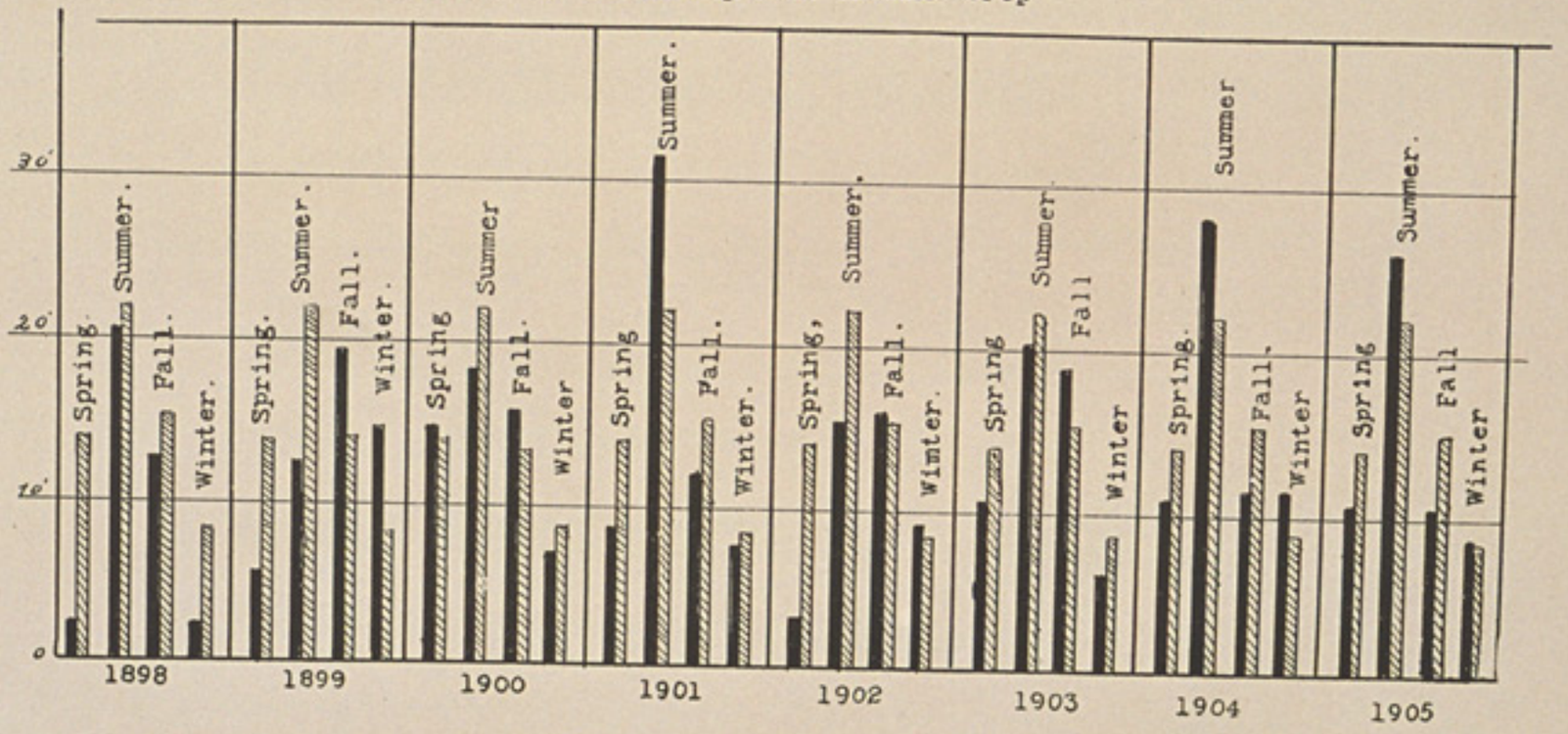
TABLE NO. 3—FORT MYERS.

	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	Average Monthly.
March	.46	1.23	4.12	2.67	.18	7.78	1.90	.18	2.84	2.35
April	.37	1.74	2.87	1.89	1.03	.00	1.10	4.83	.21	1.56
May	3.53	1.15	4.65	2.30	1.23	.71	3.57	3.97	6.12	3.02
Total	4.36	4.12	11.64	6.86	2.44	8.49	6.57	8.98	9.17	
June	2.83	5.93	7.12	20.28	8.63	10.45	14.86	5.97	11.00	9.67
July	8.16	12.08	9.63	5.23	4.60	11.40	5.60	13.90	9.69	7.81
August	11.62	6.72	9.77	12.41	3.97	5.50	6.30	10.52	12.02	8.75
Total	22.62	27.43	26.52	37.92	17.20	27.35	26.76	30.39	32.71	
September	10.73	2.31	8.29	6.86	6.60	4.15	3.07	9.09	3.39	6.05
October	4.99	2.58	10.33	.78	7.46	1.62	1.78	1.51	2.41	3.81
November	1.29	.94	1.91	.52	.96	2.02	1.93	.06	.32	1.10
Total	17.01	5.83	20.53	8.16	15.02	7.79	6.78	10.66	6.12	
December	3.12	.58	2.78	1.62	2.93	1.69	.83	6.31	.02	2.20
January	.05	5.21	3.17	.50	.52	4.76	3.12	.50	2.02	2.20
February	.02	8.77	3.99	.72	6.79	3.37	2.00	.10	2.18	3.10
Total	3.19	14.56	9.94	2.84	10.24	9.74	5.95	6.91	4.22	
Total annual	47.17	49.24	68.63	55.78	44.90	53.37	46.00	56.84	52.22	

