10.1.3 Microscopic Use-wear and Residue Analysis of Stone Tools from 7K-F-11 (Gray Farm Site), Kent County Delaware by Bruce L. Hardy

Microscopic Use-wear and Residue Analysis of Stone Tools from 7K-F-11 (Gray Farm Site), Kent County Delaware

Bruce L. Hardy
Department of Anthropology
Kenyon College

Introduction

Microscopic use-wear and residue analyses were performed on a sample of 33 stone artifacts from the Gray Farm Site (7K-F-11), Kent County, Delaware. Typologically, the sample included projectile points (n=9), scrapers (n=3), microtools (n=14), drills (n=3), and shaft abraders (n=4). All artifacts were minimally handled and unlabeled prior to analysis.

Methods

The methods used here are a combination of microscopic residue and use-wear analysis that follow the protocol of Hardy et al.:

> All artifacts were examined with an Olympus BH microscope under bright-field incident light at magnifications ranging from 100 to 500 diameters. All wear patterns and residues were photographed using a Nikon Coolpix 995 digital camera, and their location on the surface was recorded on a line drawing of the artifact. Identifications of residues were made by comparison with published materials and a comparative collection of experimental stone-tool replicas (Brunner and Coman, 1974; Catling and Grayson, 1982; Beyries, 1988; Anderson-Gerfaud, 1990; Hoadley, 1990; Fullagar, 1991; Teerink, 1991; Hather, 1993; Hardy, 1994; Brom, 1986; Kardulias and Yerkes, 1996; Williamson, 1996; Hardy and Garufi, 1998; Pearsall, 2000; Haslam, 2004; Dove et al., 2005; Fullagar et al., 2006). Residue recognition was the primary goal of the analysis; therefore, no special procedures were conducted to clean the tools for the sake of rendering use-wear patterns more visible. While this procedure may limit the use-wear information obtained, it serves to maximize the residues observed (Hardy and Garufi, 1998; Hardy et al., 2001; Hardy, 2004). Potentially identifiable residues include plant (plant tissue, plant fibers, starchy residue, epidermal cell tissue, wood, raphides, phytoliths, resin) and animal tissues (muscle tissue, collagen, fat, bone/antler, blood, hair, and feathers) (Hardy et al., 2001; Lombard, 2004; Wadley et al., 2004). Distribution of residues and use-wear on the artifact surface were used to help demonstrate use-relatedness and to identify use-action (Hardy and Garufi, 1998; Hardy et al., 2001; Lombard, 2004).
>
> Use-wear patterns recorded included edge damage (microflake scars, edge rounding), striations, and polishes. These were used to help identify use-action (Odell and Odell-Vereecken, 1980; Mansur-Franchomme, 1986). Due to the potential overlap of polishes produced by different materials, use-wear polishes were categorized as either ‘‘soft’’ or ‘‘hard/high silica’’ (e.g., Newcomer et al., 1986, 1988; Moss, 1987; Bamforth, 1988; Hurcombe, 1988; Bamforth et al., 1990; Grace, 1990; Fullagar, 1991; Shea, 1992). Soft polish often results from processing animal tissue such as skin and meat. Hard/high-silica polish is produced when processing soft plants with high silica content, such as reeds and grasses, and wood, bone/antler, and tilling soil. The amount of time a tool was used, silica content of the processed material, and presence of water are all factors that can influence polish formation (Fullagar, 1991; Hardy, 2004). A combination of residue and use-wear analysis can provide complementary and corroborative information, potentially producing more accurate results than either technique

used alone (Hardy, 1998; Hardy and Kay, 1998; Hardy et al., 2001; Rots and Williamson, 2004). (Hardy et al., 2008:651-2)

One deviation from these methods is that all residues were photographed with a Dino-Lite DinoEyepiece Digital USB Camera and DinoCapture 2.0 software. One further modification involves the identification of starch grains. Since small starch grains 5 µm or less in size, can be confused with other small particles (Haslam, 2006; Loy, 2006), the identification of grains at this site through reflected light alone is viewed as probable or possible. Extraction and analysis with other techniques is advised.

Results

Projectile Points

For a visual summary of results, see Figures 1-6.

Seventy-eight percent (7/9) of the projectile points show evidence of hafting in the form of hard/high silica polish, abraded ridges and striae on the proximal portion of the tool only. This wear pattern is caused be movement of the tool within the haft (Hardy et al., 2001). All of these points show exhibit signs of hafting on both faces, suggesting that they were hafted with a male or socket arrangement (Stordeur, 1987). Six of the points were used as projectiles. The seventh has striae and hard/high silica polish on the tip and may have also been used as a drill.

The remaining two points show minimal evidence of hafting. One has an impact fracture on the tip and may have been used. The other has hard/high silica polish on the distal end and may have been used to cut a hard material.

One further level of detail is provided on artifact 867.3 (Figure 7). A fragment of wood fiber is preserved on the proximal portion on one side in the area of the haft. This wood fiber displays paired bordered pits. Paired bordered pits are relatively rare in wood anatomy and are most commonly found in sitka spruce (*Picea sitchensis*) and larch (*Larix laricina)* (Hoadley, 1990). Sitka spruce occurs only in western North America. Larch (also known as tamarack) distribution today in North America extends from Alaska to Labrador and south to northern New Jersey. It is also found locally in Virginia and western Maryland (Little 1980).

Scrapers

All three scrapers shows signs of use. Two were handheld while one was hafted. All three scrapers exhibit soft polish with two having hair fragments indicative of scraping hide (Figure 8). It is likely that the third was also used to scrape hide but no residues were found to confirm this.

Microtools

Two of the 14 microtools exhibited no functional evidence. The remainder chowed a range of uses including perforating hide, scraping and piercing soft material, scraping and piercing hard or high silica material, scraping starchy plant, and scraping resinous plant. Five microtools had no residues and their function is based solely on wear patterns. One microtool has hard/high silica polish associated with a resinous material. Further plant tissues are absent

on this tool. The final microtool has soft polish associated with starch grains and raphides (calcium oxalate crystals) (Figure 9). The starch grains are small (~ 5-6 microns) with a centric hylem and are not very numerous. No other diagnostic plant tissue is present.

