Between Stones and Trees
An Ecologist Hikes Western Pennsylvania

Essay:

“Trees of Western Pennsylvania”

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The first Europeans to see Western Pennsylvania had to be overwhelmed by the extreme “treeness” of the place. Gigantic white pines and hemlocks, immense oaks and chestnuts, and a staggering array of maples, beech, ash, cherry, birch, poplar and more filled almost all of the physical space of this vast wilderness. The trees covered the valleys, the hillsides, and the mountain slopes. Trees grew in the wet-muck soils of swamps and wetlands and on the bare rocks that capped the ridge tops. The trees covered the rich, fertile soils of the bottomlands and the thin, acidic soils of the mountains. It is estimated that 95% of the 29 million acres of what is now Pennsylvania was covered with forest (USDA 2004).

The “Primary” Forests

Few early explorers or settlers in Western Pennsylvania recorded detailed observations about the types of trees that made up the vast forests that surrounded them. Some early journals, though, along with land survey notes, land company description flyers, and saw mill records are available, though, to piece together a tentative picture of what the undisturbed forest of Western Pennsylvania looked like.

In southern Pennsylvania, the ridges and valleys described by Charles Mason in his journals from the 1763 Mason and Dixon survey expedition were dense with hemlocks (which they called “spruces,” not an uncommon error of the time). They were also richly covered with chestnut (“to the very top of Laurel Hill”) (Mason, 1969). Overall, though, white oak was the most abundant species over the southern part of the state (Schoepf [1788]1968 from Whitney 1994) and in total made up 65% of the entire state’s forest cover (Whitney 1994). Around Confluence, Pennsylvania and all across Laurel Hill and Chestnut Ridge the forest, especially in areas of drier, sandy soils, was a dense growth of mixed hardwoods dominated by oak, chestnut and poplar (Kline 1973). This mixed hardwood forest had abundant hemlocks intermixed, and, in places (cooler, moister micro-sites) the hemlocks formed pure stands (Kline 1973). White pine grew in cove forests and in stream valleys in the south (Abrams 2001).

Moving northward, the forests of Cambria County were mostly hemlock with silver and sugar maple, and mixes of rock and yellow birch, chestnut, basswood, cucumber, white ash, and red and white oak (Kline 1973). The last extensive primary hemlock forest in the eastern United States was located in southeast Cambria and northeast Somerset Counties

Indiana County had extensive stands of hemlock, white pine with a diverse array of hardwoods intermixed (Kline 1975). The valleys of the Conemaugh and Kiskiminetas Rivers were covered with dense stands of hardwoods (especially oaks, hickory, ash, chestnut). In especially dry, well drained areas (which were subject to periodic burns) white pine may have been found. Hemlocks grew in moist, shady ravines and coves.

An extensive Hemlock-Beech forest covered the northern parts of the state. Hemlocks and beeches made up 60% of the trees throughout the area according to analysis of surveyors’ witness tree records (Lutz 1930) and these two species combined with the maples, birches, white pine, and chestnut present accounted for 88% of the forest’s trees. White pine (which only made up about 6% of the trees in this area) formed pure stands (“pineries”) in the coarse textured soils of the glacial outwash terraces along the Allegheny River and its various tributary streams (Whitney 1994, Abrams 2001). White pine also grew on the upper, drier, southeast facing slopes of the river valleys. The pines were most abundant in sites that had potentials for fires and for wind storms and massive wind throw (Abrams 2001). These catastrophic events were critical to the continued renewal and re-establishment of the pure white pine forests.

In the north-central regions of the state, hemlocks dominated the forests (Taber 1974). In the Tionesta Valley, hemlocks made up 75% of the trees in many forest stands (Casler 1973), and an inventory of timber resources along Tionesta

Creek in 1882 generated the following data: 50% of the trees were hemlock, 16% white pine, 11% “oaks,” and the remaining 23% was a mix of beech, birch, cherry, chestnut, maple, and ash (Casler 1973).

