The use of multiple-effect evaporation made it possible to raise the steam for all the work required to be done in a well-equipped factory, making crystals, under skilful management, by means of the bagasse alone proceeding from the canes ground, without the aid of other fuel. The bagasse so used is now commonly taken straight from the cane mill to furnaces specially designed for burning it, in its moist state and without previous drying, and delivering the hot gases from it to suitable boilers, such as those of the multitubular type or of the water-tube type. The value of fresh bagasse, or as it is often called “ green" bagasse, as fuel varies with the kind of canes from which it comes, with their treatment in the mill, and with the skill used in firing; but it may be stated broadly that 1 lb of fresh bagasse will produce from 11/2 lb to 21/4 lb of steam, according to the conditions.

The use of preparing rolls with corrugations, to crush and equalize the feed of canes to the mill, or to the first of a series of mills, has become general. The Krajewski crusher has two such steel rolls, with V-shaped corrugations extending longi­tudinally across them. These rolls . run at a speed about 30% greater than the speed of the first mill, to which they deliver the canes well crushed and flattened, forming a close mat of pieces of cane 5 to 6 in. long, so that the subsequent grinding can be carried on without the stoppages occasioned by the mill choking with a heavy and irregular feed. The crusher is preferably driven by an independent engine, but with suitable gearing it can be driven by the mill engine. The Krajewski crusher was invented some years ago by a Polish engineer resident in Cuba, who took out a patent for it and gave it his name. The patent has expired. The increase in the output for a given time obtained by the use of the Krajewski crusher has been estimated at 20 to 25 % and varies with the quality of the canes; while the yield of juice or extraction is increased by I or 2%.

The process of continuous defecation which was introduced into Cuba from Santo Domingo about 1900 had by 1910 borne the test of some ten years’ use with notable success. The Hatton defecator, which is employed for working it, has been already described, but it may be mentioned that the regulation of the admission of steam is now simplified and secured by a patent thermostat—a sell-acting apparatus in which the unequal expansion of different metals by heat actuates, through compressed air, a diaphragm which controls the steam stop-valve—and by this means a constant temperature of 2100 F. (98∙8° C.) is maintained in the juice within the defecator during the whole time it is at work.

Earthy matter and other matter precipitated and fallen on the copper double bottom may be dislodged by a slowly revolving scraper—say every twelve hours—and ejected through the bottom discharge cock; and thus the heating surface of the copper bottom will be kept in full efficiency. With ordinary care on the part of the men in charge Hatton defecators will work continuously for several days and nights, and the number required to deal with a given volume of juice is half the number of ordinary defecators of equal capacity which would do the same work; for it must be borne in mind that an ordinary double-bottomed defecator takes two hours to deliver its charge and be in readiness to receive a fresh charge, *i.e.* 20 minutes for filling and washing out after empty­ing; 60 minutes for heating up and subsiding; and 40 minutes for drawing off the defecated juice, without agitating it. Apart from increased yield in sugar of good quality, we may sum up the advantages procurable from the use of Hatton defecators as follows: cold liming; heating gently to the temperature required to coagulate the albumen and not beyond it, whereby disturbance would ensue ; the continuous separation of the scums; the gradual drying of the scums so as to make them ready for the fields, without carrying away juice or requiring treatment, in filter presses; and the con­tinuous supply of hot defecated juice to the evaporators, without the use of subsiding tanks or eliminators; and, finally, the saving in expenditure on plant, such as filter presses, &c., and wages.

*Beetroot Sugar Manufacture.—*The sugar beet is a cultivatcd variety of *Beta maritima* (nat. ord. Chenopodiaceae), other varieties of which, under the name of mangold or mangel-wurzel, are grown as feeding roots for cattle.

