8 pages

Geographic Integration of Industry on the Wynants Kill 1816-1911

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Introduction

The Wynants Kill is a very small tributary of the Hudson River – just 14.1 miles long with a drainage basin of 29.1 square miles – but it falls some 850 feet, notably down the steps of three shale overthrusts, each providing many excellent sites for the development of water power. The stream draws our attention because of its rapid industrialization leading to the powering of the largest waterwheel in the world by mid-19th century[1]; and for the cooperative organization of its waterpower in the wake of the 1820 court decision of Merritt vs. Brinkerhoff.[2]

These two exemplifications - extrinsic and intrinsic; technological and geographical – are complementary, the warp and weft of social networks. We learn from the Wynants Kill how geographic pattern becomes implicit in community, relieving the need for explicit control in the economic result. We learn how the multiple choices of technology serve communal needs. In a way, geography is the Invisible Hand shaping the commercial potential of the stream.[3]

Unlike the Hudson River and most of its tributaries, the Wynants Kill drains northward. When the glaciers retreated, gravels left behind in the watersheds of streams that drained southward were flushed downstream. In the Wynants Kill and its chain of small lakes, they remained as deposits to operate as ideal water holding sinks. Jedediah Morse observed that no New Yorker is more than 20 miles (or a day's hike) from a navigable waterway.[4] So, too, with the Wynants Kill watershed; but implicit in the remark is the role of water altogether, not only in the shaping of the land over time but also in the daily fall, drain, and evaporation.

When Henry Hudson sailed into the largest fresh water tidal estuary in the world looking for a global sea route, he might have been disappointed that navigation ended at what would become Albany. But the Patroon Van Rensselaer who was given development rights to the area under the Dutch West India company recognized the watery advantages. His 1,152 square miles were the gateway to: an ocean port (and global markets); the Mohawk River leading west (especially important once canalized); the valley going north to Lakes George and Champlain to the St. Lawrence River. The Patroon system of feudal settlement begun in 1629 was maintained in 1685 under British Royal Charter, and upheld by the new Republic.

Mill Site Leases

Stephen Van Rensselaer III, in taking over the management of the Manor of Rensselaerwyck in 1785, was not interested in mere tenant subsistence but turned to his watersheds for commercial gain. The contracts drawn up with the tenants of farms surveyed in 1788 for the Patroon by Job Gilbert and Evert Van Alen (along the Wynants Kill and throughout 'Middletown' as well as the other areas of Rensselaerwyck) rented the farmer the use of the land and required him to pay the taxes while the Patroon retained the water and timber rights, and extracted one quarter of the sale price every time the farm was sold. Van Rensselaer had every intention of leasing the water privileges separately and advantageously.[5] (Eventually, 19 water privileges were engineered on the Wynants Kill. This paper is based on our editing a local history initiative to fully map these 19 sites, and untangle the mill histories at each.[6]) He rented WP 11 to Joshua Lockwood & William Carpenter in 1768 and WP 1 to David DeFreest in 1793 to build grist mills – one to grind local produce for sale, one to commercially process grain shipped from the Mohawk and Champlain valleys. The site at the mouth of the Wynants Kill is obviously close to riverine transportation (though Troy wasn't founded until 1789), but the site upstream is not so obvious – the hamlet of Ulinesville (now West Sand Lake) had yet to be established. But the course of the 'King's Road,' built 1752 to 1754 from Bath (now Rensselaer, opposite Albany on the Hudson) to Deerfield in Massachusetts intersected the Wynants Kill at the site of this first grist mill.[7] WP 1 and WP 11: river and road gave these grist mills greater market reach.

The site at WP 19 (also near the King's Road) had been leased to Mead Merrill for a saw mill in 1797. But, even though Merrill leased an adjacent 209 acre parcel and was productive, Van Rensselaer terminated his and a neighboring farmer's leases in 1806 to build a Glass Factory in which he had a financial stake. As with the early saw mills (1788 leases to Fonda and DeFreest at WP 12 and to John Crannel at WP 13; 1788 lease to Spencer at WP 18; 1820 to Gregory at WP 15) the glass factory consumed the standing forests in the watershed (the plentiful sand needed to be heated to temperature by a charcoal fire), and actually had moved to the Wynants Kill having exhausted its woodlots on the west side of the Hudson. These

factories were only profitable as long as there were adequate local resources. The glass making business at WP 19 went through seven different company reorganizations before running out of fuel in 1852. By the same date all the saw mills mentioned above were in the textile business.

