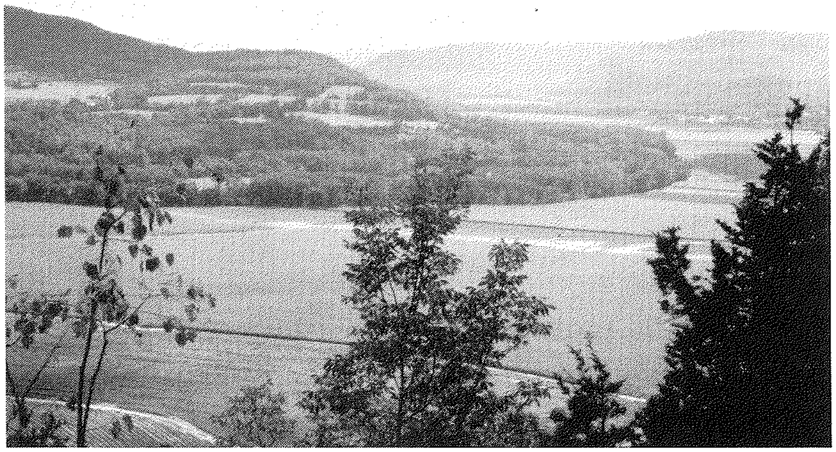
Lopuch Farm along Schoharie Creek (facing east).



Middle Schoharie Valley from Vromen's Nose (Onistagrawa *"Corn Mountain"). Schoharie Creek along base of trees in distance (facing east).*

Archaeological Sites and Historical Floods in the Schoharie Valley, Eastern New York

by Christopher R. Lindner

The historical geography of the Schoharie Valley exemplifies the need for archaeologists to dig deeply when they look for sites in river floodplains. The hypothesis formulated and addressed by this article makes a connection between the Schoharie Creek's notoriety for frequent severe flooding and the noteworthy scarcity of remains on the floodplain of the lower Schoharie: nineteenth-century land-use in the Schoharie drainage caused an increase in rates of soil erosion and runoff, and thereby produced floods that altered the contexts of sites along the lower reach of the river, either by displacing artifacts or by covering them with alluvium.

The study reported here began at a time of methodological crisis when prehistorians finally started to confront the long-recognized problem of the mixture of successive occupations at their sites, that occurred either during deposition or by subsequent disturbance (see Binford 1982:19). Just as several decades before, when stratigraphy served as the best tool for chronological placement of artifacts and sites, an increased importance could be accorded now to settings (principally floodplains, valley edges below steep slopes, and rock-shelters) where sediments would cover cultural materials and thus protect them from disturbance. I set out to demonstrate that such burial occurs on floodplains with a higher frequency than usually acknowledged, in order to focus greater attention on the potential of this environment for research and cultural resource management. I hoped also to contribute to development of methods for the identification of this problematical phenomenon in order to strengthen the mandate for more extensive and intensive testing for sites in alluvial settings.

Floodplains comprise huge areas by comparison to the small deposits of remains for which archaeologists must search. Survey crews often assess site abundance by surface inspection of plowed fields, which because of disturbance represents the top 20cm out of a meter or more of alluvium that potentially contains sites. Some areas receive shovel test pits, often at too large an interval. Hand-dug units deeper than 50cm consume great amounts of labor and are used infrequently. Yet the more usual mechanized corings and trenches are likely to discover only the most conspicuous sites, missing the sometimes significant remains of more ephemeral occupations.

This synopsis of my dissertation in anthropology (Lindner 1987) will first present the salient characteristics of the region's Indian sites and then sketch the prehistory of the Hudson River Basin and nearby watersheds, with special attention to the bottomland environment. Next, a discussion of methodology and study area will situate this research as a development of geomorphological approaches in archaeology. Then will follow a background study of Schoharie Creek, the small river that drains the northern Catskills. To conclude I will summarize four test excavations that support the hypothesis about flood impacts on archaeological sites.

Prehistoric Archaeology in the Region of the Hudson Valley

Introduction. Scatters of chert or quartzite flakes, from the manufacture of stone tools, and cracked stones from campfires most frequently indicate to archaeologists in this region that prehistoric activity once took place on a particular spot. On sites of the last several millennia broken pottery occurs. Although organic debris does not often preserve in the ground, certain sites still contain food refuse, particularly if charred, such as nuts, seeds, shells, and the bones of mammals, fish, birds, and reptiles. Occasionally the remains of hearths, storage pits, and post molds suggest greater permanence than at the usual transitory camps. In some instances middens have accumulated on the periphery, or are spread thinly across the site, ash and charcoal mixed with discarded tools like pitted hammerstones and notched pebble netsinkers.

Radiocarbon dating of charred organic material found in undisturbed context (in close to original position) near stylized chipped stone points or distinctive pottery can assist these tools in their role as temporally diagnostic artifacts that serve to tell the age of a deposit, like index fossils in geological strata.[1] We cannot as yet reliably assign tribal affiliations to remains older than about 500 years. Instead, an ecological framework enables us to interpret the adaptive characteristics of the cultural system, the relationships between a past environment and the people who lived in it.

Chronology. Back about 10,000 years ago some of the earliest inhabitants of this region, nomadic peoples descendent from Siberian populations, left remains along the Delaware River that allow us to infer an adaptation that included the gathering of wild plants and fish, in addition to the hunting of animals (see Funk 1983 for the most recent summary of the Northeast). During the next few thousand years food resources may have been concentrated along waterways because climatic change brought about a high proportion of less productive evergreen forest cover in most other environments (Dincauze and Mulholland 1977). On the upper Susquehanna River the New York State Museum investigated this potential settlement pattern shift to riparian locations. Although they found evidence of some occupations of considerable antiquity, the excavators' interpretation of the data was that population during this time must still be regarded as very sparse indeed (Funk and Wellman 1984:88; cf., Nicholas 1987).

A great number of camps have been recognized in the region from the several millennia after 6,000 years ago, as the oaks took hold outside the sheltered bottomlands. Many chert points of this age have been found in the central stretch of the Schoharie Valley (Ritchie 1952:8), its earliest substantial evidence for human occupation. From the millennium after 3,500 years ago a larger proportion of camps appear close to rivers (Ritchie 1969:136). But for the subsequent nine centuries very few sites have been recognized, at least in eastern New York (Funk 1983:337). The sites that again appear in abundance 1,500 years ago evince an emphasis on fish in the usual subsistence mix of gathered and hunted resources (Funk 1976). With the advent of plant husbandry about a millennium ago, grain storage pits became "masked with alluvium" (Ritchie 1969:274) when located at seasonal camps in bottomlands, while villages occupied higher terraces or landforms even further away.

To summarize the prehistoric attraction of the riverine environment two generalizations deserve notice. The first study of the Northeast within the framework of settlement pattern analysis (Ritchie 1956), a method of cultural ecology (also called ecological anthropology), concludes that in central and eastern New York the shift to farming and larger semi-permanent villages finally made settings well away from the waterside suitable for occupation. The desire for proximity to aquatic resources appears to have previously guided the placement of most seasonal camps:

> [People lived] along the banks of the larger streams and ponds and the smaller lakes. The preferred situation was a knoll, terrace, or ridge of well-drained, warmer, sandy or loamy soil, at or close to a hydrographic outlet point, preferable the mouth of a stream (Ritchie 1956:74).

And although Curtin (1981) in south-central New York criticizes the bias by archaeologists against upland locations, Funk (1984:132) remarks, in a preview of his detailed analysis of several hundred sites in the upper Susquehanna watershed, that "valley bottoms were clearly preferred by all known prehistoric groups." Certainly other locations had importance, but highly significant adaptive changes appear to have taken place in the floodplain. This habitat came into use either as refuge from environmental impoverishment in the first half of the prehistoric occupation of the Northeast, as source of diverse or concentrated wild foods during the next several millennia, or as ground where newly adopted domesticants would grow reliably in the final few centuries before European colonization.

Yet the character of these adaptations, their timing, their extent and relationship with upland activities, will always be conjectural without clear demonstration of the representativeness of the sites sampled. Such certainty must come from comprehensive surveys whereby the entire sampling universe becomes known. Areas without sites must be shown to be truly vacant, due to either avoidance in the past or erosion since they were utilized. These seemingly vacant areas instead could be deeply alluviated, with sediments obscuring and at the same time protecting the best preserved contexts of remains in the whole area.

The Problem of Gaps in the Prehistoric Record.

Butzer's (1977) research framework for the archaeologically significant lower Illinois Valley was the first thorough application of geomorphology to assist the design of survey work in discovery of prehistoric sites. He had become aware of how floods could distort the archaeological record by recognition of the absence of the Predynastic sites along the Nile in Middle Egypt (Butzer 1960). In a comprehensive monograph entitled *Archaeology As Human Ecology* he formulated a "landscape approach to settlement survey" (Butzer 1982:261) by which the dating of the various deposits in a given area (such as a succession of increasingly lower and therefore more recent terraces), guides assessment of whether such landforms contain sites of corresponding ages. Bettis and Thompson (1981) call a similar method in Iowa "the stratigraphic approach," while Gardner and Donahue (1985) term theirs in Missouri "the temporal surfaces approach."

Only Butzer (1982:261), however, asks a preliminary question specifically about whether flooding, or simply a less attractive habitat than neighboring areas, had caused conspicuously low site frequency to appear in certain landscapes:

> Do discernable archaeological gaps relate to erosion of coeval sediments or surfaces, to more recent sedimentation over broad areas, or to a lack of former habitation, either because of unattractive mesoenvironments or because of location in the interstitial space between operational environments?

