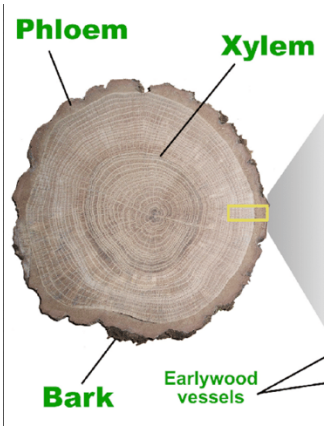
May Your Sap Run Strong and Sweet: Nature, History, Technology & Food

Colvin Run Mill's annual maple syrup boil-down provides another opportunity to explore nature, history, technology, and food, a combination that Colvin Run offers that is hard to match. The February event is timed when the seasons begin to change, cold nights and warm days. Making maple syrup is hard labor. As Robin Wall Kimmerer reminds us in *Braiding Sweetgrass,* mother earth has endowed us with the gift of the sugar maple, but "It is our work, and our gratitude, that distills the sweetness." Good results are never certain. The weather, the tree's health, soil moisture, and leaf production are variables affecting the outcome. When syrup season starts, sugar makers wish each other good luck: "May your sap run strong and sweet."

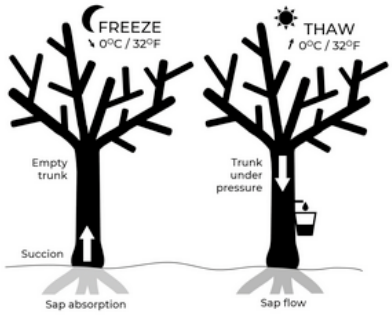
Nature: The Sugar Maple



During the growing season leaves of a tree produce sugar and oxygen from carbon dioxide and water by photosynthesis – "photo" meaning that light generates the energy for the "synthesis," the chemical conversion. Some of the sugar is converted to cellulose, the plants' cell walls that increases the size of the tree. The leaves produce more sugar than they need for growth, so it flows back into the branches, trunk roots through the *phloem* – the area between the bark and the wood - where it is stored as starch and sugar. This basic description provides a clue as to what makes a worthy, sap producing sugar maple: (1) a large crown with many leaves is called a 'sweet tree' since it has the capacity to generate more sugar than smaller trees; and (2) age, the sugar maple needs to be about thirty to forty years old to produce sap from an accumulation of starches throughout a well-developed, healthy tree.

As days become longer, the increased sunlight activates photochromes in the tree buds that signal the roots to start pumping to support a new season of growth. Water is drawn up to the leaves through "sapwood," aka *xylem*, the conduit. Each year new xylem is formed – those account for the "rings" in a cross-section of a cut tree trunk. The signal from the photochromes also triggers an enzyme to covert the starch stored in the tree to sugar.

This sugar-making process is common for trees. What makes the sugar maple special is that its sap is about two percent sugar, higher than other trees. Sure, the sap of black walnuts, birches, butternut, and a few other maples is tasty and can be used for hot brews, but, other than the black maple, their sugar concentration is low making their sap unsuitable for syrup production.



The sugar maple possesses a unique pumping system. The tree's ray cells surrounding the xylem are filled with gas, not water. For sap to readily flow, night temperatures must be freezing, in the teens, and days mild, in the thirties. At night the sap in the xylem freezes and, following nature's laws, expands (you remember that don't you?), drawing up more water from the roots. In contrast, the gas in the ray cell's contract. Sugar in these cells turns to frost. Thawing adds this sugar to the watery sap and causes the gas to expand, creating pressure throughout the tree that is greater than the atmospheric pressure outside the tree. Sap then exits at the point of least resistance: through the tap hole drilled to collect sap – like air coming out of a punctured tire.

History: Native Americans and New Americans on a Sugar High

Of the several Native American Indian legends regarding the discovery of the sweet sap of the sugar maple, the most straightforward, if least colorful, is that to quench a thirst on a brilliant sunlit late winter's day, a parched Indian tore off a tantalizing icicle dangling from a broken twig of a sugar maple. Boom! Such sweet "sapsicles" sparked the search for the motherload – the tree's trunk. When the "maple moon," appeared in February, the Indians set up a sugar camp in a large grove of maple sugar trees – the sugarbush.

With a hatchet they etched a "V-shape in the trunk, placed a wedge at the bottom of the "V," and caught the sap with woven bark baskets or hollowed out logs. A night's freeze would solidify the water, leaving concentrated sap. More night freezes, more concentration. Or they boiled the sap in birch baskets, watching the water evaporate (at 220 degrees F) while tending the fire which would burn the basket if it became too hot (500-degrees F). Syrup spoils so they boiled down the sap until it crystalized. Throwing some on the snow would yield taffy-like "snow sugar." More boiling would produce "grain sugar," coarse like brown sugar. Packed into molds, this became "cake sugar," hard blocks that could be kept for a long time. They were offered as gifts, traded, had a bit shaved off to blend with berries, other foods, or added to water for an energy boost.

European settlers learned to tap maple trees from Native Indians because sugar maples, *Acer saccharum*, are native to eastern Canada and eastern United States, not Europe. While there are around 132 species of maple many are native to Asia. Those found in Europe tend to be ornamental shade trees.

The first written record by a European of the maple's sweet sap was in 1557 by André Thévet, a French priest and explorer who transcribed accounts of compatriots returning from New France, now Canada. Elaborate detail was added fifty years later by Marc Lescarbot in his *Histoire de la Novuvelle France*. A French lawyer, he accompanied an expedition to Arcadia, a colony of New France (now roughly Canadian Maritime Provinces) and took detailed notes on customs of local

Indians, the Mi'kmaq and the Malécite, their songs, chants, and sugaring process. He considered them in some ways more civilized and virtuous than his European brethren.

