CHAPTER II

THE DISCUSSION

Introductory

It is easily recognized that climate and soil are the first factors having to do with the Sugar Industry. It is also accepted that man may not change these materially. He can, and does, so operate as to take advantage of opportunity to conserve his natural resources, or even to build back that which he had lost; but fundamentally he cannot modify the weather, nor materially change the basic soil. These two will be given first consideration in this study, and after that, we will look into those things which the Sugar Planters have done in using their lands. We will discuss their soil treatment and its preparation, what methods of rotation they have used, what variety of cane they have found best, and what methods of cultivation and fertilization have been practiced. All of these have had their effect, either for good or for bad, in the development of the industry and its final outcome. It will be my aim to point out both the good and the bad, to show their influence, and if it is possible, how advantage can be taken of the recorded facts as found in the literature to lift the industry to a higher plane of prosperity, based on a sounder principle, and founded on historic facts.

The Weather

It is by no means unusual to find that, in the times of low yields, planters are liable to come to the conclusion that the seasons are changing. This thing has no doubt happened in the case of all farmers, and the Louisiana Sugar planter is no exception. Examination of weather records has shown that climate makes no rapid changes from the natural condition. There are seasonal variations that are in some cases sufficient to influence crop production to a marked degree. In the case of a crop like sugar cane, which is by nature a tropical plant, seasonal variations, when it is grown in a sub-tropical country, may have a considerable influence on the yearly outcome. Dr. W. C. Stubbs[1] made a careful study of the seasonal influence of the weather on the growth and maturity of sugar cane in Louisiana. His material was limited, but his conclusions are clear and definite, and have been accepted by the best students of sugar cane as a standard for sub-tropical conditions. His conclusions are: "Taking the table and the seasons, we find that a dry, warm winter, followed by a moderately dry spring, and this, in turn, followed by a hot, wet summer, are conditions favorable to a maximum growth of cane. It seems too that a dry, cool autumn, beginning early in September, is necessary to produce a larger sugar content."

"After the cane is laid by, frequent showers of considerable intensity appear highly beneficial, and if not sup-

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[1] The Sugar Cane, by W. C. Stubbs, Page 41. (1897).

plied, the crop will not reach the maximum tonnage."

In 1926, W. F. McDonald[1], Assistant Meteorologist of the United States Weather Bureau, located in New Orleans, published an elaborate study on this subject. His material was much more abundant than that of Stubbs, and while he agreed with the conclusions drawn by Stubbs, he went further and showed that several weather factors are of considerable importance in the production of sugar cane in Louisiana.

McDonald concludes that a spread of almost 8 degrees between the favorable warm March and the mean of the unfavorable cold March of a low yield year is of marked importance in determining sugar cane yields. He further shows that the high yield secured between the years 1895 through 1909, as compared to the lesser yield during the years 1910 through 1924, are traceable to the dry July to January, followed by warm March weather, during the former years, as compared with wet July to January, and cold March, during the later years. This author states that a dry summer and fall, where lack of rain is not of drought intensity, is of great benefit to the crop of the following year. He also believes that over an average length of time that the probable loss during the harvest time from freezing weather is less than the "Greatly diminished returns due to late Spring frosts which shortens the growing season."

In 1927, C. W. Edgerton and E. C. Tims[2] published

[1] A Study of Weather Influences on Sugar Cane Production in Louisiana. Reprint from the Planter and Sugar Manufacturer May 29, 1926. July 17, 1926, Inclusive.

[2] C. W. Edgerton and E. C. Tims. Louisiana Bulletin No. 197.

a bulletin in which they make some studies on the influence of the weather on sugar cane production in Louisiana. Their findings are largely in line with those of McDonald. They found that a wet winter, rainfall more than 15 inches during January, February, and March, is conducive to stubble deterioration and consequently a low yield of cane per acre during the following Fall.

The Soil

The first sugar cane planted in Louisiana was on lands now a part of the City of New Orleans. The growing of cane spread from there, first down the river to what is known as "The Lower Coast", and next, up the river from that City to the "Upper Coast". Gradually the sugar plantations found their way along the bayous and ridges wherever land was most accessible and easiest to bring into a state of cultivation. By 1845 (Article 2) sugar cane was cultivated and made into sugar in nineteen parishes of South Louisiana and was bidding fair to extend into adjoining territory.

In the earlier writings, lands are classified according to their location with reference to the streams. "Front lands" were found on or near the rivers or bayous, and "Back lands" were those away from such streams. A little later in the history of the sugar belt, we find that two other terms become common. At that time, planters be-

gan to use the heavier types more generally, and to distinguish between the clay soils, or "Black lands", and the lighter sandy or silty loam soils, which they called "Light or Sand Lands". This nomenclature is quite common today, and is in fact all that is known to the overseer or even the owner of many of the plantations today. In all the expressions found so far, we know but one in which the author seems to express a preference for the heavy land. In Article 1, if we understand the writing, one man seemed to lean toward the strong or compact soil. It is but natural that, with an abundance of land to pick from that planters very early leanred to select the more easily worked soils, and that they left the heavy soils to be cleaned at a later day. After the establishment of the United States Department of Agriculture, soil surveys of different parishes were made. These, however, were made sporadically and have never been completed to the extent where the work could be put together in an orderly manner to show the extent or the location of the soil types within the sugar belt. Although this work is as yet incomplete, it has furnished a great deal of information as to the nature of the soils found in the regions and their proper classification.

In 1929, the Louisiana Sugar Experiment Station, in cooperation with the United States Bureau of Chemistry and soils began the work of making a reconnoissance survey of the Sugar District of South Louisiana. The result of this work has been published in a station bulletin[1]. From it we

[1] A. M. O'Neal and S. J. Breaux, Soil Fertility Investigations Sugar District of Louisiana. Bulletin 222. 1930.

learn that the cane soils of Louisiana can be generally classed as: Mississippi Alluvial First Bottom Soil, Mississippi Alluvial Terrace Soil, Red River Sediments, Mississippi-Red River Sediments, and Coastal Prairie Sediments.

Each of these main soil types is divided into two series. The Mississippi Alluvial First Bottom Soils are divided into the Yazoo Series, and the Sharkey Series. Mississippi Alluvial Terrace Soils are divided into the Lintonia Series and the Olivier Series. The Red River Sediments are divided into the Yahola Series, and the Miller Series. The Mississippi Red River Sediments are divided into the Pharr Series and the Franklin Series. The Coastal Prairie Soils are divided into the Crowley Series and the Lake Charles Series.

This work has proven to be of great help and will be discussed later in this thesis.

