Excavations at Meadowcroft Rockshelter, 1973-1974: A Progress Report*

By J. M. Adovasio, J. D. Gunn, J. Donahue, and R. Stuckenrath

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Abstract:
Meadowcroft Rockshelter is a deeply stratified, multi-component site in Washington County, Pennsylvania, The 11 well defined stratigraphic units isolated at the site span some 15,000 years of intermittent occupation by groups representing all of the major cultural stages/periods now recognized in northeastern North America. Throughout the sequence the site served as a locus for hunting, collecting, and food processing activities which involved the seasonal exploitation of the immediately adjacent Cross Creek Valley and the contiguous uplands.

Article:
General Setting
Location and General Geology
MEADOWCROFT Rockshelter (36WH297) is a stratified, multi-component site located 48.27 air kilometers (78.84 km via road) southwest of Pittsburgh and 4.02 surface kilometers northwest of Avella in Washington County, Pennsylvania (Fig. 1). The site is situated on the north bank of Cross Creek, a small tributary of the Ohio which lies some 12.16 km to the west. The exact location of the site is 40° 17' 12" N. 80° 29' 0" W (USGS Avella, Pennsylvania 7.5' Quadrangle).

Meadowcroft Rockshelter is oriented roughly east-west with a southern exposure and stands some 15.06 m above Cross Creek and 244.92 in above sea level. The area protected by the extant overhang is ca. 65 m2 while the overhang itself is some 13 in above the modern surface of the site. In addition to the water potentially availabe from Cross Creek, springs are abundant in the immediate vicinity of the shelter. The prevailing wind is west to east across the mouth of the shelter providing almost continuous ventIIation and ready egress for smoke and insects.

Geologically, Meadowcroft is located in the unglaciated portion of the Appalachian or Allegheny Plateau, west of the valley and ridge province of the Appalachian Mountains, and northwest of the Appalachian Basin. The surface rocks of this region are layered sedimentary rocks of Middle to Upper Pennsylvanian Age (Casselman Formation). The predominant lithologies are shale, quartz sandstone, limestone, and coal in decreasing order of abundance. Deformation is very mild with a regional dip of 3° to 5° to the southeast.

Physiography
Typographically, the region within which Meadowcroft is located is maturely dissected. More than 50% of the area is in valley slopes with upland and valley bottom areas in the minority. The stream pattern is dendritic with drainage running northwestward to westward toward the West Virginia-Ohio border and the Ohio River.

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* Editor's note: The authors wish to stress that this report is by no means final or in any sense complete. Rather, it is, a progress report of some of the work done at Meadowcroft to date. It is assumed, or rather expected, that a portion of the data presented in the following pages will be modified, perhaps extensively, by further work at the site. Nonetheless, it was the author's desire to present a working synopsis of the Meadowcroft project as it now stands.

Present topography was probably generated during the Pleistocene when increased precipitation and runoff caused extensive downcutting. Since the Wisconsin Glacial boundary only extends southward to northern Beaver County (some 40 odd km north), the Cross Creek Valley and Meadowcroft Rock- shelter probably existed in nearly their present configuration well before the close of the Wisconsin, ca. 11,000 B.P.

The excavations at Meadowcroft Rockshelter partially reported herein were conducted under the auspices of the Archaeological Research Program, Department of Anthropology, University of Pittsburgh. Generous financial and logistic support for the 19734974 excavations was provided by the University of Pittsburgh, the Meadowcroft Foundation, and John Boyle of Oil City, Pennsylvania, Radiocarbon assays were supplied "with tender loving care" by R. Stuckenrath.

The 1973-1974 excavations at Meadowcroft as well as the preliminary analyses of the artifactual, floral, and faunal remains were conducted by graduate and undergraduate students from the University of Pittsburgh and other institutions under the direct supervision of J. M. Adovasio and J. D. Gunn. Sedimentary analyses were directed by J. Donahue. Donahue also provided all pertinent geological data on the site.

Major assistance in the analysis of materials from Meadowcroft Shelter was provided by co-operating scientists at a number of institutions. Pollen remains were analyzed by V. M. Bryant and G. Williams- Dean, Texas A & M University while W. Bias, Division of Molluscs, Smithsonian Institution provided consultation in the analysis of molluscan material. G. F. Fry, Youngstown State University, assisted in the analysis of floral materials. D. Krinsley, CUNY, is currently examining quartz grain surface textures via scanning electron microscopy while V. Schmidt, University of Pittsburgh, is examining a series of clay samples with a magnetometer to determine magnetic secular variation throughout the occupation of the site. Contemporary flora at Meadow- croft was identified by P. V. Wiegman, Western Pennsylvania Conservancy, Pittsburgh. Human remains from Meadowcroft Rockshelter are presently being analyzed by P. Sciulli, Ohio State University.

Computer studies of the Meadowcroft data were directed by J. D. Gunn who also prepared the illustrations for this report. Photographs utilized herein were prepared by M. A. McConnaughy.

The co-authors especially wish to acknowledge Albert Miller, Vice-President, Meadowcroft Foundation, for his constant encouragement, assistance, and interest throughout the excavations.

Climate

The contemporary climate of Washington County may be classified as continental— characterized by wide seasonal temperature range and by a moderate amount of precipitation that falls principally during the warmer parts of the year. The temperature in Washington County ranges from 0°F in January to 90°+ in August. Precipitation averages approximately 1016 mm per year. The amount of precipitation correlates closely to elevation and roughness of terrain, particularly on windward slopes. Temperatures tend to be lower in hilly areas than in more level places due to the effects of elevation and air drainage. Nighttime temperatures are generally colder while daytime temperatures are slightly higher on the valley bottoms than on hill tops.

Flora

The contemporary flora in the immediate vicinity of Meadowcroft Rockshelter represents secondary growth post-dating the extensive commercial lumbering of the area in the late 19th and early 20th centuries (Table 1).

The aboriginal flora of the site is discussed in the Floral Remains section of this report.

Fauna

The area immediately adjacent to Meadow- croft Rockshelter presently supports a remarkable range of terrestial and avian fauna. During the course of the 1973-1974 excavations,

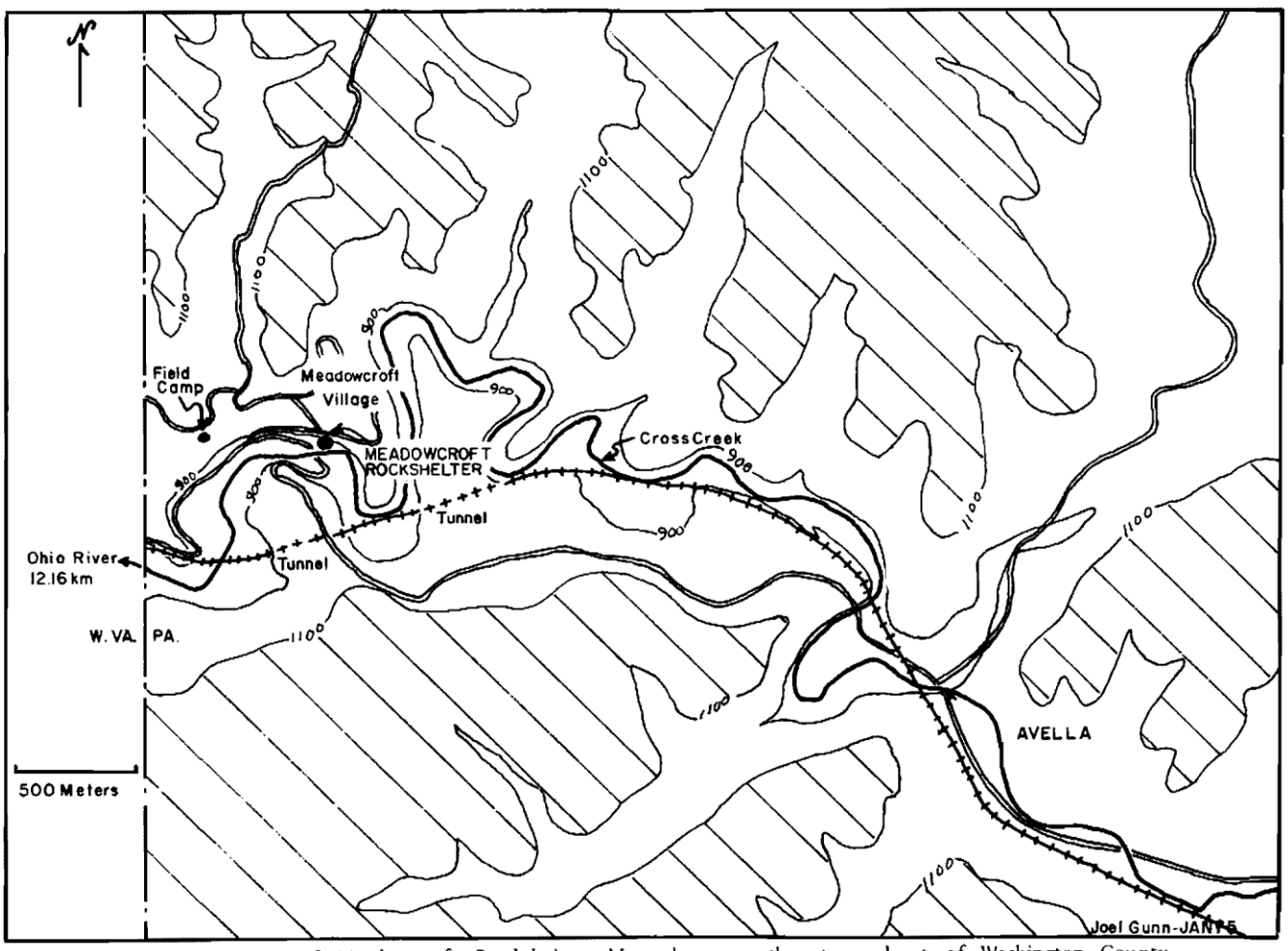

Fig. 1. Location of Meadowcroft Rockshelter. Map shows southwest quadrant of Washington County, Pennsylvania. Contour intervals are in feet.

Table 1

Checklist of Contemporary Flora in the Vicinity of Meadowcroft Rockshelter
(Prepared by P. G. Wiegman)

Genus	Species	Common Name	Occurrence
Acer	saccharum	sugar maple	C
Acer	rubrum	red maple	C
Acer	nigrum	black maple	R
Fagus	grandifolia	American beech	C
Quercus	rubra	northern red oak	C
Quercus	alba	white oak	C
Fraxinus	americana	white ash	C
Ulmus	americana	American Elm	C
Ulmus	rubra	slippery elm	C
Tsuga	canadensis	hemlock	C
Ostrya	virginiana	hop hornbeam	C
Platanus	occidentalis	sycamore	C
Tilia	americana	bass wood	C
Sassafras	albidium	sassafras	C
Prunus	serotina	black cherry	C
Betula	nigra	black or river birch	C
Juniperus	virginiana	eastern red cedar	R
Carya	tommentosa	mockernut hickory	R
Asimina	triloba	paw-paw	U
Hamamelis	virginiana	witch hazel	U
Cerkis	canadensis	red bud	U

C = Common
R = Rare
U = Understory

the authors and crew observed numerous species of mammals including deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), opposum (*Didelphis marsupialis)*, sku Ilk (Mephitis mephitis), woodchuck (*Marmota monax*), gray squirrel (*Sciurus carolinensis*), chipmunks (*Tarnias striatus*), cottontail rabbits (*SylvIIagus floridanus*), as well as a large and perniciously abundant variety of rodents. Terrestrial reptiles are represented by black (*Zamenis constrictor*) and garter snakes (*Thamnophis sirtalis*) as well as turtles (*Terrapene carolina carolina*). Amphibians include various Plethodontidae, toads (*Bufo americanus*) and tree frogs (*Rana clamitans*). The resident or transient avifauna numbers at least 2 species of bats as well as some 12 species of birds.

In contrast to the abundance of terrestrial and avian fauna noted above, riverine fauna is presently depauperate. Cross Creek was, and is, heavily polluted by raw sewage and mine effluvia and hence supports only a restricted range of fauna. As expected. freshwater mussels are wholly absent though a minimum of 9 species of fish occur, albeit in small numbers, as do snapping turtles (*Chelydra serpentina*) and bull frogs (*Rana catesbeiano*). Despite the relatively large number of species represented, it is presumed that the current distribution and frequency of fauna is but a dim reflection of the conditions which persisted here aboriginally (see Faunal Remains).