Mill Site Interdependency

Geography places mill owners along the same waterway in a de facto cooperative situation – a hieracrchy of relations according to positions on the stream which can be read form the mouth to the head, or vice versa, whether you are interested in water power or water control. The water privilege lessees along the Wynants Kill had also in common the threat of lease termination. The 'Merritt vs Brinkerhoff' court case in 1820 emphasized their interdependency. At the mouth of the Kill, water privilege #1 was held by Daniel and Jacob Merritt who operated a flour mill. Upstream, at water privilege #2, John Brinkerhoff had erected a 28 foot high dam to control flow to a water wheel operating a rolling and slitting mill. To overcome low water flow in the dry summer of 1815, Brinkerhoff had temporarily closed the control gate on the flume, storing the water in his mill pond while the iron was heated to rolling temperature, and then opened the gate – interfering with the Merritts' grist mill. The Merritts won the suit with $700 damages.[8]

In the wake of the assertion of Merritts' rights, and after private arrangements began to be made to safeguard water supply,[9] the mill operators decided to create a cooperative association. In 1829, the Wynants Kill Association was formed to shape and control the lakes that discharged into the stream, and to draw down and drain the lakes in a way that would be most useful to the mill operators. The rationing of responsibility for costs was commensurate with the power extraction of their respective mills. At first, the proportionment was with shares: one to each member at or below the Uline Grist Mill at WP 11, fractional shares to members above according to water use. With reorganization in 1848, as the Wynants Kill Improvement Association, a fresh judgment was made for proportioning each mill owner's share according to the diameter of the water wheel, the volume of water used, and position on the stream: those nearer the headwaters presumed to have less interest in downstream improvements.[10]

Committees at each lake oversaw the construction of dams and negotiated with farmers for appropriate reservoir levels. Gates, closed at night and opened at dawn (or on whatever schedule might suit downstream needs), maintained a flow sufficient to run the mills, conserving water. Under the aegis of the Association, mill owners could better cooperate with the township governments in the watershed, as well as with individual land holders. When the dam, built by Richard Knowlson who owned the glass factory at WP 19, was washed away in an 1846 flood, the Association allotted $700 for its rebuilding. When the cost exceeded that, the Town of Sand Lake agreed to pay the $197.25 deficit in return for using the top of the dam as a right of way for a road. This road is shown passing to the right in Joseph Hidley's painting of Glass Lake[11] (see reproduction of painting, and map), past the Control Gate House on Glass Lake Road (leaving the Wynants Kill for the Kinderhook watershed draining south).

Eventually, the power of the Association was sufficient even to help end the control of the Patroon over the water privileges. Stephen Van Rensselaer died in 1839, and his successor as Patroon, William Van Rensselaer, had a heavier hand with the mill owners. An Anti-Rent Association was formed under the leadership of Smith H. Boughton, M.D. who lived near the headwaters of the Kill, and George Cipperly, the lessee of WP 12 who was secretary-treasurer. In 1844 Van Rensselaer served papers on Cipperly for back rent, threatening to destroy the dam at his factory site. The Wynants Kill Association rallied to his aid, and in 1845 convinced the Patroon to allow them to incorporate and purchase the flood lands of the Kill.

Links with Rensselaer Polytechnic Institute

The more enlightened self-interest of Stephen Van Rensselaer extended to importing the leadership and for fostering the scientific development that stimulated industrial growth along the Kill. Knowing he was on the lookout for talent, the U.S. Minister to Great Britain sent a Scot, Henry Burden, to him with letters of introduction in 1819. Burden's inventive genius and organizational savvy led to the Wynants Kill powering the largest waterwheel in the world[12] and to Troy becoming the horsehoe capital of the nation.[13]

Van Rensselaer wanted to train genius as well as import it – and founded the Rensselaer School in Troy in 1824[14] (later Rensselaer Polytechnic Institute, RPI) to fulfill Amos Eaton's innovative program for the "application of science to the common purposes of life."[15] (He had earlier commissioned Eaton to make an 1819 survey of his lands for more

productivity[16]). Waterways were, from the beginning, on the curriculum. The school's first site was on the U.S. Lock #1 in the state dam on the Hudson (a system of hydrological power which was more like the Lowell mills model[17]). In 1835 it moved to the old Van der Heyden mansion on the hill above Troy through which ran a rill draining a pond atop the same shelf of land down which the Wynants Kill finally tumbles. Eaton called it Laboratory Creek,[18] to augment his announced course of study which emphasized practical engineering to understand the force and application to machinery of water, steam, wind and animal power.

The men who leased the water privileges and built mills were, within the Patroon's hierarchy and through their own Association, in a relationship of authority in their communities. They not only provided jobs, and contributed to a cash economy, they almost naturally took over the leadership of town councils, bank boards of directors, and intitiatives to build roads, canals, railroads &c. Many of them were Trustees of, or otherwise affiliated with, RPI.[19] The mills also changed hands (and direction) following familial ties.

