CONTENTS

TWO GROOVED AXE ASSOCIATIONS FROM THE SOUTH SHORE
Gerald D. Zeoli.................................................................41

NATURE'S TRANSFORMATIONS AND OTHER PITFALLS:
TOWARD A BETTER UNDERSTANDING OF POST-OCCUPATIONAL
CHANGES IN ARCHAEOLOGICAL SITE MORPHOLOGY IN THE
NORTHEAST. PART 1: VEGETATION
Alan E. Strauss.............................................................47

THE AUTHORS..................................................................64
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This, the Society Museum, is located on the 5th Floor of the Attleboro Trust Co. building, at 8 North Main Street, Attleboro, Massachusetts. Museum Hours are from 9:30 a.m. to 4:00 p.m. daily, Monday through Friday. Although this schedule is usually adhered to, it is wise to call the Museum before coming if you come from some distance. The Museum is also open by appointment at other times. Call the Museum Director, Maurice Robbins.

The Museum has extensive exhibits of stone implements, obtained for the most part from the Massachusetts area. They are arranged in culture periods identified in the Northeast, and cover a time extension of some 10,000 years.
On July 6, 1976, the writer, accompanied by William J. Casiottolo, explored an area along the borders of Bear Swamp in Randolph, Massachusetts. This was one segment of an expedition to uncover prehistoric sites along the inland drainage of the Blue Hills quadrangle. The map used, published by the United States Geological Survey, already includes such major prehistoric camps as Ponkapoag, Cochato River, and the Milton-Quincy sites (Bowman & Zeoli 1977). It was our intention, however, to focus on lesser occupied areas, thinking that the study of such areas would shed some light on the interpretation of the multi-phase occupation sites. The discovery of one important feature led to the writing of this article.

Upon arriving at the first site (site #M35NE26), we were not at all surprised to see that the wooded area on the map was, in fact, now heavily developed for apartments. Fortunately, the land closest to the wooded swamp had only been slightly disturbed by the development. The recovery of a full-grooved axe (Fig. 2:5) prompted a closer inspection. As shown on the map (Fig. 1), the site, with an elevation of 20 feet (6 m), is so well drained today that the first 2 inches (5 cm) of subsoil appeared as dry as flour. A few flakes of Blue Hills felsite (aporhyolite) were the only other form of artifactual evidence to appear on the surface. Rather than remain at that particular location any longer, we decided to explore the general area further. Bill found a Corner-Removed #5 on a similar projection of land across the marsh. We speculated, then, that the axe might be of that age; however, that was not certain.

Realizing the importance and rarity of a full-grooved axe in association with a classifiable projectile point, we returned to the first locale the next day. Short-handled trowels were used to strip away the remaining soil. Three large slabs of diorite were uncovered adjacent to where we found the axe (Fig. 1). The orange soil around the slabs, discolored by ancient fire, was extremely compacted. A sufficient quantity of well preserved charcoal was extracted from the soil by a simple means of flotation. This material would be used for a C-14 date. Flakes were extremely scarce here beside the charcoal deposit. However, a sizeable concentration did show up on the other side of the diorite slabs. All but two of the flakes were Blue Hills felsite. It seems that an Indian once sat on this side of the fire and fabricated projectile points. Among these flakes, two diagnostic projectile points and a third fragment of the same type were found in close association. The projectile points were characteristic of the style earlier suspected (Corner-Removed #5: Fig. 2). Photographs of the artifacts in situ were taken along with field records of the feature and associations.
It seems that the feature was left by one person, or a small band of prehistoric hunters who visited the site at least once. Attractive even today because of its proximity to the swamp and flowing brook nearby, the site must have offered a dry place to stop for a while.

Here they constructed a stone axe of the local rock (Salem gabbro-diorite) which outcrops on the site. The axe might have been used to clear the immediate area around the camp. It is fortunate that the site was so sparsely occupied, for it affords the archaeologist a pure component to work with. There should be no question as to the full-grooved axe’s cultural affiliation. All artifacts and debris were found at the same level – roughly three to four inches below junction. It is believed that these artifacts, charcoal flecks and waste flakes are of the same age.

Results from the C-14 test were disappointing. The sample (UGA-1575) revealed an age of 2,445 BP ± 145. All precautions were taken to make sure that no contamination could have occurred. However, such a recent date could only mean that it had or that the charcoal was in fact that young. Many possible reasons could be stated here, not excluding the association of this date with Corner-Removed #5 projectile points. However, we will not commit ourselves to any one possibility and merely present these data for the record. [Ed. See following article for examples of possible "contaminants".]

DISCUSSION

It is significant that this full-grooved axe can be associated here with Corner-Removed #5 projectile points, which are here equivalent to the Middle Archaic Neville points of the seventh millennium B.P. (Dincauze 1976). The full-grooved axe has, unquestionably, been assigned in this area to a later period in time (Fowler 1975). Grooved stone axes are commonly displayed in historical society collections throughout the state; more often than not, the records, if any, lack detailed information concerning their associations. On occasion, this artifact is mentioned in M.A.S. site reports, but they are usually found on unstratified multi-component sites, making it difficult to assign them to the proper horizon or phase.

