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Studying Human Adaptation at a Paleo-Indian Site: A Preliminary Report

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Cultural materials collected from a Paleo-Indian site in southwestern New Hampshire will be used to test hypotheses concerning human adaptive strategies and related cultural responses in the rapidly-changing late glacial and early postglacial period in central New England. A predictor model derived from a completed regional paleoenvironmental reconstruction postulates at least four major environmental changes during this time span. Material remains of human activities should reflect responses to such changes. In addition, geological, palynological, and pedological data will be employed to refine further local aspects of the regional paleoenvironmental model. The value of microstratigraphic excavation and soil collection techniques in testing such a model will be evaluated on the basis of preliminary site material analysis.
During the field seasons of 1976 and 1977 an interdisciplinary study focused on the excavation of a Paleo-Indian site, Whipple Paleo-Indian site, in southwestern New Hampshire (12,000-11,000 B.P.?). The project involved the collection and analysis of archaeological and contextual data with two research goals. The first goal is to evaluate a processual model of human adaptation to the rapidly-changing late glacial and early post-glacial environment of central New England. This model postulates at least four major environmental changes requiring cultural responses in adaptive strategies. The second research goal concerns the methodological problems associated with studying environmental changes in frost-churned soils. This is crucial for assessing a cultural period in New England which is virtually undefined at present. In this paper I will present the paleoenvironmental model and explain the data collection and analytical procedures which are being used to attempt to test this model. I wish to identify all natural and cultural changes from deglaciation to about 9,000 years ago, the maximum time estimate for Paleo-Indian occupation.

Paleoenvironmental Reconstruction

Since each archaeological site may contain fragmentary data on several aspects of an adaptive system, one must be able to divide the continually-changing cultural system into analytically distinct temporal units, to permit the recognition of a change to a new state (Wobst 1974). Wobst suggests that "changes in fauna and flora, associated with glacial events in the northern hemisphere, may be the least arbitrary boundary markers by which a societal continuum can be partitioned" (1974:156). With such units identified, one then may consider the interactions between a prehistoric society and its natural environment, as both change through time. Sufficiently dramatic changes should be recognizable in the archaeological record, in the form of changes in artifact assemblage composition, site size, and duration of occupation of a particular site. Procurement strategies, as well as dispersal and aggregation of human populations within a given area, are closely related to the existing biotic communities of a particular region. Therefore, they may be reconstructed as the paleoenvironmental models are verified.

A regional paleoenvironmental reconstruction provides a predictor model for the environmental changes that would have elicited cultural responses in adaptive behavior. Within the Connecticut River Valley Lowland four major environmental changes have been identified which should be reflected in cultural material remains associated with exploitative strategies of early man in New England. Regional pollen diagrams and a mapped summary of the northeastern pollen record were used to identify major changes in vegetative sequences (Curran 1976; Curran and Dineauze 1977; Bernabo and Webb 1977).

The first major vegetation change recorded was the transition from tundra to spruce parkland, at about 12,500 B.P. in southwestern New Hampshire, followed by a spruce pollen period that probably represented a spruce parkland-open spruce woodland transition. This latter transition cannot be determined accurately due to difficulties with pollen analysis. A sharp rise in pine pollen, about 10,600 B.P., indicated the end of spruce
dominance. Deciduous elements began appearing with the arrival of the mixed pine-oak forest. The movement of the coniferous, northern hardwood/deciduous ecotone slowed after 8,000 B.P., moving only slightly northward in New England. According to Bernabo and Webb (1977), the largest changes in plant distributions occurred between 11,000 B.P. and 7,000 B.P., during the period of final deglaciation. Following a dramatic collapse of the ice sheet, the rate of change decreased until the beginning of European settlement.

**Procurement Strategies and Changing Biotic Communities**

New interpretations of the late glacial tundra suggest that it was biotically impoverished, especially in New England (Davis 1969). Therefore, the following open spruce parkland/spruce woodland environment should have been the preferred habitat for earliest man in the Northeast. According to Mulholland (1978), during the succeeding pine pollen period there was a peak in plant species diversity. Exploitative potential should have decreased during this time, because of the increased unpredictability of resources with such high species diversity - especially since it was still accompanied by relatively low species density (Dincauze and Mulholland 1977; Mulholland 1978).

The above argument does not exclude habitation in the tundra or pine transition period, but one should expect different population densities and/or adaptive strategies for any groups living in the intermediate open spruce woodland environment. Similarly, a shift toward high population densities should have occurred with the move from a primary succession phase to a more stable coniferous/deciduous forest secondary succession.

