10.1.6 Starch Grain and Phytolith Analysis of Stone Tools, Steatite Fragments, and Ceramic Sherds from the Gray Farm Site, 7K-F-ll, Delaware by Chad Yost

STARCH GRAIN AND PHYTOLITH ANALYSIS OF STONE TOOLS, STEATITE FRAGMENTS, AND CERAMIC SHERDS FROM THE GRAY FARM SITE, 7K-F-11, DELAWARE

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INTRODUCTION

A total of 15 artifacts were submitted for starch grain analysis from the Gray Farm site (7K-F-11), located in Kent County, Delaware. These artifacts included stone tools and ceramics that have an Eastern Woodland cultural affiliation. Prehistoric occupation of this site spans the period from 3000 BC to AD 1500, and was followed by historic settlement and farming to the present day. The primary goal of this analysis was to recover and identify starch grains derived from plant resources that may have been stored within or processed with these artifacts. Any plant opal phytoliths of economic significance that were observed in the starch grain extraction samples were also noted and discussed.

METHODS Starch

and Phytolith

The extraction of starch grains from the artifact surfaces was based primarily on a phytolith extraction method, with exposure to oxidizing chemicals kept to an absolute minimum to preserve starch grains and calcium carbonate microfossils that are likely to be extracted along with the phytolith fraction. Because historic period land use at this site included corn cultivation and other crops, each artifact was thoroughly washed to remove post-use dirt and debris which can harbor modern plant microfossils. Wet brushing with water was used to aggressively remove silt and clay-sized particles, with the expectation that microfossils related to the actual use of these items will be preserved within microscopic crevasses and pores on the surface of each artifact. Next, a sonicating toothbrush and a mild detergent of 5% Triton X-100 was used to facilitate the release of microscopic residue particles adhering to the artifacts' surfaces. The washes from each artifact were collected in centrifuge tubes and rinsed thoroughly using short-duration spins of 30 seconds at 3000 rpm to remove clay particles. Next, the samples were freeze-dried using a vacuum system, which freezes out all moisture at -107°C and < 10 millitorr. The dried samples then were mixed with potassium cadmium iodide at a density of 2.3 g/ml and centrifuged to separate the microfossils, which will float, from most of the inorganic silica fraction, which will not. Next, the samples were mounted in optical immersion oil for counting with a light microscope at a magnification of 500x. The entirety of the slide was scanned for starch grains and phytoliths of economic significance. Diatoms and sponge spicules, organisms with silica shells, also were noted. Some of the samples required additional extraction steps, which are mentioned in the discussion. A diagram was produced indicating the total number of potentially significant microfossils observed using Tilia 2.0 and TGView 2.0.2.

DISCUSSION

The Gray Farm site, 7K-F-11, is located in Kent County, Delaware, near the town of Frederica. The landscape surrounding the site is composed of gently rolling low hills, which are part of the Lower Coastal Plain physiographic region. The site itself is adjacent to the Murdelkill River and wetland areas. Most of the project area has been under cultivation during the historic period. In fact, at the time of the Phase II and III field investigations, the area was in corn and hay cultivation. Thus, extra care was taken to remove post-use soil and debris from these

artifacts that may contain plant microfossils deriving from modern agricultural activities. A total of 15 artifacts were submitted for starch grain analysis from this site: eight ceramic sherds, two steatite fragments, two mortar/pestles, a groundstone tool, and a flaked microtool (Table 1). These artifacts have an Eastern Woodland cultural affiliation. Prehistoric occupation of this site spans 3000 BC to AD 1500. Because of the extraction method used, phytoliths and other biogenic silica microfossils were extracted along with the starch grains (Figure 1). These particles were noted and discussed when they were of potential economic significance. The results of the artifact analysis are discussed chronologically by feature, starting with the oldest cultural affiliation.

Feature 371

Feature 371 is a pit feature measuring 250 cm x 150 cm and 75 cm deep. The entire fill in this feature is a single stratum of soil. Numerous microtools and hand tools were recovered. Charcoal from the feature returned a radiocarbon age of 3740 ± 30 BP, indicating an early Woodland I (Late Archaic) cultural affiliation. A single stone tool (sample 2) was submitted for analysis from this feature. This tool fit very well in-hand and had one end with visible discoloration and use wear/damage that was targeted for analysis. After the initial starch/phytolith extraction, the sample was determined to be overwhelmingly dominated by silt-sized mineral particles, making the observation of phytoliths and starch grains difficult, since phytoliths are the same size and have a similar weight. Therefore, the sample was scanned for phytoliths of economic importance and then re-dried and floated with a less-dense heavy liquid (1.8 g/ml). This allowed much of the silt to “drop out” and be removed from the sample; however, most of the phytolith fraction was removed, as well. Despite this effort to recover starch, no starch grains were observed from this sample.

TU 38

Test Unit 38 is located in the northeastern part of the site where a number of Early Woodland ceramics were found in the plow zone and in a tree throw. A radiocarbon age of 3260 ± 30 BP was returned from a bulk sherd sample, indicating a middle Woodland I (Early Woodland) cultural affiliation. A single Marcey Creek sherd (Marcey Creek Vessel #2) recovered from the E horizon (50–60 cmbs) was submitted for analysis from this test unit (Sample 14).