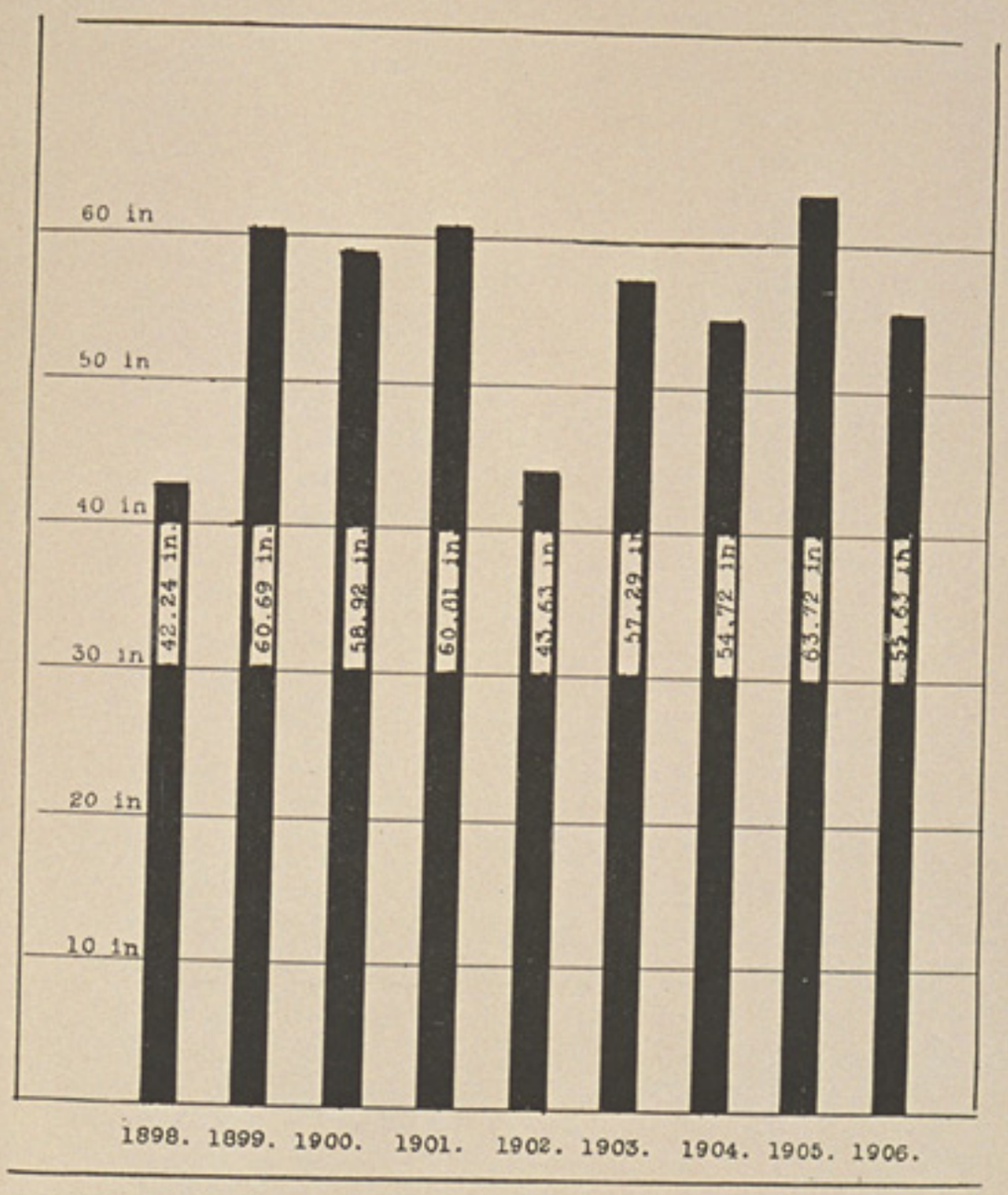
DIAGRAM SHOWING MEAN SEASONABLE DISTRIBUTION OF RAINFALL AT JUPITER, KISSIMMEE AND FORT MYERS

DIAGRAM SHOWING MEAN SEASONABLE DISTRIBUTION OF RAINFALL
AT
JUPITER KISSIMMEE AND FORT MYERS

Explanation The solid line indicates the actual rainfall during each season
The shaded line indicates approximately the amount of water
required for maximum growth of cane crop



AVERAGE OF ANNUAL RAINFALL
AT
JUPITER KISSIMMEE AND FORT MYERS



The accompanying diagrams show in graphic form the average of the annual rainfalls at Jupiter, Kissimmee and Fort Myers, and also the seasonable distribution of the same for nine years. In the absence of actual gaugings of the rainfall in the Everglades, covering a period of several years, these diagrams may be accepted as the most reliable data available on the subject:

From a careful inspection of the foregoing tables and diagrams the following conclusions are reached:

1. In five of the nine years reported the total rainfall, if properly distributed, was sufficient to produce a good cane crop.