Cases that the writer is aware of, where this rare association does occur, are quite interesting. The tool has been found close to a zone yielding Stark and Merrimack points at the Neville Site in New Hampshire (Dincauze 1976:73) and might be assigned to those complexes. The site has also produced a quantity of Neville points, named so after the property on which they were found. The Neville point is commonly referred to as "Corner-Removed #5" by M.A.S. members and they usually occur with Stark (Corner-Removed #8) points in Massachusetts.

A similar situation occurred in Hull, Massachusetts, where a full-grooved axe was recovered from the Sandy Court Site (unpublished records, Eastern Massachusetts Archaeological and Geological Research, Inc.) along with many stemmed projectile points of the Corner-Removed #5, #8 and #9 varieties. It is only the presence of a handful of Squibnocket stemmed and triangular points from the site which raises doubt as to who made the axe. However, these latter kinds of points are sparsely scattered over the site and might only reflect the phase in transition or some hybrid component which occurred latest at Sandy Court. At most, Squibnocket (Late Archaic) influence here is considerably less significant than the main assemblage, and is presumed to be non-diagnostic of the true phase’s material culture.

While this draft was in preparation, and only weeks after the Randolph association was discovered, William J. Casiottolo uncovered another full-grooved axe occurring with Corner-Removed #5 (Neville) points.
A summary of what he found follows. A number of related Woodland sites have been excavated in the past years by E.M.A.G.R., Inc, along Hayward Creek in Braintree, Massachusetts. Almost every style of Woodland projectile point has been found along this tributary of the Monatiquot River. Until this year, only two projectile points of the "early Middle Archaic" horizon were found among recorded artifacts.

On July 28, 1976, while following the destructive path of a bulldozer, Bill Casiottolo came upon a concentration of small patinated flakes exposed by the excavation. As he dug off the plowed area into undisturbed turf he uncovered four Corner-Removed #5 (Neville) points, four leaf-shaped blades, one bifacial scraper, one rough blank, and a full-grooved axe (Fig. 3:5) associated with a hearth and occurring with more flakes. The area is relatively sandy although granite ledge often protrudes above ground surface. The feature is roughly 25 feet (7.5 m) above a wooded swamp. At one end of this swamp there exists a cattail marsh fed by a brook which once flowed from a lake of substantial size. The lake has been recently filled due to extensive granite quarrying.

The projectile points and leaf blades are made of well-known felsites, while the grooved axe, unlike the Randolph axe, is fabricated from another local stone - Braintree slate. So once again, a grooved axe has been found with Corner-Removed #5's.

This association was remarkably similar in every way to the Randolph find. Fortunately, the timing couldn't have been better. The evidence further strengthens the theme of this report.

CONCLUSION

It is not the intention of the author to imply that all full-grooved axes are early Middle Archaic tools. It seems that the full-grooved axe is found frequently on village sites, stone bowl quarries and burial sites of a later age - particularly where Susquehanna Broad points (Side-Notched #1) are found. However, it is the author's opinion, solely, that Neville and Susquehanna axes more often vary substantially in style than intergrade. The only true point to be made here is that the full-grooved axe is a much earlier invention in Eastern Massachusetts than has been realized.

In light of this new evidence from the South Shore, one wonders just how many of these stone axes were made and utilized by Middle Archaic peoples. Although nothing is forever certain, it is safe to say that the full-grooved axe can, at least, now be assigned to the Neville phase in the Northeast.

E.M.A.G.R., Inc.
Weymouth, August 1976

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2. Artifacts from the Randolph group. 1, perforator; 2-4, Corner-Removed #5's; 5, fully grooved axe. See appendix for descriptive data.
Figure 3. Artifacts from the Braintree group. 1-4, Corner-Removed #5's; 5, fully grooved axe. See appendix for descriptive data.
APPENDIX

Description of Artifacts

FIGURE 2

#1 Overall length 6.75cm, length of tip 3.75cm, overall width 4cm, width of tip 1.1cm, width of stem at base 1.2cm, basal thinning present on both faces, Blue Hills felsite, medium rust patina, restored.

#2 Length 5.5cm(?), width 3cm, width of stem at base 1.1cm, basal thinning barely detectable, but present on both faces. Blue Hills felsite, medium rust patina, restored.

#3 Length 5cm(?), width 3cm, width of stem at base 1cm, basal thinning present on one side. Blue Hills felsite, light patina, restored.

#4 Length 5cm(?), width 3cm, width of stem at base 1cm, basal thinning. Marblehead felsite(?), no patina present, significantly restored.

#5 Length 13.5cm, width at widest point 7.75cm, overall thickness 4-5cm, width of groove from lips 2.75cm-3cm, depth of groove 1cm, weight 670 grams. Dedham granodiorite. This example exhibits polishing over entire surface, except where weathering has taken place, particularly on one face.

FIGURE 3

#1 Length 4.7cm, width 2.5cm, width of stem at base 1.1cm. Light patina present, Blue Hills felsite, basal thinning present on both faces.

#2 Length 5cm, width 2.6cm, width of stem at base 0.85cm. Light to medium patina, Mattapan felsite, basal thinning present on one face.

#3 Length 5.7cm(?), width 2.2cm, width of stem at base 0.85cm. Light patina. Unidentified felsite, basal thinning.

#4 Estimated length similar, estimated width similar, width of stem at base 0.8cm. Light patina present, Blue Hills felsite, basal thinning present on one side.

