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THE AGE, FUNCTION, AND DISTRIBUTION OF KEYHOLE STRUCTURES IN THE UPPER SUSQUEHANNA RIVER VALLEY

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ABSTRACT

This paper provides a summary of current data regarding the age, geographical distribution, and function of keyhole structures in the upper Susquehanna River Valley of north-central Pennsylvania and south-central New York. Keyhole structures have been identified at 11 sites in the West and North Branches of the Susquehanna River Valley. The feature type likely originated in the West Branch Valley from which it spread to the north, south, and east. Their main period of use was during the latter portion of the Late Woodland period, between approximately 1230 and 1670 A.D. Given the locations of the sites along major waterways, as well as their possible associations with agricultural villages and hamlets, keyhole structures may have functioned as storage facilities for foodstuffs or, perhaps, as winter houses; however, the possibility that they served multiple functions, including the common interpretation as sweat lodges, cannot be ruled out based on current data.

INTRODUCTION

This paper provides a summary of current data regarding the age, geographical distribution, and function of keyhole structures in the Susquehanna Valley region of northcentral Pennsylvania. These structures date to the Late Woodland period, specifically between approximately 1200 and 1700 A.D. They are limited in their distribution to the West Branch and North Branch Susquehanna River Valleys in northern Pennsylvania and southern New York (Figure 1). Their function has long been the fodder of archaeologists in the Middle Atlantic region (Dent 1995; Custer 1996), with various interpretations as storage features (Hatch 1980), sweat lodges (Smith 1976), and winter lodges (East, personal communication, 2006).

Keyhole structures are identified exclusively within Late Woodland villages of the northern reaches of the Susquehanna Valley, either within the limits of villages themselves (most common) or just exterior to the village (rarer). Within the villages, one or two keyhole structures were likely present at any given time. As reflected in the schematic diagram in Figure 2, keyhole structures contain two major components, including (1) a main circular-to-oval structure connected to (2) an entrance tunnel. The main structure is typically circular and semi-subterranean, measuring approximately 1.5 to 3 m in diameter on average. The connecting entrance tunnel may or may not be semi-subterranean and generally measures between 1-2 m in length.

Archaeologically, the shapes of keyhole structures are denoted by post molds. During their use, the post molds likely contained timbers for a domed structure. Contents of keyhole structures typically include a variety of archaeological debris, such as a wide variety of food stuffs at the Fisher Farm site on Bald Eagle Creek in Pennsylvania (Hatch 1980). More typically, keyhole structures contain general domestic debris, such as fire-cracked rock, lithics, and ceramics, as at the Quiggle (Smith 1984) and Nash sites in Pennsylvania (BHE 2003).
Figure 1. Map of Late Woodland sites with keyhole structures.

Figure 2. Schematic planview and profile of keyhole structure.
The remainder of the paper provides details regarding the geographic distribution of keyhole structures at key sites in the West and North Branch Susquehanna River Valleys, with a focus on their chronology of use and geographic distribution. After establishing the environmental background and culture history, each of the key Late Woodland sites with keyhole structures is discussed, followed by a summary of available data to better understand their age, function, and geography.

**BACKGROUND**

**Environmental Setting**

Keyhole structures are limited in their distribution to the West and North Branches of the Susquehanna River in north-central Pennsylvania and, presumably, into south-central New York (Figure 1). The drainage basin of the Susquehanna River encompasses the majority of central Pennsylvania, as well as portions of Maryland, New York, and Delaware, before it empties into Chesapeake Bay and the Atlantic Ocean (see Figure 1). The Central West Branch Susquehanna River—which contains the vast majority of keyhole structures discussed herein—encompasses 2,539 square miles of total drainage area within the northwest portion of the Susquehanna River basin. The West Branch Susquehanna River—hereafter referred to as the West Branch—splits two physiographic provinces, the Appalachian Plateau and the Ridge and Valley (Faill and Nickelson 1999; Sevon 2000).

The ridges and valleys of the Susquehanna Valley and vicinity formed by differential erosion of the various rock systems, with coarse Silurian Tuscarora Formation quartz and Ordovician Juniata and Bald Eagle Formation sandstone forming the major ridgetops. Less resistant Cambrian and Ordovician carbonates, Silurian mudstones and limestones, and Devonian mudstones form valley floors of major streams (Way 1999:356).

Valleys are wide in the Ridge and Valley and much of the available water is located below the ground surface due to the region’s karstic geology. Major water courses in the study area include the West and North Branches of the Susquehanna River, as well as their main tributaries, Bald Eagle Creek, Pine Creek, Spring Creek, Slab Cabin Run, Buffalo Run, Fishing Creek, Marsh Creek, and Beech Creek (Hatch 1980:2). Sites with keyhole structures are exclusively located in the wide valleys of the major streams of the Susquehanna Basin, including the West and North Branches, Bald Eagle Creek, and Pine Creek.