Analysis of sherd residue sample 14 yielded numerous starch grains and phytoliths derived from the contents of the vessel. One starch is angular in 3D shape and has a centric hilum (Figure 2 A). This type of starch grain is typical of maize (*Zea mays*) and several varieties of grass seed, in particular bristlegrass (*Setaria*). Some analysts would identify this starch as maize derived; however, we are much more conservative about identifying maize starch. In fact, we usually require supporting evidence such as maize cob phytoliths or pollen. As we examine more and more grass seed starch, we are observing many grains that overlap in shape with maize starch. Both little barley grass (*Hordeum pusillum*) and bristlegrass (*Setaria* sp.) were utilized for subsistence in the northeast (Hart and Matson 2008). In our opinion, *Setaria* seed produces angular starch that would be difficult to separate from maize with certainty, even though the *Setaria* starch that we have examined is typically smaller than maize starch. It is interesting that the angular starch observed here is within the size range typical of maize, and is

larger than the two native species of *Setaria* in our reference collection (*S. macrostachya* and *S.viridis*). There are many non-native species of *Setaria* that have become established in the United States. However, there are only three species native to the northeastern U.S.: *Setaria parviflora*, *Setaria magna*, and *Setaria viridis*. With *Setaria magna* restricted to brackish/saline marshes, *parviflora* and *viridis* seem to be the species most likely to have been utilized for subsistence in the northeast. Based on the age of the pottery type from which this sample was removed, a species of *Setaria* is most likely the source for the angular grain recovered. Any starch-based claim for the presence of maize from this residue sample would have to be substantiated by phytolith or pollen evidence.

The second starch grain recovered from this residue sample is a very large grain that is lenticular in cross-section, has visible lamellae, and displays an extinction when viewed under cross-polarized light (Figures 2 B and C). This grain also exhibits evidence of being cooked. The somewhat-irregular shape of the grain is due to its being swollen from its original uncooked state. Also, the extinction cross (viewed under cross-polarized light) has weakened and become diffuse. This type of damage is consistent with that observed experimentally with *Hordeum* starch that was cooked (Henry et al. 2009). All of these characteristics taken together allow us to ascribe this grain to barley (*Hordeum*). Although there are several wild *Hordeum* taxa native to the northeast, little barley grass (*Hordeum pusillum*) is the most likely source for this starch grain.

The third starch grain recovered is an elongated spherical form with an eccentric hilum (Figure 2 D). Due to a lack of distinctive characteristics, ascribing this starch to a particular plant is difficult. However, it does fall within the range of variation exhibited by tuber starch from *Sagittaria* (Indian potato, wapato). Wapato starches are oblong and may or may not have one end that is more pointed than the other. The hilum is eccentric in side view and centric in polar view. Wapato starch also has the characteristic that when rotated under cross-polar illumination, the “arms” of the cross “wave.” In order to ascribe the starch recovered here to *Sagittaria*, a few more grains would have to be recovered that fall within the range of expected morphological variations. What we can say with certainty is that this starch grain is derived from root or tuber material.

Although phytoliths diagnostic of plants such as maize and squash were not observed, sherd residue sample 14 yielded a considerable amount of phytoliths derived from sedge roots. These phytoliths are somewhat irregular in shape, and have tube-like projections extending out from the body (Figure 2 E). Phytoliths identical to this have been observed in starchy root material from species of *Scirpus*. *Scirpus* roots are a very well-known edible plant part; however, archaeological evidence for the utilization of *Scirpus* roots is rare. This is due to the highly perishable nature of the roots and the difficulty in identifying fragments of charred root and tuber material. Another factor that explains the paucity of evidence for use of *Scirpus* roots is the underutilization of microbotanical analyses in investigating subsistence in the archaeological record. The recovery of *Scirpus* root phytoliths from this sample is likely a first for the northeast.

In summary, Marcey Creek sherd residue sample from TU 38 yielded some very interesting starch grain and phytolith evidence for subsistence. The angular starch, based on its size, is suggestive of maize; however, bristlegrass seed (*Setaria* sp.) is the most likely source for this grain. The diagnostic *Hordeum* seed starch grain is most likely derived from *Hordeum pusillum* (little barley grass), a native grass that was cultivated and probably domesticated in

North America. The *Sagittaria*-like starch and the recovery of sedge (*Scirpus*) root phytoliths indicates that wetland plant resources were utilized for subsistence. It is likely that some of these microbotanical findings are a first for the northeast, and this information should be disseminated to the greater archaeological community.

TU 21

Test Unit 21 is located in the southwest side of the project area, along the south edge of Trench 5. No AMS date is reported for this unit; however, a Marcey Creek (Early Woodland) ceramic sherd was recovered. One ceramic sherd of unknown type was submitted for analysis (sample 15). No starch grains and no phytoliths of taxonomic or economic importance were recovered from this sample.

Feature 185

Feature 185 is a pit measuring 130 cm x 130 cm and 30 cm deep. The entire fill in this feature is a single stratum of soil. One ground stone tool and numerous ceramic sherds were recovered. A bulk sherd sample from the feature returned a radiocarbon age of 2710 ± 30 BP, indicating an early Woodland I (Late Archaic) cultural affiliation. However, Late Woodland ceramics were also recovered from this feature. A single Selden Island ceramic sherd (1000 BC to 750 BC, Middle Woodland I) was submitted for analysis (sample 13). This residue sample yielded one subangular starch grain derived from grass seed (Figure 2 F). The subangular 3D shape of this grain, as well as the size, is suggestive of *Setaria*. Although little barley grass produces starches with a wide size range, they are lenticular in shape, rather than subangular. This starch exhibits evidence of cooking and is most likely derived from *Setaria* or another grass seed that produces angular to subangular starch.