2. In four of the nine years reported the total rainfall was not sufficient to meet the requirements for a maximum cane crop.

3. In four of the nine years the monthly distribution of the rainfall conformed quite closely to the quantities required by the growing cane.

4. In five of the nine years the distribution was quite irregular, there being a large excess in some months and a deficiency in others.

6. During the fall months there is too much rain for the proper ripening of the cane and a good yield of sugar.

In studying the climate of the sugar-producing countries in no place is found a uniform distribution of the rainfall throughout a series of years, and in no place do they grow a maximum crop of cane each year. In Louisiana the rainfall during the spring months ranges from 6.42 to 20.4 inches; in the summer months from

13.49 to 29.98; in the fall months from 3.71 to 20.39; in the winter months from 4.53 to 21.36.

In Porto Rico the rainfall during the spring months ranges from 1.13 to 13.78; in the summer months from 3.92 to 16.12; in the fall from 5.13 to 13.90; in the winter from .51 to 8.11.

In the Everglades it ranges from 3.4 to 11.2 inches in the spring months; from 15 to 30 inches in the summer; from 10.6 to 19 inches in the fall; and from 3.5 to 15 inches in the winter.

Advantageous Features of the Everglades.

The amount and distribution of the rainfall cannot be controlled by human agency. In some months there will be too much rain, and in some too little for the best growth of sugar cane. With the overflow from Lake Okeechobee cut off, and the outlet canals (seven to ten feet deep) completed, practically all the land in the Everglades can be properly drained by the digging of sufficient lateral ditches. Just how close together and how deep these ditches should be to properly drain the land for the cultivation of sugar cane will depend largely upon the methods of cultivation and the degree of risk, from too much rainfall, the proprietor is willing to assume.

Although sugar cane is a water-loving plant, any amount of rainfall in excess of that required by the plant must be promptly removed or it works an injury. This can be done only by providing adequate drainage. The field ditches must be of sufficient capacity to remove promptly the heaviest rainfall that is likely to occur.

Cane growers, as a rule, do not appreciate this fact. They plant land that is imperfectly drained with a hope that heavy rains may never come. The result is the crop is often damaged and the financial loss in a single year greater than the cost of proper ditching.

Opinion of Dr. Stubbs.

On the importance of drainage for sugarcane I desire to quote at length from the "Cultivation of Sugar Cane," by William C. Stubbs, Part I, page 39:

"Nowhere on earth is drainage more essential than in the alluvial districts of Louisiana, and while many plantations may be considered well drained, the average planter has not yet fully appreciated the necessity for multiplying open ditches to the extent of forcing his soils to their fullest capacity. This is evidenced by a trip over the State and observing the varying distances between ditches which obtain in different plantations.

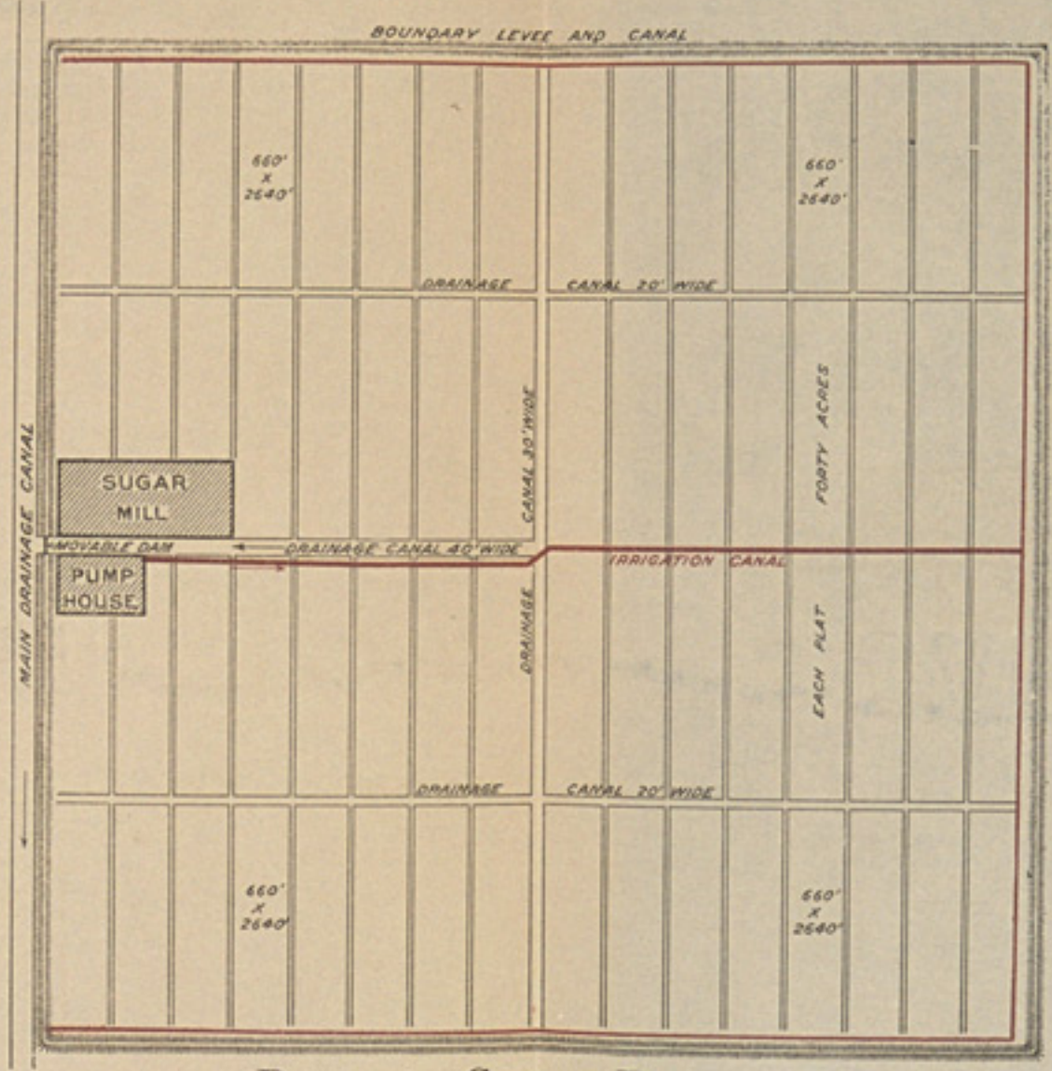
"Only in very dry seasons can badly drained lands be made to yield large crops. Since these unfortunately occur only at long intervals, the average yield on such lands is far below their natural capacity. On badly drained lands neither fertilizer nor cultivation have their full effects, hence the discordant opinions which frequenty prevail among our planters from the use of the same fertilizer or the same method of cultivation. From the experiences of this station it is almost impossible to be 'over-drained,' providing the work of draining be intelligently