**The Late Woodland Period in the Susquehanna River Valley**

The Late Woodland is typically divided into three sub-phases within the Susquehanna Valley and vicinity: Clemson Island (A.D. 800-1250); Stewart (Shenks Ferry) (A.D. 1250 - 1350); and McFate-Quiggle (A.D. 1350-1600), although recent studies have called into question the value of such sub-phases (Espenshade 2001). As discussed more in this paper, Late Woodland Native Americans may have initiated use of keyhole structures during the latter portion of the Clemson Island sub-phase, but their popularity peaked during the Stewart (Shenks Ferry) and McFate-Quiggle sub-phases.

Clemson Island has been intensively studied during recent years, including major overviews by Graybill (1995), Hay et al. (1987), Hatch (1980) and Stewart (1990). Among Late Woodland sites in the region, the Memorial Park and the West Water Street sites in Lock Haven are among the most well known. No evidence of keyhole structures was observed at either site. Clemson Island is an early-Late Woodland sub-phase based largely on the presence of punctated “Clemson Island” pottery at archaeological sites in Centre, Clinton, Dauphin, Huntingdon, Juniata, Lycoming, Mifflin, Northumberland, Perry, Snyder, and Union counties (Graybill 1995; Stewart 1990). As noted above, keyhole structures are not common during the Clemson Island sub-phase.

After Clemson Island, the Shenks Ferry (Stewart) sub-phase emerges with slight changes in village organization and technology. Keyhole structures increase in importance along with an increase in use of fortifications at villages. The Fisher Farm and Piper Airport sites (Hatch 1980, 1983), as described below, contained Shenks Ferry (A.D. 1250-1350) occupations with keyhole structures. Memorial Park in Lock Haven also yielded a Stewart (Shenks Ferry) occupation, but it was less intensive than the preceding
Clemson Island occupation, both of which lacked keyhole structures. Stewart (Shenks Ferry) sites typically yield Shenks Ferry plain and cordmarked pottery wares, triangular projectile points, clay smoking pipes, and increasing numbers of ground stone tools.

Finally, the McFate-Quiggle phase (A.D. 1350-1600) appears infrequently in the upper reaches of the Susquehanna, but is characterized by the increasing use of Susquehannock type, high-collared, shell-tempered pottery (Hatch 1980). The Quiggle and Bonner-Young sites, discussed more below, yielded McFate-Quiggle occupations with keyhole structures. Due to the dearth of archaeological data on the McFate-Quiggle sub-phase and its overall similarity to the preceding Stewart (Shenks Ferry) sub-phase, MacDonald (2006) recommends an abandonment of the McFate-Quiggle sub-phase and an extension of the Stewart (Shenks Ferry) sub-phase into the 17th century.

KEYHOLE STRUCTURES: AN OVERVIEW AND KEY SITES

The emergence of keyhole structures is a unique phenomenon during the Late Woodland period in the Upper Susquehanna River Valley. Of the dozens of Late Woodland sites in the region, only 11 have revealed keyhole structures (Figure 1), including seven within the West Branch Valley:

1. Ramm site (36Cn44)
2. Piper Airport site 1 (36Cn210)
3. Fisher Farm (36Ce35)
4. Miller (36Ly97)
5. Nash (36Cn17)
6. Bonner Young (36Cn23)
7. Quiggle (36Cn6).

Four additional sites in the North Branch Valley also have yielded keyhole structures. Smith (1976:3) records keyhole structures at two sites in Luzerne County, including the Parker site (36LU14) and the Schacht site (36LU1), while Skelly and Loy (East, personal communication, 2006) has excavated keyhole structures at two additional sites on the far northern portion of the North Branch in Pennsylvania near the New York state line, including the Losey 3 (36Ti28) and Wood (36Ti24) sites.

Thus, in the northern portions of the Susquehanna River basin in Pennsylvania, 11 sites have yielded keyhole structures, with nine of those yielding radiocarbon dates (discussed below). The geographic distribution of these sites appears to be limited to the main watersheds within the northern Susquehanna River basin, with the main stem of the West Branch between Lock Haven and Jersey Shore containing six of the nine sites in the Central West Branch subbasin: Ramm, Piper, Miller, Nash, Bonner Young, and Quiggle (see Figure 1 for site locations). Two additional sites have been identified along Pine Creek and one along Bald Eagle Creek, both major feeder streams of the West Branch (see Figure 1). As discussed above, four additional sites—Parker, Schacht, Losey 3, and Wood—are located on the North Branch Susquehanna River.

Each of these 11 sites is located on a terrace of the West Branch, North Branch, or important tributary stream within 100 m of the river bank. Late Woodland sites located on more remote and smaller feeder streams—including Kettle Creek, Spring Creek, and the upper reaches of Pine Creek—do not contain keyhole structures. Below, I provide details regarding each of the key Late Woodland sites with keyhole structures. The discussion proceeds on a south to north trajectory, starting with the southernmost site, Fisher Farm on Bald Eagle Creek and proceeding through each site to the northernmost two sites in Pennsylvania with keyhole structures, the Losey 3 and Wood sites near the New York state line. For each site, radiocarbon dates for keyhole structures are highlighted in bold italics.

