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By M. MAC LEAN.

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AGRICULTURAL.

SOME REMARKS ON THE MANUFACTURE OF MAIZE SUGAR.

By William Webb, of Wilmington Del.
(Published by the National Society.)

The most profitable application of labor is a desideratum too frequently overlooked or disregarded by those who attempt the introduction of new manufactures into a country. All calculations of advantage which is to result from the production of any article, must be made with due regard to this point, or practice will prove them to be erroneous.

Fully impressed with this truth, the most rigid examination is invited into every thing now offered, so that, as far as possible, we may arrive at a correct decision respecting the real value of the proposed manufacture.

In common with many others, I have felt considerable interest in the plan for extending the cultivation of sugar in temperate climates, and have made many experiments; first, upon the Beet, and recently upon Maize, or Indian corn, in the hope of discovering some mode by which the desired end might be attained. The results from the latter plant have been extremely encouraging. The manufacture of sugar from it, compared with that from Beet, offers many advantages. It is more simple, and less liable to failure. The machinery is less expensive, and the amount of fuel required is less by one half. The quantity of sugar produced on a given space of ground is greater, besides being of better quality.

An examination into the nature and productive powers of these two plants will show that no other results could have been reasonable expected. It is a well established fact, that every variety of production found in plants is derived from the sap. It is ascertained that the principal substance found in the sap or juice of many vegetables, is sugar. Therefore the amount of sacharine matter produced by any plant of this description, may be estimated from an analysis of the fruit, seed, &c., of such plant, when ripe.

The grain yielded by corn, and the seed from beet in the second summer of its growth, are nothing more than this sap or juice, elaborated by the process of vegetation, and presented to our view in another form.

Now, as it is contrary to the economy of nature to suppose that there should be any loss of nutritive matter in this change of sap into seed or grain, does it not follow that there must by the same difference in the quantity of sugar produced be the two plants as there is between the nutritive properties of beet seed and corn?

The juice of Maize contains sugar, acid, and a gummy mucilaginous matter which forms the scum. From the experiments of Gay, Lussac, Thenard, Kirchoff, and others, it appears that starch, sugar, and gum, are extremely similar in composition, and may be as readily converted into each other, by chemical processes, as they are by the operations of nature. For example: starch boiled in diluted sulphuric acid, for thirty-six hours, is converted into sugar of greater weight than the starch made use of. This result goes to show that every pound of starch found in the seed of a plant, has required for its production at least one pound of sugar in the form of sap. If it be objected that this deduction is too theoretical to be admitted, it may be answered that experiment, so far as it has gone, has fully attested its correctness.

The raw juice of Maize, when cultivated for sugar, marks 10 degrees on the saccharometer, while the average of cane juice (as I informed) is not higher than 7 degrees, and best juice not over 3 degrees. From 91-2 qts. (dry measure) of the former, I have obtained 4 pounds 6 ounces of syrup, concentrated to the point suitable for crystalization. The proportion of cristalizable sugar appears to be larger than is obtained from cane juice in Louisiana; this is accounted for by the fact, that our climate ripens corn perfectly, while it but rarely if ever happens that cane is fully matured. In some cases the syrup has crystalized so completely, that less than 1-6th part of molasses remained. This, however, only happened after it had stood from one to two months. There is reason to believe that if the plant were full ripe, and the process of manufacture perfectly performed, that the syrup might be entirely crystalized without forming any molasses. This perfection in the manufacture cannot however be attained with the ordinary apparatus. Without any other means for squeezing out the juice than a small hand-mill, it is impossible to say how great a quantity of sugar may be produced on an acre. The experiments have been directed more to ascertain the saccharine quality of the corn stalk, than the amount a given quantity of ground will produce; but the calculations made from trials on a small scale leave no room to doubt that the quantity of sugar will be from 800 to 1,000 pounds.

This amount will not appear unreasonable, when it is considered that the juice of corn is as rich as that of cane, and the weight of green produce, at least equal. Mr. Ellsworth, in one of his publications, states as the result of actual weighing and measuring, that corn sown broadcast yielded five pounds of green stalks per square foot; this is at the rate of 1081-2 tons to the acre.