History of Research

Meadowcroft Rockshelter is located on the property of Meadowcroft Village, a restored predominantly 19th century, rural community operated by the non-profit Meadowcroft Foundation. The village was developed by Albert and Delvin Miller (Vice-President and President, respectively, of the Meadowcroft Foundation) on a portion of their old home farm presently some 800 acres in extent. The farm and the rockshelter have been in the continuous posession of the Miller family since 1795. The original patent of the 1780's was a Virginia land grant.

Due to its location within the precincts of Meadowcroft Village as well as the specific protection afforded by Albert Miller even prior to the creation of the village, the rock- shelter has escaped serious despoliation.

The archaeological potential of the shelter was long suspected by Albert Miller though he refrained from any excavations until 1967. In that year, his enlargement of a badger(?) burrow yielded lithic debitage, shell and faunal remains confirming his suspicions of aboriginal occupation at the shelter. Efforts to interest professional archaeologists in the site resulted in its recording in 1968. For one reason or another no excavations were initiated and the site remained, with the exception of the ca. 60 X 60 X 60 cm Miller "hole," untouched until 1973.

During the spring of that year, the site was brought to the attention of the Department of

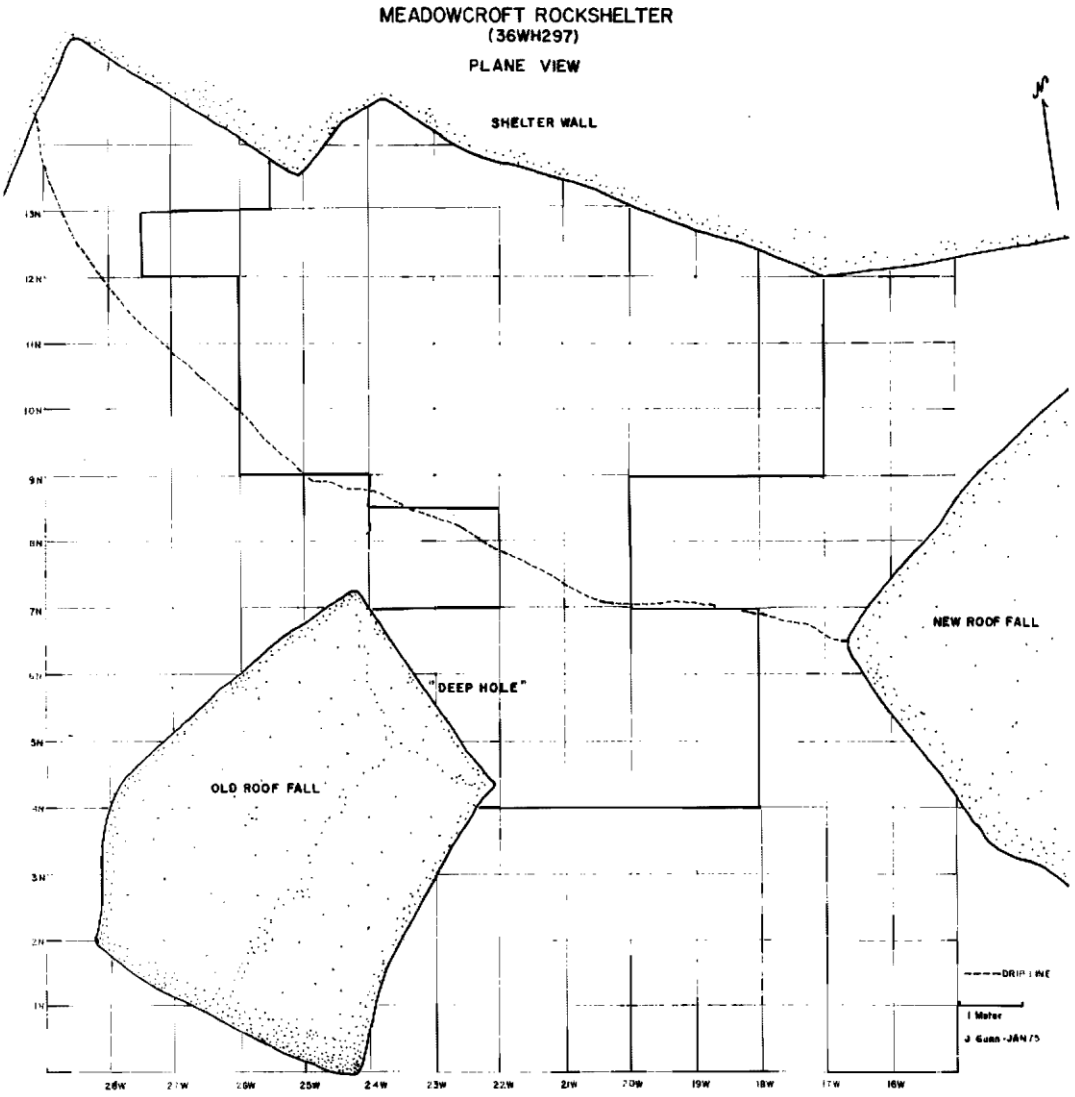

Fig. 2. Plane view of Meadowcroft Rockshelter. Dark lines indicate limits of excavation to date.

Anthropology, University of Pittsburgh. A visit to the shelter and a subsequent test excavation culminated in a formal application to the Meadowcroft Foundation to initiate major excavations in the summer of 1973. Permission for the proposed work was immediately forthcoming and the 1973 excavations were begun in mid-June and terminated in late August. The results of the first season warranted a second and work was resumed in early June 1974 and terminated in early September of that year. During the 102 working days of 1973-1974, some 57.95 m2 of surface area were excavated resulting in the removal of 98.55 cubic meters of fill. In addition to the excavations at Meadowcroft Shelter, a massive multi-period settlement pattern study of the entire Cross Creek drainage was begun in 1974. This survey as well as the excavations at Meadowcroft will be resumed in 1975. In addition, a series of other sites in the Cross Creek drainage will be tested during the 1975 field season.

Excavation Procedures

Meadowcroft Rockshelter was mapped with an alidade and plane table and a grid system was established originally consisting of 2 meter square units. All horizontal provenience co-ordinates were reckoned relative to this grid. In addition, a permanent elevational datum was affixed to the north wall of the shelter from which all vertical measurements on all observable phenomena were taken. This combination of a fixed elevational datum and a grid provided absolute Cartesian co-ordinates on all features encountered during the excavation. The grid was amended where necessary into 1 meter or smaller units and was used solely as a recording device.

Excavations were initiated by a south to north trench which proceeded from outside to inside the drip line. This trench was subsequently expanded as the situation dictated to its present configuration (Fig. 2).

All excavation was done by natural levels and where warranted by arbitrary levels within natural strata of considerable thickness. All fill was processed through 1/4-inch mesh screen. In addition. a constant volume sample of fill (2900 cc) was taken from each natural strata or arbitrary unit within each natural strata from every excavated square on the site. This sample was then processed by water flotation to insure representative recovery of materials which would ordinarily pass through 1/4-inch mesh.

All features were 3 dimensionally mapped and all pertinent phenomena were photographed four times each with a 4" X 5" BW camera and a 35 mm color camera.

All artifacts. etc. were, initially processed and labeled on the site and all recovered data was subsequently computerized for retrieval and analysis. Analysis of data is currently being conducted at a number of institutions (see Acknowledgments).

Because of the inordinate amount of rock- fall in the fill of the site, 90% of the excavation was done with trowels or smaller instruments.

Geology and Stratigraphy of Meadowcroft Rockshelter

Geology of Site

Meadowcroft Rockshelter is formed beneath a cliff of Morgantown-Connellsville sandstone: the Morgantown-Connellsville is a thick fluvial or channel sandstone within the Casselman Formation (Upper Conemaugh) of the Pennsylvanian Period. This sandstone varies from a subgraywacke to protoquartzite in composition. It is an immature sandstone composed predominantly of quartz grains with minor amounts of mica, feldspar, and rock fragments.

The rock unit immediately underlying the Morgantown-Connellsville sandstone was not observed in the field but is undoubtedly a less resistant lithology, most probably a shale. Thus, a re-entrant is formed beneath the sandstone cliff. The ceiling of this re-entrant or rockshelter is gradually migrating upward and cliff-ward as erosion occurs both on the rock- shelter ceiling and the cliff face. Within the face of the shelter excavation, the recession of the drip line representing the cliff edge position, can be plainly seen (Fig. 3). Most typically, erosion results in the dislodgement of individual sand grains. More rarely, rock fragments up to the size of a small house have fallen.

Rock Shelter Sediments

Location of Samples

Two trench sample columns were collected at the site from the walls of the excavation. Successive bulk sediment samples were taken with each sample representing a 10 cm increment. One trench was located on the east wall of the excavation, well within the drip line. The second trench was cut on the south wall of the "deep hole" outside the drip line.

Analysis Technique

To date, 2 analytic techniques have been completed. The samples were first randomly

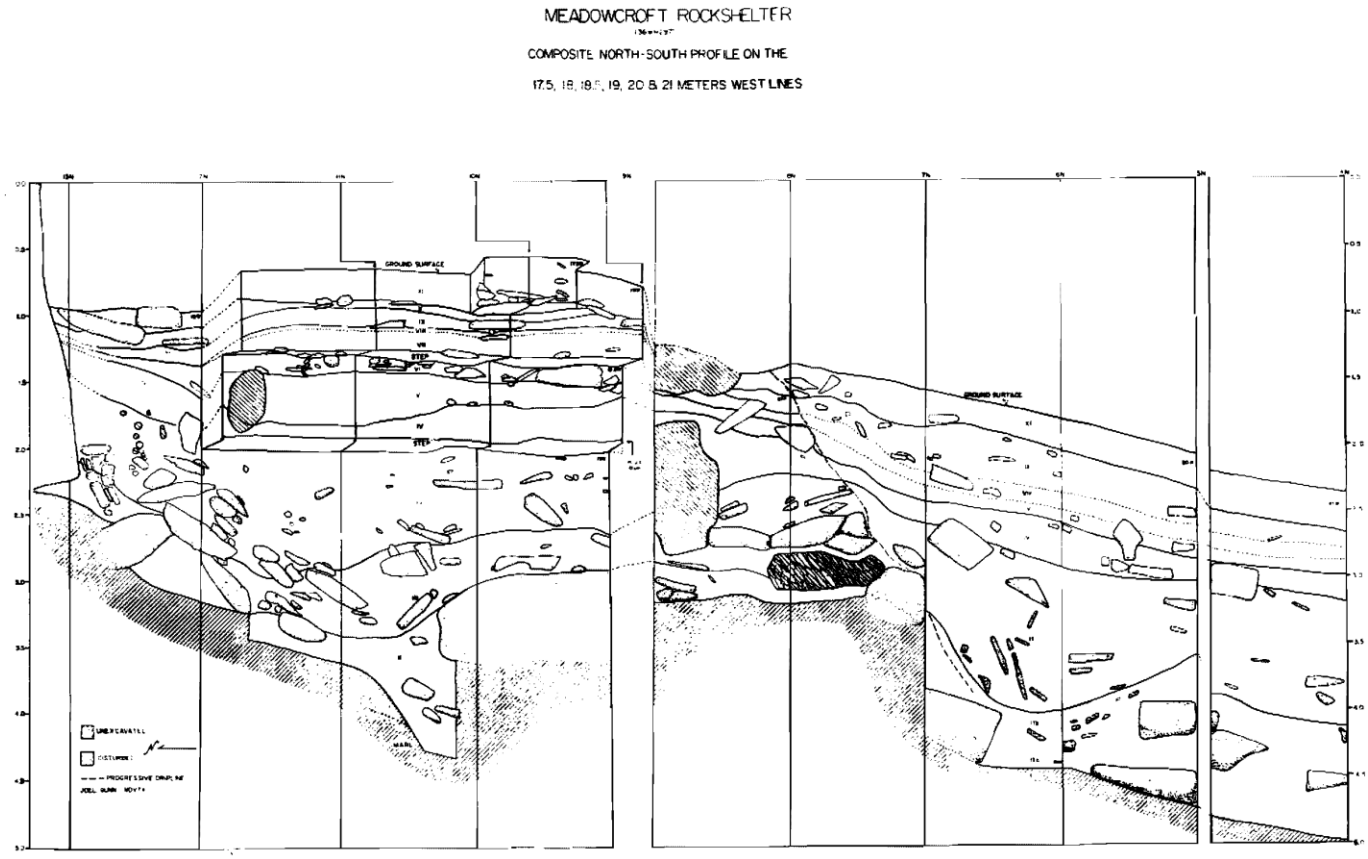

Fig. 3. Composite north-south profile of stratigraphy in Meadowcroft Rockshelter.