After a review of the 11 sites, I present a summary of the chronology, geography, and function of keyhole structures. Figure 1 provides a map with each of the 11 site locations.
Fisher Farm Site (36Ce35), Bald Eagle Creek

The Fisher Farm site (36Ce35) is located on the west bank of north Bald Eagle Creek, approximately 20 miles upstream (south) of its confluence with the West Branch Susquehanna River in Lock Haven (Hatch 1980, 1983). Ten culturally-associated radiocarbon dates from the Fisher Farm site reflect a series of Late Woodland Clemson Island and Shenks Ferry/Stewart phase occupations, with only the Shenks Ferry occupation yielding a keyhole structure (Feature 28). A list of the radiocarbon dates is provided below:

- 705±70 A.D. (Uga-2683) Feature 12, circular pit with “incidental occurrences of maize, chenopodium, and hickory nut” (Hatch 1980:260). This is the earliest cultural feature at the site and is associated with early Clemson Island pottery in the vicinity of the feature.
- 960±90 A.D. (Uga-2458) Interface of level 5/6, charcoal collected from dense concentration of Clemson Island ceramic sherds
- 1075±125 A.D. (Uga-2676) Feature 4, large shallow area of charcoal and burned clay associated with Clemson Island pottery
- 1125±60 A.D. (Uga-2680) Possible wooden post in problematic contexts
- 1130±80 A.D. (Uga-2677) Collection of charcoal fragments from excavation levels in the vicinity of Feature 9, dated to 1130±110 A.D. with large concentration of Clemson Island ceramics
- 1130±110 A.D. (RL-702), Feature 9, concentration of Clemson Island ceramics, with large sections of whole vessels.
- 1350±105 A.D. (Uga-2276) Feature 28, charcoal from southwest portion of one of the keyhole structures. Shenks Ferry rim sherd was recovered in close association, supporting the date. Hatch (1980:258) interprets this date as confirmation of the Shenks Ferry age for keyhole structures in the region (supporting dates from Piper Airport below).
- 1505±55 A.D. (Uga-2679) Possible yellow pine post fragment.
- 1520±55 A.D. (Uga-2678), Large charcoal sample from excavation level 4A which supports the assertion of a late-Late Woodland occupation at Fisher Farm.
- 1600±150 A.D. (RL-701), Wooden post fragment, also confirming the late-Late Woodland occupation.

This range of radiocarbon dates reflects an intensive Late Woodland occupation, ranging from the earliest Clemson Island to terminal Shenks Ferry/Stewart phases. Penn State excavated 59 features during the 1977 field season (Hatch 1980). Faunal remains were rare at the site and were typically burned and/or poorly-decayed. Botanical remains indicate reliance on a variety of wild and domesticated foods. Carbonized Zea mays (corn) was recovered in four features and is interpreted to be a staple of the Late Woodland diet. Other domesticated food remains include sunflower (Helianthus), bean (Phaseolus vulgaris), squash (Cucurbitaceae), and goosefoot (Chenopodium). Wild foods include raspberry, walnut, hickory, and oak.

As noted above, the lone keyhole structure was identified as Feature 28, a semisubterranean keyhole structure similar to those discussed above for Piper Airport and the Ramm site in Lock Haven. Feature 28 was radiocarbon dated to 1350 A.D., placing its use within the middle of the Late Woodland period (Shenks Ferry/Stewart phase). This is the southernmost keyhole structure of those identified in the West Branch watershed, with their density increasing on a northward trajectory along the river system. The Fisher Farm keyhole structure was a semi-subterranean, rectangular pit feature with a superstructure defined by 17 postmolds in the shape of a keyhole. The main body of the feature measures 2.2 m east-west and 2.1 m north-south. Artifacts from the feature include the remains of corn, bean, squash, sunflower, cattail “matting,” shell- and grit-tempered pottery, and unidentified bone fragments, among a variety of other items (Hatch 1980:179-182).

Based on these feature contents, Hatch (1980:186-187) objects to Smith’s (1976) interpretation of keyhole structures as sweat lodges (see discussion below). The detailed botanical analysis clearly shows
the presence of foodstuffs of wild and domesticated plants and animals in the Fisher Farm structure; thus, he interprets the feature as a food storage facility. In addition, three tightly-packed strata of grass, wood chips, and marsh grass were observed in the structure, likely to produce smoke for food processing or hide tanning. Hatch, thus, interprets the Fisher Farm keyhole structure to be a purely functional food storage and processing facility and suggests that detailed botanical studies are necessary for other keyhole structures in the area to determine if they served similar functions (or were sweat lodges or both).

In addition to the variety of pit features and the keyhole structure, Fisher Farm yielded the partial remains of nine human burials during the 1976-1977 field seasons. The remains are poorly preserved and are largely comprised of soil stains, decayed bone fragments, and tooth crowns. Of the nine burials, teeth remains indicate the presence of three adults (25 - 35 years old), three adolescents (11 - 14 years old), and one infant (<5 years old). Two of the burials lacked diagnostic remains indicative of the individual’s age. Excessive wear on teeth indicate consumption of foods with a high grit content, typical of foraging populations which occasionally use teeth as tools and stone for food processing.