About 1760 the Berlin apothecary Marggrafï obtained in his laboratory, by means of alcohol, 6∙2% of sugar from a white variety of beet and 4·5% from a red variety. At the present day, thanks to thc careful study of many years, the improve­ments of cultivation, the careful selection of seed and suitable manuring, especially with nitrate of soda, the average beet worked up contains 7% of fibre and 93% of juice, and yields in Germany 12∙79% and in France 11∙6% of its weight in sugar. In Great Britain in 1910 the cultivation of beet for sugar was being seriously undertaken in Essex, as the result of careful consideration "during several years. Thc pioneer experi­ments on Lord Denbigh’s estates at Newnham Paddox, in Warwickshire, in r900, had produced excellent results, both in respect of the weight of the beets per acre and of the saccharine value and purity of the juice. The average weight per acre was over 251/2 tons, and the mean percentage of pure sugar in the juice exceeded 151/2. The roots were grown under exactly the same cultivation and conditions as a crop of mangel-wurzel— that is to say, they had the ordinary cultivation and manuring of the usual root crops. The weight per acre, the saccharine contents of the juice, and the quotient of purity compared favourably with the best results obtained in Germany or France, and with those achieved by the Suffolk farmers, who between 1868 and 1872 supplied Mr Duncan’s beetroot sugar factory at La venham; for the weight of their roots rarely reached 15 tons per acre, and the percentage of sugar in the juice appears to have varied between 10 and 12. On the best-equipped and most skilfully managed cane sugar estates, where the climate is favourable for maturing the cane, a similar return is obtained. Therefore, roughly speaking, one ton of beetroot may be con­sidered to-day as of the same value as one ton of canes; the value of the refuse chips in one case, as food for cattle, being put against the value of the refuse bagasse, as fuel, in the other. Before beetroot had been brought to its present state of per­fection, and while the factories for its manipulation were worked with hydraulic presses for squeezing the juice out of the pulp produced in the raperics, the cane sugar planter in the West Indies could easily hold his own, notwithstanding the artificial competition created and maintained by sugar bounties. But the degree of perfection attained in the cultivation of the roots and their subsequent manipulation entirely altered this situa­tion and brought about the crisis in the sugar trade referred to in connexion with the bounties (see *History* below) and dealt with in the Brussels convention of 1902.

In beetroot sugar manufacture the operations are washing, slicing, diffusing, saturating, sulphuring, evaporation, concentration and curing.

*Slicing.—*The roots are brought from the fields by carts, canals and railways. They are weighed and then dumped into a washing machine, consisting of a. large horizontal cage, submerged in water, in which revolves a horizontal shaft carrying arms. The arms are set in a spiral form, so that in revolving they not only stir the roots, causing them to rub against each other, but also force them forward from the receiving end of the cage to the other end. Here they are discharged (washed and freed from any adherent soil) into an elevator, which carries them up to the top of the building and delivers them into a. hopper feeding the slicer. Slicers used to be constructed with iron disks about 33 to 40 in. diameter, which were fitted with knives and made 140 to 150 revolutions per minute, under the hopper which received the roots. This hopper was divided into two parts by vertical division plates, against the bottom edge of which the knives in the disk forced the roots and sliced and pulped them. Such machines were good enough when the juice was expelled from the small and, so to speak, chopped slices and pulp by means of hydraulic presses. But hydraulic presses have now been abandoned, for the juice is universally obtained by diffusion, and the small slicers have gone out of use, because the large amount of pulp they produced in proportion to slices is not suitable for the diffusion process, in which evenly cut slices are required, which present a much greater surface with far less resistance to the diffusion water. Instead of. the small slicers, machines made on the same principle, but with disks 7 ft. and upwards in diameter, are used. Knives are arranged around their circumference in such a way that the hopper feeding them presents an annular opening to the disk, say 7 ft. outside diameter and 5 ft. inside, with the necessary division plates for the. knives to cut against, and instead of making 140 to 150 revolutions the disks revolve only 60 to 70 times per minute. Such a slicer is capable of efficiently slicing 300,000 kilos of roots in twenty-four hours, the knives being changed four times in that period, or oftener if required, for it. is necessary to change them the moment the slices show by their rough appearance that the knives are losing their cutting edges.

*Diffusion.—*The diffusion cells are closed, vertical, cylindrical vessels, holding generally 60 hectolitres, or 1320 gallons, and are arranged in batteries of 12 to 14. Sometimes the cells are erected in a circle, so that the spout below the slicing machine revolving above them with a corresponding radius can discharge the slices into the centre of any of the cells. In other factories the cells are arranged in lines and are charged from the slicer by suitable telescopic pipes or other convenient means. A circular disposition of the cells facilitates charging by the use of a pipe rotating above them, but it renders the disposal of the hot spent slices somewhat