The former two situations, massive erosion and extensive burial, have never been systematically addressed as a specific problem with widespread manifestations, one brought about most recently by cultural activity. These impacts take place in human terms so gradually, and in such a widespread, diffuse manner through natural agencies, that the phenomena are somewhat imperceptible while in process and the magnitude of their results are often underestimated.

The Study Area. I chose to work on Schoharie Creek because, in response to my interest in the way floods affect prehistoric sites, Robert E. Funk (personal communication, 1982) pointed out that he and William A. Ritchie, the previous New York State Archaeologist, had noted the scarcity of aboriginal remains along its lower reach. Local avocational archaeologists Jan Swart and Wayne Lenig (personal communications, 1983) confirmed this impression and also remarked on the river's bad reputation for flooding.

The study area consisted of the bottomlands for 11km between the gorge below Esperance, that separates the middle from the lower reach of the Schoharie, and the valley of the Mohawk River. The Schoharie's lower reach has a meandering channel pattern. Low shelves of bedrock cause falls in the river at two locations; elsewhere its channel consists of alternating pools and riffles. Glacial till and bedrock form the banks in some places and occasionally rise into cliffs tens of meters high. More frequently one or more of a series of four alluvial terraces rise in steps toward the moderately steep valley sides. The maximum relief approximates 250m.

An abundance of fertile, well-drained soil still exists in the the Schoharie bottomlands and to some extent on the high terraces and hillslopes (Davis and Landry 1978). The catalogue of local flora and fauna by Starna (1976) indicates the rich diversity that would have been available since at least 5,200 years ago when the oak-hickory forest of today became established in the Northeast (Funk 1983:305).

Review of official records, interviews with local residents and avocational archaeologists, and field reconnaissance confirmed the impression of a gap in the study area. I checked official records at the New York State Museum and found them to reveal a rather small number of locations of prehistoric cultural material along the lower reach of the Schoharie. In the records, all ten lack data on age, size, and kinds of artifacts found. Their data on location seem at best approximate on maps at the State Museum, originally from the Mohawk-Caughnawaga Museum in Fonda, New York, and the Van Epps-Hartley Chapter of the New York State Archeological Association. Lower Schoharie Creek was hitherto never surveyed professionally, but had been examined with care by avocational archaeologists R. M. Hartley, John Swart, and Jan Swart. A comparable extent of the middle valley, between the Fox Creek confluence and the bridge over the river at Middleburgh, has roughly five times as many sites; and a fair amount of information about them exists (files at the New York State Museum and the Schoharie Museum of the Iroquois Indian, September, 1986).

During interviews with local residents and avocational archaeologists, and study of private collections, I learned of 19 more locations, of which only a few could be verified. In the process of field reconnaissance to familiarize myself with every individual floodplain and some of the higher terraces, I found another 32 locations of prehistoric cultural material, mostly rather ephemeral sites, for a total of 61. The few temporally diagnostic artifacts that the 30 bottomland sites yielded range in date from roughly 5,000 to 500 years ago.

Accelerated Soil Erosion

Butzer (1982:133-134) describes landscapes that potentially contain cultural remains in various places, but have undergone alteration by floods attributable to accelerated soil erosion. He had previously reviewed this phenomenon, from the perspective of impacts that have been culturally induced. In times of climatic and tectonic stability or dynamic equilibrim, people bring about the most rapid and extensive effects (Butzer 1974). For example, Mediaeval abandonment of farms, not climatic change, caused soil from hills to completely cover Classical sites located in valleys. Yet the impoverishment of the southeastern United States by the tobacco and cotton crop denuded the landscape even more than the Mediterranean degradations.

Impacts on Alluvial Sites. After the upset of a drainage basin, material is transported in such great quantities as to "favor the development of a higher floodplain along great stretches of river" (Butzer 1982:134). The effects of accelerated soil erosion are widespread enough to be located by testing for three attributes:

1) Surfaces that antedate the cultural disturbance of the watershed become buried under alluvium, sometimes deeply, where they can be recognized by stratigraphy. The overburden may appear "anomalously thick and extensive", according to Butzer (1982:134).

2) Sands and gravels laid down by the unusually strong current rest high in the sedimentary column, and thereby produce a marked departure from the normal fining-upward sequence of grain sizes (Allen 1965:153-154). These coarse sediments will rest above the earlier site surfaces.

3) Sedimentation is accompanied by erosion, the traces of which are more elusive evidence of inundation. Overbank flow displaces cultural material; older artifacts can become redeposited above younger ones (Foley 1981).

These three effects comprised the signs, or test implications, for which the excavations on lower Schoharie Creek searched. Their identification suggested that such impacts extend well beyond the locality investigated in depth.

Causes of Accelerated Soil Erosion. When climate is not hostile, an equilibrium between erosion and soil development is normally maintained by physical-chemical processes and the organisms that live in the top layers of earth. Accelerated soil erosion, which often reaches catastrophic proportions, has been since the Ice Age predominantly a consequence of cultural activity (Butzer 1974, 1976, 1982; see also Marsh 1864; Sauer 1938) rather than a result of gradual environmental change. It takes place as a tripartite process:

1) Devegetation, cultivation, grazing, or construction initially leaves the ground open to proportionally greater soil loss when heavy rains or high winds occur.

2) Next, as the soil's capacity for absorption diminishes, runoff from snow melt and rainfall transports the eroded soil.

3) Then, runoff causes severe floods that carry away much of the sediment that has washed down slopes. These inundations may subsequently deposit the material on alluvial terraces.

Cultural Influences. Human attitudes and economics determine how the land is affected. Vegetation normally retains the soil by soaking up precipitation and by sheltering the earth from rainsplash that dislodges top particles. The community of plants that people cultivate or allow to grow accelerates erosion by the amount of earth exposed and the depletion of soil nutrients. Upon significant decrease of fertility, a plot needs to be reseeded for protection during recovery; simple abandonment causes greater erosion to occur than in the cultivation of open row crops (Butzer 1974:65; 1982:125). Fallowing, crop rotation, and alternate strip planting are some other conservation measures. Plowing oriented perpendicular to slope (on the contour) also keeps the soil in place, but tillage done uphill and down aggravates loss by runoff. Compaction by heavy farm machinery diminishes the percolation of moisture through the soil and promotes overland flow.

Physical Conditions. The likelihood of extensive disturbance by improper land-use in a watershed should be discernible by consideration of four non-cultural conditions known to have an accelerating influence on erosion (Wischmeier and Smith 1978; Butzer 1974).

1) Slope contributes heavily to the process through both steepness and length.

2) Soil composition determines the likelihood of erosion through its chemical composition and particle size: clay minerals and organic contents hold material together, sands promote loss.

3) Similarly, unconsolidated substrate adds to the vulnerability of an area (e.g., glacial till can increase destructive gullying and mass movement of debris).

4) Climate acts as a mobilizing agent, with precipitation rendered erosive by its intensity and timing, especially in relation to the annual cycle of tillage and plant growth, in particular open row crops.

Constraints to Prediction. Unfortunately for attempts to evaluate disturbance, pedologists cannot yet reliably predict the amount of erosion under a given set of circumstances (Butzer 1974:59-60), and hypothesized soil losses must be documented. Even when known to have happened, the cultural disturbance of a region will affect in the same way neither every drainage basin, nor parts thereof. Thus work in one area of a drainage to demonstrate the presence of various impacts cannot simply be extrapolated elsewhere in the same basin. If a pattern of effects upon floodplains does emerge to substantiate abnormal geomorphic change, one must be cautious about attributing it to particular alterations in the drainage basin. Therefore, timing of the soil equilibrium disruption becomes significant in assignment of causality for a period of flooding.

Accelerated Soil Erosion in the Schoharie Valley

Natural Conditions. Sediment flows into the lower valley of Schoharie Creek from an area of 2453 square kilometers (Thompson 1966:507). The trunk stream traverses a distance of 134km, of which the study area borders the last eleven. The Catskill Mountains underlie more than half the drainage (see Figure 1). Their steepness (Cressy 1966:48) exceeds the moderate range used for soil loss estimation by Wischmeier and Smith (1978:47), beyond which formulae for erosivity cannot make reliable predictions. The length of the Catskill slopes also has the potential to aggravate soil loss because the growing momentum of overland flow is relatively unimpeded by natural declivities, as brooks rarely interrupt the landscape due the porosity of its sandstone bedrock (Cressy 1966:32-33).

The Catskills surround the upper and middle reaches of the Schoharie; the division is made somewhat arbitrarily at North Blenheim (east of Stamford in Figure 1). The middle valley contains the bed of former post-glacial Lake Schoharie (LaFleur 1978). The fairly narrow expanse of lacustrine plain may have stored water and debris, so as to mitigate or simply delay flood effects in the lower valley. Downstream from the middle reach is the kilometer-long Schoharie Gorge, virtually devoid of floodplain. Together with the lower valley it forms a corridor through the physiographic province of the Mohawk Lowlands. Only a few tributaries to the Schoharie drain these hills and rolling plains.