Feature 279

Feature 279 is pit feature measuring 220 cm x 160 cm and 40 cm deep. Numerous steatite bowl fragments and two ground stone tools were recovered from this feature. A charcoal date of 1170 ± 30 BP (Late Woodland I; syn. Middle Woodland) was returned from this feature, which is odd, because steatite bowls are a marker of the Late Archaic/Early Woodland transition, a time period much older than the charcoal date from this feature. Two groundstone tools and a steatite bowl fragment were submitted for analysis from this feature. Discussion of the results will start with the specimen recovered from the lowest position in the feature.

Broken Cobble (Sample 4)

A broken cobble ground stone tool recovered from a depth of 49–59 cmbs was submitted for analysis (sample 4). This tool yielded a single angular starch grain (Figure 2 G). Because of its smaller size, this grain is a very good match with *Setaria* starch and appears to be too small for maize starch. This tool also yielded two dendriform phytolith fragments (silicified dendritic long cells). Dendriforms originate in the bract material (lemmas, paleas, and glumes) that surrounds the seed (caryopsis) of some wild and domesticated grasses. They are very common in the bract material of C_3 Pooideae grasses, many of which are native to North

America. *Setaria*, a C_4 Panicoideae grass, also produces dendriforms. The presence of these dendriforms suggests that grass seeds were processed with this tool. This type of phytolith is significant because the dendriform-bearing plant material that encapsulates the grass seed is never entirely removed from all of the grains during the parching and winnowing steps. These dendriforms can then be cooked, digested, and incorporated into the archaeological and geological records. The two dendriforms observed here were disarticulated from the silicified epidermis layer of long cells that held them in place and, thus, cannot be reliably ascribed to a particular grass. However, these dendriforms do exhibit more similarity to those found in the inflorescence of our reference *Setaria* taxa than our *Hordeum* taxa. Finally, an opaque perforated plate phytolith with papillae was observed (Figure 2 H). This fragment is derived from the inflorescence of a member of the sunflower family (Asteraceae). In fact, these same morphotypes have been observed in both sunflower (*Helianthus*) and marshelder (*Iva*) seed shells. It is likely that other members of the Asteraceae also produce these types of phytoliths, so we cannot, at this time, ascribe this phytolith-type exclusively to *Helianthus* and *Iva*. Thus, the phytolith and starch evidence from this tool indicates that it was used to process grass seed (cf. *Setaria*) and possibly Asteraceae seeds (cf. *Helianthus*, *Iva*).

Ground Stone (Sample 3)

A ground stone tool that resembles a pestle or mano was submitted for analysis (sample 3). This tool was recovered from a depth of 49 to 59 cmbs. This tool and the previously discussed cobble tool (sample 4) were recovered in association with each other. Two areas around the body of the tool, and one end of the tool that appears to have been utilized, possibly for pounding, were targeted for analysis. This tool did not yield any starch grains; however, four dendriform fragments were observed, one of which can be seen in Figure 2 I. Thus, the phytolith evidence suggests that this tool was used for processing grass seed.

Steatite Bowl Fragment (Sample 5)

A steatite bowl fragment (sample 5) was recovered from a depth of 34 to 44 cmbs from Feature 185. No starch grains and no phytoliths of taxonomic or economic importance were recovered from this sample.

Feature 3

Feature 3 is a tree throw pit and is treated as a disturbed context. Charcoal from this feature returned a radiocarbon age of 1140 ± 30 BP (late Woodland I; syn. Middle Woodland). A steatite rim recovered from a depth of 80–90 cmbs was recovered from this feature and submitted for analysis (sample 6). Residue extracted from this rim fragment yielded both starch grain and phytolith evidence for grass seed utilization. Two starches were recovered. The first grain is angular in 3D morphology and has a centric hilum (Figure 2 J). The size of this grain is within the range that is typical for bristlegrass (*Setaria*). The second grain is spherical, has visible lamellae, and has a somewhat diffuse extinction cross (Figure 2 K). Under normal brightfield microscopy, this grain appears darkened, most likely from being cooked. Spherical grains are rare in *Setaria* but not completely absent from its starch grain morphological assemblage. This grain is not consistent with *Hordeum* starch. What we can say is that this grain is certainly derived from a grass seed, possibly *Setaria*. Two notable phytoliths were recovered from this tool, a dendriform fragment (Figure 2 L), and an opaque perforated plate

phytolith derived from Asteraceae inflorescence material. Thus, the phytolith record provides supporting evidence that grass seeds were cooked within this vessel and that Asteraceae seeds such as those from *Helianthus* and *Iva* may have been cooked as well. These findings are potentially important pieces of evidence that could be used to better understand the function of steatite bowls. The hypothesis that steatite bowls were specialized tools used for mast processing has been contested recently by Hart et al. (2008), who report dendriform and papillae phytolith evidence that *Hordeum* and hook-shaped hair phytolith evidence that pods from a legume were cooked within steatite vessels from New York. Hart et al. (2008) suggest that steatite bowls were generalized cooking vessels. Our findings support the latter hypothesis, as both grass seed starch and phytoliths were recovered from the steatite bowl fragment.