Drainage

With the lands of this district lying chiefly along the water ways, it is not to be wondered at that the pioneer planters came to appreciate the necessity of good drainage. Manual Andry, (Article 1) 1830, is specific in laying out a drainage system which is very much in line with that found on the plantations of today. F. Henderson, writing from the German Coast, in that same reference, is even more specific in his instruction that the ditching be done in such

a manner that the cane will be two to three feet above the level of the water in the ditches. Just fourteen years later we find a "planter" (Article 6) saying that ditches should not be more than a half acre apart, and of a depth not less than three feet. In this same year, R. A. Wilkinson (Article 7) adds to our information in regard to the system of ditching which is necessary in this section. Wilkinson not only believes that every plantation should have a front ditch, which was no doubt intended to catch seepage water from the streams, but he thinks that this front ditch should be connected by panel ditches running straight back to a canal which is surely at the back of the plantation. His description is so like some of the modern plantation drainage systems that we can find but one difference. His cross ditches which were to take the water from the rows of cane to the panel ditches, unlike the small drains of Manuel Andre, or the quarter drains of today, are truly small ditches of a permanent nature.

R. A. Wilkinson in his article written in 1847 is the first we find to make mention of the drainage machine. He gives no description of his machine, but it no doubt was of the old horse-driven type which is spoken of in an Editorial (Article 60). In this editorial we find a good idea of the development of the drainage machine used in Louisiana. The Menge pump is still the most popular, as well as one of the most economic, to be found on a plantation today. Except

for those plantations located on reclaimed marsh land, which are often below sea level, we do not often find the expensive rotary or centrifugal pumps. Where great volumes of water are to be handled in a short while, these are undoubtedly the most efficient, but their first cost makes them unpopular for ordinary drainage work.

With the exception that in many cases the cross ditches of old have been done away with, and that planters depend upon the panel ditch to take excess water off of the land and carry it back to the canal, the modern drainage system differs but little from thatof 1830. The distance between ditches varies with the elevation of the land. In the extreme southern part of the State, it is not uncommon to find a ditch for every fifty feet of width in the field. Further up the river this distance widens out to a hundred feet, and in the vicinity of Baton Rouge, the general practice is to place the ditches at one hundred and fifty feet. If we investigate the point on up into the cotton territory, Tensas Parish and up, we find that the distance between panel ditches becomes very wide. The effect of this lack of ditches can be easily seen by noting the run-off there, and down in the sugar cane territory. In the cotton parishes after heavy rains, the fields flood to such an extent that they may even given the appearance of lakes. In the sugar parishes necessity has driven the planters to provide sufficient drainage to prevent flooding, for his seed cane is in the field twelve months in the year and must be protected.

With such a high percentage of land in ditches, the Louisiana sugar planter was easily interested in tile drainage. In 1890-91 a great deal of interest was shown in this mode of drainage, and a number of plantations went in for it. Armant Plantation in St. James Parish so drained a large acreage, and much good was expected from it. The Sugar Experiment Station at Audubon Park put in some experimental plats. For a few years, increased yields of cane was secured from the tiled lands, and it was found that the canes planted there germinated earlier and were able to withstand more cold during the harvest season, or in other words the soil was warmer. All of this tile was emptied into canals in such a manner that the mouth of the main tile flooded at times of heavy rain. Stopping the mouth of the tile, of course, stopped the flow within and allowed silt to settle out. In three years so much silt had settled out that the tiles were choked, and ceased to flow. The United States Department of Agriculture has located a project on Southdown Plantation, near Houma, to study the effect of tile drainage when the mouth of the tile is under a pump to keep up the flow continuously. This work is now underway for the third year, and the tiles at ordinary depth are reported to be working satisfactorily. Some tiles which were placed at a great depth are filling up. Should the tiles in use here continue to function satisfactorily and the project prove a success, this work may be the means of bringing about great changes in the general practice of growing cane. More of the land can be planted to cane, a longer growing season secured, and improved implements put in-

to use.

Land Preparation

So far as the author knows, no experiments have ever been conducted to determine the effect of the depth of plowing during the preparation of the soil on the yield of cane. Early in the history of the industry, it seems to have been accepted as a fact that deep plowing is an essential factor in cane production, but no one seems to have run actual tests for the purpose of measuring the effect. Some opportunity has by chance been presented through which we can observe the effect of shallow plowing on cane yields. Observation on the matter has always borne out the fact that our pioneer planters were sound in their judgment, when they established the practice of plowing the land deeply. Andre in 1830 (Article 1) states, "The ground is plowed as deeply as possible and harrowed." DeBow's Review (Article 4) in 1847 says that land should be plowed deep. Stubbs[1] gives several reasons along with explicit directions for plowing the soil. These and many more writers agree that it is necessary for the planter to thoroughly break land on which he hopes to grow cane.

From early times, it became common practice to flat break land with four-, six-, or eight-mule plows, depending upon the texture and physical condition of the particular soil. It was customary to begin plowing half way between the ditches, and to throw the soil always toward the center. This was done

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[1] W. C. Stubbs. The Sugar Cane. Page 57. 1897.

in order to bring about a ridged condition of the land within a cut, to assist in running off surface water to the ditches. In 1878 M. A. Montejo (Article 22) said, "The Louisiana Planter may be said to have, as a general rule, a great deal of land but to lack laborers. He has but little capital and still less credit to enable him to put this to good use." This condition has periodically become chronic with the sugar planters, and on account of it, they have abandoned some of their best practices. Today, because economy has led them to discontinue the flat breaking of their lands, we can find plantations where the ditches, once well placed, are now on the highest parts of the field, and it is almost impossible to get the water out of the center of the cuts into the ditch. This thing played a good part in the great decline which started about 1906 and continued until about 1922.

Some of the economies forced upon the planter of today by the depression have been for his good. They enable him to discontinue some of the unnecessary expenses, which were the outcome of a natural development under easy circumstances. Whenever changes have been the means of bringing about faulty work, the planter has had to pay dearly for his savings. Shallow preparation of the land, particularly the black lands, is one of the costly experiences. Such work has always been followed, not only be expensive cultivation, but by poor cultivation, and that in turn by short crops. The result of the two have been clearly reflected in the low yields of cane per acre secured since 1929.

Rotation

For a considerable time after the beginning of the planting of sugar cane in Louisiana, no attention was paid to the rotation of crops. The soils were virgin and extremely fertile. Many times in the literature, we find writings that indicate that excessive fertility was a problem. Canes made rank growth and failed to mature to a satisfactory degree until the soil had been partially exhausted. Under such conditions it is by no means surprising that no thought was given to means of maintaining fertility. On the other hand it is more of a surprise to find that this rich soil after twenty-five years (Article 6) of use had become so non-productive that all effort to make it produce was of no avail.

