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some fresh leaves, minced as has been directed, may be infused in a mixture of vitriolic acid and water, of about the degree of acidity of vinegar; and it may be neutralised as it is wanted, by chalk, or fixed or volatile alkali. Avoid an excess of alkali, as it will turn the colour yellow.

By the same process Mr. Watt made a red infusion of violets, which on being neutralised formed a very sensible test; but how long it might be preserved, he had not determined.

Mr. Watt recommends to use the tests in a liquid state; as he observes, and with justice, that the size and alum in writing-paper in some degree fix the colour, while paper not sized becomes too transparent, when wetted, to render small changes of colour perceptible.

To the above useful hints of Mr. Watt we shall add another.—The skins of red radishes yield by being bruised a very sensible test, and, no doubt, might be preserved by the means he has pointed out.

XIV. *An Account of the Sugar Maple of the United States,*
by BENJAMIN RUSH, M. D. *Professor of the Institutes of*
Medicine in the University of Pennsylvania, communicated
by ROBERT JOHN THORNTON, M. D. *Lecturer on Me-*
dical Botany at Guy's Hospital.

THE *acer saccharinum* of Linnæus, or sugar maple tree, is found in great abundance in the western counties of all the middle states of the American Union. Those which grow in New York and Pennsylvania yield the sugar in a greater quantity than those which grow on the water of the Ohio. They are when at maturity, that is, when about twenty years old, as tall as an oak, and from two to three feet in diameter. They put forth a beautiful white blossom in the spring before they shew a single leaf. The colour of the blossom distinguishes the sugar maple from the *acer rubrum*, or common maple, which has a red flower. Its small branches

Branches were cut by the first settlers for the support of cattle during the winter, who threw greatly upon them. The wood is extremely inflammable, and therefore makes fine fire-wood. Its ashes afford a great quantity of pot-ash, exceeded by few, or perhaps by none, of the trees that grow in the woods of the United States.

The acer saccharinum is not injured by tapping; on the contrary, the oftener it is tapped, the more syrup is obtained from it. The effects of a yearly discharge of sap from the tree in improving and increasing the sap, is demonstrated from the superior excellence of those trees which have been perforated in an hundred places by a small wood-pecker which feeds upon the sap. The sap of such trees is much sweeter to the taste than that obtained from trees which have not been previously wounded, and more sugar is afterwards procured. In this last particular it follows a law of the animal œconomy. It is well known, that when a person has been once tapped, the process requires afterwards to be more frequently repeated. A single tree has not only survived, but flourished after forty-two tapplings in the same number of years.

A tree of an ordinary size yields, in a good season, from twenty to thirty gallons of sap, from which are made from five to six pounds of sugar. To this there are sometimes remarkable exceptions. Samuel Low, Esq. a justice of peace in Montgomery county, in the State of New York, informed Arthur Noble, Esq. that he had made twenty pounds and one ounce of sugar from the 14th to the 23d of April, in the year 1789, from a single tree that had been tapped for several successive years before. The quantity obtained per diem varies from five gallons to a pint, according to the variations of the weather. The influence which this has in increasing or lessening the discharge of the sap is very remarkable. I have seen a journal of the effects of heat, cold, moisture, drought, and thunder, upon the discharges from the sugar tree; which disposes me to believe there is some foundation

in Dr. Tongue's opinion, who supposes that changes in the weather of every kind might be as readily ascertained by discharges of sap from trees, as by the barometer. (Vide *Philosophical Transactions*, N^o 68.) Warm days succeeding frosty nights are most favourable to a plentiful discharge of sap. If frosty nights succeed a warm day, there is always a total suspension of the discharge*.

The

* Dr. Hale, in his *Vegetable Statics*, relates that he cut down a vine, and cemented to its mutilated stump glass tubes, each 7 feet long, and one fourth of an inch diameter, with brass caps, by which they were screwed on one above another, till they rose to the height of 36 feet.

By these gages it appeared,

1st. That the sap began to rise March 10, when the thermometer by day stood only at 3 degrees above the freezing point.

2^{dly}. That, April 18, it was at its height and vigour.

3^{dly}. That from that time to May 5, the force gradually decreased.

