MORE ON MIGRATION IN PREHISTORY: ACCOMMODATING NEW EVIDENCE IN THE NORTHERN IROQUOIAN CASE

Dean R. Snow

Crawford and Smith have developed important new evidence that bears on the hypothesis that the Northern Iroquoians migrated into the lower Great Lakes region sometime after A.D. 900. Clarification of the Princess Point Complex in Ontario forces a revision of the hypothesis. While an Appalachian origin for the Northern Iroquoians and their subsequent migration is not rejected, new evidence strongly suggests that the population shift took place three centuries earlier than I previously proposed. The situation calls for both further refinement of paleodemographic theory and new empirical research into Owasco and other earlier Northern Iroquoian complexes.

Crawford y Smith han desarrollado nueva e importante evidencia con respecto a la hipótesis de que los iroqueses del norte emigraron hacia el sur de la región de los Grandes Lagos alrededor de 900 d.C. Un reexamen del complejo Princess Point en Ontario amerita la revisión de esta hipótesis. Si bien no se rechaza un origen en los Apalaches para los iroqueses del norte ni se descarta su migración subsiguiente, la nueva evidencia sugiere fuertemente que el cambio de población ocurrió tres siglos antes de lo anteriormente propuesto. La situación exige un mayor refinamiento de la teoría paleodemográfica y de las nuevas investigaciones sobre el Owasco y otros complejos de los iroqueses del norte.

I very much appreciate the opportunity to comment on the article written by Gary Crawford and David Smith (this issue). They have undertaken some much needed research in their effort to clarify the Princess Point Complex, and their recent findings necessarily force a major rethinking of the evidence for Iroquoian origins and the advent of maize horticulture in the Lower Great Lakes region. That said, while the new findings necessitate a revision in the specifics of the migration hypothesis I proposed in 1995, I conclude that they provide additional support for a migration hypothesis of some kind. The following discussion includes a revised hypothesis.

The Princess Point Complex is currently a very different construct from that initially defined by Stothers (1976, 1977) two decades ago. As currently used, the complex is comprised of sites found along the lower Grand River of southern Ontario and the nearby shorelines of western Lake Ontario and northeastern Lake Erie. Stothers initially referred to this as only one of three "foci" of Princess Point culture, the other two lying westward in two areas between Lake Huron and Lake Erie. He estimated the age of the complex to be in the A.D. 800–1000 period. Later researchers reassigned the two western expressions to other traditions and extended the age of the remaining Grand River expression of Princess Point to A.D. 600 or 650 (Fox 1990). Furthermore, while Stothers (1976:139, 158) made the Porteous site on the Grand River a component of the Princess Point Complex, Noble and Kenyon (1972) argued that it was probably an early Glen Meyer village site. So far as I am aware, everyone agrees that Glen Meyer is an archaeological construct found in roughly the same area as Princess Point, that it is later than Princess Point, and that it was associated with Northern Iroquoian people.

My main problem in applying the migration hypothesis to the Ontario evidence was in deciding whether Princess Point was part of the developmental continuum begun by Iroquoian immigrants and evolving into Glen Meyer and later phases, or (alternatively) that it was an independent Middle Woodland period development that was not directly ancestral to Glen Meyer. I was influenced by evidence that charred maize kernels once attributed to Princess Point occupa-

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tions at key sites were by 1990 thought by at least some investigators to have come from later occupations (Fox 1990:178). Although Princess Point seemed to have appeared suddenly and without predecessors in the Grand River area (Stothers 1977:155–158), from published accounts there seemed also to be a discontinuity between Princess Point and Glen Meyer. Given that Princess Point sites did not include the large compact village sites usually associated with early Iroquoians, that their ages often predated A.D. 900, and that doubt had been cast on the association of charred maize with Princess Point components, I decided that Princess Point was probably outside the continuum of Iroquoian development, not inside it. Crawford and Smith are quite right in saying that this conclusion depended on either negative or inconclusive evidence at the time I came to it.

Crawford and Smith's new data have changed matters considerably. They have shown with as much certainty as one can expect from archaeology that charred maize is indeed associated with Princess Point sites and that AMS dates carried out on the maize kernels indicate that the sites were occupied by at least A.D. 600, perhaps earlier. Furthermore, their recent work has shown that at least the Lone Pine and Grand Banks sites are the large compact village sites that we previously thought were missing from the Princess Point Complex.

The findings of Crawford and Smith put Princess Point within and at the beginning of the long continuum leading to the historic Ontario Iroquois. Furthermore, they indicate that Princess Point is at least as old as, and perhaps older than, Clemson's Island culture in central Pennsylvania. If Stewart's dating of Clemson's Island sites is correct, the later Owasco sites in New York could be derivative from Clemson's Island, but Princess Point cannot be. Thus the specific hypothesis that Owasco, Glen Meyer, Pickering, and other later Iroquoian expressions all derived from Clemson's Island must be modified.

Although the 1995 version of the migration hypothesis must be modified, the anomalies that I cited in 1995 still persist. Matrilocality and matrilineality do not develop slowly over time, they usually appear suddenly and as a feature of migrating communities having means of subsistence that allow for relatively large compact permanent villages. The communities are typically large relative to those of the population(s) being displaced by the migrating one. Anomalies also still persist in Iroquoian historical linguistics. The speakers of Proto-Northern-Iroquoian knew about maize and had a vocabulary that strongly suggests origins in the Appalachian uplands. Moreover the site distribution data and ceramic data that I argued pointed to discontinuity in the sequence have also not gone away. The difference in the latter is that Smith's reanalysis of Princess Point ceramics indicates that they are similar in basic construction to later Iroquoian ceramics and not fundamentally similar to Point Peninsula ceramics (Smith 1995). I inferred too much from Williamson's (1990:295–298) statements contrasting Princess Point and Early Iroquoian vessels. The discontinuity is now clearly at the boundary between Princess Point and Point Peninsula, around A.D. 600 or earlier.

Where I must continue to disagree with Crawford and Smith is on the nature of the association of horticulture, matrilocality, migration, and compact villages. Horticulture need not be associated with matrilocality, as cases from interior Alaska attest. However, matrilocality and migration are often associated with compact villages, and the latter must be supported by means of subsistence that are productive enough to allow their persistence over the long term. Thus, while matrilocality is often associated with horticulture, horticulture does not in itself produce matrilocality (Divale 1984). This is contrary to assumptions in much earlier literature (e.g., Trigger 1978). I do not now conclude that Princess Point was just another Middle Woodland complex with a little maize added. What I do conclude is that the new Princess Point evidence puts the Iroquoian intrusion into Ontario about three centuries earlier than I had previously thought. The new data have not erased the discontinuity in the sequence, they have pushed it back. Migration is still necessary to explain discontinuity in the archaeological record.

I am grateful that migration is no longer a taboo subject. It is one of a small number of essential demographic processes, and its denial does not facilitate realistic archaeological inference in the long run (Anthony 1990). Bogucki's very recent synthesis of the evidence for the spread of agriculture into Europe is additional evidence of the new appreciation for a realistic assessment of paleodemography. If farming entered Europe from Anatolia by way of Greece, then a major issue becomes whether the process involved colonization or the spread of domesticated plants and animals to indigenous foraging groups. The answer appears to be that both processes were going on, and that archaeologists can often detect which one characterized any particular case. Colonizing farmers moved into flood plain habitats not much used by indigenous foragers, and their sites appear without precedent in the seventh millennium B.C. Elsewhere in Greece there is evidence for continuity on forager sites in terms of most of their artifactual inventories, with the addition of domesticated plants and animals. In the former case there is archaeological discontinuity, in the latter there is continuity, and the two can be distinguished (Bogucki 1996).