Industrial Diversity

With the various levels of cooperation in place, the mills could better respond to change. Instead of developing into a single product mill stream (like the textile mill streams in the Connecticut River valley[20] or a paper mill stream in western Massachusetts[21]), the industry activity on the Wynants Kill was always diverse.

At the most local level, there was probably the vertical integration, for instance, of bakery and brewery at the grist mills of the Wynants Kill – a common pattern both in the old world and in New England. Certain sites went through several ownerships, but remained dedicated to the same kind of manufacture. The glass factory site at WP 19 wasn't again used for industry after the business moved to Massachusetts chasing trees. The grist mill at WP 11 ground grain from 1768 to 1951 – though it branched out into cider pressing in the autumn. WP 1 hosted a grist mill to produce commercial grade flour to 1858 then was gobbled up by the Bessemer behemoth that came to dominate an iron industry spreading over the three water privileges at the stream's mouth.

We'll look more closely at two of these 'dedicated' sites, for their own development, and for their influence on other mills on the Kill.

The first is WP 4, the site of the first paper making mill on the stream in 1802 – operated by David Buel who moved to Troy in 1797 and began making a superior royal printing paper from rags ground with water power. In the 1820s and 1830s there was a severe shortage of rags for paper, and raw cotton was often used direct from southern fields. Particularly in Troy, inventors looked for a way to turn almost anything else into paper slurry. Henry Burden's first U.S. patent in 1822 was for a flax and hemp grinding machine for paper pulp, and 6 other Troy area residents filed patents under the same heading in 1829 and 1830. The grist mills of the Wynants Kill could supply all kinds of straw and, for a time, the Kill contributed to Troy being the straw paper capital of the nation – producing a heavy grade of wrapping paper much in demand for railway express and other mercantile packaging (the largest early straw paper mill was William and Alexander Orr's at the state dam, U.S. Lock #1, on the Hudson[22]). Enter the Smart brothers at WP 4, in 1853. Joseph and Andrew turned 300 tons of straw and 300 tons of coal into 43,000 reams of paper, and in 1873 advertised they could process orders by the railway car full. In 1859, another brother Robert bought the neighboring flour mill at WP 5 and began making paper. He also bought his brother's mill in 1873 and renamed it "Gold Leaf." In the expansion mood, Robert Smart looked upstream to WP 13. The 1788 saw mill there had had a brief flirtation with fulling and carding wool beginning in 1834 but had been making straw paper since 1854. Robert Smart bought the mill in 1873, and made 700 tons of straw wrapping paper per year until 1891. The Smarts are a good example of family specialization. Father Joseph emigrated from England in early childhood and manufactured paper first in Hempstead, Long Island. His three sons all worked in the paper mills – only Joseph Jr. briefly escaping to the California gold fields in 1852 – but none of the men lent their energies otherwise to the community.

David DeFreest began the textile industry on the Wynants Kill around 1800, at WP2 – building a fulling mill to wash and fluff out home spun cloth and wool. But that site was taken over for good by the iron industry in 1807. Upstream at WP 6, Gerret Van Schaick shared his grist mill site with a bleachery (WP 6a) around 1820 – the latter factory using chemicals to bleach and then dress and calender cloth for 1 to 2 cents a yard. The cotton cloth was produced nearby at the Troy Wool and Cotton Factory, opened 1812 at WP 8. The three mill sites in the village of Albia, WP 6, 7 and 8, are a good example of community industry. Tobias Schermerhorn first leased the water privilege at WP 8 to build a fulling mill around 1800. It was bought out by a group of Troy merchants and in 1812 enlarged for the manufacture of wool and linen goods – their water-

powered Spinning Mule could keep 30 to 40 hand operated looms busy in nearby homes making cloth. In 1813, John and Marvin White and Randolph Taylor moved to Albia and rented machine and trip hammer shops belonging to the Troy Wool and Cotton Factory, to put on display the various kinds of cotton machinery they had been making for use in Rhode Island and Connecticut factories. Their power looms transformed the factory so that by 1830 2000 spindles and 60 power looms produced 74,000 pounds of yarn woven into 250,000 yards of sheeting.

In 1827, one of the owners of the Troy Wool and Cotton Factory joined with one of Troy's leading businessmen[23] to open a second factory in Albia at another water privilege site (WP 7). They were poised to take advantage of the Merino wool craze. By 1830, this factory had 1000 spindles, 20 power looms to weave satinet (a fake satin from wool on a cotton warp), and 10 broad flannel looms.