performed. It is well for every planter to study his system of drainage and examine his ditches, and see if they be deep enough, wide enough and sufficiently abundant to carry off our heaviest rainfalls and retain the 'bottom or ground water' at a constant depth below the surface. Excellent results can be obtained with open ditches, provided they are numerous, deep and wide. In the lower sugar district these ditches should be at least as close as 100 to 125 feet, and deep enough to hold the bottom water at least three feet below the surface."

Drainage in the Everglades.

The rainfall is just as heavy in the Everglades as in Louisiana, and because of this field ditches are absolutely necessary; but the muck soil of the Everglades is more porous than the alluvial soil of the sugar lands of Louisiana, and for this reason field ditches need not be so close together.

There is much speculation and difference of opinion as to the proper distance apart, and size and depth of field ditches required, for perfect drainage in the Everglades. While the land is new and the soil porous I believe that field ditches with free outlets 660 feet apart will afford good drainage for the cultivation of sugar cane. When the land has been cultivated a number of years it will become more compact and the ditches will need to be closer together, probably 330 feet apart for good drainage. These ditches should be at least four feet deep and not less than three feet wide on the bottom. The plot between the lateral ditches should



PLAN OF SUGAR PLANTATION

Showing System of Drainage and Irrigation Canals

have frequent shallow surface ditches (called in Louisiana **quarter drains**) to lead the surface water, when the ground is saturated, into the lateral ditches. These should not be deep enough to interfere with cultivation.

Without a complete system of lateral ditches the growing of sugar cane in the Everglades will be a hazardous business. There are times when there is too much rainfall for it to be taken up by free evaporation from the soil and by the growing crops. This surplus must be promptly removed by proper drainage, or the crop will be impaired. This is particularly necessary in the late fall, when the cane begins to ripen. Unless the land is thoroughly drained at this time the cane will remain green and the sugar content will be small.

A perfect arrangement for controlling the supply of water can be secured by placing movable dams in the canals on the sugar plantation to cut off the supply from the main arteries and installing a pumping plant of sufficient capacity to empty the canals on the plantation when desirable to do so. By this method the plane of soil water can be reduced to any level desired. Such a system will provide perfect drainage at all times, thereby insuring the planter against adverse weather conditions.

This same pumping plant can be used to raise the water for irrigation when there there is a low stage in the drainage canals. The water can be distributed over the land in shallow ditches and let into the furrows between the cane rows and drawn off through the drainage canals, or the dams can be closed and the ca-

nals filled to the proper stage to water the crop by sub-irrigation.

Because of the low lift and the abundant supply of water at hand the cost of irrigation will be less in the Everglades than in any other sugar-producing district in the world.

Since sugar cane is a crop of high commercial value—$90.00 to $150.00 per acre—no pains should be spared to prepare the land in such a way as to produce a full crop each year. The grower cannot afford to assume any risk that can be provided against by irrigation and drainage.

Dual Use of Canals.

In planning a system of drains for a sugar plantation in the Everglades the use of the canals for transportation purposes must be given due consideration. The distribution of seed cane at planting, and the hauling of cane from the field to the sugar mill, are important items.

In Louisiana the cane is usually handled from the field to the sugar house in cars, holding from three to seven tons, drawn on a tram road by a small locomotive. This work can be done at much less cost in the Everglades by means of canals and barges.