4^{thly}. That it constantly rose fastest from sun-rise to about 9 or 10 in the morning, and then gradually subsided till about 5 or 6 o'clock in the afternoon.

5^{thly}. That it rose sooner in the morning after cool weather, than after hot days, and in proportion to the coldness of the night and subsequent heat.

6^{thly}. That after several successive cold days and nights, the sap would rise during the whole day, if it chanced to be fine, although slowest at noon.

7^{thly}. That if warm weather had made the sap flow vigorously, that vigour would be abated immediately by a cold easterly wind and a cloudy sun, when the sap would sink at the rate of an inch per minute; but when the sun shone out, and the wind shifted, it rose again as usual.

8^{thly}. The oldest vines were soonest affected by a change of temperature, and in them the sap first began to sink.

9^{thly}. And, on the contrary, when the tube was fixed to a very short stump of a young vine, and at only 7 inches from the ground, the sap flowed incessantly, and fastest of all, in the greatest heat of the day, sinking only after sun-set.

He then makes this general conclusion, that the rapidity with which the sap circulates in the vine during the spring, is five times greater than the rapidity with which the blood flows in the arteries of a horse; that it is considerably slower in the summer than in spring, very languid in autumn, and ceases altogether in the winter.

The

The sap usually flows for six weeks, varying according to the temperature of the weather. The season for tapping is in February, March, and April. During the remaining part of the spring months, as also in the summer, and in the beginning of autumn, the maple tree yields a thin sap, but not fit for the manufactory of sugar.

Baron La Hontan gives the following account of the sap of the sugar maple tree, when used as drink, and the manner of obtaining it. The tree, says he, yields a sap which has a much pleasanter taste than the best lemonade or cherry water, and is the wholesomest drink in the world. This liquor is drawn by cutting the tree two inches deep in the wood, the cut being made sloping to the length of ten or twelve inches; at the lower end of this gash, a knife is thrust into the tree slopingly, so that the water runs along the cut or gash, as through a gutter, pervades the knife, and falls upon some vessels placed underneath to receive it. The gash does no harm to the tree. Some trees will yield five or six bottles of this water in a day, and many inhabitants of Canada might draw twenty hogheads of it in one day, if they had a mind to notch all the maple trees upon their plantations; but common things are slighted, and scarce any but children think of extracting this liquor from the trees.

The mode of tapping is different, and is performed with an axe or an auger. The latter is preferred, from experience of its advantage. It is introduced about three quarters of an inch, and is afterwards deepened gradually to the extent of two inches. A spout is introduced about half

The above experiments clearly demonstrate, that it is not from heat and light alone that the sap rises in the vine, or any other tree; for, if that were the case, it would increase as the heat increased; it would be greatest in the noon-day, and in the height of summer, and less in spring than in autumn, whereas the reverse is here shewn to be the case. It must therefore depend on the irritability of the fibres composing the vessels, which gets exhausted by the stimulus of heat and light, and is accumulated by its absence. T.

an inch into the hole, and it projects from three to twelve inches. The operation of tapping is first done on the south side; and when the discharge of sap lessens, an opening is made with the auger on the north side, when an abundant flow takes place.

Wooden troughs large enough to contain three or four gallons are placed under the spout to receive the sap, which is carried every day to a large receiver made of wood. From this receiver it is conveyed, after being strained, to the boiler. The following facts have been ascertained by experiment: The sooner the sap is boiled, after it is collected from the tree, the better. The larger the vessel the more sugar is obtained. The sugar is also improved by straining the sap through blankets, or cloth, either before or after it is half boiled. Some fatty substance is added to the sap in the kettle, to prevent its boiling over. Lime, eggs, or new milk, is mixed with it in order to clarify it. I have seen clear sugar made without the addition of either of them. A spoonful of slack lime, the white of one egg, and a pint of new milk, are the usual proportions of these articles, which are mixed with fifteen gallons of sap. The maple sugar clarified with milk alone had the evident superiority of all others. After being sufficiently boiled, it is *grained*, and *clayed*, and afterwards *refined*, or converted into loaf sugar. The method of conducting each of these processes is so nearly the same with those which are used in the manufactory of West India sugar, and are so generally known, that I need spend no time in describing them.