Feature 10

Feature 10 is a cylindrical pit that measures 100 cm x 100 cm and is 110 cm deep. Charcoal from this feature returned a radiocarbon age of 330 ± 30 BP. Shell, bone, and diagnostic ceramics were recovered from this feature and associate it with Woodland II (Late Woodland). Fill in this feature was stratified, and the five ceramic sherds submitted for analysis were recovered from the upper three strata. Discussion of the results will start with the ceramic from the lowest position within the feature.

Ceramic Sample 8

Sample 8 is a ceramic sherd from a Killens vessel. This sherd was recovered from stratum 3 (54–64 cmbs). Residue from this sherd yielded a large number of starch grains, the highest amount recovered for all of the artifacts analyzed from this site. Five single starch grains and four clusters of starch grains were recovered. The starch clusters contained tens to hundreds of starch grains per cluster. The largest cluster of starch grains is shown in Figures 3 A and B. A smaller cluster is illustrated in Figures 3 C and D. All of the clusters contained grains with visible lamellae on the larger grains, and all were lenticular in cross section. Thus, all of the clusters appear to be derived from barley (*Hordeum*). The five single grains exhibited slightly different characteristics from one another. One was a large, lenticular grain with lamellae (*Hordeum*). Two were small lenticular grains without visible lamellae, most likely derived from *Hordeum*, but they may also be derived from a species of wild rye (*Elymus*). One grain was a centric/ellipse type, most likely derived from grass seed (Figure 3 E). The fifth grain was perfectly spherical in 3D shape, centric, and most likely derived from grass seed. Thus, there is overwhelming starch evidence that grass seed was processed, cooked, or contained within Killens vessel #1, recovered from Feature 10. The starch evidence also indicates that barley (*Hordeum*) was the main type of grass utilized, although there is evidence of the presence of at least one, and possibly more, other types of grass seed.

Ceramic Sample 11

Sample 11 is a ceramic sherd from a Townsend vessel. This sherd was recovered from stratum 2 (44–45 cmbs). This sherd also yielded a large number of grains, all of which were classified as subangular. One of the six grains recovered is illustrated in Figure 3 F. As previously discussed, both maize (*Zea mays*) and bristlegrass (*Setaria*) produce subangular to angular starch grains, and *Zea* starch tends to be larger in size than *Setaria* starch. The six

grains observed here tend to be more of a *Zea* size than *Setaria* size; however, we require corroborating evidence such as maize pollen or maize phytoliths to ascribe these grains to *Zea*. Thus, the starch evidence from this sherd indicates that either maize or a grass seed such as *Setaria* was processed, cooked, or contained within Townsend vessel #9.

Ceramic Sample 10

Sample 10 is a ceramic sherd from a Townsend vessel. This sherd was recovered from stratum 2 (44–45 cmbs), the same level as the previously discussed sample 11. No starch grains were recovered. One dendriform phytolith was recovered, suggesting that grass seeds may have been cooked or processed within this vessel.

Ceramic Sample 9

Sample 9 is a ceramic sherd from a Townsend vessel. This sherd was recovered from stratum 1 (34–44 cmbs) of Feature 10. Analysis of the sherd yielded both starch grain and phytolith evidence for subsistence. A total of three singular starch grains and one starch cluster were observed. One grain is a large lenticular grain with visible lamellae (Figure 3 G) derived from barley (*Hordeum*). A second grain is angular in 3D shape and torn on one side (Figure 3 H), suggesting that it was ground. This grain is a good match with maize (*Zea mays*) but may also be derived from grass seed. The third grain is centric and slightly elongated, and is derived from grass seed. The starch cluster comprises spherical grains with centric hila (Figure 3 I and J). This cluster is derived from grass seed that has been cooked. One dendriform phytolith was recovered as well, providing supporting evidence that grass seed was processed or cooked within Townsend vessel #6.

Ceramic Sample 12

Sample 12 is a ceramic sherd from a Townsend vessel. This sherd was recovered from stratum 1 (34–44 cmbs) of Feature 10, which is the same level as the previously discussed sample 9. Analysis of ceramic sherd sample 12 did not yield any starch grains; however, two dendriform phytoliths were recovered. These dendriforms suggest that grass seed was processed or cooked within Townsend vessel #10.

Feature 280

Feature 280 is a basin that measures 220 cm x 160 cm and is 10 cm deep. Two flaked microtools were recovered from this feature, one of which was submitted for analysis (sample 1). There is no date and no cultural affiliation associated with this microtool. Background information provided to us indicated that this tool was examined for use wear and that starch and raphides were observed. No starch grains, raphides, or phytoliths were recovered from this sample. However, five fragments of plant material were observed. One of these fragments is shown in Figures 4 A and B. This particular piece of material has a row of circular bordered pits that when viewed under polarized light, can resemble starch grains (see red arrows in Figure 4 A). Also, some portions of this and other plant fragments can exhibit a birefringence that resembles tightly packed bundles of raphides (see right side of plant material in Figure 4 A). The recovery of five plant tissue fragments like the one in Figure 4 A indicates that this tool was most likely used to cut plant material.