#5 Length 14.5cm, width at widest point 8.2cm, overall thickness 3.5cm, weight 616.5 grams. Average width of groove from lips 1.5 cm, depth of groove, 0.9 cm. Braintree slate with very pronounced black banding, polished over entire surface. Small portion of bit missing.
Traditionally, when artifacts are found at archaeological sites in clusters, these clusters are interpreted as being the result of human activities. Furthermore, this cultural debris is considered as being static—"fossilized"—or in primary archaeological context. However, recent studies have indicated that artifact cluster "fossilization" is only a myth, and that in many instances cultural remains are removed from their original context by both natural and man-induced agencies, before the excavator uncovers them.

The study of natural disturbance processes and their effects on site reconstruction and interpretation is still in its embryonic stage. This paper will bring to light some of the processes affecting archaeological sites and will offer some suggestions as to the implications of these processes for site interpretation and reconstruction in the Northeast.

"N-TRANSFORMS"

The record may be so altered in a period of a generation as to be read ten thousand years instead of fifty. Such is the magic of nature's transformations and such are the pitfalls set for unwary explorers.

(Holmes 1893)

A distinction has recently been made between cultural site formation processes and natural site formation processes called, respectively, "C-transforms" and "N-transforms" (Schiffer 1976:11). The C-transform has been the highlight of archaeological investigation in the past, leaving the N-transforms in the background, often remaining unnoticed. Spatial analysis of cultural debris, be it vertical or horizontal, has long been a tool for determining behavior patterns and site activity.

Since these spatial distributions play such an important role in archaeological analysis, it is surprising that very little attention has been paid to the human and natural processes which can destroy or change culturally created patterns of artifact distribution. Post-depositional changes caused by easily recognizable natural forces include modern erosion, rockfalls or landslides. Other natural agencies, especially those acting on artifacts soon after their deposition, may not leave obvious signs, but still can completely alter artifact distribution.

(Rick 1976:133)

The disturbance of sites is a very common phenomenon and as just mentioned, greatly affects the reconstruction and interpretation of their original structure. Therefore, when artifacts are found at a site it is more likely than not that they are not in their original location. We do not find prehistoric tools exactly where their makers or users dropped them.

Between the time artifacts were manufactured and used in the past and the time these objects are unearthed by the archaeologist, they have been subjected to a series of cultural and noncultural processes which have transformed them spatially, quantitatively, formally, and relationally.

(Schiffer 1976:11)
In order to reconstruct or interpret archaeological data we must learn to "weed out" the cultural variables from the natural variables. Furthermore, we must incorporate N-transforms into our methodology and understand their implications during site excavation.

If we desire to reconstruct the past from archaeological remains, then these processes must be taken into account, and a more generally applicable methodological principle substituted for the one that asserts that there is an equivalence between a past cultural system and its archaeological record.

(Schiffer 1976:11)

DISTURBANCE PROCESSES

When asked "What is a disturbed site?" most archaeologists will reply that a disturbed site is one that has been plowed or bulldozed. This is quite true since plowing and bulldozing are among the greatest and most obvious single factors of site destruction. Bearing this in mind, those sites in the Northeast that are shallow (especially Woodland sites) are usually partially, if not totally, disturbed by these processes. However, we should not be fooled into thinking that older or deeper sites are free from disturbance.

First, we should bear in mind that in the Northeast, soil forming processes are slow and that even Paleo-Indian sites may have the majority of cultural debris clustered at only 40 cm from the surface (Sawyer's Crossing Site, New Hampshire). The reason for such slow soil buildup is mainly climatic.

The soil-making processes operate slowly in Massachusetts, since the climate is humid and temperate, with rather severe winters and short, cool summers which bring considerable rain alternating with brief, warm, sultry periods.

(Griffith, Hartwell and Shaw 1930:16)

Second, we should remember that even though older sites may not be disturbed by bulldozing or plowing, they were and are still subject to disturbance by natural agencies.

At this point it should be noted that many of the processes mentioned in this study are not exclusive to the Northeast, and the general principles presented may be applied to other areas of the world having similar soils and climatic conditions.

The natural agencies of disturbance in the Northeast range from ants to windblown trees. Some agencies such as water erosion have been recently examined by archaeologists; these studies of erosional effects will not be included in this paper. There are many agencies that churn up site stratigraphy without removing it. MacDonald, in referring to soil disturbance at the Debert site in Nova Scotia, notes, "Post-occupational factors comprised seasonal frost action and disturbance due to vegetation [root action, tree-throw] and fauna [animal and insect burrows]."

(MacDonald 1969:16). This study will consider the effects of tree-throw and root action.

A note about frost action is relevant here. The effect of frost action on archaeological sites is dependent on soil types, climate, and ground cover. In general, frost action causes a raising or lowering of artifacts from their original locations. Because of the small amount of research done to date on the effect of frost action on archaeological sites, this topic will not be covered in this paper. It should be remembered, however, that frost may cause movement of artifacts, and this must be considered in the reconstruction and interpretation of site remains.
A common characteristic of New England forest floors is the "mound and pit micro-relief". Lutz and Griswold (1969) made a study of the influence of tree-throws on soil morphology in Southern New Hampshire. They suggest that "all soils which bear or in the past have born forest stands have been more or less disturbed." The tree-throw process in general is that, "As trees are blown over, their root structures with adhering soils leave large pits and corresponding mounds when the tree roots decay and where the soil supported by them slumps" (MacDonald 1969:20).