Drills

All three drills appear to have been associated with animal processing. Two have hairs and soft polish suggesting they were used to perforate hides. Both appear to have been handheld. The final drill was hafted, probably with a juxtaposition arrangement (Stordeur 1987) as hafting traces are present on only one side of the tool. Near the tip are numerous possible blood residues. Blood residues vary greatly in morphology so this identification should be considered preliminary.

Shaft Abraders

All shaft abraders exhibited occasional striations in line with the movement of the tool (Figure 10). They also occasionally showed undiagnostic plant fragments.

Discussion

The evidence from the projectile points is unsurprising. However, the identification of a larch (tamarack) tracheid deserves discussion. The tracheid is located in the region of the haft and could derive from the arrow shaft itself. Larch is tough, waterproof wood that comes relatively knot-free and produces a good, durable arrow (Fadala, 1999). Today, the range of larch is near to but does not include Delaware. If the identification of larch is correct, it may represent trade from or travel to places further north or west.

The scrapers were likely all associated with hide scraping. Two showed soft polish and hair fragments indicative of hide processing while the third had the same wear pattern but no residues. While it is possible to identify hair to species by the shape and arrangement of scales on the cuticle (Teerink, 1991), it is usually not possible with an isolated hair fragment. Scale patterns vary on different parts of the body and as you move from root to tip on an individual hair. In this case, scale patterns were not preserved, but other diagnostic features of the hair (medulla) were visible. Analysis of the nearby and closely related site of Hickory Bluff also showed evidence of hide processing with scrapers (Petraglia et al., 2005). As with the scrapers, all three drills are associated with animal processing. Together, this evidence suggests that hideworking was a relatively common activity at the site.

The microtools showed a variety of different uses. Despite their small size, they show no evidence of hafting. Most of these are similar in morphology to microlithic drills (also called Jaketown perforators) from Poverty Point, Louisiana (Ford et al., 1955; Yerkes, 1983). In experiments scraping antler with the lateral edges, Ford and Webb (1956) produced tools of similar morphology. Several of the microtools from Gray Farm appear to have been used as scrapers in a similar fashion, albeit on different materials. However, others appear to have been used as perforators despite their relatively blunt nature.

The shaft abraders present evidence that is consistent with their assumed function. Striae parallel to the direction of movement and occasional fragments of plant tissue are consistent with

abrading arrow shafts. The evidence, however, is relatively scarce given the depth of the grooves in the sandstone. Due to the soft nature of the sandstone, other traces of use must be removed as the sandstone itself breaks away.

Based on this analysis, the overall pattern suggests a somewhat flexible and opportunistic tool use. Although the sample size is small, there is variation in use of some tool types. Microtools served a variety of different uses and even projectile points show multiple types of use.

Table 1: Functional Interpretations

Artifact #	Tool Type	Function
185.11	Projectile point	Hafted projectile point
230.12	Projectile point	Hafted projectile point
840.29	Projectile point	Hafted, striae and polish on tip, possible drill
867.3	Projectile point	Hafted projectile point
1580.30	Projectile point	Hafted projectile point
1584.49	Projectile point	Hafted projectile point
1845.1	Projectile point	Hafted projectile point
1868	Projectile point	Minimal hafting evidence, distal end used on hard material
1869	Projectile point	Impact fracture only, no hafting evidence
195.31	Scraper	Scraping hide
1352.6	Scraper	Scraping soft material
1423.6	Scraper	Scraping hide
899.38	Microtool	Perforating hide
980.7	Microtool	Unknown/unused
993.41	Microtool	Broken tip, used, unknown material
994.4	Microtool	Unknown/unused
995.34	Microtool	Scraping soft material
996.27	Microtool	Broken tip, used, unknown material
1354.6	Microtool	Scraping starchy plant
1401.13	Microtool	Scraping hard material
1430.25	Microtool	Piercing soft material
1508.39	Microtool	Piercing soft material
1509.36	Microtool	Piercing hard material
1676.28	Microtool	Perforating resinous plant
1713.12	Microtool	Scraping hard/high silica material
1725.20	Microtool	Unknown/unused
226.31	Drill	Perforating hide, possible juxtaposition haft
1583.41	Drill	Scraping hide
1844.2	Drill	Perforating hide
1071	Shaft abrader	Shaft abrader
1530	Shaft abrader	Shaft abrader
1580	Shaft abrader	Shaft abrader
3611	Shaft abrader	Shaft abrader