Cane Trash

When this condition arose, if we judge the writings correctly, the planter's efforts toward re-building the fertility of his partially exhausted soils were directed toward the use of cane tops as green manure. R. A. Wilkinson (Article 7) wrote in 1887 that an opinion was gaining ground that the cane trash was sufficient to keep the lands up. He states that cane trash can be so used on old lands, but immediately follows that statement with one to the effect that he had conducted parallel tests, with and without trash, and could "see no difference whatever." In this same article Wilkinson writes that the use of cane trash had been abandoned on an ad-

joining plantation in favor of deep plowing and the growing of cow peas. The idea of using cane trash as a soil builder did not die with Wilkinson, but continued to crop up from time to time, and in fact is still with us. Stubbs[1] wrote that for every ton of cane delivered to the mill, there is a saving of 1.9 pounds of nitrogen by burying the trash. If the trash from a twenty ton crop of cane were to be buried instead of burned there would be saved 38 pounds of nitrogen. This is two pounds more than is recommended by the Louisiana Sugar Experiment Station to be applied to a crop of average stubble cane. The fertilizer bill on a modern plantation is no small item, and for that reason alone we can well understand why men from time to time have attempted to utilize this material, which after harvest, is already on the land. The writer observed that wherever cane trash was buried shallowly, and kept moist it would decay sufficiently to cause no serious mechanical trouble in the cultivation. With this in mind in 1914, he put down tests in which the trash was covered with just sufficient soil to hold it down. Covered in this manner the trash had free access to air and at the same time kept moist in any ordinary winter. Decomposition took place satisfactorily, except in winters when rainfall was far below normal. The work was continued at Audubon Park for nine years, and then run at the Experiment Station at the University for four years. Under this condition trash was apparently of neutral effect on the crop immediately following. The

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[1] W. C. Stubbs. Sugar Cane. Page 87. 1897.

crops following in the second year showed some increase but not sufficient to justify the work required in carrying out the necessary operations. Feeling that further investigations might develop a means of using this valuable waste product, the problem was turned over to the Bacteriologist, W. L. Owen,[1] who began the work and it was continued by M. B. Sturgis[2]. The findings from this investigation were to the effect that cane trash is a material which has a high carbon-nitrogen ratio, requiring additional nitrogen before it can be decomposed by the organism in the soil. Such being the case, if cane trash should be turned into the soil and no nitrogen added, nitrogen from the soil would be used up by the organisms which were at work on it. This resulted in so-called nitrogen competition, and is the true explanation why, in the work done before their investigations, no marked benefit from the buried trash had been secured. They further showed that in the due course of time this nitrogen from the soil, as well as that from the cane trash which was locked up within the bodies of the microorganism, would become available to growing plants. Sturgis found that in addition to the effect on the soil nitrogen, the decomposition of cane trash within the soil would render phosphate available to the growing plant. In order

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[1] Owen, W. L. and Denson, W. P. The Effect of Plowing Under Cane Trash Upon the Available Nitrogen of the Soil. Zentr. fur Bakt. etc. 11, 82: 174-199. 1930.

[2] Sturgis, M. B. The Effect of Nitrogen on the Decomposition of Sugar Cane Trash Under Field Conditions. Journal of the American Soc. Agron. Vol. 24, No. 9: 690. 1932.

to take advantage of their work it would be necessary to first chop up the trash and work it into the upper strata of the soil, apply some additional nitrogen and give it sufficient time to decompose. At the present time there is no machine which will satisfactorily chop the trash as it is left in the cane fields. A manufacturer has become interested and has done some work on a machine. Should one of moderate cost be perfected, we may yet utilize cane trash as a source of plant food, and save a great part of the money now going into the purchase of commercial nitrogen for the cane crops.

Cow Peas

Early in the history of cane growing, legumes became of importance in the cane rotation. Apparently they were valued for their use as food for the slaves. F. Henderson, 1830, (Article 1) says in discussing the acreage on a 750 acre plantation, that 250 acres would be planted in corn or beans and further, that, "The corn and beans are given to the slaves and are not sufficient for them one year in ten."

It was not long, however, before this valuable class of crops was appreciated for its real worth, that of soil building. Wilkinson (Article 7) wrote in 1847, "We formerly failed in making this land produce when I lived there by planting peas with corn; it was of some service, but cannot bring up exhausted lands. Peas were then tried for two years without the corn, and that was all well turned in -- and the result

has been perfectly satisfactory."

The results reported in Wilkinson's writings do not seem to have fallen on fertile soil, for just nine years later we find another record (Article 17) in which the author complains of the short crop, and the gradual change for several years past, from sugar cane to cotton. He suggests that, "In accounting for the decline in the production for years past, it is probable that it may be in some degree (possibly a very important one) attributed to the deterioration of the plant from the partial exhaustion of the peculiar qualities of the soil necessary for its sustenance." At this time we find the planters at the cross roads, truly seeking for information that will tell them what fork to take. Like their fellowmen the world over, they failed to see the value of what they had, and finally found what they most desired, some magic, which, if added to their soil would restore its productive power. Wilkinson had recorded for their benefit in very clear terms the value of soil building effort, but they chose to follow Frank Lapiee and Victor T. Forestall, (Article 13). No doubt many of them joined Forestall in the belief that, "with Guano, I feel confident, no rotation of crops is required to produce the finest and heaviest canes in Louisiana."

As a whole the planters did not follow Forestall long, for in 1888, W.W. Pugh, of Ascension (Article 23) points out that the cow pea is almost universally employed after two crops of cane have been taken off. Almost immediately after that statement, he says further that all the lands needed before the war, was to have a crop of cow peas grown between planting of cane, but that due to abuse and the rundown con-

dition of the soil during the war period, thinking men had turned to the use of fertilizers for both cane and corn. Five years later, Miss Kate Minor (Article 32) says that one-third of the land is planted to corn and cow peas, and that while the growing of the pea crop is of great advantage to the soil, when the crop is turned under in August, it is of greater value still.

So far the planters seem to have been content with observations and general returns, and to have had no very accurate measurement of the productive return from cow peas in a rotation. Stubbs[1] conducted carefully planned experiments so designed that they would give the value of the cow pea crop when turned under as compared to one grown on the land, but cut off for hay. That Bulletin shows an average increase of 7.42 tons of cane per acre, extending through the plant and stubble in favor of cow peas turned under over cow peas cut for hay. In 1915, the author, (Article 63) published records running from 1898 through 1905. The average difference as shown was 3.37 tons of cane in favor of the cow peas turned under.