Returning to the Iroquoian case, there is additional evidence from the Eastern Woodlands that deserves mention. It is clear from maps published by Anderson (1991) that the spatial distribution of archaeological phases in the Eastern Woodlands was very spotty over the last thousand years of prehistory. A recent revision of those maps confirms that there were large buffer zones in the region and that core areas defined by site clusters shifted in space over time (Milner et al. 1992). Anderson's (1994) examination of Savannah River chiefdoms reveals cycles of subregional florescence and abandonment that can only be explained in terms of dynamic demographic processes that must have included migration. The signatures of those processes are repeated many times over in the region. Of specific interest to the Iroquoian case is the sudden appearance of the Cashie phase in North Carolina sometime around A.D. 800 (Anderson 1991:12; Phelps 1983:43). This phase persists in modified form and without discontinuity into the seventeenth century, and is identified with the historic Tuscarora, Meherrin, and Nottoway, all of them Northern Iroquoian speakers. This branch of Northern Iroquoians represents, on linguistic grounds, the oldest divergence from Proto-Northern-Iroquoian. All other differentiation of Northern Iroquoian languages must have taken place after the separation of ancestral Tuscarora, Meherrin, and Nottoway. The associated archaeological evidence (i.e., the Cashie phase) indicates that this must have taken place by at least A.D. 800, perhaps a century or two earlier. Northern Iroquoian glottochronology, such as it is, supports this inference.

Glottochronology continues to be alternately used and condemned by archaeologists and linguists. Although it has worked in specific cases, it has failed spectacularly in others. One problem appears to be that the persistence of linguistic homogeneity over large areas is density dependent (Shaul 1986). A thin population of foragers might maintain a widespread common language for centuries, and in this kind of situation one should expect glottochronology to fail. While linguistic diversification may be maladaptive for low-density populations, it may characterize locally dense populations of horticulturalists. Unfortunately, historical linguists have typically given up on glottochronology rather than make an attempt to refine it by finding ways to control for the density effect and other possible variables. Based on archaeological tests, glottochronology does appear to work reasonably well for the last millennium of prehistory in the portion of the Eastern Woodlands lying south of the subarctic (Fiedel 1987, 1991). My hope is that historical linguists will take a fresh look at demographic factors and attempt to refine a technique that in my judgment is not hopelessly flawed.

The new evidence from Princess Point sites suggests that the breakup of Northern Iroquoian languages must have begun at least three centuries earlier than I previously thought. In other words, it now appears likely that Princess Point, Clemson's Island, and Cashie all represent early Northern Iroquoian speech communities. On the basis of current evidence, Owasco still looks like it is derivative from Clemson's Island, for the accepted dates for Early Owasco sites in south-central New York average around A.D. 900. However, there are at least four radiocarbon dates from Owasco occupations in that area that calibrate to earlier than A.D. 900 (Funk 1993:158–171; Wurst and Versaggi 1993). The earliest of these is a date of 1425 ± 150 B.P. (QC-1001), which calibrates to 644 cal A.D. with the program CALIB 3.0.3 (Stuiver and Reimer 1993). Funk, Wurst, and Versaggi discount this very early date as well as three dates calibrating to the eighth century A.D. However, this rationalization of early dates might have more to do with expectations arising from the generally accepted orthodox New York sequence than with a critical appraisal of the age determinations, the samples from which they derived, and their associations. I have argued elsewhere (Snow 1995:65) that the Hunter's Home phase, the last in the Point Peninsula tradition, is a spurious construct. If that phase never existed and it is actually based on an archaeological amalgam of earlier Point Peninsula and intrusive Early Owasco remains as I have argued, then perhaps the growing number of radiocarbon dates calibrating to the period A.D. 644–900 should be taken at face value rather than dismissed. If the Hunter's Home phase never existed, then Owasco sites in south-central New York dating to the eighth century or even earlier should not be unacceptable. Indeed, the early dates are consistent with dates for early Clemson's Island sites and (thanks to Crawford and Smith) what we now know to be similar dates for Princess Point sites.

If Owasco eventually proves to be as old as Clemson's Island and Princess Point, then it too cannot be derivative from Clemson's Island. My hypothesis will have to be modified again, and I will do it without regret. Either way, a more basic question remains: where did all of these complexes (including Cashie) come from? What persists from my original hypothesis is the argument that they cannot have come from the Point Peninsula tradition. What is new is that some and perhaps all of them arrived earlier than we had realized.

What is thus also new is that the Princess Point evidence makes it likely that the initial spread of horticulture (and horticulturalists) into southern Ontario was not simply a consequence of the onset of the Medieval warm epoch, for this climatic episode did not begin until ca. A.D. 1000 (Ingram et al. 1981). If Owasco proves to be similarly older than currently thought, then we have additional evidence leading to the same observation.

I remain mindful that general acceptance of the migration hypothesis, or some further revision of it that might be made necessary by still more new data, depends on prior acceptance in principle of some important demographic processes. The spottiness of Middle and Late Woodland populations and their mobility over the long term are necessary assumptions. So too is the assumption that there was linguistic and other cultural continuity over time within the shifting clusters mapped by Anderson (1991) and others (Milner et al. 1993). That said, it is worth noting that the historic Cheyenne case provides both a supportive example and a cautionary tale. In the seventeenth century the Cheyenne were wild rice gatherers living in temporary camps in what is now northern Minnesota. By the middle of the eighteenth century they were sedentary maize horticulturalists living in southern Minnesota and the Dakotas. By the early nineteenth century they were mounted buffalo hunters living in nomadic tipi dwellings on the Plains. Archaeologists have pretended for too long that this kind of movement over time and space was a special and generally unprecedented consequence of the rapid displacements, population declines, and technological changes brought on by contact with Europeans. It may be that normal demographic processes were accelerated and/or magnified by European contact, but they were surely not created by it without precedent. The same criticism can be leveled at traditional archaeological inferences regarding the presumed lack of demographic dynamics in northern Europe before contact with the Roman armies that supposedly both set them in motion and documented the process. I argue that paleodemography is not exempt from uniformitarian principles.

The cautionary part of the Cheyenne case has to do with the rapid, perhaps even revolutionary, transformation that Cheyenne culture went through at least twice in only two centuries. One could not hope to track such an evolution archaeologically without the assistance of documentary sources. There are at least two great discontinuities in the Cheyenne archaeological record despite documented cultural continuity over time (Moore 1987:82–87). Moreover, the transformations they experienced each involved pervasive cultural reconstruction from elements derived from two or more antecedent societies, a rhizotic form of ethnogenesis that is very different from the cladistic model often used to describe the inferred development and diversification of cultures over time (Moore 1994). We would not necessarily be able to assume continuity in various Northern Iroquoian sequences after A.D. 600 were it not present in the archaeological record. Fortunately for us that continuity is present. More important, perhaps, is that we cannot necessarily expect to find a clear common archaeological ancestor for the related Princess Point, Clemson's Island, Owasco, and Cashie complexes. Lexical items in Proto-Northern-Iroquoian and the deeper relationship between Northern Iroquoian languages and the sole surviving Southern Iroquoian language (Cherokee) all point to origins in the Appalachians. Proto-Northern-Iroquoian has words for red oak, hickory, maple, elm, basswood, and pine, but words for northern species like birch, hemlock, fir, and tamarack were added later to descendant languages. Even the historic distribution of those languages points to origins in the central Appalachians. Unfortunately, their adaptive radiation out of their homeland might have involved speed and transformational change like that of the historic Cheyenne, leaving us at least for now with no means to identify their common archaeological origins with reasonable certainty. We may search for them, and we might even find them, but we should not be surprised if we do not.

I suspect and hope that Crawford and Smith will find much to agree with in all of this. They have made an important empirical contribution to Iroquoian archaeology. What seems to me to be most needed now is further refinement of the theoretical issues I have raised and new empirical studies to better define the beginnings of Owasco in New York. If the prehistoric Iroquoians force us to deal with those issues more productively, they too will have done another service for archaeology.