A community grew up with the two mills. In 1830, 70 of the 80 employees at the cotton factory were women, and 75 of the 80 at the woolen. In 1824, a Mrs. Frost established a nursery to care for the children of the workers and a day school also operated throughout the year averaging 80 to 90 students.

In 1841, another prominent Troy businessman, Stephen Warren, bought into WP 8, becoming manager of what was then called the Albia Cotton Factory, and soon joined by his son Joseph. The Warrens are a good example of familial industry where the members did not necessarily specialize (Joseph M. owned a hardware store) but lent their energies to community opportunities.[24] (Like four other mill owners, Joseph Warren served as Mayor of Troy.)[25]

In 1854, the relationship among the 3 mill sites was formalized and they incorporated under the name of Troy Woolen Co. and assumed a 13% interest in the Wynants Kill Improvement Association. Its success can be measured by the 1855 census. But it can also be measured in how quickly the mill building at WP 7 was rebuilt after a fire on July 4, 1857 – by December they were up and running.

In 1867 Troy ranked as the 4th largest wool market in the U.S., behind Boston, New York and Philadelphia, with sales of ten million pounds of fleece wool. Wool dealers whose advertisements had appeared in the Troy City Directories in the previous three decades were, themselves, active in the Wynants Kill mills – Jedediah Tracy (WP 8); John Kerr (WP 18); Richard J. Knowlson (WP19; his son James S. Knowlson, was affiliated with WP 7; his son Andrew B. Knowlson owned WP 16); and John Rankin, who was president of the Albia mill (WP 7) when he died in 1864. But the wool trade in the area climaxed after the Civil War, and the Troy Woolen Company went bankrupt in 1870.

What happened then is an interesting move amongst all the textile mills then operating on the stream. By mid-century, many of the mills upstream of Albia had turned to the different steps in producing woolen cloth. In West Sand Lake, the Uline family diversified at their water privilege (WP 11) and built a wool carding and cloth dressing mill on the bank opposite their grist mill around 1855. The Cipperly saw mill at WP 12 had also switched to making satinet (weaving wool on cotton warp) around 1848. In Sand Lake, at WP 14 what had been a satinet and then a cotton factory making "nigger cloth" for the southern trade was rebuilt as a woolen factory in 1846. At WP 15 the "Sand Lake Cotton Factory" of 1835 made cotton warp for the satinet mill upstream at WP 18, where the mill site had processed wool since 1825, and in 1842 was renamed the "Sand Lake Wool Factory."

Then, as the wool industry flagged in the 1870s, all the length of the Kill, the mills switched to knitting from the woolen yarn. In Albia, the Troy Hosiery Mfg. Co. operated from 1875-1884 and then the two mill sites diverged again, into the Albia Knitting Mill (yarn & stockings) and the Wynantskill Knitting Mill (shirts & drawers). In West Sand Lake, Akin & McLaren knitted shirts and drawers at WP 11 (the mill at WP 12 failed in 1865). In Sand Lake, the cotton mill continued making warp, but at WP 16 the grist mill was replaced by a hosiery mill in 1866. At WP 17, a site that had been a tannery off and on since 1823 was purchased in 1862 for a knitting factory (shirts and drawers) by an entrepreneur who also converted the WP 18 woolen mill to a hosiery mill.

Disaster of 1891 and Rebuilding

Knitwear also produced a fascinating local anomaly: a post-industrial flowering of a complete-system mill town in the 20th century in the hamlet of Averill Park. Although the advent of electrical power generation in the late 19th century as well as steam engines after the Civil War relaxed the geographic constraints on industrial activity and eroded the viability of the smaller mills along the Wynants Kill, the coup-de-grace was one late summer rainstorm of 1891 that caused a freshet to annihilate mills all down the system (bolts of fabric, cords of wood, reams of paper, and whole mill buildings washed up at

the mouth of the Kill in Troy, taking out 15 bridges including a major railway trestle). Many businesses did not rebuild. But it could have been worse.

The Wynantskill Improvement Association in 1889 had hired David Maxon Greene, Professor of Geodesy, Road Engineering and Topographical Drawing at RPI, to survey the dams on the upper lakes of the Kill. He found the dams, dykes, gates, spill-ways, trunks &c to be seriously eroded or underbuilt and made many detailed recommendations to make the whole water system both safer and more productive. He offered as a cautionary tale the recent devastation in the Johnstown Flood. The mill owners complied with all his suggestions – which meant that, in the 1891 flood, the lake dams held and prevented even worse damage.

