

SALT

AND THE EASTERN NORTH AMERICAN INDIAN
AN ARCHAEOLOGICAL STUDY

Ian W. Brown



LMS
LOWER MISSISSIPPI SURVEY

Bulletin No. 6

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Peabody Museum
Harvard University
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For My Folks . . .

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Cover - Recreation of Eastern
Amerindian production of salt.
Painting by Edward G. Cassidy (1937)
to accompany David I. Bushnells'
unpublished ms. "Salt among native
tribes of the Mississippi Valley and
Eastward." Courtesy, Dr. Bruce D.
Smith, Smithsonian Institution,
Washington, D.C.

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Preface

The role of salt in human prehistory is far from understood. When I started this study three years ago I had little appreciation of the enormous effect this mineral has had on socioeconomic events throughout the world. What started out as a small study on the manufacture of salt at a saline in southwest Louisiana, has blossomed into a monograph on the aboriginal utilization of salt in Eastern North America. This research developed out of the Petite Anse Project, an archaeological expedition sponsored by the Lower Mississippi Survey of Peabody Museum, Harvard University. Between 1977 and 1979 survey and excavations were conducted along the southwest coast of Louisiana in Iberia, St. Mary, and Vermilion Parishes. Avery Island, the location of an important prehistoric and historic salt spring, served as both the headquarters and the principal focus of the project. The general archaeological investigations will be presented in a future volume.

Numerous people and organizations have contributed to this salt study, and I would at this time like to express my appreciation to them. Professor Stephen Williams and Dr. Jeffrey P. Brain have guided the research from its inception and have constantly encouraged its progress. The study would not have begun at all had it not been for a number of generous grants from anonymous members of the McIlhenny-Avery family and from Avery Island Inc. The natural hospitality of this large extended family made my work a delight. It is not possible to thank all the members individually, but I would at least like to single out the ones who were directly involved with the research. Without the aid and enthusiasm of Walter and Jack McIlhenny, and Ned and Lanier Simmons, the Petite Anse Project would never have existed.

The State of Louisiana also contributed to the project by issuing the Lower Mississippi Survey a Historic Preservation Grant-In-Aid award. Instrumental in obtaining this grant for us were Drs. J. Larry Crain, E. Bernard Carrier, and Kathleen M. Byrd. The International Salt Company also generously contributed to the second half of the project. In particular,

I would like to thank its president, John L. Ryon, Jr., and Lester Jay, the Avery Island plant manager, for their interest in the work.

An initial draft of the report presented here was read by a number of my colleagues. For their welcomed comments and suggestions, I would like to express my appreciation to John S. Belmont, Dr. Jeffrey P. Brain, Dr. David S. Brose, Patricia S. Essenpreis, Dr. James B. Griffin, Vincas P. Steponaitis, and Dr. Stephen Williams. Two other people deserve special mention; Richard S. Fuller, for all the time and effort he put into the archaeology, and Nancy Lambert-Brown. Nancy is not only responsible for the beautiful graphics which enliven the text, but she contributed in so many other ways that the research could not have been conducted without her.

CHAPTER I

Introduction

The institution of trade has always been a major means of interaction between different peoples. Salt, a biologically necessary mineral, was and still is a very common trade item throughout the world. In this country, the prehistoric use of salt has been given relatively little attention. Despite David I. Bushnell's pioneering research on primitive salt production in the Mississippi Valley (1907; 1908), there have been few modern detailed studies of the role of salt in prehistoric Eastern North America. Only one monograph (Keslin 1964) and an unpublished master's thesis (Wentowski 1970) have dealt in any depth with the archaeology of salt in this area. The primary reason may be that the trade item itself has disappeared from the archaeological record. The only evidence of its production and dispersion are the byproducts of the salt industry.

In this monograph, I will examine the role of salt among the Indians of the Eastern United States from an archaeological perspective. Following a brief discussion of the physiological need of salt and its world-wide cultural importance, I will focus in on the eastern portion of the North American continent. The historic aboriginal usage of salt will be followed by a discussion of previous archaeological studies on this subject. The materials used in salt production, where they have been found, and how their distribution corresponds with the location of salines in Eastern North America, will then be dealt with.

It should be mentioned at this point that the archaeological evidence for salt production has largely, but not totally, been associated with the development of Mississippian cultures in the Southeast and Midwest; ca. AD 900 through historic times. Salt production seems to have been characteristic of most of this interval. In this volume I am proposing three basic stages of salt production in Eastern North America. The first two stages were principally characterized by the use of thick heavy ceramic containers called salt pans. The earliest stage involved the use of fabric-impressed pans, smooth-surfaced pans generally having become most common in the succeeding stage. Brine is thought to have been evaporated

within these pans by using fire-heated stones. In the late prehistory of the East, the use of salt pans was clearly on the decline. A major change in salt production appears to have occurred at this time. Instead of throwing heated stones into large pans, it is proposed that the third stage of salt production employed thin, medium-sized bowls supported over fires. In this last method, the brine evaporated more efficiently and without the excess labor of creating large salt pan vessels.

The last stage described above has not yet been recognized in the archaeological literature. Previously it has been assumed that salt production was on the decline in late Mississippian times. This "decline" may merely be a reflection of our limited knowledge, it being more probable that a change occurred in the technology of salt production in Eastern North America. The changing methods may have produced debris which lacked the high archaeological profile of preceding techniques. To obtain a better idea of what byproducts might be traced in the archaeological record, an examination of world-wide salt production technology has been made and is presented in Chapter 7. Some interesting parallels have been observed between the material remains of European, African, and Asian salt technology and objects occasionally found on late prehistoric sites in Eastern North America. The parallels are not the result of global diffusion brought about by transoceanic contacts. Rather, the material analogies are a reflection of different peoples having evolved similar technologies when faced with the same problem of having to extract salt from solution.

CHAPTER 2

The Physical and Cultural Importance of Salt

Salt has been shown to be indispensable for the physiological life of man. If the body chemistry is to work properly, the salt concentration in the blood must maintain a constant level. A salt-free diet forces the body to increase its secretion of water so that the salt concentration can remain balanced. If salt is not forthcoming, the body eventually desiccates and the organism dies (Bloch 1963:89; Dauphinee 1960:391-397; Kaunitz 1956; Nenquin 1961:9; Neumann 1977; Wentowski 1970:7-11). There is little agreement on the amount of salt required in the diet. The physical environment (climate, etc.) obviously influences salt intake to a certain extent (Wentowski 1970:12-13). Multhauf (1978:3) estimated a requirement of between .3 and 7.5 kilograms a year, and Bloch (1963:89) suggested a minimum daily requirement of between 2 and 5 grams of salt. Dauphinee (1960:413) estimated a daily intake of 6 grams if the climate is temperate and the diet primarily a vegetarian one, but Nenquin (1961:140) felt that the minimum daily use is between 12 and 15 grams for an adult with a mixed diet (a rather high estimate). C. O. Carter (1975) argued that additional salt intake is not at all necessary, providing that a "normal diet" is followed.

Whatever the exact requirements, it is quite clear that the absence of salt in the diet can be severely detrimental. Extremely prolonged salt deficiency can result in weight loss, irritability, tiredness, loss of appetite, cramps, and reduced fertility (Dauphinee 1960:422-425; Kent 1980; Wentowski 1970:8-9). A gruesome account of a physiological reaction, supposedly related to the absence of salt, was provided by a chronicler of the DeSoto expedition:

Some of those whose constitutions must have demanded salt more than others died a most unusual death for lack of it. They were seized with a very slow fever, on the third or fourth day of which there was no one who at fifty feet could endure the stench of their bodies, it being more offensive than that of the carcasses of dogs or cats. Thus they perished without remedy, for they were ignorant as to what their malady might be or what could be done for them

since they had neither physicians nor medicines. And it was believed that they could not have benefited from such had they possessed them because from the moment they first felt the fever, their bodies were already in a state of decomposition. Indeed, from the chest down, their bellies and intestines were as green as grass (Garcilaso de la Vega 1951:421).

It has been demonstrated that hunter-fishers do not require salt in a free form. A considerable quantity of mineral salts occurs in the flesh of freshly-killed animals and fish, and these are absorbed by the human consumer. Herbivorous animals and agricultural man, however, require additional salt (Bloch 1963:89; Dastre 1902; Dauphinee 1960:405-406; Hunter 1940; Keslin 1964:4,11-13; Kondo 1975; Mendizabel 1928; Multhauf 1978:4; Nenquin 1961:11,158; Wentowski 1970:11-12). Leacock (1971:17) has argued that salt was the only material which was a necessary trade item, all other articles traded prehistorically having been luxury goods. George Catlin, as early as 1832, recognized the direct association between agriculture and the aboriginal use of salt (Catlin 1841:124-125). Early hunter-gatherer materials are often recovered at salines in Eastern North America, probably because the Indians were following animals to the "licks". The term licks itself was derived from the tendency of animals to furrow out the earth around springs to lick the salt-impregnated soil (Ashe 1808:186-188; Bushnell n.d.; Imlay 1793:46-47; Wentowski 1970:15-16). The remains of extinct Pleistocene fauna and Paleo-Indian materials have been found at numerous salines, including Avery Island in Louisiana (Aratata 1964:69; Hay 1924:215-220; Joor 1895; Leidy 1889; Veatch 1899), Kimmswick in Missouri (Adams 1853; Anon. 1979; Bradbury 1817:257), Bone Bank in Indiana (Black 1969), Big Bone Lick in Kentucky (Hale 1886:41; Haynes 1966:209; Myer 1928b: 580; C. B. Schultz et al. 1967; Super 1904:252-253), and the Scioto River salines in Ohio (Bushnell n.d.; Harris 1805:181-182; Stout et al. 1932: 11-12).

Although free salt became a necessity once man made the transition to agriculture, one should not underestimate the effect of culture on its consumption. Agricultural peoples do not consume equivalent amounts of salt. Overall, there does indeed appear to be a universal biological craving for salt, but among some peoples the craving is somewhat amplified (Gilmore 1955:1014; Kaunitz 1956; Kroeber 1941:1-6; Multhauf 1978:4). Salt had a number of other uses in prehistory and in early historic times. In the American Southwest and in Mexico salt was used in ritual contexts, in

addition to being consumed. Long elaborate expeditions, bearing much ceremony, typically characterized the salt procurement (Bushnell 1914; Denmore 1929:169-173; Hill 1940; Hoebel 1941; Keslin 1964:20; Titiev 1937). In the Southeastern United States, historic Cherokee peoples used salt in their mortuary rituals. When an adult of either sex died, a little cup or glass of salt was placed on their chest, presumably to prevent the flesh from decaying (Mooney and Olbrechts 1932:134,pl.9b).

In other regions of the world salt was employed in the cleaning, bleaching, and dyeing of fabrics. It served as an absorbent material in the leather industry and it was also used in working precious metals, in the conservation of oils, in mummification, in cheese-making, and as a fertilizer in agriculture. One of its prime usages was in the preservation of meat and fish (Bloch 1963:89; Bradley 1975:22-23; Multhauf 1978:3; Nenquin 1961:29,47,62,139-140,153). Because of the physiological need for salt and its relatively limited distribution, salt has always been an ideal trade item. In addition, it is generally used in small quantities and thus can be easily shipped over long distances (Gayton 1948:181; Gilmore 1955: 1013-1014; Keslin 1964:3; Wentowski 1970:2).

The importance of salt in world trade is clearly reflected by historic events (Bridbury 1955). Kings and chieftains have been known to fight for salt sites (Mendizabal 1928; Nenquin 1961:10). Salt sources were highly valued and were often protected (Cushing 1896: 353-355). One particular salt lake in the Shansi province of China even had a wall built around it (Multhauf 1978:32). In the Middle Ages, the sharing of salt was a symbol of fraternity. Certain nomadic groups made alliances by eating a piece of salt-sprinkled bread (Nenquin 1961:10). In many areas of the Old World salt was used as a form of currency, or as revenue. The original meaning of the term "salary," for example, was the money given to Roman soldiers for the purchase of salt; in other words, their pay (OED 1971: 2624). The Gabelle, a word meaning salt tax, was the most hated of all taxes in France. It was felt by some to have been one of the major causes of the French Revolution (Multhauf 1978:11). England, Germany, and Italy also taxed salt, and it was a basic source of revenue in China as early as 2,000 BC (Ibid.:xvi,12,108-109; Nenquin 1961:137-139). The production of salt itself is believed to have occurred as early as late Neolithic times in Europe (Bradley 1975).

Salt was an important item in the economy of Bronze and Iron Age cultures throughout Europe. Some have argued that the earliest cities were

established as centers for the salt trade, and that the earliest roads were made for the transportation of this commodity (Bloch 1963; Multhauf 1978; xvi). It even has been hypothesized that salt was the substance carried within Bell Beakers (Nenquin 1961:13). We do know that the development of Halstatt was directly related to its importance as a salt center (Ibid.: 11,16-17). It is also quite definite that the prehistoric development of Mesoamerican cultures was affected by this important mineral. During the Classic period there had been a salt trade between the Petén and Yucatan, and by Post-Classic times, the island of Cozumel served as an important stopping point in the heavy salt trade between Yucatan, Belize, and Honduras (Andrews 1980; Rathje 1974:89).

The importance of "salt roads" can hardly be overemphasized. The Eastern United States, west of the Appalachians, was penetrated in Colonial times by following the paths of animals to the various salines (Black 1967: 581; Bowmocker 1906:9; Bradbury 1817:284-285; Clark 1938:42,51-52; Hulbert 1900:6,8; Multhauf 1978:5; Myer 1928b; Turner 1977:83-84; Wentowski 1970: 16-17,43-44). The Zuni, both historically and prehistorically, used deeply embedded roads to get to their salt source (Cushing 1896:353-355), and salt roads were apparently a characteristic feature of certain South American countries:

...from remote parts of South America trails lead, some from the Amazon and from Argentina, more than a thousand miles away, some from nearer points and from all local directions to this famous "Cerro de Sal" (Ibid.:354).

Salt roads were equally important in the economic development of Western Civilization. A principal road started at the salt works near the mouth of the Tiber River and cut through the Italian peninsula towards the Adriatic. Another important road was the North African caravan route which passed through the salt oases (Nenquin 1961:147).

In the Middle Ages, brine springs in Western Europe became sites for principal towns, the centers of bureaucratic activity (Multhauf 1978:39). Venice is a prime example of a major center which developed as a result of its control of the salt trade (Ibid.:xvi,8). The rise of England in the seventeenth and eighteenth centuries was also, in part, a result of its control of the world salt markets. Liverpool, a minor tobacco port in the early eighteenth century, became a major city due to its role in the salt trade (Hyde 1971:27-28; Multhauf 1978:56,58). Of some importance to the

history of the Western Hemisphere is the fact that Columbus' voyages were financed by the wealthy proprietors of the Mata salt region of Spain (Multhauf 1978:21). Most of the early Colonial expeditions to North America also made sure that salt specialists were included in the entourage of craftsmen (Ibid.:35-36).

In addition to the physiological need of salt, it can easily be seen that this mineral played an important cultural role in the history and prehistory of the world. We will now turn to its usages among the historic Indians of Eastern North America.

CHAPTER 3

Salt and the Historic Eastern North American Indian

There are a number of means by which salt can be produced. The sea is an obvious source, but interior salines have generally been more attractive because of the ready availability of fuel. Fuel, of course, is necessary to evaporate the brine (Multhauf 1978:7,20). The ocean was rarely used as a salt source by the Indians of Eastern North America, but at least one exception did exist. The Chitimacha Indians, for example, are reported to have boiled sea water along the southwest coast of Louisiana (Swanton 1911:346; 1928:690-691). Solar evaporation of sea water was rarely practiced because of the moist climate of the Southeast (Wentowski 1970:50-51), but the early explorers did make frequent note of the production and trade of salt in the East (Swanton 1946:300-304).

In 1670 John Lederer noted that the Sara (Cheraw) Indians had cakes of white salt. Mooney (1894:58) believed this salt was obtained from the Moneton (also referred to as Mohetan and Moheton), or some other tribe to the north. The Moneton were an unclassified tribe who were living in the mountains of southwest Virginia or in adjacent portions of West Virginia at this time (Mooney 1907:927; Swanton 1946:152; Wentowski 1970:42). Driver (1961:237) considered salt to be one of the most important single items of trade in the Southeast, and he too felt this mineral was typically shaped into small cakes weighing two or three pounds.

While in the province of Cofitachequi, Hernando DeSoto was given, "an abundance of very good salt (Ranjel in Bourne 1904,II:99)," and when he was among the Capaha (or Pacaha by the other expedition accounts) in the Lower Mississippi Valley, some Indian merchants appeared who were traveling throughout the various provinces selling salt and other merchandise (Garcilaso de la Vega 1951:449). DeSoto received salt as a gift when in the province of Utiangué, and he and his men observed the actual production of salt in the provinces of Cayas, Chaguaté, and Aguacay (Bourne 1904,I:136, 166-168;II,148). The province of Naguatex (also called Nabadache), another area mentioned by the expedition chroniclers, was undoubtedly located in

what is now northwestern Louisiana. The term Naguatex means, "place of salt" in the Caddo language (Swanton 1942:139; 1946:154,218).