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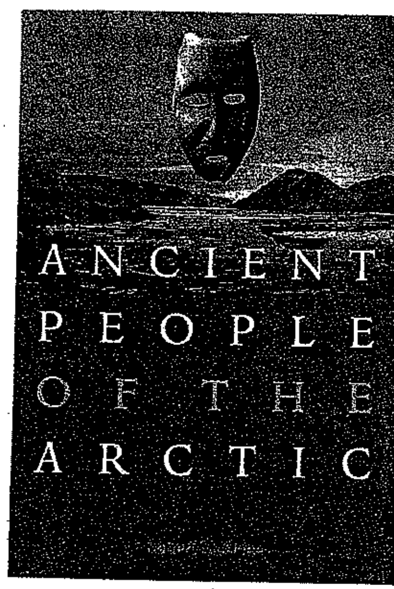

A NEW APPROACH TO DATING THE LEAGUE OF THE IROQUOIS

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When did the League of the Five Nations Iroquois originate? This study presents a new approach to answering this age-old question. Compositional data were collected on ceramics (pottery and smoking pipes) from Seneca and Mohawk sites in an attempt to identify and reconstruct exchange and interaction patterns between these two widely separated League members. X-ray fluorescence (XRF) and particle-induced X-ray emission (PIXE) spectrometry were employed to collect data on 15 elements. Using pottery as a baseline for each area, pipe data were utilized in a discriminant-function analysis to identify exotic pipes in Seneca assemblages from different time periods. The investigation focused on pipes because they were a probable item of exchange and because the symbolism of pipes and tobacco made smoking an important part of Iroquoian political protocol. Results showed that Mohawk pipes first occurred in Seneca assemblages sometime between A.D. 1590 and A.D. 1605. This is considered likely to reflect the inception of peaceful political relations between these two groups brought about by the final coalescence of the Iroquois Five Nations Confederacy. The approach developed for this study employed nondestructive analytical techniques applied to common classes of ceramic artifacts. As such, the methodology should be broadly applicable to other studies of interaction and exchange in this and other regions.

¿Cuándo empezó La Liga de las 5 Naciónes Iroquís? Esta investigación presenta una nueva avenida para contestar una pregunta antigua. Datos composicionales sobre alfarería y pipas fueron recolectados de fumar de sitios Séneca Mohawk, para de identificar y reconstruir normas de intercambio e interacción entre estos dos distantes miembros de la liga. Fluorescencia de rayos-X (XRF) y espectrometría de emisiones de rayos-X inducidas por partículas (PIXE) se emplearon para a recoger datos sobre quince elementos quimicos. Usando alfarería como base para cada región, datos de las pipas fueron utilizados en un análisis de función discriminante para identificar pipas cerámicas exóticas en conjuntos Sénecas de diferentes períodos de tiempo. La investigación se concentró en pipas porque estas fueron un probable artículo de intercambio y porque el simbolismo de pipas y de tabaco hizo del fumar una parte importante del protocolo politíco de los Iroquís. Los resultados mostraron que las pipas Mohawk ocurrieron primero en conjuntos Sénecas entre D. C. 1590 y D. C. 1605. Esto se considera, probablemente, un reflejo del principio de relaciones políticas pacíficas entre estos dos grupos, ocasionadas por la unión final de la Confederación de las 5 Naciones de los Iroquís. La avenida desarrollada para esta investigación usó técnicas analíticas no destructivas, aplicadas a clases comunes de artefactos cerámicos. Por eso, la metodología debe ser ampliamente aplicable a otras investigaciones de interacción e intercambio aquí y en otras regiones.

The League of the Haudenosaunee, or Iroquois, involved the confederation of five autonomous and previously inimical, Iroquoian tribal groups with adjoining territories that spanned present-day New York State—the Mohawk, the Oneida, the Onondaga, the Cayuga, and the Seneca (Figure 1). The Iroquois Confederacy, as it came to be known, is widely recognized as the most powerful and enduring political alliance in pre-Revolutionary eastern North America. During the seventeenth century its members successfully subdued or assimilated virtually all non-League native neighbors in the region. Subsequently, this growing Iroquois confederation was to have a profound impact on the policies and politics of the various European powers attempting to make inroads into eastern North America at this time. League members—sometimes acting in concert, sometimes separately—effectively influenced the course of seventeenth- and eighteenth-century Euro-American politics and events by playing one colonial power against another. Ultimately, the influence of the League of the Iroquois extended as far west as the Mississippi, as far south as the Carolinas, and well north into Canada.

Initially, the alliance appears to have constituted a loosely bound, nonaggression pact designed to end

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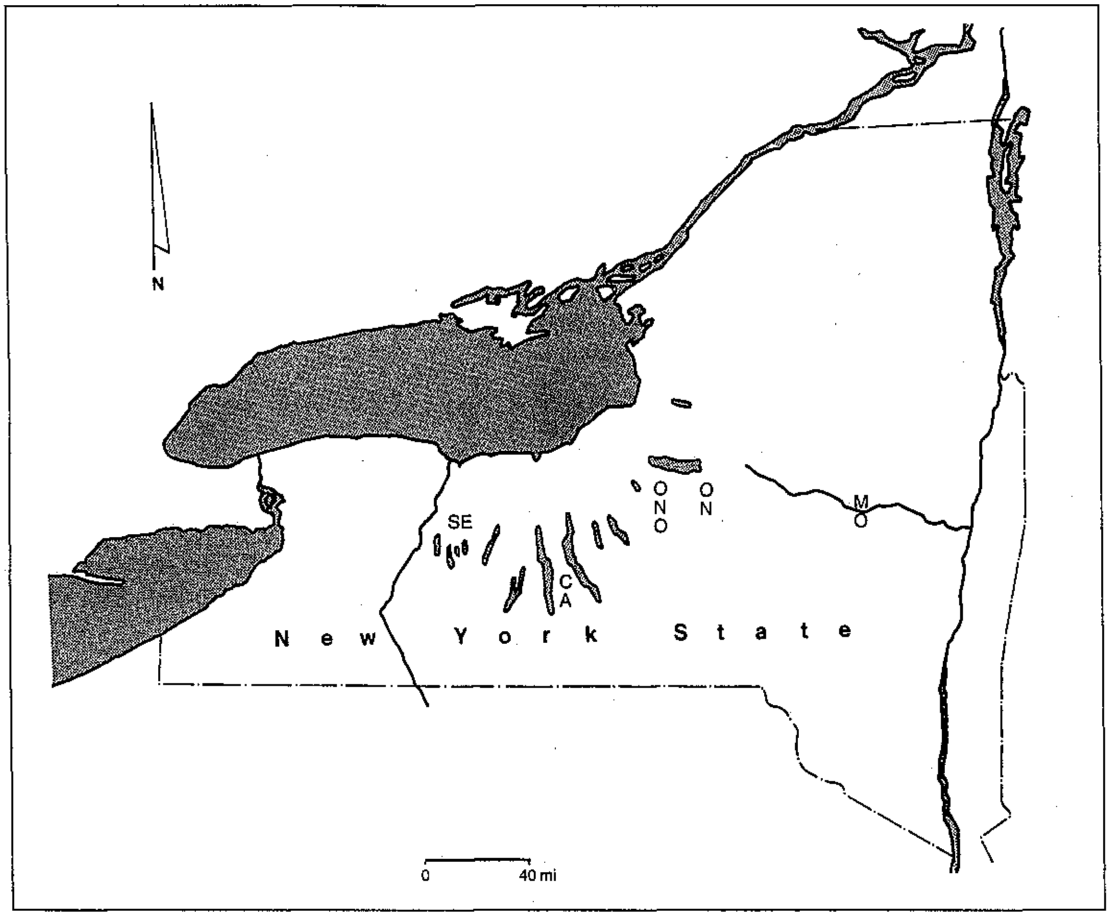

Figure 1. Map of New York State showing relative locations of the five tribal members of the Haudenosaunee, or People of the Longhouse. SE = Seneca; CA = Cayuga; ONO = Onondaga; ON = Oneida; MO = Mohawk. Drawing courtesy of the Rochester Museum & Science Center.

the debilitating pattern of mutual hostilities and blood revenge that had previously existed among these groups. The nature of its political growth from a relatively small, provincial alliance to that of a major player in regional colonial politics has been the subject of considerable discussion and debate by Iroquoianists (Fenton 1998; Jennings 1984; Richter 1992; Snow 1994). Crucial to a potential archaeological contribution to that discussion is establishing some measure of chronological control over the major events and circumstances involved in that development, beginning with an approximate date for the League's formation. One major issue is whether the alliance predated the arrival of Europeans on the continent and therefore developed completely independent of it, or whether it followed European contact and was in some way a reaction to the new threats and interactions that accompanied it.