In spite of the observations, the investigations, and the writing on this subject, it continued to live, and in 1918 we find the Louisiana planters giving it their earnest consideration. From that year on through 1923, their association had a committee studying the problem and reporting to them annually, on "Agricultural Progress". In 1918, (Article 64), Krumbharr, Billeaud and Morse report that they have found

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[1] Stubbs, W. C. Louisiana Bulletin No. 28. Sec. Series. 1893.

little progress has been made in soil maintenance, and that the yields of cane are falling off and that in general the planters are trying to meet the situation by successioning cane, a practice which causes a wasteful use of fertilizer, and is a forgetfulness of the fundamentals of soil fertility maintenance. They did find that some planters have turned to a four-year rotation including two years of cow peas, and that where this rotation is practised, as much cane is raised on fifty per cent of the land as was formerly raised under the old three-year rotation using sixty-six and two-thirds per cent of the land in cane. Seventy-one years have passed since Wilkinson published his observation on the work of his neighbor, and it would seem that grim necessity has been required to revive a good practice. One year later (Article 65), Munson, Taggart and Supples reported to the Association as follows: "From reports reaching us, we are convinced that the great move to build up and keep the soil in the highest state of fertility is gaining many friends. The use of commercial fertilizers not being as popular as in years gone by, planters generally are using the soil building crops, and plowing them under on lands suitable to cane."

In 1920, (Article 66), the committee, Landry, Gouaux, and Comeaux, reports that as a rule the land planted to plant cane has been in peas, and that all or a portion of the peas have been turned under. The nitrogen from the peas is sufficient to grow a good crop of cane without the assistance of commercial fertilizer. This report is followed by one in

1923, (Article 70) rendered by Barrow, Wilkinson and Murrell, in which they report that one year of peas in a rotation, is insufficient to maintain yields of cane, and that two years is effective but expensive.

Soybeans

A real turning point in the history of sugar cane rotation was reached in 1925, (Article 71). Patout, Burguieres writes as follows: "My five years of experiment convince me that the soybean is the legume that my land is best adapted to." The pathologist of the experiment station had known for some years that the cow peas was doomed insofar as the Louisiana sugar plantation was concerned. A disease of the plant or a soil toxicity towards it had developed and success in its growth was becoming more and more difficult. As the cow peas failed, soil fertility decreased and cane production diminished. The Experiment Station was trying to meet the situation by substituting some other leguminous plant for the cow peas. In this work the Biloxi and the Otootan soybean were found even superior to the cow pea, and they were generally recommended as substitutes for the pea. The Agricultural workers at the Louisiana State University lead by W. R. Dodson put on an extensive campaign to push the soybean. Their information on the subject was sound, their efforts were untiring, and they found the planters in need. The work succeeded and there is no doubt that the soybean has been responsible for a good part of the upward swing in sugar pro-

duction in Louisiana since 1924.

Melilotus Indica

Another legume which has proven of great value in a cane rotation in Louisiana is Melilotus indica. The first reference to this plant in the literature used in this work is by Stubbs, who says that this plant was introduced into Louisiana by ships dumping dirt balast, containing the seed, along the river front in the vicinity of New Orleans. The next mention of it that we have found is given in Article No. 58. That article reports Melilotus as a pest on the sugar plantation. The author found it growing wild on the headland and ditch banks, and conceived the idea of using the plant in the winter and early spring months as a cover crop. The results of his efforts are given in a Louisiana Bulletin[1]. More than forty per cent increase of plant cane was secured by growing this plant as a winter cover crop. In that same bulletin, Walter Godchaux is reported to have gotten a 22 per cent increase in cane production at Raceland, Clark Liebermouth reported getting from four to five tons increase, and L. Murrel as saying, "Personally I believe that in three or four years all of our old lands will become new lands." Article 70 gives the findings of county agent Roemer in his work with Melilotus in Iberville Parish. He got 5.3 tons increase in some experimental tests. From this beginning, the use of Melilotus indica has spread all over the Mississippi and Red River First

[1] Taggart, W. G. Louisiana Bulletin No. 189. 1923.

Bottom Soils, and from there on into the cotton territory of North Louisiana.

Other Work on Rotation

In 1922 the Sugar Experiment Station was removed from Audubon Park in New Orleans to the University in Baton Rouge, and all of the plans for its investigations were revised or rewritten. At that time the trend of the sugar production in the State was distinctly downward. Two major difficulties were recognized. One of them was a cane disease situation and the other was a depleted soil situation. In order to meet the problems, a very elaborate series of experiments based on soil building effort was outlined and put into test. The main object of this work was; first, to devise practical means of building back soil fertility rapidly and economically; and second, to determine if it was possible to supply all the nitrogen required by the cane crops in a rotation from leguminous plants grown on the land within that rotation. In this work rotations were set up containing one summer legume, and others containing one summer legume and one winter cover crop. In another series, rotations were set up containing two summer legumes, and others two summer legumes and one winter cover crop. Nitrogenous fertilizer was used on parts of these rotations varying from a full ration (36 pounds of nitrogen per acre of land) down to no nitrogen at all. This work will have to run for a long period of time to give full

answers to all the questions asked, and the data secured should become valuable as time goes on. Progress has been made to the extent that we know now that thin, badly used river land can be brought back to maximum productivity by the turning under of two consecutively grown crops of Biloxi soybeans. Further, that after this condition has been attained, one crop of soybeans turned under in rotation, seems sufficient to maintain productivity. On such lands, a crop of soybeans grown on the land, even if it be cut off for hay, leaves enough nitrogen in the soil to supply the plant cane crop, but the deficiency will be reflected through the following two stubble crops, and even into the crop of corn which comes after the three years of cane. In these rotations during the past two years, we have not used economically more than one quarter to one half ration (36 pounds) of nitrogen per acre. Melilotus indica on fall plant cane can be made to supply the nitrogen needed in the first stubble and to show its residual effect on through the second stubble crop and even into the corn crop which follows.

Varieties

The next subject in sequence of practice is that of varieties of cane. If we should discuss these subjects in the order of their importance, varieties would be up for first consideration. As has been said before, the business of adapting a tropical plant to a sub-tropical climate is by no means

an easy job. During the history of the industry, nearly all the varieties of any importance anywhere in the world have at one time or other been imported into Louisiana and tried out one or more times. This work of importing varieties into the State was first done by the individual planters. The same work was continued on a large scale by the Sugar Experiment Station, and is now being carried on by the Office of Sugar Investigations of the United States Department of Agriculture. As is well known, the first cane to be of commercial use was the old Creole. It served its day and failed. In the failure of this variety, perhaps we find one of the greatest weaknesses of the general system of cane growing which has been common throughout the history of cane cultivation. Article 3 states that, "the smallest and poorest cane is saved for planting, it is necessary to put up 30-40 and sometimes 50 acres to plant 100 acres." Though the difficulty caused by the failure of the Creole cane was surmounted by the introduction of the Purple and the Striped canes, and the sugar industry grew at a rapid rate, all of the progress with its resulting prosperity did not save Louisiana planters from suffering the consequences in failing to heed the warning there was in the observation which was given in Article 3. Had they learned their lesson, many depressions might have been prevented and a more prosperous record would have been the result. The practice of planting the "smallest and poorest", has followed through the years and more than once