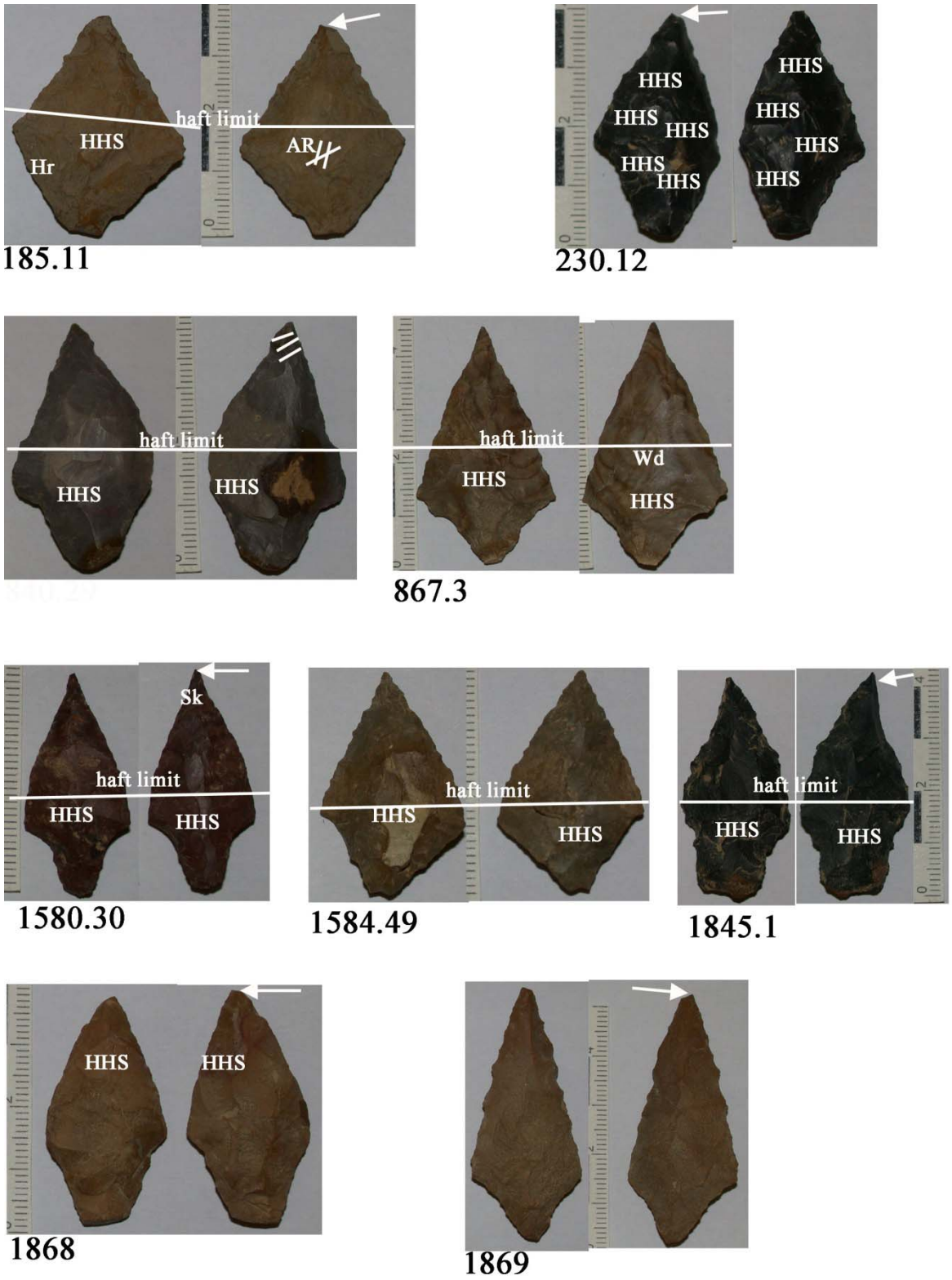


Figure 1: Projectile points. AR= abraded ridges; HHS= hard/high silica polish; short lines indicate striations; arrows indicate impact fractures

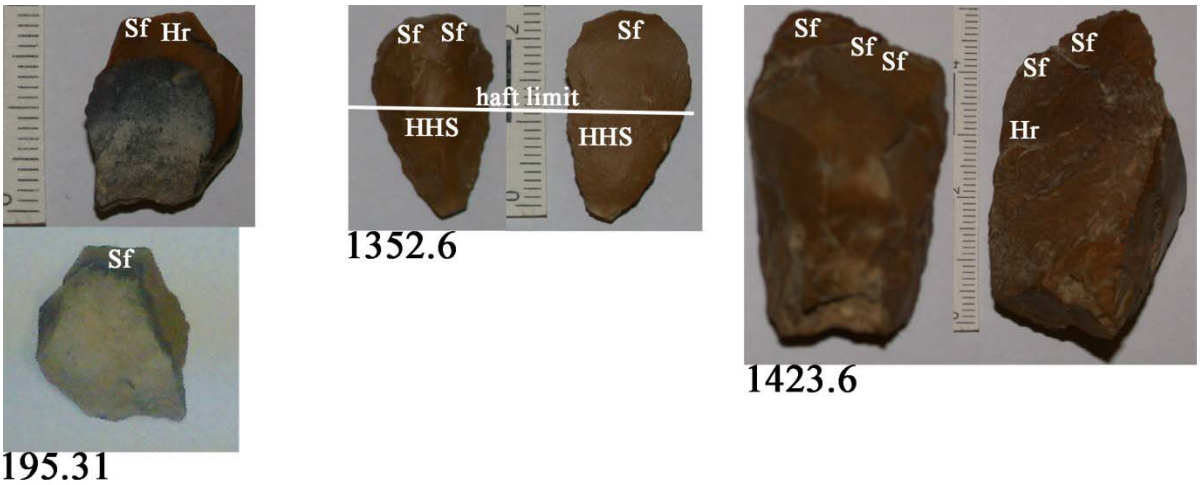


Figure 2: Scrapers. HHS= hard/high silica polish; Hr=hair; Sf= soft polish

Figure 3: Microtools. HHS= hard/high silica polish; Lt= light polish; Rp= raphides; Sf= soft polish; Sk=skin fragments; SG= starch grains; short lines indicate striations; arrows indicate damage to tip