Traditional and Historical Accounts of League Formation

Early descriptions of when and how the League was established vary widely, depending on when a particular tradition was recorded and the tribal affiliation of the narrator/informant. They are, however, structurally consistent in their telling of an epic journey by the Peacemaker and/or Hiawatha across the state, and the efforts of the pair to obtain agreements for peace from each of the five nations (see, e.g., Beauchamp 1892, 1905, 1921; Clark 1849; Hale 1963 [1883]; Heckewelder 1876; Hewitt 1892, 1920; Morgan 1962 [1851]; Parker 1916). There is also general agreement as to the relative order of the acceptance of the plan by individual tribes as roughly east to west, with the westernmost Seneca as the last to join (Clark 1849:1:28; Dunlap 1839–40:29–30;

Fenton 1998:63; Heckewelder 1876:56n; Parker 1916:25). In essence, the plan called for maintaining the peace through the symbolic kinship relations of the extended house, or Longhouse, and adherence to the Great Law. At least in the beginning, League functioning seems to have been largely at a ceremonial rather than purely political level (Hale 1963[1883]; Richter 1992). Mourning rites were central, as grief was assuaged and the traditional blood feuds averted through mutual condolence and gift-giving among the tribes (Richter 1992:30–40).

The critical question of when the League of the Iroquois originated, however, has been somewhat more controversial. The first historical mention of it appears to be in A.D. 1634 according to Gehring and Starna's (1988:46, fn 111) interpretation of a passage in Adrian van den Bogaert's account of a journey to Mohawk and Oneida country, in which he notes a native speaker's reference to the five separate nations, as well as to the League itself (i.e., "kanosoni" or the "extended house"). The earliest known narration of the founding story was from Mohawk Chief David of Schoharie, as recorded by Pyrlaeus in 1743; it indicated that the League formed "one age before the white people came into the country" (Heckewelder 1876:56n), a date interpreted by Heckewelder as the mid-sixteenth century. Somewhat later, Cusick (1825) provided an estimate of a millennium earlier, although this has been largely dismissed for its obvious inconsistency with other known oral traditions. A subsequent mid-nineteenth-century Onondaga version of the founding (Ephraim Webster) again repeated the "one lifetime before the Dutch" period (Clark 1849:1:20; Schoolcraft 1847:120), although Schoolcraft also referred to a Seneca tradition that it had occurred in 1605. Then, several decades later, Mohawk and Onondaga informants indicated that the founding had taken place as much as "six generations," or 150 years, before the coming of Europeans (i.e., ca. 1450) (Hale 1963[1883]:177–178; Morgan 1871:151). Later reanalysis of these sources by Hewitt (1892, 1920:528) and Beauchamp (1892:138, 1921:29) led back once again to dates in the mid-to-late sixteenth century (1559–1600). Fenton first suggested a date of around 1600 (1961:27), although he has since concluded that the date may be too recent (1998:69). Finally, after a comprehensive review of all relevant estimates, Elisabeth Tooker (1978:420) noted the general concurrence on the period between roughly 1400 and 1600, but would draw no definitive conclusion as to when the League originated.

There has been increasing recognition of the futility in trying to assign a specific year to the League founding because of the gradual evolutionary nature of this complex political development (Engelbrecht 1985:177; Fenton 1998:72, 82, 95; Hale 1963[1883]:xxi, Introduction by Fenton; Snow 1991:139; Trigger 1976:1:163). According to Fenton (1998:72), "precise dates for complicated social institutions are at best spurious. Rather than a single event, the formation of the Iroquois League was a process that occupied the lifetimes of its founders."

Thus, it seems reasonable to assume that the League developed over a period of years as tribal groups gradually allied themselves with one another. When that first began, and how long it took, are uncertain. What is agreed upon is that the earliest alliances involved the easternmost groups, and that the Seneca were the last of the original Five Nations to become affiliated. Their incorporation with the other four tribes should, then, mark the point at which the League assumed its classic Five Nations form. This condition characterized the League during its apogee in the seventeenth and early eighteenth centuries, according to historical records and traditional native accounts. The purpose of this paper, then, is to present the results of a new archaeological approach to dating the culmination of the series of alliances that resulted in the classic Five Nations League of the Iroquois.

An Archaeological Approach to the League

Identifying potential archaeological correlates of the League has proven to be a difficult task. At its essence, the League represented an alliance among five autonomous tribes that was based upon a protocol of ceremony and ritual. Since this relationship between the tribes may have had little impact on Iroquois material culture, the archaeological record may not manifest clear and unambiguous evidence of the League's institutions. Indeed, previous attempts to discern the origins of the League in changing patterns of Iroquois ceramic styles have proven to be largely unsuccessful (Engelbrecht 1971, 1974).

Interaction systems and patterns of trade and exchange may be one aspect of Iroquois culture that was affected by the establishment of the League. The development of peaceful ties among the tribes and the ceremonial relationships that ensued would have fostered increased contact among the League's members. Such a change in interaction patterns may be detectable archaeologically if material items were moving within this new interaction sphere. Tracing changing patterns of trade and exchange over time through the movement of exotic artifacts between the tribes might provide an indication of the coalescence of the League.

One artifact type that would lend itself to such an analysis is the ubiquitous Iroquoian smoking pipe. There are a number of lines of historical and archaeological evidence indicating that pipes were traded or exchanged as gifts. Historical accounts of early missionaries recorded that during Iroquoian dream-guessing episodes pipes were among the items frequently given as gifts (Tooker 1964:110). Tobacco pipes were also presented to Europeans as gifts (Smith 1910 [1608]:118). Also, at least during the colonial period, the Iroquois presented pipes as gifts to other tribes as a symbol of friendship and alliance (Jacobs 1966:24). Archaeologically, stone pipes made of exotic material have been discovered on Iroquois sites and interpreted as trade items (Bradley 1979:166; Wray et al. 1987, 1991). Furthermore, the broad geographical range of Iroquois ceramic pipe styles has led some to the conclusion that the Iroquois "traded their pipes far and wide" (Brasser 1978:83). Finally, trace-element analysis of ceramic smoking pipes has successfully identified pipes of exotic composition in Iroquois site assemblages (Kuhn 1985, 1986).

It is also likely that smoking pipes had a direct role in activities closely related to League affairs. The Jesuits noted that in political councils "the Indians never spoke of business nor came to any conclusion without having a pipe in their mouths" (Tooker 1964:50), and the primary documentation is littered with examples of references to smoking at political councils (e.g., Heidenreich 1978:Figure 2; Sagard 1939[1632]:150). One typical example was Frontenac's remark at a meeting with representatives of the Five Nations in 1670 when he stated "I have lighted a fire to see you smoke and to talk to you" (West 1934:239). Pipe smoking "was a mental device used by the smoker to concentrate his thought. Huron and Iroquois informants stated good thoughts resulted from continuous smoking during formal discussions" (Brasser 1980:96). Therefore, it seems certain that pipes would have been an important accoutrement of council meetings from the very inception of the League.