Data from the 1814 to 1815 survey of the forest around Kane and Warren, Pennsylvania by Samuel Dale generated the following picture of the primal forest (percentages are rounded off): 30% beech, 27% hemlock, 8% sugar maple. 6% birch, 6% chestnut, 6% white pine, 5% red maple (accounting for 88% of the trees and all of the most frequently found species) (Lutz 1930). Analysis of more extensive survey records for a broader area of northwestern Pennsylvania describes a forest that is 43% beech, 20% hemlock, 6% birch, 5% sugar maple, 5% red maple, 4% white oak, 3% white pine, and 3% chestnut (Whiney 1990). Dry sites were predominantly oak, red maple, white pine, and chestnut. Ridges had a mixed of oak and chestnut with abundant mountain laurel. Moist areas had hemlock and mixed hardwoods (especially beech). Sugar maple was especially abundant in the better drained ridges that had sandstone derived soils (Whitney 1990).

Human Uses and Influences

The suitability of land for farming was judged in part upon the kinds of trees that grew there. The “best” lands in Western Pennsylvania had a covering primal forest of elm, walnut, basswood, ash, sycamore, and cucumber tree. This forest would grow best in nutrient rich alluvial soils or upland soils associated with limestone bed rock. These soils would be good for corn production. The poorest soils were the rocky upland soils or coarse outwash soils that had supported forests of chestnut, sassafras, mountain laurel, red maple, or pitch pine (Cronon 1983, Whitney 1994). Land companies advertised their holdings and emphasized (and often exaggerated) the composition of the forest cover. The abundance of white pine (the most important commercial “timber” tree of the colonial and post-colonial years) in particular was greatly exaggerated in flyers produced by the land holding companies (Whitney 1994, Abrams 2001).

The native peoples living in Western Pennsylvania had in modest ways modified the forests to fit their needs. There were clearings probably generated by controlled burns in which villages could be built and crops could be planted. There were stands of oaks that were possibly maintained by periodic (every other year) burns, from which acorns could be efficiently harvested and within which deer could be more efficiently hunted. These “deer parks” with their minimum densities of undergrowth were well adapted to bow and arrow hunting technology (Whitney 1994). Further, the Seneca Chief Cornplanter, stated that his people frequently burned the forests along the Allegheny River to destroy the very abundant rattlesnakes (Whitney 1990). The relatively small numbers of Native Americans in these forests, though, coupled with their predominant hunter-gatherer life styles probably limited the magnitude of their overall impacts. There are some researchers, though, who contend that use of fire in the eastern forests by Native Americans did have widespread and substantial impacts on the structure and species composition of the resultant forest ecosystems. Abrams (1992), for example, outlines and extensively supports a hypothesis that the extensive, primal, “oak-climax” forests of Pennsylvania and other eastern states was a direct consequence of the fire management practices of the region’s Native American tribes.

The first Europeans passed through Western Pennsylvania on its rivers and used these waterways for many years as their primary transport systems. Eventually, pack and wagon trails were cut through the dense forests often following the narrow footpaths of the Indians. These roads were like tunnels cut through the solid mass of living trees. The dark shadows of the un-touched woods around them and the soaring heights of the standing trees had to have deep impacts on the minds and emotions of the Europeans. To these settlers, “the trees were the enemy” (thanks to Dr. Carl Meyerhuber, Associate Professor of History Emeritus, Penn State University for this insightful quote). The trees stood in the way of their plows, Indians could (and did!) hide behind them in ambush, and the forests were so claustrophobically dense! In novels about the Great Plains the madness that grew from living in the unbroken expanses of the prairies has

been well described. The crowding, towering, omnipresent trees of this great eastern forest also had to have its own unique set of impacts on the mental health of these early settlers.

The first settlers cut the trees out of their fields. They used some of the logs to build their cabins and barns and, slowly, year by year expanded their fields by taking down row after row of bordering trees. The incredible labor and expense of cutting the massive trees and pulling their stumps to generate a clear field for plowing was both physically and economically impractical. Instead, several more expedient methods of field clearing were employed. In the "cut and burn" system, trees were cut two or three feet up from the ground. The trunks were then cut up into logs and drug away either to be used for building or, more likely, to be burned. The tall stumps, then remained and were planted around for several years until they had dried sufficiently to be burned in place (Whitney 1994).

An even faster way to get land into crop production was to girdle the trees in a field. Girdling involved removing a wide ring of bark from the around the base of the tree thus cutting off the nutrient rich sap flow to the potential leaves. The leafless tree no longer shaded the soil and the farmer could then plow his furrows or plant his crop in discrete mounds while the dead and drying trees stood by. Branches would break off and be gathered up and burned. After three or four years only the trunk would still be standing. Finally, the trunk would either blow down or be cut down, drug to a brush and wood pile in a corner of the field and burned (Cronon, 1983).