The salt springs of western Arkansas and northwestern Louisiana were well known to the early eighteenth century Indians. Many groups frequented these areas to produce and trade salt (Darby 1816:29-30; Harris and Veatch 1899:11,121). Both the Pawnee and Osage collected salt along the banks of the Arkansas River (Bushnell n.d.; Schoolcraft 1819:207-208). The Osage are reported to have obtained this mineral from the mouth of the Verdigris River in Oklahoma (Keslin 1864:21-22). Salt was the main item of trade between the French and a number of Caddoan groups, especially the Washita and the Natchitoches. The Quapaw, Tunica, Koroa, Taënsa, Illinois, Kaskaskia, and Shawnee were also involved in the salt trade as, no doubt, were a number of other aboriginal groups (Atkinson 1876:224-225; Bushnell 1922:41-42; Keslin 1964:21; Myer 1928b:741-742; Swanton 1911:78,264,306-307,317; 1942:139-140; 1946:300-304; Wentowski 1970:25-27,29,33-34,43,47-49). East of the Mississippi River, the salt springs of Clarke County in Alabama were often frequented by historic aboriginal groups (Swanton 1922:pl.5; 1946:303; Wimberly 1960:2).

The DeSoto expedition observed four principal ways in which salt was produced. It was made from the ashes of plants, from brine water at salines, from salt-impregnated sand, and it was also gathered in a free state (rock salt) (Keslin 1964:20). There is no evidence for salt having been used by the Indians for preserving meat or fish. Drying meat over a low fire seems to have been the standard Southeastern aboriginal method of preservation (Hudson 1976:300). While in the present state of Alabama, DeSoto may have observed the production of salt from plants. The Indians made a lye from the ashes of a certain herb and dipped their food into it (Garcilaso 1951:421-422). Similar practices existed among the Choctaw and Chickasaw in the late eighteenth century (Adair 1775:115-116; Swanton 1928:691), and certain aboriginal groups along the Atlantic Coast produced salt out of ashes and calcined bones (Lawson 1718:222). It is possible that the lye mentioned above was merely an alkaline ash used in the production of hominy, to increase the nutritional value of the corn (Vincas P. Steponaitis-pers. comm.). According to Wentowski (1970:46), plants vary greatly in the amount of sodium and chloride contained in their tissue. Burning tends to concentrate these minerals, but in any case it is unlikely that the amount of salt obtained was of great significance.

The DeSoto expedition recorded the presence of rock salt west of the

Mississippi River (Garcilaso 1951:449-450). The Indians may actually have mined salt, as rock salt has supposedly been found in the Arkansas River area (Bradbury 1817:242-243). Swanton (1939:252) suggested that an old salt mine near Bald Knob, Arkansas may have been worked by the Indians. It is also possible that DeSoto observed hardened salt formed by artificial means. Rock salt does not last long at ground surface in a humid environment (Roger Saucier-pers. comm.).

The gathering of salt-impregnated sand appears to have been a fairly common method of salt production in North America (Brackenridge 1962:66; Bushnell n.d.; Gifford 1931:24-25). Elvas provided an excellent description of this process while in the province of Cayas, in what was probably northwestern Arkansas:

The salt is made along by a river, which, when the water goes down, leaves it upon the sand. As they cannot gather the salt without a large mixture of sand, it is thrown together into certain baskets they have for the purpose, made large at the mouth and small at the bottom. These are set in the air on a ridge-pole; and water being thrown on, vessels are placed under them wherein it may fall; then, being strained and placed on the fire, it is boiled away, leaving salt at the bottom (Elvas in Bourne 1904, I:136).

There is some evidence that the production of salt was historically the chore of women, but it is quite clear that the trade was in male hands (Foreman 1930:154-155; Keslin 1964:22,171; Wentowski 1970:90). Keslin (1964:22-23) has argued for the presence of salt specialists in Mississippian times, an opinion I also share (Brown 1980a).

We have seen that the historic Indians of the Eastern Woodlands took advantage of most available salt resources as, no doubt, did their ancestors. As mentioned above, it is most probable that the interior brine springs were employed as principal sources in both prehistoric and historic times. Let us now turn to the distribution of past and present salines in the Eastern United States.

CHAPTER 4

Distribution of Salines in Eastern North America

The salines of Eastern North America are the product of two extensive rock salt deposits. The Eastern Salt Basin, also called the Salina Basin, underlies the states bordering the Great Lakes. The salines which emerge in Illinois, Missouri, Kentucky, Ohio, New York, West Virginia, Tennessee, and Virginia are located along the margins of this major rock salt deposit (Figure 1). The Salina Basin is believed to be of Silurian and Devonian age (450-375 million years ago). The second major rock salt deposit, the Gulf Coast Basin, occurs along the northern and western rim of the Gulf of Mexico. Salines in Alabama, Louisiana, Texas, and along the east coast of Mexico are related to the Gulf Coast Basin which is of Jurassic age (135-190 million years ago) (Borchert and Muir 1964:19-24; Landes 1960:41; Lang 1957:pl.4; Lefond 1969:1-21,46-66; Stout et al. 1932:25-26; Turrentine 1913:14-19; Wentowski 1970:20).

Numerous salines once dotted the landscape of northern and, especially, northwestern Louisiana (Figure 2). They occurred along both the Red and the Ouachita Rivers (Harris and Veatch 1899:124; Stoddard 1812:399-400), being found in Red River Parish (Wentowski 1970:29), Webster Parish (Harris and Veatch 1899:55,124; Veatch 1902:81-89), Bienville Parish (Harris and Veatch 1899:52,63-64,122-123; Veatch 1902:71-80), Natchitoches Parish (Darby 1816:29-30,35-36,211; Fowke 1928:408; Harris and Veatch 1899:13-14, 55,121; Swanton 1946:302; Veatch 1902:51-63), and Winn Parish (Harris and Veatch 1899:55,125; Veatch 1902:64-70,92). There was also an excellent saline in the vicinity of Catahoula Lake in LaSalle Parish (Harris and Veatch 1899:124; Le Page du Pratz 1774:153; Swanton 1946:302; Veatch 1902:91-92). Brine springs were quite common in east Texas and along the Sabine River on the Louisiana/Texas border, especially in Sabine Parish (Harris and Veatch 1899:74-75,124; Keslin 1964:164; Skinner 1971; Swanton 1942:140; Veatch 1902:90). The most important saline, in terms of the history of the salt industry in the United States, occurred on the Avery Island salt dome, located on the southwest coast of Louisiana (Beyer 1899; Gagliano 1967; 1970; Harris and Veatch 1899:239-240; Hilgard 1881; Hotaling 1863; Joor 1895;

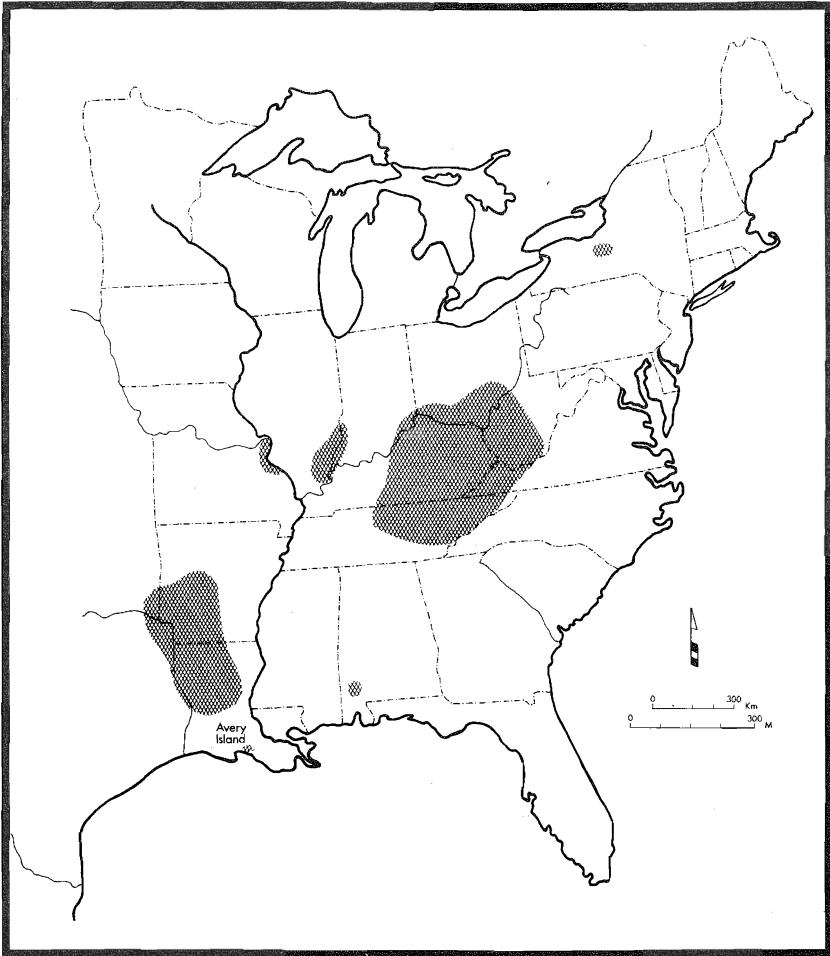


FIGURE 1. Principal Saline Areas in Eastern North America.

Parish Index for Figure 2

1	Webster
2	Bienville
3	Winn
4	LaSalle
5	Red River
6	Natchitoches
7	Sabine
8	Iberia

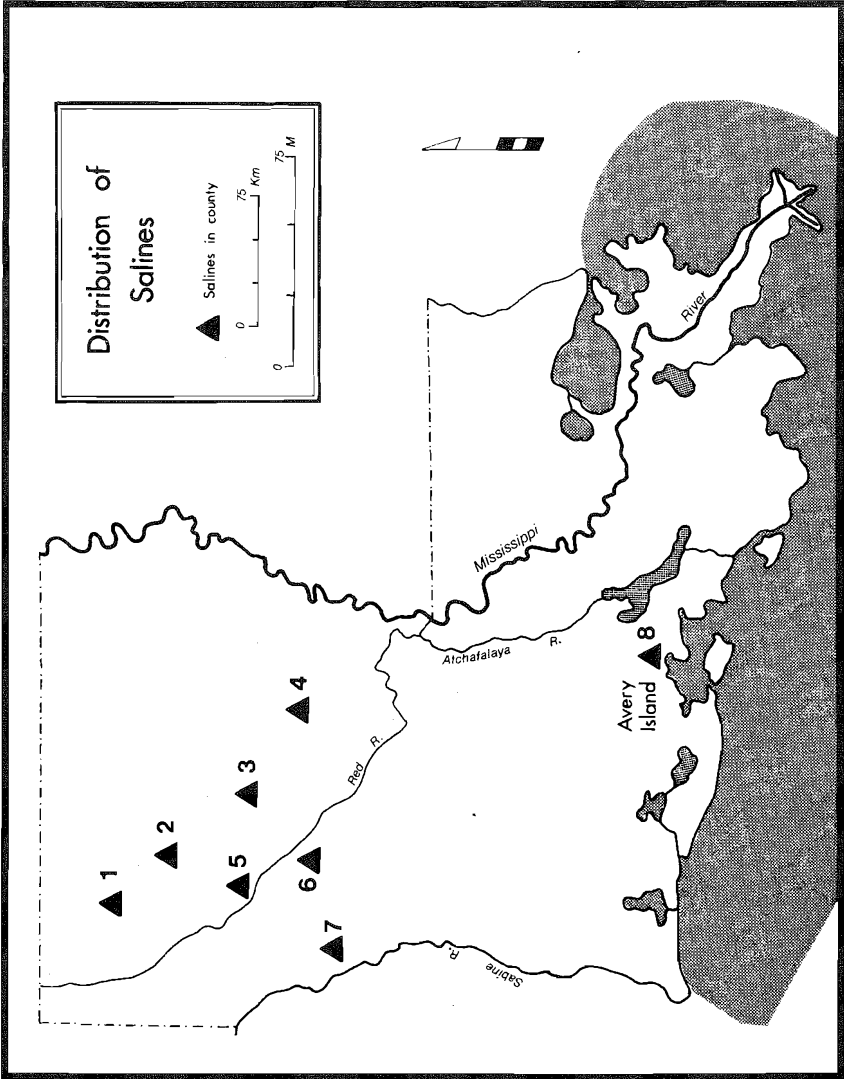


FIGURE 2. Distribution of Salines in Louisiana.

Lefond 1969:6-13; Leidy 1866; 1889; Lonn 1933:32-34; Mercer 1895; Owen 1866).

Arkansas also had some important salines which were used by the Indians. Salt springs occurred along the Ouachita, Saline, and Red rivers, and far up the Arkansas River (Brackenridge 1962:65-66; Bradbury 1817:185-187,242-243; Bushnell n.d.; Foreman 1930:96,154-155; Stoddard 1812:400-402; S. Williams-pers. comm.). Clark and Saline counties were particularly rich in salines (Foreman 1930:21; Holmes 1903:28; Keslin 1964:21; Wentowski 1970:23-25, map 1).

One of the prime areas for salines in the Mississippi Valley was in Missouri (Figure 3). Principal salines in St. Louis County included Clamorgan's Salt Spring (Collett 1882:107-108), Clifton Springs (Thomas 1894:167-168), and Cerre Springs (Collett 1882:104-107; Seever 1899). Many salines and sulfur springs occurred along the Meramec River and around Kimmswick in Jefferson County (Bradbury 1817:257; Bushnell 1914:645; Fowke 1928:487; Keslin 1964:157; Mills 1949; Schoolcraft 1819:208; Seever 1899; Stoddard 1812:401-402). At the Kreilich site, in St. Genevieve County, a major saline was employed sequentially by Indians, French, and Anglo-Americans (Keslin 1964:30; Lippincott 1912:1044-1045; McWilliams 1953:39-40; Wentowski 1970:31-32,63). Salines have also been recorded for Howard (Lippincott 1912:1045), Washington (Bushnell n.d.; Schoolcraft 1819:54), and Perry (Seever 1899) counties in Missouri.

Very important salines occurred in southeast Illinois, primarily in Gallatin County along the Wabash and Saline rivers. Brine springs were scattered throughout this county, but the principal salt works were at Shawneetown, often called the "Ohio Saline," and at Equality, also known as the "Half Moon Lick." The Indians referred to Shawneetown as the "Great Salt Spring." (Beck 1823:155-156; Bradbury 1817:284-285; Bushnell 1922:174; n.d.; Carpenter 1829:4; Cuming 1904:174,270-271; Foster 1873:248-249; Holmes 1903:186; Lippincott 1912:1042-1044; McMurtrie 1937; Multhauf 1978:18,38; Myers 1921; Peithmann 1953; Schoolcraft 1825:199-202; Sellers 1877; G. Smith 1904). Salines have also been recorded in Bond, Jackson, Madison, Marion, Randolph, St. Clair, and Vermilion counties, Illinois (Lamar 1938:222-224; Lippincott 1912:1037; Wentowski 1970:25-26).

Southern Ohio was particularly rich in salines in prehistoric/historic times. Salt springs were common along the tributaries of the Scioto, Muskingum, and Hocking rivers. They have been reported in Athens, Delaware, Gallia, Jackson, Jefferson, Morgan, Meigs, Muskingum, Noble, Trumbull, and Washington counties (Ashe 1808:183-184; Bownocker 1906:9;

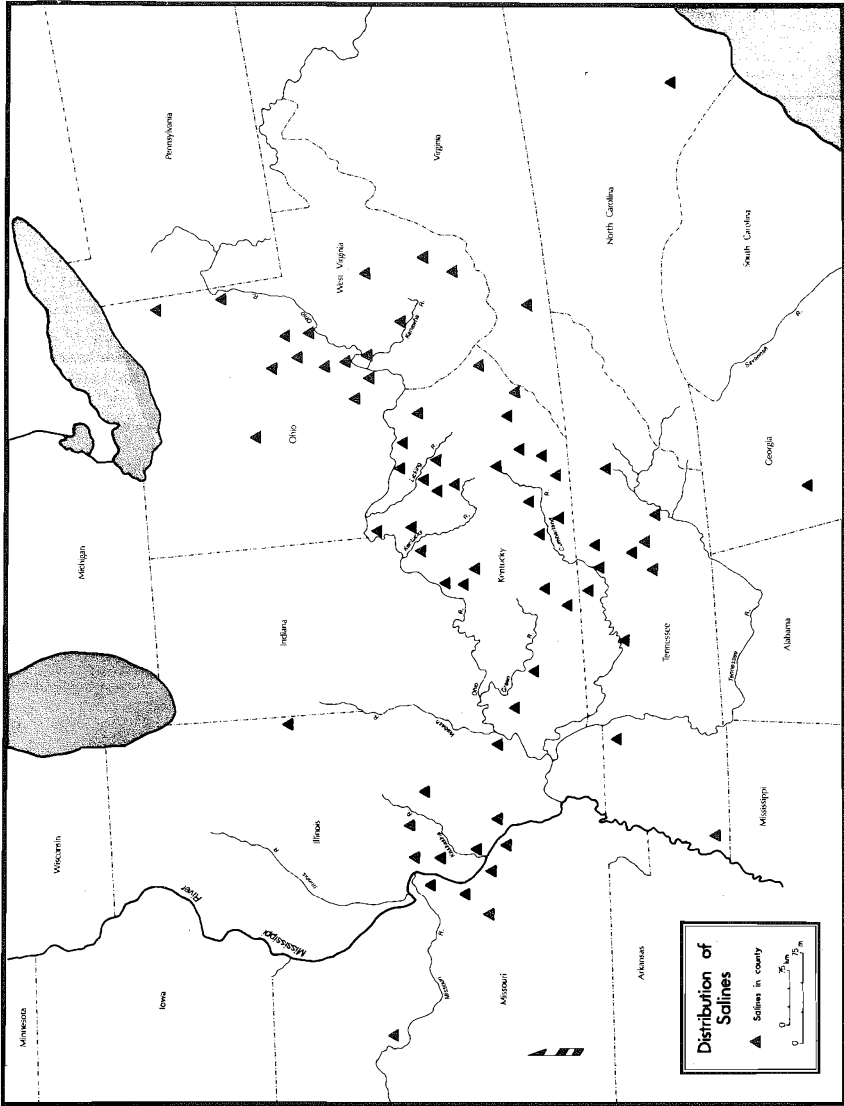


FIGURE 3. Distribution of Salines in the Midwest.