One mile of tram road, with good ties and thirty-pound steel rails, will cost at least $2,500.00 per mile without the equipment for operating same. A canal twenty feet wide and seven and one-half feet deep will cost about $1,765.00 per mile. The barges and launches necessary to handle 1,200 tons of cane per day

will cost much less than an equipment of cars and locomotives for the same service. In addition to handling the cane, the barges can be used to haul the finished product to the shipping point, while locomotives and cars cannot, without the building of a road for that purpose.

METHODS TO BE EMPLOYED AND COST OF PREPARING THE LAND.—PLANTING AND CULTIVATING SUGAR CANE IN THE EVERGLADES.

Condition of the Land.

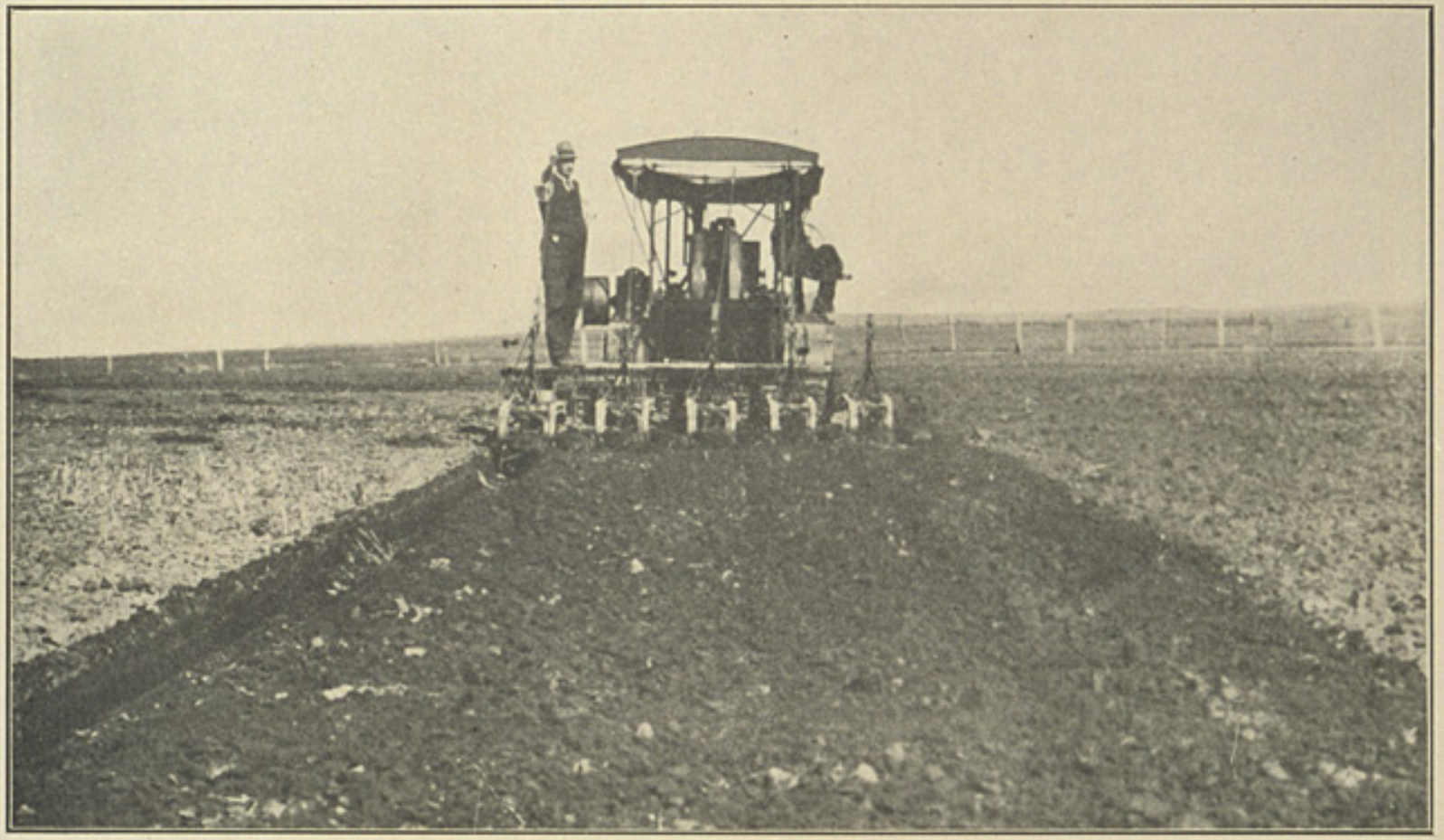
Practically all the land in the Everglades is free from trees and bushes, so there is no expense to be incurred for clearing and grubbing. The saw grass can be burned off, leaving nothing on the ground but a coarse stubble. This burning destroys the seeds of any grasses or weeds, making the cultivation the first year quite easy. The land is too soft, at the present time, to admit of the use of animal power for plowing and cultivating. When it is drained and put in cultivation it will become more compact each year, and in a few years will be firm enough to be cultivated in the usual manner. In Louisiana this work is done with the best mules that can be secured, the initial cost and maintenance of which is a large item of expense. In Cuba, oxen are largely used as the motive power on the sugar plantation.

A Tractor as Power.