Peter McCarthy was an experienced mill man, a prominent citizen of Troy, whose summer house was opposite the abandoned mill sites at WP 15 & 16 in Averill Park. He convinced William D. Mahony, a local civic leader, in 1897 to form a partnership to buy up the old mill buildings and sites, and put the labor force back to work spinning cotton and wool yarn and knitting hosiery and underwear (Faith Mills). When they expanded after a fire in 1906, the knitting machines were powered by steam. Water from the Kill was used for fire protection as well as for washing and scouring of the knit goods. The partners expanded throughout the first decades of the century, attracting workers to the rural community with a sumptuous Clubhouse in 1919 – complete with dance hall, motion picture parlor, cafeteria, bowling alleys, pocket billiard room, and a shower room. In 1923 they rebuilt the dam upstream from their operations to provide hydro-electric power (via a Rodney Hunt water turbine and a 75 kilowatt Westinghouse alternating current generator) for the knitting machines. Government contracts providing knit underwear for the military in two world wars kept the factories humming. In 1939, they bought the remaining active factory in West Sand Lake, at WP 12a[26] and operated there from 1940 until 1950; the end for the whole enterprise was 1956.

Industrial Climax and its 'Portrait' in 1855 Census

Much has been written about iron and steel, the "climax" industry in Troy – which involved WP 1, 2 & 3 on the Kill. The first iron process was a slitting mill at WP 2 in 1807 – which evolved into the Albany Nail Factory under the directorship of several investors, among them Erastus Corning and John Flack Winslow. In direct competition with the Albany Nail Factory, the Troy Nail Factory at WP 3 (started in 1810 as Converse Iron Words) was by 1848 owned outright by Henry Burden whose inventions dominated the whole industry, particularly the rotary concentric squeezer, a machine for working wrought iron adopted by iron industries world wide; a hook-headed spike machine that fueled the rapid expansion of railroads in the U.S.; and a horseshoe machine capable of making 60 horseshoes a minute, that shod all Union mounts in the Civil War (Burden expanded into WP 1a in 1862 – his "lower works" were steam powered). But Corning & Winslow had the Bessemer process – importing it via engineer A.L. Holley from England in 1863 (after their iron factory rolled the plates for the Monitor "of scrap iron, greatly superior in strength and purity to puddled ship plates.") The first Bessemer furnace in the U.S. was erected at WP 1, opposite Burden's lower works.

One of the data resources we'd like to highlight is the enumerators' manuscript for the 1855 Census of the State of New York. Containing more detail than was eventually published, the notes give us a "portrait' of activity along the Kill. (See typescript of the data appended.) The 'heavy' industry at the first water privilege sites were also the heaviest capitalized and paid the highest wages.[27] But women at the textile sites in upstream Albia earned as much as men in mills even further upstream. We have included all the Wynants Kill watershed industries that were listed as being water powered – which included a brace of small saw mills, none of which were sited at an established water privilege but were, perhaps, on small tributary streams. Certainly, local building with wood still had to be accommodated, not to mention the large demand for barrels, and pallets for the products, especially, of the iron works and commercial grist mills.

Postal Activity Data and Reinvention

We also want to highlight data of the United States postal system – a rich vein of information that is rarely mined by scholars. To discover the signature of local activities we use the Official Registers which reported postmaster compensation, a per centage of postal revenues, from 1816 to 1911.[28]

The graph of postmaster compensations for Sand Lake, for instance, shows the signature of the loss of the Glass Factory to fire in late 1852. But what is instructive is that the fortunes of the factory apparently had been declining for quite a while.

(Though not shown here, graphing the postal activity at the hamlet of Alps, a settlement of charcoal burners serving the glass factory at WP 19, reveals the same downward slope but to a more diminished point.)

For the story of reinvention, the most remarkable event is the birth of the post office in the village of Sand Lake called Averill in 1880. Until then, the Sand Lake post office (open 1815) was still tied to the proximity of the glass factory. Our data show that while Sand Lake (at Sliter's Corners), with an index of 1, remained an average post office while Averill Park (in what had been the village of Sand Lake) over the course of a generation grew to twice the productivity of the average post office; and that both, together serving the same vicinity, trebled the national average. And this was the same period when the fortunes of water-powered mill towns had to adjust to competition from steam power (steam engines were made in Troy). It also included the period after the flood of 1891 when the mills couldn't afford to rebuild. Moreover, during the whole period the population of the area remained constant (2,000 ± 20%). What caused this renewal and steady growth?

The success of Faith Mills after 1897 certainly contributed to the rise in the area's fortunes. But our conclusion is that it was primarily due to a concerted development of the Town of Sand Lake as a summer resort. Beginning in 1885, the postal contract (#6272 Troy to Stephentown 23 1/4 miles, 6 times a week) allowed for 6 additional trips per week between Troy and Sand Lake from July 1 to September 30.