There are two other methods of reducing the sap to sugar. The first is by *freezing*. This method was tried by Mr. Scott, a farmer in this state, with great success. He says, that one half of a given quantity of sap reduced in this way, is better than one third of the same quantity reduced by boiling. If the frost should not be intense enough to reduce the sap to the graining point, it may afterwards be exposed to the action of fire for that purpose.

Secondly,

Secondly, by *spontaneous evaporation*. The hollow stump of a maple sugar tree, which had been cut down in the spring, and which was found some time after filled with sugar, first suggested to our farmers this method of obtaining sugar. So many circumstances of cold and dry weather, large and flat vessels, and above all so much time is necessary to obtain sugar by either of the above methods, that the most general method among our farmers is to obtain it by boiling.

The kettles and other utensils of a farmer's kitchen will serve most of the purposes of making sugar, and the time required for the labour (if it deserves that name) is at a season when it is impossible for the farmer to employ himself in any species of agriculture. His wife, and all his children above ten years of age, may assist him. The following receipt was published in the Albany Gazette: "Received of William Cooper, Esq. sixteen pounds for 640 pounds of sugar, made with my own hands, without any assistance, in less than four weeks, besides attending to all the other business of the farm. John Nicholls."—A single family consisting of a man and his two sons, on the Maple Sugar Lands between the Delaware and Susquehannah, made 1800 pounds of maple sugar in one season. Not more knowledge is necessary for making this sugar, than is required to make cyder, beer, &c. and yet one or all of them are made in most of the farm-houses in the United States.

Let us now take a comparative view of this sugar with that obtained from the cane, with respect to its *quality*, *price*, and the *quantity* that might probably be made in the United States, each of which I shall consider in order :

1. The *quality* of this sugar is necessarily better than that which is made in the West Indies. It is prepared in a season when not a single insect exists to feed upon it, or to mix its excretions with it. The same observation cannot be applied to the West India sugar. The insects and worms which prey upon it, and of course mix with it, compose a page in a nomenclature of natural history. I shall say no-
thing

thing of the hands which are employed in making sugar in the West Indies; for slaves have not that obligation to cleanliness which those have who work for their own benefit, and have received a proper education. It has been conceived that the maple sugar is inferior to the West India sugar in strength. The experiments which led to this opinion I suspect have been inaccurate, or have been made with maple sugar prepared in a slovenly way. I have examined equal quantities by weight of both the grained and the loaf sugar, in hyson tea, and in coffee, made in every respect equal by the minutest circumstances that could affect the quality or taste of each of them, and could perceive no inferiority in the strength of the maple sugar. The liquors which were to decide this question were examined at the same time by Alexander Hamilton, Esq. secretary of the treasury of the United States, Mr. Henry Drinbur, and several ladies, who all concurred in the above opinion.

2. *Price.* Whoever considers that the gift of the sugar maple tree is from a benevolent Providence; that we have many millions of acres in our country covered with them; that the tree is improved by repeated tappings; and that the sugar is obtained by the frugal labour of a farmer's family; and at the same time considers the labour of cultivating the sugar cane, the capitals sunk in sugar works, the first cost of slaves and cattle, and the expences of provisions for both, &c. will not hesitate in believing that the maple sugar may be manufactured much cheaper, and sold at a considerably *less price* than that which is made in the West Indies.

3. The resources for making a sufficient *quantity* of this sugar, not only for the consumption of the United States, but for exportation, will appear from the following facts:—There are in the states of New York and Pennsylvania alone, at least ten millions of acres of land which produce the sugar maple tree in the proportion of thirty trees to one acre. Now, supposing all the persons capable of labour in a family to consist of three, and each person to attend 150 trees, and each

each tree to yield 5 pounds of sugar, the product of labour of 60,000 families would be 135,000,000 pounds of sugar, and, allowing the inhabitants of the United States to compose 600,000 families, each of which consumed 200 pounds of sugar a year, the whole consumption would be 120,000,000 pounds a year, which would leave a balance of 15,000,000 pounds for exportation. Valuing the sugar at 6—90 of a dollar per pound, the sum saved would be 8,000,000 dollars of home consumption, and the sum gained by exportation would be 1,000,000 dollars.