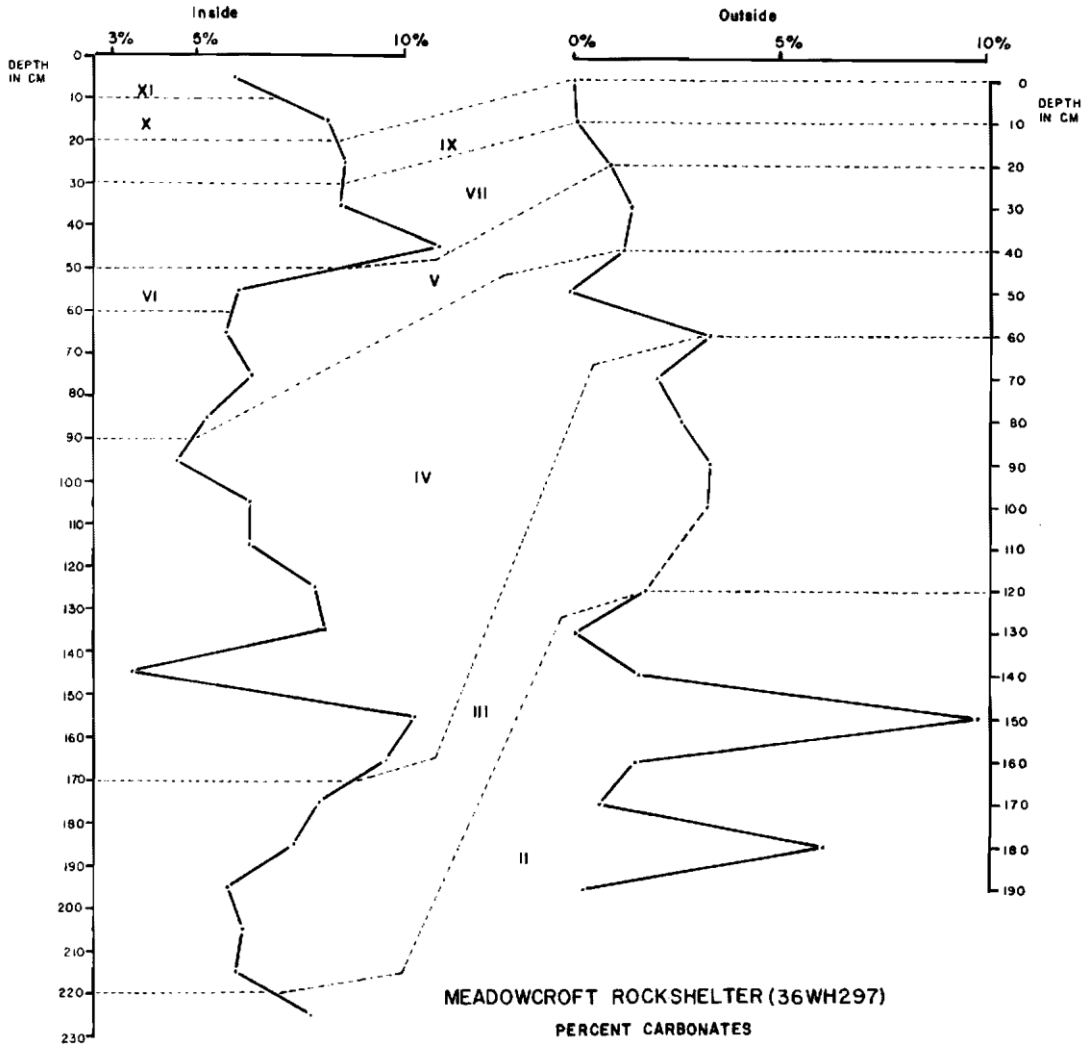

Fig. 4. Curve showing percentage of carbonate in sediments from trenches located inside and outside of drip line. Sample intervals are 10 cm thick with points located at the top of each interval. Dashed line segment indicates a missing sample at 110-120 cm in trench outside the drip line.

quartered, using a sample splitter. One fraction has been analyzed for carbonate content. A known weight of dried sample was treated with 10% hydrochloric acid and the remaining residue filtered and dried. The dried residue was then weighed to determine carbonate loss. Carbonate percentage varied from 0 to 10. The curves for both trenches are summarized in Fig. 4.

The second fraction was wet sieved to determine distribution and abundance of sand-sized grains. The sieve sizes used were 4.75, 2.38, 1.00. 0.495, 0.246, 0.150 and 0.088 mm. Each sample was weighed before sieving and then the dried sieve fractions weighed. Sediment loss represents the less than 0.088 mm fraction or silt and clay-sized fraction. Changes in the percentage of this fraction are plotted in Fig. 5.

Presently, we are determining size frequencies within the silt and clay fraction using hydrometer analysis. The sand-sized fractions will be scanned to estimate particle composition. Hopefully, clay mineral composition will be determined for the silt and clay-sized fraction. Additionally, David Krinslcy (CUNY) is examining quartz grain surface textures with a scanning electron microscope. This work should provide information on weathering and ultimately climatic conditions. Victor Schmidt (University of Pittsburgh) is examining a series of samples with a magnetometer to determine magnetic secular variation within the period of time represented by the excavation.

Sediment Grain Composition

Preliminary examination has provided good indications of general sediment composition. The coarser grain sizes (1.00 mm and larger) consist of sandstone fragments with minor amounts of bone, shell fragments, charcoal and flaking detritus. The bones are mainly from small mammals such as bats and rodents. Medial grain sizes (0.495 to 0.088 mm) consist predominantly of single quartz grains with minor amounts of mica, charcoal, flaking detritus, shell and bone fragments. The fine grain sizes (less than 0.088 mm) have not been analyzed as yet but should consist mainly of silt-sized quartz and clay minerals. A significant carbonate fraction may be present in some samples.

Sediment Size Distribution

Since only sand-sized grains have been measured as yet, a discussion of size distribution must be tentative. Histograms of size distribution, including silt and clay sizes (less than 0.088 mm) as 1 category, can be placed into 3 end. member categories with gradations between the categories. One category is tri- modal with the 3 modes being 4.75, 0.246 and less than 0.088 mm. The second type is bimodal with 1 mode at 0.246 and the other at less than 0.088 mm. The third end member is unimodal with the modal class in the silt and clay size. In the trimodal and bimodal distributions, 1 modal class is not dominant from sample to sample. Size distributions tend to reflect the horizons defined during excavation.

Stratigraphy

Eleven natural strata have been distinguished in Meadowcroft Rockshelter to date. These are described below with numerical prefixes beginning with the earliest stratum and proceeding to the latest. A composite profile of the stratigraphy is presented in Fig. 3.

Stratum I

Extent: This, the basal stratum at the site, has been exposed thus far only outside the drip line in a limited section of "deep-hole." It lies directly beneath Stratum II and is presumed to be continuous across the site. The large roof fall on the western edge of the site rests on the surface of this stratum.

Composition: Stratum I consists of badly decomposed, foliated sandstones (possibly roof fall?) interbedded with lenses of charcoal. Compositional analysis of this unit is presently incomplete.

Associations: The upper 1,0 cm of this unit contains 5 lithic artifacts which may represent intrusions from Stratum IIb, otherwise this unit is sterile.

Stratum II

Extent: Thickness of this unit varies from 40-120 cm. The upper 50 cm are distinguished as Stratum Ha which is continuous across the site. IIa is separated from the lower deposits (lIb) by massive roof fall. IIb has been exposed thus far only outside the drip line in the "deep-hole," Stratum H lies above Stratum I and directly beneath Stratum III.

Composition: The 1 sample inside the drip line is trimodal with equal primary modes at 0.246 and less than 0.088 mm and a secondary mode at 4.75 mm. Carbonate percentage is 7.5.

Size distribution is bimodal outside the drip line with modes at 0.246 and less than 0.088 mm. The silt to clay sized mode is dominant. In a few samples (1.3 to 1.4 m, 1.5 to 1.6 m), a weak tertiary mode at 4.75 mm develops. The carbonate content ranges from 0.5 to 10% with 2 distinct spikes of 10% (1.5 to 1.6 m) and 6% (0.8 to 0.9 m).

Associations: Lithe materials, bone, firepits and fire floors, floral remains, shell.

Stratum III

Extent: Continuous across site. Thickness varies from 30-110 cm. Stratum III lies directly above Stratum II and below Stratum IV.

Composition: Inside the drip line size distribution is trimodal with the primary mode at 0.246, secondary at less than 0.088 and a weakly developed tertiary mode at 4.75 ram. Carbonate content ranges

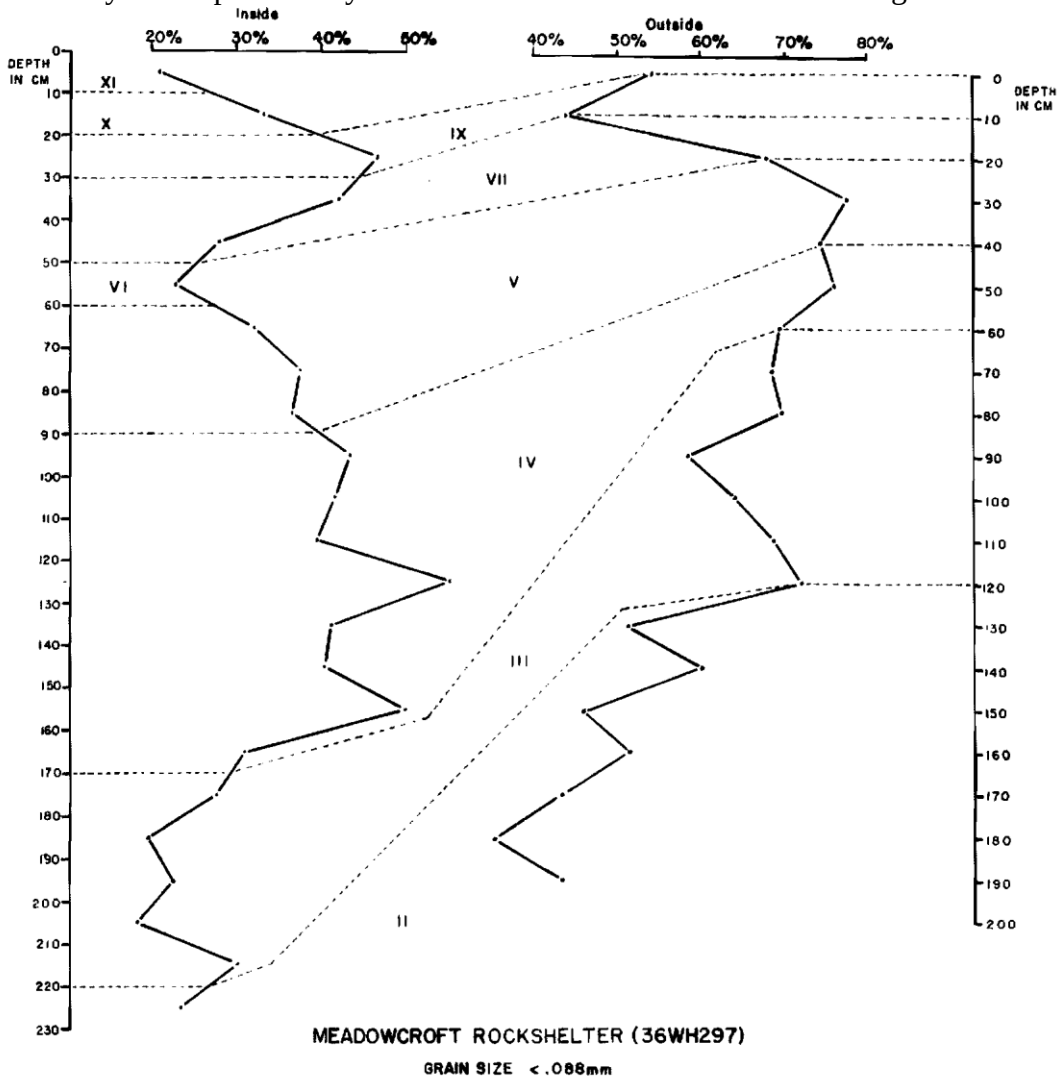

Fig. 5. Curves showing percentage of silt and clay-sized grains in sediments from trenches located inside and outside the drip line. Sample intervals are 10 cm thick with points located at the top of each interval.

from 5.5 to 8%. Stratum HI cannot be distinguished from Stratum II inside the drip line if only these 2 parameters are used.

Stratum III is distinctly different from Stratum H outside the drip line. Size distribution is unimodal with a highly predominant mode at less than 0.088 mm. Carbonate content averages around 2.5% with fluctuations of only ±0.5% as compared to side fluctuations with spikes at 6 and 10% in Stratum 11 (Fig. 4).

Associations: As above.

Stratum IV

Extent: Continuous across site. Thickness varies from 30-70 cm. Stratum IV lies directly above Stratum III and below Stratum V.