The movement of ceramic artifacts, including smoking pipes, can be traced archaeologically if the clays from which they are manufactured can be sourced. Chemical characterization of ceramic pastes has become a major area of research in the field of archeometry (Neff 1992), with a number of successful studies conducted in the northeast (Clark et al. 1992; Kuhn 1985, 1986; Trigger et al. 1980, 1984). If patterns of interaction between League members can be reconstructed by tracing the movement of ceramic pipes, these patterns might shed light on the development of the League.

An adequate sample of ceramics, from a sequence of sites in one of the individual tribal areas, was required to develop an appropriate framework for conducting such a study. Fortunately, the Seneca sequence of late prehistoric and historic sites in western New York presented a suitable case. Large collections of archaeological materials (including ceramics) from a reliably dated continuum of sites (ca. 1500–1687) are available for study at the Rochester Museum & Science Center (Niemczycki 1984; Wray and Schoff 1953; Wray et al. 1987, 1991). The Seneca sequence and chronology is widely recognized as the chronological baseline for historic-period archeology in the northeast—a template for site-sequence formulations and chronologies elsewhere in the region (e.g., Bradley 1987; Kent 1984; Pratt 1976). This Seneca continuum contains prehistoric sites (before ca. 1550), protohistoric sites (late sixteenth century), and historic sites (seventeenth century)—the three time periods of possible League development. In addition, the Seneca of western New York represent an excellent choice for this study because they were the last of the original Five Nations to join the League, marking the coalescence of this institution in its classic form. For these reasons, the sequence of Seneca sites was selected as a basis for ceramic compositional analysis.

A comparison of Seneca ceramics with those of at least one other Five Nations tribe would be necessary to interpret compositional characterizations with confidence. Therefore, a sample of ceramics from Mohawk sites was selected for inclusion in the analysis. A Seneca-Mohawk comparison was chosen because these two tribes were the "keepers of the western and eastern doors" of the League's symbolic longhouse, and an alliance between the two would be most likely to reflect the coalescence of the Confederacy as it was known historically. Further, the Seneca and Mohawk are the most geographically dis-

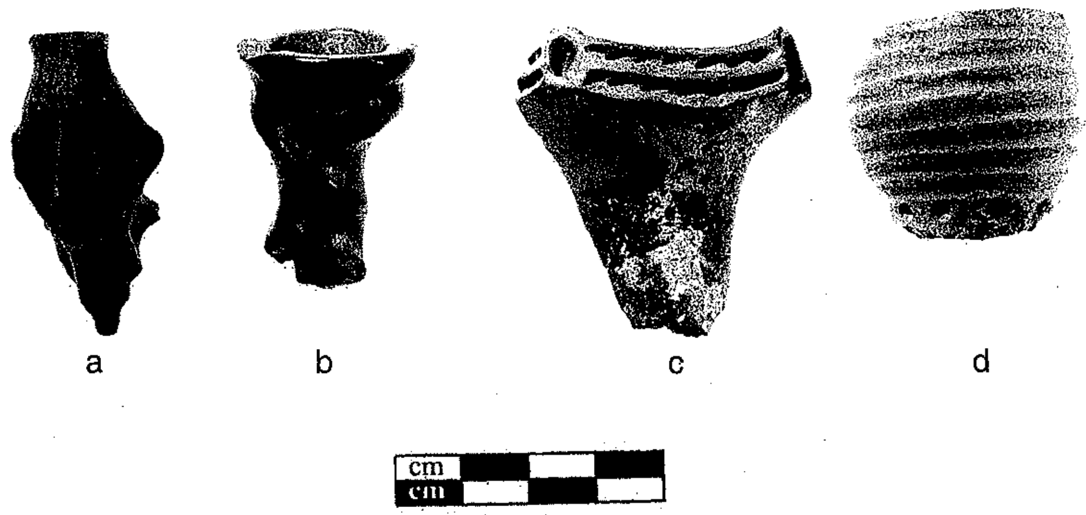

Figure 2. Sample of representative types of ceramic smoking pipes used in this study (left to right): a. human effigy, 5364/V, Dutch Hollow Site; b. snake effigy, AR 18307, Dutch Hollow Site; c. coronet, AR 27859, Belcher Site; d. ring bowl, 414/102, Factory Hollow Site. Photo courtesy of the Rochester Museum & Science Center.

tant of the League members, suggesting that they would provide the best opportunity for the successful differentiation of ceramic source materials. A considerable number of archaeological investigations have been conducted on Mohawk sites over the years (Lenig 1965; Ritchie and Funk 1973; Snow 1995), and well-provenienced ceramic assemblages are readily available for analysis in the collections of the University at Albany, State University of New York.

Samples of Seneca and Mohawk pottery (excluding pipes) were compared in an attempt to identify differences in source composition. The pottery samples from each tribe are presumed to represent the local clay resources that were being exploited by potters of that region. Studies have shown that most potters gathered their clay from sources very close to the location of pottery production (Arnold 1985:35–57). The vast amounts of pottery found on village sites were undoubtedly made locally and have been successfully matched to nearby clay sources (Kuhn 1989). At the same time, it is unlikely that Iroquois pottery moved around very much. Iroquois pots were typically large, bulky, and fragile, and not well suited to long-distance transport. Therefore, the use of pottery samples to characterize local ceramic pastes is an effective approach, and one that has been advocated and used by others conducting similar research (Perlman 1984:130).

If the results indicate that the clays used by the Seneca and Mohawk can be distinguished based upon their composition, then ceramic pipes from sites dating to different periods of the Seneca sequence could be sourced. The results should reflect patterns of exchange and interaction between the two groups over time. An increase in interaction between the Seneca and Mohawk during a specific time period might be an indicator of the beginning of peaceful relations between them. This, in turn, might provide an approximation of when the League coalesced in its classic Five Nations form.

Materials and Methods

A sample of 115 pottery sherds and 96 ceramic pipes or pipe fragments was selected from eight Seneca sites that span a continuum from ca. A.D. 1550 to ca. A.D. 1625. Of the 96 pipe specimens, 21 were complete or nearly complete pipes with human, mammal, bird, and snake effigies, as well as a variety of geometrically decorated coronet, ring, and trumpet bowls (Figure 2). The samples included in the analysis are listed in Table 1. Occupation dates for these sites are according to the most recent revisions of the Seneca Archaeology Research Project (Sempowski and Saunders 2001). The comparative sample of Mohawk pottery included 121 potsherds from the Mohawk Martin ($N = 54$) and Briggs Run ($N = 67$) sites.

The analysis employed energy-dispersive X-ray fluorescence (XRF) and particle-induced X-ray emission (PIXE) spectrometry to collect data on a

Table 1. Seneca Samples Included in the Analysis.

Site	Approximate Dates	Pottery Sample	Pipe Sample
Factory Hollow	1610–1625	20	21
Dutch Hollow	1605–1620	20	22
Fugle	1605–1625	15	6
Cameron	1590–1605	20	14
Tram	1575–1590	10	4
Adams	1565–1575	20	3
Belcher	ca. 1550	0	9
Richmond Mills	ca. 1550	10	17
Total		115	96

range of 15 elements including K, Ca, Sc, Ti, V, Cr, Mn, Fe, Cu, Zn, Rb, Sr, Y, Zr, and Ba. After data collection, Sc and Cr were excluded from the study because the quantities for these elements were sometimes below detection limits. XRF and PIXE are similar in their fundamental approach. Both analyze secondary X-rays using an energy-dispersive detector to identify the elements present in a sample. They differ primarily in the techniques employed to excite the specimen. XRF uses an X-ray beam to irradiate the specimen and cause the emission of secondary or fluorescent X-rays whose energies identify the elements present and whose intensities are proportional to the quantities of these elements (Hanson 1973; Jenkins 1988; Van Grieken and Markowicz 1993:151–180). In contrast, PIXE utilizes a proton beam to excite the specimen and stimulate X-rays characteristic of the elements in the sample (Johansson et al. 1995; Pollard and Heron 1996:36-41). PIXE's ability to provide superior detection limits for the lighter elements K through Fe is a second difference between the two techniques (Van Grieken and Markowicz 1993:572), and the reason that both were employed in a complementary fashion for this study.