Feature 344

Feature 344 is a tree throw feature that yielded one metate that was submitted for analysis. This tool was recovered from stratum 1 (34–44 cmbs). There is no date and no cultural affiliation associated with this tool. Analysis of the tool yielded numerous starch grains and phytoliths of economic significance. A total of three starch grains and seven phytoliths were recovered. Two of the grains are subangular in shape, and one of them exhibits damage from cooking that borders on gelatinization (Figure 4 C). Gelatinization is a process involving both water and heat resulting in the loss of a clear, geometrically-defined shape and structure. These subangular grains may be derived from either maize or grass seed. The third grain is somewhat irregular in 3D shape, but it has a centric hilum (Figure 4 D) and is most likely derived from grass seed. Six dendriform phytoliths were recovered, the most from any of the items analyzed for this study. One of these dendriforms can be seen in Figure 4 F. One cone cell phytolith derived from the achene of a sedge (Cyperaceae) was observed, suggesting that sedge seeds were collected and processed with this tool. Sedge (Cyperaceae) phytoliths have been recovered previously from residue in the northeast by Robert Thompson (See Hart and Matson 2008:734). And finally, one opaque perforated plate phytolith was observed (Figure 4 E). This phytolith is derived from the inflorescence of a member of the sunflower family (Asteraceae), and suggests that sunflower seeds were also processed with this tool. Thus, the starch and phytolith evidence from this tool indicates that it was used to process grass and sedge seeds, and possibly used to process sunflower seeds as well.

SUMMARY AND CONCLUSION

A total of 15 artifacts recovered from the Gray Farm site were submitted for starch grain analysis. Because of the extraction technique utilized, phytoliths were also extracted and discussed when they were derived from economically important plants. Starch and phytolith analysis are expected to provide information concerning user processing of plants that are starchy (seeds, some nuts such as acorns, roots, and tubers) and/or that produce phytoliths that are unique. Plants expected to be documented in the phytolith record include grasses, maize, legume pods, sedges, members of the sunflower family, and a few others. A wider range of plants that were used or processed might be documented if pollen analysis were also included as an analytic tool, particularly on ground stone. Pollen recovery in residue from ceramics has been proven possible, although standard 100 or 200 grain counts are usually not obtained. Instead, pollen analysis should be viewed in the same light as starch and phytolith analysis, when employed on ceramic residues. Recovery of small quantities of pollen might be very valuable in identifying foods cooked in the vessels represented, just as small quantities of phytoliths were valuable in this study.

The 15 artifacts included ceramic sherds, steatite bowl fragments, ground stone, and a flaked lithic microtool. Starch was identified on eight of these items, and phytoliths were recovered from eight, as well. The phytolith and starch evidence indicates that grass, sedge, and possibly sunflower seeds were utilized by the site occupants from Middle Woodland I to Woodland II periods. The grasses utilized consisted of barley (*Hordeum*), bristlegrass (*Setaria*), and probably some other locally gathered taxa. Phytolith evidence for the exploitation of sedge (cf. *Scirpus*) roots were observed from sample 14, residue from a Middle Woodland I ceramic

sherd. Angular starch grains that resemble those produced by maize (*Zea mays*) were recovered from samples 14, 4, 6, and 9; however, based on our reference collection, it would be very difficult to separate maize starch from bristlegrass (*Setaria*) starch with 100% certainty. This is why we require supporting evidence (e.g., phytolith or pollen) when angular maize-like starch is recovered from a sample. For example, sample 14, a Middle Woodland I sherd (Marcey Creek: 3200 to 2800 Cal BP), yielded a maize-like starch. If this starch were unequivocally derived from maize, it would be considered an extremely early record of maize for the northeast. Phytolith research by John Hart and colleagues indicates that maize was being cooked in pots by 2270 ± 35 BP (cal 2348–2157 BP) in the Finger Lakes region of New York (Hart and Matson 2008:89). Since no maize cob phytoliths were observed from sample 14, *Setaria* is the likely source for this angular starch grain. However, as more microbotanical studies, such as phytolith analysis, are undertaken, the history of maize in the northeast is likely to be extended further back in time.

Our analysis of sample 6, residue from a steatite rim fragment, yielded potentially important pieces of evidence that could be used to better understand the function of steatite bowls in the eastern United States. The hypothesis that steatite bowls were used for mast processing has been contested recently by Hart et al. (2008), when they found phytolith evidence that barley (*Hordeum*) and a legume were cooked within steatite vessels from New York. This evidence led them to suggest that steatite bowls had a more general function, which our findings support, as both grass seed starch and phytoliths were recovered from the steatite bowl fragment examined in this study.

TABLE 1
PROVENIENCE DATA FOR STARCH SAMPLES FROM THE GRAY FARM SITE, 7K-F-11, DELAWARE

Sample No.	Bag No.	Feat. No.	Chronological Period	Unit	Stratum	Depth (cmbs)	Provenience/ Description
12	401	10	Woodland II (Late Woodland)		1	34-44 Level 1	Ceramic from SE ¼ of cylindrical pit; Townsend Vessel # 10
9	401				1	34-44 Level 1	Ceramic from SE ¼ of cylindrical pit; Townsend Vessel # 6
10	402				2	44-45 Level 2	Ceramic from SE ¼ of cylindrical pit; Townsend Vessel # 7
11	402				2	44-45 Level 2	Ceramic from SE ¼ of cylindrical pit; Townsend Vessel # 9
8	403				3	54-64 Level 3	Ceramic from SE ¼ of cylindrical pit; Killens Vessel # 1
6	286	3	Late Woodland I (Middle Woodland)		1	80-90 Level 4	Steatite rim from suspected tree throw feature
5	882	279	Early Woodland I (Late Archaic)		1	34-44 Level 1	Steatite fragment from S ½ of pit
3	883				1	49-59 Level 2	Long, flat stone associated with sample 4; from S ½ of pit
4	883				1	49-59 Level 2	Broken cobble associated with sample 3; from S ½ of pit
13	851	185	Mixed, Middle Woodland I (Early Woodland)		1	45-55 Level 1	Ceramic from S ½ of pit; Selden Island Vessel #1
15	38		Middle Woodland I (Early Woodland)	21	3	40-50 Level 3	Ceramic from B horizon; Unknown tyoe
14	83		Middle Woodland I (Early Woodland)	38	2	50-60 Level 4	Ceramic from E horizon; Marcey Creek Vessel #2
2	997	371	Early Woodland I (Late Archaic)		1	95-105 Level 6	Goundstone from N ½ of pit