we find it recorded that this thing has caused harm. In 1885 (Article 55), we find complaint to the effect that seed cane is decaying in the ground; and while the evidence here indicates that this trouble is due to unseasonably cold, wet, winter weather, it well might be that diseased and weakened seed cane was at the bottom of the difficulty. In 1856, (Article 17) we find the suggestion that the absence from the soil of some peculiar mineral is responsible for the deterioration of the Purple and Striped canes. In 1872, (Article 21) the sugar planters are found arranging to send Mr. Lapice to Asia to search for better canes. In 1893, (Article 34) Thomas Edson is getting some results from his experiments in seed selection. In 1895, Stubbs[1] published his elaborate work on the selection and pedigreed planting of sugar cane. In 1897[1], the same author gives the reason why this question has remained unanswered. He says that cutting cane for seed early in the fall causes injury to the following crops, and further that plant cane should be windrowed, the effect of the plow on the stubbles in covering the cane is so detrimental to the stubble that it is usually lost. On account of this injury to the following crop, planters have as a rule, used the oldest stubble cane for planting. An exaggerated idea of the effect of this usage was clearly shown in the crop of 1921 and thereafter. In 1920 sugar was worth sixteen cents, and hence sugar cane was worth sixteen dollars a ton at the mill. To plant an acre of cane

[1]Stubbs, W. C. Louisiana Bulletin No. 38. 1895.

at that time at least four tons of cane were required. Under such conditions, it was but human that planters used all the scrappy cane, even that which had grown voluntarily in the corn fields for planting. The results was that the State was thoroughly stocked with the most diseased cane that it was possible to get together. The result of this unfortunate happening had much to do with the serious decline in production from that time on. Working with such material, Edgerton and Taggart[1] showed clearly that by selection this badly diseased cane could be made to produce normal cane.

If we remember that for a very long time the introduction of canes into this country was a free matter, and that any one so inclined was at liberty to bring canes here from any place, it will be easy to imagine how the diseases of the cane world would migrate to Louisiana. In fact, we congratulate ourselves that the three or four worst diseases known to attack the plant occur only in the Far East. Had they occurred in the West Indies for instance, we would have most assuredly had them here before now. As it is, we are almost surprised they have not crossed the Pacific to attack our crops. A number of cane diseases are accumulative in their effect, and for that reason the planters' practice of planting the smallest and poorest canes for so long a time has been responsible for many of their difficulties.

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[1] Edgerton, C. W. and Taggart, W. G. Tolerance and Resistance to the Sugar Cane Mosaic. Jour. Agr. Res. Vol. XXIX. No. 10: 501. 1925.

The discovery that sugar cane did produce viable seed and that canes could be crossed was of inestimable value to the entire sugar cane world. The use of this knowledge not only freed us from a dependency on the known varieties, but it enabled men to plan systematically a definite program of plant breeding aimed for a particular goal. The first benefit that Louisiana received from this work was through the D. 74 and D. 95 canes, two seedling canes from Demarara. The D. 74 became the most popular variety in this State, and more acreage was planted to it than to all the others combined. With the introduction of mosaic disease, the accumulation of other diseases through the use of poor seed cane, and a rundown condition of the soils, it failed as did all the other of the so-called noble type canes. When this occurred, had it not been for the breeding work of Java, the Louisiana Sugar Industry would no doubt have been doomed. The P.O.J. canes were finally brought through the Federal Horticultural Board Quarantine and established here. It is to these varieties that we owe our present chance for existence.

Realizing the necessity of breeding work, and also the inability of the Louisiana Sugar Experiment Station to import either cane or seed through the Federal Quarantine, Professor W. R. Dodson,with the aid of the Louisiana delegation in Congress, induced the United States Department of Agriculture to take up the work for us. That effort was the beginning of the activities of the Office of Sugar Investi-

gations' work in breeding cane for the southern states. Their work takes advantage particularly of the Java and the India breeding, and now we are getting cane varieties which have been especially bred for Louisiana, without the risk of importing a parasite from a foreign country. We are not satisfied with that safe guard, and every cane brought to the station field is watched very carefully by both the pathologist and the entomologist, to see that no new pest is allowed to enter our fields. Any cane that shows signs of weakness when attacked by those now prevalent in the state, is discarded before it can get into general planting. If the present program of work is kept up, and the sugar planters continue to support the scientist, there should never be another calamity like the one we have just gone through. The sugar business of Louisiana should within the next five years build back to where it was in 1904.

Fertilizers

Under the head of rotation, it has been pointed out that when the sugar planters became aware of the fact that their soil fertility was on the decline, they seemed to have met the situation, at least in part, through the use of legumes. Soon after Wilkinson told us that river soils of low productive power could be rebuilt, by the proper rotation with cow peas, we find that there was an interest developed in manures. Manures at that time consisted of animal refuse, and some form of farm compost. At the time, there was

an insufficient quantity of those materials to supply the demand of the sugar crop, and hence, there was no great change in the fertility program until Forestall and Lapiee (Article 13) did their work, which for the time was indeed a remarkably well-done piece of investigation. These two planters blazed a path which was to be trod by many of their followers. Through the use of guano (no doubt Bat guano) these men were able to more than double the yield of sugar per acre of cane. For that reason we can well imagine their work receiving more attention than did that of Wilkinson. Almost immediately we find that man, who has already been referred to, thinking that there was a peculiar element missing from the soil. Strange is it that he did not appreciate the fact that his colleague had discovered that in Bat guano they could supply the element. If this man and his brethren had been wise enough to use the soil building legume, along with the missing element which was supplied in guano, there would have been less work for those of us who followed to do for the sugar planter.

The use of commercial fertilizers seems to have become quite common, and with it the amount of sugar increased steadily. In 1889, Pugh (Article 23) tells us that the cane planter had learned of the good results gotten by the cotton growers from the use of cottonseed meal on both cotton and corn. They applied this knowledge to their advantage, and Pugh gives us information as to the time to apply the material to cane and what quantities he thinks is best

tion." He found that 48 pounds of nitrogen per acre was the maximum from which a Louisiana planter could hope to get returns, but that this ration should be cut down when the conditions of the soil were known to be good. As regards phosphoric acid and potash, his recommendations were to the effect that neither of these materials had any influence on the maturity of the cane, and that all of his work showed that the last named element was sufficiently supplied by the soil. Response was secured from an application as high as 36 pounds of available phosphoric acid per acre, but that higher dosages were of no commercial value. in 1890.