My attention was first directed to Maize as a material for sugar, by observing that in some stalks the juice was extremely sweet, while in others it was weak and watery. On examination it appeared, that the latter had borne large and perfect ears of grain, while on the former, these were either small in size, or entirely wanting. The natural conclusion from this observation was, that if the ears were taken off in their embryo, state, the whole quantity of saccharine matter produced by the process of vegetation, would be preserved in the stalk, from which it might be extracted when the plant was matured. But the idea occurred too late in the season to test it by experiment. A few stalks however were found, which from some cause, had borne no grain; these were bruised with a mallet, and the juice extracted by a lever press. Some lime was then added, and the defecation, evaporation, &c., began and finished in a single vessel. By these simple means sugar of fair quality was produced, which was sent to the Horticultural exhibition of our Society in 1840.

I have since been informed, through Mr. Ellsworth, that Mr. Pallas of France had discovered in 1839, that the saccharine properties of Maize were increased by merely taking off the ear in its embryo state. An experiment, however, which I instituted to determine the value of this plan, resulted in disappointment; the quantity of sugar produced was not large enough to render it an object. The reasons of this failure will be sufficiently obvious on stating the circumstance. It was found that taking the ear off a large stalk, such as is produced by the common mode of cultivation, inflicted a considerable wound upon the plant, which injured its health, and of course lessened its productive power. It was also found that the natural disposition to grain was so strong, that several successive ears were thrown out, by which labor was increased, and the injuries of the plant multiplied. Lastly, it appeared, that the juice yielded from those plants contained a considerable portion of foreign substance not favorable to the object in view. Yet under all these disadvantages from one hundred to two hundred pounds of sugar per acre may be obtained.

The manifest objections detailed above, suggested another mode of cultivation, to be employed in combination with the one first proposed: it consists simply in raising a greater number of plants on the same space of ground. By this plan, all the unfavourable results above mentioned were obviated; a much greater quantity of sugar was produced, and of better quality.

The juice produced by this mode of cultivation is remarkably pure and agreeable to the taste. Samples of the sugar yielded by it are now in the Patent Office, with a small hand-mill by which the stalks were crushed. Some of the same kind was exhibited to our Agricultural Society in October, 1841, accompanied with an answer to an invitation from its President, Dr. J. W. Thompson, to explain the mode of culture, and process of manufacturing the sugar.

The molasses, after standing as before mentioned, from one to two months became filled with small crystals, which, on being drained, exhibited a peculiar kind of sugar; the grain is small, and somewhat inferior in appearance, but still it is as sweet and agreeable to the taste as can be desired. A small sample of this sugar I have brought for your inspection. This product, from what was though to be molasses, is a new and unexpected discovery, and discloses an important fact in the investigation of this subject. It shows the superior degree of perfection attained by the corn plant compared with the cane in any part of the Union. It is generally understood that the latter cannot be fully matured in any except a tropical climate, and the proportion of molasses obtained from any plant, is greater or less according to the immaturity or perfection of its growth.

The sweetness of the corn stalk is a matter of universal observation; our forefathers, in the revolutionary struggle, resorted to it as a means to furnish a substitute for West India sugar. They expressed the juice, and exerted their ingenuity in efforts to bring it to a crystalized state, but we have no account of any successful operation of the kind. In fact, the bitter and nauseous properties contained in the joints of large stalks, render the whole amount of juice from them fit only to produce an inferior kind of molasses. I found on experiment, that by cutting out the joints, and crushing the remaining pith of the stalk, that sugar might be made, but still of an inferior quality. The molasses, of which there was a large proportion, was bitter and disagreeable. From one to two feet of the lower part of these stalks was full of juice, but the balance as it approached the top, became dry and afforded but little. From the following experiments we see, that in order to obtain the purest juice, and in the greatest quantity, we must adopt a mode of cultivation, which will prevent the large and luxuriant growth of the stalk.