Piper Airport Site 1 (36Cn210) and Site 2 (36Cn211), Lock Haven

MAAR Associates, Inc. (MAI) conducted data recovery excavations at Piper Airport, revealing significant Shenks Ferry/Stewart occupations, including evidence of a stockade and keyhole structures (Payne and Wagner 1999; Payne et al. 2000). The Piper Airport site is located along the West Branch within the city limits of Lock Haven, approximately 20 miles north of the Fisher Farm site discussed above. A total of 12 radiocarbon dates were assayed from a variety of feature types, including the stockade, two houses, four keyhole structures, and four pits from Site 36Cn210, as well as a single pit feature from Site 36Cn211. These dates are listed below from oldest to youngest with keyhole structures in bold italics (Payne et al. 2000:IV-5):

- 1100 A.D. (920±110 B.P.) (Beta-136223) 36Cn211 Feature 2 Pit
- 1280 A.D. (730±60 B.P.) (Beta-136222) 36Cn210 House 3
- 1395 A.D. (590±70 B.P.) (Beta-134672) 36Cn210 Feature 12 Pit
- 1400 A.D. (590±60 B.P.) (Beta-151167) 36Cn210 Feature 9 Keyhole Structure
- 1405 A.D. (560±60 B.P.) (Beta-136220) 36Cn210 House 4 postmold charcoal
- 1410 A.D. (540±60 B.P.) (Beta-134673) 36Cn210 Feature 1 Pit
- 1450 A.D. (420±70 B.P.) (Beta-136221) 36Cn210 Stockade Postmold
- 1450 A.D. (420±80 B.P.) (Beta-134670) 36Cn210 Feature 1 Keyhole Structure
- 1450 A.D. (420±60 B.P.) (Beta-136219) 36Cn210 Feature 10 Pit
- 1480 A.D. (380±50 B.P.) (Beta-134797) 36Cn210 Feature 8 Keyhole Structure
- 1490 A.D. (370±60 B.P.) (Beta-134671) 36Cn210 Feature 1 Pit
- 1645 A.D. (270±50 B.P.) (Beta-134798) 36Cn210 Feature 9 Keyhole Structure

Payne et al. (2000:IV-6) groups these dates into three site occupations, including the Pre-Fortification Period (1350 - 1425 A.D.), the Fortification Period (1425 - 1480 A.D.), and the Post-Fortification Period (1480 - 1560 A.D.). Initial occupation of the Piper Airport area was at Site 36Cn211, the smaller of the two sites, at approximately 1100 A.D. There was an occupational hiatus until approximately 1300 - 1350, after which there was a series of overlapping site visits during the Shenks Ferry/Stewart phase of the Late Woodland. Interestingly, these initial dates of intensive site occupation—ca. 1350 A.D.—correspond approximately with the decline in use of the nearby Memorial Park site at ca. 1385 A.D. which lacks keyhole structures (Graybill 1995; Hart 1995).

During the Pre-Fortification Period of Site 36Cn210, a single longhouse (House 4) was present, as was at least one keyhole structure (Feature 9). The building resembles a classic Iroquois longhouse, measuring 41 m east-west and 7.7 m north-south, with walls consisting of double posts. Inside the longhouse, a series of hearth stains were present, including Feature 12, at approximately 3 m intervals which may have been shared by two families each. Several gaps were observed along these alignments, one of which contained a child burial. The infant burial was identified within House 4, dated to approximately 1400 A.D. The flexed burial consisted of poorly-preserved cranial and long bones along an
east-west orientation. The individual was approximately 5 years old, based on preserved dentition, but its sex was uncertain.

Five pit features were excavated near House 4, two of which dated to the Pre-Fortification period. Each of the pits contained Stewart phase incised rim sherds similar to those recovered inside the longhouse.

During the Fortification Period—ca. 1450 A.D.—a stockade was constructed consisting of a single line of posts with two entrances. The eastern end of the longhouse extended into the extant airport facilities and remains unexcavated. The stockade measured 28 m north-south and 38 m east-west with a postmold dated to approximately 1450 A.D. Payne et al. (2000:V-2) suggests that the stockade contained two longhouses (Houses 2 and 3) aligned parallel on an east-west axis, with similar construction patterns (double posts) as the earlier house (House 4). Hearths were aligned in a central corridor at approximate 3-m intervals. House 3 was dated to approximately 1280 A.D. and is considered to be too early, although it could represent an earlier occupation. A keyhole structure in the northern longhouse (House 2) was dated to 1450 A.D., which matches the fortification, suggesting contemporaneity. Payne et al. (2000) estimates a population of approximately 70 - 75 persons, if both houses in the stockade were occupied simultaneously. A square pit feature (Feature 10) within the stockade yielded abundant floral and faunal remains, three Owasco pottery sherds, a Clemson Island sherd, and also was dated to ca. 1450 A.D. This feature was ringed by postmolds, suggesting the presence of a structure.