I have made a series of predictions of cultural responses to specified paleoenvironmental changes for the drainage in which the site is located - the Ashuelot River Valley. See Table 1. These predictions are based on the assumption that environmental changes should be reflected in the archaeological record, since population densities and the attendant communication networks are proscribed by the resource base of a given environment. For example, in regions that cannot support dense populations, a geographically widespread network is needed to meet such social needs as marriage mates (Wobst 1976). As the natural environment begins to support larger population densities, less widespread networks are needed to maintain group size.

Tracing the origins of the lithic material at archaeological sites has been a major way of judging the extent of these networks. One should expect to find more material goods from greater distances during periods in which widespread communications networks are critical for survival. Projectile point styles may indicate similar changes in territorial range. Widespread point styles may be the result of poorly established regional boundaries, mirroring extensive contact/communication among hunting-gathering populations. Where exploitation territories become restricted, one may see an increase in typological differentiation (e.g., variations between drainage basins (Ritchie and Funk 1973)).
<table>
<thead>
<tr>
<th>ESTIMATED TIME</th>
<th>BIOTIC COMMUNITY</th>
<th>DURATION OF OCCUPATION-SITE SIZE</th>
<th>CULTURAL RESPONSES</th>
<th>CHANGE IN ARTIFACT ASSEMBLAGES</th>
</tr>
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<tr>
<td>DeGlaciation (ca. 13,450 B.P.)</td>
<td>Tundra to open spruce parkland</td>
<td>Minimal, if any</td>
<td>?</td>
<td>Scattered hunting tools</td>
</tr>
<tr>
<td>12,600 B.P.</td>
<td>Open spruce parkland-woodland (big game habitat?)</td>
<td>Notable increase, recognizable short-term occupations</td>
<td>Wide, open</td>
<td>Similar stylistic attributes and manufacture technology over long distances; presence of &quot;exotic&quot; lithics; limited toolkits (big game); increase in wood-working tools through time</td>
</tr>
<tr>
<td>Ca. 10,600 B.P.</td>
<td>Decreasing spruce, increased pine pollen</td>
<td>Probably decreasing, due to change in resource base = stress</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ca. 10,000 B.P.</td>
<td>Shrub peak - beginning of mixed pine-oak forest; increasing species diversity - stress on big game populations - extinction?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ca. 9,000 B.P.</td>
<td>Pine pollen dominance; very high species diversity, low species density; hemlock, some mast</td>
<td>Minimal, due to unpredictable ability of resources</td>
<td>Wider, open; (out-migration?)</td>
<td>Materials from greater distances; toolkit beginning shift to smaller game equipment</td>
</tr>
<tr>
<td>Ca. 8,000 B.P.</td>
<td>Coniferous pollen dominance, with 20% or more oak (baft); decreasing species diversity, increasing density, more stable secondary succession</td>
<td>Increasing through time</td>
<td>Decreasing territorial range, due to more predictable, clustered resource</td>
<td>Expanding toolkit; increase in equipment for hunting small, solitary game; increased use of local lithics and more specialized toolkit</td>
</tr>
</tbody>
</table>

Table 1: Southwestern New Hampshire vegetational sequences and anticipated cultural responses
The first set of predictions I make, based on the relationship between human behavior and the natural environment, deals with the period from deglaciation to about 12,600 B.P. — a period of tundra-open spruce parkland. The following open spruce woodland should have been dominant by 12,600 B.P. in central New England. I predict human occupation would have been minimal to non-existent during the initial period, with the only likely cultural remains in the form of scattered hunting tools. In contrast, during the following period, there should be many more sites, with at least recognizable short-term occupations. The communications network would need to be wide and open, therefore one could expect to see similar stylistic attributes and manufacturing techniques of lithics at sites over long distances. The quarry sources of those lithics may lie at considerable distance from some sites. In response to the spruce woodland environment, the toolkits would be limited, with emphasis on big-game hunting equipment. Through time one would expect an increase in woodworking tools. These characteristics should be reflected in materials from the New Hampshire site. Similar predictions have been made for changes up to the coniferous-deciduous forest period.

To prevent misinterpretations one must consider the fact that variations in toolkits between sites and through time at one site may not be directly correlated with environmental change/stress, since the presence of the total range of adaptive strategies at one location is extremely unlikely. Numerous studies have discussed the pattern of seasonal rounds of hunting gathering groups, with its implications for settlement pattern and site-specific interpretations (Campbell 1968; Bicchieri 1972).