As we are only upon the threshhold of this inquiry, many other improvements may be effected in the mode of operation; for example, it may be that cutting off the tassel as it appears on the plant, will prevent the formation of grain, and prove a preferable means for effecting that object.

On the whole, there appears ample encouragement for perseverance; every step in the investigation has increased the probabilities of success—no evidence having been discovered why it should not succeed as well, if not better, on a large scale than it has done on a small one. In the first place, it has been satisfactorily proved, that sugar of excellent quality, suitable for common use without refining, may be made from the stalk of Maize. That the juice of this plant when elevated in a certain manner, contains saccharine matter remarkably free from foreign substances. 3rd, The quality of this juice, (even supposing we had no further evidence about it) is sufficiently demonstrated by the great amount of nutritive grain which it produces in the natural course of vegetation.

It is needless to expadiate on the vast advantages which would result from the introduction of this manufacture into this country.

Grain is produced in the West, in such overflowing abundance, that the markets become glutted, and inducements are offered to employ the surplus produce in distallation. This business is now becoming disreputable. The happy conviction is spreading rapidly, that the use of alcohol as a beverage, instead of conducing to health and strength, is the surest means of destroying both. Some other production, therefore, will be required, in which the powers of our soil may be profitably employed. This, it is hoped, will be found in the business now propsed. Instead of distilleries, converting food into poison, we may have sugar houses, manufacturing at our doors an article in universal demand, not merely useful, but necessary; furnishing as it does one of the most simple, natural, nutritious varieties of human sustenance, found in the whole range of vegetable production. It is said that the general use of sugar in Europe, has had the effect to extinguish the scurvy, and many other diseases formerly epidemical.

The time of the crop in the sugar island, (says Edwards,) is a season of gladness and festivity to man and beast. The meagre and sickly among the negroes exhibit a surprising alteration in a few weeks after the mill is set in action. But though the use of sugar is attended with all these agreeable effects, there is no agricultural production furnished at so great a sacrifice of human life. The reasons of this mortality may be found in the climate, and the peculiar situations in which cane is cultivated. How much then will be taken off the load of human suffering, if this article can be produced in more temperate and healthful regions! The wide prairies, and fertile alluvial valleys of the West offer an ample field, rich with all the elements of success.

A glance at the history of the sugar manufacture will render it evident that, whether our project is destined to succeed or not, something of the kind must, of necessity, ere long be introduced.

The cane was first planted in the Island of Barbadoes about the year 1642. On comparing the accounts given by Ligon, who lived at that time, with the average of others taken one hundred and fifty years afterwards, it appears that the cultivation of a given quantity of land in canes required, at the latter period, more than three times the number of slaves found necessary at the former. The amount of crop, at the same time, was much diminished. It is believed that this progressive increase in labor, and decrease in produce, has occured in every situation where the cultivation of sugar is carried on under the same system. This being the case, it requires no gift of prophecy to discover that the constantly increasing demand for this article cannot continue long to be supplied from the same sources.

An expectation is entertained by many, that a greater amount of exports will be furnished from the West Indies in consequence of emancipation; but they will probably be disappointed. The system of forcing human labor beyond the point of endurance, though unfortunately common in many parts of the world, has no where been carried to greater extent than in these Islands. It was commenced by the Spaniards, shortly after their discovery, and continued with unrelenting severity, until the native population, which was originally large, had dwindled to nothing. It has been continued since upon the negro race, and the same result has only been prevented by successive importations from Africa. But as the slave trade is now generally condemned by civilized nations, a supply of laborers from that source cannot be expected. The effect of emancipation in the West Indies, will be, to render manual labor more moderate, and the exports less. For, although the produce of the Islands may be increased by a more judicious application of labor and capital, it may be expected that the domestic consumption will be extended, by the increased ability of the free laborers to purchase the staples for their own use.

The amount of exertion which can be sustained under a tropical sun, without injury to health, is very small.

On this subject Dickson remarks—"That in no part of the Creator's works is his beneficent economy more admirable, than in providing the inhabitants of hot regions with food, clothing, and shelter, at a comparatively trifling expense of labor. Had the same severe and incessant toil been necessary for subsistence in hot, as in temperate climates, the torrid zone could never have been inhabited."