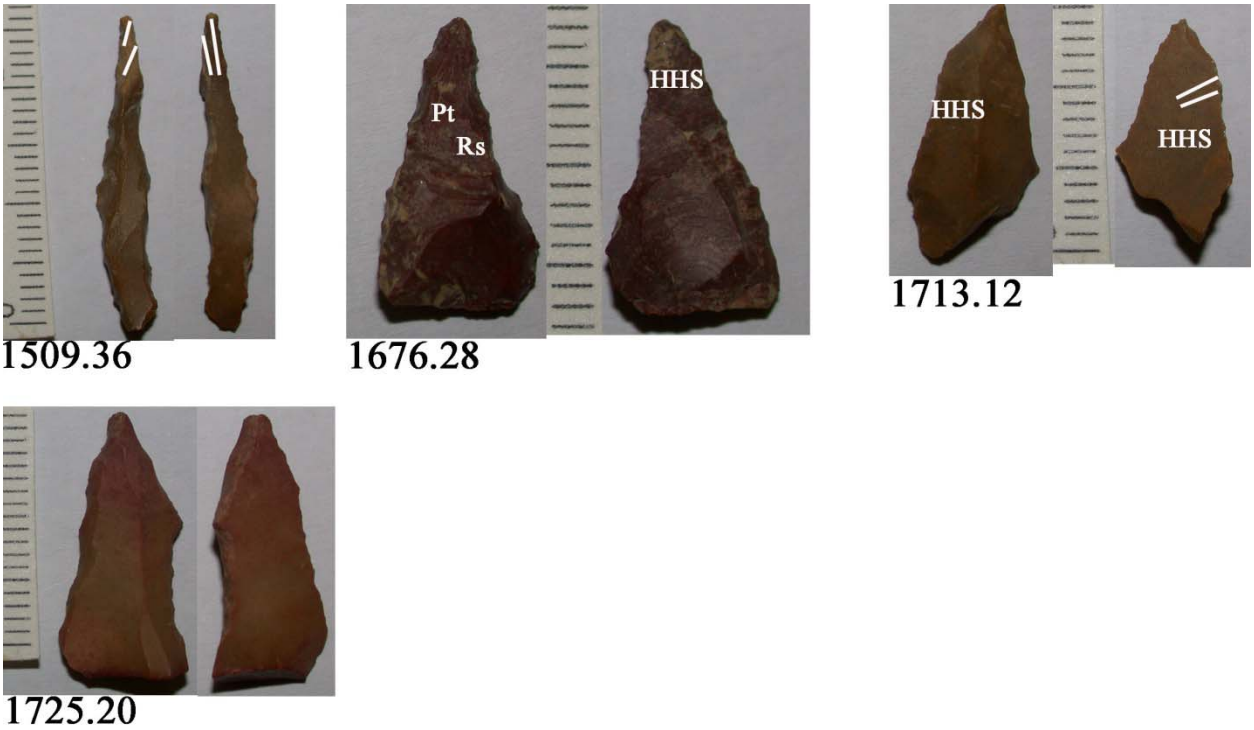


Figure 4: Microtools. HHS= hard/high silica polish; Pt= plant tissue; Rs= resin

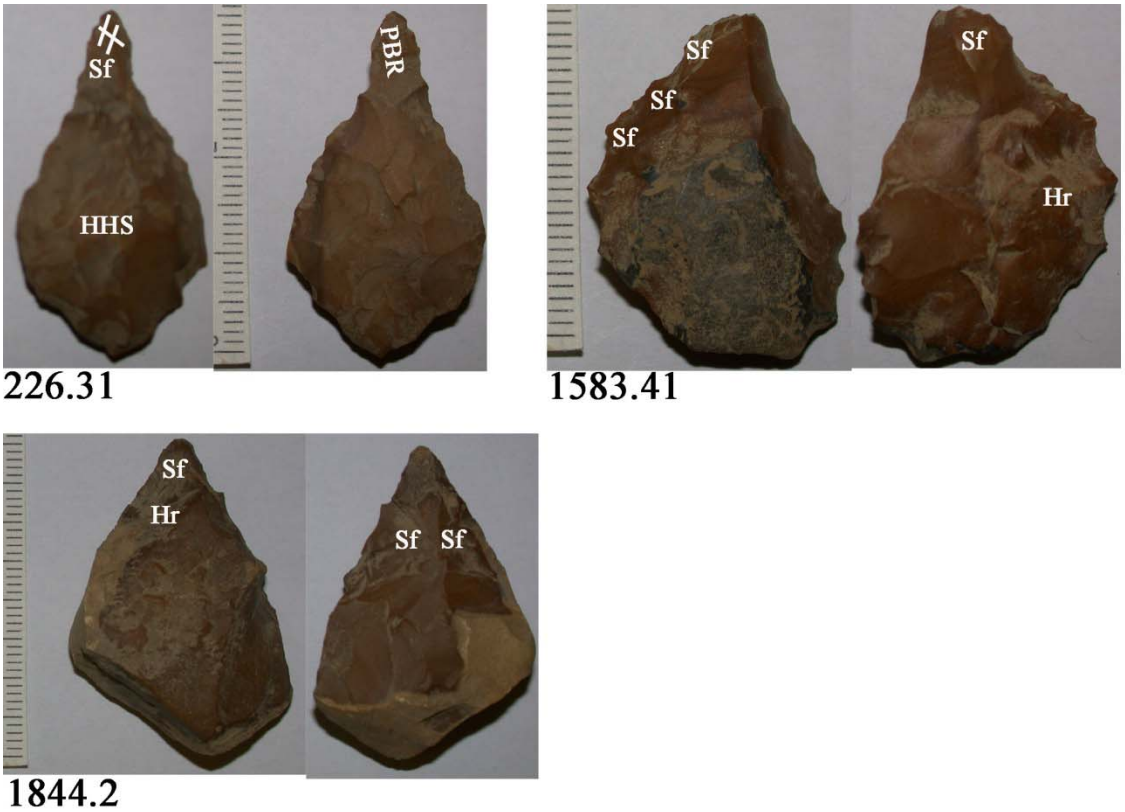
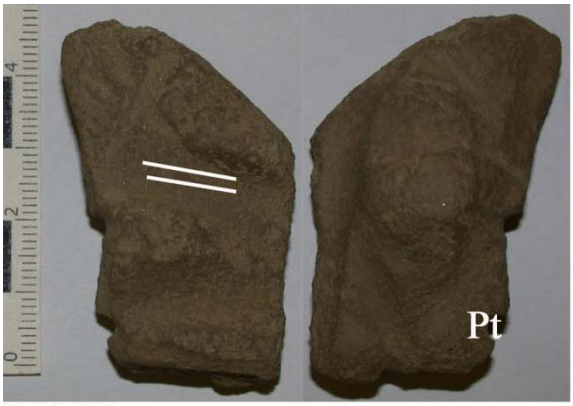


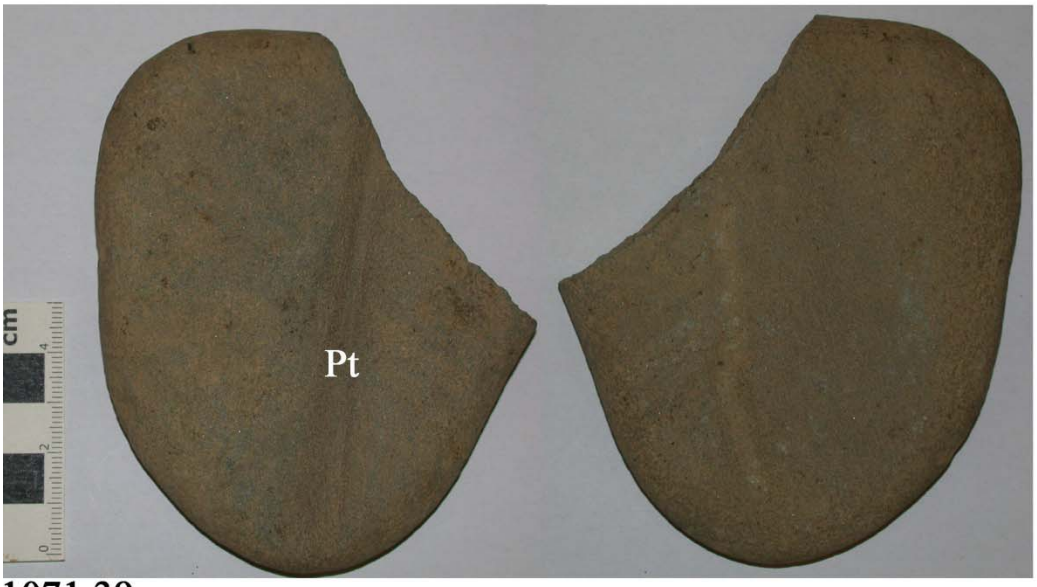
Figure 5: Drills. HHS= hard/high silica polish; Hr= hair; PBR= possible blood residue; Sf=soft polish; short lines indicate striations.