The maple sugar also affords excellent vinegar; its molasses is capable of affording a very pleasant summer beer. The sap is also capable of producing spirit; but we hope this wholesome juice will never be prostituted to such a purpose. A diet consisting of a plentiful admixture of sugar has many advantages.

Sugar affords the greatest quantity of nourishment in a given quantity of matter of any substance in nature. Hence the Indians use it in their excursions. They mix a certain quantity of maple sugar with an equal quantity of Indian corn, dried and powdered. This mixture is packed up in little baskets. A few spoonfuls of it mixed with half a pint of spring water, afford them a pleasing and strengthening meal. From the great degree of strength and nourishment which are conveyed into animal bodies by a small bulk of sugar, it may be given to horses with great advantage. A pound of sugar with grass or hay, I have been told, has supported the strength and spirits of a horse during a whole day's labour in one of the West India islands. A larger quantity given alone has fattened horses and cattle during the war before last in Hispaniola, for a period of several months, in which the exportation of sugar and the importation of grain were prevented by the want of ships.

3. A plentiful use of sugar is the best preventative of worms. The author of nature seems to have implanted a love for sweets in all children for their growth, and to ward off the disease of worms,

4. I think it probable, that the frequency of malignant fevers of all kinds has been lessened by this diet, and that its more general use would defend that class of people who are most subject to malignant fevers from being so often affected by them.

5. It has been said, that sugar injures the teeth; but this opinion now has so few advocates, that it does not merit a serious refutation.

It has been a subject of enquiry, whether the maple sugar might not be improved in its quality, and increased in its *quantity*, by culture. From the influence which culture has upon forest and other trees, it has been supposed, that by transplanting the maple sugar tree into a garden, or by destroying such other trees as shelter it from the rays of the sun, much advantage might accrue. I know but of one fact. A farmer in Northampton county, in the state of Pennsylvania, planted a number of these trees above twenty years ago in his meadow, and he declares that the quality is so improved, that from three gallons of the sap he obtains every year a pound of sugar; and it is a known circumstance that, to produce the same quantity of sugar from the trees which grow wild in the wood, it requires five or six gallons of sap. To transmit to future generations all the advantages which have been here enumerated, it is necessary that this tree should be cultivated in the old and improved parts of the United States, and a bounty given upon the maple sugar by Government. Afterwards men would find out their own advantage in rearing them. An orchard consisting of 200 trees, planted upon a common form, would yield more profit than the same number of apple or any other trees. If a greater exposure of a tree to the action of the sun has the same effect upon the maple that it has upon other trees, a larger quantity of sugar might reasonably be expected from each tree planted in an orchard. Allowing it to be only seven pounds, then 200 trees will yield 1400 pounds of sugar; and deducting 200 from the quantity for the consumption of the family, there will remain for sale 1200 pounds,

pounds, which at 6—90 of a dollar per pound will yield an annual profit to the farmer of 80 dollars. Should this mode of transplanting for the purpose of obtaining sugar be successful, it will not be a new one. The sugar cane of the West Indies was brought originally from the woods of the East Indies by the Portuguese, and cultivated at Madeira, from whence it was transplanted directly or indirectly to all the sugar islands of the West Indies.

In contemplating the present opening prospects in human affairs, I am led to expect that a material share of the happiness which Heaven seems to have prepared for all mankind, will be derived chiefly from the manufactory and general use of the maple sugar, which I flatter myself will not be confined to us, but will extend itself to other nations. With this view of the subject, I cannot help contemplating a sugar American maple tree with a species of affection and even veneration; for I have persuaded myself to behold in it the happy means of rendering the commerce and slavery of our African brethren in the West India islands as unnecessary as it has always been inhuman and unjust*.

XV. *An Account of Mr. PARK's Journey into the Interior Parts of Africa. From the Proceedings of the African Association, 1798.*

THE account of the proceedings of the African Association, from which the following extract is taken, though it abounds with many curious particulars which we have been obliged to omit, contains but a small part of the information obtained by Mr. Park during the course of his peregrinations in the wild regions of Africa. A detailed relation of

* The friends to the abolition of the Slave Trade should not allow the information contained in this article to escape their notice. It would require very little expence or industry to introduce the sugar maple into England, where it would probably thrive as well as in America. T.