During the time that Stubbs was doing his work at Audubon Park, C. S. Townsend, who was in the employ of B. Lemann and Sons of Donaldsonville, was doing fertilizer experimental work on a plantation scale. The findings of this man are not only of interest but throw new light on the subject. The first point to be considered in studying this man's work is the fact that his soil seems to have been naturally in a productive condition. His yields from unfertilized plant cane was about 33 tons per acre, and from the stubble crops as high as 22 tons per acre. Under such conditions nitrogen applied alone was a detriment and on some of his plats he charged a loss as high as $10.00 to $15.00 an acre to the use of nitrogen. Quite opposite results were secured from the use of phosphoric acid. Under varying conditions he got variable results. In one case he reports a gain of

$19.35 per acre from the use of the material. Again he reports that on lands where nitrogen failed and where phosphoric acid paid, combinations of the two paid, but not as handsomely as did the phosphoric acid alone. He did not so interpret his work, but it would seem that on that rich land, no nitrogen at all was required; that the return where the combination of the two was of benefit, was the result of the difference between benefits from the use of phosphate less the harmful effect of the nitrogen. That thought might be called a theoretical one, but it seems to be a possible explanation. From a further study of Townsend's work, all of which is not included in the abstracts given under the Literature, it would seem to be that whenever he found his soil fertility declining, as measured by the yields of the check plats, nitrogenous fertilizers were profitable, but on lands where the check plats gave high yields of cane, the effect of added nitrogen was always seen in an increase yield in tons of cane of lower sucrose content. Another publication, which will bear out this thought, is found in Article 3 published three years after Townsend. In that article, Comeaux says that while some may contend that fertilizer produces green cane, it is useless to argue that we can do without the use of the material. Such differences of opinion are not due to faulty work nor to the methods used. Many times it has been found that soils under usage, change in their chemical composition and even in their physical condition. It is on account of

this well-established fact that soil investigation should be established on permanent plats, and conducted for indefinite periods of time without harmful changes in methods of procedure. Without it we are forced to establish new projects which result in so-called new discoveries, sometimes apparently contradictory to the older work. If such conditions are allowed to arise, they nearly always result in confusion, and often breed lack of confidence in investigational work of all kinds. A good example of this point is found in an article published by Agee, Article 57. He gives the results from certain plats at the Sugar Station for 1908 in comparison with a previous ten-year average from the same plats. The tables show increases at the time nearly twice as high as were the ten year average figures from the same plats. Had this been new work which had been just started by Agee, he would have no doubt come to the conclusion that the soils on account of their natural condition were deficient in nitrogen. Having the records back of his work for so many years, he knew the truth in the matter. The rotation practice was insufficient to maintain soil fertility under the cropping system in use. Again, if we will consult articles 61 and 68, we will find that Taggart, working at that same station, found for a number of years that the application of 72 pounds of phosphoric acid was giving highly beneficial returns on land which in Stubbs' time would yield to 36 pounds only. In this case, Taggart found that one rotation with the 72

pounds of nitrogen was sufficient to build back the deficiency and that, thereafter, for at least a while, heavier applications that had been recommended by Stubbs would be to no avail. This is a good picture of what happens to soils. Experimenters have found that soil is much more sensitive than is generally thought by the average man, and that the response from treatment, either good or bad, is reflected sometime through many years.

Under Rotation we have discussed the fact that in Louisiana within recent years it became necessary to change from the cow pea to the soybean. That change was responsible for a change in the fertilizer requirements of the sugar cane crop. The soybean is a more luxurious growing plant than is the cow pea, and it was but natural to expect this increased legume crop to lessen the nitrogen requirement of sugar cane which followed after it.

It was overlooked that there might also be a change in the mineral matter requirement. After the introduction of the soybean in our rotation system, the experimenters noticed a gradual change in the response to superphosphate when applied to sugar cane. The change which was seen in a lessening return from phosphate, continued until there was no return from phosphate fertilizers at all. Experiments conducted by the writer showed that while it was true that D. 74, one of the varieties of cane grown when phosphate was required, would respond to applications of phosphate under

conditions where a P.O.J. cane would not, there was a much larger amount of available phosphate in lands where soybeans had been grown than where cow peas had been grown. And much more phosphate available in lands where a crop of soybeans had been turned under than where a crop of cow peas had been similarly treated.

This subject is being thoroughly studied at the Louisiana Experiment Station at the present time. For the last two years cane growing in a rotation behind soybeans, which have been turned under, has not been able to use but one-half ration, (18 pounds)of nitrogen per acre at a profit, and no commercial mineral matter at all.

If this finding in regard to the response to phosphate was confined to the work at the Sugar Station, we would be inclined to doubt its accuracy, or to believe that it was a peculiarity of the particular soil. We have seen it happen in a number of places throughout the cane belt. A conspicious example is reported by A. K. Smith in a bulletin which will come out in the near future as Louisiana Bulletin No. 237. In that work Smith found that Yazoo Sandy Loam soil, which had been turned out to weeds for at least seven years, gave good response to phosphoric acid both in cases where it was applied alone and when in combination with nitrogenous material. On another place where the same soil type was in use, but where the soybeans had been grown and turned under for a number of years, phosphoric acid showed

no benefit at all. On a plantation near Lafayette, C. B. Gouaux[1] was able to get good response from applications of phosphate before the adoption of soybeans. Since they have become a part of the rotation there, A. M. O'Neal and S. J. Breaux[2] have failed to get any response at all.

The study of the fertilizer requirement of the sugar cane crop in Louisiana has been greatly broadened within the past few years. Now in cooperation with the Bureau of Chemistry and Soils, this station has an elaborate series of tests underway on the several soil types. If this work is continued for a long enough time, we will be able to recommend in specific terms just what fertilizer should be applied to cane on all the different soils in the belt.

Cultivation

The methods of cultivating cane in Louisiana have changed more than probably all of the other phases of sugar raising put together. From the very beginning, we can well imagine that since the planters abandoned those lessons taught them by the slaves, from the West Indies, who were imported by the Jesuit Priests for that purpose, they have truly allowed their imagination full sway. As a result, their methods for cultivation have changed with their fancy. Some of the changes which they inaugurated were not well founded, and though much money and time was spent on them, and in some instances

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[1] Gouaux, C. B. Mimeographed Report. 1928.

[2] O'Neal, A. M. and Breaux, S. J. La. Bulletin 222. 1931.

they lasted for quite a number of years, always such practices ultimately were abandoned. In other cases we find that good thought was expressed in the earliest writings, and that though some of the ideas which were put forth, even though basic in principal, were allowed to lag, or were worked on for a time and then dropped, to be taken up at a later date, and some of these have come through to our time to become problems for investigation by the Sugar Experiment Station. This lack of a definite policy, with reference to methods of cultivating cane, must have cost the industry millions of dollars before sufficient information was secured to bring about some stage of stability of procedure.