364.38

1580.30

1530.23



1071.39

Figure 6: Shaft abraders. Pf= plant fibers; Pt= plant tissues; lines indicate striations.

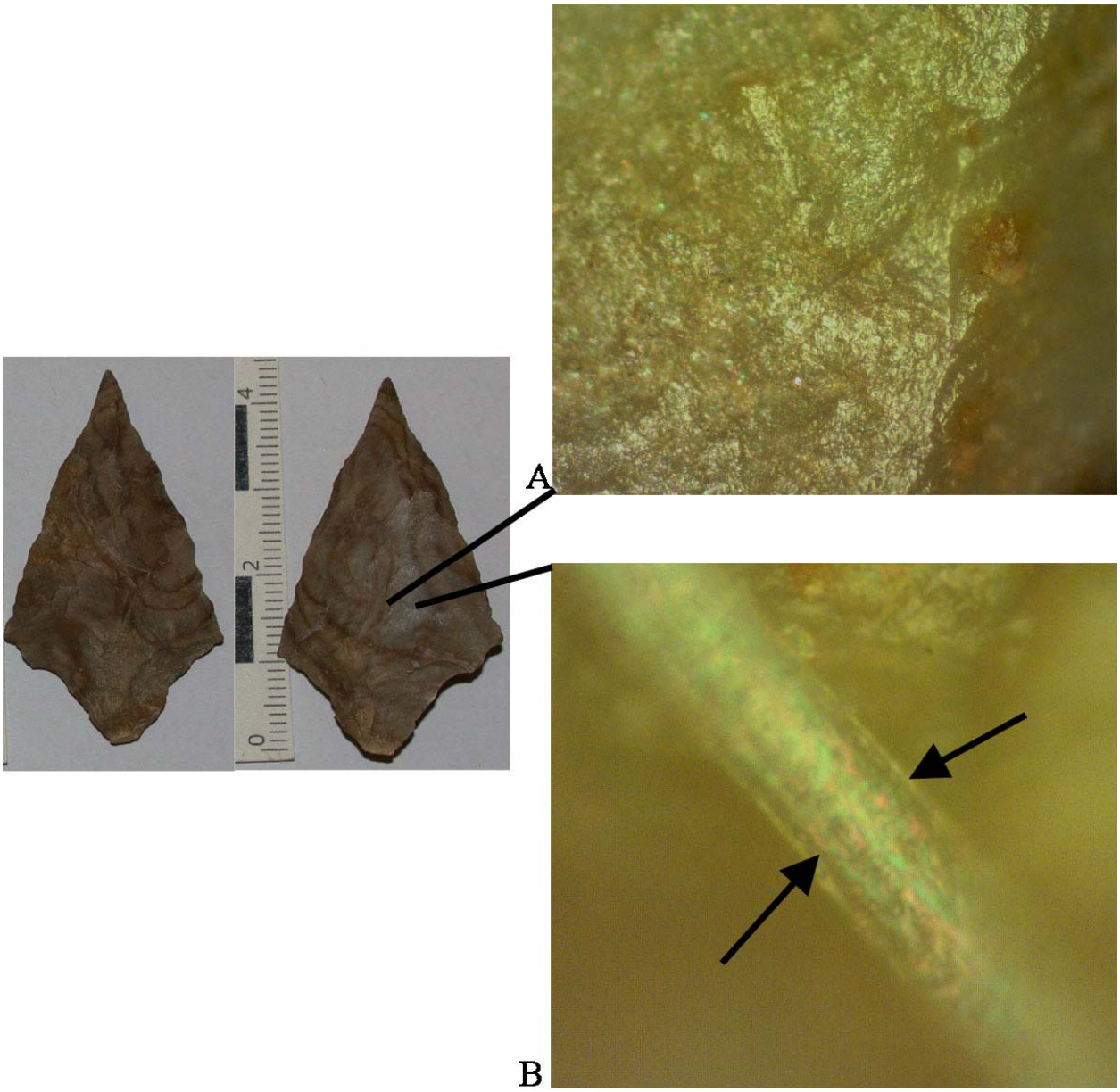


Figure 7: 867.3 A) Hard/high silica polish and abrasion on ridge; B) tracheid, arrows indicate one of the pairs of bordered pits