Finally, MAI identified at least three keyhole structures associated with the Post-Fortification Period—ca. 1480 - 1500 A.D. One keyhole structure—Feature 8—was radiocarbon dated to 1480 A.D. and overlaid postmolds from the fortification, implying use of the keyhole after abandonment of the fortification. Two other keyhole features were nearby, including Feature 8, which overlaid the remains of the stockade’s wall and was dated to 1645 A.D. The three keyhole structures each contained Stewart (Shenks Ferry) pottery.

Subsistence remains from the various late-Late Woodland occupations at Piper Airport indicate a mixed diet, including beans, corn, and squash, with corn the apparent staple of the diet, along with hickory nut and walnuts. Fish remains from the site include catfish and suckers, with a surprising number of toad and frog remains as well. Mollusks were the predominant shellfish type, while mammal remains included deer as well as others too fragmentary to type.

**Ramm Site (36Cn44), Near Great Island**

Located immediately east of the confluence of Bald Eagle Creek and the West Branch Susquehanna River, the Ramm site (36Cn44) was a focus of Smith’s 1973 excavations near Great Island in Lock Haven. An unpublished manuscript of Ira Smith’s 1973 work at Site 36Cn44 is available for review at the Pennsylvania State Museum in Harrisburg and provides the basis for this section.

After plowing of the field in 1973, several pit features were observed and approximately 7000 sq. ft. of the site was surface surveyed. Smith’s 1973 field season exposed 44 pit features, two keyhole structures, and dozens of postmolds, as well as over 1300 grit-tempered—predominantly Clemson Island and Shenks Ferry/Stewart—pottery sherds and 1200 lithic artifacts. The postmolds formed portions of two rectangular longhouses. One of the structures was completely exposed, measuring 25 x 20 ft. with rounded corners. A bark-lined pit feature was identified in the northwestern corner of the structure, yielding calcined bone fragments, FCR, charcoal, and two Clemson Island (fabric-impressed) pottery sherds. Portions of a second rectangular longhouse were identified 40 ft. east, measuring approximately 18 ft. in diameter, with an undetermined length.

In addition to the two longhouses, Smith’s 1973 excavations identified two semi-subterranean keyhole structures at the Ramm site. Smith (1976) defines these structures as sweat lodges, although their precise function is uncertain. The body of the keyhole structure is below ground and is encircled by postmolds, with an entrance tunnel extending eastward from the body to the ground surface, also with postmolds along its edges. Several hundred FCR were recovered from the keyhole structure, as were 29 Clemson Island and seven Shenks Ferry pottery sherds. A second sweathouse was identified at the site, once again oriented directly east. Only the postmolds were present to define the boundaries of the second
keyhole structure, which yielded similar contents and was of a similar shape. Pottery sherds in the second keyhole structure at the Ramm site were exclusively of the Shenks Ferry (Stewart) variety \((n=79)\).

Wood charcoal from three features—two pits and one of the keyhole structures (Feature 15)—at the Ramm site were subjected to radiocarbon analysis at the Radioisotope Laboratory, Dicar Corporation, Cleveland, Ohio. Two pit features (14 and 34) produced radiocarbon dates:

- 530±100 years B.P. (A.D. 1420) (DIC-211)
- 1230±200 years B.P. (A.D. 720) (DIC-210)

The charcoal sample from one of the keyhole structures (it is uncertain which one based on available documents) was radiocarbon dated to:

- 720±100 years B.P. (A.D. 1230) (DIC-212)

These three radiocarbon dates confirm the artifactual data that indicate the presence of early-Late Woodland Clemson Island and middle-late Late Woodland Shenks Ferry/Stewart components. The A.D. 1230 radiocarbon date is among the earliest of any from keyhole structures in the region.

Quiggle Site (36Cn6), Near Jersey Shore

Downstream from Lock Haven, the State Museum of Pennsylvania conducted extensive archaeological work at the Quiggle site along the south side of the West Branch Susquehanna River. Ira Smith (1984) led the early-1970s excavations at the site as part of the salvage operations along the river after Hurricane Agnes. The Quiggle site is located at the base of Bald Eagle Mountain, approximately 0.5 mile south of Avis/Jersey Shore and 0.5 mile west of the confluence of Pine Creek and the West Branch. Initial work was conducted in the 1920s by Dr. Thomas Stewart, a local physician who had collected hundreds of artifacts from the Quiggle farm. Among the more interesting artifacts collected by Stewart were a variety of Woodland artifacts, including rattlesnake’s tail and bird’s head effigy pipes, a copper bracelet, two copper rings, and a Jesuit cross, perhaps indicative of a Contact-period occupation. Stewart excavated 207 2x2-ft. holes at close intervals (“every few feet”) across the main “village” area. These early excavations apparently did not reveal significant features and local collectors had “destroyed every pit which had not been filled in” (Smith (1984:9, Figure 22).