One author suggests that the disturbance of soil horizons by roots occurs in the following ways:

1) By raising large masses of material when trees are overturned.

2) By leaving, after decay, canals or channels which may be filled by material from the surface or side walls.

3) By pushing the soil materials aside as a result of tree growth.

4) By agitation of the soil as trees sway in strong winds.

(Lutz and Griswold 1969:392)

The following is a quote from a study done in 1891 which describes in detail the process of tree-throw.

When a forest is overturned by a strong wind the trees, unless they be tap-root species, are commonly torn from the ground or uprooted, and thus it occurs that the soil about the base of the bole is rended away so that it lies at right angles to its original position. This mass of uprent roots is often as much as ten feet in diameter and contains a cubic yard or more of soil. The pit from which it has been torn is often two or three feet in depth. This cavity becomes filled with vegetable waste, and as the roots decay the earth which they interlock gradually falls back upon the surface whence it came, burying, it may be, a thick layer of leaf mold to a depth of a foot or two below the surface.

(Shaler 1891:273)

Tree-throws cause certain peculiarities in the soil horizons. In a study done at Yale Forest in Keene, New Hampshire, it was noted that,

...frequently the soil horizons were very irregular and occasionally long tongues from the upper layers penetrated deeply into the layers below. In some instances horizons were discontinuous and masses of the soil material were found translocated to positions above or below those normally occupied. Occasionally, material from the upper and lower horizons was rather intimately mixed. In short, it was clear that some agency, or agencies, had disturbed the soil body.

(Lutz and Griswold 1969:389)

The agency of disturbance is the tree-throw. Furthermore, Wretlind (1934) studied pine forest stands in Sweden and he notes, "Tongues of light-gray material from the leached A horizon extended down into the dark-brown B horizon". He concluded that these irregularities resulted from wind throw of the deep-rooted pines. Furthermore, a detailed study done in New Brunswick indicates that "All mounds show some inversion or disruption of the A and B [soil] horizons and this supports the view that mounds are formed as a result of tree throw" (Lyford and MacLean 1966:9).
SOIL PROFILES

Since the disruption of soil by tree-throw is so great, it is important to examine some of the soil profiles produced by this activity. This section will provide a diagramatic view of the effects of tree-throw on the soil horizons associated with these occurrences. It is appropriate to note here that the profiles to be presented are only a few examples of the wide variety of soil profiles that occur from tree uprooting. I have selected some common profile types and also some that may prove useful for the archaeologist.

Why do we look at profiles? The answer is simple. Even after the actual thrown tree is gone, the evidence of its effect on the soil still remains. Thus, the effect of the tree-throw still can be examined in light of how it may have disturbed the archaeological resources as well.

The effects [of tree throw] persist as internal features of the soil for a long time and even where the mound-pit pairs are faintly expressed on the surface the disruption can be detected within the soil. In fact the effects can be seen in almost any trench dug in formerly forested areas and even if the soil has been plowed the irregularity of the B horizons below the plow layer usually provides some evidence of former disturbance.

(Troedsson and Lyford 1973:10)

Figure 4 is an example of a profile from Keene, New Hampshire. It represents a trench dug through a pit which was formed when a large white pine was uprooted.

The features most noteworthy are the tongues of disturbed B horizon material which penetrate deeply into the C horizon. They were formed when large, nearly vertical roots were torn out of the soil body, allowing the B material to slump down into the cavities. The roots which formerly occupied the positions now marked by the tongues could be identified on the upturned stump. Another feature of interest is the stratification [at the right of the figure] developed in the material which was washed down from the upturned roots. This same phenomenon was noted in several other profiles.

(Lutz and Griswold 1969:393)
Figure 5. Mound-pit sequence showing vertical inversion of $A_1$, $A_2$, and $B_1$ horizons. The key is the same as for Figure 4. (After Lutz and Griswold 1969).

Figure 6. Disturbance in Hermon soil showing folded and lobate horizons. The key is the same as for Figure 4; $R$ indicates rock, $O$ indicates surface duff. (After Lutz and Griswold 1969).
Figure 5 presents an example of a cross section through a mound and pit in the same type of soil as Figure 4 (Merrimac soil). The outstanding feature of this profile is the vertical soil sequence.

Directly below the top of the mound are found relict A1, A2 and B1 layers, normal with respect to their sequence, but standing vertically. The material in these layers has been slightly disturbed but not intermixed; the identity of each layer was unmistakable. Light-gray soil material, derived for the most part from the A2 horizon, capped the mound whereas the flanks consisted of well mixed B material which slumped or washed down from the upturned mass.

(Lutz and Griswold 1969:394-395)

Figure 6 shows probably the most common type of soil profile. Its most striking feature is the thick, folded and lobate AB horizon.

Surface soil material was translocated down and material from the deeper lying horizons was carried upward. The most striking feature, however, is the great thickness and abrupt termination of the relict A2 material seen in the cross section of the mound. This resulted when the tree uprooted and the A horizon was folded over, doubling its thickness.