The number of trees cut was far greater than an individual family's building or fuel needs so great piles of tree trunks and branch wood were stacked and burned in the open fields. Accounts of travelers in areas being cleared describe clouds of choking smoke from these fires and slippery flows of wet ashes covering the fields and the paths. Steams ran gray with the masses of wood ashes flushing into them from the burning field piles, and the fires frequently "escaped" into the surrounding forests causing even more destruction of trees (Cronon 1983, Whitney 1994).

The ashes from these pyres, though, if they were gathered and stored away from rainfall, could serve as much needed "cash crop" for these farmers. The gathered ashes, especially from the burning of hardwood trees, were rich in potash (potassium carbonate) (Whitney 1994). A farmer might sell a water leechate (potassium lye) from these ashes or might even cook the leechate in a "potash kettle" to make concentrated potash itself (Cronon 1983). Potash was used in many industrial processes including glass, soap, and gunpowder manufacturing and the processing of linens and wools.

If the settler farmstead was near a large enough waterway, the logs cut from the field trees could be stored until the spring floods allowed their reliable floating downstream to saw mills that sprang up all along the migrating edge of the county's frontier. White pine was the only tree valuable enough to be so intensively handled and transported. It was also because of its light weight an easily floated tree. Great white pines of 170 foot height or more were taken down and cut into logs and fed into the downstream mills. The white pine, then, also represented a source of much needed income for the farmer, and land with white pine stands was especially prized and valued (Casler, 1976).

Farmers also cut firewood, and, if water transportation was nearby, shipped many thousands of cords to the growing towns of the east that typically had exhausted their local forests years before (Whitney 1994). Many farmers spent their winters cutting firewood as they continued clearing and breaking new land for fields.

The impact of this farming phase of human interaction with the Pennsylvania forests was locally quite substantial but more broadly, in spite of its extreme labor and human effort, probably just a bit more consequential than the past impacts of the native peoples. Small, isolated farms arose. Fields were cleared, and fires "escaped" into the surrounding forests scouring the old growth away along with the nutrient rich humus. Cattle and pigs were turned out into the forests to forage on their own. They consumed mast (acorns, beech nuts, walnuts, hickory nuts etc), herbs of the forest

floor, seedlings and young trees, and standing tree branches up as high as they could reach. For example, it took one cow on two acres of forest land just five years to remove every piece of standing vegetation under four inches in diameter!(Whitney 1994). These animals wreaked havoc on the forest floor and tore its surface apart with their hooves and feeding habits.

But, the forest was still largely intact. It surrounded each small farm and its fields like the walls of a great fortress. Human efforts and energies were scratching at its edges, but the great mass of it remained.

The Europeans, though, kept on arriving in central and western Pennsylvania. Farms were less productive here than in the rich, flat lands of the Ohio Valley, so those who stayed here often had to have multiple ways to make a living. One of these ways involved harvesting the trees along the rivers and streams and transporting the lumber from these trees to growing cities and towns along the east coast. Thus, logging came into an increasingly intense phase and the forest began to shrink away from the river banks and retreat up the surrounding rugged ravines and mountainsides (Taber 1975).

This "Water Transport" phase of logging first concentrated on the white pines. They were cut through the year and then floated in the spring to the growing saw mills of towns (becoming cities!) like Williamsport (which in 1880 was named the "logging capital" of the United States). As the white pine began to decline in numbers, hemlocks which grew in even greater abundance were cut and floated to the mills (Kline 1975).

Another way to make a living in Western Pennsylvania of the early 1800's involved making iron. Iron ore was present in the sedimentary rocks of the region, and the technology involved to transform the ore into useable iron was labor and material intensive, but relatively simple. Three tons of iron ore mixed with 190 bushels of charcoal and 300 pounds of limestone and then put into a large, vertical furnace and ignited would yield one ton of pig iron (USDA). The "charcoal iron furnaces" sprang up throughout Western Pennsylvania in the early decades of the nineteenth century due to the coincidental abundances of hardwood trees from which charcoal could be made, and limestone and iron ore deposits throughout the area. The furnaces were located in the centers of sources of each of these raw materials.

Increasingly, because of the transportation barriers of the mountainous ridges of the central part of the state, these furnaces sent their pig iron via boats and barges to Pittsburgh for processing. This westward flow of iron was the beginning of the rich history of Pittsburgh's iron and steel industries.