James K. Averill was a key figure in this new industry: a local man, but also a powerful New York City lawyer, he began to buy up farms formerly leased by the Patroon and to map out cottage developments. He renamed the sites: the lake at Sand Lake became Crystal Lake and the hamlet became Averill in 1880 and Averill Park in 1882 when he built a pleasure park on the shores of the lake. He formed a company to build an electric trolley system to link with Troy in 1895 (the Troy & New England Railroad which also carried freight, including raw material for the mills). He joined the Wynants Kill Improvement Association, as he had purchased land that included two dams, and insisted on the "pleasure grounds" rights to set the summer water level.[29]

These initiatives of Averill's built on an infrastructure of hotels (which were soon augmented by boarding houses, holiday camps, and farm resorts) and a tradition of stocking the Kill and the lakes with sports fish. By the early 20th century, a resort on Crooked Lake (served by the Sand Lake post office) was a favorite haunt of Teddy Roosevelt and other sportsmen from New York City.

Conclusion

The postal activity in the upper Wynants Kill Watershed was never more than 1% of Troy's and, according to most other measures, it is a small stream with a modest history. But it industrialized rapidly, contributed greatly to the growth of Troy, and responded quickly to reinvention as a recreational destination. The reservoir lakes along the Kill gave it an advantage in water-powered industry. They also gave it an esthetic advantage: the powerful men of Troy who owned the mills were attracted to building their summer, or even permanent, homes by the lakes – and thereby had a stake in changing rather than abandoning enterprises. Under the aegis of the Wynants Kill Improvement Association, the small mills could be retooled on an experimental basis. Industry in the watershed is now dominated by mining the glacial till to build roads and buildings elsewhere, even as the inhabitants celebrate the watery landscape with its robust ecology.[30]

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[1] Henry Burden's overshot wheel of 1851 was not the largest diameter (two in Scotland were larger) but provided the most power (before gearing down, 278 horsepower). It was 62 feet in diameter and 22 feet in breadth, and operated continuously, day and night, until the 1890s. The Burden wheel was the subject of 4 graduate theses at RPI 1855-1867. Louis C. Hunter, *Waterpower: A History of Industrial Power in the United States, 1780-1930*, Charlottesville VA 1979, page 571

[2] See footnote 8

[3] Crucial to the 'invisible hand' as a sensible notion is that the individuals are rational (always, in the realm of numbers implicating scale) and selfish, or, let us say, honest to 'self,' such a self being rational. In the case of mill owners along this stream, individual acts compile themselves in the aggregate to maximize the communal result in terms of the scales of individual choice. The question is how the linkage works between the individual acts and the cumulative result: is it primarily hierarchical, according to a 'mechanical' determinism; or is it social, working through personal, familial, institutional networks? We see that on the Kill, it is more social than hierarchical: the 'firm' (Chandler) arising to deal with the transaction costs less important than the efficiency of the landscape.

[4] Jedediah Morse, *Geography Made Easy*, Boston 1813. "New York" p. 150: "there are few places which are more than 15 or 20 miles from some boatable or navigable stream."

[5] In 1650, water power rights at the mouth of the Kill had been taken away by the Patroon from Thomas Chambers who had leased both the farm and the right to build a saw mill, and given to another man who, in turn, asked to be released from the agreement, and in 1656, Abraham Pietersz Vosburgh and Hans Jansz Van Rotterdam built the first recorded mill on the Wynants Kill.

[6] To be published in 2005 under the auspices of the Rensselaer County Historical Society, author Robert J. Lilly.

[7] "Thro' a Country Not well Settled: The "Albany Road" of 1752-1773" October 23, 1999, papers collected by the Rensselaer-Taconic Land Conservancy; Rensselaer County Historical Society, Taconic Valley Historical Society, ed. Warren Broderick

[8] "Merritt and others, against Brinkerhoff and Van Wagenen" *Cases in the Supreme Court of the State of New-York*, 17 Johns (Albany 1820) pages 306-325. Justice John Woodworth [Hunter, see note 1, page 154, is apparently mistaken in his citing "Justice Wordsworth"]: "Where several owners of mill-seats on a stream, have a common and equal right to the use of the water, though no action lies against the owner of a mill above, for any damage which the owner of a mill below may incidentally suffer from the reasonable use of the water by the former, for his own benefit; yet the owner of the mill above has not an unlimited right to use the water as he pleases, or to stop the natural flow of the stream, so as to destroy or render useless the mills below. And if he shuts down his gate, and detains the water for an unreasonable time, or lets it out in such unusual quantitites as to prevent he owner of the mill below from using it, or deprives him to a reasonable and fair participation in the benefits of the stream, he will be answerable to the party injured to the extent of the loss he has thereby sustained."