(Lutz and Griswold 1969:396)

Figure 7 shows a set of profiles from New Brunswick, Canada. The previous profiles have been examples of distinct micro-relief. Figure 7 indicates a series of profiles, A, B and C, respectively, showing faint, distinct and prominent profiles. It is important to examine the least distinct profiles as these usually indicate the older mound-pit sequences. It is most likely that these types of faint micro-relief will be encountered by the archaeologist and it is important to be familiar with their characteristics. Although faint mounds and pits may appear to be little more than a "bump and a shallow" on the surface, they may have severely disturbed horizons below. These mounds and pits should not go unnoticed. Weathering and erosion cause these sequences to become less distinct. "With the passage of time microrelief becomes more and more subdued and the uppermost mineral horizons tend to become continuous" (Troedsson and Lyford 1973:10).

"In the mound-pit sequence with low relief [plot 1-1, Fig. 7A] the A2 and B2 horizons are noticeably more continuous than in the mound-pit sequence of higher relief [plot 1-3, Fig. 7C]" (Lyford and MacLean 1966:9).

Figure 8 indicates the corresponding root distribution for plots 1-1, 1-2 and 1-3 as shown in Figure 7.

Figure 9 indicates a set of three profiles from Garpenberg, Sweden. These profiles indicate in detail the position of the A horizon and the irregularity of the disturbed B material.

In two of the trenches the A horizons are continuous over the surface but are noticeably thicker in the former pits. In these trenches the upper B horizons are discontinuous and in many places the B23 or B24 horizons lie directly under the A horizons. In one of these trenches the A horizons are completely absent in one place and the B23 horizon then lies directly under the forest floor and is the topmost mineral horizon.

(Troedsson and Lyford 1973:10)

The profiles presented here will be used in comparison with archaeological site data in a subsequent part of this study. The final part of this section will deal with determining the age of pits and mounds.
Figure 7. Soil horizons exposed in trenches across faint (top), distinct (middle), and prominent (bottom) mound-pit sequences on Plot 1. The soil is well drained and on sandy glacial till. Symbols are those used in the May 1962 supplement to the Soil Survey Manual, U.S.D.A. Handbook No. 18, 1951. (After Iyford and MacLean 1966)
Figure 8. Profiles corresponding with Figure 7, indicating the location of roots in Plot 1. (After Lyford and MacLean 1966)
Figure 9. Horizons exposed in trenches dug through distinct mound-pit microrelief. A horizons are solid black. B2ir horizons have vertical lines. Large stones and boulders are crosshatched. (After Troedsson and Lyford 1973)

DETERMINING THE AGE OF MOUNDS AND PITS

When determining the age of recent tree-throws, the age of the mound may be determined by the age of the trees growing on top of the mound. This involves the use of an increment borer and counts of growth rings. It should be noted, however, that boring does not work on all trees and may not work on certain species, especially if the trees are old. These older trees may be hollow inside or may have the shakes (swaying of the trees causes the rings of wood to separate) and may therefore not be suitable for aging by this method. Lutz and Griswold used the method of tree dating to estimate the age of a mound in New Hampshire. "Judging by the ages of the two hemlock trees growing on the top of the mound the wind throw occurred 85 to 100 years ago" (Lutz and Griswold 1969:394)

A second method for relative dating is by the examination of the soil horizons.

It seems probable that the mounds with nearly continuous A2 and B2ir horizons nearly parallel to the surface are older than the ones with disrupted irregular horizons. At any rate the soils with well-developed horizons essentially parallel to the surface are generally considered to have been undisturbed a long time. But so little is known about the rate of soil development that not much can be said about age. On the basis of Stephani's hypothesis that mounds about 500 years old begin to show continuous horizons, we can postulate that mounds with nearly
continuous horizons are rather old - say at least 500-1000 years as an estimate. (Lyford and MacLean 1966:15)

Finally it should be noted that disturbance of the upper three feet (1 meter) of the soil body by tree roots may be manifested in exceedingly diverse ways. Therefore, soil profiles may not fit any single pattern and may not imitate the profiles presented in this study. We can, therefore, only use these examples as a starting point from which to do more analysis and form more questions.

ROOT DISINTEGRATION

At the outset of this section on tree-throw I mentioned several different ways in which roots disturb the soil body. One of the ways mentioned was by root growth and root disintegration. One author notes,

Another influence recognized was the development of canals in the soil following decay of roots. As roots grow they may compact the soil adjacent to them as a result of outward pressure. On decay of the roots, channels or canals are left which may persist for some time until filled with material falling in from the surface or sidewalls.

(Lutz and Griswold 1969:390)

Another author, discussing the infilling of root channels, notes:

Volume of the root system of forest trees amounts to a quarter or a third the volume of the portions above ground. As roots grow, soil is gradually pushed out of its normal position and conversely when roots disintegrate soil collapses or slumps into the areas once occupied by the living woody roots. This process is so well known that its magnitude easily can be overlooked. The fact that few open root channels occur in the soil of continuously forested areas in spite of at least 4-5 generations of trees suggests repeated and substantial local soil movement. In general the soil that fills the root cavity is exactly like that originally pushed away and so the old root cavities can not be identified. There are instances, however, where vertical root channels are filled with soil from contrasting horizons above.