Bushnell n.d.; Filson 1793:343; Keating 1824,I:42-43; Lippincott 1912:1037; Nuttall 1904:59-60; G. Smith 1904:247; Stout et al. 1932:1-14; Turrentine 1913:29-31; Wentowski 1970:33-34).

An incredible amount of extremely weak salines occurred in the central and northeastern portions of Kentucky, in what has been called the "Mound Area." The density of population was, in part, attributed to the vast quantity of salines scattered throughout this region (Clark 1938; Imlay 1793:57; Lefond 1969:102-103; Lippincott 1912:1038; Michaux 1904:196-197; C. Schultz 1810,I:175; Webb and Funkhouser 1932:417; Wentowski 1970:26-27). They were quite common along the Licking River, as the name suggests, in Bath County (Webb and Funkhouser 1932:23) and in Nicholas County. The famous Blue Licks were located within the latter county, a series of highly brackish springs made even more famous because of their historic association with Daniel Boone (Ashe 1808:187-188; Bushnell n.d.; Clark 1938:43; Cuming 1904:164-165,174-178; Filson 1793:340; Lippincott 1912:1038-1039; McFarlan 1943:245,247; Myer 1928b:786; Webb and Funkhouser 1932:322).

Another major saline, the Big Bone Lick, occurred near the juncture of the Ohio and Licking rivers in Boone County, Kentucky (Ashe 1808:233; Black 1967:580; Hale 1886:40-44; Imlay 1793:47-48; Lippincott 1912:1039; McFarlan 1943:241-246; Myer 1928b:580; C. Schultz 1810,I:185-188; C. B. Schultz et al. 1967). Salines also occurred above the falls of the Big Sandy River on the Kentucky/West Virginia border (Ashe 1808:169-170; Bushnell n.d.; Carpenter 1829:4), and in Russell (Webb and Funkhouser 1932:359), Henry (Ibid.:183-184), Lewis (Ibid.:234), and Muhlenberg (Ibid.:314) counties, Kentucky. A particularly important saline was situated at the headwaters of the Kentucky River in Clay County (Myer 1928b:782; Webb and Funkhouser 1932:87-89). Clark County, in this same watershed, similarly possessed a number of salines (Myer 1928b:784). Salt springs also occurred in Allen, Barren, Bourbon, Bullitt, Carter, Jackson, Jefferson, Knox, Letcher, Mason, Nelson, Owen, Perry, Pike, Pulaski, Wayne, Webster, and Whitley counties (Clark 1938:50; McFarlan 1943:425,429; Wentowski 1970:26-27, map 1).

The principal saline in West Virginia, used both historically and prehistorically, was the Kanawha Works, located near Charleston in Kanawha County. This saline was also called the Big Buffalo Lick (Atkinson 1876: 223-249; Bradbury 1817:285-286; Carpenter 1829:4-5; Hale 1886:62; Ingham 1830:30-35; Multhauf 1978:38; Skinner 1971:17; Wentowski 1970:36-37). Other salines in West Virginia were situated in Braxton, Greenbrier, Mason, and

Summers counties (Turrentine 1913:37-38; Wentowski 1970:36-37).

Tennessee also had numerous salines (Lefond 1969:103). A very important one, called the French Lick, occurred along the Cumberland River at Nashville (Jones 1869:58; 1876:7; Myer 1928b:741; Robertson 1878; Wentowski 1970:36). Salines have been recorded in Macon, Overton, Jackson, Van Buren, Warren, and White counties, all in Middle Tennessee. Eastern Tennessee was also rich in salt springs, the most important ones occurring in Anderson and Rhea counties (Bushnell n.d.; Dayton 1872; Jones 1876:12; Safford 1869:501-502; Swanton 1946:302, map 13; Wentowski 1970:35-36). Salt springs were rare in western Tennessee, but ones have been recorded in Henry County and in Shelby County near Memphis (Swanton 1946:302; Wentowski 1970:36).

The regions described above are essentially the "core" area of saline distribution in Eastern North America, but a number of important salines occurred outside of these locales. Several strong salt springs, used by both historic Indians and early Anglo-American settlers, existed in Onondaga County in western New York (Beck 1842:103-108, 111-118; DeWitt 1798; Ingham 1830:18-20; Multhauf 1978:18, 37-38; C. Schultz 1810, I:31-34; S. Smith 1829; Turrentine 1913:24-28;). Virginia generally lacked salines, but one major one occurred near Saltville in Smyth County. Several others have been reported along the Holston River (Cooper 1966; Lonn 1933:26-28; Stose 1913; Wentowski 1970:36).

The Indians of North Carolina seem to have sometimes produced salt along the coast line, particularly in the Cape Fear region and at the mouth of the Roanoke River, but there was at least one interior saline available for their use. The early Anglo-American settlers in the region took advantage of brackish water along Salt Marsh Creek in Bladen County (LeGrande 1955; Wentowski 1970:32-33).

Mississippi and South Carolina lacked inland salt sources, but the Indians of South Carolina are known historically to have received and used this mineral (Swanton 1946:302; Wentowski 1970:31, 34-35). Georgia also generally lacked salines, but at least one existed. It was located near Atlanta at Lithia Springs Station, Douglas County (McCallie 1908:228-230; Wentowski 1970:25). Alabama had a number of salines. The most important one, used prehistorically and historically, occurred in Clarke County along the Tombigbee River. Others existed in Choctaw and Washington Counties (Bushnell n.d.; Lefond 1969:3-4, 6; Swanton 1946:303; Trickey 1958:389, fig. 1; Wentowski 1970:22-23; Wimberly 1960:2).

Overall, the Indians of the Eastern Woodlands had a goodly number of springs available to obtain their salt. This was especially the case in northwestern Louisiana, east-central Missouri, southeast Illinois, southern Ohio, West Virginia, Kentucky, and Tennessee. We know very little concerning the prehistoric usage of the northern Louisiana salines, but abundant data has accumulated over the years concerning aboriginal salt production in the Midwest. Let us now turn to this subject.

CHAPTER 5

Prehistoric Evidence of Salt Production in Eastern North America

Salt Pans - General Description

Most early travelers in the Midwest at one time or another visited the various salines, and many of them wrote descriptive accounts of the contemporary Anglo-American salt works. Consistently mentioned in these accounts is the abundance of Indian ceramics at the salines. Most of the remains were sherds from thick heavy shell-tempered vessels which have since come to be known as salt pans (Figure 4). According to Holmes (1903: 60-61), salt pans are the largest ceramic pots known in any section of the country. They are vat-like in shape, round or oval in circumference, with thick walls, and usually even thicker rims (Bushnell 1914:663-664; Fairbanks 1940; Holmes 1903:28). Although basically the same throughout the East, salt pans have been classified under a number of different type names, including Beckum Plain, Fox Farm Salt Pan, Grassey Plain, Hawkins Fabric Marked, Kimmswick Fabric Impressed, Kimmswick Plain, Langston Fabric Marked, McDougal Plain, Mobile Cane Impressed, St. Genevieve Plain, Saline Fabric Impressed, Saline Plain, and Salt Pan Fabric Marked (Adams 1949:8-9; Bennett 1941; Broyles 1967; Fairbanks 1956a:80; Griffin 1943:167-169,345; Heimlich 1952:26; Jennings and Fairbanks 1940:5-6; Keslin 1964:50,53,56,figs.13-16b; Marshall 1965a:100-102,fig.33I-L; Phillips 1970:95-96,158; Trickey 1958; Williams 1954:219-221; Wimberly 1956:19; 1960:185-188). However, there are really only two salt pan types. One type has a flat or rounded base and is adorned with textile impressions on the exterior and sometimes on the interior surface (Figure 6a). The other salt pan type, also circular with thick heavy walls, differs in that it has a smooth or merely roughened exterior surface (Figure 6b). Vessels of the latter type are generally basin-shaped, and have rounded bases, although flat-bottomed smooth-surfaced pans have also been observed. These two types are often found at the same sites (Adams 1941:pl.VIIIA; 1949:9; Griffin 1939:150-151; 1943:167-169; Hanson 1966:81,figs.35-36; 1970:44,46; Keslin 1964:5; Myer 1928a:576-578,

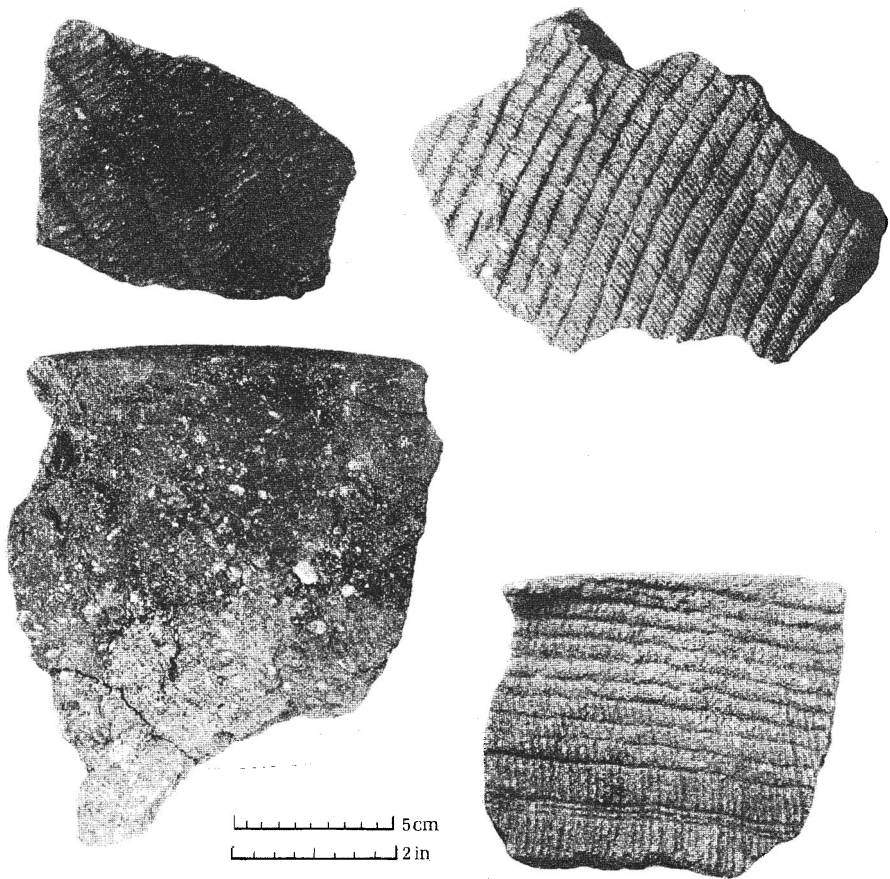


FIGURE 4. Typical Salt Pan Sherds. Provenience: Kimmswick, Jefferson County, Missouri (PM no cat. #).

p1.130b,figs.169-170; Orr 1951:318, fig.14c-g; Potter and Evers 1880:pl.17, fig.173).

As mentioned above, both salt pan types are extremely large. Their diameters generally range between 20 in (50.8 cm) and 32 in (81.28 cm) (Bushnell 1907:1-2; Griffin 1938:266-270,280; Holmes 1903:29; Keslin 1964; 5; Munger and Adams 1941:166-168; Myer 1928a:525,533,576-578,p1.130b,figs. 140,147,169-170; Thruston 1973:157-159,p1.X; Webb 1938:58,122-123; 1952:88-94,fig.40a-b; Webb and Funkhouser 1929:13-14,22,figs.18-22,31). Smaller ones have, however, been observed in the Norris Basin of east Tennessee (Griffin 1938:284-286). One recovered at the Harris Farm Mounds was only 11 in (27.94 cm) in diameter (Ibid.:293-294). Pans larger than 32 in (81.28 cm) in diameter are not uncommon (Webb and Funkhouser 1933:23-24). One site in Cooper County, Missouri, produced pans which are almost 48 in (121.92 cm) in diameter (Holmes 1903:31), and they have been reported as large as 54.6 in (138.68 cm) at the Tolu site in Crittenden County, Kentucky (Webb and Funkhouser 1931:table II). They have reached as much as 60 in (152.40 cm) in diameter at the Equality works in Gallatin County, Illinois (Sellers 1877:580) and at the West site in Davidson County, Tennessee (Dowd 1972:52).

The depths of the salt pans generally range between 8 in (20.32 cm) and 12 in (30.48 cm) (Bushnell 1907:1-2; Munger and Adams 1941:166-168; Myer 1928a:525,576-578; Thruston 1973:157-159; Webb 1952:88-94; Webb and Funkhouser 1929:13-14,22), although some at the Walters Farm Village in the Norris Basin of east Tennessee are reported to be as shallow as 6 in (15.24 cm) (Griffin 1938:266-270). The pans found at Equality in Illinois are 18 in (47.72 cm) deep (Sellers 1877:580). Rim thickness, generally in the range of .5 in to 1.5 in (1.27 cm - 3.81 cm), is generally greater than body wall thickness, particularly on fabric-impressed pans. The Indians often added an extra layer of clay around the exterior rim, probably to facilitate lifting the vessel. The extra layer provided a bit more protection for that portion of the pan sticking out of the ground while it was in use (Bushnell 1907:1; Miller 1943; Webb 1952:88-94).

The capacity of the salt pans has seldom been computed in the various archaeological studies. When capacity is recorded, there is considerable variation in the estimates. Fabric-impressed pans found at the Sulfur Spring (French Lick) in Nashville are said to have contained only between 12 and 15 gallons of brine (45.42 - 56.78 liters) (Thruston 1973: 157-159,p1.X), while a large pan at the nearby West site is reported to have been able to hold 110 gallons (416.35 liters) (Dowd 1972:52). If true, the

latter vessel must have been of an incredible size.

Salt Pan Decoration

Fabric impressions are the most common decoration on salt pans. Reconstructing textile industries from the impressions left on salt pans has been a major focus of ceramic studies in the nineteenth and twentieth centuries (Cole 1951; Griffin 1938; 1939; 1941; Holmes 1884; Miner 1936; Munger and Adams 1941; Orr 1951; Rachlin 1955a-b; Thomas 1894:23; Willoughby 1938). The textiles generally appear to have been coarse and open-mesh, although a close "cloth" weave impression sometimes occurs (Holmes 1903:28; Orr 1951:318). Bushnell (1914:663) felt that buffalo wool was used to make the threads observed on salt pans in east-central Missouri. His interpretation was no doubt influenced by his knowledge that the local Kaskaskia women spun buffalo wool in the early eighteenth century. The Indians of the Eastern Woodlands used a number of different materials for making fibers, and so there is probably no one single source for the salt pan textiles. They obtained fiber from the stalks of various plants, including Indian hemp, nettle, and the inner bark of trees such as linden and slippery elm (Munger and Adams 1941:168; Willoughby 1938:274).

Plain twining was the most common weave employed. In this weave, the two active weft elements alternately twine over and under each succeeding warp thread. The warp and weft are perpendicular to each other, a rectangular mesh being the result (Griffin 1938:267; Miner 1936:186, fig. 3, no. 8). In some locations, such as at the Lea Farm Village site in the Norris Basin of east Tennessee (Griffin 1938:296) and at the Equality saline in southeast Illinois (Sellers 1877:580-581), plain twining is the only weave used. In areas where it occurs with other weave forms, it is still usually the most common weave. It has been observed at the Ausmus Mounds, the Irvin Village site at Caryville, and at the Harris Farm Mounds, all in the Norris Basin (Griffin 1938:280, 284-286, 293-294). In the Wheeler Basin of northern Alabama, plain twining is characteristic of Li^V36 and Ma^O4 (Griffin 1939: 146, 150-151). It is also the most common weave observed at the Herrell Village and Cemetery sites in Jefferson County, Missouri (Munger and Adams

1941:168-169).