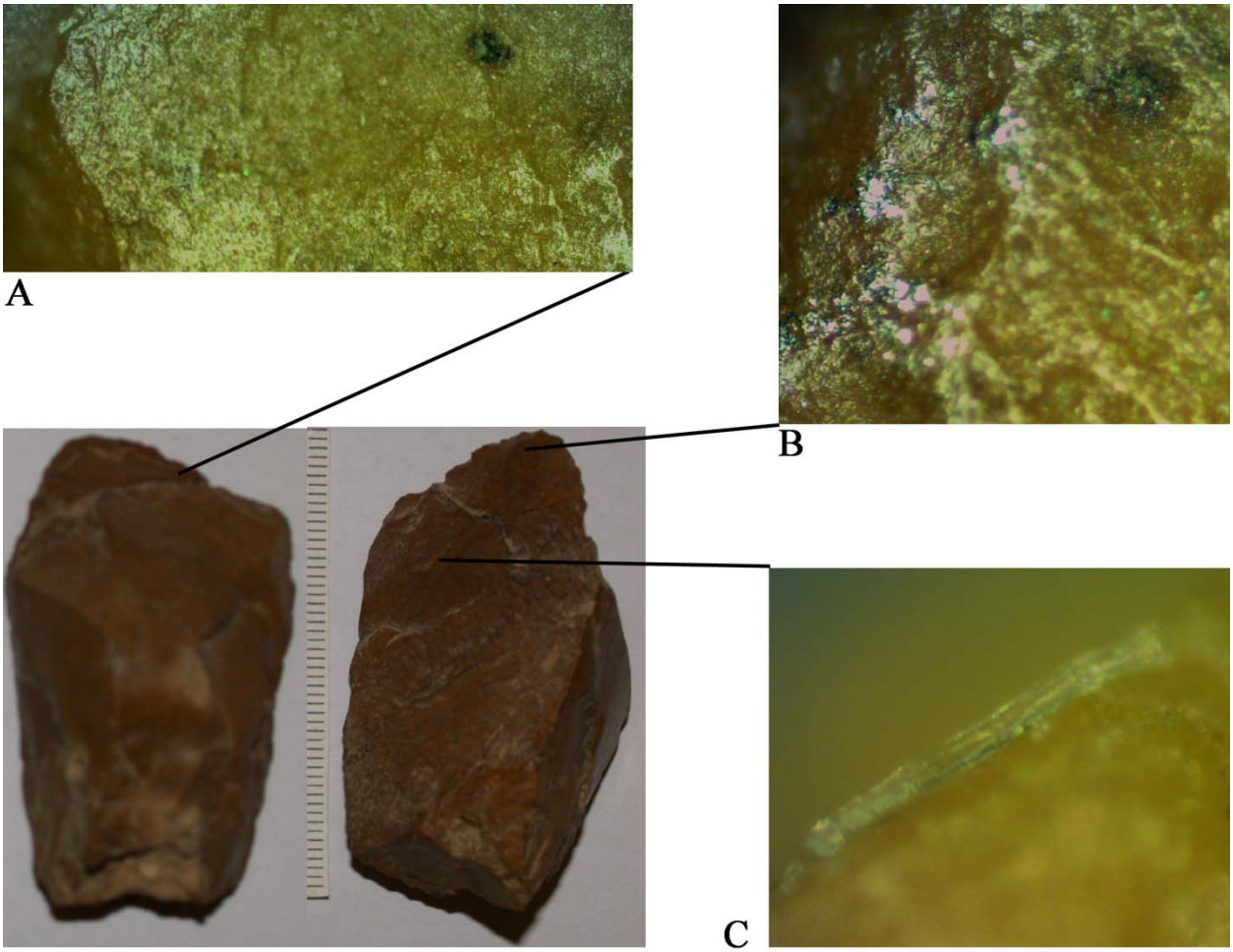


Figure 8: 1423.6 A and B) soft polish; C) hair fragment

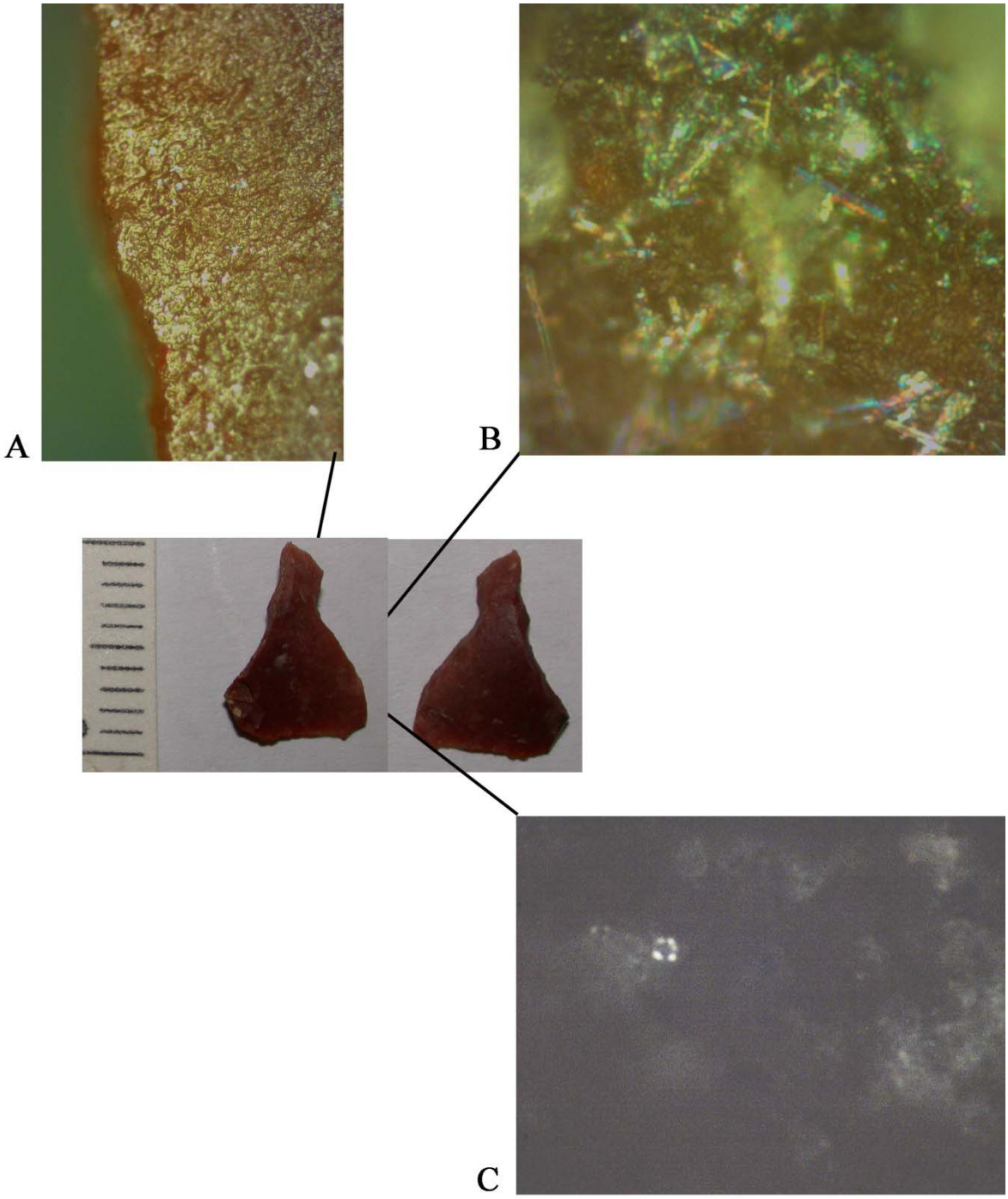


Figure 9: 1354.6 A) soft polish; B) raphides; C) starch grain (cross-polarized light)