Glaciation not only swept away the watershed's previous soils, but it also spread a mantle of erosive material that for the twelve millennia since recession of the ice has been the main subject of erosion either directly or after soil formation (Davis and Landry 1978; Flora *et al.* 1968). The glacial deposits comprise, for the most part, unconsolidated till, heterogeneous in grain size, with inclusions of cobbles and boulders. Its less cohesive character, relative to bedrock, makes this material subject to gullying and mass movements, some of which have resulted in highly unstable cliffs along streams. Scattered glacial outwash beds, kames, and deltas supply gravels and sands to the fluvial system, while lacustrine deposits in the middle valley predominantly yield silts and clays (Robert J. Dineen, personal communication, 1984).

Silts held together by clay particles or organic material comprise the bottomlands; sands and gravels are either mixed with the silt or form discrete strata more prone to erosion. Above the alluvial terraces, weathering causes a residual soil layer to form, that undisturbed is fertile, due to admixture of organic material. If disrupted, it becomes

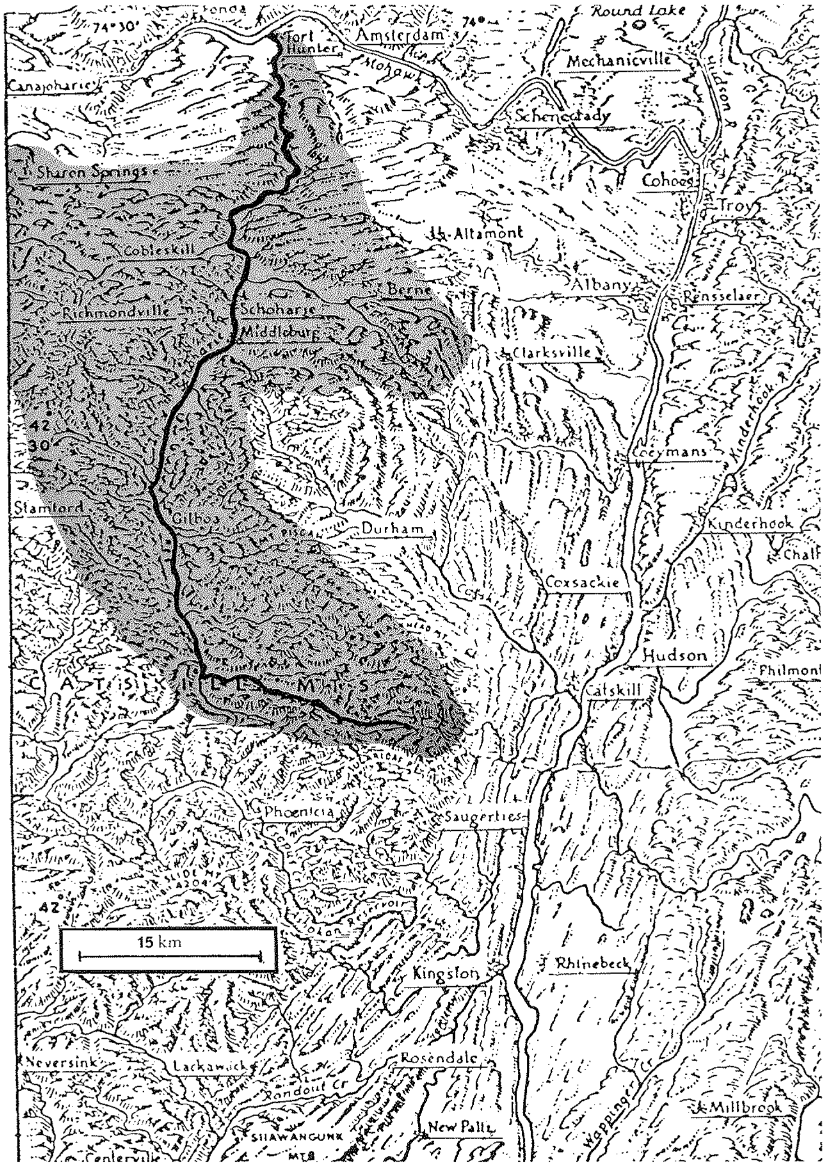


Fig. 1 Schoharie Creek and Watershed (after LaFleur 1969; Zembrzuski and Evans 1989).

friable and easily compacted, highly vulnerable conditions (Butzer 1982:125). The prehistoric vegetation of northern hardwood forests (Kuchler 1964:106) protected the landscape. Once people cut the forests and cultivated the soil, the land was in great danger of erosion.

Timing of rainfall has a greater influence on soil loss in the Schoharie watershed than intensity or volume of precipitation. Wischmeier and Smith (1978:28) note that the peak months for erosion in New York are June through August. Zembrzuski and Evans (1989:10) note that more than half the average 50cm annual runoff in the Catskills takes place between February and May. Their remark that "severe thunderstorms often cause flooding in the mountains" during the summer implies that intensity has a strong part in erosion because the most loss of the precipitation in this season happens by evapotranspiration (Zembrzuski and Evans 1989:10). A sizable amount of the 112cm average annual precipitation must be lost as autumnal runoff as well. At these times, agricultural land often has been either recently tilled or has become dry and compacted. The drainage's headwaters rank among the highest runoff rates in the state (Eschner 1966:80). The runoff rates in eastern New York rank among the highest in the country (Leopold et al. 1964:58), based on measurements taken since the first part of this century.

In sum, for the Schoharie drainage, the timing and intensity are the factors of precipitation that contribute most to its erosivity; devegetation renders the soils and substrate vulnerable; and when exploitation reaches the uplands and hillsides, erosion becomes greatly accelerated due to the steepness and length of slope.

Historical Circumstances. During Euroamerican colonization the image of the Schoharie watershed changed from promising fertility to alarming impoverishment in just over a century. For times prior to record keeping, to weigh the results of erosive disturbance requires appreciation of indirect historical evidence. In the Schoharie drainage such knowledge must come from rough population indices and descriptions of farming practices.

Cultural attitudes and economics determine which of the available land-use and conservation practices are put in place. A British agronomist, from his first-hand observations in New York, presented this characterization of the frontier mentality in 1775 (Carman 1964:93):

> The rural management in most part of this province is miserable; seduced by the fertility of the soil on first settling, the farmers think only of exhausting it as soon as possible, without attending to their own interest in a future day.

The economic causes and technological effects in the Northeast during the Colonial period are summarized by *Ellis et al.* (1967:78):

> The condition of agriculture was very low. The principles of rotation and the use of fertilizers were universally ignored. The abundance of land and the scarcity of labor made intensive cultivation pointless. An almost inevitable corollary was the custom of cropping the land until it was exhausted.

Cronon (1983:9, 123-124, 147) analyzes the ecological effects of the Euroamerican colonization of New England and cautiously identified land use as the cause of increased destructiveness of floods. By furnishing the two comments quoted below, he provides evidence that suggests that observers of the time made this connection more boldly.

> . . . above 20 years past when the woods was not pastured and full of high weeds and the ground light then the rain sunk much more into the earth and did not wash and tear up the surface (as now). The rivers and brooks in floods would be black with mud but now the rain runs most of it off on the surface is colected into the hollows which it wears to the sand and clay which it bears away with the swift current down to brooks and rivers whose banks it overflows.
>
> (John Bartram in Eliot 1934:204; original 1748-1762)

> The quantity of water, falling upon the surface, may be the same; but when land iz cuvered with trees and leevs, it retains the water; when it iz cleered, the water runs off suddenly into the large streems. It iz for this reezon that freshes in rivers hav becume larger, more frequent, sudden and destructiv, then they were formerly.
>
> (Webster 1790:371-372)

Cronon offers an interpretation of a note by Timothy Dwight(1822) on the Connecticut River that expands upon the original. It adds to the model of accelerated soil erosion a sequence of deforestation, earlier melt of snows on cleared land, and deeper freezing of soils without the insulation of snow cover (thereby inhibiting percolation).

Merchant (1989) explores colonial New England attitudes in depth and follows their transformation through the Industrial Revolution, with attention to geographic variability, particularly in regard to differences in population size between certain areas.

Widespread soil erosion had been recognized in New England by the mid-eighteenth century (Stallings 1957:12-15); yet the destructive pattern of cultivation prevailed even after contour plowing and the practice of fallowing were extensively publicized. The conservationist attitudes of the traditional European peasantry described by Wolf (1966) generally failed to cross the Atlantic (Butzer 1974:73-74). In

1852 less than half the farming population of New York had adopted measures to maintain the fertility of their land (Ellis *et al.* 1967:275).

The Palatine German arrival in the middle Schoharie valley ca. 1713 was "the first sizable penetration into the hill country of Upstate New York" according to geographer Meinig (1966:131), who remarks that these settlers came as large groups capable of rapid regeneration even in times of adversity. They derived from "the largest mass migration [into New York] during the colonial period" (*Ellis et al.* 1967:61) and maintained their culture fairly intact. Vogt's (1953) note on the severely erosive plowing of steep slopes in their homeland west of the Rhine during the eighteenth century suggests that these people were not predisposed to the conservation necessary to maintain the soil balance. Population along the middle Schoharie was diminished by some of the Palatines moving away from hostile land ownership policies emanating from Albany; they found refuge to the south, and with others became known as the Pennsylvania Dutch (Knittle 1937:205-211). Despite its early promise of bountiful security (Greene 1925:476), fear of hostile Indians to the north and west dissuaded many prospective newcomers to the valley (Ellis 1946:6). Even so, Schoharie farms produced grain enough for the Revolutionary Army that George Washington voiced his acclaim for their productivity (Roscoe 1882:54).

