The nature and properties of the Sugar-Cane, with practical directions for the improvement of its culture, and the manufacture of its products.—By GEORGE RICHARDSON PORTER.

THE author of the volume before us, informs us in his preface, that his attention has been particularly called to the subject of the manufacture of sugar, by the circumstance of his having obtained the grant of a patent for an invention, which he does not doubt will be eminently useful to the sugar planter, in the successful and economical manufacture of his produce; and further, that in attempting to supply the deficiency, which he has detected as arising from the want of any publication in our own language of adequate authority on the general nature of the subject, he has not relied alone on his own experience, but has availed himself of every source of knowledge to which he could obtain access.

In the first chapter, Mr. Porter endeavours to trace the origin of the sugar cane, and gives a brief sketch of its gradual progress throughout the world, to the time of its produce being considered almost a necessary of life in every civilized land. He then gives a description of the plant in its botanical character, as well as of its peculiar properties, and the manner of its secreting its juice; and proceeds to point out the influence of soil and climate in the cultivation, and the vegetable economy of the plant.

In the sixth chapter, in speaking of the expressed juice, he remarks—

The proportion and quality of the different juices vary, more or less, in the cane liquor, depending, not only on the kind of cane and the season, but also on numerous other local circumstances. The water which the liquor contains must be considered under two different relations; the one holding the mucus and mucilage in a saturated solution: this is called the water of solution, and, combined with these matters, takes the name of sirop; the second is the superabundant water, and is generally from sixty to eighty-five per cent. in quantity, over and above the water of solution.

In order to exhibit the relative proportions of water and sirop, we give the following table, taken from Dr. Dutrone's work; an authority which we have uniformly found so accurate, that we do not hesitate to take this table as a guide. It is constructed from experiments made with solutions of very pure sugar, taken at all-degrees of the saccharometer. By means of the saccharometer and this table, the proportion of sugar contained in the expressed juice may be immediately ascertained, and the quantity of water which must be evaporated, to bring it to the point of saturation, can be accurately determined. It will also enable us to judge, by approximation, of the proportion of water and soluble matter contained in juices of middling and bad qualities.

Table of the quantity of Sugar contained in one hundred pounds of expressed cane juice or sirop of good quality; and also of the quantity of water that must be evaporated, to reduce the same to the state of saturated sirop, taken at each degree of the saccharometer.

Scale of Baume's Degrees.	Weight of Sugar in each 100 lbs. juice or sirop.			Weight of Water in each 100 lbs. juice or sirop, beyond the water of solution.			Specific gravities of solutions at each Degree.			
	lbs.	oz.	dr.	lbs.	oz.	dr.	Deg.	Sp. gr.	Deg.	Sp. gr.
1	1	13	6	97	..	15	1	1006	35	1312
2	3	10	12	94	1	14	2	1013	36	1324
3	5	8	3	91	2	13	3	1020	37	1336
4	7	5	10	88	3	12	4	1028	38	1349
5	9	3	..	85	4	10	5	1035	39	1361
6	11	..	7	82	5	11	6	1042	40	1374
7	12	13	14	79	6	9	7	1050	41	1386
8	14	11	4	76	7	8	8	1058	42	1400
9	16	8	11	73	8	7	9	1065	43	1413
10	18	6	1	70	9	6	10	1073	44	1427
11	20	3	8	67	10	5	11	1181	45	1441
12	22	..	15	64	11	4	12	1090	46	1456
13	23	14	5	61	12	3	13	1100	47	1470
14	25	11	12	58	13	3	14	1106	48	1485
15	27	9	2	55	14	1	15	1114	49	1500
16	29	6	9	52	15	1	16	1125	50	1515
17	31	4	..	50	..	..	17	1132	55	1618
18	33	1	6	47	..	15	18	1140		
19	34	14	13	44	1	14	19	1148		
20	36	12	3	41	2	13	20	1157		
21	38	9	10	38	3	12	21	1167		
22	40	7	1	35	4	11	22	1176		
23	42	4	7	32	5	10	23	1186		
24	44	1	14	29	6	9	24	1195		
25	45	15	4	26	7	8	25	1205		
26	47	12	11	23	8	7	26	1215		
27	49	10	1	20	9	6	27	1225		
28	51	7	8	17	10	5	28	1235		
29	53	4	15	14	11	4	29	1246		
30	55	2	5	11	12	3	30	1256		
31	56	15	12	8	13	2	31	1267		
32	58	13	3	5	14	1	32	1278		
33	60	10	9	2	15	..	33	1289		
34	62	8	..				34	1301		

A saturated solution of very pure sugar contains five parts of sugar and three parts of water. This is indicated by 34° of Baume's saccharometer, at the temperature of 82° Fah.

The variation in the proportion of superabundant water is sometimes so considerable, that Dutrone found in the same plantation, at three months' interval, cane-juice, differing from 5° to 14° of the saccharometer. The first contained, according to the table, 9 lbs. 3 oz.; the second 25 lbs. 11 oz. of sugar in 100 lbs. of juice.