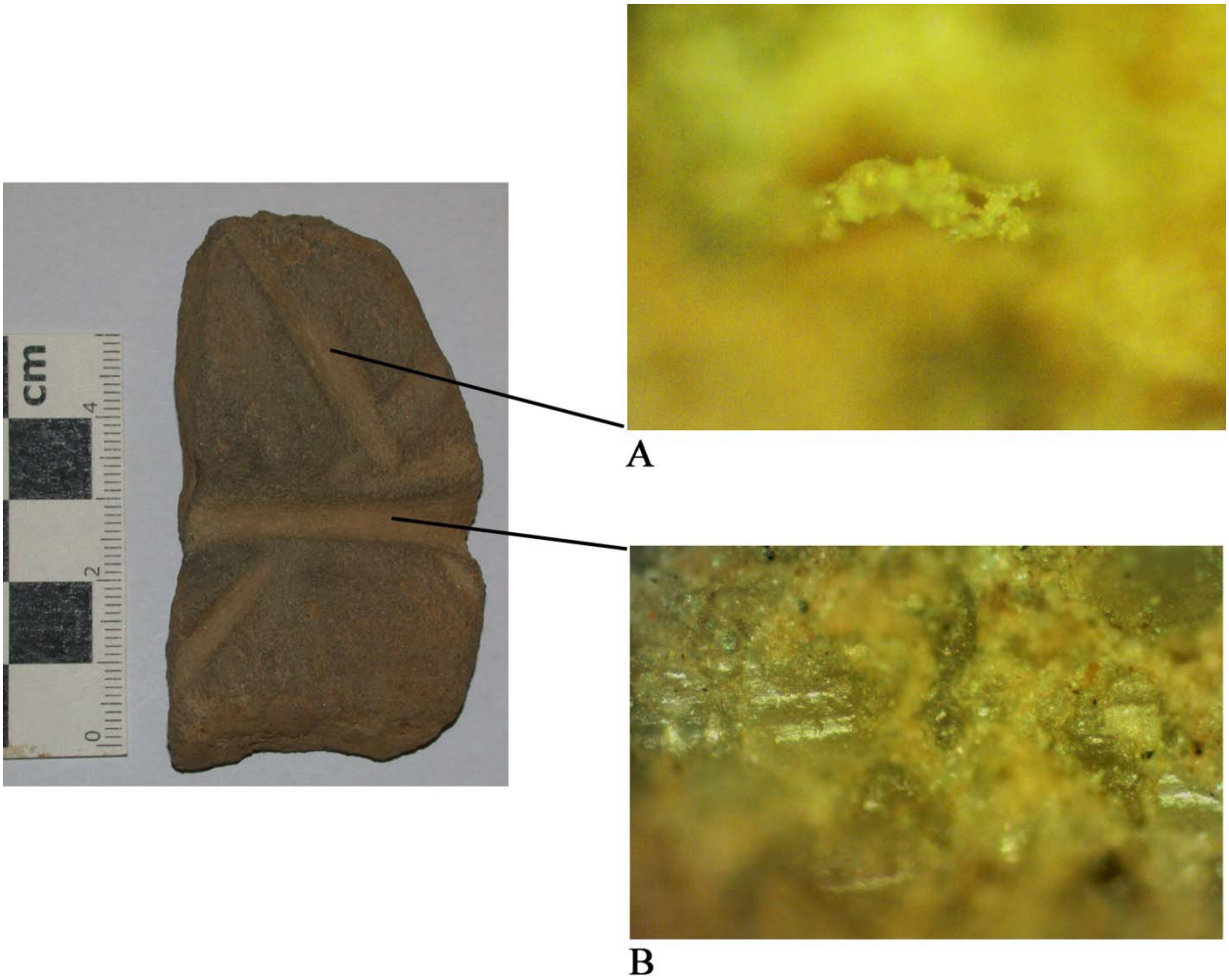


Figure 10: 1580 A) plant tissue; B) striations

References Cited

Anderson-Gerfaud, P., 1990. Aspects of behaviour in the Middle Paleolithic: Functional analysis of stone tools from southwest France. In: Mellars, P. (Ed.), The Emergence of Modern Humans: An Archaeological Perspective. Cornell University Press, Ithaca, pp. 389-418.
Bamforth, D., 1988. Investigating microwear polishes with blind tests: The institute results in context. J. Archaeol. Sci. 15, 11-23.
Bamforth, D., Burns, G., Woodman, C., 1990. Ambiguous use traces and blind test results: New data. J. Archaeol. Sci. 17, 413-430.
Beyries, S., 1988. Industries Lithiques: Traçeologie et Technologie. British rchaeological Reports International Series, London.
Brom, T., 1986. Microscopic identification of feathers and feather fragments of palearctic birds. Bijdr. Dierkd. 56, 181-204.
Briuer, F. 1976. New clues to stone tool function: plant and animal residues. Am. Ant. 41(4), 478-484.
Brown, K., Potter, d., Hall, G., Black, S. 1982. *Excavations at 41LK67, A Prehistoric Site in the Choke Canyon Reservoir, South Texas.* Choke CanyonSeries Vol. 7. Center for Archaeological Research, University of Texas, San Antonio.
Brunner, H., Coman, B.J., 1974. The Identification of Mammalian Hair. Inkata Press, Melbourne.
Catling, D., Grayson, J., 1982. Identification of Vegetable Fibres. Chapman and Hall, New York.
Creel, D., 1991. Bison hides in Late Prehistoric exchange in the Southern Plains. Am. Ant. 56, 40-49.
Dove, C.J., Hare, P.G., Heacker, M., 2005. Identification of ancient feather fragments found in melting alpine ice patches in southern Yukon. Arctic 58, 38-43.
Fadala, S. 1999. Traditional Archery. Stackpole Books: Mechanicsburg, PA.
Ford, J., Phillip, P., Haag, W. 1955. The Jaketown site in West-central Mississippi. Anthropological Papers of the American Museum of Natural History 45(1). New York.
Ford, J., Webb, C. 1956. Poverty Point: A Late Archaic Site in Louisiana. Anthropological Papers of the American Museum of Natural History 46(1). New York.
Fullagar, R., 1991. The role of silica in polish formation. J. Archaeol. Sci. 18, 1-24.
Fullagar, R., Field, J., Denham, T., Lentfer, C., 2006. Early and mid Holocene tool-use and processing of taro (Colocasia esculenta), yam (Dioscorea sp.) and other plants at Kuk Swamp in the highlands of Papua New Guinea. J. Archaeol. Sci. 33, 595-614.
Grace, R., 1990. The limitations and applications of use-wear analysis. Aun 14, 9-14.
Hardy, B.L., 1994. Investigations of stone tool function through use-wear, residue and DNA analyses at the Middle Paleolithic site of La Quina, France. Ph.D. Dissertation, Indiana University.
Hardy, B.L., 1998. Microscopic residue analysis of stone tools from the Middle Paleolithic site of Starosele, Crimea, Ukraine. In: Monigal, K., Chabai, V. (Eds.), The Middle Paleolithic of the Western Crimea, Vol. 2. Études et Recherches Archéologiques de l'Université de Liège, pp. 179-196.
Hardy, B.L., Garufi, G.T., 1998. Identification of woodworking on stone tools through residue and use-wear analyses: Experimental results. J. Archaeol. Sci. 25, 177-184.