The XRF and PIXE analyses were both conducted in the accelerator laboratory of the University at Albany, State University of New York. In the XRF technique, Americium 241 was employed to irradiate a changeable target (tin), and the radiation emitted from the target served to excite the sample. The absorption of these primary X-rays causes the sample to emit fluorescent X-rays whose energies are characteristic of the elements present in the sample. A Si(Li) high-energy resolution solid-state detector was used to detect these fluorescent X-rays. In the PIXE technique, a proton beam from the State University of New York, Albany accelerator was used to excite the sample with characteristic X-rays identified by an energy-dispersive Si(Li) detector.

A 512-channel pulse height analyzer was used to collect and store a spectrum of the number of X-rays detected versus their energy for each sample. Energy spectra could then be displayed and analyzed on a microcomputer. Least-squares regression analysis was used to establish peak area counts and standard deviations for each element using the program AXIL (Van Espen et al., Version 3.0). The concentration of each element in the sample is proportional to the number of counts observed for each element. The chi-square statistic was employed as a measure of the adequacy of the least-squares fit.

XRF and PIXE have the advantage of being nondestructive techniques. As is the case with many archaeological specimens, the artifacts available for this study required a nondestructive approach. The Seneca materials, particularly the pipes, are rare Native American objects of irreplaceable value (Figure 2). Many of them are whole specimens that derive from burial contexts. The application of XRF and PIXE is supported by a growing advocacy for the use of nondestructive analytical techniques in art and archaeology (Malmqvist 1995:367).

No sample preparation other than standard cleaning of the surface of each ceramic specimen was undertaken. Avoiding sample preparation or keeping it to a strict minimum has been advocated in the literature in order to eliminate or reduce potential contamination (Van Grieken and Markowicz 1993:657–658). Iroquois ceramics typically have flat and reasonably smooth exterior surfaces, satisfying an important aspect of XRF and PIXE sample requirements (Pollard and Heron 1996:47) without the need for sample modification.

Neff, Bishop, and Sayre (1988, 1989) have demonstrated that elemental variability as a result of differences in tempering can affect the compositional analysis of ceramics. For the present purposes, when selecting an area for analysis on each sherd, an effort was made to avoid surface pieces of temper, and to focus the beam on the clay matrix. Both XRF and PIXE are surface-sensitive measurement techniques. Penetration depths for PIXE are in the range of a few microns and for XRF are 2–3 mm (Jenkins 1988:106; Van Grieken and Markowicz 1993:548). The XRF method measures an area 7mm in diameter and PIXE provides even smaller analysis diameters. In addition to avoiding temper, any surface areas suspected of contamination from leaching or other sources were also avoided. The data collected using this approach are believed to reflect the clays from which the ceramics were manufactured.

Crushed rock, including plagioclase feldspar, was used as the primary tempering material in both Seneca and Mohawk pottery and pipes. Therefore, even if some temper were being included in the data collection, it is doubtful that it would confound the results of the study. Any samples that appeared to be tempered with unusual or exotic material were excluded from the analysis. This step was taken to further ensure that the ceramic tempering did not become a source of uncontrolled variability in the data.

Finally, as a further measure of our ability to control for this factor, multiple measurements were taken on a sample of ten specimens. This was also done in order to evaluate the homogeneity of individual ceramic specimens included in the study. This analysis clearly indicated that there is a considerable amount of variation within individual sherds, as has been demonstrated by other compositional studies of Late Woodland ceramics from the northeast (Trigger et al. 1984:8). Yet, different readings on the same sherd were classified with the same group in the multivariate discriminant function analysis 100 percent of the time. This demonstrates that the variation inherent in individual sherds, whether caused by tempering or some other factor, is not great enough to confound the results of the analysis. This is consistent with the results of other work conducted on this topic (Shenberg and Boazi 1975:459; Trigger et al. 1980:123).

The use of whole samples in a nondestructive approach did require the elimination of a number of pottery specimens from the PIXE analysis because of sherd thickness. As has been amply documented, PIXE can perform poorly in the analysis of thick samples containing large amounts of heavy elements (Johansson et al. 1995:421). As both XRF and PIXE are essentially surface-sensitive measurement techniques, the exclusion of thick sherds from the analysis does not inherently bias the sample.

A variety of statistical applications were employed to evaluate the data collected. In general, we have attempted to follow the guidance provided by Bishop and Neff (1989:57–69) and Glascock (1992:15–25) regarding appropriate statistical applications for pottery-characterization studies. Univariate statistics for each element were evaluated, as well as bivariate plots of pairs of elements, in order to develop an understanding and assessment of the variation inherent in the compositional data. Multivariate statistics constituted the principal tools for identifying and evaluating structure in the multidimensional data matrix. The computer package SYSTAT (Version 5) was used for all statistical analyses (Wilkinson et al. 1992).

Principal components analysis was used to examine the correlations between variables (elements) and identify those elements or groups of elements that account for maximum variance in the data set. Principal components is an exploratory data analysis that groups highly correlated variables into factors beginning with those factors that summarize as much of the joint variation in the data as possible. The technique is important for discerning those elements (or components of correlated elements) that may be useful in the subsequent effort to identify meaningful groupings within the data, as well as significant discriminators that help define those groups.

The principal components analysis utilized a correlation matrix based on list-wise deletion, and loadings were rotated using the varimax rotation method. The output includes the correlation matrix to be factored, the component loadings for each factor, the factor score coefficients, and the percent of total variance explained by each factor. The relationship between factors can also be visually presented in a variety of two-dimensional plotting applications.

Cluster analysis of element means for each site was conducted as a procedure for identifying natural groupings in the data and providing a general indication as to whether the site samples clustered naturally according to Seneca-Mohawk groups. The cluster analysis utilized normalized Euclidean distance for its distance metric and an average linkage algorithm for its clustering method. The output is a typical dendrogram establishing groups of sites.

Discriminant function analysis was employed as the principal analytical tool for testing our research question. Discriminant analysis can be divided into two steps. The first step includes establishing discriminant functions that best separate the groups, in this case, the Seneca and Mohawk pottery samples. The second step involves using these functions to allocate unknown samples to one of the two groups. In this case, Seneca pipe specimens were treated as unknowns.

The discriminant analysis also produces jacknifed classification results that may be used to evaluate the accuracy of the classification functions. In the jackknife technique, each case is classified into a group according to the functions derived from all the data except the case being classified. In this way, the data are used to evaluate the discriminant function's ability to correctly identify individual specimens.

The results of discriminant analysis are severely affected by non-normal distributions and outliers in the data (Jones 1986:60, 66, 68–69). Measures of skewness and kurtosis for the Seneca and Mohawk samples were evaluated for each element and outliers greater than 2.0 standard deviations from the mean were deleted. Discriminant analysis was performed using this reduced data set.

The element data for the Seneca pipe specimens were entered in the discriminant function analysis as unknowns, and then each pipe sample was assigned to the ceramic group with which it was most similar based on its elemental composition. Posterior probabilities were calculated for each specimen as a means of assessing the strength of the association between the specimen and the group with which it clustered. Essentially, the results identify whether each pipe was manufactured from clays in the Seneca or Mohawk regions.

The discriminant function analysis employed standardized canonical coefficients using a within-groups covariance matrix and the probability of group membership was computed from the Mahalanobis distances. The results include classification functions to be used in a linear equation that defines each group, multivariate test statistics that serve as a measure of the significance of the groupings, the jacknifed classification table, and individual pipe classifications with associated posterior probabilities.