[9] In 1818, Nathaniel Adams (WP 3) contracted with Peter Moul for a fee of $10 to draw down the pond on his farm to feed into the Kill. In 1820, a dam and control gate were built at the outlet of Orrey's Lake on Harman Snyder's farm, for a one time fee of $75 and $5 yearly to open the gate in the morning and close it at night. Snyder stipulated that a half inch hole be drilled in the gate to provide a constant flow of water for his cattle. Both initiatives would have benefitted WP 1 to 8.

[10] The New York State Legislature by an act of 21 April 1846 created a Trust "for the benefit of persons owning or occupying mill privileges on the stream called the Wynants Kill." The first trustees were Erastus Corning of Albany Nail Works WP 2, John Townsend in partnership with Henry Burden of Troy Iron and Nail WP 3, and Stephen Warren of Albia Cotton Factory WP 7. The Association remained active through all the changes in water use; the final chapter has yet to be written about its rights to the Kill.

[11] Glass Lake, one of two paintings of the hamlet, ca1866, by Joseph Hidley whose family was a 1776 tenant of Rensselaerwyck, in the Wynants Kill watershed, near Aries, "Orrey's" [now Snyders] Lake. Rensselaer County Historical Society, Troy

[12] Great Britain in general powered its industrial revolution with steam, but Burden was probably familiar with large water wheels in his native Scotland.

[13] Samuel Rezneck "Burden Iron Company, Troy" in *Mohawk-Hudson Area Survey*, Robert M. Vogel ed. Smithsonian D.C. 1973

[14] Daniel D. Barnard, *A Discourse on the life, services and character of Stephen Van Rensselaer; delivered before The Albany Institute, April 15, 1839. With an historical sketch of the colony and manor of Rensselaerwyck in an appendix.* Albany 1839

[15] Emma Hart Willard, a well known educator of young women in Vermont, determined in 1819 to move her efforts to the headwaters of navigation in New York State. A pamphlet "An address to the Public; Particularly to the Members of the Legislature of New York, Proposing a Plan for Improving Female Education" published and distributed at her own expense garnered support from Monroe, Jefferson, Adams and other influential men. But, even though she established a school at Waterford on the west bank of the Hudson, north of Albany, the state legislature would not fund her. The City of Troy would, though, and raised money by a special tax to buy her a building in 1821. Before it was ready for occupancy, she held classes at Eaton's Lyceum of Natural History, and then, when his Rensselaer School opened, she studied with Eaton. If Eaton's passion was geology, Willard's was geography, particularly mapping - in 1822 she and William Channing Woodbridge collaborated on *A System of Universal Geography on the Principles of Comparison and Classification*, which made her famous. The Emma Willard School's present site is near Albia in the Wynants Kill watershed. See Alma Lutz, *Emma Willard: Pioneer Educator of American Women*, Boston 1964.

[16] These were the first surveys published anywhere that offered geologic information for the benefit of farmers: crops to soil typing, drainage, fertilizer &c. Amos Eaton, *A Geological and Agricultural Survey of Rensselaer County in the State of New York*, Albany 1822.

[17] At mills such as the Lowell system, the vertical integration of a water power facility combines hydrological engineers to maintain the dams and canals with calibrated flows, the mill buildings, and perhaps even wheels and transmissions; machinists making and maintaining the machines; and the managers of industrial enterprise.

[18] Amos Eaton, manuscript journals, Rensselaer Polytechnic Institute, special collections

[19] To 1884, a president {John F. Winslow 1863-1867 (WP 1, 2)} a vice president {David Buel, Jr. 1829-1860 (WP 4)} and 11 trustees {John Hack Winslow 1860-1868 (WP 1, 2), David Buel, Jr. 1829-1860 (WP 4), Joseph M. Warren 1849- (WP 8), Gurdon Corning 1843-1847 (WP 7), Richard P. Hart 1826-1843 (WP 1), John Augustus Griswold 1855-1856, 1860-1872 (WP 1), Isaac McConihe, Jr. 1860-1861 (WP 7, 15), James Somerville Knowlson 1866- (WP 7), Francis S. Thayer 1868-1880 (WP 1), Alexander L. Holley 1865-1867, 1870-1882 (WP 1), Jedediah Tracy 1824-1825 (WP 8)} were Wynants Kill mill owners. Burden's nephew, Henry, graduated from RPI, but took his practical course at Burden Iron Works 1872-1879 in charge of the blast furnaces, thereafter in charge of the furnaces at the competing Albany Iron Company. But, by then, the Cornings and the Burdens had symbolized their interdependency, the former donated the land for

the latter to build a Presbyterian church at WP 2 (which, now de-consecrated, is causing new dispute among Cornings and Burdens over ownership). Six other Burdens entered RPI, from 1834 to 1881, but did not graduate. Henry B. Nason, ed. *Biographical Record of the Officers and Graduates of the Rensselaer Polytechnic Institute* (1824-1886) Troy 1887.