Smith returned to the Quiggle site with a small field crew in 1971, exposing approximately 25,000 sq. ft. of surface area during feature exploration. As a result, a stockade outline with a surrounding ditch was identified at the site. The interior village was approximately 160 ft. wide, with the southern edge along Bald Eagle Mountain consisting of a single line of posts. The density of posts increased toward the river and occurred within two parallel lines, interpreted to be a result of more-intensive fortifications along the more exposed portions of the stockade.

Inside the stockade, excavations exposed thousands of postmolds, so many that observing patterns among them was impossible. Artifacts from the features include “hammerstones, mullers, anvil stones, netsinkers, celts, shale discs, flint detritus, complete projectile points, fire cracked rocks, shell-tempered rim and body sherds, unfired clay, toy pots, mussel shells, animal bone, bone beads, awls, and beaming tools” (Smith 1984:14). Along with the posts, Smith identified 18 keyhole structures, each of which was outside of the stockade wall on the edge of the site. Despite the findings of Hatch (1980) at the Fisher Farm site, Smith (1984:18-20) continues to maintain that these keyhole structures are sweat lodges, as opposed to storage structures for foodstuffs. Based on pottery styles, Quiggle site keyhole structures date to the end of the Late Woodland period (~ Shenks Ferry-Stewart). However, no radiocarbon dates are available from the Quiggle site keyhole structures.

In addition to the stockade and keyhole structures, two infant and two adult burials were recovered at the Quiggle Site, with one infant buried outside of the stockade, one in the surrounding ditch, and the two adults within the stockade wall. Each of the burials possessed a flexed position within rock-lined pits. Pottery at the Quiggle site included 3,650 sherds, with most of the shell-tempered “McFate-Quiggle” variety, indicative of a terminal Late Woodland/Contact period site. Several “exotic” sherds indicate
cultural associations with Native Americans of the McFate culture of southwestern New York and northwestern Pennsylvania (Smith 1984:58-63). Only 37 grit-tempered Clemson Island sherds were recovered, confirming that the site dates to the latter portion of the Late Woodland.

**Bonner-Young Site (36Cn23),**

Located near the Quiggle site in Jersey Shore, the Bonner-Young site (36CN23) was excavated by Ira Smith and the PHMC in 1972 (BHE 2003). The site is located at the confluence of Pine Creek and the West Branch Susquehanna River. Herbstritt (BHE 2003) reports that Smith and the PHMC team excavated a keyhole structure at the site in 1972, resulting in a radiocarbon date of 1665 A.D. (240±50 B.P.) (Beta-98779). The date is from a wall post excavated in situ from Keyhole Structure #2. Associated artifacts at the site include a triangular biface and Quiggle and Clemson Island pottery. Unfortunately, little additional information is available regarding the Bonner-Young site.

**Miller Site (36Ly97), Pine Creek**

In their Pine Breeze Island data recovery report, BHE (2003) includes a summary of Clemson Island radiocarbon dates by James Herbstritt in an appendix. In this report, Herbstritt provides radiocarbon dates and site summaries for several unreported sites in the current study area. One of these sites is the Miller site, upriver from Pine Breeze Island. According to Herbstritt’s report in BHE (2003), the Miller site yielded a variety of features, including the earliest dated keyhole structure in the region; however, this 810 A.D. date is considerably earlier than other dates from the period and, thus, is considered anomalous. Clemson Island pottery was recovered from features with two radiocarbon dates:

- 1180 A.D. (910±60 B.P.) (Beta-98784) pit feature with Clemson Island pottery
- 810 A.D. (1140±120 B.P.) (DIC-213) Clemson Island Keyhole Structure

**Nash Site (36Cn17), Pine Creek**

The Nash site was excavated in the early 1970s by Ira Smith of the PHMC on the western shore of Pine Creek, within sight of Pine Breeze Island site discussed above. Features include rock clusters, pits, postmolds, and a keyhole structure. Five radiocarbon dates are provided by Herbstritt in the appendix of BHE’s (2003) report:

- 960 A.D. (990±80 B.P.) (Beta-7266) carbonized organics from base of flat-bottomed storage pit with grass lining with triangular bifaces and Clemson Island pottery
- 1020 A.D. (1030±80 B.P.) (Beta-98778) wood charcoal in deep basin pit, with bone, mussel shell, and Clemson Island pottery
- 1235 A.D. (860±90 B.P.) (Beta-98777) carbonized wood (?) from feature with bone, mussel shell, and Clemson Island pottery
- 1595 A.D. (355±80 B.P.) (Beta-7265) wood fragment from Keyhole structure with Clemson Island artifact assemblage
- 1715 A.D. (235±80 B.P.) (I-7264) wood fragment from Keyhole structure with Clemson Island artifact assemblage

Skelly and Loy excavated a series of Late Woodland sites on the North Branch Susquehanna River near the New York state line during the early 2000s (Thomas East, personal communication, 2006). Results of this work indicated a substantial village occupation with at least four keyhole structures from two sites, 36TI24 (Losey 3 site) and 36TI28 (Wood site). The conclusion below provides more details regarding the keyhole structures at these sites.
KEYHOLE STRUCTURES: SUMMARY AND INFECTION