1976 Field Season

With the above assumptions and predictions in mind, a systematic testing was begun in 1976 at the Whipple Paleo-Indian site. The aims of fieldwork were to delineate at least one complete activity area from which cultural behavioral data could be derived, and to establish, as accurately as possible, the relationship of those data to the postulated paleoenvironmental changes. To increase the possibilities of refining the local aspects of the model, attention was directed toward a thorough description of past and present landforms, the processes of natural soil development, and the collection of paleobotanical data.

The site matrix is unstratified, frost-churned sand. This necessitated using microstratigraphic excavation techniques and developing new laboratory procedures. These field and laboratory procedures should have wide applicability in frost-churned soils. Specifically, excavations were directed toward delineating the artifact scatter in the original "findspot" locale and at isolating other intact clusters, while simultaneously establishing the sediment depositional history.

Microstratigraphic techniques consisted of recording the horizontal and vertical position, cardinal direction, and inclination of every artifact recovered in its original location. All other artifacts recovered
In screening were recorded within their original 50 cm. area (2 cm. depth) in the 1976 season and within their original 25 cm. area in the 1977 season. Initially, similar detailed recording was done for all pebbles found in the sand matrix. It is possible to identify such phenomena as slope wash, which would have affected artifact clustering, with pebble pattern maps. Due to considerable natural mixing of soil fractions in the frost zone, it was impossible to recover a statistically meaningful sample of pebble locations. During the latter period of fieldwork, unless there were particularly large natural pebbles or cobbles, detailed locational information was collected for artifacts alone.

In 1976 testing established one intact Eastern Clovis Paleo-Indian artifact assemblage, while several other clusters were identified whose perimeters were poorly defined.

1977 Field Season

The 1977 field season excavated the intact artifact cluster identified in the 1976 field season and continued intensive areal survey. During the summer a 9 x 6 meter area containing cultural debris was excavated. Detailed locational data was obtained for about fifty tools, including fragments from thirteen different fluted points, a fluted endscraper, numerous endscrapers and sidescrapers, several hammerstones, channel flakes, and about 30,000 quartzite and chert flakes. Tools were concentrated in a 6 x 3 meter area. Parts of several fluted points especially concentrated in a 1 x ½ meter area - with calcined bone and small charcoal fragments - probably the remnants of a firehearth. See Map 1.

Through detailed plotting, numerous discrete lithic events were recorded, suggesting both horizontal and vertical variations in cultural deposition. All cultural materials were located in the zone of frost action, unless they had been dragged down to a deeper level by obvious root activity. Computer mapping programs are planned, to plot the collected material and relate it to detailed soil profiles of all visually and chemically obvious stratigraphic disturbances.

The rationale for the above plotting is based on results of work by Wobst in unstratified loess in Paleolithic open air sites in Yugoslavia, using a three-dimensional computer plotting program, BACKPLOT, to isolate former land surfaces (1977). While some conditions of deposition are radically different (rate of soil deposition, for example), preliminary results of excavation suggest that former land surfaces may be discernable in non-stratified frost zone soils.

Numerous artifacts seem undisturbed by post-deposition soil disruption (e.g. tree growth activities, freeze-thaw cycles, and riverine and lacustrine activities). There was repeated recovery of artifacts and some calcined bone and charcoal at identical levels below site datum. Furthermore, a broken biface was reconstructed from two locations two meters apart at the same depth. This indicates that at least remnants of the old land surface are identifiable and that there has been minimal disturbance by post-depositional geologic processes.
MAP 1
THE WHIPPLE SITE
NH 41-6
ACTIVITY AREA A

KEY:
- AREA EXCAVATED
- A CALCINED BONE CONCENTRATION
- B LITHIC DENSITY OVER 900 FLAKES PER SQ. METER
- C LITHIC DENSITY OVER 100 FLAKES PER SQ. METER
- VANDALIZED AREA

CONTOUR INTERVAL = 25 CM.

SCALE : 1 SQ. METER = ———
During excavation pedological, geological, and paleobotanical samples were collected. These will provide the data for evaluating the predictive model of environmental change. Of particular interest is the question of the depositional history that may be reconstructed in frost zone areas through pebble counts, granulometry (mechanical analysis of soils) (Laville 1976), and microscopic analyses. Using fine-increment sediment fractionation, Fletcher believes that he will be able to distinguish material of the aeolian mantle from other modes of deposition (pers. comm.). While frost activity will mix deposits, there should still exist a peak level at which materials of the particular event will concentrate - which can be discriminated statistically. As a further check, scanning electron microscopy will be employed to help interpret the unstratified sand deposits. Krinsley, for example, has confirmed the history of a sand dune and other depositional events inferred from surficial mapping, through a study of the microtextures on the surfaces of sand grains (Connally and others 1972). It is hoped that the use of the various techniques will result in confirmation or strong support for particular depositional events.

