CHEMICAL OBSERVATIONS ON SUGAR.

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CONTENTS.

CHEMICAL OBSERVATIONS

ON

SUGAR.

SECTION I.

INTRODUCTORY.

SUGAR has ſo long been an important and extenſive article of commerce, that its natural hiſtory, the mode of its culture, and the various proceſſes, by which it is purified, and otherwiſe prepared, are very well known. It is, likewiſe, ſo univerſally made uſe of, for a variety of œconomical purpoſes, that its general properties are ſufficiently underſtood. But until very lately, little progreſs has been

made in the chemical inveſtigation of its conſtituent principles; the various accounts of the chemical nature of ſugar, given by different writers, being ſufficient proofs of its true analyſis being unknown to them.

By ſome it has been deſcribed as the native ſalt of a vegetable, rendered inflammable by the mixture of a certain portion of oil.—By others it has been called an eſſential ſalt, conſiſting of an acid united with a large quantity of a very attenuated and mucilaginous earth, and with a certain quantity of ſweet and not volatile oil. And by others it has been ſaid to be a native ſoap, conſiſting of an oil rendered miſcible with water, by means of a ſaline ſubſtance.

These accounts are, obviouſly, too vague and indeterminate, not to ſay unintelligible, to be admitted as chemical definitions, and they appear, evidently, to have been derived

rived from experiments which were too imperfect to exhibit a true analyſis of this ſubſtance. For until the experiments which were made on ſugar, a very few years ago, by thoſe celebrated and indefatigable chemiſts Bergman and Scheele, and which are, certainly, the only ones which lead to a rational conjecture reſpecting its compoſition, the only proceſſes employed for this purpoſe were ſimple diſtillations, without addition, by different degrees of heat.

FROM the experiments of Scheele and Bergman, which have been alluded to, it is, however, probable, that ſugar is compoſed of a peculiar acid and phlogiſton, and the proceſs by which a ſeparation of theſe principles may be effected, is as follows.

To one part of pure refined ſugar, finely powdered, add three parts of nitrous acid; expoſe this mixture in a glaſs alembic, to a very gentle heat; a violent efferveſcence will enſue, and phlogiſticated nitrous acid

will be condenſed in the head of the alembic. When nearly one-half of the nitrous acid is diſtilled, three additional parts of the nitrous acid ſhould be mixed with the reſiduum in the alembic; a ſecond diſtillation will now take place, and when the reſiduum begins to exchange its yellow for an orange hue, the veſſel is to be removed from the heat, and expoſed in a cold air, which will very ſoon produce the ſeparation of chryſtals. The liquor in the veſſel ſhould be decanted, and the cryſtals ſhould be well waſhed in warm diſtilled water. The cryſtals may then be conſidered as the pure acid of ſugar. By adding three more parts of the nitrous acid to the remaining mixture, more chryſtals may be obtained.

The acid obtained from ſugar by the preceding operation, poſſeſſes many peculiar properties, which ſufficiently diſtinguiſh it from all other acids. It would be ſuperfluous, in this place, to enumerate theſe,

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as they may be ſeen, with its affinities for other ſubſtances, in Bergman's Diſſertations, and in his Eſſay on elective attractions.

ADMITTING the exiſtence of ſuch a principle as phlogiſton and its various affinities, according to the preſent received doctrines of chemiſtry, there can be little doubt, from the reſult of the preceding experiment, but ſugar really conſiſts, as was before obſerved, of a peculiar acid and phlogiſton; and that their ſeparation, in this proceſs, is effected by the greater affinity which the phlogiſton has to the nitrous, than to the ſaccharine acid.

IT will be the object of the ſubſequent pages to enquire whether any of the facts and phenomena which reſpect the natural production of ſugar, or any of the changes produced on this ſubſtance by other chemical operations, agree with the foregoing analyſis.

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And this enquiry, according to the rules of chemical inveſtigation, obviouſly divides itſelf into three parts, comprehending three different ſtates or circumſtances reſpecting ſugar.

I. Its production or compoſition by natural proceſſes.

II. Its decompoſition by art, and more eſpecially by the moſt general operation to which it is ſubjected, namely, fermentation.

III. Its revivification by the artificial reunion of its conſtituent parts. Which ſeveral ſtates I ſhall endeavor to conſider ſeparately.

SECTION

SECTION II.