Composition: Inside the drip line size distribution is strongly bimodal with the primary at less than 0.088 and the secondary mode at 0.246 mm. Carbonate content averages around 6% with fluctuations of ±4%. Stratum IV is distinctly different from Stratum III.

Outside the drip line Stratum IV issimilar to Stratum III in terms of size distribution. The carbonate content is distinctly lower with an average value of 1.5%.

Associations: As above plus ceramics.

Stratum V

Extent: Continuous across site. Thickness varies from 20-40 cm. Stratum V lies directly above Stratum IV and below Stratum VI inside the drip line. Outside the drip line it lies directly below Stratum VII.

Composition: Inside the drip line Stratum V issimilar to Stratum IV with the exception that the upper 15 cm of the sample is trimodal with a tertiary mode at 4.75 mm.

Outside the drip line size distribution and carbonate content remainsimilar to that in Strata III and IV.

Associations: As above.

Stratum VI

Extent: This stratum exists only inside the drip line where it directly overlies Stratum V. It lies beneath Stratum VII. The large roof fall on the eastern edge of the site is contemporary with this unit.

Composition: In the 1 sample availabe inside the drip line, the trimodal size distribution seen in the upper 15 cm of Stratum V develops more strongly with distinct modes at 4.75 (tertiary), 0.246 (secondary) and less than 0.088 mm (primary). Carbonate content is at 6%, no different than Stratum V below.

Associations: As above.

Stratum VII

Extent: Continuous across site. Thickness varies from 20-40 cm, Stratum VII lies directly below Stratum VHI inside the drip line and below Stratum IX outside. Stratum VIII lies above Stratum VI inside the drip line and Stratum V outside.

Composition: Inside the drip line, the trimodal size distribution seen in Stratum VI continues with the less than 0.88 mm mode becoming strongly primary and the 4.75 mm mode strongly secondary at the top of the stratum. Carbonate content increases to an average value of 8.5%.

Outside the drip line a change occurs from underlying Stratum V. A secondary size mode develops at 0.150 and a very weak tertiary mode develops at 4.75 mm. Carbonate content is about 0.5%.

Associations: As above.

Stratum VIII

Extent: Continuous over western 1/4 of site inside the drip line. It lies beneath Stratum IX and above Stratum VII inside the drip line. Outside the drip line Stratum VIII lenses out. Thickness varies from 0-5 cm.

Composition: No samples were analyzed. Associations: As above.

Stratum IX

Extent: Continuous across site. Thickness varies from 5-15 cm, Stratum IX lies directly above Stratum VIII inside the drip line and above Stratum VII outside. Inside the drip line Stratum IX lies beneath Stratum X while outside the drip line it lies beneath Stratum XI.

Composition: Inside the drip line the sediment is very poorly sorted with a tetramodal size distribution. The primary and secondary modes remain at less than 0.088 and 4.75 mm as in Stratum VII. Carbonate content is 8.5%.

Outside the drip line the primary mode is at less than 0.088 mm. In contrast to Stratum VII, the secondary mode shifts to 4.75 mm. Carbonate content is essentially 0%. This stratum occurs at ground surface outside the drip line.

Associations: As above.

Stratum X
Extent: Continuous over western 3/4 of site inside the drip line. Thickness varies from 0-5 cm. Stratum X lies directly above Stratum IX inside the drip line and below Stratum XI,

Composition: Inside the drip line Stratum X is not distinctly different from Stratum IX. Size distribution remains tetramodal with less than 0.088 and 4.75 mm remaining strong primary and secondary modes, Carbonate content is 8%.

Associations: As above with intrusive historic materials.

Stratum XI
Extent: Continuous across the site. Thickness varies from 12-15 cm. Stratum XI is the uppermost stratum at the site and overlies Stratum X inside the drip line and Stratum IX outside.

Composition: Inside the drip line size distribution becomes trimodal with a strong primary mode at 0.246 and weaker secondary and tertiary modes at less than 0.088 and 4.75 mm. Carbonate content falls to 6%.

Associations: As above.

Preliminary Conclusions from Sediment Analysis

Several tentative conclusions may be drawn from work completed thus far concerning origin of the rockshelter sediments and climatic variation during the span of time represented by the sediments.

Origin of Rockshelter Sediments

Both field examination and laboratory analysis indicate that sediments in the rock- shelter were derived by gradual erosion from the Morgantown-Connellsville sandstone cliff and the uplands above it. Accumulation was a slow process, and there is no evidence of stream or lake deposits.

Field Criteria: Stratification as observed in the excavation profiles consists essentially of thick, poorly sorted units. Sandstone blocks which have fallen from the MorgantownConnellsville cliff are scattered throughout the sediment, occasionally in large concentrations suggestive of major roof fall episodes. Three such episodes may now be distinguished and are discussed in detail below.

The existence of a distinct drip line shows that sediment was not transported after falling from the cliff and upland region. If the sediments had been reworked by stream or lake currents, a finer stratification would be expected and any indication of a drip line would have been erased. With stream action especially, layers of better sorted sand would be expected.

Laboratory Criteria: Examination of the sediment size distribution shows a significant difference between samples inside and outside the drip line. The samples from inside the drip line have a greater percentage of material in the medium to coarse sand and gravel fraction. The higher percentage of fine sand, silt, and clay found outside the drip line (Fig. 5) were derived from soil profiles located above the rockshelter cliff.

Carbonate Content of Sediments

Fig. 4 shows the variation in carbonate content down both trenches. Two aspects of these curves are of note. There is a grosssimilarity between the curves showing that carbonate content changed in the same manner both inside and outside the drip line. Secondly, the sediments inside the drip line contain a higher carbonate content (mean equals 7.0%; standard deviation equals 7.23%) than those outside (mean equals 2.13%; standard deviation equals 3.15%).

The variation in carbonate content may reflect one or both of two factors. Climatically, a higher carbonate content may indicate less humid conditions. Occupationally, with respect to an aboriginal culture, it may reflect consumption of larger amounts of mussels and thus a higher percentage of molluscan fragments in the sediments.

The lower percentage of carbonate in sediments outside the drip line probably reflects more extensive leaching and dissolution of carbonate by rainfall.

Silt and Clay-Sized Fraction in Sediments

Fig. 5 shows variations in silt and clay-sized material for both trenches. Both curves show a trend towards increasing percentages of silt and clay with the percentage being significantly higher outside the drip line (mean of 59.60% outside compared to 34.09 inside; standard deviation of 12.83% outside compared to 10.45% inside). Both curves have a notable decrease in silt and clay at the top of the trench. The curve for outside the drip line shows the progressive increase especially well.

The silt and clay content in the sediments is probably mainly derived from the soil profile developed on the upland surface above the rockshelter cliff. Thus a higher clay content outside the drip line is not surprising. The gradual increase in silt and clay content could indicate either gradually warming or a more humid climate. Both would promote more rapid weathering of an upland soil profile while more humid conditions would cause increased transport of sediment from the upland surface.

Summary of Cultural Features

The most common cultural features encountered during the 1973-1974 excavations at Meadowcroft Rockshelter are firepits of a variety of configurations (79). large burned areas herein designated as fire floors (6), ash/ charcoal lenses (8), and refuse pits (16). Also encountered were concentrations of lithic materials suggestive of manufacturing and/or activity areas (4) and possible human (1) and animal burials (1). The frequency of these features is plotted in Table 2 and is discussed below by stratum.

Stratum I

No recognizable features are definitely associated with this unit. However, a series of thin charcoal lenses occurs, notably in the upper 10-20 cm, whose origin is presently unknown. The uppermost of these lenses yielded, as noted above (see Stratigraphy). 5 lithic artifacts which may represent intrusions from Stratum IIa.

Stratum IIa

The earliest positive cultural features excavated at Meadowcroft are associated with the deepest arbitrary levels within this unit. These include 3 circular to oval. unrimmed, unlined, basin-shaped firepits in the lowest occupational "floor" and a fourth firepit ofsimilar configuration located stratigraphically above the other three. A concentration of 46 lithic artifacts of indisputable human origins is associated with the firepits of the deepest level (see Artifact Summaries). Fill of all Stratum IIa firepits consists of unlaminated ash and charcoal and the

interiors of all pits are fire-reddened (Fig. 6). Charcoal samples from 2 of the 3 firepits on the deepest "floor" have been radiocarbon dated and the assays currently constitute the oldest evidence of human occupation in eastern North America (see Radiocarbon Chronology).

All of the Stratum IIa features are located outside of the drip line in the southernmost excavation unit (the so called "deep hole") of the site. The full horizontal extent of the IIa occupations is presently unknown.

Stratum IIb
Six firepitssimilar in configuration and character of fill to those in IIa as well as 3 fire floors are ascribable to this unit. These features are unevenly distributed throughout the site with evidences of slightly heavier, or more intense utilization of the central and eastern portions of the shelter. All features are located above or directly on the rock fall separating Stratum IIa from IIb.

Stratum III
Ten firepits including oval to circular, unrimmed, basin-shaped configurations with and without rock lining as well as 2 refuse pits are associated with this stratum. All are concentrated in the central and eastern portions of the site. Many of the firepits contain multiple lenses of stratified ash and charcoal indicative of extensive reuse.

Stratum IV
A quantum increase in cultural features is apparent in this unit. Twenty-one circular to oval, unrimmed, basin-shaped firepits were encountered which are distributed principally in the central and eastern portions of the site. Again, many of the firepits bear evidence of reuse.

Stratum V
The densest concentration of cultural features excavated to date at Meadowcroft is associated with Stratum V. Twenty firepits including circular to oval lined and unlined types of widely varying cross sections were excavated during the 1973-1974 seasons. Three thick ash/charcoal lenses, 1 major fire floor and 9 refuse pits of varying sizes were also encountered. Stratum V features are distributed throughout the excavated portions of the shelter with markedly eater incidence in the central to eastern portions of the site. Many firepits exhibit evidence of expansion and multiple reuse.

Stratum VI
A sharp diminution in the frequency of cultural features occurs in Stratum VI which as noted above is directly associated with the collapse of the overhang on the eastern edge of the site. Stratum VI contains a single unrimmed, unlined basin shaped firepit though other evidences of human occupation arc present (see below).

Stratum VII
Six firepits, 1 ash lens, 1 fire floor, 2 lithic concentrations, and 1 possible human burial are associated with this unit. The firepits include principally circular to oval, lined and unlined basin- shaped forms though other variations occur. All features are located in the central and western portions of the site under the present expanse of the drip line. Firepits again show evidence of expansion and multiple reuse.

Strata VII-XI
These units collectively contain 11 firepits of varying configurations, 2 ash lenses. 2 refuse pits, and 1 possible dog burial. The horizontal distribution of all these features is restricted to the central and western portions of the site.

Radiocarbon Chronology
A total of 35 charcoal samples were submitted for radiocarbon assay to the Radiation Biology Laboratory of the Smithsonian Institution. In all but 1 case the charcoal was derived from firepits, fire floors, or charcoal

Table 2

Frequency of Cultural Features at Meadowcroft Rockshelter by Stratum

Strata	Firepits	Ash/Charcoal Lenses	Firefloors	Lithic Concentrations	Refuse Pits	Burials	Totals
XI	3				2	1 (dog)	6
X	2	1					3
IX	4	1					5
VIII	2						2
VII	6	1	1	2		1 (human)	11
VI	1						1
V	20	3	1		9		33
IV	21		1		3		25
III	10				2		12
IIb	6		3				9
IIa	4			1			3
I		2		1			3
Totals	79	8	6	4	16	2	115

Fig. 6. View of partially excavated firepit (stain in center of photo beneath tag) on the lowest "floor" of Stratum IIa.

lenses within the deposits. The exception represents a portion of a completely carbonized simple plaited basketry fragment (SI-1680). To date 17 of the samples have been processed and the results are presented in Table 3.

With the lone exception of S1-1681 from upper Stratum IIb, there are no reversals and the resultant radiocarbon chronology is consistent with the observed stratigraphy. The sole reversal is inconsequential as the dates overlap well within the range of counting error allowed by 1 standard deviation. It should be stressed that the processing

of radiocarbon samples is incomplete and that further assays should present a much clearer picture of the absolute chronology of the site than is currently availabe.

Depositional Episodes

The data presented above suggests that the long depositional sequence at Meadowcroft Rockshelter may be viewed in terms of 3 sequent overlapping episodes (Fig. 7).