The iron furnaces used prodigious amounts of charcoal. An acre of forest a day needed to be cut and cooked into charcoal in order to keep a furnace fired (USDA). A single furnace required up to 30,000 acres of available forest around it to keep the cutting and natural re-growth cycles running (Penn State University 2005). Hardwoods (like hickory, oak, ash, and chestnut) were preferably cut and fed into the collier's pile. Secondary growth that sprang up from stump sprouting and seedling growth on the logged sites was in turn harvested after 20 or 30 years of growth. Some colliers, in fact, preferred these smaller, secondary trees to the primary trees for the quality of the charcoal produced (USDA). Great swaths of forest lands throughout Western Pennsylvania were repeatedly clear cut through the nineteenth century to meet the demand for charcoal.

The iron furnaces continued production even after 1850 when coke from the area's soft coal began to serve as the fuel for the increasingly large scale system of iron and steel production. Charcoal iron production in Western Pennsylvania continued until 1921 when the last charcoal furnace near Juniata closed. Some steel production, in fact, required charcoal since it was free of the sulfur and other contaminants common to coal and coke. Iron made using these charcoals was said to be easier to work with and could hold a sharpened cutting edge better that the coke manufactured irons (Penn Stewards 2006). So the forests kept on being cut and millions of tons of charcoal flowed into the fires of the furnaces.

An equilibrium developed in the mid-nineteenth century between the logging and charcoaling processes and the status quo of the forests. As long as a forest stand was an inconvenient distance or in a difficult topographic relationship to a stream capable of log or charcoal or iron transport, that forest would not be destroyed. Any forested site, through, that did have access to water transport was likely to cut. There was little thought of replanting the forests. There was little thought of sustainable management. There were so many trees, and there was so much forest available to be cut. When the trees in one area were gone, the logging or charcoaling operation simply moved to a nearby suitably situated site. The forest was "endless." How could anyone think that the harvest would ever end?

The continued development of the railroad changed this fragile equilibrium. Railroads themselves had created new, almost insatiable commercial demands for wood. The need for staggering numbers of railroad ties for the ever expanding miles of track and millions of cords of wood each year for fuel, caused more and more forestlands to be cut and cleared (Whitney 1994). Finally, new railroad technologies (especially the geared locomotive) opened up the previously inaccessible countryside to logging (Taber 1975).

Logging railroads sprang up in almost all of the counties of Western Pennsylvania and ran mile after mile of track into the previously inaccessible forests. These tracks were often placed directly on miles of cut tree logs that had been laid end to end and cross-tied together by shorter but equally stout cut logs. Sometimes, continuous beds of cut saplings were laid perpendicular to the track line and the rails were nailed directly into them. Swamps were forded by great floating logs onto which the rails were then spiked. Gullies were crossed often not by trestles but instead by great piles of space filling logs (Casler 1976). There were trees everywhere and they were being cut and hauled and used with abandon.

Great crews of men worked in the forests cutting and trimming the logs with axes and handsaws. The logs were then drug to the rail sidings by teams of horses and oxen and loaded onto the flatcars of the logging train. The logs might be taken to a river for floating down to established saw mills, or, increasingly, they were carried directly to the newly constructed, ever larger and more efficient saw mills that were established in the new towns in the epicenters of the growing webs of track. Rapidly, the natural chaos of the forest was being simplified into orderly stacks of uniformly cut lumber.

Once again, it was the white pine that was taken preferentially. Its value and applicability in construction as framing lumber was unsurpassed. But soon, the white pine was exhausted and the incredibly abundant hemlock began to be logged and milled for framing lumber in exponentially increasing amounts.

The hemlock, though, had other historical uses. Beginning in the 1850's hemlocks were cut not so much for their wood, which was much despised by the white pine using construction industries because of its brittleness, coarseness, and abundance of knots (Whitney 1994), but for their bark (Taber 1974). Great trees felled in the woods during the spring and summer had their bark peeled away from the inner wood. The sheets of bark were stacked and hauled and raft floated to tanneries where, after a year or so of drying, the rich tannins were leeched out to be used to preserve and tan animal hides into leather. Tanneries were found in almost every county of Pennsylvania due to the widespread distribution of many tannin rich trees (including white, black, and chestnut oaks)(Taber 1974), but it was especially the hemlock that served as the primary resource for this industry.