(Troedsson and Lyford 1973:12-13)

As just noted in many cases we may not be able to identify disturbance by root activity. However, root infilling where soil and other material enter from contrasting layers may be useful to the archaeologist trying to identify disturbance processes.

THE APPLICATION OF TREE-THROW AND ROOT DECAY TO ARCHAEOLOGY

In this section I will show how the data previously presented can be used by the archaeologist in interpreting and reconstructing sites.

One of the first applications of tree-throw disturbance data to archaeology was by W.H. Holmes in 1893. Holmes encountered a stratum, three to four feet (1-1.3 m) thick, with quartz fragments distributed throughout its entirety. This confused Holmes because he expected to find a living floor. In questioning the occurrence of these quartz fragments Holmes notes,

...these quartzes were not in beds or in layers at definite depths beneath the surface, as if made and used on the site at intervals in glacial inundation; or as if distributed from the sites of manufacture by water during the formation of these deposits. It seemed a most significant fact that they were, in all
observed cases, distributed somewhat uniformly through the stratum of sand extending from the surface downward, as if let into the deposits from above by some distributing agency.

(Holmes 1893:237)

As a good archaeologist, Holmes felt impelled to find out what agency had distributed the quartz flakes through the deposit. Holmes was a keen observer and noted the following:

In digging a trench on the Babbitt site it was observed that the rotting of the roots of large trees would permit the lowering of the surface objects into the superficial deposits, and that as a result general distribution would in time result; but this did not seem to be a sufficiently potent agency.

(Holmes 1893:237)

The kind of detail that Holmes presents in his excavation is remarkable for the 1890's. His eye for observation should be an example for today's archaeologists, so I will include another short excerpt from his excavation notes:

A little further on, at about the 32d foot, we came upon the root of a tree, the tap root of an oak, still preserved up to the dark soil of the surface, here some twelve inches thick, and extending down through the strata below the water level, an observed depth of six or seven feet. Having partly rotted, the root was surrounded by blackish earth. Further on a similar root was encountered which had penetrated the like depth, but which was almost totally decayed. The space was filled with blackish sandy loam containing to some depth bits of gravel descended from the surface beds of heterogeneous materials.

(Holmes 1893:229)

We can see in the preceding paragraph and Figure 10 how Holmes applied tree root data to his interpretations of the site. With further investigation, Holmes found the agency which had distributed the quartz flakes through the Babbitt deposits.

Figure 10. Detailed section of talus and normal gravels, showing disturbances by crumbling and sliding, and by growth and decay of oak roots. (After Holmes 1893).

Passing through the western part of the village I came upon a large area recently cleared of its growth of young forest trees. The surface was varied by countless humps and hollows, and I found, by careful inspection, that it was the site of an ancient forest which had been uprooted by a tornado. A few of the great root
masses were still preserved, and in some cases where the wood had entirely disappeared the mounds of earth were still three feet high and the associated pits or hollows were nearly that deep. The humps and pits were so numerous as to disturb nearly one-half the original level surface of the ground, and the disturbance must have extended in many cases to a depth of from four to six feet. Here, evidently, was the distributing agency sought, and one entirely competent to accomplish all that had been observed of distribution.

(Holmes 1893:235)

This time Holmes applies tree-throw data to the situation at the Babbitt site. He also provides four diagrams in which he attempts to portray the events leading up to the mixing of the deposit. The following are the descriptions that accompanied each of the diagrams (adapted here as Fig. 11A-D).

The section presented in [Fig. 11A] exhibits the conditions of a cluster of shop sites such as had accumulated on the prairie margin when the manufacture of quartz implements was going on. There may, or may not, have been a forest at the time without affecting the final result, although a longer period must be allowed if the forests had to grow after the site was deserted by the arrow-makers. The immediate result of the uprooting of a forest upon such a site is depicted in [Fig. 11B]. Portions of the quartzes would descend into the pits and portions would be carried up with the roots. When the wood rotted away the quartzes would be distributed over the mounds and the hollows somewhat as shown in [Fig. 11C] and by the time the elevated portions of the soil had again settled into the general level of the prairie the conditions would be pretty much as indicated in [Fig. 11D].

(Holmes 1893:237-239)

Not only did Holmes make these conclusions, but he also generalized about tree-throw activity and its effect on archaeological sites in general.

Indeed, it may be said that, in a locality where forests grow on and in deposits so unstable as are these Little Falls loams, it is impossible that the surface accumulations of articles of stone should remain for a long period entirely upon the surface; and the explanation thus furnished of the distribution of the worked quartzes of this locality through glacial deposits, to a depth of four feet or more, is so satisfactory that no other theories are called for and little further discussion seems necessary.

(Holmes 1893:237)

We can see from the last sentence that Mr. Holmes was pretty convinced that tree-throw was the answer to the distribution problem. What is Holmes' contribution to the archaeology of the Northeast?