While the function of keyhole structures remains uncertain (as discussed in more detail below)—they could be sweat lodges, storage/smoking features, and/or winter houses—their main period of use was clearly the latter portion of the Late Woodland period. As reflected in Figure 3, nine sites have yielded radiocarbon dated keyhole structures, including 6 in the West Branch Susquehanna River basin:

- **Ramm (36Cn44)**
  1230 A.D. (720±100 B.P.) (DIC-212)

- **Piper Airport I (36Cn210)**
  1400 A.D. (590±60 B.P.) (Beta-151167)
  1450 A.D. (420±60 B.P.) (Beta-134670)
  1480 A.D. (380±50 B.P.) (Beta-134797)
  1645 A.D. (270±50 B.P.) (Beta-134798)

- **Fisher Farm (36Ce35)**
  1350±105 A.D. (Uga-2276)

- **Miller (36Ly97)**
  810 A.D. (1140±120 B.P.) (DIC-213)

- **Nash (36Cn17)**
  1595 A.D. (355±80 B.P.) (Beta-7265)
  1715 A.D. (235±80 B.P.) (I-7264)

Figure 3. Summary of radiocarbon dates from keyhole structures.
Smith (1976:5) reports two radiocarbon dates for keyhole structures at the Parker site on the North Branch Susquehanna River as well:

- Parker (36LU14)
  - 1470 A.D. (480±90 B.P.)
  - 1600 A.D. (350±90 B.P.)

Of these 12 radiocarbon dates from the seven sites, 10 have conventional radiocarbon ages that post-date 1350 A.D., while eight post-date 1450 A.D. The terminal dates for keyhole feature use are 1715 A.D. from Nash and 1665 A.D. from Bonner Young, with a total of five sites having dates between 1595 A.D. and 1715 A.D. Certainly the very early 810 A.D. date from the Miller site appears anomalous, as perhaps does the 1230 A.D. date from the Ramm site near Great Island, although this early date may simply mark the origin of the feature type. These dates confirm Smith’s (1976:12) speculation that these features were utilized primarily during the latter portion of the Late Woodland period and are likely not associated with the Clemson Island culture. Certainly, the lack of keyhole structures at sites such as Memorial Park, West Water Street, and Kress supports this interpretation, as each of these sites was occupied most intensively prior to 1300 A.D. during the heyday of Clemson Island. As such, based on radiocarbon dates assembled herein, keyhole features are interpreted to be a post 1350 A.D. phenomenon along the Central West Branch and vicinity, with their use extending well into the 17th century A.D.

Thomas East of Skelly and Loy (personal communication 2006) reports 13 additional radiocarbon dates from keyhole structures at the Losey 3 and Wood sites on the North Branch Susquehanna River near the New York State line, the farthest north of any of the sites with keyhole structures. Some of the earliest and latest recorded dates for keyhole structures were assayed from these two sites. However, as would be expected given their northern locations, of the 13 dates from the two sites, 11 of them post-date 660 BP, or 1290 A.D., while five post-date 1400 A.D.

The following is a list of conventional radiocarbon ages for the keyhole structures at the Losey 3 and Wood sites in sequence from earliest to latest, as provided by Thomas East of Skelly and Loy:

- 1130±40 A.D. (820±40 B.P.) (Beta-191969), AMS Maize, Feature 74.3, Losey 3 (36TI28)
- 1130±40 A.D. (820±40 B.P.) (Beta-191965), AMS Maize, Feature 74, Losey 3 (36TI28)
- 1290±40 A.D. (660±40 B.P.) (Beta-191967), AMS Pitch, Feature 74, Losey 3 (36TI28)
- 1320±40 A.D. (630±40 B.P.) (Beta-191966), AMS Pine, Feature 74, Losey 3 (36TI28)
- 1360±40 A.D. (590±40 B.P.) (Beta-191968), AMS hawthorn seed, F. 74, Losey 3 (36TI28)
- 1360±40 A.D. (590±40 B.P.) (Beta-191964), AMS bean, Feature 74, Losey 3 (36TI28)
- 1400±40 A.D. (550±40 B.P.) (Beta-191970), AMS hawthorn, F. 74.3, Losey 3 (36TI28)
- 1500±60 A.D. (450±60 B.P.) (Beta-181653), wood charcoal, Feat. 254, Losey 3 (36TI28)
- 1500±40 A.D. (820±40 B.P.) (Beta-214955), AMS hornbeam twig, F. 22, Wood (36YI24)
- 1540±60 A.D. (410±60 B.P.) (Beta-181650), wood charcoal, F. 254a, Losey 3 (36TI28)
- 1550±40 A.D. (400±40 B.P.) (Beta-214956), AMS squash stem, F. 22, Wood (36YI24)
- 1560±40 A.D. (390±40 B.P.) (Beta-181652), wood charcoal, F. 265, Losey 3 (36TI28)
- 1600±40 A.D. (350±40 B.P.) (Beta-181651), wood charcoal, F. 254c, Losey 3 (36TI28)