Episode I, ?=ca. 13,000 B.C., is represented on the site only by the as yet poorly known Stratum I and any units which may lie beneath it. During this time the large sections of roof fall on the eastern and western perimeters of the site were in place in the overhang making the shelter 3 or 4 times larger than it is now. The small exposure of Stratum I is more or less flat lying, perhaps dipping away (south) from the face of the shelter very slightly. Apparently, the great expanse of the overhang protected the interior fairly well from outside disturbance during the deposition of Stratum I and any as yet undetected lower units.

Herein, it may be inserted that an enigmatic marlish deposit has been encountered in a very restricted section of the shelter well within the drip line which may be ascribable to Episode I. J. Donahue believes this unit (?) may have developed in standing water at the back of the shelter which may or may not contradict the statements made in the pre ceding paragraph. As only 4 m2 of this marl have been exposed to date, further excavation is needed to ascertain the nature of the unit. No human occupation is as yet associated with Episode I.

Episode II, ca. 13,000-ca. A.D. 1+, is initiated by an event labeled the Old Roof Fall during which time the large roof block on the western edge of the site fell from the overhang. The presence of the Old Roof Fall on the floor of the shelter controlled the direction and form of subsequent deposition. The collapse of the roof opened the shelter to deposition from the west with the result that all Episode II strata dip to the east and southeast. This includes Strata II through V.

Episode II also includes a major period of heavy roof spalling which occurred shortly before 3000 B.C. This roof spalling period effectively sealed the early Episode II deposits from the later ones and in fact marks the boundary between Stratum IIa and IIb.

The human occupation of Meadowcroft began at the onset of Episode II during which time presumably all of the area beneath the then extant drip line was utilized. After the mid-Episode II roof spalling occupation was clearly concentrated in the central and eastern portions of the site.

Episode HI was again initiated by a spectacular roof fall (the New Roof Fall) resulting in the dislodgement from the overhang of the massive roof block on the eastern edge of the site. This relatively recent rock fall, ca. A.D. 1 or later 1-2000 B.P., is directly associated with Stratum VI which appears between Strata V and VII in the eastern part of the shelter. As in Episode II the New Roof Fall opened the shelter to deposition from above the cliff, this time from the east, with the result that the uppermost strata dip to the southwest. These include Strata VI through XI.

The New Roof Fall appears to have fallen directly on the main locus of habitation in the eastern half of the shelter forcing the latter occupants to utilize the central and western portions of the site. This occupational pattern persisted into the Historic Period.

Table 3

Radiocarbon Dates from Meadowcroft Rockshelter as per February 14, 1975 (Uncorrected)

Strata	Provenience/Description	Lab Designation	Date	Cultural Period
XI	No samples submitted			Late Woodland/Historic
X	Charcoal from firepit	Sample not yet processed		Late Woodland
IX	Charcoal from firepit	Sample not yet processed		Late Woodland
VIII	Charcoal from firepits/ fire floors	Samples not yet processed		Late Woodland
VII	Charcoal from firepits/ fire floors	Samples not yet processed		Late Woodland
VI	Charcoal from firepits/ fire floors	Samples not yet processed		Middle/Early Woodland
V	Charcoal from firepits/ fire floors	Samples not yet processed		Middle/Early Woodland
IV	Charcoal from firepits/ upper 1/3 of unit	SI - 1674	375 ± 75 B.C.	Early Woodland/ Transitional
	Charcoal from fire floor/ middle 1/3 of unit	SI - 1665	865 ± 80 B.C.	
	Charcoal from firepit/ middle 1/3 of unit	SI - 1668	870 ± 75 B.C.	
III	Charcoal from firepit/ upper 1/3 of unit	SI - 2066	980 ± 75 B.C.	Transitional (Broadspear Tradition)/Archaic
		SI - 1664	1115 ± 80 B.C.	
	Charcoal from firepit/ middle 1/3 of unit	SI - 1679	1305 ± 115 B.C.	
	Charcoal from firepits/ fire floors—lower 1/3 of unit	Samples not yet processed		
IIb	Charcoal from firepit/ upper 1/2 of unit	SI - 1681	1260 ± 95 B.C.	Archaic
	Carbonized basketry fragment/upper 1/3 of unit	SI - 1680	1820 ± 90 B.C.	
	Charcoal from firepit/ middle 1/3 of unit	SI - 2063	2000 ± 240 B.C.	
		SI - 1685	2870 ± 85 B.C.	
	Charcoal from firepits/ lower 1/3 of unit	Samples not yet processed		
IIa	Charcoal from firepits/ fire floors—middle and upper 1/3 of unit	Samples not yet processed		
	Charcoal from firepits/ middle 1/3 of unit	SI - 2064	6060 ± 110 B.C.	
		SI - 2061	7125 ± 115 B.C.	
	Charcoal from firepit/ lowest arbitrary level in unit	SI - 2065	11,300 ± 1000 B.C.	Paleo-Indian
		SI - 1872	12,900 ± 200 B.C.	
		SI - 1686	13,170 ± 165 B.C.	
I	Charcoal from lenses/ upper (?) 1/3 of unit	SI - 2121	19,430 ± 800	No cultural associations
		SI - 1687	28,760 ± 1140 B.C.	

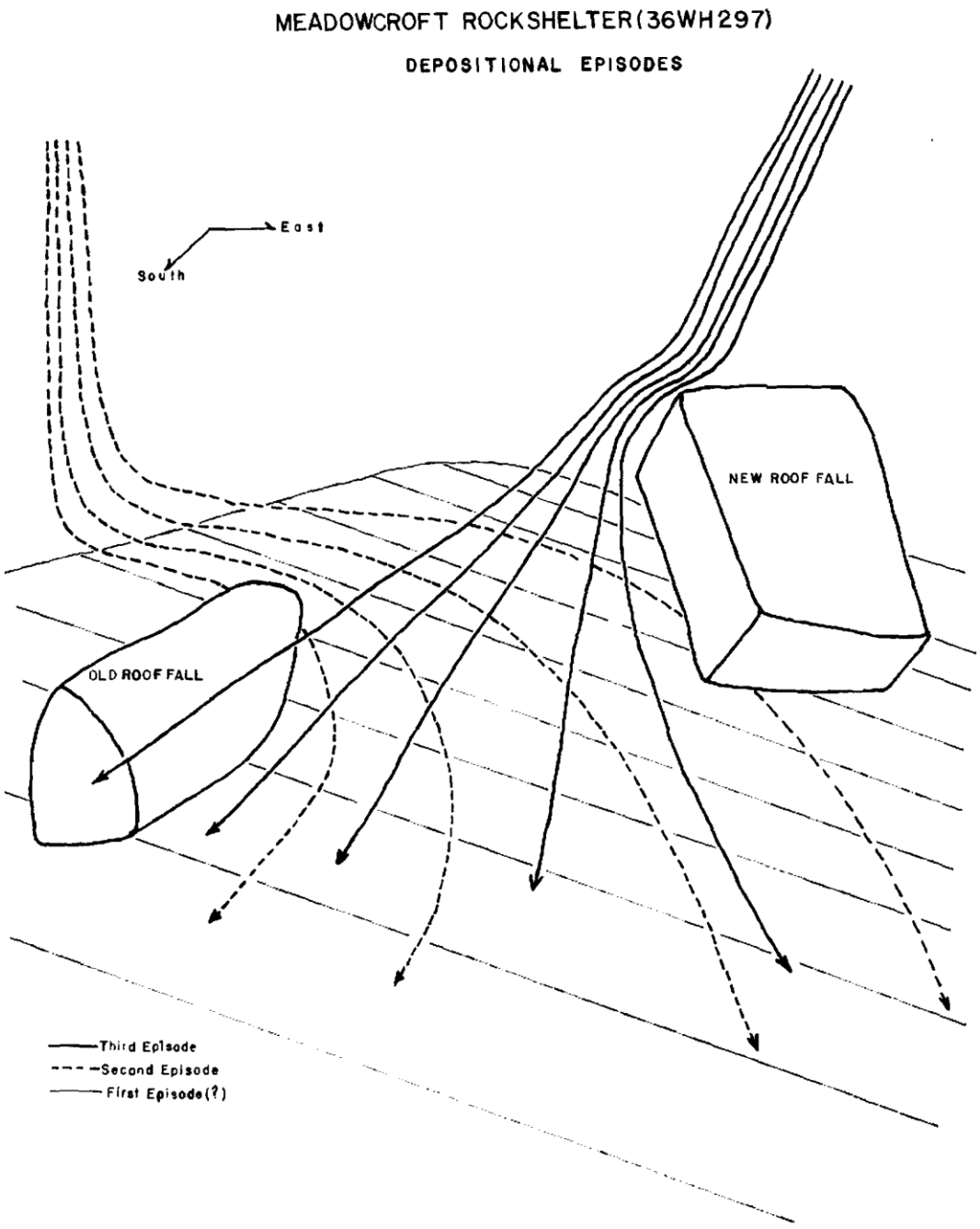

Fig. 7. Depositional Episodes at Meadowcroft Rockshelter.

Artifact Summaries

Six classes of artifacts have been recovered to date at Meadowcroft Rockshelter. These include lithic. ceramic, bone, wood, basketry, and shell materials which are briefly discussed below by class. As the analysis of much of this material is incomplete, data for each class is not quantified except in special instances.

Lithic Artifacts

Both flaked and ground stone artifacts were recovered from Meadowcroft. Flaked stone artifacts as well as flaking debitage were recovered from all strata while the incidence and frequency of ground stone tools is quite restricted.

Flaked Stone

Discounting for the moment the 5 possibly intrusive lithic artifacts in upper Stratum I, the earliest flaked stone assemblage from the site is derived from basal Stratum II and includes 9 tools and 37 pieces of debitage (Fig. 8). These 46 specimens were directly associated with the dated firepits from that level and arc hence ascribable to the late 14th millennium B.C. Included in this, the earliest securely dated collection of tools in eastern North America. are a bIIaterally sharpened, rhomboidal blade/ flake knife herein designated the Mungai knife, 3 true prismatic blades, 1 scraper, I rectangular biface, 1 unifacial denticulate tool, 1 graver and another amorphous knife-like tool. The 37 waste flakes include a number of bifacial (7) thinning flakes of high quality as well as primary and secondary decortication flakes. No diagnostic fluted or unfluted projectile points are associated with the assemblage. Lower Stratum IIb produced a single Middle Archaic point similar to a Neville (or Stanly) projectile point (Fig. 9) as well as lithic debitage. The Neville-like point has some resemblance to Kanawha stemmed types except that the former is barbed while the latter is not (Broyles 1971; Dincauze 1974).

Upper StratumIIb and lower Stratum III yielded Brewerton side-notched points, Lamoka-like points, and Normanskill points (c.f. Adovasio et al. 1974) as well as scrapers, knives, and flaking detritus.

Upper Stratum III and lower Stratum IV are characterized by Snook Kill and Orient-like (Ritchie 1961) projectile points as well as several untyped varieties while upper Stratum IV produced Adena and other untyped Early Woodland forms. Knives and scrapers of a variety of configurations as well as an abundance of lithic debitage were also found in these units.

Strata V and VI yielded predominantly Middle Woodland point types though sonic Early Woodland forms are present as well, Notable in these strata are Chesser-Notched points (Prufer 1967) as well as drills, scrapers, knives, and flaking debitage.

The upper Strata, VII through XI, produced Late Woodland point types including triangular and other forms as well as the usual debitage, scraper, and knife forms. Also encountered were several large limestone choppers and scrapers associated with Stratum VII,

Taken as a unit the Meadowcroft lithic assemblage is roughly 75% flaking detritus with the remaining 25% representing finished tools of one sort or another. Of this 25% most arc projectile points followed in descending order by knives, scrapers, drills, and other forms.

Herein, it should be noted that the greatest concentration of lithic materials are in Strata III through V with the frequency of lithic artifacts diminishing above and below these units. Further. despite the relatively large amount of flaking detritus, evidence for hi situ manufacture of tools is limited. Most of the debitage consists of resharpening flakes of small size with only an occasional decortication or large thinning flake represented. The only exceptions to this general statement are 2 concentrations of indurated limestone in Stratum VII which surely represent work areas where limestone cobbles were heat treated and subsequently flaked into large choppers and scrapers.

Raw Materials

With the exception of the limestone artifacts noted above, most of the flaked stone tools and lithic debitage are cherts, "flints," chalcedonies, or jaspers from an astonishingly wide range of quarries. Only 10% of the material is of directly local origin (i.e. Washington County) while the remainder includes Kanawha flint. Sky Hill chert, Onandaga and Coshocton cherts/flints, Plum Run chert, Pennsylvania jasper, and Flint Ridge flints/cherts and chalcedonies. Interestingly, the Stratum IIa assemblage is largely composed of exotic materials, notably Flint Ridge flint.

