but white bone ashes, which would be worse than useless. When the kettle is cold, remove the clay earth, and afterwards the clay, which was wet and was on the bones.

Take out the bones which now ought to be all perfectly black and tasteless. Make a good heavy rammer of hard wood, cut it to fit the bottom of the kettle, and then pound up the burnt bones little by little in the kettle, a good potash kettle will be plenty strong enough, (there is no fear of your pounding them too fine) - as you proceed you should sift the powdered bones through a sieve, a fine sieve like a timothy sieve will answer, throw back what will not go through, and pound it over again.

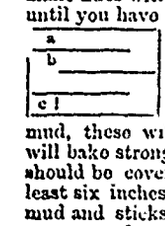
When you have got as much as you want according to the size of your works, (but for a few acres of beet three bushels would answer), put this bone charcoal in a tub with a false bottom, have the bone black about three feet thick—there must be room enough above it for the syrup or juice, when all is done, leach boiling clean water through it, so long as it has either smell or taste, then let it run dry, and the filter will be ready for the juice.

As soon as the filter is found to lose its effect, you must sprinkle boiling water on it —if done gradually the water will take out all the syrup which the bone black retains, the syrup will at first come through of its full strength, the liquor will then get weaker, until finally nothing but water will come. the weak liquor must be used in the fresh ground roots, and thus no loss will take place.

Hot water well washed through the filter will for a time renew its purifying qualities, when it will act no longer, it must be reburned in the potash kettle, the loss from reburning is very trifling, if it is done with judgment.

Boiling Down for Crystallization.

This requires a good deal of judgment, and the greatest care must be taken not to burn the syrup, but at the same time the evaporation must be as rapid as possible, and must be continued until all the water is off, when ready to set by, the liquor will, on being cooled, draw out in a string between the finger and thumb the string will break and the ends turn back in the shape of a hook, and it is the shape of this hook by which you know whether the syrup is boiled sufficiently, nothing but experience will show this, altho' it may appear that you have got all the water off, yet the syrup, on cooling, will sometimes seem to get thinner again, and in this case it must be reboiled. In other cases it will get thicker and crystallize in the course of a short time, when it is set by to crystallize, it must be in *shallow* vessels and in a warm place, and the syrup must be kept at about the heat of new milk, or blood heat. If you have not proper convenience for this you should make a place, thus, make a fire place of mud, or bricks, or stones, if you have them, but mud will do, from this make flues with mud walls backwards and forwards until you have filled up the size of the crystallizing house, make it thus, a, fire place; b, flues; c, chimney. The flues and fireplace may, in the first place, be covered with sticks to hold up the mud, these will afterwards burn out, and the mud will bake strong enough to support itself; the whole should be covered with mud to the thickness of at least six inches, the chimney may also be built of mud and sticks, and carried to a sufficient height to ensure a draught, the sides and top of the house should be of board made quite close, and the roof must have a good overhanging to throw off the water. Mud building is strong enough so long as you keep it dry; the chimney must also be defended from the wet by a roof, but, of course, there must be plenty of exit for the smoke. A fire of chips or any refuse wood lighted in the fireplace, will soon bring this mass of mud flues to a good heat, and when it is once warm stop the chimney and close the fire door; a little fire, lighted once or twice a day, will keep it hot. The crystallizing pans must stand on the surface of the flues and fireplace. The building must be as low as convenience will allow, and for fear of fire it ought to be erected at a safe distance from buildings, of course a good brick building would be better where expense is no object.



In four or five days the syrup will commence to crystallize from the top, the crystals should then be stirred down, and more will form, they seem to increase fastest from the top. When the crystallization is complete, the syrup will be ready to barrel up for sale to the refiner, or if you wish it you can proceed to further operations with it as hereafter described, or where you do not want to make sugar for yourself, but mean to dispose of the syrup to the refiner, the syrup may, as soon as ready, be poured into casks while hot and bunged up for sale *if the water is all out of it*, it will keep for any length of time.

This is as far as the writer recommends the farmer or small manufacturer to go, but as there are many who may wish to pursue the subject to a greater extent, the instructions to that end are given further on. Before proceeding, however, the writer cannot urge the following general observations too strongly on the mind of the reader.

There is nothing in the foregoing processes which a person of ordinary intelligence and information cannot do. The processes are simple, and the result, an article of a certain commercial value.

Refiners of sugar want to get their crude materials with as little done to them by people who do not understand refining as possible; as they have certain processes to go through, and they do not of course want to have to amend the blunders of other persons Any attempt at partial refining, or the use of chemicals by the producer, is quite as likely to be wrong as right, for the after processes. The difficulty with beet sugar has always been the crystallization, and the getting rid of the potash and salt, and the trouble has been what the Germans and French call "slime sugar;" but if the foregoing rules are *exactly* followed, there will be no slime sugar or treacle —scarcely enough to enable you to get off that portion of the syrup which contains the salts, and which must be got out from the mass with the turbine. If you proceed to the second operation, bear these few rules constantly in mind. In the first operation when you add the milk of lime to the juice to clear it:—

1st. Never keep the lime in contact with the *hot juice a minute longer than you can help it;* the lime cannot be dispensed with to clear the juice, but its action on the hot juice produces more or less of slime sugar.

2nd. Do not agitate the juice with the lime in it, more than enough to mix, or you will spoil your filtration; the larger the flakes remain in the juice the better it will filter.

3rd. Never carbonate at any other than a cow milk heat. If you carbonate hot, as most of the books tell you, you will make slime sugar.