A form of tractor for use on soft ground is now being built by a number of manufacturers. It is used in the same manner as an ordinary traction engine, and moves readily over ground too soft to carry the weight of a horse or an ox. These tractors have been thoroughly tried out in the Everglades and are a decided success. They are also successfully used for plowing swamp lands in southern Louisiana and in the cultivation of sugar beets in the Western States. Where the land is practically level and free from obstructions, it can be broken and cultivated much cheaper by a steam or gasoline plow than by animal power.

On a large plantation the initial cost of the required number of tractors and gang plows is but little, if any, greater than the cost of the necessary mules and implements to do the same work. The cost of fuel to operate a tractor is much less than the cost of feed for the animals that would be required to do the same work. The cost of the labor to operate a tractor and gang plows is much less than the cost of the labor necessary to cultivate the same land with animal power.

During that portion of the year when the tractor is not in use it requires no attention or expense, while mules must be cared for and fed, whether idle or at work. Where a large number of animals are employed on a plantation, the loss from accident and disease is a large item—much greater than the depreciation of a mechanical equipment.



PLOWING WITH A TRACTOR.

With a machine of this type the raw land in the Everglades can be prepared and planted, at a less cost per acre, than by the methods now in vogue in Cuba, Louisiana or the Hawaiian Islands. One of these tractors will travel at the rate of two miles per hour and will plow a strip one-half rod wide as fast as it moves. At this rate it will plow twenty acres per day of ten hours at a cost for labor and gasoline of twenty dollars per day, or a unit cost of one dollar per acre. The same tractor can be used for harrowing the ground and opening the furrows to receive the seed cane.

Seed Cane.

For planting any large area in the Everglades for the first time, seed cane will have to be secured from the cultivated lands in Florida and brought to Fort Myers or Fort Lauderdale by rail or on barges. Here it can be transferred to small barges and delivered to the plantation through the drainage canals. This seed cane, delivered at the plantation, will probably cost six dollars per ton.

In common practice four or four and a half tons of seed cane are required to plant one acre. Since the seed cane for planting in the Everglades must be brought a long distance, there is a possibility that many of the eyes or buds will be injured and that some will not sprout. For these reasons it will be prudent to plant at least five tons of seed per acre to insure a good stand.

Method of Handling.

In order to distribute the seed cane economically in the field, and for the purpose of harvesting the crop, a quantity of portable track in sections of fifteen feet each, made of fifteen-pound "T" rails, and a supply of cane cars, holding two or three tons each, will be required. With this equipment cane can be distributed and planted quickly and cheaply with a minimum of laborers. The cane can also be distributed over the field very economically by means of the tractor used for plowing the land.

Seed cane is usually planted by opening a furrow with a double mould-board plow, and laying the stalks about two to the running foot in the furrow and covering by hand, or with a disc-plow. In some localities, the stalks are cut into short pieces, but this is not necessary unless they are very crooked.

Cane may be planted in the Everglades any time from October to April. Where a large plantation is being established, it will be more economical to purchase seed, and plant about fifteen per cent. of the area the first year, and then use this crop for seeding the remainder of the plantation. After a few years, when the stubble cane begins to deteriorate, about twenty per cent. of the plantation should be replanted each year.

Cultivation.

The cultivation of sugar cane in the Everglades will be light work. After the saw grass

SUGAR CANE ON MIAMI CANAL.

is burned, and the land broken, there will be no weed and grass seeds left on the soil, to germinate and spring up the first year. The soil is loose and finely pulverized, and will not bake, and become compacted, so as to break up in clods. The cultivation can be done largely with the tractor, and some form of disc or gang plow. But little hand labor will be required. The land is free from those fine grasses, like nut grass and Johnson grass, that are so hard to destroy. The most common vegetation, after the first year, is coarse weeds, that grow rapidly and are easily killed.

Care of Ditches.

Since complete and perfect drainage is the key to success in cane culture, the ditches must be kept at all times in good order. The cane rows will run parallel with the field ditches, and the furrows between the rows will collect the surface water in times of heavy rains. Provision must be made for leading the water from these furrows into the side drains. This can be done by shallow furrows or surface ditches, across the plot, at frequent intervals. These need not be deep enough to interfere with the cultivation, but must be kept open at all times.

Commercial Fertilizer.

It is the opinion of the writer that no commercial fertilizer will be required on this land. Experience will, however, finally determine the matter.

Harvesting.

Cutting, stripping and delivering the cane to the sugar mill is an arduous task on a sugar plantation. When one considers there may be thirty to forty tons of cane per acre; that it may be badly blown down and tangled; that each stalk must be cut separately; the heavy cost of harvesting becomes apparent. Each sugar-producing country has its own method (best suited to its conditions) for doing this work. In the Everglades I think the method best suited will be similar to that used in Louisiana. Each stalk of cane will be cut by hand flush with the ground, stripped of its leaves and topped at the proper joint. Three or four rows may be thrown together in small piles, of 100 to 200 stalks. These piles can be gathered by hand labor and placed in cane cars on a portable track alongside the piles of cane. These cars can be handled by a hoisting engine and a wire rope, leading to barges holding forty to sixty tons in the collecting canals. The cars can be unloaded by means of a derrick and grapple. It will probably cost a little more per ton to handle cane in the Everglades than it does in Louisiana, where the ground is firm enough to use mechanical cane loaders and carts.