[20] See Agnes Hannay, A Chronicle of Industry on the Mill River Vol XXI Nos 1-4, Oct 1935-July 1936, *Smith College Studies in History*. The Mill River, like the Wynants Kill, was also a small stream (flowing into the Connecticut River above Northampton) whose mills diversified, but chiefly within the textile field: wool, buttons, silk.

[21] See Judith A. McGaw, *Most Wonderful Machine: Mechanization and Social Change in Berkshire Paper Making, 1801-1885*, Princeton NJ 1987 – the paper making industry in the Housatonic valley of Berkshire county, western Massachusetts. McGaw coined the term "mutually-made men" for her successful mill owners – equally applicable to those of the Wynants Kill.

[22] William Orr claimed to have invented and used the first pattern-bearing cylinder press for wallpaper, though he didn't patent it. He also claimed to have made the first merchantable printing paper with wood fiber (25% bass wood fiber to 75% rags) in 1854. Arthur James Weise, *The City of Troy and Its Vicinity*, Troy 1886, page 230.

[23] Gurdon Corning, 1781-1853, arrived in Troy in 1801 from Norwich CT, served on the commission to build a bridge across the Hudson in 1814, on the Western canal Commission, as trustee and president of the Board of Education, trustee of RPI, supporter of the Troy Orphan Asylum, director of the Farmers Bank, and three terms as Mayor of Troy.

[24] Joseph M. Warren's estate in Troy became the present campus for RPI, where he had been a Trustee.

[25] Richard P. Hart, 1836-1837 (WP 1); Gurdon Corning, 1843-1847 (WP 7); Joseph M. Warren, 1851-1852 (WP 8); John A. Griswold, 1855-1856 (WP-1); Isaac McConihe, Jr., 1860-1861 (WP 7, 15) – Mayors of Troy

[26] Samuel T. Freeman & Co., auctioneers, "Industrial Real Estate, Machinery and Equipment in the West Sand Lake Plant (Woolen Mill) of the Thermo Mills, Inc., Located at West Sand Lake, N.Y." Boston 1939 [collection of the authors]

[27] The highest wages on the Wynants Kill had been for the skilled glass blowers (of German and Scots heritage to make cylinder and crown glass, respectively) at the glass factory, WP 19. Wages were as high as $60 a week, and the factory employed as many as 60 men. In 1825, 467 boxes of window glass were made and sold in ten days, valued around $3,000. But the factory burned in 1852, the business already having moved eastward into Massachusetts for more fuel. Rachel D. Bliven et all, *A Resourceful People*, Rensselaer County Historical Society 1987.

[28] We generated a postal activity index of the village of Schaghticoke (on the Hoosick River, a large mill stream forming the northern border of Rensselaer County) in 1980 for Beth Klopott's doctorate in history at the State University of New York, Albany, which showed a plummet in gross postages in the 1847 to 1849 period uncorrelated with any other known factors. On a hunch, we discovered that the first seven months of 1847 were devoid of precipitation in the area – the worst drought for the 50 year period before 1876, and a killer for industries on an unregulated stream that had no natural reservoirs. This same drought may have affected the iron industries on the Wynants Kill, to the extent that the next year Burden was able to buy out his partners and take control at WP 3. Perhaps mindful of that drought, he built a dam at his own (not the Association's) expense on the Wynants Kill upstream of WP 3 in 1849 to form Burden Pond for his own greater reserve.

[29] TLS 7 June 1898, on printed letterhead "Averill Park Land Improvement Co." in the papers of the Wynants Kill Improvement Association, Rensselaer County Historical Society. "It seems to me unfair that the pleasure grounds should be robbed of the attraction the lake affords and the mills compelled to remain idle in the Summer months, or be operated by steam power, simply because there is no one to oversee or govern Gabler's action. … My pecuniary interests warrant my giving the matter personal attention."

[30] The upstream hamlets: West Sand Lake, Averill Park, Sand Lake &c depend on household wells for water (though there is town sewerage) – only possible because of the good drainage. The lakes still support swimming, boating, and ice and summer fishing – though there is only one public access for all town residents at the Town of Sand Lake Beach, Reichards Lake (Averill's pleasure park on Crystal Lake survives as a beach and event site open to the public for a fee.) Property values on the lakes are high for the area, those around Crystal Lake the highest.