Cazaud found that in January, four hundred gallons of juice commonly yielded forty-eight gallons of sugar and molasses, one with the other; in February, from fifty-six to sixty-four; in March, from

sixty-four to seventy-two; and in April, sometimes eighty. He affirms, that the dryness of the season, and not the age of the canes, is the cause of this increase of produce: he considers the greatest relative maturity of the canes to be, when the juice is four parts water and one part sugar and molasses. Edwards considers the average proportion to be eight parts water and two sugar and molasses, the latter equally divided.

The juice of canes, just arrived at their full growth, is in the sweet mucous state; this, when clarified and concentrated, assumes a very deep brown colour, and becomes sirop of very thick consistence; if the heat applied be greater than 221° Fah. it will be decomposed; if the juice be expressed from the cane while maturing, the mucous juice is then in the saccharine state, and when clarified and concentrated, produces sirop of a very deep colour and thick consistence; it can scarcely support 225° Fah. without decomposition, while the mucous juice, in the state of essential salt, remains undecomposed at the heat of 260° , and pure sugar will bear exposure to 300° , and even higher, without injury.

It can now be easily perceived, how greatly the presence of sweet and saccharine juices is injurious to the manufacture of sugar, when, as is now always the case, degrees of heat are used sufficiently high to decompose them. The mucilage is more or less abundant according to the nature of the cane and the situation in which it grows; it is the colouring matter of the juice, which varies from lemon colour to a deep brown, according as the heat and alkalis, in separating this matter from the feculencies, increases the proportion of mucilage which is held in solution by the fluids. We have already said that alkalis, combining with the mucilage, give intensity to its colour in proportion to their causticity, and the smell peculiar to the cane is lost in that of leys.

Mineral and acetic acids revive the yellow colour of the juice, and change it to amber, more or less dark, according to their strength. The vegetable acids, such as cream of tartar, citric acid, &c. &c. weaken and partially destroy its colour; oxalic acid destroys it entirely, when the base of this juice, deprived of the colouring principle which held it in solution, shows it under a solid form, white and insoluble in all menstua. It can readily be conceived that the mucilage, having for its base a substance which is only held in solution by a colouring principle, will injure the crystallization of the sugar in proportion to the quantity of that mucilage which is contained in the expressed juice; whence it may be concluded, that alkalis are injurious in proportion to their activity in separating the mucilage from the feculent parts, and that, in the necessity of employing them to clarify the expressed juice, we should carefully seek for every means of judiciously conducting the operation. This delicate and important office is, however, generally performed in the most slovenly and careless manner.

We next have a description of the general method of manufacturing the juice into sugar, as practised in our colonies, and also of the distillation of rum from the molasses and other matters usually sub-

jected to this process. From the next chapter, which describes at considerable length the French method of manufacturing sugar, as practised by Dutrone, we propose making some extracts.

In speaking of Dutrone he says—After having examined with the greatest care, and in every possible point of view, the means generally in use in his time; after having minutely and profoundly studied the nature of the cane, and acquired the most intimate knowledge of its juice, he discovered and adopted what he considered the most advantageous method for the manufacture of this juice. Many methods seem to have passed in review before him, and many appear to have been rejected before he ultimately fixed his choice. In this selection he was guided, by experience, to the adoption of plans in agreement with the soundest principles of chemistry, and appeals to the result as confirming the propriety of his choice.

In the description about to be given, every operation will be shown perfectly distinct; it will be seen, that each follows the other without confusion, or intermixture; that every step of this method, and the order of its progress, is simple, easy to be understood, and certain in its execution. It will readily be acknowledged, that this progress can be applied to all circumstances under which the juice may be found; that it does not always require the presence of the superintendent; that it may be confided to persons comparatively ignorant, without their being able to derange it, and that all the faults, which are the inevitable effect of negligence, can be repaired with smaller loss than has usually arisen from similar causes.

Dutrone was convinced of the absolute impossibility of entirely removing, by the scummer, the impurities belonging to the juice, and the extraneous earthy matters, which are always in a greater or less proportion found in it; he therefore saw that it was absolutely indispensable to filter, and to leave the cane liquor to deposit before concentrating. For this purpose he adapted two reservoirs, to communicate with the concentrating vessels, which fulfilled this end admirably well, and produced the greatest advantages.

In order that every operation which the manufacture of the juice requires, and the order which it ought to keep, may be easily seen and followed, we will explain the arrangement of the interior of a sugar-house, which Dutrone conceives best qualified for the proper application of this method. All the operations required can be accomplished, either by the assistance of one furnace or two separate ones. In the greatest number of plantations one furnace is preferable, because, while it equally well accomplishes the proposed end, it effects economy of fuel and labour. In very large plantations, where the most powerful means are required, two furnaces should be erected, but it will make no difference in the arrangement of the sugar-house. The vessels used for boiling, are called, collectively, the laboratory, which generally consists of three or four boilers placed in a line. Whatever may be the disposition of the laboratory, the order of the work is the same. The laboratory should be placed in the sugar-house, in such a manner that its two sides and the end, formed by the concentrating pan, should be isolated through