There are two of these old problems which well illustrate the situation; namely, the effect of root pruning and what constitutes a stand of cane. In looking into the first of these we find that as early as 1847 some planter writing in Article 3b says, "that barring the stubble too close of earth in the spring is an injurious practice, as the buds of young sprouts are mainly dependent on the moisture from the soil for the growth, until it puts forth roots of its own." Miss Kate Minor seems to have taken notice of this same idea. In 1893, Article 32, she says that it has been found that shaving and digging out of stubble late in April is far better than the old method. In Article 35, written by T. P. Hutchinson in the same year, he discusses the fact that with the older methods of cultivation too much

root pruning is effected, and that this is an injurious thing. T. Mann Cage, in Article 36, goes to the extreme by advising that cane be laid by when the roots are two inches long. Comeaux, writing in Article 44, 1899, says that deep plowing in July, which causes root pruning must stop. Caldwell in Article 51, written in 1902, says, "Do not cut roots". And a committee reporting to the Louisiana Sugar Planters Association in 1918, Article 64 is still found advising that the cutting of roots should be avoided. With this much positive recommendation on one subject, we would imagine that by now it should have had its effect. On the other hand if the recommendation had not been so regular in their appearance we might imagine that the advice of some of these leaders had been heeded, yet we find that Ryker and Edgerton[1] along with other facts, in 1931, are pointing out the same thing that was written in Article 3 of 1847.

With reference to what constitutes a stand of cane, we find that question cropping up one year earlier than the root pruning one. In 1846, Article 3, Judah P. Benjamine states that "crowding the cane causes it to not ripen". In 1893, Edson writes in Article 34 that the undue suckering of cane causes a waste of energy and results in a green cane at harvest time. Stubbs[2] working with planting of definite spacings, says that suckering is a definite function of cane, and that the difference he found in sucrose from the different

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[1] Ryker, T. C. and C. W. Edgerton. Louisiana Bulletin No. 223. 1931.

[2] Stubbs, W. C. Louisiana Bulletin No. 24, Page 810. 1894.

plantings was within the limit of experimental error. E. C. Simon, at the Sugar Experiment Station, has been working on this same problem during the past two years. He is inclined to believe like Judah P. Benjamine, that crowding cane causes it to not ripen. Probably nowhere within the literature do we find so much difference of opinion as that on the distance between rows. The diversity here shows up in Article 1, which was written in 1830, with rows three to four feet apart depending upon the age of the land. In Article 3a, 1846, we immediately jump to eight foot rows with three stalks in a row planted four inches apart, and in one year later, Article 3b, we meet with our standard row of today, the six-foot row. In that same year we find "A Planter" advocating the planting of two rows of cane and one row of corn in alternation, the reason being to let in plenty of sun light and air, thereby inducing maturity of the cane. This idea of light and air is one which was at the time world-wide, and for this same purpose, great pains were taken in some countries to strip the leaves off as the joints colored. It is comparatively recently that the theory has been wrecked and the practice discontinued. In 1847, Valcour Aime, Article 8, says: "An actual progress has been made, the most prominent one, however, consists in the placing the cane rows at a much greater distance from one another than was formerly done. By that means they can now do with the plow about three fourths of the weeding for which the hoe alone was heretofore put in requisition." And in 1848, Delavigne, Article 11, says that it is well to

give the cane more space, either placing the rows eight or nine feet apart or at six feet planting two rows of cane and one row of corn. This is to some extent reverting back to "A Planter". Delavigne, goes further and draws the philosophical conclusion that the less number of rows we have per acre the less rows of cane we have to cultivate. By 1865, according to Pugh, Article 24, we find that the cane rows had made two other changes. He says that a change has been made in the width of the cane row, for they have been altered from three and one-half, to five and one-half or six feet, and that the two-mule plow has been substituted for the one-mule plow between rows. In 1889, it is suggested by that same author, Article 25, that the change from the old Creole cane to the more vigorous Purple and Striped varieties was responsible for this widening of the rows. It is true that the changes seem to have begun to take place about the time of the introduction of these canes, but arguments to the effect that the substitution of two-mule plows for the one-mule plows seem to be more logical, and too, the next reference seems to dispute him, for in it, Miss Minor reverts to the four-foot row. Article 32, printed in 1893, by that author, reports four-foot rows, and the highest yields of sugar per acre than we have yet encountered. She reports that in 1893 nearly 3000 pounds of sugar were secured on her place and that as high as 7000 pounds resulted from the most favorable circumstances.

This difference of opinion as regards the proper width of rows was not in any way settled until after the establishment of the Sugar Experiment Station. Early in its history, Stubbs set up a set of experiments to establish definitely the most economic row for sugar cane in Louisiana. His results are reported in his book "Sugar Cane". On page 112 he says, "In almost every instance the narrower the row, the larger the yield of cane without injury to its sugar content or its purity. But while the increase in the very narrow rows has been quite apparent, the increments have hardly paid for the increased seed used in planting. For, it will be remembered that there is required twice as much cane to plant an acre in three-foot rows as six-foot rows." He finds that the five-foot row is the economic row to be used.

Planters found it somewhat difficult to work two mules between five-foot rows, and for their convenience, or probably to suit their fancy, the implement manufacturers have standardized all cane tools and wagons to fit a six-foot row. For that reason on nearly all the plantations of today, the question of width of rows is settled. It is and will be six feet.

We could take up every phase of the cultural practices and show that each and every one of them have gone through this same violent set of rapid changes. That, however, would not add to the value of our work, and we will now discuss the cultivation of sugar cane in its broader sense. In the beginning the cultivation of cane was a plow and hoe

business. Slave labor was abundant, for according to Article 1, there was one slave to every seven or eight acres. As long as the prices for sugar held up, and there was no competition from the outside world, this sort of farming was no doubt a remunerative business, but as other countries developed their sugar production, and prices began to drop, even slave labor and a protective tariff were insufficient to justify the continuance of so expansive a system of raising cane. The matter of expense seems to have registered rather early, for in Article 8, written by Valcour Aime in 1847, he tells us that by the use of plow the planters can save nearly three-fourths of the weeding formerly done by the hoe. Again, in Article 11, we find Delavigne saying in 1848, that the use of the plow had caused an economy in labor. This primitive form of culture was expensive, and to some of us today, it may even seem to have been amusing, but later in this work, we will try to show merit in it, which like so many other things in the sugar business was forgotten and had to be rediscovered.