Yankee settlers poured into the middle valley after the Revolution, eager for land to exploit for the burgeoning wheat market opened by political and economic upheaval in Europe. The essentially agrarian population of the middle valley doubled from 1790 to 1800, then grew at a substantial rate for three more decades (Ellis 1946). Exhaustive cultivation practices continued. In 1819 the soils of the "famed Schoharie Flats" in the middle valley were described by a farmers' periodical as "totally inert" (Ellis 1946:136). That same year one of the first county fairs promoting conservation took place at the village of Schoharie (Ellis *et al.* 1967:171). Abandonment of some parcels in the bottoms may have been postponed by the adoption of deeper digging plows to deal with diminished crop yields (Ellis 1946:142), soon rendering more soil vulnerable to erosion.

The flight of farmers from the floodplain illustrates the complexities involved in human reaction to ecosystemic upset. Settlers could clear the hillslopes rapidly for planting; and there they more safely avoided malaria or "swamp fever" (Ellis *et al.* 1967:164). This scourge's threat may have derived from increasingly marshy conditions on the valley floor, due to a rise in the water table brought about by greater runoff in the drainage basin (see Trimble 1974:120; Butzer 1982:131).

After two decades a rent rebellion began in the uplands because farmers were no longer able to survive financially due to soil depletion (Noyes 1964:35; Ellis 1946). Abandonment of plots probably exacerbated erosional conditions.

Deforestation could also have contributed greatly to soil loss. In the wintertime farmers burned trees to produce ash, that rivaled wheat in export value at the port of New York in 1822 because of its usefulness in the manufacture of fertilizer and soap (Ellis *et al.* 1967:167). The Catskills also had the state's greatest abundance of hemlock trees, that in mid-century were cut and stripped of bark for tanneries, the wood left to rot (Fox 1902:61). Until ca. 1850 lumbering concentrated on the white pine, a tree not prevalent in these mountains compared to the more northern forests—the hardwoods that predominate in the Catskills were not removed as logs, because they do not float well, until railroads penetrated this terrain after 1860 (Fox 1902:11, 51-52). The destructive practice of cutting spruce of all sizes for woodpulp began later in the century, before conservation was introduced into forestry (Fox 1902:12, 77-78, 86).

In the 1830s cereal blights and competition in grain production with the Genesee country dealt serious blows to the economy of eastern New York (Meinig 1966:166). Besides planting hay, that allowed further nutrient depletion, attempts were not made to salvage the formerly cultivated plots. Farmers soon gave much of their attention to raising livestock, particularly sheep and goats, which caused more erosion by their feeding habits. Rills were no longer filled and the ground made absorbant by plowing; gullies grew and runoff went unchecked. After mid-century, the conservation movement gradually brought these processes under control through reforestation and careful planting, as dairying became pre-eminent in the middle and lower portions of the Schoharie drainage (Thompson 1966:210-211). Zimmermann (1988) documents the continuation of wheat agriculture until the 1870s that suggests further land clearance and more erosion.

Euroamerican exploitation thus affected the soil balance in four ways: 1) by stripping the land of its vegetational cover; 2) by raising crops that offered little protection to the ground and that exhausted its nutrients; 3) by raising animals further destructive of cover; and 4) by abandoning farm land, leaving the ground exposed. Since slope exerts the heaviest influence on erosion, the movement from exhausted bottomlands to the uplands in the third decade of the century suggests that fluvial reaction would have taken place a few years later, and probably continued as farmers moved through the uplands.

Flood Records. Although detailed records of inundations are not available before the twentieth century, some data on alteration of the flood regime can be gleaned from local histories. Disturbance of the fluvial system would have entailed an increase in the frequency of severe floods (Butzer 1982:134). The number of catastrophic events that were noteworthy enough to make their way into historical accounts provides some indication of the timespan of upset and its relation to land-use patterns.

Some of the disasters may reflect a final collapse of man-made constructions after gradual weakening, but in almost every case high water would probably have been the immediate cause. The spring breakup of the frozen river, caused by waters rising from beneath the ice, compounds the threat in two ways: huge blocks could batter down bridges and dams, or they could jam on a curve and cause a overbank surge to deluge the adjacent bottomlands (e.g., Roscoe 1882:57).

Table 1

Noteworthy Destructive Floods on Schoharie Creek

Year	Description
1784	Overtopped Indian high water mark at Middleburgh
1814	Ft. Hunter bridge damaged
1832	Dam at Ft. Hunter damaged by two floods
1843	Dam at Ft. Hunter damaged
1846	Ft. Hunter bridge damaged
1850	Dam at Ft. Hunter damaged
1858	Destruction of floodplain in the middle valley
1863	Dam at Ft. Hunter damaged by two floods
1869	Destruction of floodplain in the middle valley
1870	Destruction of floodplain in the middle valley
1894	Dam at Ft. Hunter damaged
1909	Destruction of floodplain in the lower valley
1955	Destruction of floodplain in the lower valley
1987	Collapse of Thruway bridge at Ft. Hunter

Severe floods happened five times more frequently between 1830 and 1870 than equal periods of time before or after (see Table 1 and discussion that follows). In the four decades of the mid-1800s a total of 10 events of destruction took place. (The periodicity of these disasters would not be expected to exhibit a pattern of increase and decrease within a 40 year span because the immediate meteorological and hydrological causes occur randomly.) Prior to these mid-century events, 18 years, and before that 29 years, had elapsed between noted damage. The only previous flood record had been marked by the area's inhabitants prior to the arrival of Europeans 71 years before. After the mid-nineteenth century, 24 years pass without a catastrophe, and the next was 15 years later. Since 1926 when the river was dammed at North Blenheim, floods continue to occur, but the intervals between severe damage are longer.

When the Palatines settled in the middle Schoharie valley in 1713, they took as the southern boundary of their lands the previous high water marker near present-day Middleburgh. There the design of a turtle and snake (elementally symbolic animals that were possibly also clan insignia) had been carved into an oaken stump. It had been hollowed out for grinding corn, and a stone pile placed alongside that was still in existence when Brown (1823:5) wrote the first history of the area in 1816. Two streams met the larger creek at this point. During floods they caused log jams that the Indians used to cross the treacherous current and called *To-wos-scho-hor* or "flood wood" (Greene 1925:471; cf., Michelson 1973:102), from which the river received its name.

Brown's (1823:21) historical sketch hailed the years 1784-1785 as "the most remarkable for overflowings." Considering the consequences that often ensue upon abandonment of tilled fields, it seems more than mere coincidence that only a few years earlier a British force had "heavily and repeatedly ravished" the farmsteads in the area as retribution for their supply of grain to the Revolutionary Army (Meinig 1966:137).

The middle valley suffered three notable floods in the mid-nineteenth century. Erosion (that could have disturbed sites) is specifically mentioned as an effect of the first and implied for the other two:

> ... in the spring of 1858 when houses and hay stacks were carried away, and *broad flats cut up* by the strong current... In the fall of 1869 another overflow did a great amount of damage, but was followed in the spring of 1870 by one of greater proportions, that did *an immense damage in the destruction of farms* ...
>
> (Roscoe 1882:58, emphasis added)

Records for the lower valley relate either to bridges over the Schoharie or constructions for its crossing by the Erie Canal at Ft. Hunter. The earliest such event occurred in 1814 when the eastern half of a 1796 bridge was "carried away" by ice (Simms 1882:380; Frothingham 1892:298).

The first construction for the Erie Canal near the mouth of the Schoharie was built in 1822 of stone and timber. The dam lasted relatively unharmed for a decade, according to a pamphlet published by the Canal Society of New York State:

> But March floods in 1832 brought down quantities of very strong ice which took out one hundred fifty feet of the dam and so injured the rest that immediate work was required to save the structure . . . The job was hardly finished when an April flood took out another hundred feet adjoining the new section.
>
> (Anonymous 1966:13)

A second Erie Canal construction, built that summer of the same materials, with the addition of brush and gravel, was damaged by a flood in 1843 (Whitford 1906:960). It was left "useless" by the flooding of 1850 (Anonymous 1966:15). A nearby toll bridge, erected in 1829, was "carried away by ice" in 1846 (Anonymous 1966:11). The 1822 dam had survived until 1863 when it was rebuilt "of concreted stone masonry"—within two months flooding destroyed part of it and within the next five months, most of the rest (Anonymous 1966:15). The third dam, of trees reinforced with stone and gravel, was built in 1864 and partly washed away 30 years later (Anonymous 1966:16).

The flood of 1987 took out the 1954 New York State Thruway bridge and another bridge at Mill Point in the middle of the study area. I note here twentieth century catastrophes partly according to the recollections of Steve Lopuch (personal communication, 1986), who has since 1927 lived on the Schoharie just upstream from its confluence with the Mohawk. In 1955 a flood scoured out the western edge of his bottomlands. A now deceased neighbor, Fred Lohmeyer, told him that around 1910 water filled the valley from one side to the other and it took all summer to refurbish the flats by filling the scour holes. This inundation probably happened in 1909, the flood year nearest those cited for the early parts of the century by the National Transportation Safety Board's review (Resource Consultants 1987:2-3 to 2-6, 3-3), that also mentions high water in 1901, 1903, 1936, and 1938. This study theorizes that repeated scour by floods gradually undermined the thruway bridge.