Results

The results of the principal components analysis provided information useful for understanding the nature of the variance inherent in the multivariate data set. The first factor, which accounted for the largest proportion of variance in the data, was dominated by high component loadings for Fe, Cu, Zn, and Sr. This suggests that it is the metallic elements included in the analysis and those other elements closely correlated with them that account for the largest proportion of variance in the data.

Subsequent factors, which contribute a steadily decreasing proportion of the total variance, tended to be dominated by high loadings for single trace elements. This result is an indication of relatively weak correlations between the remaining trace elements, which is not unprecedented in chemical characterization studies of ceramics. In such a situation, the principal components analysis is simply ordering the elements by variance (Jones 1986:60).

A problem can arise with a compositional data set that combines major, minor, and trace elements. Many authors have noted that multivariate statistical analyses of such a data set tend to be dominated by those elements having the highest concentrations (Bishop and Neff 1989:63; Glascock 1992:16; Jones 1986:69). This means that the elements entered into the analysis will not be given equal weight and the results will misleadingly reflect the contribution of major and minor elements over trace elements. The high loading of Fe in the principal components analysis suggests that this factor may be at work.

Transformation of the data set into logarithms has been suggested as one method to control for this problem. Therefore, the principal components analysis was repeated using this approach, to compare the results to the analysis conducted on the unmodified compositional data. The results were very similar, but the analysis conducted on the logged data did lead to a much higher loading for Sr on the first factor relative to Fe. This suggests that the problem of the magnitude of concentrations did affect the data set, but only in a minor way.

Tabulation of the percentage of variance explained by each principal component is presented in Table 2. These results are based on the log-transformed pottery data with outliers deleted ($N = 223$). The percent of total variance explained by the first four factors was 82.425 percent. This is remarkably similar to other studies of Late Woodland ceramics in the northeast (Clark et al. 1992:257), and suggests that the principal components analysis was effective

Table 2. Results of the Principal Components Analysis.

Principal Component	Eigenvalue	Percentage of Variance	Cumulative Percentage
1	.11046	39.449	39.449
2	.05238	18.707	58.156
3	.03624	12.944	71.101
4	.03171	11.325	82.425
5	.02068	7.386	89.811
6	.01758	6.277	96.088

at reducing the dimensionality of the data set while sacrificing minimal variance. Including six principal components accounts for 96.088 percent of the variance. The ability of the analysis to isolate those elements most responsible for variance in the data, and the ability of the analysis to reduce the dimensionality of the data, provide a firm basis for the multivariate grouping (cluster) and group evaluative (discriminant) analyses that were conducted.

The results of the cluster analysis are presented in a dendrogram (or tree diagram) in Figure 3. The results are very encouraging. Two principal groups were created by the analysis: the Martin and Briggs Run sites link together forming a single group representing the Mohawk, and all of the Seneca sites link together forming a single group representing the Seneca. The results indicate that all of the Seneca sites are more similar to each other than they are to the Mohawk sites. The two groups are only joined into a single group in the final linkage at a distance that suggests that they may be significantly different. The analysis appears to indicate that the elements included in this study can be successfully

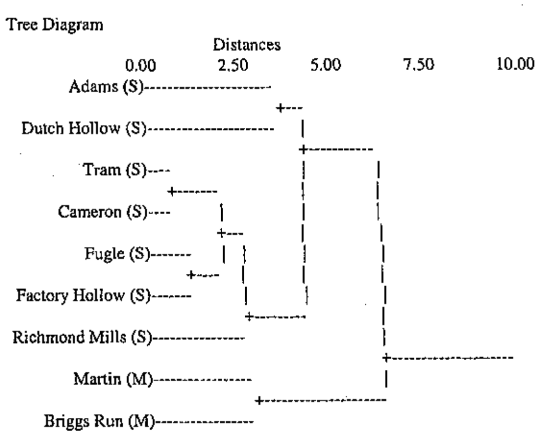

Figure 3. Dendrogram of cluster analysis results. (S) = Seneca. (M) = Mohawk.

employed to differentiate between Seneca and Mohawk ceramics.

As a minor aside, thorough analyses (not reported here) appear to indicate that the subgroupings of Seneca sites are not particularly meaningful or interpretable as regards Seneca archaeology. These linkages do not appear to reflect site proximities, drainage associations, temporal affinities or any other interpretable relationships. In relative terms, all of the Seneca sites are so close together that these analyses were unsuccessful at identifying significant differences in the chemical compositions of their ceramics.

The functions for Seneca and Mohawk pottery samples produced by the discriminant function analysis successfully differentiated the samples based upon their elemental composition. All of the multivariate test statistics used to evaluate the differences between the two groups were highly significant, and the canonical correlation was .844, indicating that the discriminant function produced by the analysis accounted for a high percentage of the variance in the sample.

The scores for each specimen on the discriminant function are illustrated by histograms in Figure 4. As the analysis was conducted on the pottery data with outliers deleted, N equalled 109 for the Seneca and 114 for the Mohawk samples. The range of factor scores for the Seneca sample was from +4.695 to –1.405. The range of factor scores for the Mohawk sample was +0.565 to –4.374. Factor scores were grouped in categories of 1.000 in the histograms, hence (–4) represents –4.000 to –4.999, and so on. The figure provides a visual illustration of the degree of discrimination achieved by the analysis.

The jacknifed classification results are presented in Table 3. Using the classification functions generated by the multivariate discriminant analysis, pottery samples were classified correctly 92.83 percent of the time. The small error factor in the results likely represents overlap in the range of elemental varia-

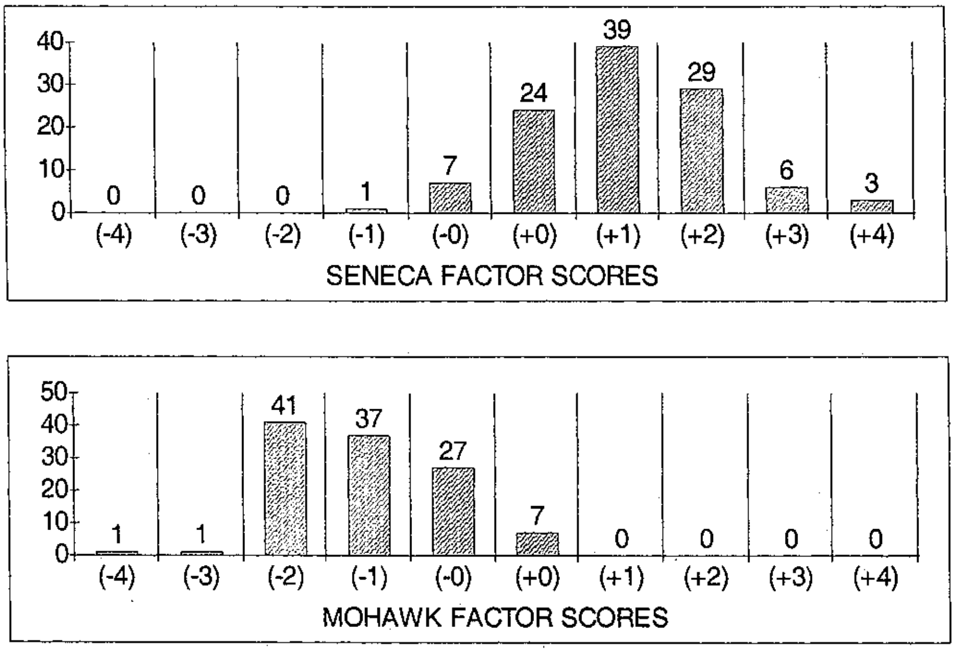

Figure 4. Factor scores for Seneca and Mohawk pottery samples.

tion in the clays of the two regions, or the margin of error inherent in the techniques of data collection. Nevertheless, these results indicate that the element data can be used to create regional characterizations of Seneca and Mohawk ceramics that are sufficiently distinct to warrant their classificatory use. Classification of unknown specimens using these chemical fingerprints can be completed with a high degree of accuracy.