The next most common weave used is twilled twining. In this technique the weft passes over and under more than one warp (usually two) (Griffin 1938:267-268; Miner 1936:186, fig. 3, no. 9). Twilled twining has been observed on salt pans from a number of sites in Jefferson County, Missouri (Adams 1949:29; Munger and Adams 1941:168-169). It has also been recorded at the Walters Farm Village, the Ausmus Mounds, the Irvin Village site at Caryville, and at the Harris Farm Mounds in the Norris Basin (Griffin 1938: 266-270, 280, 284-286, 293-294; Webb 1938:122-123), and at Li^V36 in the Wheeler Basin (Griffin 1939:146). Zig-zag twilled twining, a variant of twilled twining, is created by pulling the warp strands from side to side as they are included in different pairs by the successive wefts (Miner 1936:186, fig. 3, no. 10). This modification is the only form of twilled twining observed at the Herrell Village and Cemetery sites in Missouri (Munger and Adams 1941: 168-169).

Plaiting, generally associated with basketry, is characterized by a simple overlapping of strands of any material which is pliable enough to withstand over-and-under ordering (Miner 1936:184). The limestone-tempered pottery of Woodland cultures is usually decorated with fabric impressions of the plain plaited type, but it is rare to find a salt pan vessel which is decorated in such a manner (Griffin 1939:161). Plaited salt pans have been seen, however, at the Kincaid site in southeast Illinois (Cole 1951:139-141, 143), at Li^V36 and Ma^O4 in the Wheeler Basin of northern Alabama (Griffin 1939:146, 150-151), and in the Mobile Bay region of southern Alabama (Trickey 1958; Wentowski 1970:86; Wimberly 1960:185-188).

In most cases, the fabric impressions on the exterior of the vessel continue up to the lip, but sometimes the outer rim has been smoothed over. The smoothing appears to have been performed using stones, shells, or sticks, and only rarely the fingers. The smoothed-rim fabric-impressed vessels at the Walters Farm Village in the Norris Basin have thinner lips than the unmodified vessels (Griffin 1938:266-270). Smoothed exterior rim sherds have also been observed at sites in southeast Missouri (Williams 1954:fig. 52), at the Hardin site in Greenup County, Kentucky (Hanson 1966:81), and at the Li^V36 and Ma^O4 sites in the Wheeler Basin of Alabama (Griffin 1939: 146, 150-151). Additional decoration is rare, but does occur. A number of the salt pans at Walters Farm Village have rows of punctations in their lips (Webb 1938:118, pl. 77a), and wide deep slanting grooves on flattened and rounded lips have been seen at Li^V36 in the Wheeler Basin (Griffin 1939:146)

and at Madisonville in Ohio (Griffin 1943:131).

Sometimes the salt pans are slipped or red-painted. A fugitive red slip on the interior of the pans has been observed at the Hardin site, mentioned above (Hanson 1966:81). Red-slipped fabric-impressed salt pans have been recorded at the Herrell Village and Cemetery sites in Jefferson County, Missouri (Munger and Adams 1941:166-168) and on both the exterior and interior surfaces of the pans at the Fewkes Group in Williamson County, Tennessee (Myer 1928a:576-577). Red-slipping is, however, most commonly associated with the smooth-surfaced salt pan, a type known as Varney Red in the Lower Mississippi Valley (Marshall 1965a:109-114; Phillips 1970:167; Williams 1954:209-210). This type of salt pan, defined on the basis of its prevalence in southeast Missouri, typically has a red slip on the vessel interior, and sometimes also on the exterior surface (eg., Potter and Evers 1880:pl.17,fig.173). It is a diagnostic ceramic marker of the Malden Plain and Hayti phases of the Malden and Little River Lowland of southeast Missouri (Marshall 1965a:76-77; Phillips 1970:926-928). Red-slipped smooth-surfaced salt pans have also been observed at the Gordon Town site in Williamson County, Tennessee, the slip again being on both the exterior and interior surfaces (Myer 1928a:525).

Distribution of Salt Pans

The salt pan vessel originally acquired its name because it is most often associated with the brine springs of the Midwest (Figure 5). Nowhere are these vessels more abundant than at the salt-making locales of the Mississippi Valley (Holmes 1896:41). Vast quantities of salt pan sherds have been observed at salines in east-central Missouri, southern Illinois, southern Indiana, north Tennessee, and Kentucky (Bradbury 1817:158; Bushnell 1922:174; Fairbanks 1940; Fiske 1820:302; Hale 1886:22-23; Holmes 1903:186; Keslin 1964:5; Phillips 1939:356; Wentowski 1970:58-87). This obvious direct association has even led some scholars to postulate the occurrence of prehistoric salines wherever salt pans are presently found (Holmes 1903:28; Webb and Funkhouser 1931:377).

The core salt pan area is basically the same as the core saline

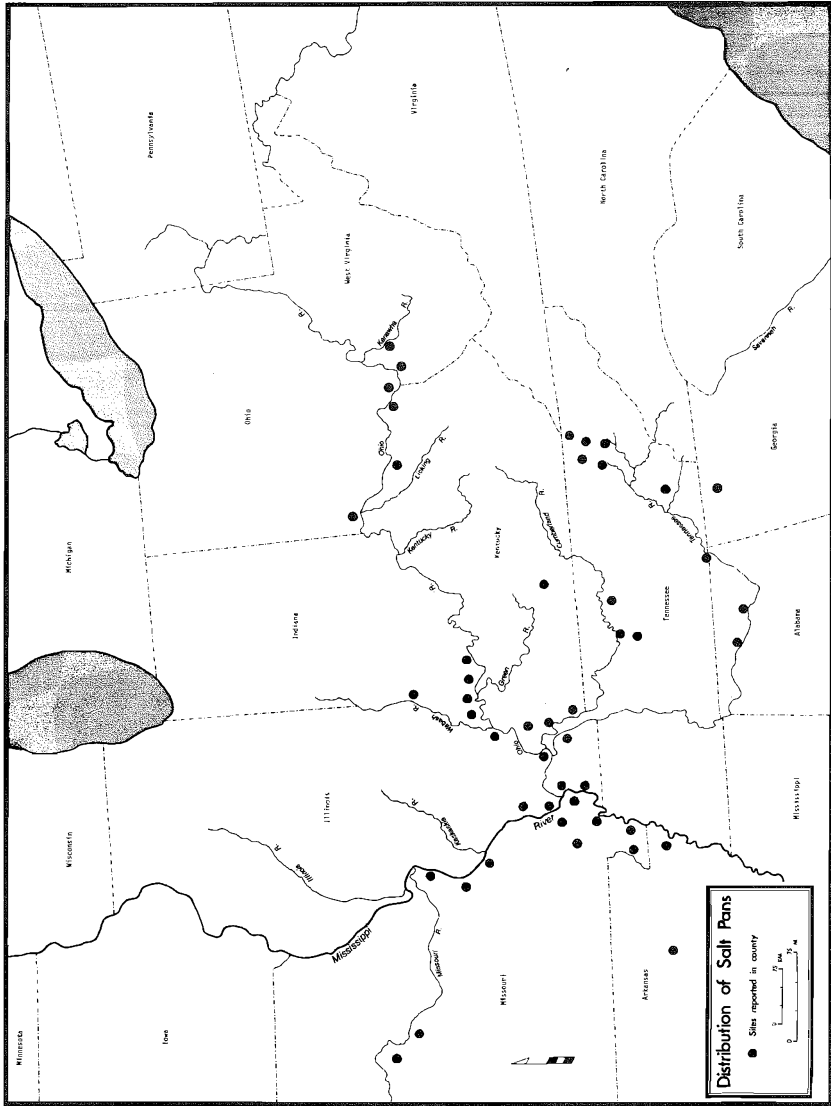


FIGURE 5. Distribution of Salt Pans.

area, which again is well within the confines of the Mississippian cultural tradition (Wentowski 1970:map 1), but it should be noted that salt pans are relatively rare at many major Mississippian mound centers. Only a few sherds have been found at Moundville in northwestern Alabama (V. Steponaitis-pers. comm.; Wimberly 1956:19), and they are quite scarce at Aztalan in Wisconsin, in the Spoon River phase of the Illinois Valley (Phillips 1939:204), at the Lake George site (21-N-1) in the Lower Mississippi Valley (Williams and Brain n.d.), and at the major site of Cahokia in Illinois (Griffin 1941:16; O'Brien 1972; Vogel 1975). They do occur in the Feurt and Madisonville phases of the Fort Ancient culture, but are not particularly abundant (Patricia S. Essenpreis-pers. comm.; Griffin 1943:81-82,84,131, 167-169), and although salt pan sherds have been found along the Tennessee River in the Wheeler and Pickwick Basins of north Alabama (Griffin 1939; Haag 1942:519,p.158,fig.1; Webb 1939), they are not common in this area. Moore (1915) did not even mention salt pan ware in his major survey of the Tennessee River but, admittedly, Moore was not overly concerned with potsherds. Salt pans have been found in considerable quantities in eastern Tennessee, in the Norris Basin (Griffin 1938; Webb 1938) and in the Hiwassee Island and Dallas phases (Lewis and Kneberg 1946:90,94,100-101), but not to the same degree as in the core area.

They have also been observed as far south as Macon Plateau in Georgia (Fairbanks 1956:43; Jennings and Fairbanks 1940:5-6; Kelly 1938:pl. 11b), and have turned up in the early Mississippian Little Egypt phase in this same state (Hally 1979:186-187,194-202,p.1,XIIf), but again, only in very minor amounts. With the exception of southern Alabama (Wentowski 1970:82-87; Wimberly 1960:185-188), salt pans have not been found, to any great extent, along the Gulf Coast. Nor do they occur in areas above the southern borders of the Great Lakes (Fairbanks 1940).

There is thus a rather loose fit between the distribution of salt pans and the extent of cultures of the Mississippian tradition. Suffice it to say that salt pans were generally associated with Mississippian peoples in the heart of the Mississippian area of development. But as they are not always found at salines, the actual function of the salt pans bears somewhat closer examination.

The Uses of Salt Pans

When found at salines, it is probable that the salt pans actually were employed in evaporating brine water (Holmes 1896:41; Webb and Funkhouser 1929:14). As stated earlier, most of the Midwestern salines were characterized by tremendous quantities of salt pan sherds (Ashe 1808:169-170; Bushnell n.d.; Holmes 1903:28-29; Myers 1921; Schoolcraft 1825:202-203; G. Smith 1904:245,257). Besides fragments, large whole vessels have been found at the Kreilich site in St. Genevieve County, Missouri. Many of the sherds at Kreilich were found in a horizontal position in a solid stratum of pottery (Bushnell 1914:646), implying that they were broken where they were used, rather than having been disposed in secondary midden. There is abundant evidence for the interpretation that the pans were embedded in basin-shaped depressions in the ground, the basins apparently having supported the large vessels (see pp. 31-32). Embedded salt pans have often been found on hilltops, high above the salines, no doubt to take advantage of solar evaporation, in addition to artificial heating (Sellers 1877:580). Lithics are relatively rare at salines, but fire-reddened stones and hearths (or extensively burned areas) have often been found in association with salt pans.

The process of salt production is generally believed to have been conducted as follows. Brine water was carried from the springs and poured into the embedded pans. Stones (often sandstone) were heated in nearby fires and dropped into the pans to speed up the natural evaporation process. At some sites stones have even been found within the pans (see p. 37). The crystallized salt was then scraped off the interior base and walls of the pan and the process began anew. This same technique was apparently also employed in the Sierra Nevada (Adams 1949:17-19,28-29; Bushnell 1907; 1908; 1914; Keslin 1964:95; Nenquin 1961:114-115; Sellers 1877:580-585). Wentowski (1970:56,70-72), however, was of the opinion that stone boiling is an inefficient process. She felt the salt pans were placed directly over the hearths on some sort of supports, possibly slabs of stone. Ashes and charcoal have indeed sometimes been found beneath the pans, suggesting that additional heat was occasionally applied (Bushnell 1907). Smoke blackening has often been observed on the exterior surface of salt pans (Griffin 1938:293-294), but staining of this sort could also have resulted from manufacture (V. Steponaitis-pers. comm.). It should be noted that at some

sites it was particularly stressed that discoloration does not occur on the exterior surface of the pans (Griffin 1938:266-270).

As noted earlier, salt pans are often found considerably far from salines (Webb and Funkhouser 1931:377). The distribution of salt pans fails to correspond neatly with the inland availability of salt (Keslin 1964:164). The Zebree site in Mississippi County, Arkansas (Morse and Million 1977:15 (11-12)) and the Gordon Town site in Williamson County, Tennessee (Myer 1928a:526-527) are but two examples of rich salt pan sites located far from salines. It is too simple an explanation to state that salines once existed in the past (eg., Holmes 1903:28). It is also dangerous to assume that when salt pans are present at a site, their specific function was necessarily related to salt production (eg., Morse and Million 1977:15 (11-13)). There is abundant evidence indicating that salt pans were often used in manners unrelated to the making of salt. Both Thruston (1973:157-159) and Webb (1952:90,93) suggested that in some places the pans were merely employed as large stationary cooking vessels. One thing is certain, the pans were not easily portable. They were probably used close to where they were made. There are historical references which indicate that salt pans, or vessels like them, were used by some aboriginal groups as hearths to make bread (Adair 1775:407-408; Hudson 1976:305).

Archaeology has revealed that salt pan fragments and the remains of other large ceramic containers often substituted for stone in the lining of "stone" box graves. They were probably used merely to spare the labor of having to find suitable stone (Adams 1941:207-219; Brown 1980b; Bushnell 1920:47-48,55,fig.4; Dowd 1969; 1972:5,23,32-33,36,38,42,50,52; Ferguson 1972:21; Hanson 1960:15; Marshall 1965a:51; Myer 1928a:530,537,603-605; Putnam 1883a-b; Schwartz 1961:24-25,85,90-91,fig.18; Sellers 1877; Stack 1949; Thruston 1973:29,157-159).

In certain areas, it is even possible that salt pans had some sort of ritual function. At a site on the east bank of the Cumberland River, opposite the city of Nashville, a fabric-impressed pan was found in the center of a mound surrounded by a circle of stone box graves:

In the centre of a mound, about three feet from its surface, I uncovered a large sacrificial vase or altar, forty-three inches in diameter, composed of a mixture of clay and river shells. The rim of this flat earthen vessel was three inches in height. It appeared to have been moulded in a large wicker basket, formed of split canes and the leaves of the cane, the impressions of which were plainly visible on the outer surface. The rim of this earthen vessel or sacrificial altar appeared to be almost mathematically circular. The surface of the "altar"

was covered with a layer of ashes, about one inch in thickness. These presented the appearance and composition of incinerated animal matter. The antlers and jaw-bone of a deer were found resting on the surface of this object. The edges of the altar or fire vessel, which had been broken off apparently by accident, were carefully placed over the layers of ashes, and then covered with nearly three feet of earth; thus the ashes were preserved to a remarkable degree from the action of the rains (Jones 1876:42).

Similar strange contexts were observed at both the West Harpeth Works and at the Old Town Mounds on the Big Harpeth River. A large pyramidal mound at West Harpeth contained seven stratigraphic layers. The fifth layer from the base consisted of a .25 in (.64 cm) thick mass of fabric-impressed pottery which had been subjected to a high degree of heating. A small burial mound located nearby similarly possessed a circular layer of intensively burned earth, around which was a ring of stone box graves, arranged like the spokes of a wheel (Ibid.:79-82). At the Old Town site, the two pyramidal mounds also exhibited tremendous heating of central areas, which Jones again called "altars." The larger mound contained, "an earthenware vessel of considerable size (Ibid.:86)," possibly a salt pan.

It is clear that we still have much to learn about the range of salt pan functions. Around salines, they were probably used in salt production, but when found in areas far from salines, made by using local ceramic techniques, we cannot be so sure of their functions. It is probable that sometimes the salt pan vessel form diffused apart from its intended function (Ball et al. 1976:18; Fairbanks 1940).

The Construction of Salt Pans

There has been considerable debate over whether the fabric impressions so often seen on salt pans were functional or decorative. Holmes (1896:45, figs. 20, 26) was a principal advocate of the decorative view, especially since not all salt pans exhibit fabric impressions. Also in support of the decorative interpretation is Bushnell's (1914:663) observation at the Kreilich site that two weaves are often neatly placed together on the same vessel; for what purpose if not decoration? Salt pans bearing different weaves have also been recorded at the Walters Farm Village site in the

Norris Basin of east Tennessee (Webb 1938:pl.78b), and at Li^V36 in the Wheeler Basin where Griffin (1939:146) recorded two weaves with a distinct line occurring between the weaves. Munger and Adams (1941:170) observed a series of wefts put together in a rather pleasing pattern on salt pan sherds at the Herrell Village and Cemetery sites in Jefferson County, Missouri. They considered the pattern to have been of decorative intent, but they were also convinced that an overall functional purpose was behind the use of fabrics in making salt pans.