Data from the United States Geological Survey guaging station at Burtonville, in the Schoharie Gorge (computer tally of April 28, 1987, with written comments by Lloyd Wagner, personal communication) has the 1955 flood as the highest since 1904, and a foot higher than the 1987. The third greatest peak since 1940, the year to which the guage records extend, happened in 1980, and was about a foot lower than the 1987 crest. Neither it, nor the other lower ranked floods listed in Table 2 below, brought about notable disaster.

Because seven of the highest twelve floods in the last forty-eight years happened in the last decade, more than twice the average frequency, recent land-use practices come under suspicion. It could be that decline of family farms due to competition with agribusiness has occasioned accelerated soil erosion and greatly increased runoff—a situation replicating the mid-nineteenth-century land-use model developed here (for background on this cultural shift, see Berry [1986]). The National Transportation Safety Board study (Resource Consultants 1987:3-21 to 3-23, 7-54) also remarks upon the increased frequency of floods in recent years, as measured by peak discharges since 1940; the highest thirteen occurred since 1950, nine since 1977, roughly three times the average frequency. The report seems to have an implicit acts-of-nature explanation for the increased flooding. It casts doubt upon replication of the land-use model by reference to a New York State Department of Environmental Conservation finding based on Soil Conservation Service observations in 1982 that only one-third of the cultivated acreage in the Schoharie Valley measured beyond the "tolerable" level of soil loss (Resource Consultants 1987:4-2). The erosion is attributed to poor conservation efforts and the cultivation of slopes. But according to the accelerated soil erosion model, this setting presents a great danger for runoff, and such farming practices may further contribute to flooding.

Early cartography affords some evidence about the filling in of low-lying land in the locality where the four excavations to be summarized below took place. A survey map of ca. 1785 (New York State Archives, Land Papers, v. XLI, p.30) figures the penultimate bend of the Schoharie as a wide expanse of water with islands (see Figure 2). A survey map of 1855 (in possession of Mrs. Bill Ripley, the landowner) shows in the same place a greatly narrowed river along one side of a floodplain field and a raceway along the other (see Figure 3). Water in this ditch on the edge of the old channel served two mills and was controlled by a bulkhead on the Schoharie. Despite the possiblility of some influence upon deposition by these constructions, the filling in of the former channel reflects a tremendous volume of sediment in transport during the period in question. That a local history remarks upon the importance of grain processing at mills in this location during the Revolutionary War (Alter 1944:4) may suggest earlier channel changes. Finally, local residents (Steve

Table 2

Twelve Highest Floods at 1940 Burtonsville Gaging Station

Year	Month/Day	Height (ft)	Discharge (cubic ft/sec)
1956	10/16	12.49	76500
1987	4/5	11.23	65000
1980	3/22	10.15	54700
1978	11/9	8.51	40400
1984	4/6	8.38	39400
1986	3/15	8.14	37400
1951	3/31	8.00	37900
1977	3/14	7.89	35500
1964	3/5	7.34	29400
1983	4/25	7.33	31000
1960	4/4	7.25	30500
1960	3/31	7.20	30100

Lopuch, personal communication, 1986) believe that the spirited fiddle tune "Devil's Dream" was composed by the guard at the bulkhead, inspired by the turbulence of the river, although Deetz (1977:129) places the origin in the southern Appalachians during the eighteenth century.

In interviews valley residents often remarked upon Schoharie Creek's bad name for flooding. (My basis for comparison of frequency of comment rests upon survey experience on a stream of similar size, Ohio Brush Creek.) The reputation may be traditional, passed down since the mid-nineteenth century, with occasional reinforcement, or it might be due to the more frequent high waters of the previous thirty years, especially during the last decade. Its folkloric quality is epitomized by one of the stories of Tim Murphy's death in 1818 (Williams 1980:36). This hero of the middle valley's defense in the American Revolution also achieved legendary status as the sharpshooter who picked off the British general at Saratoga, the shot that won the battle that turned the course of the war. Murphy purportedly contracted a fatal illness during his unsuccessful attempt to save a local judge from a freshet in 1818, the same Judge Brown who personally published the first county history in 1823.

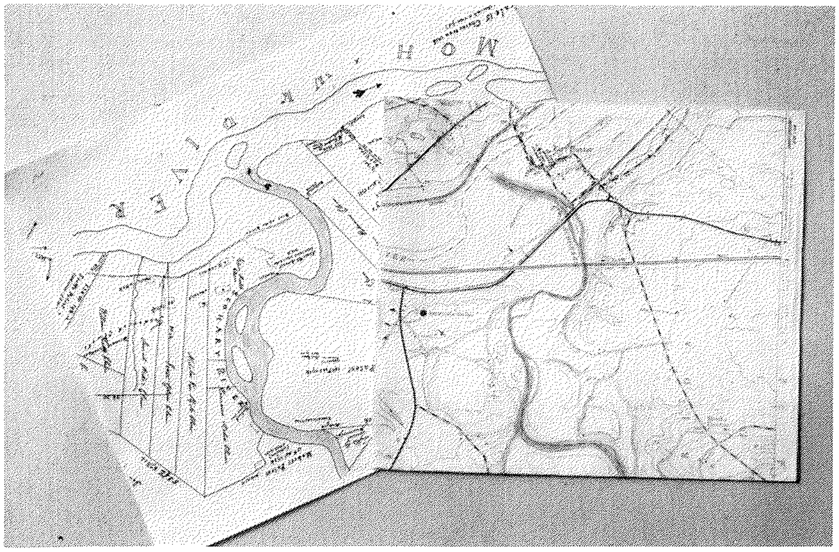


Fig. 2 Lopuch Locality 1785 and 1944 (after New York State Archives Land Papers; U.S.G.S. Tribes Hill Quadrangle).

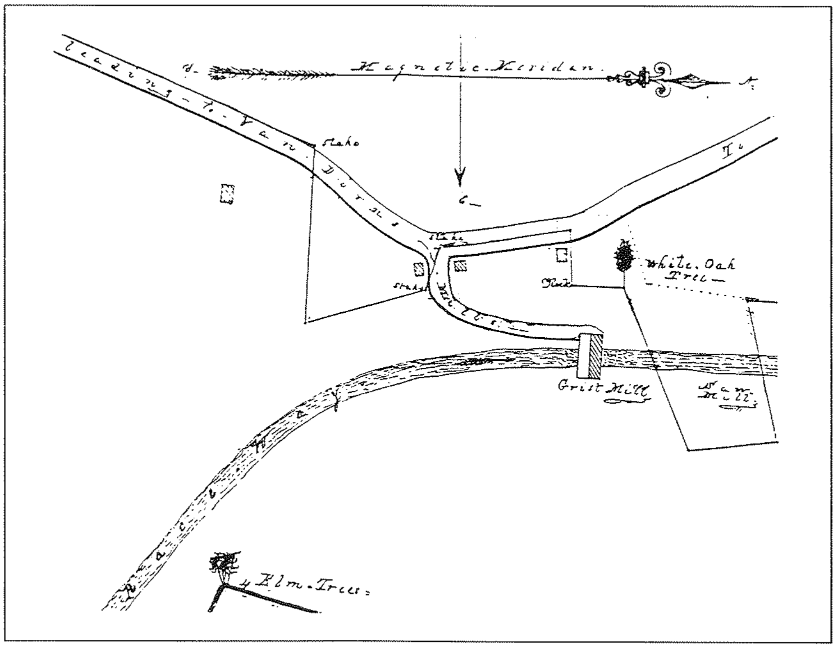


Fig. 3 Lopuch Locality Western Floodplain 1855 (map courtesy Mrs. Bill Ripley).

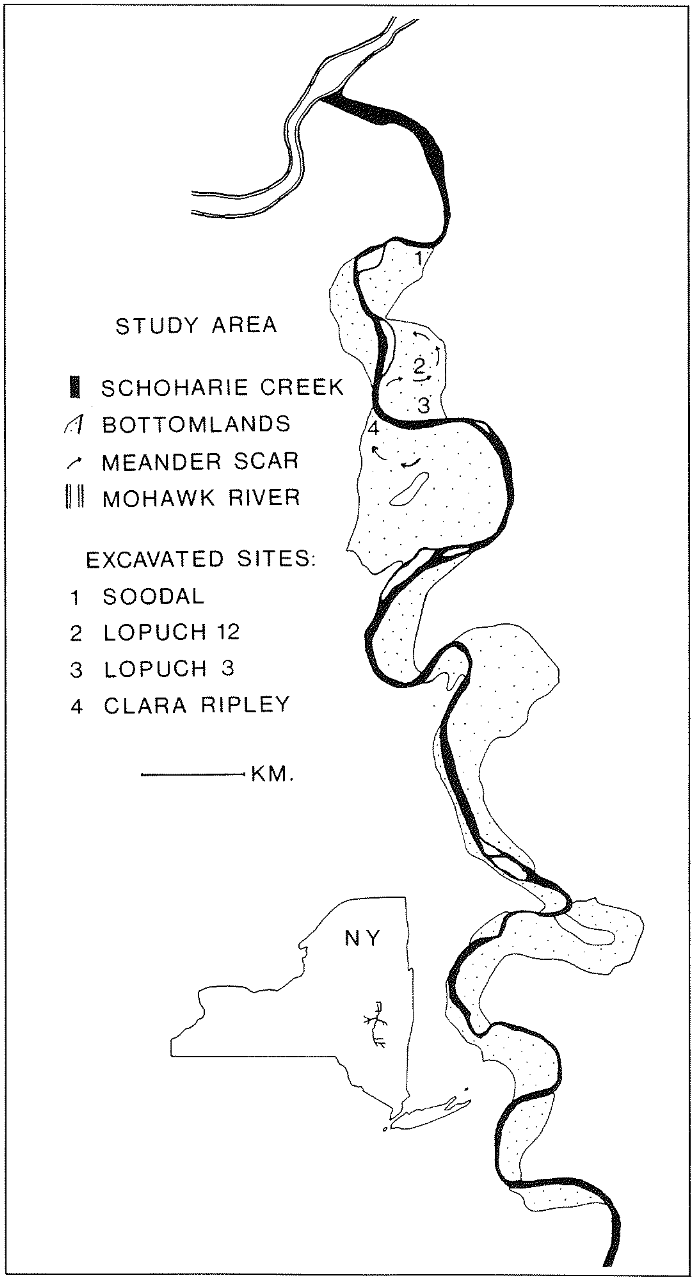


Fig. 4 Lower Schoharie Creek Study Area and Sites in the Lopuch Locality.