Edge Wear

Edge wear studies of the finished lithic tools from Meadowcroft are currently in process and indicate the same general range of functional variation as that found in the Boarts assemblage (McConaughy 1974).

Ground Stone

Few ground stone artifacts were recovered from Meadowcroft. The extant assemblage includes only 2 or 3 manos (pestles), several "nutting" stones, and a few amorphous forms of unknown function. All are confined to Stratum III and are made of local sedimentary rock.

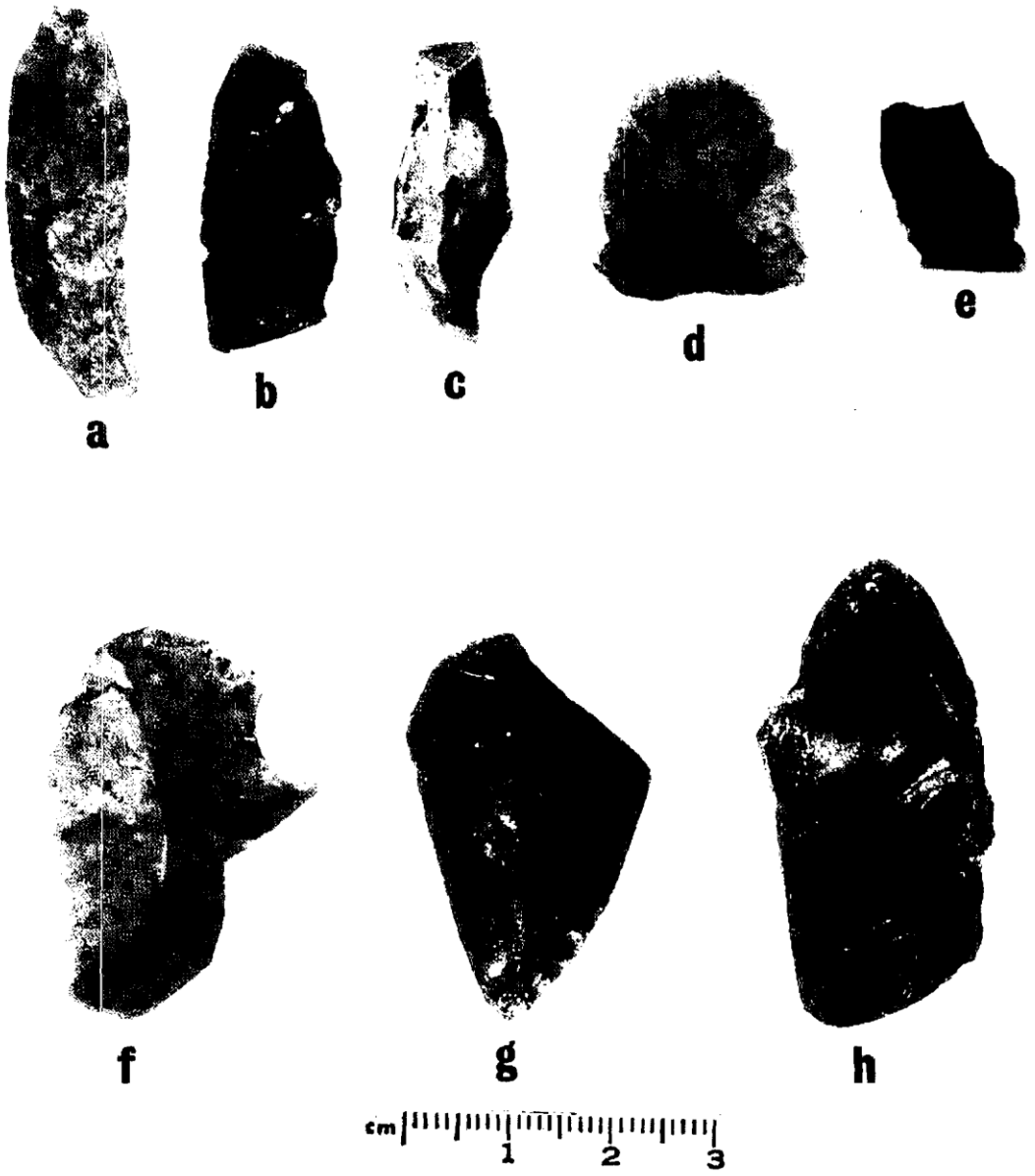

Fig. 8. Representative artifacts from lower Stratum IIa: a-c, prismatic blades; d-f, Flint Ridge flaking detritus; g. Mungai "knife"; h. biface.

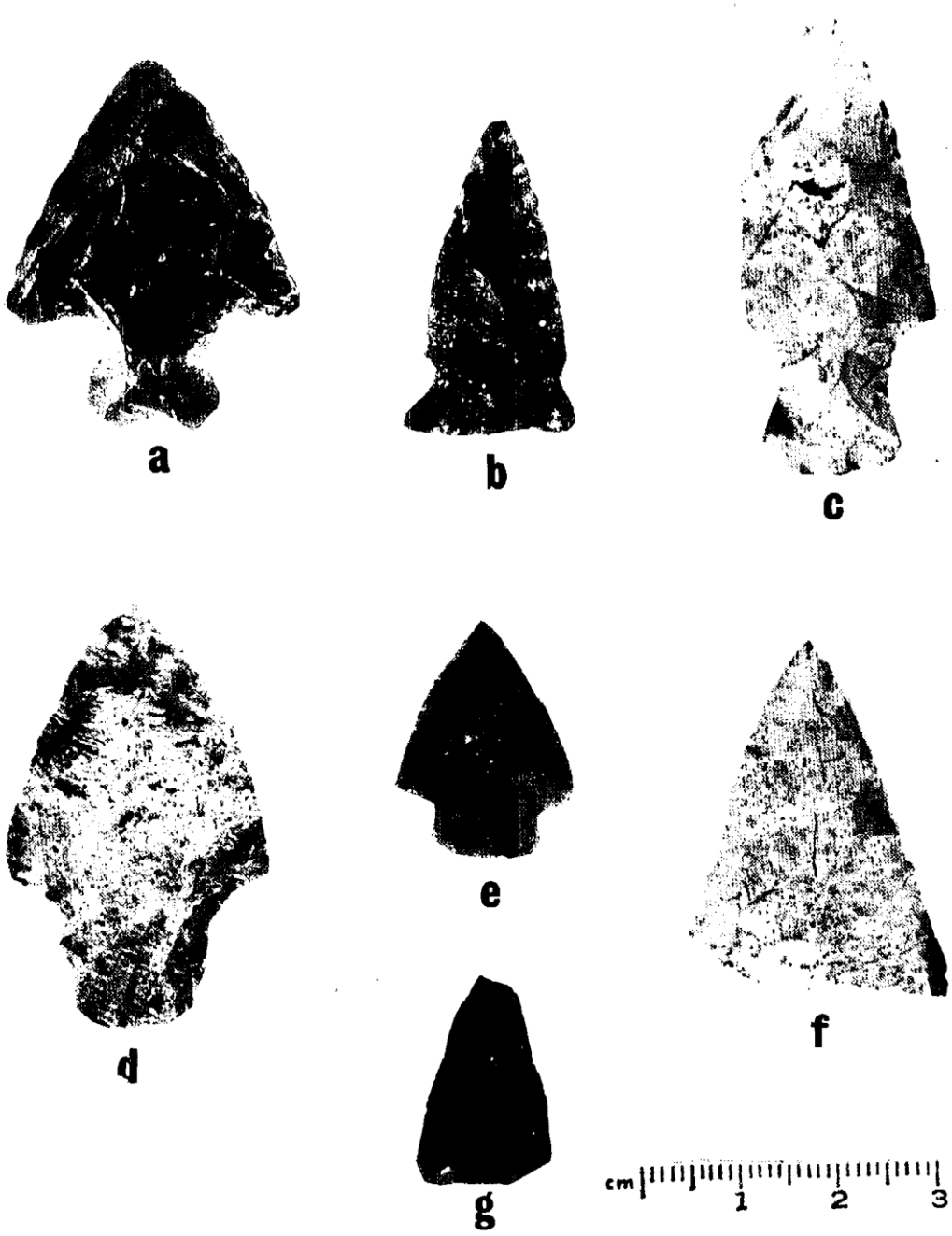

Fig. 9. Representative projectile points from Meadowcroft Rockshelter: a, Neville-like (Stanly)-Stratum IIb; b, Brewerton Side-Notched-Stratum III; c, Normanskill-like-Stratum III; d, Adena Ovate Base-Stratum IV; e, untyped Middle Woodland corner-notched point-Stratum V; f-g, Triangular points-Strata VII, IX.

Ceramic Artifacts

Ceramics at Meadowcroft Rockshelter are restricted to Stratum IV and above and include 4 basic types: grit tempered Half-Moon Cordmarked, limestone tempered Watson ware, grit tempered Mahoning ware and shell tempered Monongahela ware (sec Mayer-Oakes 1955).

The earliest type represented is Half-Moon Cord- marked which occurs in and is restricted to lower Stratum IV. This is followed by Watson ware which occurs in upper Stratum IV and dominates in frequency most of the remaining ceramic bearing units. Mahoning ware occurs sporadically above Stratum IV while Monongahela ware is restricted to the latest ceramic bearing strata.

Vessel surface treatment of the Meadowcroft ceramic assemblage is limited. The vast majority of the sherds (98%) arc either plain (54.7%) or cord- marked (44.1%). Net and fabric impressed sherds constitute the remainder of the sample.

In 21 cases direction of final twist is identifiable in the cordmarked pottery. Eight sherds exhibit S twist while 13 are Z. Interestingly, S twist is confined to the lower ceramic strata (IV, V, VIII) while Z is found in the upper units (IX, X, XI). Ninety six and six tenths percent of the cordage represented in the cordmarked sherds is of the 2 ply variety.

No painted or polished sherds were recovered though a single sherd from Stratum X appears to have either a heavy concentration of hematite on its interior surface or a red slip. Conversely, carbon concentrations on the interior of sherds are common and presumably reflect use.

Sherd thickness ranges from 4-12 torn with, as might be expected, the thicker sherds generally restricted to the lower ceramic units. Sherd colors which range from grays to tans, buffs and oranges are scattered randomly throughout the ceramic bearing strata.

Only 2 rims were recovered from the site including a poorly executed, everted, squarish form on a limestone sherd with a cordmarked exterior and plain interior and a rounded lip form on a grit tempered sherd with cordmarked exterior and plain interior.

Though most of the Meadowcroft ceramics were probably manufactured elsewhere, some evidence for ceramic manufacture on the site is indicated by the presence of poorly fired or unfired sherds.

Bone Artifacts

Bone tools of a number of types and configurations were recovered from Meadowcroft Rockshelter. These include bone awls in a variety of forms, delicately carved snare triggers, grooved antler frag ments, antler flakers, bone beads, and a number of items tentatively associated with basketry manufacture (Fig. 10).

Awls, with 1 exception, are confined to Stratum VII or above. The exception is ascribable to StratumIIb. The snare triggers are restricted to Strata X and XI while the antler flakers occur sporadically from Stratum III through VII. Grooved antler fragments are confined to Stratum III while bone beads arc presently restricted to Stratum V.

The bone tools tentatively associated with basketry manufacture include a chiseloid form presumably used as a plane found in direct association with a basketry fragment in Stratum IIb and several bone shuttles from units IIb and III.

Given the abundance of bone including thin splinters recovered from most strata at Meadowcroft, it is not unlikely that bone tools were manufactured on the site though direct evidence in the form of work areas is lacking.

Wood Artifacts

The 1973-1974 excavations at Meadowcroft produced a small number of wooden artifacts, the analysis of which is incomplete. The predominant forms are "peg"-like items sharpened on 1 end and truncated on the other.

Basketry

Four carbonized basketry fragments were recovered from Stratum [lb at Meadowcroft with a fifth possible fragment in IIa. All have been analyzed and classified according to terminology and procedures outlined in Adovasio (1974, 1975). All specimens represent simple plaiting with a 1-1 interval and appear to be portions of rectangular or circular containers of some size. One of the specimens (Fig. 11) has an end selvage of the everted

180° variety folded over a rod which circumscribes the exterior of the rim. After folding the plaiting elements may have been sewn to the body of the vessel with cordage.

All specimens appear to be made of strips of birch-like bark of more or less equal size which could have been prepared via soaking and then planing of the interior surface with a bone or stone tool (see Bone Artifacts). Presumably the packing of the plaiting elements was facilitated by bone or wood shuttles.

Of particular note is the fact that 1 of the basket fragments appears to be a more or less complete vessel which collapsed on itself. Within the vessel are several pieces of limestone which may offer mute testimony to the aboriginal practice of boiling via hot stones.