Most current archaeologists accept a functional explanation for the fabric impressions, as did a number of earlier scholars (eg., Dellenbaugh 1898). It has been noted that the fabric impressions were often smoothed over, a curious thing to have done if decoration were their sole purpose (Griffin 1939:150-151). Most people are now convinced that the fabrics served, in some way, to facilitate molding the pans (see below). Fabrics, however, are too pliable to have been used without additional support. It has been demonstrated that basketry was sometimes combined with the fabric, the stronger basketry serving as the mold. The fabric is believed to have been the lining between the clay and the basket, allowing the latter to be used many times (Bushnell 1914:664-665, pls.55a-c,57c). There is some weak historical evidence in support of this interpretation. Baskets were reported to have been used by some Indian groups to make large ceramic containers. Clay was supposedly packed on to the basket interior, the basketry then being burned away (Bradbury 1817:158; Bushnell 1914:664-665; 1922:173-174; n.d.; Hunter 1823:297). This technique of pot construction was accepted by some archaeologists as an explanation for basketry impressions on sherds (Foster 1873:248-249; Sellers 1877:573-574), but Hunter (1823) was a notoriously unreliable author and his observations must be highly suspect (J. Griffin-pers. comm.; Kinietz 1938). The above process obviously would involve a horrible waste of basketry, but some explanation must be found for the plaited cane-impressed salt pans which have occasionally turned up on sites (Cole 1951:139-141,143; Orr 1951:318; Trickey 1958; Wimberly 1960: 185-188).

Even if the considerably stronger basketry was used, without some additional support it would have been a sizeable feat to hold in place the thick heavy wet clay forming the sides of the salt pans. One current opinion is that the pans were made in large earthen basins, as salt pans have often been found embedded in the ground at or near salines. Basin-shaped depressions bearing pans have been observed at the Herrell Village and

Cemetery sites near Kimmswick, Jefferson County, Missouri (Adams 1941:183, pl.VIII A; 1949:17-19,29; Bushnell 1907; Fowke 1928:487). They have also been recorded at the Kreilich site in St. Genevieve County, and at the Cole site in Saline County, Missouri (Keslin 1964:33-34,72-73). The Equality saline in Gallatin County, Illinois similarly had pans embedded in the earth (Sellers 1877:580).

There can be no question that salt pans were often used in earthen basins. Their final resting place has apparently also given rise to the interpretation that the pans were always made in earthen molds. Bushnell (1908:1) appears to have been the first person to promote the idea of earthen molds, but others have readily accepted this interpretation (Adams 1949:29; Fairbanks 1940; Fowke 1928:487; Keslin 1964:50; Mayer-Oakes 1955:168). Orr (1951:fig.4a) illustrated the method (Figure 6c). Textiles were first laid down over the basin-shaped depression. Clay was packed on the textiles and, when dry, the pan was lifted out of the mold by using the textiles. Orr felt that the baked clay "fire basins," so commonly found in the domiciliary mounds at the Kincaid site, would have served admirably as pan molds (*Ibid.*: 316; see also Bennett 1951:364). Further proof was provided by the "potters' area" at Mx^V1B, where two clay basins were found. These basins were approximately 46 cm (1.5 ft) in diameter, essentially the same as the salt pans recovered at Kincaid. Caches of clam shells and several balls of unfired clay were found near the basins (Cole 1951:53,139; Orr 1951:318).

The formation of salt pans in earthen molds was undoubtedly practiced in a number of areas, but it is possible that other methods of construction also existed. As early as 1877, Sellers suggested the use of wooden or clay molds, the salt pans being made in an inverted position over the mold (Figure 6d). Along the raised rim of a sink at Equality in southern Illinois, Sellers found heaps of shell, clay, and salt pan debris, in addition to a number of small mounds of stone which had been covered by yellow clay. He felt the latter served as molds for making salt pans, the method having been as follows. Fabric was first draped over the mold. A clay and shell compound was then applied to the dome and packed tightly using the polished flat river pebbles which were scattered all over the site. Fabric, which was necessary for both removing the clay from the mold and for preventing the clay from cracking, was then applied over the clay. It was tightly wrapped around the sides of the vessel, the binding being performed by joining and twisting several pieces of fabric together using a stick. Fabric impressions are rare on the flat vessel base, because the binding was really

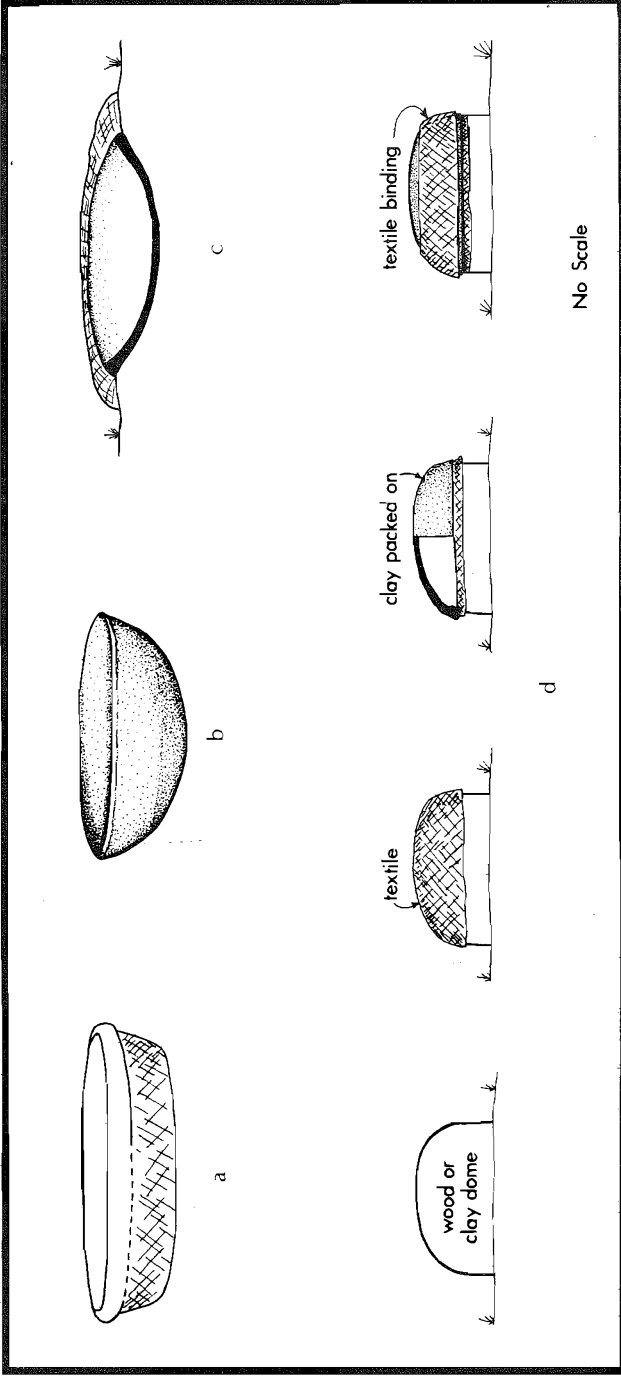


FIGURE 6. Salt Pan Forms and Hypothesized Construction Techniques. a, Fabric-impressed salt pan (Holmes 1903:pl.III); b, Smooth-surfaced salt pan (*Ibid.*:pl.Xc); c, Earthen mold hypothesis (Orr 1951:fig.4); d, Inversion technique on wood or clay molds (reconstructed from Sellers 1877).

only needed around the sides of the vessel (Sellers 1877).

According to Sellers, the tight band would have served to prevent cracking during the drying process, but the fabric had to be removed in order to be used again. Removal would have been difficult had the fabric been directly applied to the hard compressed clay, but if a final thin layer of river silt or mud was applied to the clay just before the textile was laid over the vessel, only a slight surface moistening would be necessary to remove the fabric from the pan.

It is not quite clear how Sellers came to the above interpretation, but it certainly is an attractive one. However, I am indebted to Vincas Steponaitis for pointing out a number of problems with the proposed technique. First of all, it is not definite that a tight binding around the exterior vessel walls would actually serve to prevent cracking:

I can't imagine how an exterior textile binding like the one in Fig. 6 would prevent cracking...as the pot shrinks, the vessel walls will tend to 'crawl' slightly up the mold. It seems to me that a tight binding would inhibit the vessel wall from adjusting its shape and position to accomodate shrinkage... and this sort of inability to adjust is the prime cause of cracking (Steponaitis 1980).

It is also not clear how Sellers knew that an application of fine river silt would facilitate the removal of the textiles from the pan. There is no indication of experimentation of any sort in his account. Sellers did not refer to the combined use of textiles and basketry in salt pan construction (see p. 31), and it is well that he did not, as the use of basketry as an additional support argues in favor of an earthen mold technique. The removal of a large salt pan vessel from its mold requires support from below, not from above (Ibid.).

There is, however, some archaeological support for the inverted mold thesis. Webb and Funkhouser may have unwittingly excavated a clay mold at the Tolu site in Crittenden County, Kentucky. The excavation of the ceremonial mound produced a great deal of fabric-impressed pottery. A huge dome of fire-hardened clay with a height of 3 ft (91.44 cm) and a basal diameter of 5 ft (152.40 cm) was also uncovered (Webb and Funkhouser 1931: figs.19-20):

It resembled more than anything else a huge inverted bowl but had none of the characteristics of pottery either in structure or material. The outside was burned to a thickness of one-half inch to form a hard crust but contained no lime nor shell nor gravel nor other binding materials.

The top was more or less flattened and showed undoubted evidence of intense heat as though it had served as an altar or sacrificial stone. A few irregular depressions appeared in the hardened surface but whether this pitting was accidental or a designed character was not apparent (Ibid. 333-334).

The roughening of the surface may have been due to textiles having been laid down prior to the addition of clay. Otherwise, it would have been impossible to remove the pan from the mold. It was noted at the Williams site in nearby Christian County, Kentucky, that some of the salt pan sherds had impressions of sagging fabric, the result of gravity working on the pans while still on the mold (Webb and Funkhouser 1929:15). Surrounding the clay "altar" at Tolu was a heavily packed floor, the result of a lot of treading. The authors also noted that adjacent to the dome was an extensive bed of wood ashes, as well as evidence of intensive fires which must have been blazing more or less continuously (Webb and Funkhouser 1931:337-338).

The so-called altar at Tolu may in fact have been a mold for making salt pans. Its presence under a mound is surprising, but not without precedent, for it will be remembered that a very similar clay altar bearing a fabric-impressed salt pan was found in the center of a mound at Nashville and also possibly at the Old Town site in Williamson County, Tennessee (see pp. 29-30).

In support of the notion of fabrics being placed over the domes prior to the addition of clay, Webb and Funkhouser (1931:379-380, fig. 51) noted that some of the salt pan vessels at Tolu have interior fabric impressions as well as exterior ones. It is probable that the fabric impressions on the interior of the salt pans were generally smoothed over, no doubt to permit the extraction of crystallized salt more easily. But it would have been difficult, and perhaps not even necessary, to remove fabric impressions from jar interiors if the lower portions of the jars were sometimes made on a mold. Orr referred to the fabric impressions on jar interiors at Kincaid as, "a consistent and somewhat mysterious occurrence (Orr 1951:314)." The type Tolu Interior Fabric Impressed is a rare but diagnostic ceramic of the Tinsley Hill phase (late Mississippian) in the Lower Cumberland region (Clay 1979:115, table 1).

The technique of binding does not, of course, solve the problem of smooth-surfaced salt pan construction. It is true that fabric-impressed salt pans were sometimes smoothed over after construction, but this practice certainly does not account for the vast quantity of smooth-surfaced salt pans found throughout the Midwest and Southeast. The types of molds used

in making smooth-surfaced salt pans are not presently understood. It is possible that molds may not have been used at all, the Indians having discovered new methods for constructing large vessels. Whatever the nature of the advance in technology, it is quite clear that textiles were no longer needed as an intermediate substance between the clay and the mold. An item which should be focused on in later studies is the typical occurrence of a red slip on the exterior, and especially on the interior, of smooth-surfaced salt pans. The application of an interior slip may have been functional, perhaps relating to the removal of a crystallized salt from the pans, or to the prevention of water absorption (V. Steponaitis-pers. comm.).

Variations in salt pan technology are also suggested by other impressions occasionally observed on the surface of the vessels. For example, leaf impressions are commonly seen on the exterior surface of the salt pans at Kincaid on a late time level. Orr (1951:318,321) attributed their occurrence to a declining use of textiles at this site, but it is more likely that a technological change was occurring in salt pan construction. Leaf impressions have also been observed on salt pans at the Hardin site in Greenup County, Kentucky, a Fort Ancient component (Hanson 1966:81), and they are a rare but constant feature on the Hawkins Fabric Marked salt pans at Macon Plateau in Georgia (Fairbanks 1956:43).

Sometimes the smooth-surfaced salt pans bear grass impressions on their exterior walls, suggestive of construction in earthen molds. Varney Red pans often exhibit this trait, especially those occurring in the Hayti phase of the Little River Lowland of Southeast Missouri (Marshall 1965a:109, 114). The Grassey Salt Pan type, so common at the Persimmon site (8-Q-4) (same as the Kersey site), is described as having been coiled in a manufacturing support lined with grass (*Ibid.*:100-102; Phillips 1970:929). Grass impressions have also been observed on Varney Red pans at the Zebree site in northeast Arkansas (Million 1977:18(18)). Although the typical heavy salt pans do not occur at Salt Mine Valley (33-I-5) on the southwest coast of Louisiana, it should be mentioned that a significant portion of the bowls, which were presumably employed in brine evaporation, also bear grass or brushed impressions on their exterior surface.

An important question is whether the variations in salt pan construction and use were synchronic or diachronic. I will deal with this subject in the next chapter, but let us now briefly examine other materials which appear to have been employed in prehistoric salt production in

Eastern North America.

Additional Equipment Used in Salt Production

I have discussed salt pans in some detail, as these artifacts are the most visible implements of prehistoric salt-making in Eastern North America. But other objects were undoubtedly also employed in the process of producing salt. Containers were necessary for carrying brine to the embedded pans, tools must have been used to scrape the crystallized salt from the vessels, and a number of implements must have been utilized in the actual construction of the pans. The use of basketry, fabrics, and clay or wooden molds has already been mentioned. Battered stone axes found in the vicinity of the Kimmswick saline in Jefferson County, Missouri, may have been used to pulverize the shell for temper (Bushnell 1907:4), but if the shell was heated first, crushing would have been a relatively easy task (V. Steponaitis-pers. comm.). Pottery trowels are thought to have been used in some manner to pack and harden the clay while the vessel was being made (Orr 1951:fig.4). Heated stones have already been referred to as tools to facilitate brine evaporation (Bushnell 1907:3; 1914:644-645; Fowke 1928:487; Mills 1949:5; Schoolcraft 1825:200). After the salt crystalized in the bottom of the pans, it is possible that shell spoons were used to scrape the salt free from the containers (Bushnell 1907:4; Fowke 1928:487). The pans were then ready to receive additional brine.

Another object which is believed to have served some function in the Eastern Amerindian production of salt is the pottery "funnel." This thick heavy ceramic funnel has been given a number of names, those most frequently encountered being Macon Thick, Wickliffe Thick, Wickliffe Plain, Wickliffe Incised, Wickliffe Cord Marked, and the Wickliffe form (Cole 1951: 140-141, pl. XXII B, q-t; Fairbanks 1956:79-80; Jennings and Fairbanks 1940:4; B. King 1939:96-98; Marshall 1965a:63,76-77,107-109; Million 1977:18(28), fig.18(15); Phillips 1970:171-172; Reagan 1977; Williams 1954:214-218). This cylindrical vessel form has thick, coarse shell-tempered walls, with a large opening on one end and a small orifice on the other.

Although primarily confined to Mississippian contexts, the Wickliffe

form has also been found in association with Baytown materials at the Persimmon site (8-Q-4) (Kersey site) in southeast Missouri (Marshall 1965a: 63). One funnel-shaped object was found associated with the Coles Creek culture at the Greenhouse site (28-H-2) in Avoyelles Parish, Louisiana. The latter vessel, however, is grog-tempered and thin-walled (J. Belmont-pers. comm.). The Wickliffe form has primarily been observed in southeast Missouri, including the Hayti phase of the Little River Lowland and especially in the Cairo Lowland phase opposite the mouth of the Ohio River (LMS files - Peabody Museum; Marshall 1965a:63,72,76-77; Reagan 1977: Walker and Adams 1946; Williams 1954:98-103, 131-136,139-149,152-154,156-166,214-218). These vessels are particularly common in New Madrid County, the Lilbourn site (6-R-1) having a large quantity of the type (Croswell 1878:537; Reagan 1977; Swallow 1858; 1875). The Wickliffe site (5-T-6), also included in the Cairo Lowland phase, is the type site for the Wickliffe form (B. King 1939:96-98).