the whole extent, in order that the attendance on them may be easy, and that the negroes may be able to execute, with the greatest economy of time and of means, every thing proper to be done for the greatest perfection of the work. The laboratory, in the interior of a sugar-house, has four copper vessels, the capacity of each ought to be from 300 to 600 gallons.* The first, which receives the expressed juice, is called the first clarifier; the next, the second clarifier, the third, the evaporator, the fourth, the concentrator. These vessels are placed very near to each other, and have only an edge of two or three inches thickness between them. The masonry in which they are set forms the sides of the laboratory, the least thickness of which, at the upper part, is about fifteen or eighteen inches. The surface of this masonry is inclined seven or eight inches from the outer edge to the lip of the boilers; there are between each of these, basins let into the masonry, where the scum which is taken off is put, and this is carried back, by channels, to the first clarifier: between this vessel and the wall is a basin, which receives the first feculencies, whence they flow, through a pipe, to a vessel placed underneath to receive them. These basins and channels are made of lead, soldered to a setting of copper, which covers the surface of the masonry of the laboratory; this setting is soldered to the circumference of the boilers, which are also soldered to each other; in this state the laboratory offers the best adaptation to the desired end.

It should be remarked, that in the centre of the basins, which are between the evaporator and the concentrator, there is an opening to a canal, which descends in the thickness of the masonry, and which is then continued horizontally to the bottom of a copper vessel, placed at the foot of the reservoirs for filtration and subsidence. On the surface of the laboratory, on each side of the concentrator, there are canals which proceed from the reservoirs through the brick work, and open near the brim of the boiler. A cooler, placed at the end of the concentrator, forms also part of the laboratory. Two reservoirs, placed at a little distance from the laboratory, serve for filtration and subsidence. The filters ought to be large enough to contain all the expressed juice (diminished to the state of sirop, indicating twenty-four or twenty-six degrees of the saccharometer,) which the mill can furnish in twenty-four hours; they ought to be made of masonry, lined with lead, and entirely covered with several sieves, the bottoms of which may be made with osier hurdles. There are fixed on these bottoms, for the purpose of filtration, first a woollen, then a linen cloth, and lastly a reticulation of brass wire. Two leaden canals form a communication between the reservoirs and the labo-

* Their dimensions are—

	Depth.	Diameter. <i>Top.</i>	Diameter. <i>Bottom.</i>
<i>a</i>	- - 27 inches.	88 inches.	64 inches.
<i>b</i>	- - 28 "	88 "	64 "
<i>c</i>	- - 29 "	80 "	62 "
<i>d</i>	- - 30 "	78 "	60 "

Their bottoms are slightly convex.

ratory, the one conveys the evaporated sirop to the vessel placed at the foot of each reservoir, from whence it is poured upon the filters; the other, the opening of which, at the bottom of the reservoir, is shut by a valve, carries back the sirop, filtered and subsided, to the concentrator. The bottom of the reservoir for subsidence, ought to be raised half an inch above the level of the opening of the canal near the brim of the concentrator. The sugar-house ought to have two laboratories, and each laboratory ought to communicate with the reservoirs.* The reservoirs for the expressed juice are common, or proper, to each laboratory; they are placed outside the sugar-house, as much for cleanliness as for preserving the juice cool; they ought to be covered by a well inclosed shed, or vaulted over. These reservoirs, lined with lead, should each be large enough to contain three hundred and seventy-five gallons, at the least; they ought to be always filled to a fixed and determinate height, equal to one charge,† in order that not only an exact account may be kept of the quantity of expressed juice which comes to the sugar-house, but also of the quantity of lime that should be employed to separate the feculencies from the juice. As it is highly proper to know the degree of richness of the juice to be manufactured, there should be a saccharometer to ascertain it from time to time.

[TO BE CONTINUED.]

The Results of Machinery, namely, Cheap Production and Increased Employment Exhibited; being an Address to the Working Men of the United Kingdom. Forming No. 1 of the Working Man's Companion.

THIS is a work just published by the Society for the Diffusion of Useful Knowledge. We can imagine nothing more suitable to the general mass of readers, and are quite sure that nothing could have been better timed. It is the very thing that was wanted to dispel that great popular delusion which has made the events of the year 1830 an absolute disgrace to us as a civilized and manufacturing people. It is the strong right arm of reason put forth in aid of the comparatively weak arm of the law. In manner and matter it is alike admirable; the style simple and familiar—the reasoning clear—the illustrations copious and well chosen—and the treatment of the subject altogether so satisfactory, that not a shadow of doubt can rest on any willing mind of the soundness of the general conclusion which it is the great purpose of the book to enforce; namely, that to oppose machinery, is to oppose the very best friend the poor, as well as rich, ever had.

* It is always better to have two fire places, though only one should be used at a time, lest any accident should happen to the one in use. This precaution is more necessary, since, as the canes cannot be kept without fermenting, all those which were cut would be lost.

† The charge must be a determinate quantity, which ought never to vary when once fixed.