Archaeological Evidence

This section will summarize the evidence from four excavations, and discuss their relevance for the hypothesis. They are all located in what I would call the Lopuch locality, a long bend in the river near the downstream end of the study area (see Figure 4). Their landform situations differ in respect to floodplain formation and disturbance. Like pieces in a puzzle, they exhibit the several context modifications that together provide strong suggestion of an unusual pattern of flood impacts. Due to geomorphic variability, different places would be subject to diverse effects or combinations of effects: deep burial, abnormal coarse sediments, and/or redeposition.

Four other sites found on the surface were briefly explored by shovel-size test units. One on the Pilicki farm displayed no signs of intact buried contexts, possibly due to erosion, and the owner expressed reluctance about greater amounts of excavation. On the Squillace farm test units encountered stratified deposits, but the crop schedule restrained further investigation. A third and fourth site at the Lopuch flats both yielded signs of buried remains, yet this study's time contraints prevented more testing.

The Clara Ripley site was found when visual inspection of vertical cut bank exposures along both sides of Schoharie Creek in the study area, done on foot in July and August of 1983, discovered its first and only deposit of prehistoric cultural material. Pottery of a thickness suggestive of 950 to 650 years antiquity lay in an ash layer 152cm below the surface and about 3m above the river's normal level. Such relatively recent artifacts ought to rest within the top 20cm of a terrace. A one by two meter trench, placed parallel to and 277cm from the bank, confirmed the depth of two occupation zones, separated by only a few centimeters (see Figure 5). A decorated pottery rim set the timespan of the site between 700 and 600 years BP (Before Present, taken conventionally as 1950). This shard and two others were uncovered among fire-cracked rocks within patches of burnt earth and ash, along with a small amount of shell and burnt wood. Radiocarbon assay of the charcoal supplied the date of 695 +/− 160 years BP (laboratory number GX 11617) in confirmation of the site's age.

The flood of 1986 exposed another stratum that contained similarly thick pottery, 30cm above the ash layers. Apparently the site received at least several utilizations during a time of rapid floodplain accretion. Nevertheless, the great depth of the overburden still argues for unusual amounts of sedimentation in the meander scar that the site occupies. The layers rest about 30cm above the former river chan-

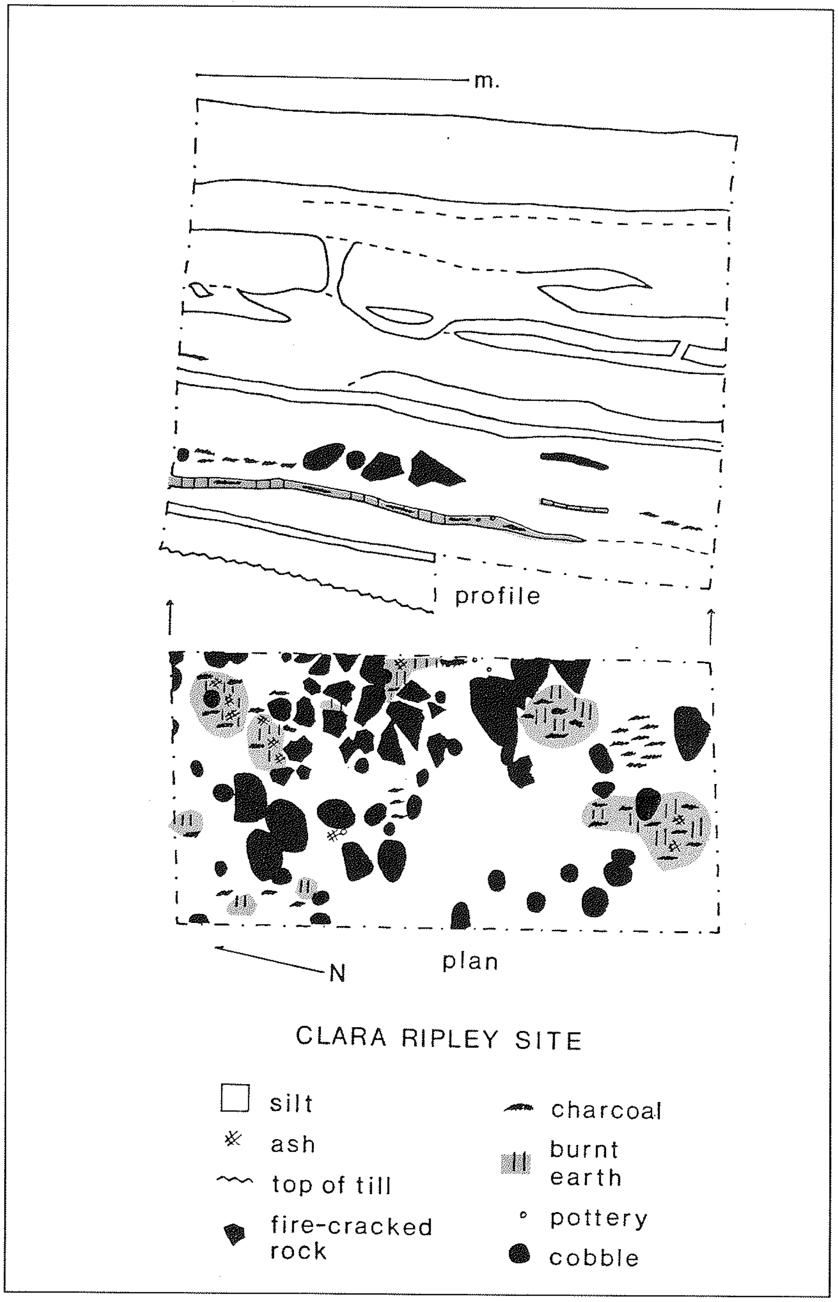


Fig. 5 Clara Ripley Site Trench.

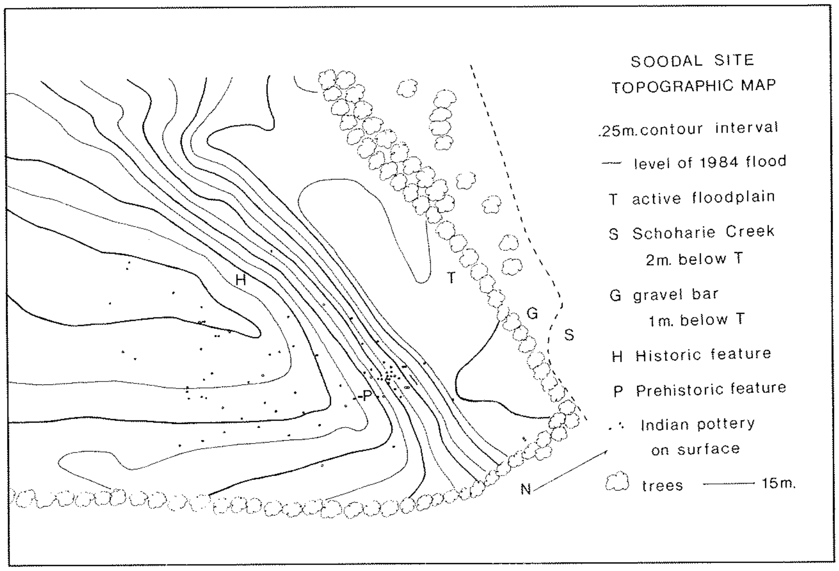


Fig. 6 Soodal Site Topographic Map.

nel. After abandonment due to meandering, this huge trough probably served as a stilling basin where flood waters backed up and in their quiescence released sediment (see Patton 1981). The 1986 flood demonstrated both the preservative and destructive aspects of high waters on the site: a thickness of 2cm of silt was deposited on top of the terrace containing the site, and a 5cm to 25cm horizontal section of the cut bank was washed away, taking another slice of the site which such erosion had just recently exposed to view.

The Soodal site turned up as chert flakes, a netsinker, historical period pottery, and white clay pipestems in surface inspection of a plowed 4m terrace that slopes down to a narrow sand and gravel bar along the Schoharie. Subsequent examination found late prehistoric pottery unearthed by tillage and probably transported downslope by the high water of 1984 (see Figure 6). More chert flakes, two additional netsinkers, points of several time periods, and a pipe bowl with the ca. 1700 cartouche with the molded letters R-TIP-PIT came to light.