Life of Sugar Cane.

In Louisiana they have found, from experience, that it is necessary to dig up the stubble, every two or three years and re-plant the field to maintain a good crop and a profitable yield.

In Cuba, owing to the mild climate, cane grows six to ten years without re-planting. In the Everglades it will probably produce a good yield six to eight years from one planting. This saving, in seed cane and labor is a very important item.

Cost of Growing Cane.

In the absence of actual experience, I think the following may be taken as a conservative estimate of the cost of preparing the land, cost of seed cane, planting, cultivating and harvesting, first and second years cane crop in the Everglades. After the first year, the cost of preparing the land and the cost of seed cane will be largely eliminated, as the cane will continue to reproduce from the rattoons for a number of years. The cultivation after the first year will be more expensive, as some hand labor will be required, while the plant is young and tender:

ESTIMATED COST OF GROWING SUGAR CANE ON A LARGE PLANTATION IN THE EVERGLADES.

STATEMENT FIRST YEAR.

Breaking land with tractor and gang plows	$ 1.00	per	acre
Pulverizing and bedding with tractor	1.50	"	"
Seed cane, 5 tons at 6.00 per ton	30.00	"	"
Distributing and planting seed cane	5.00	"	"
Three cultivations with tractor and gangs	3.00	"	"
One cultivation with hand tools	2.00	"	"
Care of ditches and quarter drains	.50	"	"
Total cost of production	$43.00	"	"
Conservative yield 35 tons per acre:			
Cutting, stripping and loading at 80 cents per ton	$28.00		
Total cost of crop	$71.00		

Value of 35 tons at $3.00 per ton	$105.00
Less cost of production	71.00
Net profit first year	$ 34.00

STATEMENT SECOND YEAR.

Off-barring and scraping stubble	$ 3.00	per acre
Five cultivations with tractor	5.00	" "
One cultivation with hand tools	2.00	" "
Care of ditches and quarter drains	1.00	" "
Total cost of production	$11.00	

Conservative yield 35 tons per acre.

Cutting, stripping and loading:		
Thirty-five tons at 80 cents per ton	$ 28.00	per acre
Total cost of crop	$ 39.00	" "
Value of thirty-five tons at $3.00 per ton	$105.00	
Less cost of production	39.00	
Net profit second year	$ 66.00	

For the third and subsequent years the cost of production will be about the same as that for the second year.

In the foregoing estimate of the cost of growing cane in the Everglades no account has been taken of interest on investment on the depreciation of the equipment required for running the plantation. The figures are intended merely to show the probable cost of growing sugar cane under favorable conditions and delivering it to a central factory.

The personal supervision and degree of intelligence exercised in the management of any business has much to do with the cost of operation. This is particularly true of farming. Judgment in preparing the land, selecting the seed and methods of cultivation often have more to do with the harvest than the character

of the land. Some planters have grown rich in Louisiana growing cane, while others have failed on similar land. The same thing is likely to happen in the Everglades. Unless the land is properly drained and advanced methods of cultivation employed the crop undertaken is likely to be failure, and sugar cane will be no exception to the rule.

From the small patches of cane, I have observed growing around the margin of the Everglades and throughout South Florida, I am fully convinced that with proper methods of culture enormous yields can be secured. In the estimate given, thirty-five tons per acre were taken as a probable yield. This I regard as very conservative. If the soil is put in proper tilth and a good stand of cane is secured and irrigation practiced when needed, I see no reason why the yield may not be forty-five to fifty tons per acre.

I have secured from a reliable source the cost of growing cane by one of the most successful planters in Louisiana, which is as follows.

Preparation of the land	$ 1.80	per	acre
Fertilizer and applying same	6.30	"	"
Cane for seed	15.00	"	"
Planting seed cane	6.00	"	"
Cultivation	9.35	"	"
Total cost of first year's crop	$ 38.45	"	"

In Louisiana the land is re-seeded once in two years, the rotation being: First year, plant cane; second year, stubble cane; third year, corn and cowpeas. The yield of plant cane will

average twenty-five to thirty tons per acre; stubble cane, eighteen to twenty-two tons per acre. The cost of cutting, stripping and hauling cane, under favorable conditions, is estimated at 70 cents per ton. It requires two good mules to properly cultivate twenty acres of cane.

The Cuban Department of Agriculture has issued a bulletin, dated March 9, 1912, in which is given the following data as to the cost of growing cane in Cuba:

Preparation of land	$10.45	to	$22.10	per	acre
Cost of planting (including seed)	10.50	to	13.80	"	"
Cost of cultivation	10.55	to	12.60	"	"
Total cost of production	$31.50	to	$48.50	"	"

The cost of hauling and delivering to the mill is given as follows

Cutting and loading	$12.75	to	$18.00	per	acre
Hauling to mill	9.00	to	18.00	"	"
Total harvesting	$21.75	to	$36.00	"	"

This bulletin says: "Good land in Cuba often yields thirty to thirty-five tons of cane per acre. If irrigation is available, and intense cultivation is employed, it is possible to raise the production to fifty to sixty tons per acre."