These 13 additional dates from the Losey 3 and Wood sites on the North Branch Susquehanna River indicate that keyhole structures were used for nearly 500 years in this area, with their main period of use between 1400 and 1600 A.D. This pattern is similar to that observed at the 7 other sites in the Central West Branch and North Branch Valleys, as discussed above. In total, thus, of the 25 total radiocarbon dates from the nine sites with keyhole structures, 19 dates occur after 1350 A.D., while only six occur before that date (Figure 3). As shown in Figure 3, the key period of use for keyhole structures (based on dates presented herein) was between the 14th and late 17th centuries A.D.
CONCLUSION

In summary, 11 regional sites—including seven in the West Branch sub-basin and four in the North Branch sub-basin—have yielded keyhole structures. Nine of these sites have yielded a total of 25 radiocarbon dates on keyhole structures. Based on data from these 11 sites, keyhole structures were used primarily during the 14th - 17th centuries along the main stem of the West Branch Susquehanna River, mainly between Lock Haven and Jersey Shore, Pennsylvania. This area is also the likely origin point for the feature type, as sites are not only concentrated here, but are earliest in time as well. Dates for features at sites along Pine Creek to the north, Bald Eagle Creek to the south, and the North Branch to the east are later, suggesting the gradual spread of keyhole structures outside of the central core area along the West Branch.

Thus, the origin of the keyhole structure was likely along the central portion of the West Branch Susquehanna River, with the earliest accepted date at the Ramm site near Great Island at 1230 A.D. Dates from Fisher Farm on Bald Eagle Creek are approximately a century later, while the two available dates for keyhole structures at the Parker Site suggest a late arrival on the North Branch, approximately between 1470 and 1600 A.D. While dates from the Losey 3 and Wood sites on the North Branch in far northern Pennsylvania range from 1130 to 1600 A.D., seven of the 13 dates occur after 1400 A.D., with the remaining six dates between 1130 and 1360 A.D. While not conclusive, these dates support a later arrival in the North Branch Susquehanna River Valley compared to the West Branch.

Additional sites with dated keyhole structures would aid in deciphering the chronological spread of keyhole structures. Based on data presented here, however, keyhole structures were utilized mainly between approximately 1230 and 1670 A.D., a span of approximately 440 years during the latter portion of the Late Woodland period.

Keyhole features were also a fairly localized feature type to the main stem of the West and North Branches, with a fairly limited range beyond that core area. Given the northern Pennsylvania locations of all of these sites, it would be reasonable to assume a possible proto-Iroquoian origin; however, Smith (1976) suggests that the features are likely of “Algonkian” cultural affiliation, with their origins associated with Shenks Ferry-Stewart cultures of the Susquehanna River basin, or even the Monongahela of southwestern Pennsylvania or McFate of northwestern Pennsylvania. Data are not available to further evaluate the ethnic affiliation of Native Americans that used keyhole structures.

Smith (1976) provides an excellent comparative overview of six of the keyhole structures in the region (Nash, Ramm, Miller, Parker, Schacht, and Quiggle) interpreting them to be sweat lodges. As discussed above, Hatch (1980) disputes this universal interpretation based on the presence of food remains of various types within the keyhole structure at the Fisher Farm site. Thomas East (personal communication, 2006) cites similarly-shaped structures in Ontario and the Midwest as winter houses and suggests a similar function for those in north-central Pennsylvania.

Given the locations of the sites with keyhole structures along major waterways, as well as their possible associations with agricultural villages and hamlets, it seems reasonable to support Hatch’s (1980) interpretation that keyhole structures were primarily utilized as storage facilities for foodstuffs or, perhaps, as winter houses, as suggested by Tom East (personal communication, 2006). However, the possibility that some keyhole structures functioned as sweat lodges, as suggested by Smith (1976) cannot be eliminated based on current data. The emergence of fortifications seems to have coincided with or immediately preceded the emergence of keyhole structures, suggesting the possible association of the two major feature types. This relationship needs to be pursued further to monitor the chronology of fortifications in relation to that presented here for keyhole structures. Also, data regarding keyhole structures in south-central New York on the upper North Branch should be investigated to determine the northern extent of the feature type.

While data regarding the chronology and distribution of keyhole structures is sufficient to make preliminary hypotheses regarding their age and geography, the record certainly could be supplemented with data beyond those 11 sites discussed herein. Even more importantly, the function of keyhole structures needs to be analyzed in more detail, likely requiring the excavation of more sites in the region, as well as a closer examination of each feature at the 11 sites discussed herein. The major period of study
of keyhole features was in the 1970s and 1980s, with very little additional study in the 1990s and 2000s. Additional excavations of Late Woodland sites with keyhole structures in these areas could shed light on their origins, cultural affiliations, functions, and geographic distributions. Future studies of the Late Woodland in the Susquehanna River Valley should attempt to better understand the role of keyhole structures. Ultimately, while sufficient data are available to evaluate the age and geographic distribution of keyhole structures, more data are needed to come to terms with their function and ethnic affiliation.

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