Saw mill and tannery factories records describing timber stands in north-central and north-western Pennsylvania indicate that seventy-five percent of the standing trees were hemlocks. Some of these trees were 170 feet or more tall and had diameters of seven or eight feet and more. It was a phenomenally abundant population of trees of great size and age and stability. The hemlocks near the rivers, like the white pine before them, were harvested first. The

development of the logging railroads, then, allowed movement through the rugged terrain and the rest of the standing trees were taken (Casler 1973).

While the hemlocks were being timbered into near extinction here in Pennsylvania, another organism further to the west was being hunted and slaughtered and pushed even closer to complete annihilation. Out on the Great Plains, the American Bison herds were being exterminated (Taber 1974).

Great train loads of buffalo hides poured into the tanneries of Pennsylvania where they were preserved and softened by the concentrated tannins leeched out the remains the hemlocks. The four largest tanneries in Pennsylvania processed over 600,000 hides a year at their peak. The hides were tanned into strong, tough leathers from which horse harnesses, drive belts for factory machines, shoes, and more were made (Casler 1973). The tanneries devoured the remains of both the hemlocks and the bison and persisted until both were almost completely gone. In 1910, the Central Leather Company of Pennsylvania was one of the ten largest companies in the United States (Taber 1974). Today, like the great bison herds and the "endless" hemlock forest, Central Leather no longer exists.

The Rail Road Logging Era began in earnest around 1880 and continued for about 30 years. The white pine and the hemlock stands were cut almost completely, and then the hardwoods were taken. At first, only the largest hardwood trees were cut. The wood from these trees was used to satisfy changing building tastes by an increasingly affluent society. Furniture, inside trim and moldings for houses, and specific products like wheels, wooden pipes, and more were fashioned from the harvested hardwoods (Kline 1973, Casler 1973). In 1889, a breakthrough in paper technology allowed the use of hardwoods mixed with conifers to make paper. As a consequence, more and more hardwood trees of wider and wider range of size and ages were being cut in and around the paper mills of northern Pennsylvania (Taber 1974).

Very small hardwoods were also cut and stacked in great cross-pile stacks along the rail sidings to be carried to wood chemical factories. In these factories the wood was put into heated retorts and cooked in the absence of oxygen to remove their rich hydrocarbons from which acetates and alcohols (chemicals used extensively by many industries) were synthesized. The carbon remains of the cooked wood became charcoal which was sold for both domestic and industrial uses and was also used as filler in animal feeds. Throughout the northern tier of Central and Western Pennsylvania these factories were constructed to take advantage of the abundant hardwood in the forest and also the area's vast reserves of natural gas and coal which were needed to fuel the retorts (Casler 1973).

Soon every woody stem on a logging site was being taken and shipped to its own specific end. Areas that had been logged decades before were once again clear cut of its young and predominantly hardwood trees and saplings. The wood from these trees were then fed into the chemical plants' retort chambers. Poor quality wood was cut into shingles or bundled into packs of kindling, prime quality wood was cut into boards, and barrel staves were cut from white oak. Even the saw dust from the milling process was used as fuel to fire the boilers of the mills and factories. Everything was taken and everything was consumed (Kline 1973).

At the end of thirty short years, the primary forests of Western Pennsylvania were for all extents and purposes gone. What was left in many places was a tired wasteland of briar and brush, a dry, frequently burned mass of dead limbs and branches. The soil eroded from the exposed slopes into the surrounding streams. The rain poured across the bare slopes and ran at incredible velocities into the runs and creeks of the watersheds. Rivers became quickly swollen with unprecedented volumes of rain water and rolled across the cities downstream in great floods. Pittsburgh was repeatedly and catastrophically flooded in the 1920's and the 1930's. Factories and homes and people were swept away by the waters that should have gathered and remained in the now dwindling aquifers of the denuded northern counties.

In 1630, forests covered almost all of Pennsylvania's 29 million acres (USDA 2004). In 1903, after what Gifford Pinchot (1937) called "a perfect orgy of forest destruction," only 30% of the state was forested (USDA, 2004). Of these forested acres only 8,000 to 10,000 acres of the original, "primal," "virgin," "old growth," forest was left (Kershner and Leverett 2004), and, most of these acres existed as widely scattered, small patches across the state. The great forests of Pennsylvania were not dead because forests are extremely resilient entities, but they were irrevocably changed into new structures and conformations.

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