Of course, throughout the whole process of boiling, heating, and evaporation, you must be extremely careful neither to burn, nor even brown the syrup The syrup will be always highly colored; but if it has not been burned, all the color comes out without waste in the after processes, and if the process of evaporation is conducted in the best manner, the sugar which crystalizes out of the colored syrup, will be nearly, if not quite white. The burned sugar can never be recovered.

The foregoing instructions are the result of *actual experiment*, and may be relied on as the result of experience of two years' continual experiments on a working scale.

We shall now proceed to discuss the process of "Diffusion."

There is another process for the extraction of sugar from beet root, which is called the "Diffusion process," and it is now almost universally adopted throughout France and Germany—great numbers of the factories being altered from the old grating and pressing process to the diffusatory process, which is thus described:—

ROBERTS' DIFFUSION PROCESS is now acknowledged to be the most economical of any, both in first cost and in working. The apparatus which is used is hardly liable to get out of order, and requires very little attention, while the operations are cleanly and free from filth. Of this process, Mr. Post, United States Consul at Vienna, Austria, wrote, in 1867, as follows:—

"The new process recently invented by Mr. Julius "Robert, a sugar manufacturer, of Seelowitz, Aus- "tria, is working a complete change in the manu- "factories here, and will doubtless exert a great influ- "ence on an extended introduction of beet sugar manu- "facture in the United States, and it is adapted "to extracting the crystalline sugar from either sugar "cane or beet root."

In the United States (and Canada) where labor is so expensive, this innovation must prove of incalculable importance. The only thing required in this new process not necessary in the old, is an additional supply of water, an article tolerably plentiful and cheap wherever this manufacture is likely to be introduced in our country,

That this process is really the great improvement claimed, no longer admits of dispute. Mr. Robert has thoroughly tested it in his factory, and has adopted it, as have also many other factories. Since 1867, no less than 130 of the old beet sugaries of Europe have discarded their old process for the new one.

The apparatus for this process, as well as the principle of its action, is different from that of any other. While the other processes are to extract all the juice from the beet, this process extracts only the crystalizable sugar contained in the juice, and leaves most of the impurities in the cells. To accomplish this result the Beet roots are cut up in small thin slices, and put into a number of vats, which are connected by pipes running from the bottom of one vat to the top of the next succeeding. Water of a certain temperature, (it must be hot, nearly boiling) and of a quantity proportioned to the weight of the beet root in the vats, is mixed with the material in the first vat, and allowed to remain until it takes up a portion of the saccharine matter, or, so to speak, until the sugar in the vat is equalized between the water and the beet root; that is to say, if the beet root contains 8 per cent. of saccharine matter, the water will take up 4 per cent.; this water is then forced into the the second vat filled with the cut slices of beet root.

The water already contains four per cent. of sugar, but the beets having eight per cent. it will again equalize itself, and when forced into the third vat will contain six per cent. of saccharine matter; in this way the water becomes more and more impregnated with saccharine matter, until it contains almost as much as the beet itself. To return to the first vat we find that the first application of water extracted one half the sugar or four per cent., when this water was forced into the second vat; the fresh water which forced it out and supplied its place extracted two per cent. more before the saccharine matter became equalized between the water and the beets. This water is then forced into the second vat, and the fresh water which supplies its place finds the beets containing but two per cent. of saccharine matter, and the next filling finds but one per cent., and in this way the water is extracted to within one half of one per cent.

It is said that by this process the raw material of syrup is much purer than when extracted by any other method, that from the same beets one half per cent. more of crystalline sugar is obtained than by the application of pressure; the expense of pressing-cloths, and the cleaning and renewing them, are done entirely away with; the expense for motive power and machinery is considerably reduced, and the expense of manual labor is much less, requiring but one-fourth the number of laborers necessary for the pressing process.

Within a short time Mr. Robert has introduced a modification of his original apparatus. In this modification the series of vessels is abandoned, and one single chamber is employed instead. In the centre of the chamber is a feeding cylinder containing a feeding screw, driven by gearing from above. The sliced beet root is passed through a hopper to the bottom of the feeding chamber, whence it passes out through openings into the outer cylinder of the diffuser, and gradually rising to the top, is carried off by a regulating rake, driven by independent gearing. From the top of the diffuser, water is slowly supplied through small pipes, meeting in its descent the most exhausted slices as they rise to the discharge level, and passing through to the richer material as it becomes more and more saturated. At the bottom, it issues through perforations or outlet pipes, and is carried off to a cistern, where it is heated, and then returned upon the beet by the central feeding tube, by which the beet is supplied to the diffusing chamber. This apparatus, which has answered well at beet sugar and spirit works, has also been applied to cane sugar factories, where it promises good results.

The heat of the liquor or water supplied must be sufficient to *kill* the vegetable life in the root, as the diffusion process does not take place, or affect the skin of the sugar cells, until the *vegetable life* is destroyed. The heat required in the mass is at least 140° Farenheit, and from that up to nearly boiling.

The shape into which the roots are sliced is such that they will not lie close together, but allow the water of diffusion readily to percolate to every part. Long finger like pieces, cut into a triangular shape, are considered the best, although some cut the roots up into small square masses, and others into fine oblong square pieces. That process is best which keeps the mass most open, and the pieces of root from packing together.

This process does not, however, do away with the necessary defecation with lime—less lime may be necessary, and the scums and curdlings will be less in amount and easier to get rid of, but the lime process must be used until the juice is properly defecated and cleared from impurities.

The carbonatation, as already described, must also be applied to the juice, and the entire process, with the exception of grating or rasping and pressing, must go on as before given.

The spent slices, when not wanted to be fed at once, may have all the waste water taken out of them by being centrifugalled, and the water so obtained will save so much of the sugar, and can be used in