W.H. Holmes was one of the first archaeologists to apply tree-throw and root decay data to an archaeological site. Holmes discovered that the lithic materials (quartz flakes) did not lie all in one narrow stratum. There was no definite living floor. The Babbit site in Minnesota, where Holmes excavated, presents a representative example of some of the problems that face archaeologists in the Northeast. Rarely will archaeological resources be found all contained within one narrow stratum. Only in extreme cases of rapid inundation such as flooding, with little natural disturbance, will there be preserved a true living floor. In most cases prehistoric remains will move up to several inches upward or downward from their original location. This process of "vertical drift" contributes to the mixing of cultural components and tends to homogenize artifacts throughout the soil horizons. The confusion that can result when arbitrary "metrical" excavation units are imposed upon such disturbed
deposits is obvious. In the case of such deposits, "metrical" excavation units must not be interpreted as if they were true stratigraphic units.

THE DEBERT SITE

The Debert site, in central Nova Scotia, was excavated under the direction of George MacDonald in the 1950's. This site was a Paleo-Indian occupation and according to radiocarbon dating methods, it is between 10,594 and 10,801 radiocarbon years old. The time and money available made possible careful analysis of the soils at the site and therefore the Debert site report, in my opinion, stands as a classic of fine archaeological procedures. The following section will deal with some of the effects of tree-throw on this site and how these effects influenced the interpretation and reconstruction of the site.

The action of tree-throw at the Debert site was extreme, churning the deposit to a depth of approximately two feet (0.6 m). The intensity of this action, however, varied considerably from one portion of the site to another. This variation was due to soil type, exposure, and so on. In reference to these differences, MacDonald notes:

In Section One soil horizons are remarkably continuous, reflecting a stable surface over a long period. Elsewhere on the site, however, where vegetation appears to have been heavier, horizons are interrupted or are lobate and folded, marking the throws of trees which have long since disappeared.

(After Holmes 1893)
This last sentence should be somewhat familiar to the reader. It reflects almost exactly the profile presented earlier in Figure 6. The interpretation of such profiles makes it easier for the archaeologist to understand the processes involved in soil profile formation, as seen from this case. Familiarity with common tree-throw profiles helps to clarify what otherwise might be confusing and irregular stratigraphy.

THE EFFECT OF TREE-THROW ON CULTURAL RESOURCES AT THE DEBERT SITE

MacDonald explains the effect of tree disturbance at the site very well; he notes:

The effect of this phenomenon tree-throw on cultural materials is extreme. Few features have not been modified or truncated by tree-throw, and it is only the deepest pockets of hearths or pits that retain a sharp boundary. Above a certain level, which averages 1.5 feet from the surface, features are blurred, sometimes beyond recognition. In a few instances, the boundaries of features have been entirely obliterated by tree-throw and are discernable only by the concentration of lithic material. A second effect is that the precise position of artifacts within this homogenized horizon is not reliable for establishing stratigraphic relationships. Unfortunately, most living floor levels occur within the disturbed zone.

(MacDonald 1969:20)

The detrimental effects of tree-throw are obvious from the above paragraph. Since soil development in the Northeast is so slow, most true living floors have been greatly disturbed because of their closeness to the surface. These living floors are constantly being subjected to many different types of natural disturbance. Therefore, one may think that accurate artifact plotting and graphing are not worthwhile. On the contrary, by increasing our accuracy in determining specific artifact locations, we are decreasing the chances for total error when it comes time to make our reconstructions and interpretations. Furthermore, by being able to distinguish between disturbed areas and undisturbed areas, we are getting one step closer to accurate reconstruction and site interpretation. An important thing to remember at this time is that even though vertical structure (stratigraphy) may be altered by disturbance processes, the horizontal distribution of artifacts may remain relatively intact. MacDonald does mention this factor at Debert.

Although the movement of artifacts by natural factors has been sufficient to destroy vertical stratigraphic relationships at the site, artifact displacement of the same horizontal order does not significantly alter the distributional patterns within the sections.

(MacDonald 1969:21)

VEGETATIVE DISTURBANCE AT SAWYER'S CROSSING

The final example of the application of root disturbance principles to archaeology comes from the Sawyer's Crossing site near Keene, New Hampshire. Remarkably, this site is located in the same area where Lutz and Griswold did their study on tree root disturbance. Microstratigraphic analysis was a major part of this site's excavation. However, even with careful excavation and recording techniques, there were still many problems encountered in trying to interpret stratigraphic relationships.

Another factor that greatly affected the site was forest burning. Indications of forest fires were observed as charcoal specks and pieces as well as ashy-gray and iron oxidized lenses. In some cases the actual outline of the tree base could be detected as a ring of burned material. It is appropriate to note here that the phenomenon of forest burning is common in the Northeast, especially where the soils
are sandy and thus well drained and droughty. These fires usually have occurred in cycles of fifty to one hundred years due to natural causes such as lightning and spontaneous combustion. One way to determine if forest fires have taken place at a site, without actual excavation, is by the interpretation of trees and plants that vegetate the site. In many cases scrub oak and pitch pine, a fire resistant tree, will be found on or near the area of burning. However, one should consult the local town records first in order to see if any fires have been recorded in the site area.

**THE EFFECT OF BURNING AND ROOT DISTURBANCE ON ARCHAEOLOGICAL REMAINS**

The most obvious effect of tree burning is that the remains of these fires often resemble prehistoric Indian fire hearths. One should be careful when examining these burned areas and I suggest that a flotation of the materials in the fired area is the best way to determine the nature of the burning. Fire hearths will often contain seeds, burned bone, and sometimes stone flakes and pottery sherds. These clues are important, especially when the charcoal from these areas may be used for carbon dating of the site. We should also note that forest burning may not be restricted to the surface and that even deep areas of charcoal may be the result of root fires.