TABLE 1 (Continued)

Sample No.	Bag No.	Feat. No.	Chronological Period	Unit	Stratum	Depth (cmbs)	Provenience/ Description
1	1354	280	Unknown		1	38-48 Level 1	Microtool from south half of basin
7	849	344	Unknown		4	34-44 Level 1	Metate from E ½ of suspected tree throw feature

FEATURE NO.	SAMPLE NO.	*Starch-subangular - cf. maize or grass seed (cf. Setaria)*	Starch-*angular - cf. maize or grass seed (cf. Setaria)*	Starch-centric - grass seed (Poaceae)	Starch-centric/elongate -grass seed (Poaceae)	*Starch-lenticular w/lamellae -barley (Hordeum cf. pusillum)*	*Starch-large lenticular w/lamellae -barley (Hordeum cf. pusillum)*	*Starch-lenticular cluster w/lamellae -barley/wildrye-type (Hordeum/Elymus)*	*Starch-small lenticular cluster -wapato-type (cf. Sagittaria latifolia)*	*Starch-eccentric*	**TOTAL STARCH GRAINS**	Cone cell -sedge achene (Cyperaceae)	Irreg. with cylindric proj. -sedge root-type (Cyperaceae)	Dendriform -grass seed indicator (Poaceae)	Xylem fragment -many plants (non-phytolith)	Opaque perf. plate Asteraceae inflorescence	**TOTAL PHYTOLITHS**	DESCRIPTION
10	12													2			2	Ceramic-Woodland II
	9		1		1		1	1			4			1	1		1	Ceramic-Woodland II
	10													1			1	Ceramic-Woodland II
	11	6									6							Ceramic-Woodland II
	8			1	1		1	4	2		9							Ceramic-Woodland II
3	6		1	1							2			1		1	2	Steatite-Late Woodland I ?
279	5																	Steatite-Early Woodland I ?
	3													4			4	Ground stone-Early Woodland I
	4		1								1			2		1	3	Ground stone-Early Woodland I
185	13	1									1							Ceramic-Middle Woodland I
TU 21	15																	Ceramic-Middle Woodland I
TU 38	14		1			1				1	3		9				9	Ceramic-Middle Woodland I
371	2																	Ground stone-Early Woodland I
280	1														5			Microtool-unknown affiliation
344	7	2		1							3	1		6		1	8	Metate-unknown affiliation