Cursory geological studies suggest a sequence of events preceding deposition of the cultural materials at Whipple Paleo-Indian site which may be correlated with other valley events, including the former presence of a glacial lake within the valley (Goldthwait and others 1969). The development of a chronology of late glacial and postglacial events should be possible when these data are confirmed with palynological data. A detailed topographic map has been completed to assist in this interpretation. Sediment cores, collected this year, suggest the existence of now-extinct streambeds in this area, but their relationship to the Paleo-Indian occupation is not yet known.

A pollen core has been collected from a bog near the Paleo-Indian site. Pollen diagrams will be developed, to provide a reliable chronology of the changes in the plant communities through time in the valley system which encompasses the site. The pollen core should provide a dated vegetational sequence against which more fragmentary data may be compared.

While botanical information recovered from the excavated area was extremely fragmentary, some material may be sufficient to validate the independently-derived environmental data. In the suspected hearth area and other selected areas, charcoal fragments were collected at all levels of excavation. A new method of dating small charcoal samples, being developed by the University of Rochester (Bennett and others 1977), will be used to date the hearth-related charcoal. The remaining charcoal is being processed in two stages. First, all charcoal is being separated into hardwood or softwood categories. Once this is complete, an attempt will be made to make generic and species-specific identifications which might suggest particular paleoenvironments.

Considerable quantities of soil are being flotated to recover microfauna and flora and other minute materials. Carbonized seeds have been recovered at considerable depths, some in disturbed soils, others possibly
in undisturbed contexts. Since these materials, at best, are only fragments of the paleoecological and cultural record, they will be able to provide minimal support for the palynological sequences derived from lake coring. Therefore, a further process will be employed on site soils—the identification of opal phytoliths. According to Carbone (1977:194)

phytoliths are microscopic opaline silica bodies that are deposited in and among the cells of plants. They are produced in large quantities by the vegetation. They exhibit morphological consistency and distinctiveness, and they are virtually invulnerable to decomposition in most sedimentary environments.

In a study of phytoliths at a stratified Paleo-Indian to Middle Archaic site in the Middle Shenandoah Valley, Carbone obtained "a general correlation between phytolith spectra, cultural stratigraphy, and environmental episodes arrived at on the basis of geomorphological and palynological evidences" (1977:204). A similar study at the New Hampshire site will be carried out through cooperative efforts with the University of Massachusetts, Boston, Department of Botany.

The last soil analyses to be considered are a combination of quantitative and quick soil chemistry tests, designed to identify vertical and horizontal variations in soil chemistry in the site area, which may relate to specific cultural activities. Emphasis will be placed on the use of phosphate and pH tests to identify chemical anomalies or patterns related to human activities. Deetz and Dethlefsen (1963) indicate that with pH testing they were able to interpret visible features more clearly and to identify non-visible features associated with cultural activities. Heidenreich and Navratil (1976), using a variety of quantitative chemical tests, concluded that analysis of phosphates and calcium matched specific activities at a Huron village site. Given the time depth of the Paleo-Indian occupation in New Hampshire, calcium tests would not be expected to be productive, while phosphate testing should. However, the retrieval of burned bone suggests that calcium testing of the soils may be successful. Recent adjustments to phosphate testing methods, developed by Eidt (1973,1977), and Woods (1975, 1977), may provide significant improvements in results. With separation of phosphate fractions, Eidt and Woods have discriminated among a variety of prehistoric land use patterns not separable by the previous quick test methods. Preliminary testing has provided several interesting relationships between the cultural materials and the soils, but further testing is essential.

Summary

The careful collection and analysis of geological, pedological, and paleobotanical data, combined with detailed site excavation, will help refine local aspects of the postulated regional paleoenvironmental model, permitting a beginning description of the Paleo-Indian environment. Preliminary site material analysis supports the value of utilizing
microstratigraphic excavation and collection techniques in this process. Since this represents the first professional excavation of a Paleo-Indian site which can test such a paleoenvironmental model at a specific locale in New England, research conclusions will provide a theoretical basis for future archaeological and paleoecological research in noncoastal New England.
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