One hundred eighty years later the young American Republic experienced a short, but naturally sweet, maple sugar bubble. William Cooper, father of the famous novelist James Fenimore Cooper, was a Quaker, a judge, a land speculator, and, linked to the later, a "sugar booster."

After the Revolutionary War he obtained several thousand acres of land in New York, moved his family up from New Jersey and founded Cooperstown. He was enthralled with the idea of substituting maple sugar for cane sugar imported from British Caribbean islands produced by slave labor. He reasoned that satisfying America's sweet tooth with domestic maple syrup could strike a blow against slavery and reinforce independence from the Crown. A Quaker friend in Philadelphia, William Drinker, shipped him kettles for distribution among locals for evaporating the sap.

No less than Benjamin Rush, the noted doctor, signer of the Declaration of Independence, and ardent abolitionist, joined the cause, writing in 1788, about the "Advantages of the Culture of the Sugar Maple Tree." He hosted a "sugar tasting" to compare tea sweetened with cane sugar with tea treated with maple sugar. The participants, including Alexander Hamilton and a "few ladies," agreed that the maple sugar tea was just as sweet, if not sweeter for the touch of liberty and honest labor. Poet David Humphry waxed lyrical: "Bleed on, blest tree!" "Turn Nature's wilder growth to human use/And fin [refine] pure sugar from the Maple's juice."

Hamilton's assistant secretary of the Treasury, Tench Cox, relying on Cooper's figures, devoted a chapter to maple sugar in his, "A View of the United States of America" on the country's economic outlook, estimating that the US could produce enough to meet domestic demand. Thomas Jefferson became a believer, eschewed cane sugar at Monticello, had maple tree seeds and saplings planted, and looked forward to the US exporting sugar.

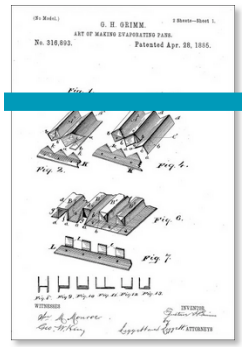
Alas, within three years the maple sugar bubble burst. Jefferson's maple groves never took root in warm Virginian clay, and long winters and short springs reduced Cooper's anticipated production. Settlers in New York, enticed by Cooper, and Vermont, where Quakers had invested in maple sugar production, preferred to be independent, not part of a conglomerate. William's son James would deride the entire episode, including his father, in the *Pioneers*.

Technology – New Gadgets, Same Process

Around 1810 sugar makers began to drill holes in the trees with augers and tapping in a spile made of a softwood twig with a soft center that could be pushed out to make a tube for the sap. In the late 1850's metal spouts were introduced and by 1875 metal buckets could be seen hanging on them.

Sap would be accumulated in large barrels on sledges and pulled to a fire pit with large cast iron kettles. As evaporation began in one kettle, the thickened sap would be poured into a smaller one for further condensation, and into another. Crystalized syrup was poured into wooden molds to form sugar blocks.

Along around 1820 a report surfaced of a sugar maker using a large flat iron pan to evaporate the sap. The logic was as simple as salt. Since antiquity salt had been produced by evaporating briny water emerging from local springs. The Romans developed large lead pans for the purpose, increasing the water's exposure to air and heat thereby acceleration evaporation, and housed them in "wiches." Thus, village names like Northwick, Ipswich, Middlewich.


G. H. GRIMM.
ART OF MAKING EVAPORATING PANS.
No. 310,893. Patented Apr. 28, 1885.

1885 Patent drawing from Grimm's method of folding metal to form raised flues (US316893).

In1861 the Maine Board of Agriculture concluded the obvious: flat bottom pans are better than kettles. Further progress was in store. Gustav Henry Grimm, a German immigrant living in Hudson, Ohio, applied his tin making skills to create a series of partitions to channel the flow of sap through a maze-like path as it condensed. He also fashioned raised flues to increase the surface expose to the fire's heat. The 1880's Champion Evaporator prompted even more innovations.

At this year's Colvin Run maple syrup boil down the old flat pan will be swapped out for a new Smoky Lake stainless steel divided "Continuous Flow" evaporator.

At the end of the 1800's cane sugar began to cost less maple sugar. The industry's concentration shifted to syrup. Technological advances included plastic tubing systems that stretch from tree to sugar shack, reverse osmosis machines to thicken the sap before boiling, and a smaller "health spout." But the process is unchanged: tap the tree, gather the sap, boil it down.

Food – Once you taste the sweet maple syrup you want more – but don't!

Maple syrup can be golden, amber, dark, or very dark, depending when on the sap emerges – early or later, with a taste offering hints of caramel and vanilla. Pairs well with pancakes. Caution: one tablespoon contains 12 grams of sugar – 52 calories. Moderation is advised. Maple syrup contains traces of minerals and natural antioxidants – that one tablespoon will deliver 33 percent of the daily requirement of manganese. Yet surprisingly, it has a moderate glycemic index (GI) (54-68), the measure of how quickly a food raises blood sugar levels. In contrast, the cloyingly sweet, gooey, heavily processed high fructose corn syrup has a GI of 75-100. Bottom line: maple syrup provides longer, sustained energy rather than a sugar spike.

That's it. A bit of nature, history, technology, and food at the mill. May your sap run strong and sweet!