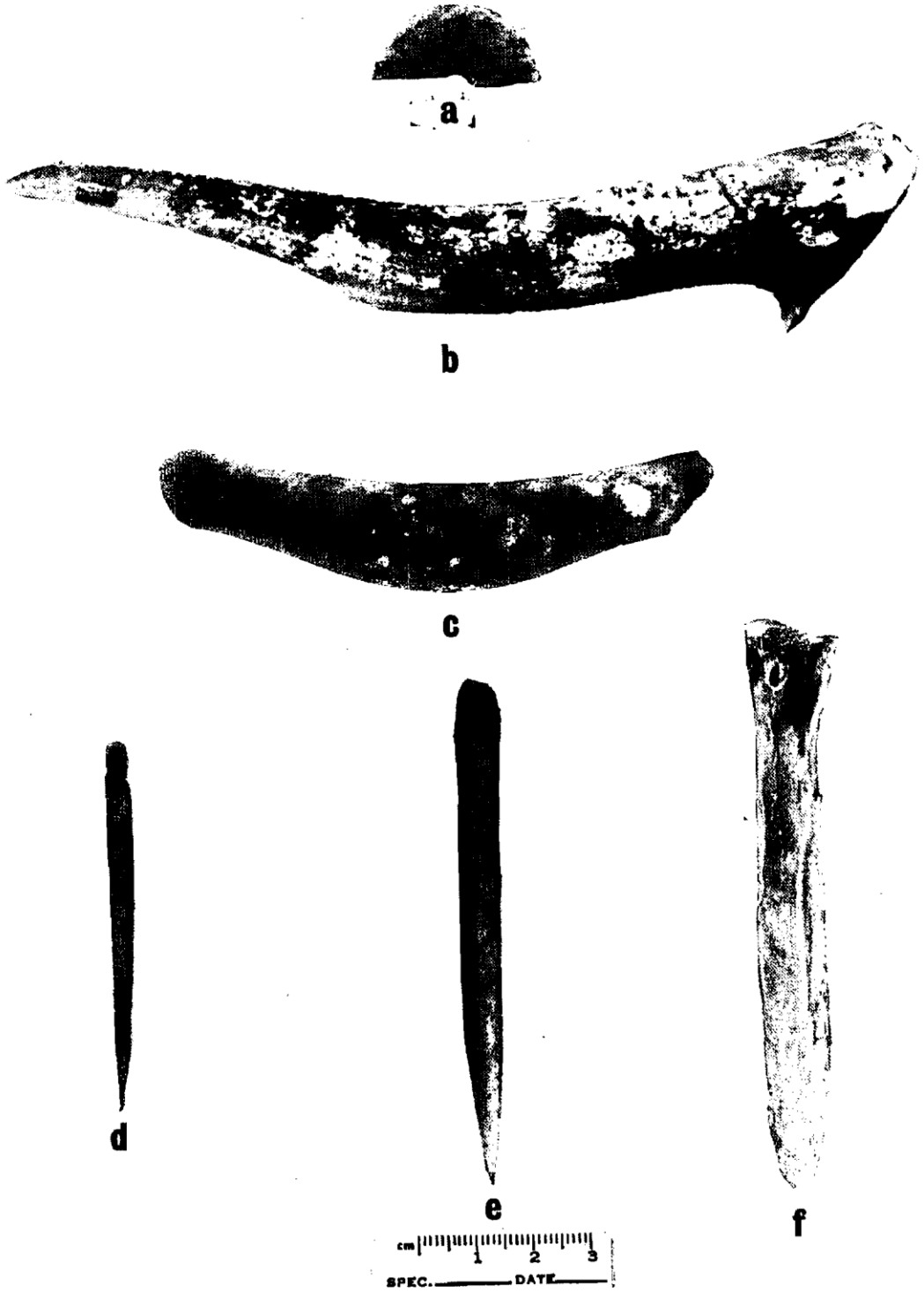

Fig. 10. Representative bone artifacts from Meadowcroft Rockshelter: a, bone bead or disc-Stratum VII; b, antler flaker-Stratum III; c, bone shuttle-Stratum IIb; d, snare trigger-Stratum X; e, bone awl-Stratum IIb; f, bone chiseloid-Stratum IIb. Note: Specimens c-d shown natural size; specimen a X2; specimen b X½.

Fig. 11. Simple plaited basketry fragment *in situ* in Stratum IIb. Note 180° rim which is clearly visible on specimen.

Shell Artifacts

Despite the relative abundance of molluscan remains from the site, only 2 shell artifacts were recovered. These include a possible notched dentate pottery stamp and a drilled pendant, both from Stratum V. The presence of a pottery stamp at Meadowcroft is somewhat enigmatic as only 1 incised sherd was recovered from the entire site.

Human, Faunal and Floral Remains

Human Remains

Human remains from Meadowcroft Rock- shelter are rare and include only 1 possible human burial and 30+ isolated occurrences of individual bones or teeth. All of the aforementioned materials are confined to Stratum IIb or above.

The single putative human "interment" is ascribable to Stratum VII and consists of a badly fragmented skull represented by the upper right quadrant of the face (palate, zygomatic. frontal, etc.) in association with miscellaneous badly disintegrated and largely unidentifiable bones. All fragments were recovered from a trash or refuse pit in a context suggestive of cannibalism.

Analysis of this "interment" and all of the rest of the human remains is currently in progress and should yield pertinent data not only on the circumstances surrounding "Burial I" but also on the 20+ well worn teeth found in the various strata at the site.

Faunal Remains

The single most numerous class of material recovered at Meadowcroft Rockshelter are faunal remains which include not only vast quantifies of burned and unburned animal bone but also such diverse items as terrestrial

and aquatic mollusc shells. feathers, claws. insect carapaces, egg shell, fish scales. etc. Though the bulk of this material is incompletely analyzed, a few observations can be made.

Some 64,250 individual bone or bone fragments were recovered during the 1973 field season with the additional 50,000+ added in 1974. Analysis of the 1973 sample and cursory inspection of the 1974 sample indicate that roughly 80% of the bones are highly fragmented or in various stages of incineration precluding any specific identification. The remaining 30% are potentially identifiable and presently include some 20,608 specimens. Of these, 15-25% are food bones while the remainder represent rodents and other generally small, resident or transient local fauna. Thirty percent of the total identifiable food bone is burned or charred while 40% of all bones arc wholly or partially incinerated. Some 50% of the unidentifiable bones (ca. 20,000 fragments) are segments of large mammals and presumably represent food bone.

Specimens identified to date (excluding molluscs and insects) are listed in Table 4 and are discussed below by class.

Mammals

Mammal bones constitute over 98% of the bone sample and are found throughout the Meadowcroft deposits with the exception of Stratum 1. In all cases the species represented are living resident or formerly resident western Pennsylvania forms. No extinct mammals have as yet been recovered. Principal food

Table 4

A Partial Listing of Fauna from Meadowcroft Rockshelter

Class	Genus	Species	Common Name
Mammals	Odocoileus	virginianus	white tailed deer
	Cervus	canadensis	wapiti, American elk
	Canis	familiaris	domestic dog
	Silvilagus	floridanus	eastern cottontail rabbit
	Marmota	monax	woodchuck
	Sciurus	carolinensis	gray squirrel
	Sciurus	niger	fox squirrel
	Peromyscus	unknown	mouse
	Microtus	pennsylvanicus	meadow mouse
	Urocyon	cinereoargenteus	gray fox
	Vulpes	fulva	red fox
	Procyon	lotor	raccoon
	Sorex	unknown	shrew
	Unknown	unknown	bat
	Unknown	unknown	bat
Birds	Meleagris	gallopavo	turkey
	Branta	canadensis	Canada goose
	Unknown	unknown	non-aquatic fowl
	Unknown	unknown	non-aquatic fowl
Reptiles	Terrapene	carolina	box turtle
	Chelydra	serpentina	snapping turtle
	Sternothorus	odoratus	musk turtle
Amphibians	Necturus	maculosus	mud puppy
Fish	Unknown	unknown	perch?
	Unknown	unknown	trout?
Others	Cambarus	obscurus	cray fish

species exploited throughout the sequence are white tailed deer (*Odocoileus virginianus*) and wapiti (*Cereus Canadensis).* The greatest concentrations of all bone (burned and unburned, identifiable and unidentifiable, food and non-food) are in Strata IIb through V. The only species tentatively identified thus far from Stratum Ha is wapiti or some other very large cervid. The only domestic animal represented is the dog (*Canis familiaris*)

which is confined to the upper strata. One fully articulated dog appears to have been intentionally interred in Stratum Xl.

Birds

Two species of birds have been identified to date—turkey (*Meleagris gallopavo*) and Canada goose (*Branta canadensis*). In addition, 2 other forms of non-aquatic fowl are indicated but presently cannot be identified as to genus or specie.. Bird bones are relatively rare and are confined to the upper strata of the site though bird egg shells have been recovered in some numbers throughout the deposits above Stratum IIa. It appears that with the possible exception of eggs, birds added little to the dietary intake of the various Meadowcroft populations.

Reptiles

Three species of turtle arc represented at Meadowcroft including the common box turtle (*Terrapene carolina carolina*), the snapping turtle (*Chelydra serpentina*), and much more rarely the musk turtle (*Sternotherus odoratus*). Turtle shell fragments, both burned and unburned, occur in all units above IIa and arc concentrated in Strata IV and V. Turtles appear to have represented a minor but nonetheless important food source during at least a portion of the Meadowcroft sequence.

Amphibians

A single species of amphibian, the common mod- puppy, *Necturus inaculosus*, has been identified to date. As only 1 or 2 individuals are represented in the upper units, little can be said about their potential as a food source.

Molluscs, Cray Fish and Other Forms

Eighteen species of terrestrial and 2 species of aquatic snails were recovered from Strata IIb and above. In addition 11 species of freshwater naiads (mussels) and 1 species of cray fish. *Cambarus obscutus*, are also present. Space precludes a discussion of the terrestrial and aquatic snails. Suffice to note that none of them appear to have been exploited as food sources. Conversely, freshwater mussels and Cray fish clearly represent dietary components and are found in some abundance in strata above IIb. The heaviest concentration of naiads is in Strata IV and V while the cray fish are most abundant in Strata V.

Insect remains from Meadowcroft are not numerous and include principally the carapaces of various genera of burrowing beetles. There is no evidence of the intentional consumption of these or any other insect forms at the site.

Fish

Fish remains including scales and bones are confined to Stratum IV and above and include several unidentified but markedly perch and trout-like species. Despite the proximity of Cross Creek, fish do not appear to have been extensively exploited at any time in the Meadowcroft sequence with the possible exception of Stratum V.

Floral Remains

Floral remains constitute the second most abundant class of material recovered from Mcadowcroft Rockshelter. These include everything from moderately large sections of tree trunks and limbs, with and without bark, to minute seeds and seed coats and hopefully (see below) pollen. As is the case with the faunal material, analysis of most of the vegetal remains from Meadowcroft is presently incomplete. In fact the analysis of the unworked wood, stems, leaves, epidermis, and bark fragments has barely begun. Analysis of nuts and seeds is, however, well underway, and it is upon this analysis that the following comments are based.

Preliminary scrutiny of the 1973 floral material from both the 1/4-inch screens and the ca. 1600 pints of flotation samples, indicates some vegetal remains have been recovered from all occupational levels including Stratum IIa. Naturally, preservation and recovery of floral remains has been much greater in units inside the drip line.

A partial listing of plant species identified to date is presented in Table 5. It is expected that this list will be trebled or quadrupled before the floral analysis is completed.

By far the most common plant remains recovered at Meadowcroft (both in the screens and flotation samples) are charred and un- charred seeds of the hackberry (*Celtis occidentalis*) or dwarf hackberry (*Celtis tennulfolia*). While found in the area today neither plant grows within 5 ken of Meadowcroft.

Table 5

A Partial Listing of Flora from Meadowcroft Rockshelter

Genus	Species	Common Name
Celtis	tennuifolia or occidentalis	hackberry, dwarf hackberry
Chenopodium	unknown	chenopods, various local names —goosefoot, etc.
Vaccinium	unknown	blueberry, deerberry
Rubus	unknown	raspberry
Coreopsis	tripteris	tickweed
Monarda	punctata	bee balm
Mentho	arvensis	wildmint
Darcus	carrota	wild carrot
Claytonia	caroliniana	Carolina spring beauty
Verbena	urticaefolia	white vervain
Cichorium	intybus	chicory
Juglans	nigra	black walnut
Juglans	cinera	butternut
Tsuga	canadensis	eastern hemlock
Acer	unknown	maple
Pinus	strobus	eastern white pine
Thuja	occidentalis	northern white cedar
Prunus	cerasus	sour cherry
Rhus	typhina	staghorn sumac
Rhus	copallina	shining sumac
Quercus	palustris	pin oak
Quercus	alba	white oak
Fagus	grandifolia	American beech
Aesculus	unknown	buckeye
Carya	glabra	pignut
Carya	tomentosa	mockernut
Carya	ovata	shagbark
Carya	laciniosa	shellbark
Carya	cordiformis	bitternut
Zea	mays	corn
Phaseolus(?)	vulgaris(?)	beans(?)