It may be doubted whether a tropical country can ever furnish a great amount of exports, except through the means of compulsory labor. It appears then, highly probable, that if the inhabitants of temperate countries wish to continue the use of sugar, they must find some means to produce it for themselves. The Beet appears to succeed well in Europe, and the manufacture from it is extending rapidly; but there is no hazard in making the assertion that Indian corn is far better adapted to our purpose.

The following mode of cultivating the plant, and making the sugar, is the best that can now be offered.

The kind of soil best adapted to corn is so well understood, that no directions on this point are necessary, except that it should be rich, the richer the better; if not naturally fertile, manure must be applied either ploughed in or spread upon the surface, or used both ways, according to the ability of the owner. Nothing can form a better preparation for the crop, than a clover sod well turned under, and harrowed fine immediately before planting.

Select for seed the largest and best ears of any variety of corn not disposed to throw up suckers, or spread out in branches: that kind most productive in the neighborhood, will be generally the one best adapted to the purpose. The planting should be done with a drilling machine. One man with a pair of horses, and an instrument of this kind, will plant and cover, in the most perfect manner, from ten to twelve acres in a day. The rows (if practicable, let them run north and south) two and a half feet apart, and the seed dropped sufficiently thick in the row to insure a plant every two or three inches.

A large harrow made with teeth arranged so as not to injure the corn, may be used to advantage soon after it is up. The after culture is performed with a cultivator, and here will be perceived one of the great advantages of drilling; the plants all growing in lines, perfectly regular and straight with each other, the horse-hoe stirs the earth and cuts up the weeds close by every one, so that no hand-hoeing will be required in any part of the cultivation.

[*To be Continued.*]

From the Annual Report of the Commissioner of Patents.

REMARKS ON THE AGRICULLURAL STATISTICS.

(*Continued.*)

COTTON.—This, it is well known, is the great staple product of several States, as well as the great article of our exports, tho price of which, in the foreign market, has been more relied on than any thing else to influence favorably the exchanges of this country with Great Britain and Europe generally. The cotton crop of the United States is more than one-half of the crop of the whole world. In 1834, the amount was but about 450,000,000 of pounds; the annual average now may be estimated at 100,000,000 of pounds more; the value of it for export at about $62,000,000. The rise and progress of this crop, since the invention of Whitney's cotton gin, has been unexampled in the history of agricultural products. In the year 1783, eight bales of cotton were seized on board of an American brig, at the Liverpool custom house, because it was not believed that so much cotton could have been sent at one time from the United States! The cotton crop of 1841, compared with that of 1839 and 1840, was probably less, by from 500,000 to 600,000 bales. In the early part of the last cotton-growing season, an average crop was confidently anticipated; but this hopeful prospect was not realized. In portions of the cotton-producing States, as in parts of Georgia, however, the crop was greater than usual; and in Arkansas it has been estimated at a gain, over that of 1839, of 33 1-3 per cent.; but probably, owing to its having suffered from the boll worm, it should be set down at 20 or 25 per cent. A similar advance is expected in future years, among other causes, from the great increase of population by emigration. Mississippi, Georgia, Lousiana, and Alabama, South Carolina, and North Carolina, are, in their order, the great cotton-growing States. An important fact deserves notice here, on account of the relation which the cotton crop bears to other crops. When ever (no whatever cause it may be owing) the price of cotton is low, the attention of cultivators, the next year, is more particularly diverted from cotton to the culture of corn, and other branches of agriculture, in the cotton-producing States. As cotton is now so low, and so little in demand in the foreign market, unless a market be created at home it must necessarily become an object of less attention to the planters; and it cannot be expected that the agricultural products of the West will find so ready a sale in the Southern market as in some former years. Other countries, too, as India, Egypt, and other parts of Africa, Brazil, and Texas, are now coming more decidedly into competition with the cotton-growing interest of our country; so that an increase of this product from those countries, and a corresponding depression in ours, are to be expected. The amount of India cotton imported into England in 1840 was 76,703,295 pounds; almost equal to the whole cotton crop of North Carolina and South Carolina, or to that of Alabama, for the past year, and nearly double the amount produced by Tennessee, Arkansas, and Florida, combined; being, also, an increase on the importation of cotton from India, the preceding year, of 30,000,000 of pounds, and, in amount, nearly one-sixth of the whole quantity imported during the same year from the United States. From the report of the Chamber of Commerce of Bombay, it appears that, from the 1st of June, 1840, to the 1st of June, 1841, the imports of cotton into Bombay amounted to 174,212,755 lbs.; and the whole India crop is estimated, on good authority, at 190,000,000 of pounds. This is a larger quantity than America produced up to 1826, and more than was consumed by England in the same year, and nearly one-third of the whole estimated crop of the United States in 1841.—From these facts, it is evident that it is becoming more and more the settled policy of England to encourage the production of cotton in India, while it is equally certain that a foreign market cannot be relied on for our cotton, to the same extent as it has hitherto been. An English authority, speaking of the decline of England and of her manufactures, as having commenced a downward progress, in accounting for this decline, attributes the distress in Leeds, and other places, to the landholders, who, by excluding the foreign bread stuffs, have driven foreigners to manufacture in self-defence. This decline, not being confined merely to her old staple of woollens, must, too, operate in the reduction and diminution of cotton exported from this country. The following statement confirms the position now taken:

"In 1824, Great Britain exported to all foreign countries, including the British possessions, of cloths, &c., 567,317 pieces; in 1828, 566,596 pieces; in 1830, 440,360 pieces; and in 1840, only 250,962 pieces. During the same year last named, (1840,) the total manufactured in only one district in Belgium and Prussia, all within a days journey of each other, was 333,245 pieces; so that, in one district only, there was made more than was exported by Britain to all the world, by 76,233 pieces."

RICE.—This product is cultivated to comparatively a very little extent in the United Sates, except in South Carolina and Georgia. In the former of these, it is an object of no small attention, and ranks second only to cotton. It forms a considerable article of export from this country to Europe. England, however, imports annually large quantities of rice from India. The crop of rice in 1841 is said to have been, on the whole, a very good one, equal, if not superior, to the usual average.

SILK COCOONS.—Notwithstanding the disappointment of many who, since the year 1839, engaged in the culture of the *morus multicaulis* and other varieties of the mulberry, and the raising of silk-worms, there has been, on the whole, a steady increase in the attention devoted to this branch of industry. This may be, in part, attributed to the ease of cultivation, both as to time and labor required, and in no small degree, also, to the fact that, in twelve of the States, a special bounty is paid for the production of cocoons, or of the raw silk. Several of these promise much hereafter in this product, if a reliance can be placed on the estimates given in the various journals to nearly 755,200,000 bushels, or 42 1-3 bushels to each inhabitant. The number of persons employed in agriculture, according to the census of 1840, was 3,717,756. This, it is presumed, refers to the male free white adult population.

The articles of CORN OIL and corn for SUGAR, together with OIL from LARD and the castor bean, &c., deserve more than a passing notice. They are destined, it is believed, to call forth increased enterprise among the agriculturists of our country:

CORN OIL is produced from corn meal by fermentation, with the aid of barley malt. It has been produced and used for some time past in certain distilleries, by skimming off the oil as it rises on the meal in fermentation in the mash tub.—It has, however, lately become the subject of particular attention, as an article of manufacture, and with success. The meal, after it has been used for the production of this oil, it is said, will make better and harder pork, when fed out to swine, than before. The oil is of a good quality, of a yellowish color, and burns well. Further clarification, it is probable, may render it as colorless as the best sperm oil. Whether or not this may be the case, the ease with which it is made offers strong inducements to engage in the production of this article.