Any such scatter on a floodplain provokes the questions of: 1) have the remains have washed in from elsewhere? 2) has the site been disturbed by tillage? and 3) do some remains rest relatively intact beneath the reach of the plow? A shovel test pit on the slope, above the densest surface cluster of pottery, brought up charcoal-

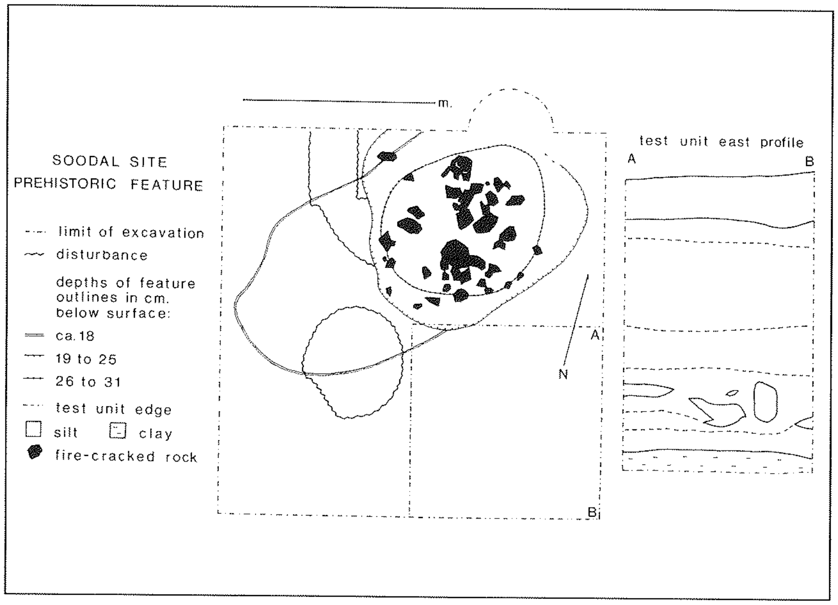


Fig. 7 Soodal Site Prehistoric Feature.

filled soil. A two by two meter excavation outward from this unit uncovered a shallow refuse-filled depression, that extended from 19cm to 31cm below surface and measured 76cm by 95cm at its amorphous orifice (see Figure 7). The depression contained pottery that fit together with sherds in the plowzone above it. Decorated sherds there and nearby on the site surface put the major occupation between 1450 and 1500. Also from the depression came a bear canine tooth, two beaver incisors, a triangular chert point, and a fragment of a clay effigy head, seemingly of a bird, with modeled eye and nostrils.

Test excavations on the terrace ca. 50m away exposed a wall (at least 1.5m long, .5m wide, and .35m high) of limestone blocks with similar stones piled on top of each other and angled down in the direction toward which high flood waters might flow (see Figure 8). Under the rocks lay a hearth containing historic artifacts (window glass, wall plaster fragments, and pieces of metal) suggestive a domicile's interior. On the other side of the wall at its base an organically-stained layer contained a metal button made between 1700 and 1776. The structure possibly belonged to Johannes Visger (Vischer, Fisher), one of the first settlers in the area (Frothingham 1892:291; New York State Archives, Land Papers, XLI:30).

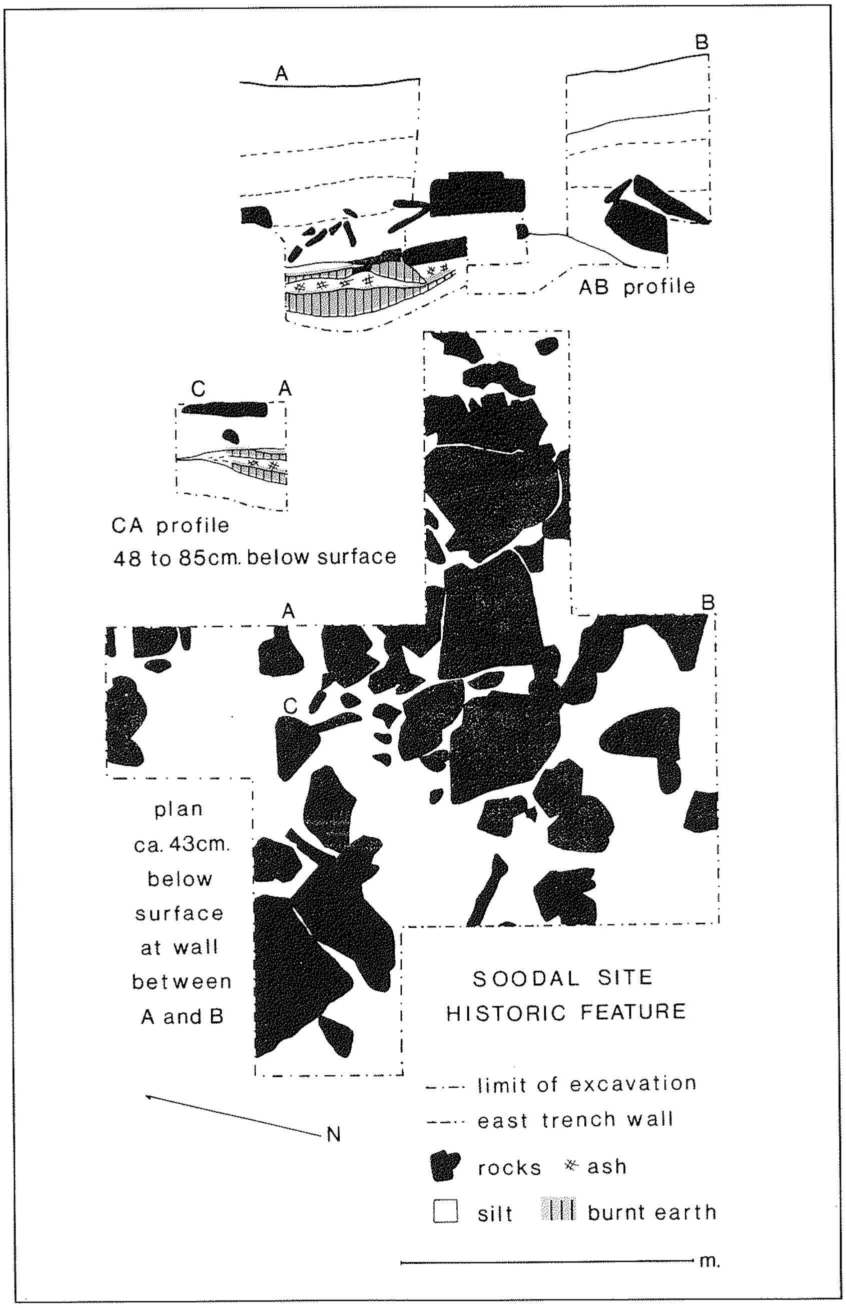


Fig. 8 Soodal Site Historic Feature.

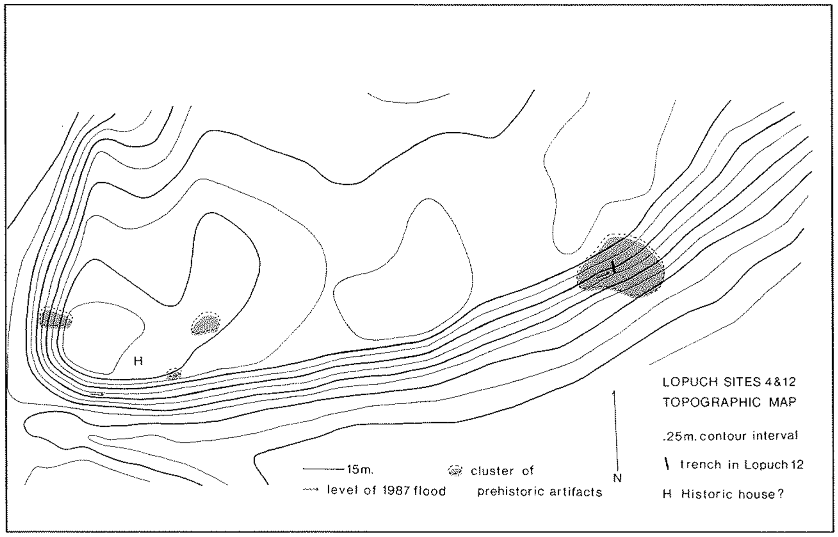


Fig. 9 Lopuch Sites 4 and 12 Topographic Map.

Three strata covered both sides of the wall and contained prehistoric chert flakes. The stratigraphy and orientation of the rocks suggest damage of the wall by a flood, with redeposition of sediments from nearby. Intentional burial by farmers to remodel their field for easier plowing might also account for the burial of the wall, such that it can not be observed on the surface today. Flood action, however, seems the most parsimonious explanation, especially upon consideration that three layers cover the wall.

The Lopuch 12 site also occupies a terrace scarp, roughly 4m above Schoharie Creek, but in a meander scar 350m away from the river (see Figure 9). Its 30m by 20m scatter of several hundred chert flakes, along with a few historical period artifacts, seemed clustered enough to reward excavation as a typical site undisturbed by flooding. The results of a 5m long test trench demonstrated the contrary (see Figure 10). The strata upslope comprised gravels and sands almost devoid of artifacts, while strata downslope contained fairly abundant chert flakes to 171cm below surface. Intensive work on stratigraphy eventually displayed an old channel bed and bank above it on the higher end of the trench, while on the lower end there were eight layers of subsequently deposited sediment above the bed and bank.