The great turning point in the history of this crop, like that of everything else in the South, was the Civil War. After the War, the land owner found his slaves free, his lands grown up in brush and weeds, and his organization wrecked. He had to start over and devise a new system based on the new conditions, and it was here that the cultivation of sugar cane was revolutionized. No longer could our planters afford one man to every seven or eight acres. To avoid this he had to devise tools to take the place of slaves. Speaking of this

period, Pugh in Article 24, says about the reconstruction period; "We needed agricultural implements, which would transfer the labor heretofore performed by human beings to our muscular mules. This want has been supplied in part; we now use a stubble digger, which does its work effectually and neatly; a rotary hoe, which to a certain extent takes the place of a darkey and his hoe; a road machine, which not only saves a great deal of work, but makes a splendid road for those who use the highway for hauling heavy loads or for pleasant rides; also Nardelph's pea vine rake for hay; the plow of itself, nearly perfect and well adapted to the work required of it, has undergone little change." In 1890, Rost in Article 28, follows Pugh by pointing out that before the war, "The cane crop was, so to speak, a hoe crop, the cleaning and the weeding, and the covering and the digging all done with the hoe." He follows this statement by pointing out that the war changed all this practice and that the old method was followed by the use of the implements mentioned by Pugh. However, he goes further to say, "Within the last five years, two new factors have appeared in support of the Louisiana Sugar Industry; First, the establishment at Kenner, by voluntary subscription of a sugar experiment station and the selection as Director of that station, Professor W. C. Stubbs." The establishment of this institution and the selection of the able director had a great deal to do with the development of every phase of the sugar industry, but just at this time there was another powerful influence which should be recorded here.

The stubble shaver, the stubble digger, the plant cane scraper, the rotary hoe, the improved middle cultivator, the revolving harrow, the improved plow, and many other tools which helped to reestablish the sugar industry on a sound foundation were invented and introduced to the sugar planter by James Mallon. Even Stubbs was skeptical in regard to some of Mallon's tools and ideas, but that did not prevent him from becoming convinced that Mallon's thoughts were well founded, and when once coverted, Stubbs became a most ardent supporter of both the tools and the principals involved in the Mallon idea of cultivation. Each man was of assistance to the other, and the two working together did a great deal for the Louisiana Sugar industry.

This question of the best method of cultivating cane was one of the first problems which Dr. Stubbs undertook after the establishment of the sugar experiment station. In 1887, he published his first results of this work. As shown in Article 43, this publication consisted of the average of three years' work in comparing the effect of cultivating cane with a plow against cultivating cane with a cultivator. The result was nearly nine tons cane or over six hundred pounds of sugar per acre in favor of the cultivator. No good description of the cultivator which was used at that time is given, but the increase was so great that the Louisiana sugar planters requested Stubbs to elaborate on his experiment and continue it. Shortly after this, Mallon came out with his middle cultivator, and the use of it was embodied in the

cultural experiments which were conducted thereafter. The new outline of work consisted of five different methods of cultivation, as follows: First, all work done with a two-horse plow; second, middles with a two-horse plow and the ridges cultivated with a disc cultivator; third, the dirt returned to the cane with a two-horse plow and all subsequent cultivation done with the disc cultivator and the middle cultivator; fourth, the middles were turned out with a double-mould-board plow, and all subsequent cultivation done with the disc cultivator and the double-mould-board plow; fifth, the middles run out with the middle cultivator, and all subsequent cultivations done with the disc and the middle cultivator. The results of this work are reported on in Articles 45, 49, 49a, and 50. The two outstanding things which are shown here are that experiments three and five are unquestionably superior to one, two, or four. Further, that cane grown under experiment three is by average the richest cane in sugar which was raised in this series of experiments. If we analyze the work, we find that the more actual cultivation and the less plowing there was done during the cultivation period, the better yields of cane there were secured. To the contrary, the more plowing instead of cultivating there was done during the growing period, the smaller the yield of cane resulting. The difference between experiments three and five would seem to be small, indeed, and to the uninitiated so slight that no significant difference in yields could be expected. We who have experimented with the cultivation of cane have learned

that the system which is set up by that plan is about ideal to promote root development and steady growth. The fact that the sucrose test on cane experiment 5 is lower than that from experiment 3 is a strong indication in itself that cane growth was maintained later in the fall in that experiment.

The differences found in this set of tests are a fairly good representation of what happened during the changes from the hoe crop idea to the modern time. If we go back to Article 11, we find that the earlier planters went to great pains in causing his plow to duplicate as nearly the old hoe work as it was humanly possible to do. Every operation seems planned to protect the roots and to encourage root development. Later the articles written by Stubbs, Mallon, Pugh, Comeaux, and Cage all show that these men had the right principle in mind, and in fact, they stress the necessity of cultivation for the purpose of developing and retaining the root growth. Here is where the planter of today has lost sight of the best thought in the past. It is true that we of today have better tools to work with, but in this day of hustle and budget system, we have paid too much attention to cost and not enough to effect. The main difference in our work today and that of the best in the past is that we have forgotten that plants must have roots in order to grow, and we are ruthless in our practice of late cultivation. Mallon's plan called for cane to be laid by with a "lay-by machine", which consisted of two large disc set as far away from the cane as it was possible to get them. This tool took the soil

out of the middles and placed it on the row. We today run the cultivator gang up close to the cane, and according to Ryker's[1] finding, may thereby cut sixty per cent of the roots at a time when the plant needs to grow the fastest. The Agricultural Extension Department of the State University is at present making a drive, through the County Agent, to correct this costly defect in the modern day method of cultivating cane.

In spite of the fact that the sugar planters have not been thoughtful in regard to the effect of their implements, or probably careless in their use, the changes from the hoe to the plow and finally to the improved cultivator, has been responsible for the greatest economic saving than any other one thing that has to do with the field work. We have said that under the slavery system, one workman was required for every seven or eight acres. When the plow was substituted for a part of the hoe work, the labor requirements dropped to one man for about fifteen acres, and the change from the plow to the row cultivator has reduced this requirement to one man for twenty-five to thirty acres. The next great change in this direction will come through the adoption of the tractor. For many years now tractors have been used for a part of the work on the plantation. Development has been slow, because the Sugar Industry of Louisiana is limited and sufficient business has not been in sight to induce the manufacturers to build special equipment for the culture of cane. Progress is being made, and, in due course

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[1] Ryker, T. C. and C. W. Edgerton. Louisiana Bulletin No. 231. 1931.

of time, equipment will be developed whereby the tractor can take its place in the economic aspect of the Louisiana Sugar Industry.

There are other questions which have to do with the culture of sugar cane which have been discussed both pro and con for many years. Some of these deal with the scraper, the stubble digger, and the stubble shaver. At times the Louisiana Planters Association has set up as question for debate the use of these tools. The argument has been to shave or not to shave, to dig or not to dig, or to scrape or not to scrape. As regularly as the spring time comes, so do these questions. There has been a great deal of experimental evidence, which all shows that the answer to the question is found in the conditions of the cane at the particular time. Since winter conditions vary widely so do we find the condition of our seed cane or our stubbles to vary from season to season. This condition factor is one which every man has to take into consideration before deciding whether to use these labor saving tools or not. If they will do the desired work without injury to the seedpiece, then they should be used. On the other hand, if the winter weather has been very favorable, and when spring arrives, we find the cane in a growing condition, then these tools will do damage and should be left in the tool shed.