Hackberry seeds have been recovered by the thousands from all levels above Stratum Ha though they sharply diminish in frequency above Stratum VII.

Charred and uncharged nut shells, notably walnut (*Juglans sp.*) and hickory (*Carya*) are also common throughout the deposits as are seeds of *Chenopodium* (sp.), *Vaccinium* (sp.). and *Rubus* (sp.). Interestingly, some nut shells as well as charred chenopod seeds have been recovered from Stratum Ha though not on the lowest occupational floor.

Domestic plants recovered at Meadowcroft include corn (*Zea mays*) from the latest levels and possibly beans (*Phaseolus vulgaris*) from Strata IV and V. Final identification of the alleged beans is pending, and this ascription must be considered tentative.

The limited data currently at hand suggests that the principal plant materials exploited for consumption at Meadowcroft were hackberry, chenopods, and to a somewhat lesser extent nuts and other berries. While it is recognized that hackberries are consumed by various animals, notably birds, it is highly unlikely that the vast accumulation of these seeds at Meadowcroft (notably in firepits and other features) is due to some prehistoric avian gustatory orgy, let alone a series of such feathered feasts. Ethnographic and prehistoric data from both eastern and western North America (see Fry 1970a,b, 1973) substantiate the intensive use of the fruits of this plant by aboriginals for food. In light of the above it is highly likely that these berries were being regularly consumed by man at the Meadow- croft Rockshelter.

While it is certain that quantification of the vast floral assemblage from Meadowcroft will yield abundant data on climatic fluctuation/ oscillation at the site, the analysis is presently too incomplete to venture even tentative observations on this subject, similarly, the analysis of the pollen columns is likewise incomplete. Though the deposits outside the drip line appear to be totally unfavorable for pollen preservation, it is hoped that the deposits from inside the drip line will yield some palynological data.

Internal Correlations

Chronology

The data presented on the preceding pages indicates that Meadowcroft Rockshelter was more or less continuously utilized as a locus for hunting, collecting, and food processing from at least the late 14th millennium B.C. to the Historic Period. As such it represents not only the oldest well dated site in eastern North America but also one of the longest stratified occupational sequences in the northern hemisphere of the New World.

Occupation or utilization of Meadowcroft was initiated ca. 13,000 B.C. by a population or populations who possessed a relatively sophisticated lithic technology which included the production of prismatic blades, unifacial scrapers, bifaces and delicately flaked "knives." Despite the lack of so called "diagnostic" fluted or unfluted projectile points, this initial occupation may clearly be ascribed to the Paleo-Indian Period or Stage by virtue of the radiocarbon dates alone. Presently, this occupation is confined to lower Stratum IIa.

While the upper arbitrary levels of Ha contain lithic debitage, ash, charcoal, and incinerated bone in abundance, no diagnostic artifacts of any sort have as yet been recovered. Nonetheless, it is suggested that the shelter was occupied by later Paleo-Indian populations during the time these levels were deposited. These as yet undefined populations may have included manufacturers of fluted points. To date the reconnaissance of the Cross Creek drainage initiated in 1974 has located 6 complete Clovis points attesting to man's presence in the area during the 9th and 10th millennia B.C. This being the case it is highly doubtful that these populations would not have utilized Meadowcroft Rockshelter during the course of their seasonal subsistence activities in the area. Additionally, it may be noted that many of the Clovis points located during the survey are made of materials lithologically identical to those recovered from upper as well as lower Stratum Ha. While scarcely conclusive this does suggest the possibility that local fluted point making populations may have visited the shelter.

The as yet incompletely dated roof spall episode which separates Stratum IIa from IIb seems to mark both the end of the PaleoIndian utilization of the shelter as well as the initiation of the Archaic occupation of the site. The amount of time which may have elapsed between the "end" of the Paleo-Indian occupation and the first Archaic utilization of the shelter is presently unknown though it is suggested by cultural data that any hiatus, if same exists, is probably of relatively short duration.

The "beginning" of the Archaic occupation at Meadowcroft is presently marked by the single Neville or Stanly-like point recovered in lower Stratum IIb. Neville points have been dated to ca. 5000+ B.C. in Massachusetts (Dincauze 1974) while Stanlys are ascribable to the same general time period (Coe 1964, Perino 1968). The verysimilar Kanawha stemmed type is likewise of comparable age (Broyles 1971).

The continuing utilization, based on point types and stratigraphy, of Meadowcroft throughout the duration of the Archaic Period is indicated by the Brewerton side-notched, Lamoka, and Normanskill-like points recovered from upper Stratum IIb and lower Stratum III. The radiocarbon assays for these units compare favorably with others associated with these point types from elsewhere in northeastern North America (see Adovasio et al. 1974. Dragoo 1959, Kinsey 1972, Ritchie 1961, 1965a, 1965b, 1969).

Despite the total absence of steatite vessels, upper Stratum Hl and lower Stratum IV may be assigned to the so called Transitional Period or Broadspear Tradition. Point types recovered from these units include Snook Kill and Orient-like forms which are associated with this time horizon elsewhere in eastern North America (Adovasio et al. 1974, Kinsey 1972, Ritchie 1961, 1965a, 1969). Interestingly, there appears to be no break between the late Archaic and Transitional occupations at Meadowcroft.

The onset of Woodland occupation at Meadowcroft is marked by the appearance of Adena ovate based points in mid-Stratum IV as well as Half-Moon cordmarked ceramics. Elsewhere in the east Adena ovate based points and allied forms are directly ascribable to the period 800 B.C. to A.D. 1 or thereabouts (Dragoo 1963) and the Meadowcroft dates are consistent with this ascription. Again there appears to be no discontinuity involved between the Transitional and Woodland utilization of the site.

Diagnostic Early Woodland materials persist into lower Stratum V while upper Stratum V through Stratum XI bracket the Middle to Late Woodland occupation of the site. Chronological diagnostics from these levels include Chesser notched points which are variously called Middle (William Johnson, per. comm.) or Late (Prufer 1967) Woodland as well as Watson ware. Later Woodland use of the shelter is further indicated by the presence of Monongahela ware and triangular points which are restricted to Stratum VII and above.

The arrival of Europeans at the site is indicated in Stratum XI by various classes of historic artifacts intermingled with the aforementioned Late Woodland materials.

Spatial and Temporal Intensity of Site Utilization

As indicated in the Depositional Episodes section, the horizonal or spatial distribution of occupational materials and hence the loci of human utilization of Meadowcroft Rockshelter have been determined by various roof fall and roof spall events. Though direct proof is lacking it is reasonable to assume that most of the western, central. and eastern portions of the shelter were utilized from ca. 13,000 B.C. until the mid-Stratum II roof spalling. At this juncture occupation appears to have shifted to the central and eastern portions of the site well away from the "epi-center" of the collapse.

After these spalls were covered by subsequent deposition, utilization of the west- central and western portions of the site may have resumed though the main locus of habitation continued to be in the east-central and eastern portions of the shelter.

This situation persisted until the cataclysmic collapse of the New Roof Fall, ca. A.D. 1+, which at once terminated all use of the eastern portion of the site. All subsequent occupations were confined to the western and west-central sections of the shelter.

A relatively accurate gauge of the temporal intensity of site utilization is reflected in the differential stratigraphic distribution and frequency of cultural features, artifacts (notably lithic debitage), food bone, floral remains, "free" charcoal in the general fill of units, and ash concentrations. Though incompletely quantified at present, all of these lines of evidence indicate that the heaviest or most intense use of the shelter occurred during Transitional through Early Woodland times encompassing upper Strata III through V. The intensity of occupation "trails off" on either "side" of this time horizon.

Seasonality, Subsistence and General Character of Site Utilization

All of the data recovered to date from Meadowcroft suggests that throughout its history the site served primarily as a locus or station for hunting, collecting, and food processing activities. The predominance of projectile points, knives, and scrapers in the lithic assemblage, the abundance of food bone, and the remains of edible plants as well as the general absence of evidence of extensive in situ manufacture of lithic, ceramic, or shell artifacts strongly supports this conclusion.

Doubtless, most, if not all, of the post- Stratum lIa populations were drawn to the site by the same factors which make it attractive at present. These include readily availabe water, protection from the elements, and abundant edible flora and fauna.

The "stimuli" which would have attracted the very early Stratum IIIa populations were possibly even more basic given the location of the Wisconsin ice front only a scant 40 km to the north. Specifically, Meadowcroft at that time may have been utilized simply and solely because it afforded the only natural protection from the rigors of the Late Pleistocene weather in the Cross Creek drainage.

The primary subsistence modes of the various post-Stratum Ha Meadowcroft populations as reflected in the deposits include the hunting of wapiti and deer presumably augmented by the taking of smaller game and perhaps bird egg collecting; the intensive collection of hackberries, nuts, chenopods, and other fruits and seeds; and the exploitation of riverine fauna notably mussels and turtles and to a lesser extent fish and tray fish.

The hunting mode seems to have remained more or less constant throughout the post Ha sequence while the other modes exhibit a number of potentially significant changes. Hackberry collecting sharply diminishes in frequency after Stratum VH while the collection of other nuts and seeds remains more or less constant, similarly, exploitation of riverinc resources which is relatively insignificant before Stratum IV becomes markedly important at that time and remains so until Stratum VI when it virtually ceases. Doubtless these changes reflect both climatically induced differential availability as well as specific food preferences: however, a full assessment of their significance must await completion of the Meadowcroft analyses. It should be stressed that the addition of cultigens at the end of the Meadowcroft sequence appears to have contributed little to the dietary intake of groups living on the site, nor did it affect the character of site utilization.

An examination of the various constituents of the dietary modes of the post Ha Meadow- croft populations suggests that the principal utilization of the shelter occurred during the fall. While the hunting and to a lesser extent riverine exploitation modes arc seasonally independent, the nuts, berries, and seeds which constitute the "staples" of the collecting mode would have been most abundant in the fall thus dictating the time of occupation. Herein it might be noted that should egg collecting prove to be an important element in the subsistence patterns of the Meadowcroft populations, some spring utilization of the site would perforce be indicated.

Data on the subsistence and seasonality of the early Stratum IIa Paleo-Indian populations at Meadowcroft is presently too incomplete to warrant any generalizations. Nonetheless, it would appear that in addition to hunting large cervids, some exploitation of locally available plant materials is also indicated. Despite the tongue-in-cheek observation offered above regarding the Pleistocene "attractions" of the site, it may well prove that the seasonal availability of plant foods dictated the pattern of Paleo-Indian occupation at Meadowcroft.

External Correlations

The archaeological assemblage from Meadowcroft Rockshelter exhibits a number of basic affinities to complexes elsewhere in the eastern United States, specifically, and North America, generally. These affinities vary in time and are predicated on stylistic and morphological resemblances of one or another of the Meadowcroft artifact classes or its constituents to similar materials from elsewhere. Though detailed comparisons of the Meadowcroft artifacts are both warranted and recognizably profitable, such comparisons will not be attempted until the Meadowcroft excavations and attendant analyses are complete.

Though the Stratum Ha assemblage is not readily comparable to anything in eastern North America, its general resemblance to the basal assemblages from Fort Rock Cave, Oregon (Bedwell 1973), and Wilson Butte Cave, Idaho (Gruhn 1961), are unmistakable. Moreover, though fluted points arc absent certain items in the Stratum Ha assemblage notably the Mungai "knife" and the prismatic blades are duplicated at Blackwater Draw (Hester 1972), Lindenmier (Wilmsen 1974), and other fluted points localities. In light of the above it may be proved that industries like those represented in Stratum Ha at Meadow- croft provided the genesis for, or represent the sub-stratum of, the widely dispersed fluted point industries of North America.

The basic affinities of the Early/Middle Archaic materials at Meadowcroft would appear to be to the south in the direction of the Carolina Piedmont (assuming the NevilleStanly-Kanawha form arises there) while the later Archaic material are clearly part of the widespread Laurentian Tradition.

Lastly, the Transitional and Woodland components at the site are essentially local manifestations of complexes with broad eastern affinities.

It is assumed that further work at Meadow- croft will yield much more data not only on the "relationships" posited above but also on the broader implications of the site for North American prehistory.

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