This form has also appeared on the Malden Plain, in the Advance Lowlands, in the Little River Lowland (Williams 1954:169-172,174-175,181-182,188-190,194-196), at the Zebree site in northeast Arkansas (Million 1977:18(28)), at Cahokia (Fowler and Hall 1972:9; Vogel 1975:table 20), and at Kimmswick in Jefferson County, Missouri (Bushnell 1907). A number of sites adjacent to the mouths of the Cumberland and Tennessee rivers are also reported to have possessed the Wickliffe form, including Kincaid (Cole 1951: 140-141,pl.XXIIB,q-t), Tinsley Hill (Schwartz 1961:76-78), and O'Byams Fort (6-T-3) (Webb and Funkhouser 1933:22-23,fig.9). These vessels have even been recorded as far south as Macon Plateau in central Georgia (S. Williams-pers. comm.).

There has been considerable debate over the actual function of the Wickliffe vessel. Speculations as to its use have ranged from functioning as a juice press to serving as a filter for the leaching of salt plant ashes. It has generally been assumed that they were in some way associated with salt production. Most archaeologists believe they were used as funnels, an interpretation perhaps deriving from Croswell (1878:537), who referred to Schliemann's description of similar funnel-like objects found at Troy. In prehistoric Europe, wood or pottery containers bearing perforated bases were used to filter impurities out of brine solution. Salt-impregnated sand was thrown into these containers which were partly filled with straw to serve as filters (Nenquin 1961:122-123).

These ceramic funnels may have served the same function as "thorn

houses," typical structures on nineteenth century salt work sites in America. A thorn house used in the Equality area of southern Illinois was described as being a large frame building (G. Smith 1904:255-256). It was filled with tightly packed bundles of thorn bushes. A perforated trough ran on top of the house. Brine was pumped into the trough and allowed to slowly trickle down through the bushes to the bottom of the structure. It was then caught in a large trench and conveyed to a containing basin for boiling. The exact function of the thorn houses is not known, but Smith felt that their primary purpose was for purifying the brine prior to boiling:

In evaporating the brine by boiling the water there were deposits of some substance like gypsum in the bottom of the pan which adhered to the bottoms of the pans and if not often removed would prevent the passage of the heat from the fire to the water and thus the pans would be burned. Now the thorn bushes were supposed to have the power to crystallize this foreign matter and thus purify the brine (Ibid.:256).

Rock salt commonly contains gypsum (Bloch 1963:91; Cooper 1966; Stose 1913), and, as the salines of Eastern North America were situated either above or along the margins of rock salt deposits, it is probable that some sort of prehistoric technique similar to the above method must have developed to filter gypsum out of the brine. Otherwise the salt producers would have constantly had to chip the incrustations of earthy substances from the pans (eg., S. Smith 1829:9). If the precipitates were not continually removed uneven heat expansion would occur and the vessels would eventually split. Nineteenth century salt makers scraped and ran fresh water over their iron kettles to remove the incrustations (Lonn 1933:50; Wentowski 1970:53). The Wickliffe vessel form may have been created to attenuate this problem.

As with the distribution of salt pans in Eastern North America, there are numerous instances in which the Wickliffe form has been found far from salines. Those found at the Wickliffe site (5-T-6), for example, have been called juice presses (King 1939:96-98), an unfortunate misnomer which continues to crop up in the archaeological literature (eg., Fowler and Hall 1972:9; Marshall 1965a:63). At the Zebree site in northeast Arkansas, also far from any known saline, Million (1977:18(28), fig.18(15)) suggested that vessels of the Wickliffe form were used to leach salt from the ashes of burnt plants. Such a technique was observed by Stanley in certain parts of Africa. The salt-plant Pistia stratiotes L. was dried and burned, the ashes then being collected and placed in pots with perforated bases. Water was poured over the ashes, the solution being collected in flat dishes and evaporated

over a fire (Dastre 1902:567; Nenquin 1961:117; Stanley 1878,II:175-176).

As discussed earlier, we know that some Eastern Amerindian groups did indeed occasionally use plants as a salt source (Keslin 1964:15-16). Whether or not the Indians of the Midwest resorted to the rather tedious process of producing salt from plants is a moot point, especially as salines were often no more than a hundred kilometers away, and usually closer. Cultural boundaries no doubt existed, but it is also probable that trade relations would have served to distribute the salt produced at salines. I suspect the funnels were not primarily used in leaching salt-plants, but I do feel they were in some way related to the production of salt. Their actual use must await the accumulation of more and better controlled archaeological data.

Summary

It is clear that abundant evidence for prehistoric salt production exists in Eastern North America. I have concentrated on salt pans, because this particular artifact type has a high visibility in the archaeological record. They have been found throughout the Midwest and Southeast, generally in association with salines. There are two basic salt pans, a smooth-surfaced pan and a fabric-impressed pan. The textiles seem to have primarily served functional purposes, but there is evidence that the Indians occasionally were careful in the application of the fabric, taking advantage of its decorative potential. Other salt pan "decorations," including red painting, leaf marks, and plaiting impressions, may in some way have been related to the construction and/or use of the vessels.

In addition to being manufactured in earthen basins, I have suggested in this study that salt pans may sometimes have been made in an inverted position on wooden or clay molds. When found at salines, salt pans were used to evaporate brine water, but it should be emphasized that the distribution of salt pans is not totally confined to areas rich in salines. It is very likely that they served different functions in different areas. Similarly, the pottery funnel (Wickliffe form), so common in southeast Missouri, probably served a number of functions, in addition to being used

in salt production. Let us now turn to the cultural context of prehistoric salt production to determine the order and distribution of the various techniques.

CHAPTER 6

The Cultural and Temporal Context of Eastern North American Prehistoric Salt Production

Presenting descriptive and distributional information on the equipment used in salt production has been a relatively easy task, but identifying the temporal and cultural contexts of the equipment is a problem bearing considerable complexity. Salt pans are remarkably similar throughout their distribution, but it is unreasonable, if not simply wrong, to assume that the salt producers in the various regions were of the same Mississippian culture. It is more probable that, being faced with the same problem of having to draw salt from solution, the peoples of different regions adopted techniques which were found to have been effective in other areas. Through studying the distribution of salt pans in Eastern North America, we are not so much witnessing the movement of salt producers as we are the diffusion of a technology.

Trying to pin down the first evidence for salt production is a problem. We do know that salt pans were made and used by a number of non-Mississippian peoples, as represented by the Dillinger Complex of southern Illinois (J. Griffin-pers. comm.; Maxwell 1951:214, pl. XXXIV), the Yankeetown phase of southwest Indiana (Green and Munson 1978:300,304; Winters 1967:70), the Hoecake (Phillips 1970:902-903; Williams 1954:30, tables 1-2) and Beckwith phases of the Cairo Lowlands (Phillips 1970:912-913), and the Late Woodland period of east-central Missouri (Keslin 1964:147; Wentowski 1970:62), but overall, salt production appears to have been primarily a Mississippian activity. There does seem to have been some changes in the process through time though. Generally, fabric-impressed salt pans and smooth-surfaced pans occur in the same areas (Figure 7). The Cumberland River drainage in both Middle Tennessee and in western Kentucky have both types, as do the Cairo Lowlands of Southeast Missouri, the various counties of east-central Missouri, and the Norris Basin of east Tennessee. Only in the extreme southern portion of southeast Missouri, in northeast Arkansas, and along the upper Ohio River does there appear to have been a spatial distinction between the two pan types. Salt pans are seldom found

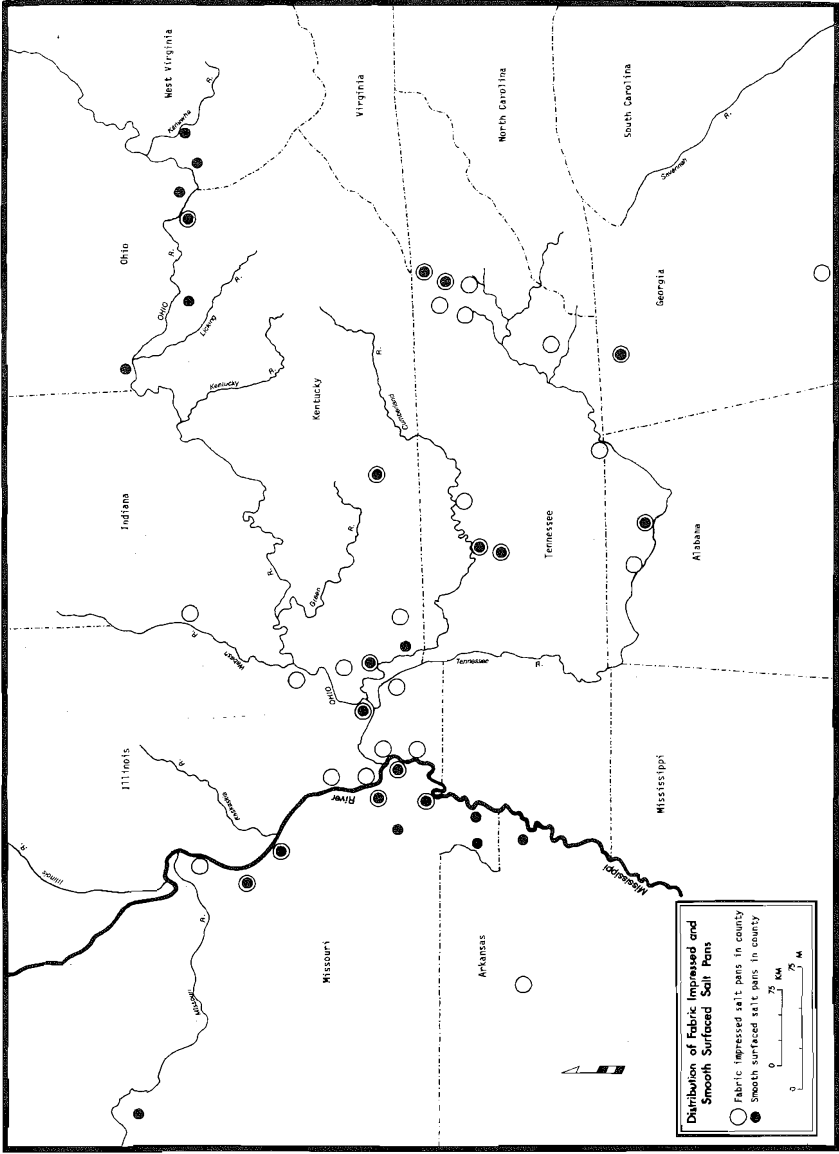


FIGURE 7. Distribution of Fabric-Impressed and Smooth-Surfaced Salt Pans.

in the Fort Ancient phases of Ohio, Kentucky, and West Virginia, and when they do occur, they are primarily of the smooth-surfaced type. In southeast Missouri/northeast Arkansas smooth-surfaced pans are quite common, while fabric-impressed pans are rare.

When one is trying to establish the relationships between these two types of salt pans, the examination of distribution by county alone can be quite misleading. A study of the salt pans by sites reveals considerable differences between the two types in the Norris Basin (Figure 8). Altogether, seven sites produced salt pan sherds. All of them have fabric-impressed sherds, but only two of these sites have smooth-surfaced sherds. If the same peoples were making both types, one would expect both pans to have been found on all seven sites. Either a spatial or a temporal disconformity is being depicted by this particular distribution. As will be demonstrated below, in discussing other regions, I believe the variations are temporal. The fabric-impressed salt pan has the more extensive distribution in the Norris Basin and is also probably the earlier of the two types. The later smooth-surfaced salt pan is confined to the northeastern periphery of the region.

As there appears to have been a marked discontinuity in the usage of smooth-surfaced and fabric-impressed salt pans in southeast Missouri/northeast Arkansas, let us turn to this area (Figure 9). There are four principal sub-regions where salt pans have been found in this portion of the Lower Mississippi Valley - the Malden Plain, the Little River Lowland, the Cairo Lowlands, and the northern portion of the Western Lowlands.

The earliest Mississippian phase in the Malden Plain is the Malden Plain phase. This phase has been set up on the basis of the Cockrum Landing (8-0-1) excavations. Smooth-surfaced Varney Red salt pans are typical of this phase, which has tentatively been dated between AD 900 and AD 1100 (Marshall 1965b; Phillips 1970:926-928; Williams 1954:34,181-182, 275, table 2; 1978). The later Lawhorn phase, observed stratigraphically above the Malden Plain phase at Cockrum Landing (Marshall 1965b), lacks Varney Red, but has a thick utility ware which Marshall called salt pan-like. The Lawhorn phase is believed to be Middle Mississippian in time, occurring between AD 1150 and AD 1400 (Morse 1978; Moselage 1962).

The Mississippian occupation of the Little River Lowland sub-region has also been divided into two phases. Hayti, the earliest phase, is characterized by abundant smooth-surfaced red-painted salt pans. The Wickliffe form and the Grasse Salt Pan type are also characteristic of the

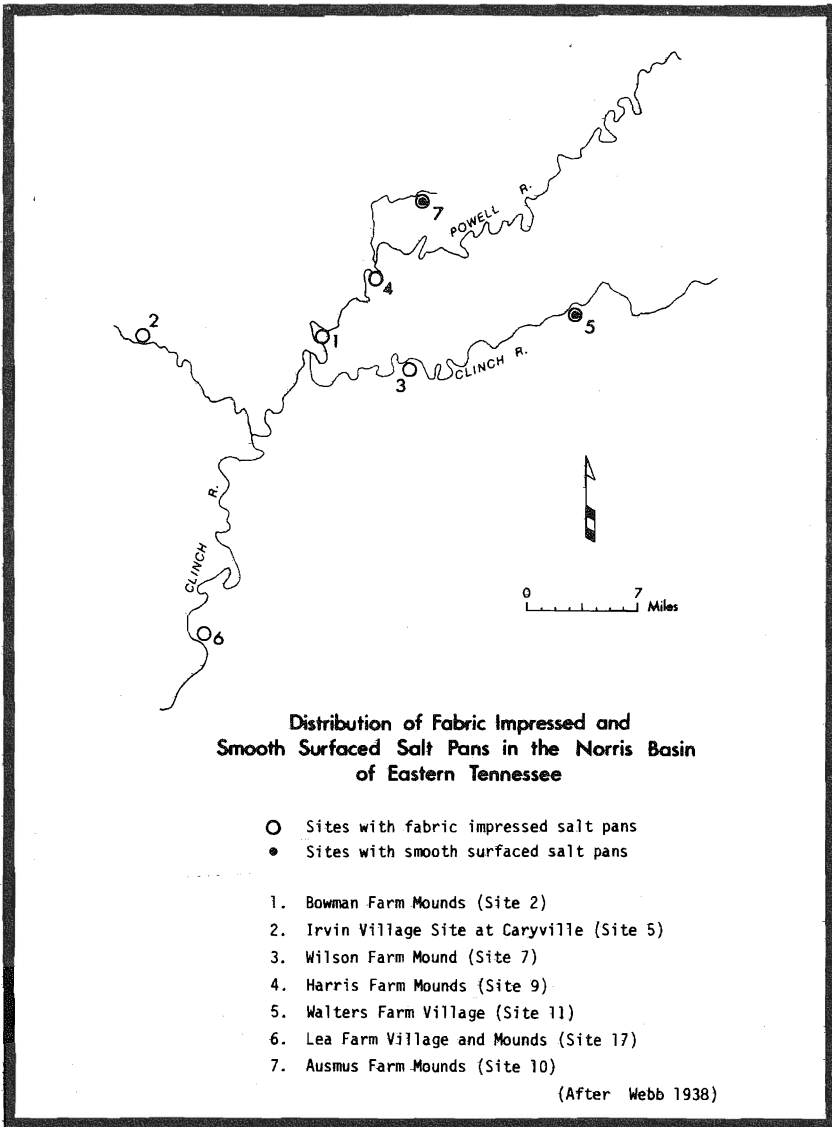


FIGURE 8. Distribution of Fabric-Impressed and Smooth-Surfaced Salt Pans in the Norris Basin of Eastern Tennessee.