Was this another redeposited site? Four centimenters below a deep woodchuck hole, and from a silty sediment rather than the burrow fill of sand, came a potsherd that must have been made more recently

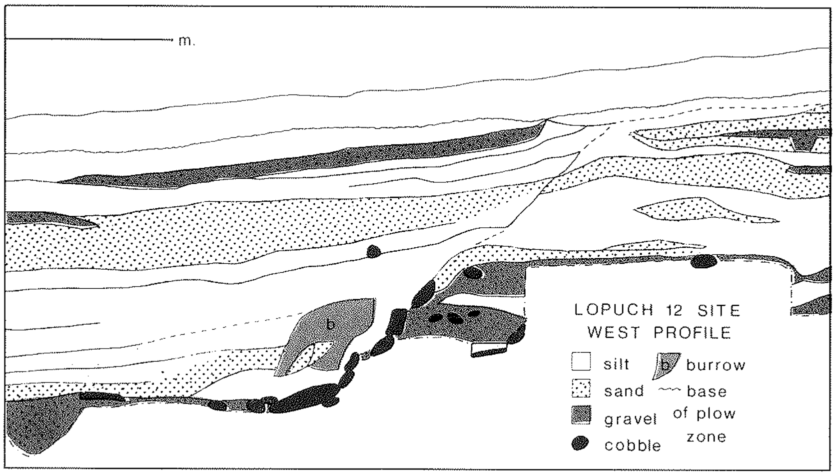


Fig. 10 Lopuch 12 Site Trench, West Profile.

than a 3850 to 3550 year old spear point found on the surface. Two fine chert blades of 2950 to 2450 years antiquity also appeared in the scatter and resembled one found on another scatter some 50m up the abandoned channel in the direction from which high waters come when the river floods. This larger site, Lopuch 4, has fairly abundant prehistoric and historical artifacts across its 150m extent along the terrace edge. It contained a British half-penny dated 1730. The British may have torched the farmstead in the early 1780s. No domicile in this location receives clear indication on early maps.

Could erosion have displaced the more recent prehistoric artifacts at Lopuch 4 and then the older ones, so that as the successive floods slowed near Lopuch 12 because of the wider channel, artifacts transported there would over time have been redeposited in reverse order? Charcoal in the middle stratum of Lopuch 12, between 85cm and 90cm below surface, provides evidence of this process and its date. The radiocarbon assay on the middle stratum yielded an age of 430 +/-180 years (GX 11955). Charcoal from earlier times may well have been mixed with much more abundant burnt wood from the Colonial era to make the date of redeposition, of the lighter charcoal together with the heavier chert flakes, appear earlier. Certainly no temporally diagnostic artifacts occurred on either sites to suggest that the prehistoric debris originated at that time. The coarse sediments, sands and gravels, at the top of the stratigraphic column provide another indication of flood impacts since at least around 1520 and probably later.

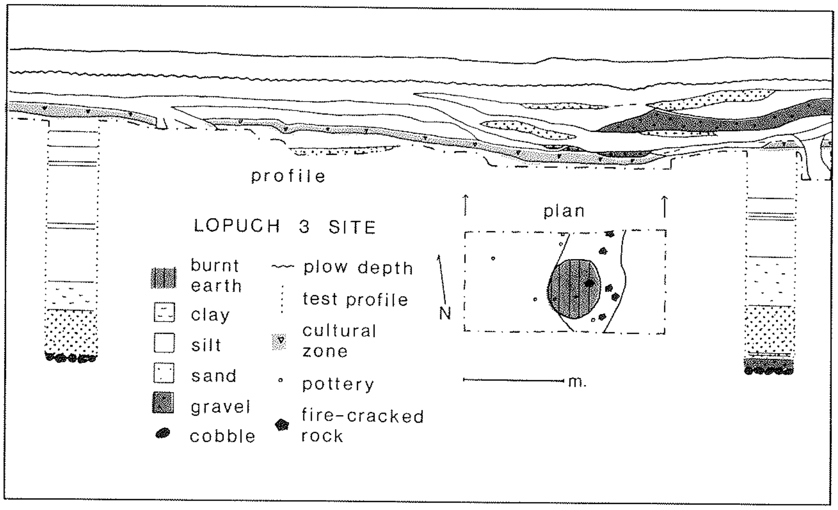


Fig. 11 Lopuch 3 Site Trench.

The Lopuch 3 site also occupies the center of a floodplain, but rests in a flood chute, a long trough perpendicular to Schoharie Creek, that normally flows about 150m away and 4m below. The site has no surface indications of the 5cm to 15cm thick cultural layer, the top of which rests 55cm to 97cm below surface. A half meter test unit placed to test sediments in this area (then in cow pasture) discovered chert flakes at 97cm below surface. A backhoe trench and trowel work then uncovered a hearth that contained a potsherd from the time span between 2450 and 1125 BP (see Figure 11). Radiocarbon assay placed the occupation at 2405 +/− 145 years BP (GX 11619). These dates place the site within an obscure nine century period, otherwise known in the region only from the fifth stratum below surface at the Westheimer site on Fox Creek, near the village of Schoharie (Ritchie and Funk 1973; see also Funk and Rippeteau 1977:32).

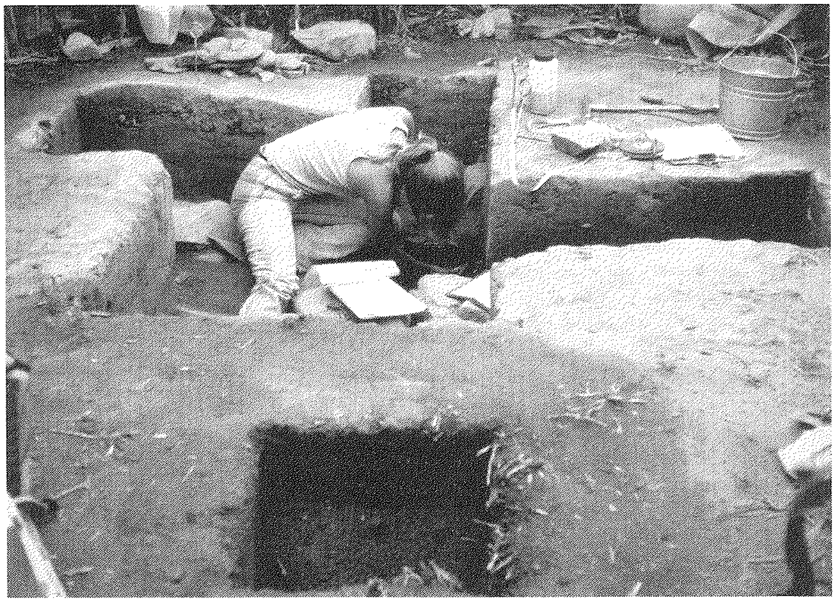
A chert hammerstone and a very small, carefully flaked chert artifact suggestive of a drill bit also come from the cultural layer. (See Lindner [1990] for more recent corroborative evidence for the age of this occupation, a carbon date of 2315 +/− 105 years BP [GX 15140] at a second hearth. This pit had nearby another microdrill along with 97 burnt nut shell fragments. Twelve other microdrills occurred beside the first hearth.) Five of the seven strata between the cultural layer and the plowzone, significantly, were composed of gravels and coarse sands. Two deeper backhoe cuts at either end of the trench, displayed the normal fining upward sequence below the prehistoric occupation. Lopuch 3 thus joins Lopuch 12 as an example of coarse sediments abnormally close to the surface. No flood effects occurred here during either the 1955 or 1987 floods, but ice jams on the nearby bend in the Schoharie have diverted high water across this area, according to resident Steve Lopuch (personal communication, 1987).

Conclusion

The four excavated sites all exhibit unusual context modification, even Lopuch 12 which seemed normal on the surface, and in each instance floods most parsimoniously account for the impacts. The evidence was manifest in this array: one site buried under unusually thick deposits; two sites overlain by abnormally coarse debris high in the stratigraphic column; and two sites that sustained massive redeposition. It remains unproven that the same set of floods brought about each effect observed, but Lopuch 12 suggests a disturbance after the 1730s, the Soodal site after the 1720s, and the Clara Ripley site at least since 1250. The flood record indicates that a high frequency of severe inundations occurred in the mid-1800s. Cartography suggests massive sedimentation happened in the Lopuch locality around the early nineteenth century.

This evidence supports the hypothesis of effects from catastrophic drainage basin upset by Euroamerican land use that acted upon non-cultural conditions conducive to accelerated soil erosion. The temporal position of the gradual upset's start a few decades before the fluvial reaction, and concurrent run of these two phenomena for another several decades, strongly suggests that these floods were the geomorphic agents that caused the alterations of the prehistoric record. Because such disturbance causes widespread repercussions, this context modification probably extends over a much broader area than the Lopuch localilty.

The effects observed at the four excavations most likely characterize many other portions of the lower Schoharie valley, and quite possibly the floodplains of the entire drainage. Although extrapolation must proceed cautiously, when confronted with a need to know for cultural resource management or research reasons, archaeologists thoughout the Hudson River Basin ought to search carefully for such impacts—indeed this situation could obtain in all watersheds where accelerated soil erosion may have taken place, which now comprise (except for naturally arid lands, polar regions, and high mountains) most of the world's land mass. ☐



Soodal Site Historical Period wall (facing north).

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Notes

1. Artifact type names and references, in addition to photographs of temporally diagnostic materials, may be found in Linder (1987).