FIGURE 1. ECONOMICALLY IMPORTANT STARCH GRAIN AND PHYTOLITH FREQUENCY

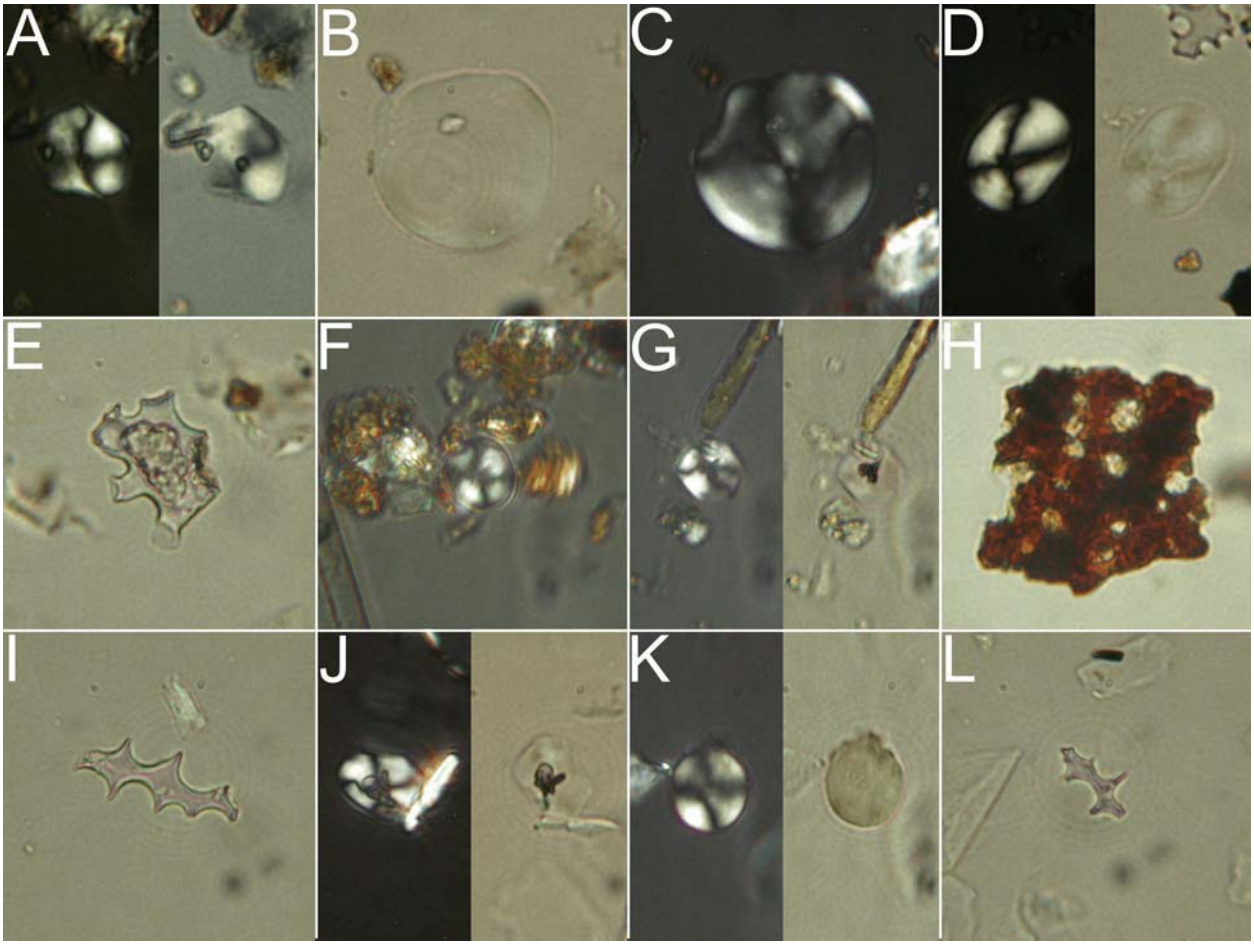

FIGURE 2. SELECTED PHYTOLITH AND STARCH GRAINS FROM ARTIFACTS RECOVERED FROM TEST UNITS 38 AND 21, AND FEATURES 185, 279, AND 3, GRAY FARM SITE, 7K-F-11, DELAWARE.

All micrographs taken at 500x magnification. Images A through E are from sample 14.

A) Angular starch grain from grass seed viewed under polarized light (left side) and normal brightfield (right side).
B) Large, lenticular (in cross-section) *Hordeum* starch grain viewed under brightfield, and C) cross-polarized light.
D) Root-type starch grain possibly from *Sagittaria*.
E) *Scirpus* sp. (Cyperaceae) root phytolith.
F) Subangular grass seed starch grain recovered from sample 13. The subangularity of this grain is hard to appreciate because this grain was at the edge of the slide and a clear image was impossible to acquire.
G) Angular grass seed starch from sample 4.
H) Asteraceae inflorescence phytolith fragment from sample 4.
I) Dendriform phytolith fragment derived from the bract material that surrounds grass seed, recovered from sample 3.
J) Angular grass seed starch starch from sample 6.
K) Spherical grass seed starch from sample 6.
L) Dendriform phytolith fragment derived from the bract material that surrounds grass seed, recovered from sample 6.