Site Index for Figure 9

- 1 Lakeville (4-Q-3)
- 2 Wickliffe (5-T-6)
- 3 Crosno (5-T-1)
- 4 Beckwiths' Fort (6-T-1)
- 5 Lilbourn (6-R-1)
- 6 Powers Fort (6-N-1)
- 7 Persimmon (8-Q-4)
- 8 Old Varney River (8-P-1)
- 9 Cockrum Landing (8-O-1)
- 10 Lawhorn (9-O-4)
- 11 Zebree (9-P-4)
- 12 Notgrass (10-P-4)
- 13 Barton Ranch (11-O-10)
- 14 Banks Village (11-P-8)

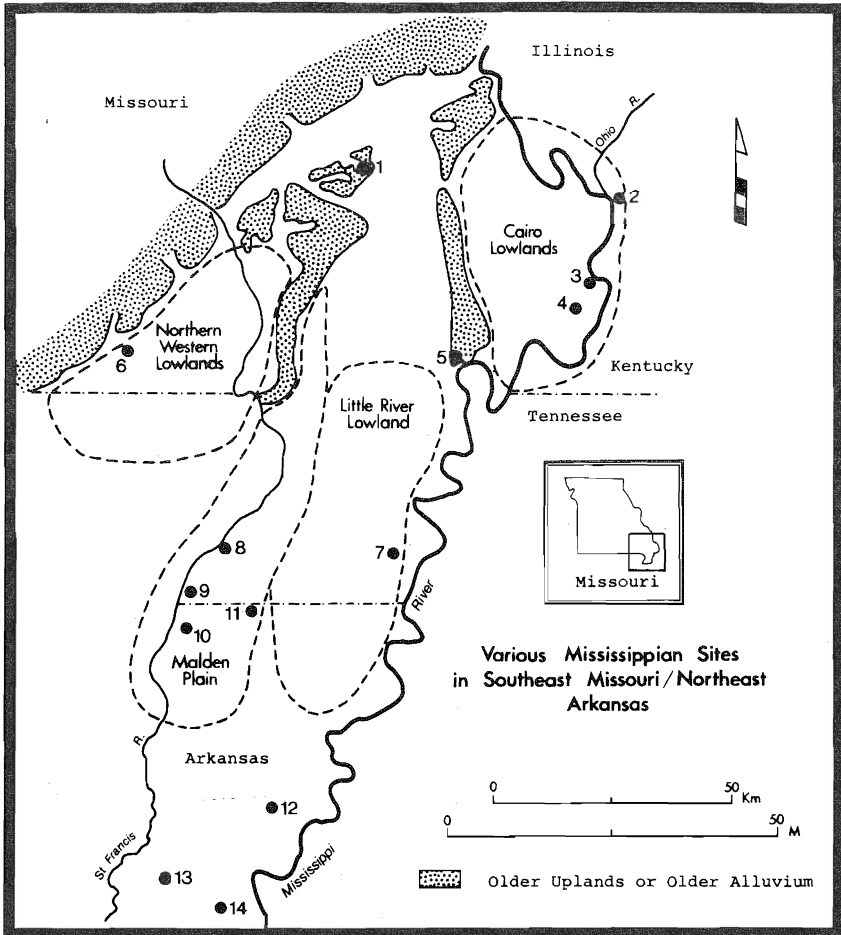


FIGURE 9. Various Mississippian Sites in Southeast Missouri/Northeast Arkansas.

Hayti phase. This phase is believed to have been contemporary with the Malden Plain phase and it is closely related to the Big Lake phase of northeast Arkansas. The Big Lake phase has been dated to AD 800 - AD 1000 (Brain 1971:75; Marshall 1965a:62-63,76-77; Morse 1978; Phillips 1970:929). The above traits disappeared in the succeeding Pemiscot Bayou phase, a phase believed to have been contemporary with the Lawhorn phase on the Malden Plain. Pemiscot Bayou lacks salt pans altogether, a trend which appears to have been occurring at the same time on the Malden Plain (Marshall 1965a:72,76; 1965b:table 3; Phillips 1970:929).

Salt pans also occurred primarily in early Mississippian times in the Western Lowlands. The Naylor phase shares close parallels with the Hayti, Malden Plain, and Big Lake phases. Price (1978a) dated Naylor between AD 1100 and AD 1200. Salt pans were rare in the succeeding Powers and Quin phases, contemporary phases dating between AD 1250 and AD 1350, but the Wickliffe form has occasionally been found on Powers phase sites (Price 1978a; 1978b; Price and Griffin 1979:82,p1.5; B. Smith 1976; 1978).

The Cairo Lowlands phase has been estimated as extending from AD 900 to AD 1400, but overall it has material analogies with early Mississippian occupations of southeast Missouri/northeast Arkansas. The Wickliffe form is quite common, as are fabric-impressed and smooth-surfaced salt pans. The fabric-impressed type overall seems to have been most abundant in the Cairo Lowlands (Chapman et al. 1977; Crowell 1878; Conant 1878; Griffin 1952:229-231; F. King 1934; 1936; Lewis 1934; Marshall 1965a:72; Moore 1916:501-506; Phillips 1939:372,379-458; 1970:925-926; Potter and Evers 1880; Swallow 1858; 1875; Thomas 1894:170-171,173-174,186-188,280-282; Walker 1942; Walker and Adams 1946; Webb and Funkhouser 1932:16,70,129; 1933; Williams 1954:129-166; 1978).

It can generally be stated that salt pans were most typical in southeast Missouri/northeast Arkansas in early Mississippian times. The smooth-surfaced red-painted type was characteristic of the Malden Plain, the Little River Lowland, and the northern Western Lowlands, whereas both salt pan types occurred in the Cairo Lowlands. I am not sure what trends were occurring in salt pan use in the Cairo Lowlands in late Mississippian times, but it is clear that in both the Little River Lowland and the Malden Plain, there was a movement away from using the thick heavy salt pans altogether. It should be pointed out that salines are absent in southeast Missouri/northeast Arkansas, so we cannot be certain that the pans were actually even used in salt production in this area.

Let us now examine the distribution of the various salt pan forms in the Lower Cumberland region. Included in Figure 10 are the lands bordering the Tennessee and Cumberland rivers, the Black Bottoms of southeast Illinois, and the bluffs of western Kentucky. The latter area is generally included under the Cairo Lowland phase, but in terms of its geophysical character, it is more at home in an expanded version of the Lower Cumberland region. In reviewing the archaeological literature, I have thus far been able to identify nine sites in the above region which produced fabric-impressed pottery. Four sites have yielded smooth-surfaced salt pans, three of these same sites also having fabric-impressed sherds. The sites where only fabric-impressed sherds have been found include Godeen (Webb and Funkhouser 1932:271), Jonathan Creek (Moore 1915:7-8; Webb 1952:88-94; Webb and Funkhouser 1932:269), Wickliffe (B. King 1939:96-98), O'Byams Fort (Phillips 1970:925-926; Webb and Funkhouser 1933:23-24, fig.10), Williams (Webb and Funkhouser 1929:13,22), and the Glover Mound and Cemetery (Webb and Funkhouser 1928:164; 1929:14,24,28). Smooth-surfaced pans may have been found at the Duncan site (Funkhouser and Webb 1931:460), but otherwise they have consistently turned up at the same sites as the fabric-impressed pans. The latter form is most common at the Tolu site, but smooth-surfaced salt pan sherds have also been found (Phillips 1939:364-367; Webb and Funkhouser 1931:341,375,392,395, fig.62; 1932:93-96). The two pan types similarly occur at the Tinsley Hill site (Schwartz 1961:24-26,42,70,84, fig.18).

Berle Clay (1979) has recently defined two cultural phases (Jonathan Creek and Tinsley Hill) of the Mississippian tradition in the Lower Cumberland region. The two phases, with Jonathan Creek being the earlier, are separated stratigraphically at the Tinsley Hill site. A sterile deposit divides the two components, a temporal discontinuity of unknown duration. Clay believed there was an overall Mississippian cultural continuity in the region, but the Jonathan Creek phase itself was thought to have been an intrusion into the local Woodland tradition. Altogether, he felt the two phases lasted from AD 1000 to AD 1600, but others have argued for a terminal date between AD 1400 and AD 1450 (Vincas P. Steponaitis-pers. comm.; Williams 1977). Fabric-impressed salt pans are common features of the Jonathan Creek phase, but there was a marked increase in the use of smooth-surfaced salt pans in the later Tinsley Hill phase (Clay 1979:table 1).

A similar sequence occurred in the Black Bottoms of southern Illinois, opposite the mouth of the Cumberland River. Recent investigations in the area have resulted in the identification of the Angelly phase, a

Site Index for Figure 10

1	Kincaid
2	Tolu
3	Tinsley Hill
4	Williams
5	Glover Mound and Cemetery
6	Duncan
7	Jonathan Creek
8	Godeen
9	O'Byams Fort (6-T-3)
10	Wickliffe (5-T-6)

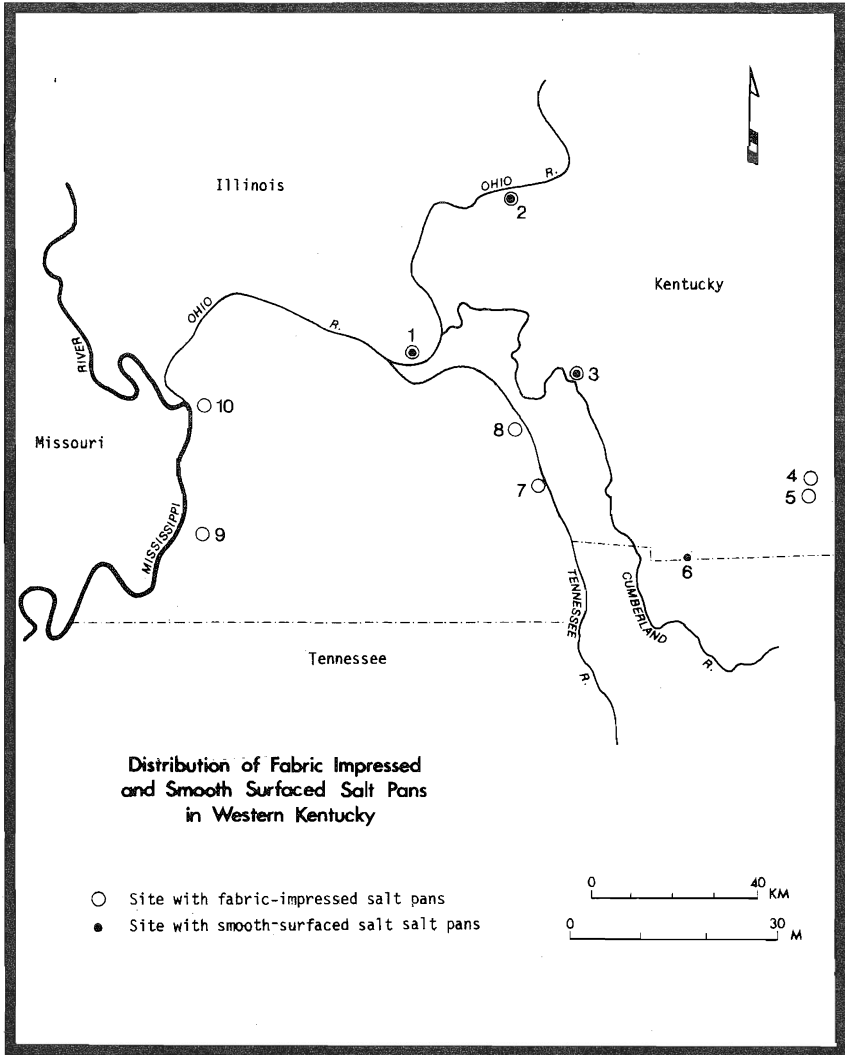


FIGURE 10. Distribution of Fabric-Impressed and Smooth-Surfaced Salt Pans in Western Kentucky.

phase preceding the Kincaid sequence. This early Mississippian phase is characterized by fabric-impressed pans and small percentages of Wickliffe Thick (Clay 1979:123; Riordan 1975). Fabric-impressed pans and smooth-surfaced pans have been found at the Kincaid site (Figure 10), but again there are clear stratigraphic distinctions between the two types. The Mississippian occupation of the Kincaid site has been divided into three subphases - Early, Middle, and Late (Cole 1951:16). Salt pans occur throughout the sequence and are, in terms of sherd count, second only to jars in relative frequency (Ibid.:139-140).

The impressions on the "decorated" salt pans at Kincaid consist of textiles, plaited cane, and leaves. Plaiting occurs only in the Early period. Twilled twining is also primarily confined to the Early period, decreasing through time in favor of plain twining and hexagonal openwork. Two basic fabric-impressed salt pan forms are recognized. One form is a very wide shallow vessel, resembling the end section of a sphere. The second fabric-impressed pan form has a high recurved rim. Through time, the lip on the first form became beveled, rather than rounded. Leaf-impressed salt pans occurred in the Late period levels in the Kincaid sequence. Although salt pans as a whole increased three-fold from Early to Late Kincaid times, the fabric-impressed pans decreased in favor of smooth-surfaced pans. The latter are generally wider in diameter, have thicker walls, and have beveled lips (Bennett 1941; Cole 1951:139-141,143; Orr 1951:314,318,320-322; Wilder 1951). For both the Lower Cumberland region and the Black Bottoms, it is thus quite clear that a transition from fabric-impressed to smooth-surfaced salt pans occurred in Mississippian times.

Let us now examine the Middle Cumberland region. The evidence for the temporal separation of the two pan types is not as solid as might be wished, but it does exist. Fabric-impressed sherds have been found at the Fewkes Group in Davidson County, Tennessee, but Myer made no mention of smooth-surfaced pans at this site. He did, however, indicate that one of the stone box graves of a later component at Fewkes had a pottery floor. He felt this later occupation was contemporary with the nearby single component Gordon Town site. Gordon Town has stone box graves lined with smooth-surfaced salt pans (Myer 1928a), as does the contemporary West site, also located in Davidson County (Dowd 1972:23,32-33,36,38,42,52). Again, there is evidence for the evolution of salt pan use from fabric-impressed to smooth-surfaced pans.

The picture is not quite so clear for east-central Missouri. At the beginning of the twentieth century, Bushnell made note of the horizontal separation of fabric-impressed and smooth-surfaced salt pans at the various sites he investigated. At both Kimmswick in Jefferson County and at the Kreilich site in St. Genevieve County he felt the fabric-impressed pan was the earlier of the two types (Bushnell 1908:1; 1914:662). Later investigations have demonstrated that the temporal separation is not so distinct. Adams divided the Mississippian occupation of east-central Missouri into two major phases (foci by his terminology). The Kimmswick phase was characterized by great quantities of fabric-impressed salt pans, while smooth-surfaced pans were common in the Platin phase (Adams 1941: 183-186, 207-219). Adams noted that the Platin phase had many Late Woodland affinities, and so he felt it occurred earlier than the Kimmswick phase. He believed the Kimmswick phase lasted as late as the sixteenth or seventeenth centuries (Adams 1949:47-50), but of course his interpretations were made prior to knowledge of radiocarbon dating.

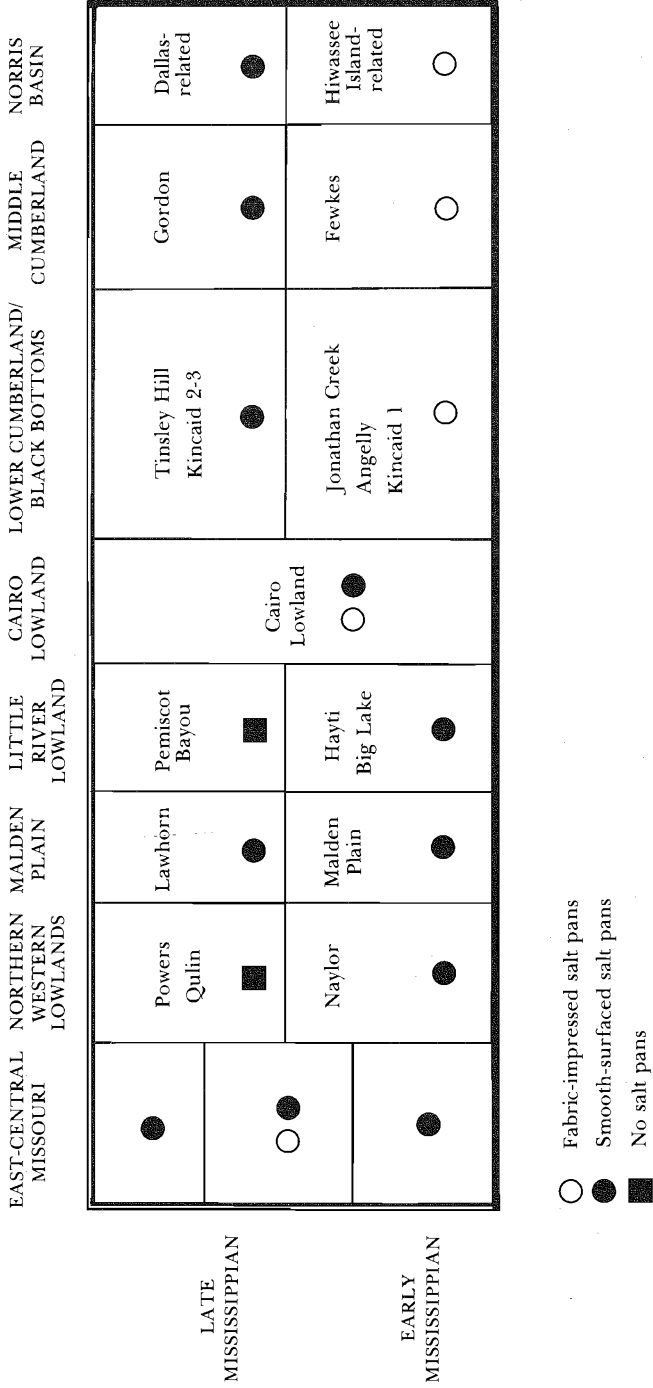
For fabric-impressed pans to have lasted so long, when they had long since disappeared everywhere else in the Midwest, would have been an incredible example of cultural retention. They did not, but there is good supporting evidence that smooth-surfaced salt pans did have temporal precedence over the fabric-impressed type in east-central Missouri. A series of test pits excavated at both the Kreilich and Cole sites in St. Genevieve County revealed that smooth-surfaced pans were used first in the area. Fabric-impressed salt pans were later introduced and rapidly increased, but eventually disappeared as the smooth-surfaced pans continued to be employed (Keslin 1964:50-56, 61-67, 89-95).