The second effect of tree burning is similar to that of root decay. When the lower section of the tree and the roots burn, the wood may become brittle and break apart. Therefore, the tap root for example, may act as a funnel for soil and nearby objects which may find their way down to lower horizons. This slumping effect has been mentioned earlier with respect to normal root decay and tree-throw. The slumping of soil causes artifacts to be carried down to levels below their normal occurrence concentrations. An example of this process is seen at the Sawyer's Crossing site. In one of the squares (N9 E2) flint flakes were being recovered from a very deep level. No other flakes had been found so deep. However, these flakes were only found in one corner of the square. Interpretation of the soil in this corner indicated that a tap root had burned in place. In some cases the flakes were found right within the root cast itself. As the excavation went deeper and deeper, fewer and fewer flakes were recovered. The profile of the square is shown in Figure 12 (Mary Lou Curran, personal communication).

We should be aware at this point that the evidences of root disturbance are varied. One indication of root decay is the root stain. A root stain is a darkening of the soil usually in a shape similar to a root. These stains many times do not contain any of the actual root material. Root stains or root casts may not always be darkly colored. Older root impressions may merely be a shade lighter or darker than the surrounding soil. Figure 13 is an example of an old root cast from the Sawyer's Crossing site (Mary Lou Curran, personal communication).

Finally, in some cases we may be able to identify tree-throw by the texture of the soil. Even though pits from tree removal may not be evident in some cases, they may be discerned by the amount of coarse fragments.

Coarse fragments in the uprooted mass of soil tend to fall into the concave pit area before much fine material is dislodged. As a result there are often concentrations of coarse fragments in pits and these resemble eggs in a nest. Conceivably one could locate many former pits if a map of the "nests" were made. (Troedsson and Lyford 1973: 12)

A similar example is the discovery of "Ortstein". These are indurated soil aggregates which may be found after the tree is uprooted and are, therefore, another clue to tree-throw.
Stratification was plainly evident in the slope facing the pit (windward side). In this slope also were found a number of large pieces of cemented soil material (Ortstein) which had been torn up by the roots.

(Lutz and Griswold 1969:395)

SUMMARY

In this article I have presented tree-throw and root decay data collected by various soil scientists and foresters. I have attempted to apply these general data to some cases of archaeological field research, in hopes that we may begin to understand how natural disturbance affects our reconstruction and interpretation of sites in the Northeast.

Binghamton, NY
December 1977

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Figure 13. A profile from Sawyer's Crossing. Bottom depth 108 cm. Notice area of white-gray silty sand; this is an ancient root cast.

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GERALD D. ZEOLI is an active member of Eastern Massachusetts Archaeological and Geological Research, Inc. and of M.A.S. His interest in local geology as well as archaeology is evident in the article. He writes: "Our archaeological interests in the South Shore have become an obligation as urbanization becomes more and more a reality."

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The following notice appeared in the M.A.S. Newsletter, Volume 4, Number 1 - March 1978.

Beginning with the April issue of the M.A.S. BULLETIN a new numbering system will be used which will coincide with the calendar year rather than the fiscal year of the Society as it has in the past. For a number of years the BULLETIN has been issued twice a year - a Volume, Nos. 1 & 2 in October and the same Volume, Nos 3 & 4 in April of the following calendar year. From now on the April issue will be a Volume, No. 1 and the October issue will be the same Volume, No. 2. The first issue to come out in April of 1978 will be Volume 39, Number 1. The old system of numbering 1 & 2 and 3 & 4 has been abandoned.
NOTES TO CONTRIBUTORS

AUTHORS of articles submitted to the M.A.S. Bulletin are requested to conform to the following regulations.

Manuscripts must be typed as originals with two carbons (or photocopies). Margins must be 1½ inches (38mm) on both sides. Corrasable paper should NOT be used. Originals and copies are to be sent to the Editor for evaluation and comment. Typing is to be on one side of paper only with at least double spacing. Proper heading and bibliographic material must be included.

Manuscript headings should be prepared as follows:

THE PONKAPOAG SITE: M-35-7

Robert A. Martin

Bibliographic references are to be presented as follows:

GOOKIN, D.
1970 Historical Collections of the Indians of New England (1674)

They should be listed alphabetically by author; several references by the same author should be listed chronologically by year.

Intratextual reference citations are to include the author's name, date of publication, and the page, plate, or figure number, all enclosed in parentheses, as follows:

(Bowman & Zeoli 1973:27) or (Ritchie 1965: Fig 12)

Illustrations must be submitted to the Editor as originals and must conform to the following set of standards:

1. All illustrations must be planned with the page size in mind, either full page, half page or quarter page. Allowance must be made for caption. Special cases must be discussed with the Editor before illustrations are made.

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   Dimensions and distances should be given in English and metric units, or metric alone. The two systems should not be mixed within a text. If feet and inches are used, they are to be spelled out (no ' for feet nor " for inches).

The Editor is receptive to archaeologically serious contributions of any reasonable length. Long pieces can usually be condensed effectively if they exceed the limits of our publication. The Editor welcomes short pieces and encourages contributors to write them.