

Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

No. 261 BROADWAY, NEW YORK.

O. D. MUNN.

A. E. BEACH.

TERMS FOR THE SCIENTIFIC AMERICAN.

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NEW YORK, SATURDAY, AUGUST 18, 1883.

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THE SUGAR CANES.

In a recent number attention was drawn to the fact that apparently a great, in reality a very radical, change in the sugar production of the United States was coming, and that too without long delay. It is laboratory work which has rendered this practicable. As in so many instances, mechanical skill has availed itself of minute scientific results, and the grains or granules of the chemist's test tubes and balances have become the predecessors and originators of the barrels of sugar from the boiling house and the refinery.

In order that we may see clearly how this has been done, and to what immense results it is about to lead, we need to look to the two kinds of sugar cane with which we have to deal. Hitherto we have had practically but one, that known botanically as Saccharum officinarum, and in common language universally as "sugar cane." Now every evidence shows that we are to have another whose importance will exceed that of the former in the same ratio as does the extent of territory available for its cultivation. This is botanically Sorghum vulgare, known everywhere by its generic title as "sorghum."

The saccharum is a semi-tropical plant, and no part of the United States is fairly within the range of its perfect development. Even the Gulf States are along the northern limit of its range for any available purposes, so much so indeed that in no case, or in next to none, is it able to ripen its seed, and thus show that it has reached its full maturity. As a result of this, the region which can be made profitable for its growth and for the production of sugar is necessarily very much restricted. Mississippi, Alabama, and Georgia have given but little attention to cane growing. Florida and Texas reach far enough south to be in the best position of all, but industrially they have as yet accomplished little. Louisiana has been the "sugar State," and the cultivation of sugar cane has been bounded by the Red River. And the immense results dependent on this industry are best appreciated from the fact that even under these adverse circumstances our annual yield of sugar has come nearly up to 200,000,000 pounds.

If now, leaving the consideration of the saccharum we turn to sorghum the conditions are entirely changed. The plant needs no such long continued heat. It is perfectly well known that the cultivation of sorghum can be carried on to full satisfaction in almost every State of the Union. New England will probably never do much in that way, except in its southern and southwestern limits, but neither Minnesota nor Dakota will be beyond the range, for they produce the plant now abundantly. The trouble however has been that the yield of sugar from the sorghum has been totally capricious and uncertain. That the sugar was present in the cane was sure, for the juice if boiled properly yielded invariably a very sweet sirup; but while occasionally this sirup would crystallize beautifully, in other instances, and in truth almost always, not a grain of sugar would make its appearance.

A crop of sorghum therefore had no definite value. It was not possible to tell while it was in the field what might result from its working. Very naturally then it did not rank high in public favor. It had its merits, for sirup and for forage, and in the Northwestern States especially it has never ceased to be grown to a large extent. But now comes in the laboratory work to which reference has been made. It is not too much to say that now we know the causes of the capricious features shown by the sorghum juice, and that knowing the evil we can avoid it. It is not too much to say that a crop of sorghum in the field can be as safely calculated on to yield its full quota of sugar of first quality as can a crop of saccharum, and still further that acre for acre its best varieties will yield fully as much sugar as is obtained from the ribbon cane in Louisiana. The chemical points which establish this belief we will consider at another time, speaking now only of the results.

The future sugar of the United States therefore viewed in this light will be for us nationally a new item. We have imported annually at least 1,700,000,000 pounds, or more than nine-tenths of our consumption. That we can produce 2,000,000,000, or whatever more may be needed, is certain. Why should we not become exporters instead of importers? We should interfere with no crop now cultivated, as we propose presently to show. And all this can be accomplished were it desirable (which it certainly is not) to encroach no further on the vast extent of domain not yet brought under human use. The corn bands from Ohio to Nebraska and from Kentucky to Minnesota can do it all, and yet feed the hungry as they do now.

GLUCOSE IN SORGHUM.

In searching for the reasons of the former failure to crystallize sugar from sorghum sirup, we find ourselves brought directly down to the chemical distinctions between glucose and sucrose, known in more common language as grape sugar and cane sugar. And with the difference in their composition we must meet also the different relations they sustain to the laws and the force of crystallization. We have long been familiar with the fact that cane sugar crystallizes readily, but that grape sugar in its ordinary states will not crystallize at all. We have also known that sorghum sirup was in chief part a solution of glucose in water, and that because of the presence of this uncrystallizable sugar we failed to obtain any crystals, though we were well aware that sucrose was also present. This may be fairly stated as about the extent of our practical knowledge, three years ago. The fact remained that no one could tell what a given

lot of sorghum sirup would do; perhaps it would crystallize perhaps it would not.