But a more important object in the production of Indian corn is doubtless the manufacture of SUGAR from the stalk.—In this point of view, it possesses some very decided advantages over the cane. The juice of the cornstalk by Beaume's saccharometer, reaches to 10 degrees of saccharine matter, which, in quality is more than three times that of beet, five times that of maple, and fully equals, if it does not even exceed, that of the ordinary sugar cane in the United States. By plucking off the ears of corn from the stalk as they begin to form, the saccharine matter, which usually goes to the production of the ear, is retained in the stalk; so that the quantity it yields is thus greatly increased. One thousand pounds of sugar, it is believed, can easily be produced from an acre of corn. Should this fact seem incredible, reference need only be made to the weight of fifty bushels of corn in the ear, which the juice so retained in the stalk would have ripened, had not the ear, when just forming, been plucked away. Sixty pounds may be considered a fair estimate, in weight, of a bushel of ripened corn; and, at this rate 3,000 pounds of ripened corn will be the weight of the produce of one acre. Nearly the whole of the saccharine part of this remains in the stalk, besides what would have existed there without such a removal of the ear. It is plain, therefore, that the sanguine conclusions of experimenters the past year have not been drawn from insufficient data. Besides, it has been ascertained, by trial, that corn, on being sown broadcast, (and so requiring but little labor, comparatively, in its cultivation,) will produce five pounds per square foot, equal to 108 tons to the acre for fodder in a green state; and it is highly probable that, when subjected to the treatment necessary to prepare the stalk, as above described, in the best manner for the manufacture of sugar, a not less amount of crop may be produced.—Should this prove to be the case, one thousand weight of sugar per acre might be far too low an estimate. Experiments on a small scale have proved that *six* quarts of the juice, obtained from the cornstalk sown broadcast, yielded one quart of chrystallized sirup, which is equal to 16 per cent.; while for one quart of sirup it takes thirty-two quarts of the sap of maple.

Again, the cornstalk requires only one-fifth the pressure of the sugar cane, and the mill or press for the purpose is very simple and cheap in its construction, so that quite an article of expense will thereby be saved, as the cost of machinery in the manufacture of sugar from the cane is great. Only a small portion of the cane, also, in this country, where it is an exotic, ordinarily yields saccharine matter, while the whole of the cornstalk, the very top only excepted, can be used.

Further, while cane requires at least eighteen months, and sedulous cultivation and much hard labor, to bring it to maturity, the sowing and ripening of the cornstalk may be performed, for the purpose of producing sugar, with ease, within 70 to 90 days; thus allowing not less than two crops in a season in many parts of our country. The stalk remaining, after being pressed, also furnishes a valuable feed for cattle, enough, it is said, with the leaves, to pay for the whole expense of its culture. Should it be proved, by further experiments, that the stalk, after being dried and laid up, can, by steaming, be subjected to the press without any essential loss of the saccharine principle, as is the case with the beet in France, so that the manufacture of the sugar can be reserved till late in the autumn, this will still more enhance the value of this product for the purpose. It may also be true that, as in the case of the beet, no animal carbon may be needed, but a little lime water will answer for the purpose of clarification; after which, the juice may be boiled in a common kettle, though the improved method of using vacuum pans will prove more profitable when the sugar is made on a large scale.

Corn, too, is indigenous, and can be raised in all the States of the Union, while the cane is almost confined to one, and even in that the average amount of sugar produced, in ordinary crops, is but 900 or 1,000 pounds to the acre; not much beyond one-third of the product in Cuba, and other tropical situations, where it is indigenous to the soil. The investment in the sugar manufactories from the cane in this country has, it is believed, paid a poorer return than almost any other agricultural product. The laudable enterprise of introducing into the United States the culture of the cane and the manufacture of sugar from the same, has, it is probable, been hardly remunerated, though individual planters on some locations, have occasionally enriched themselves. The amount of power required, with the cost of the machinery and the means of cultivation, will ever place this branch of industry beyond the reach of persons of moderate resources, while the apparatus and means necessary for the production of corn and other crops lie within the ability of many.

Should the manufacture of sugar from the cornstalk prove as successful as it now promises, enough might soon be produced to supply our entire home consumption, towards which, as has been mentioned, at least 120 million pounds of foreign sugars are annually imported, and a surplus might be had for exportation. In Europe, already, more than 150 million pounds of sugar are annually manufac-