Marketing and Manufacturing.

After a cane crop is grown it must be marketed in the field or converted into syrup or sugar. Throughout Florida and Georgia, where small areas of cane are grown, it is

A MODERN SUGAR FACTORY.

usually ground in a small mill in the neighborhood and converted into syrup.

In Louisiana, before the war, most of the cane grown was ground on the plantation and made into yellow sugar. Experience has demonstrated this practice is wasteful. A small mill, costing but a few hundred dollars, will extract from forty to sixty per cent. of the juice from the cane, while a heavy, modern mill will extract ninety to ninety-six per cent. at a much less cost per ton of cane ground. Improved methods of converting the juice into sugar are too expensive to install in a small factory. It is also much more profitable to manufacture a high grade of sugar than cheap sugar or syrup. Because of these facts practically all the cane grown in Louisiana, Cuba and the Hawaiian Islands is now ground at Central Factories and made into a high grade of sugar.

Where a plantation is large enough to justify the initial cost, it builds and operates its own factory for grinding the cane grown on the place. For the accommodation of the numerous small planters in a given section, central factories are built, which purchase the cane, within reach, at a fixed price per ton, direct from the grower. In this way the planter gets a fair price for his cane, and the manufacturer makes a profit because of the efficiency and superior advantages of his factory. In most places the price paid per ton for cane is determined each week, by the market price of sugar and the per cent of sucrose in the cane that week. A similar arrangement can be made in the Everglades. To encourage cane growing a large plan-

tation—2,000 to 4,000 acres in cultivation—should be established to furnish seed cane to small planters and provide a reasonable supply of cane for the factory throughout the grinding season.

The sugar mill should have ample capacity to grind all the cane raised on the plantation, and also be able to purchase and grind all the cane raised on the smaller farms near by. Such an arrangement will make it possible for the owners of small tracts to grow sugar cane as a profitable staple crop.

Although sugar cane may not yield as large a return per acre as some vegetables that are now grown, it is practically a sure crop. Where the conditions are at all favorable a total failure of a cane crop is unknown. With adequate provisions for controlling the water the growing of sugar cane in the Everglades is less hazardous than any other branch of agriculture. It is probably more free from disease than any other staple crop produced in the Uinted States. It requires no special skill in planting and cultivation; it can be harvested any time from December to May; it will produce a profitable crop for five to eight years without replanting. In fact, sugar cane is the ideal staple crop to be grown in the Everglades.

Supply and Consumption.

There is no probability that the supply of sugar produced in the United States will ever exceed the demand for home consumption. The

SUGAR CANE ON FELLSMERE FARMS.

annual consumption of sugar per capita in this country is steadily increasing. In 1870 it was 32.7 pounds; in 1880, 39.5 pounds; in 1890, 50.7 pounds; in 1900, 58.9 pounds, and in 1910, 79.9 pounds.

The total consumption in the United States, in 1910 (according to the report of Willett & Gray) was 3,405,204 tons. Of this amount (including both cane and beet sugar) 824,574 tons, or less than one-fourth, was produced in the United States. The deficiency was supplied by importing from Hawaii 489,974 tons; from Porto Rico 285,128 tons; from the Philippines 171,112 tons; making a total of 946,214 tons from our insular possessions, on which no duty was collected. We imported 1,431,888 tons from Cuba, with twenty per cent reduction from the full tariff rates. From other countries were imported 202,536 tons, at full tariff rates, making the total importation for the year 2,580,630 tons. This enormous importation should be produced in the United States. It would require only about 800,000 acres of the best Everglade land, if properly cultivated, to supply this deficiency.

Value to the State.

There are at least 2,000,000 acres of land in the Everglades and adjacent thereto that are especially adapted to the growth of sugar cane. Most of this land is now non-productive, yielding no revenue either to its owner or to the State.

This land can be cleared and prepared for

planting at a cost of $8.00 to $20.00 per acre. If this were done, and the land planted in sugar cane and properly cultivated, the average yield would not likely be less than thirty tons per acre. Many persons who have studied the subject, place the yield much higher—forty to fifty tons per acre.

With an average of thirty tons per acre, the yield from this area would be 60,000,000 tons of cane per annum, which, at $3.00 per ton (a very low price), would amount to the enormous sum of $180,000,000.00 per year This is almost as much as the assessed value of all the property in the State at the present time. It is more than twenty times the value of the largest citrus crop ever grown in the State.

These figures may seem incredible, yet they are susceptible of actual demonstration and proof. There are numerous small patches of cane now growing in South Florida, under adverse conditions, that will make more than thirty tons per acre. It is easy for any one interested to prove this statement, by selecting a small area, measuring the ground, and weighing the cane. In December or January, when the cane is mature, samples can be selected and analyzed, and the actual sugar content definitely ascertained. This will be found to be worth more than three dollars per ton, after deducting a reasonable price for grinding and manufacturing. Such an examination and test can be readily made, and it is worth a great deal more, in determining the value and possibilities of Everglade land, than the opinion of

any expert agriculturist or soil physicist, in the country.

When this land shall have been reclaimed, and utilized for the production of sugar, South Florida will no longer be spoken of as the "rich man's winter playground," but it will actually become the greatest wealth-producing section of the United States.