Of the production or compoſition of ſugar by natural proceſſes.

SUGAR is well known to be the inſpiſſated, or cryſtallized juice of a vegetable, and it has been aſcertained by the experiments of Margraaf and others, that it forms a part of a great variety of plants, though in moſt of them it is in ſuch ſmall quantities, and ſo cloſely combined with other matter, that its ſeparation is too difficult, and the quantity obtainable, too inconſiderable, to make the proceſs worth carrying on as a manufacture: The plant from which it is obtained in the greateſt abundance, and which is at preſent alone cultivated for this production, is the ſugar cane, a native of tropical climates.

ITS exiſtence in the fruits and ſeeds of many plants, is, likewiſe obvious, from their ſweet taſte, and from their juices or infuſions being capable of the fermentatory proceſs.

THERE can be no doubt, therefore, but ſugar is of vegetable origin, and our next enquiry muſt be, whether theſe two principles, the acid and phlogiſton, of which it ſeems to conſiſt, can be detected in a ſeparate ſtate in vegetables; or whether the experiments which have at preſent been made on vegetation, the food of plants, its aſſimilation, &c. render it probable that theſe principles are depoſited during the growth of vegetables.

VEGETABLES receive food in two ways, by their roots, and by their leaves; by their roots, probably, water and ſome mineral ſubſtances are abſorbed; by their leaves, it is ſuppoſed that water and the air

air of the atmoſphere are taken in: Light too, both by the direct rays of the ſun, and as it is reflected from other bodies, ſeems to furniſh ſomething ſalutary to vegetable life and increaſe.

It would, perhaps, be very difficult to aſcertain the peculiar kind of matter, which plants take in by their roots, much leſs to prove that the acid of which we are ſpeaking, is derived from the earth in which they grow. The exiſtence of an acid in vegetables is, however, not the leſs certain; the ſour taſte of the leaves of ſome, of the ſtalks of others, and of the unripe fruits of many, ſufficiently proves this; and that this acid is the ſame as that which is derived from ſugar, is highly probable, from its having been obtained by Scheele, ſome time ago, from the juice of lemons, and, more lately, from the foot ſtalks of the rhubarb plant, in which it ſeems to exiſt very abundantly.

THE nature of the principle which plants derive from the ſurrounding air, has, however, been lately more ſatisfactorily demonſtrated; and that this principle greatly contributes to the ſupport of vegetable life, and to promote the growth of plants, is evident, from the large apparatus which nature has contrived for the purpoſe of its admiſſion; an apparatus ſo admirably adapted, by the very extenſive ſurface it affords, to receive a ſubſtance of ſuch great rarity.

THE chemical reader need not be informed that this ſubſtance is phlogiſton: From the ingenious experiments of Dr. Prieſtley, and Dr. Ingenhouſz, it would ſeem, that the atmoſpheric air is received into vegetables by the medium of their leaves, that during its circulation through the plant, the phlogiſton, which was combined with the air, is depoſited in the plant, and that the air, when perfectly freed from this principle, is returned from the plant,

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through different veſſels in the leaves, into the common maſs of the atmoſphere; the leaves of plants being, therefore, analogous, as performing a ſimilar office, to the lungs of animals; with this obvious difference only, that plants return the air of the atmoſphere depurated from phlogiſton, and animals return it loaded with that principle.*

* From ſome experiments which have been made by Dr. Prieſtley, ſince the publication of Dr. Ingenhouſz's Experiments on Vegetables, and, more eſpecially, from the more recently publiſhed Experiments of Sir Benjamin Tompſon on Dephlogiſticated Air, in the firſt part of the Philoſophical Tranſactions for the year 1787; there ſeems ſome reaſon to believe, that the dephlogiſticated air, which is generated by putting the leaves and green ſtalks of vegetables into water, and expoſing them, in glaſs veſſels, to the light of the ſun, does not iſſue from the vegetables, but that it is ſeparated from the water.

This circumſtance, however it may affect the particular ſyſtem of Dr. Ingenhouſz reſpecting the reſpiration of plants (and which, I confeſs, I ſhall relinquiſh very reluctantly, it being at once ſo beautiful and ſimple) by no means diſproves the general agency of vegetables in purifying the atmoſphere, in ſome way or other; nor does it leſſen the proofs that phlogiſton forms a very material part of the food of plants.

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