Hardy, B.L., Kay, M., 1998. Stone tool function at Starosele. In: Monigal, K., Chabai, V. (Eds.), Combining use-wear and residue analyses. The Middle Paleolithic of the Western Crimea, Vol. 2. Études et Recherches Archéologiques de l'Université de Liège, pp. 197-209.
Hardy, B.L., Kay, M., Marks, A.E., Monigal, K., 2001. Stone tool function at the Paleolithic sites of Starosele and Buran Kaya III, Crimea: Behavioral implications. Proc. Natl. Acad. Sci. U.S.A. 98, 10972-10977.
Hardy, B.L., 2004. Neanderthal behaviour and stone tool function at the Middle Paleolithic site of La Quina, France. Antiquity 78, 547-565.
Haslam, M., 2004. The decomposition of starch grains in soils: Implications for archaeological residue analyses. J. Archaeol. Sci. 31, 1715-1734.
Haslam, M. 2006. Potential misidentification of in situ archaeological tool-residues: starch and conidia. J. Arch. Sci. 33, 114-121.
Hather, J., 1993. An Archaeobotanical Guide to Root and Tuber Identification, Vol. I: Europe and South West Asia. Oxbow Books, Oxford.
Henry, A.G., Hudson, H.F., Piperno, D.R., 2009. Changes in starch grain morphologies from cooking. J. Archaeol. Sci. 36, 915-922.
Hoadley, R., 1990. Identifying Wood: Accurate Results with Simple Tools. Taunton Press, Newtown.
Hurcombe, L., 1988. Some criticisms and suggestions in response to Newcomer, et al. (1986). J. Archaeol. Sci. 15, 1-10.
Kardulias, N., Yerkes, R., 1996. Microwear and metric analysis of threshing sledge flints from Greece and Cyprus. J. Archaeol. Sci. 23, 657-666.
Little, E. 1980. The Audobon Society Field guide to North American Trees: Eastern Region. Knopf: New York.
Lombard, M., 2004. Distribution patterns of organic residues on Middle Stone Age points from Sibudu Cave, Kwazulu-Natal, South Africa. S. Afr. Archaeol. Bull. 59, 37-44.
Lombard, M. and Phillipson, L. 2010. Indications of bow and stone-tipped arrow use 64 000 years ago in KwaZulu-Natal, South Africa. Antiquity 84:1-14.
Loy, T. 2006. Optical properties of potential look-alikes. In Torrence, R., Barton, H. (Eds.), Ancient Starch Research. Walnut Creek, CA, Left Coast Press, p. 123.
Mansur-Franchomme, M.E., 1986. Microscopie du Matériel Lithique Préhistorique: Traces d'Utilisation, Altération Naturelles, Accidentelles, et Technologiques. CNRS, Paris.
Moss, E.H., 1987. A review of ''Investigating microwear polishes with blind tests.'' J. Archaeol. Sci. 14, 473-481.
Newcomer, M., Grace, R., Unger-Hamilton, R., 1986. Investigating microwear polishes with blind tests. J. Archaeol. Sci. 13, 203-217.
Newcomer, M., Grace, R., Unger-Hamilton, R., 1988. Microwear methodology: A reply to Moss, Hurcombe, and Bamforth. J. Archaeol. Sci. 15, 25-33.
Odell, G., Odell-Vereecken, F., 1980. Verifying the reliability of lithic usewear assessments by ''blind tests'': The low-power approach. J. Field Archaeol. 7, 87-120.
Pearsall, D., 2000. Paleoethnobotany: A Handbook of Procedures, second ed. Academic Press, New York.
Piperno, D., 1988. Phytolith Analysis: An Archaeological and Geological Perspective.

New York: Academic Press.
Rots, V., Williamson, B.S., 2004. Microwear and residue analyses in perspective: The contribution of ethnoarchaeological evidence. J. Archaeol. Sci. 31, 1287-1299.
Shea, J.J., 1992. Lithic microwear analysis in archaeology. Evol. Anthropol. 1, 143-150.
Sobolik, K.D., 1996. Lithic organic residue analysis: An example from then Southwest Archaic. J. Field Archaeol. 23, 461-469.
Teerink, B.J., 1991. Hair of West European Mammals: Atlas and Identification Key. Cambridge University Press, Cambridge.
Wadley, L., Lombard, M., Williamson, B., 2004. The first residue analysis blind tests: Results and lessons learnt. J. Archaeol. Sci. 31, 1491-1501.
Williamson, B.S., 1996. Preliminary stone tool residue analysis from Rose Cottage Cave. S. Afr. J. Field Archaeol. 5, 36-44.
Yerkes, R. 1983. Microwear, microdrills, and Mississippian craft specialization. Am. Ant. 48, 499-518.