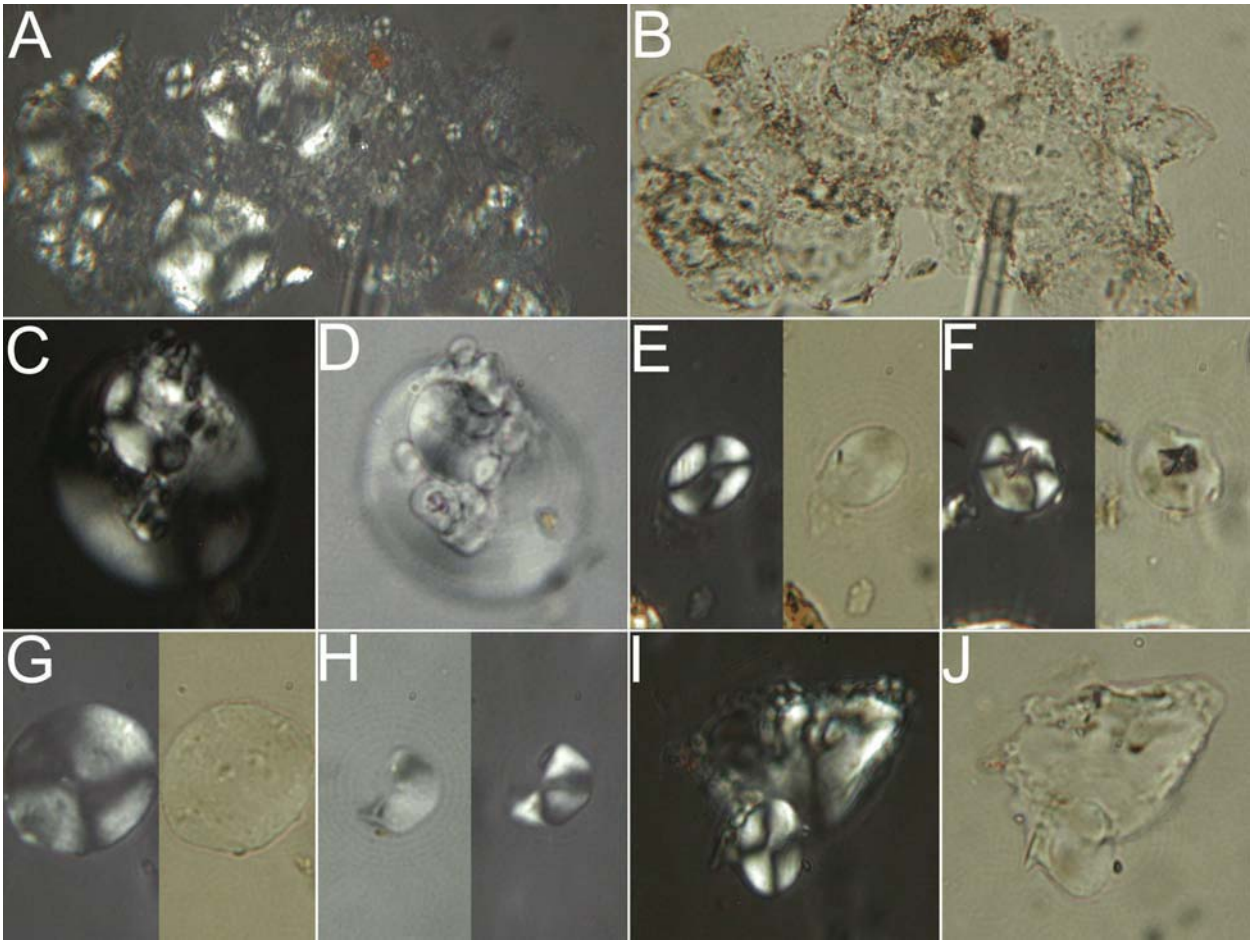

FIGURE 3. SELECTED STARCH GRAINS REMOVED FROM CERAMIC SHERDS RECOVERED FROM FEATURE 10, GRAY FARM SITE, 7K-F-11, DELAWARE.

All micrographs taken at 500x magnification.

A) Cluster of hundreds of grass seed starch grains viewed under cross-polarized light, and B) normal brightfield light, recovered from sample 8.
C, D) A smaller cluster of grass seed starch from sample 8.
E) Grass seed starch from sample 8. Angular grass seed starch recovered from sample 11.
G) A large, lenticular *Hordeum* seed starch recovered from sample 9.
H) Angular and torn grass seed starch from sample 9.
I) Small cluster of grass seed starch viewed under cross-polarized light, and J) normal brightfield light.

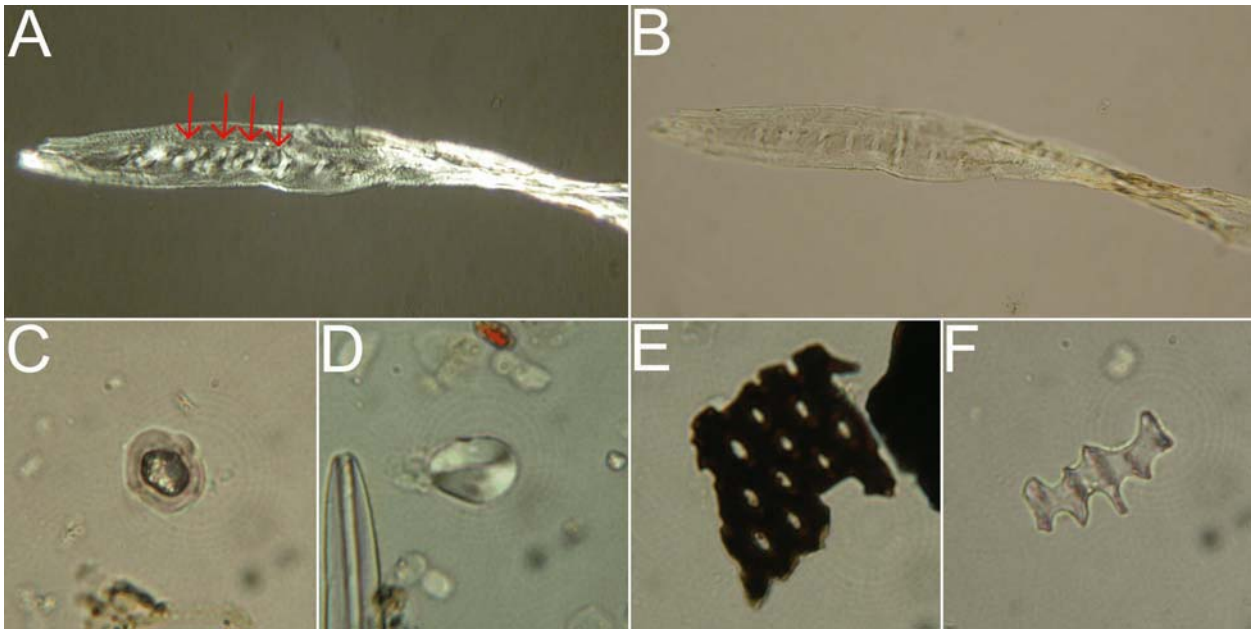

FIGURE 4. SELECTED PLANT FIBER, PHYTOLITH AND STARCH GRAINS REMOVED FROM ARTIFACTS RECOVERED FROM FEATURES 280 AND 344, GRAY FARM SITE, 7K-F-11, DELAWARE.

Micrographs A and B taken at 250x magnification, and are from sample 1. Micrographs C through F taken at 500x magnification, and are from sample 7.

A) Plant xylem material viewed under cross-polarized light and B) normal brightfield light. This particular piece of plant xylem material has a row of circular bordered pits that, when viewed under polarized light, can resemble starch grains (see red arrows in A). Also, some portions of this and other plant fragments can exhibit a birefringence that resembles tightly packed bundles of raphides (see right side of plant material in A).
C) Subangular grass seed starch grain, damaged from cooking.
D) Irregular to subangular grass seed starch.
E) Opaque perforated plate phytolith from Asteraceae inflorescence material.
F) Dendriform phytolith fragment derived from the bract material that surrounds grass seed.

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