The data for the Seneca pipes were entered into the discriminant function analysis as unknowns and then classified based upon the smallest computed distance to the centroids of the Seneca and Mohawk groups. Factor scores and posterior probabilities were evaluated for each specimen as a means of assessing the strength of the association between the specimen and the group with which it clustered. Pipe specimens classified with a .998 percent probability or higher were interpreted to be Mohawk in origin. This conservative threshold was employed for two reasons. First, the classification system had an approximate error factor of seven percent based on the jacknifed classification results. Therefore, a conservative approach to evaluating pipe assignments was required. Second, the .998 percent probability coincided with the range of factor scores for Seneca pottery defined in Figure 4. Pipe specimens with a .998 percent probability and higher fall entirely outside the range of Seneca pottery, strongly suggesting that they were not manufactured from clays of the Seneca region.

Ninety pipes fell within the range of the Seneca pottery control group, indicating that they could have been manufactured from clays local to the Seneca area. Five pipes were identified as Mohawk in origin using the criteria established for this assignation. These specimens are listed in Table 4. All of these pipes fall outside the range of the Seneca control group (compare factor scores with Figure 4), and were classified as Mohawk with less than a .002 per-

Table 3. Jacknifed Classification Results.

Tribe	Percent Correct	Seneca	Mohawk	N
Seneca	91.74%	100	9	109
Mohawk	93.86%	7	107	114
Total	92.83%			223

Table 4. Seneca Pipes Classified as Mohawk.

Site	Artifact Number	Factor Score	Probability
Factory Hollow	1247/102	–3.353	1.000
Factory Hollow	12805/102	–2.738	1.000
Dutch Hollow	5385/V	–2.338	.999
Factory Hollow	12211/102	–2.036	.998
Cameron	422/41	–1.949	.998

cent chance of error. Two of the pipes were classified as Mohawk with a zero percent chance of error.

In order to confirm the results, these five pipe specimens were returned to the accelerator laboratory for additional analysis. XRF and PIXE data were collected from one and, in some cases, two additional locations on each pipe sherd. These data were again entered into the discriminant function analysis. In all cases the discriminant function analysis continued to classify these pipes as Mohawk, confirming the original results.

Also of note is pipe specimen 15284/V from the Dutch Hollow site that had a factor score of +6.872. This falls outside of the range of both the Seneca and Mohawk control samples, suggesting that it should not be classified with either group. It likely represents a pipe brought in to the site from some as yet unidentified source. This is the only specimen in the pipe sample that did not closely associate with one of the two groups included in the analysis.

Interpretations

The results indicate that ceramic smoking pipes manufactured from Mohawk Valley clays are found in Seneca site assemblages. No Mohawk pipes were identified from Seneca sites occupied prior to about A.D. 1590. The earliest site in the Seneca sequence to produce a Mohawk pipe is the Cameron site that, according to the most recent revisions of the Seneca chronology, was occupied ca. A.D. 1590 to A.D. 1605 (Sempowski and Saunders 2001). The pipe assemblage from the Dutch Hollow site also yielded a single Mohawk pipe. The occupation of the Dutch Hollow site may slightly overlap that of Cameron, but extends into the second decade of the seventeenth century (ca. A.D. 1605–1620). Finally, three fragments of exotic Mohawk pipes were identified in the pipe assemblage from the Factory Hollow site, which is the latest site included in this study, dating from about A.D. 1610 to A.D. 1625.

In addition, the results identified a single pipe specimen from the Dutch Hollow site that likely comes from an unknown source. It must be acknowledged that the Seneca-Mohawk comparison presented here is in some ways a simplification of the historic reality, since the Seneca undoubtedly contacted and interacted with other tribes around them. The unidentified exotic Dutch Hollow specimen is evidence of this. Furthermore, there may be other exotic pipes in the sample that have not been identified because only Seneca and Mohawk control groups were employed. A larger study including control samples from a number of tribal areas would help elucidate broader interaction and exchange patterns within the region. Although this issue cannot be eliminated as a possible confounding factor to the results presented here, it is suggested that the highly conservative thresholds employed for identifying Mohawk pipes in the Seneca assemblage argue against this possibility.

The results suggest that Mohawk-made pipes were first acquired by the Seneca sometime during the late sixteenth or very early seventeenth century. This indicates an increased level of interaction between the two groups at this time, which may mark the affiliation of the Seneca with the Mohawk in the League of the Five Nations Iroquois. When earlier alliances among the eastern Iroquois may have formed is uncertain, but the coalescence of the Confederacy in its classic Five Nations form appears to have been a phenomenon that occurred between circa A.D. 1590 and A.D. 1605.

We recognize that the exotic Mohawk pipes were identified from those Seneca sites that have some of the largest samples included in this study (Table 1). In this regard, it must be emphasized that there is a significant paucity of ceramic smoking pipes in mid-sixteenth-century Seneca artifact assemblages (Wray et al. 1987, 1991). Not until the Dutch Hollow-Factory Hollow occupations do ceramic pipes become prevalent on Seneca sites. This means that the smaller pipe samples from the earlier sites actually represent a much larger percentage of the site's total pipe assemblage. Nevertheless, the absence of Mohawk pipes on Seneca sites from the 1565 to 1590 period must be interpreted with caution until additional pipe samples from these sites can be obtained and analyzed.

The strong correlation between the large increase in the numbers of ceramic pipes on Seneca sites and the appearance of exotic pipes contributes to our interpretation of the results of this analysis. It seems likely that both of these factors are manifestations of the same phenomenon: Seneca inclusion in an expanding confederacy that functioned according to a set of ceremonies, rituals, and protocols based upon traditional nativistic beliefs. One of these protocols, based upon the concept of reciprocity, was gift giving, which functioned as a means of incurring social obligation. Another, based upon traditional beliefs about sacred tobacco, emphasized the importance of smoking in council as a means of enhancing decision-making. The formation of a confederacy with these protocols would likely lead to an increase in smoking paraphernalia and an increase in exotic pipes on the sites of its member nations.

Supporting archaeological evidence for this process comes from two sources. First, there appears to be a significant elaboration of mortuary practices among the Seneca at this time, which may reflect a heightened interest in condolence associated with League ceremonialism (Sempowski 1997). Second, a significant increase in glass beads and other goods occurs on Seneca sites at this same time. These goods appear to derive from Dutch posts along the Hudson River and would have had to pass through the Mohawk, the "eastern door" of the League, to reach the Seneca (Sempowski and Saunders 2001). Seneca inclusion in the League would have certainly facilitated Seneca access to the burgeoning trade in European goods.

In conclusion, the results of this study confirm the accuracy and legitimacy of native oral tradition. Although there are notable exceptions, a number of the earliest Iroquois consulted on the matter placed the origins of the League around the late sixteenth or early seventeenth centuries. The results of this analysis appear to confirm that the League of the Iroquois coalesced into its classic Five Nations form sometime during the ca. A.D. 1590 to A.D. 1605 period. When earlier, formative alliances among the other four groups in the League may have occurred still lies open to question. The approach presented here may offer similar potential for identifying the timing of these earlier stages of League development.

More generally, the methodology developed for this study may have potential application to a wide range of questions concerning native exchange and interaction patterns. It has the advantage of using nondestructive data collection techniques, which permits the use of large samples from the most significant and best provenienced ceramic assemblages. It also employs a methodology based on the use of control samples for comparative analysis, in contrast to many chemical characterization studies that try to assign meaning to synthetic chemical groups produced by multivariate analyses without meaningful reference points. Finally, the approach should be widely applicable since ceramic pottery and pipe assemblages are common from sites throughout the eastern woodlands, and the assumptions upon which this approach is based may apply in other areas beyond Iroquoia.

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