In the special report No. 33 of the Department of Agriculture we have the "analytical and other work done on sorghum and cornstalks, by the chemical division of the department, July to December 1880." Dr. Collier, chemist of the department, establishes here certain points, from which we may make our own inferences. One of the chief objects he had in view was to ascertain the actual and the relative quantities of sucrose and of glucose contained in the juice of the sorghum during the successive stages of its growth. This was done carefully and continuously and with extreme accuracy. The laws of increase and of diminution were ascertained as fully as the work of a single season would allow, and in the report he was able to represent these results in a series of "graphical plates" which show at a glance the proportions of sucrose and of glucose at the dates given. One of these may serve for all very correctly, for though no two agreed fully, as might have been expected, yet all agreed in the main features, and they prove this succession of events.

Commencing in the late days of July, we see that the glucose exceeds the sucrose in quantity, but this condition ceases by about the first of August. From this time the sucrose increases rapidly though not uniformly, partial retrogressions occurring, of brief duration. When the seeds begin to harden, say about the middle of September, the increase is checked until the seed is nearly ripe; then it goes on, and at the full maturity of the seed it has reached its maximum, which it maintains with only at the most a small waste. This maximum is equal, as a schedule shows, to the average sucrose of sugar cane, and in some varieties goes decidedly above it.

While these changes have taken place in the amount of sucrose, precisely the opposite has been going on with the glucose. It has as steadily grown less and less, and at the time of maturity it has fallen to very nearly the average of the glucose of sugar cane, and in some varieties is even below it.

We have then this condition: when the sorghum cane is fully mature, its sucrose has reached its maximum and its glucose its minimum, and each of these is in about the quantity and the proportions in which it exists in average sugar cane. We may therefore infer that it will yield a return of sugar of equal weight and value to that of sugar cane, and will do it as surely and as readily. If this were absolutely true, we should have the key of the situation in our hands, but our sugar is not yet certain, though fortunately we are able to make it so. Sorghum juice is not sugar cane juice. It is unstable in its chemical character. Its sucrose, though so largely in the ascendancy, has a strangely perverse tendency to take to itself another equivalent of HO, and thus become at once glucose. Unless this tendency is arrested every grain of available sugar may have disappeared, and probably will, within twenty-four hours from the commencement of the change, that is, from the time of the cutting of the sorghum. The transformation can be prevented by the use of lime, but practically this is best done by boiling.

Here then is the mystery laid bare; the key is now fairly in our hands. Perfect maturity of the cane, and prompt boiling of the juice; these are the two essential points. With them success is sure; without them we may expect failure; we shall have a glucose sirup and nothing else. Nor are these assertions made at random. Dr. Collier proved in the laboratory, it is true, the points which we have here seen, and it is scarcely possible to award to him too great credit for his skill and the truly practical results at which he arrived. But we can now go beyond him, to that which his researches have secured in actual field work. Sugar from sorghum cane has begun now to be a reality, and not as it was before, a chance shot only. The return is a matter of business certainty; as much so as that from sugar cane. We cannot here detail the crop reports of 1882, but they fully justify all the statements we have made.

It is easy to understand now the capricious character acquired by sorghum in previous years. It was merely a thing of chance, soto speak. Every now and then maturity and promptness would combine, and as a matter of course beautiful sugar showed itself; if either of these two were wanting, beautiful sirup was the only reward.

INCREASED SPEED BETWEEN NEW YORK AND LIVERPOOL.

After many sleepy years of slow boat employment the Cunard Company now begins to show hopeful signs of wakefulness to enterprise and appreciation of the public wants. During the past year it has put into service two new and splendid steamers, the Servia and Aurania, which are almost equal in speed to some of the fast boats long used on rival lines. The company has now made a contract with Messrs. John Elder & Company, of Glasgow, for the building of two additional steamers of a character and power far in excess of anything that has hitherto been devised for the Atlantic mail and passenger service.

They are to be vessels of 8,000 tons burden, and are to have engines of 13,000 horse power indicated, their dimensions being 500 feet long by 57 feet in breadth of beam, by 40 feet in depth of hold; and what is perhaps the most striking fact of all is, that they are to be guaranteed to steam at the rate of nineteen knots per hour, thus crossing the Atlantic, between Liverpool and New York, in less than six days. These two ships are to cost about three millions of dollars.