Across the Mississippi River at the Cahokia site, the smooth-surfaced salt pan is predominant. Fabric-impressed sherds do occur, but not to the same extent as the plain type. The salt pans are primarily confined to the Stirling and Moorehead phases (AD 1050 - AD 1250) (Griffin 1941:16; O'Brien 1972:53-55, 70, figs. 31-33, 82, table 16). Somewhat further afield, the synchronic utilization of fabric-impressed and smooth-surfaced salt pans may also have occurred at the Beckum Village site in Clarke County, Alabama, but overall, the smooth-surfaced type was typically common in the upper occupation levels at this site (Wentowski 1970:82-84; Wimberly 1960: table 6).

A conflicting number of trends have become apparent by examining the distribution of salt pans within the five principal regions of their occurrence - southeast Missouri/northeast Arkansas, east-central Missouri, the Lower Cumberland/Black Bottoms, the Middle Cumberland, and the Norris Basin. Southeast Missouri/northeast Arkansas has been further divided into four sub-regions to clarify and highlight some of the changes which are believed to have occurred in the evolution of salt pans. Presented in Figure 11 is a very schematic illustration of the various regions, basically divided into early and late Mississippian times. The chart is merely a heuristic device to show general changes in salt pans through time. I am well aware of the fact that for some of the regions the sequences are far better understood than is represented in the chart. I also do not wish to give the impression that the changes from one type to another were abrupt and/or simultaneous throughout the large area under examination. The chart is designed to give the reader a general visual impression of what has occurred in the development of salt pans through time.

Looking first at the entire region in the early Mississippian period, a number of patterns are quite clear (Figure 12). Fabric-impressed salt pans were widely distributed, typical of the Cairo Lowland, the Lower Cumberland/Black Bottoms region, the Middle Cumberland, and the Norris Basin. Smooth-surfaced salt pans (often red-slipped) at this time were confined to the Malden Plain, the Little River Lowland, the northern Western Lowlands of southeast Missouri/northeast Arkansas, and probably the Cairo Lowlands. They also appear to have been produced in east-central Missouri in early Mississippian times, but were subsequently succeeded by the fabric-impressed type.

By late Mississippian times, a marked change occurred in the use of salt pans in the above regions (Figure 13). For some reason, the smooth-surfaced salt pan was revived in east-central Missouri. The red-slipped smooth-surfaced salt pans were no longer made in the Malden Plain, being replaced by a thick "salt pan-like" ware. Salt pans were no longer made in the Little River Lowland and the Western Lowlands, although these areas were still occupied. There is no evidence at all for late salt pan production in the Cairo Lowlands. In all of the remaining regions, there appears to have been a shift from fabric-impressed to smooth-surfaced pans in late



- Fabric-impressed salt pans
- Smooth-surfaced salt pans
- No salt pans

FIGURE 11. Occurrence of Salt Pans in Various Regions of Eastern North America.

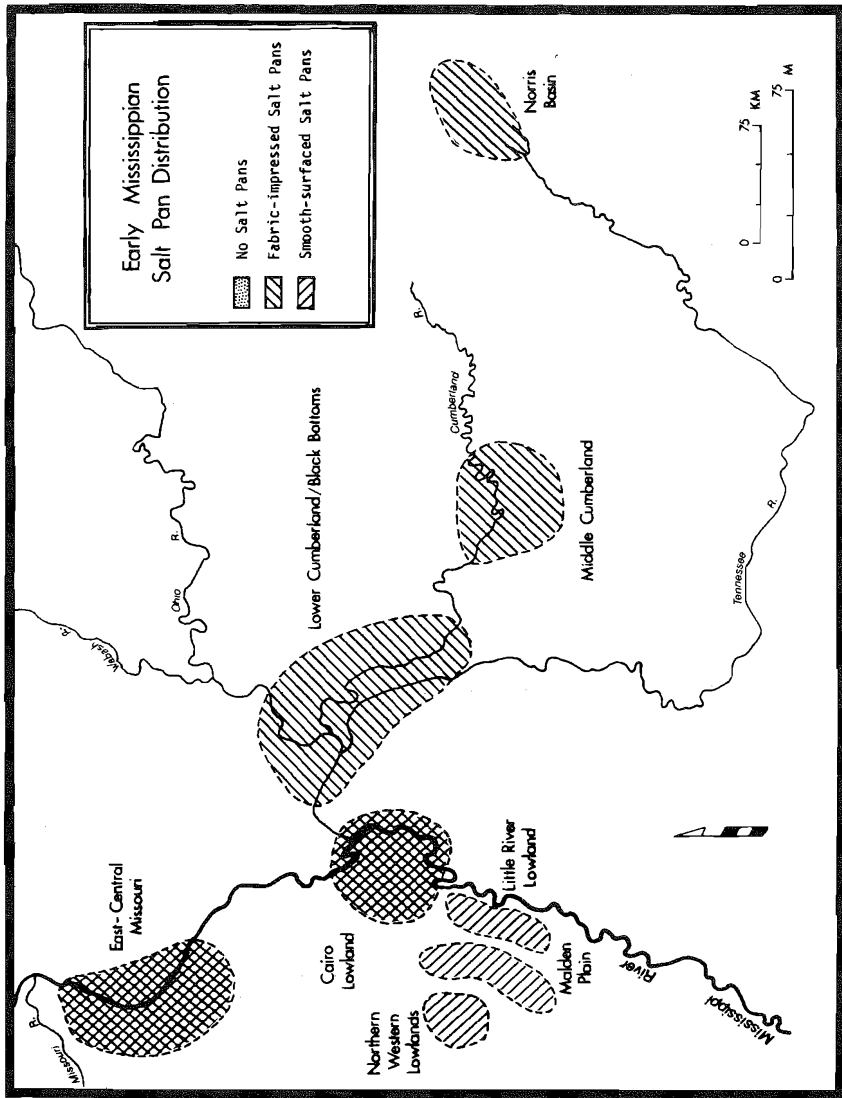


FIGURE 12. Early Mississippian Salt Pan Distribution.

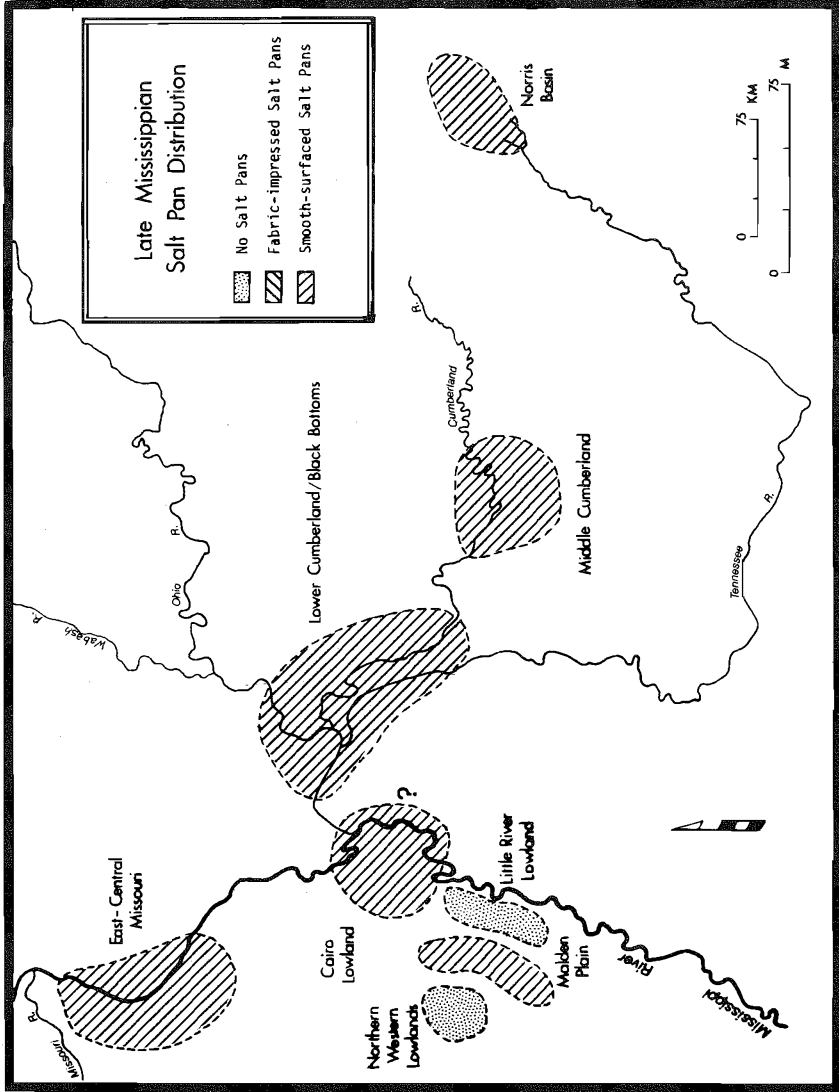


FIGURE 13. Late Mississippian Salt Pan Distribution.

Mississippian times. Although it is not depicted in the figures, the smooth-surfaced salt pan was also used by Fort Ancient peoples of the late Mississippian period.

So what does the distribution mean? Certainly the spread of the various salt pan forms is not a reflection of mass migrations. As stated earlier, it is probable that the idea of salt pans diffused as the different populations recognized the value of the large vessels and learned the techniques involved in making them. Where the fabric-impressed salt pan developed is highly questionable. There is some suggestion that it may have had its roots in the Late Woodland cultures of Missouri, Illinois, and Indiana, but no matter where the type began, it apparently spread rapidly. Of the five regions considered above, the only area where fabric-impressed salt pans were not made was in the southern portion of southeast Missouri and in northeast Arkansas. In these areas, smooth-surfaced red-slipped salt pans were being made in early Mississippian times, but it cannot be demonstrated they were actually used in salt production. The construction of smooth-surfaced pans undoubtedly involved technological changes. The exact changes are not known, but the smooth-surfaced pan seems to have been an improvement over the fabric-impressed type as textiles were no longer needed in its production. By late Mississippian times smooth-surfaced pans were used in all areas which had previously had the fabric-impressed type. Despite our lack of knowledge of the specific use of the smooth-surfaced salt pan in southeast Missouri/northeast Arkansas, it is quite clear that the late Mississippian populations of the core saline area used them in the production of salt.

As indicated above, the innovation of the smooth-surfaced salt pan is believed to have occurred in southeast Missouri/northeast Arkansas, though it also appeared in east-central Missouri on an early time level. Materials associated with southeast Missouri cultures have been found throughout the Southeast in late Mississippian times. Schwartz (1961:83) and Clay (1979: 114-117) have indicated ties between the Lower Cumberland region and southeast Missouri at this time, as has Thruston, Putnam (James B. Griffin pers. comm.) and Dowd (1972:52,54,pl.XII) for the Middle Cumberland. Even in northeast Kentucky, material associations have been detected with southeast Missouri in late prehistoric times (Hanson 1970:46,fig.16c). Trade contacts were undoubtedly strong between the different regions at all times, and ideas, including the technology involved in making smooth-surfaced salt pans, also traveled along the same trade routes.

But something happened in southeast Missouri/northeast Arkansas in late Mississippian times. The Malden Plain, the Little River Lowland, and the Western Lowlands were populated, yet for some reason smooth-surfaced salt pans were no longer being produced, at least not in the quantities of earlier times. A similar decline in salt pan use has been noted in the very latest Mississippian occupations of other regions. One interpretation is that salt production was no longer an important endeavor. This may indeed be a valid explanation for some areas, but it does not adequately explain why, if the production of salt was declining, it was still of such vital importance in the economies of many historic Indian groups. Another possibility is that new processes were involved in the production of salt, processes which have a low archaeological profile, as compared to the earlier abundant salt pan debris. The byproducts may perhaps be of an as yet unrecognized nature. To obtain an idea as to what byproducts might have occurred, we must look to ethnological and archaeological salt production studies in areas where this subject has attracted considerable attention.

CHAPTER 7

Ethnographic and Archaeological Comparison of Prehistoric Salt Production Techniques

Introduction

Primitive techniques of salt production have received a great deal of study in the Old World, primarily in Europe (De Brisay and Evans 1975; Multhauf 1978; Nenquin 1961). One thing which has become quite clear from the various studies is that there was a great deal of uniformity in the salt production techniques employed throughout the world. The parallels should not be that startling, as nature has limited the ways in which salt can be obtained. If it is not mined, it has to be removed, in some manner, from solution (Nenquin 1961:156-157). Sea water, brine, rock salt, and salt-plant ashes are the only sources (Riehm 1961:191). The techniques which evolved seem to have remained fairly stable through time:

In general, primitive methods proved susceptible to increased levels of production, and there was, until the last century [nineteenth], no compelling reason for innovation in salt production... (Multhauf 1978:21).

It is because of the great stability of salt production techniques and their uniformity throughout the Old World, that I have pursued this comparative study with some rigor. It is hoped that the methods of salt production presented below may shed some light on certain innovations which may have occurred in the late prehistory of Eastern North America.

General Techniques of Salt Production in the Old World

Salt production in Europe has been referred to as "harvesting." It was a seasonal occupation, its scheduling being adjusted to agricultural

activities (Multhauf 1978:100). Bradley (1975) has convincingly demonstrated that in Iron Age Sussex and Hampshire, in England, salt producing was conducted along the sea coast during the summer months. The weather was warm at this time, and the precipitation minimal. It was a community project, not a specialized occupation. In Japan also, salt production was a seasonal community task. It did not become a specialized occupation until the 1st millenium AD (Kondo 1975).

The sea was a logical source of salt, and it appears to have been employed in most areas of the Old World. The boiling of sea water alone was seldom done, because the process was uneconomical. Too much fuel was needed to produce a comparably small amount of salt (Nenquin 1961:112). Usually salt-saturated materials, like driftwood, were added to the solution to increase its salinity. Nenquin (Ibid.:39-63) listed a total of four prehistoric sites in Germany where salt was produced from the sea. Five locations were recorded along the Atlantic coast of France (Ibid.:22-39), and 106 locations in the Fenland of southeastern England (Ibid.:64-76).

Many peoples took advantage of solar evaporation by permitting the sea water to flow into large enclosed areas (also called salt pans). Natural salt pans were common in the Shantung province of China, where windmills were employed in the salt industry, in Mauritania of northwest Africa, and in Bilma, Niger (Cunningham 1702:1208; Gale 1953:8; Multhauf 1978:31-32; Nenquin 1961:114; Spencer 1935). Artificial solar salt pans have been discovered at Halle-Gieβichenstein in Germany (Nenquin 1961:46), and they were commonly employed all along the coast of Japan (Kondo 1975:61). A variation on the natural solar salt pan occurred at Mata on the Spanish coast. Lagoons were permitted to fill up seasonally and evaporate naturally. The same process occurred on the Black Sea along the Dnieper Delta. "Salt gardens" (artificial salt pans) were a natural outgrowth of this method. They were employed in Sicily as well as along the French Atlantic coast (Multhauf 1978:21-24, figs.3-4; Smyth 1824:236-237). Salt gardens were also used in Guinea in West Africa, at Vada on the Italian coast in the fifth century AD, and at Cervia in northeastern Italy in the late eighteenth century AD (Bosman 1705:307-309; Multhauf 1978:21).

It was also common for early salt producers to use a variety of methods at the same location. A combination of solar pans and artificial sea water boiling was employed in England in the fourteenth century AD (Multhauf 1978:9). Riehm summarized Swinnerton's (1932) account of salt production along the Lincolnshire coast:

In the spring the sea brine was permitted to run into flat sunpans (possibly with a light roof) and the supply trench was cut off. The liquid was left to evaporate during the summer months. In the autumn the remaining crust of salt and the underlying layer of clay containing a great amount of salt were scraped off the dry floor of the basin and the material thus collected thrown into an open fire. Even today such firemarks can be recognized in the old sunpans. Through the intense heating the clay, which had been grey, ferrous and extremely finely granulated, now changed into a red coarsely granulated mass. The salt clay, which was now sand-like, was put into a container and brine was added until all the salt present was taken up in a concentrated solution. Had the clay not been roasted prior to being diluted in water, a milky loam broth would have resulted in which the salt solution could but very imperfectly have been separated from the smeary clay mush. A great deal of salt would thus have been lost. Only the roasting of the salt clay made it possible to separate cleanly the salt from the clay. The saturated salt solution was poured off the sediment while the red dry residue was thrown away.

The liquor gained was put on the hearth in large vessels for boiling. When after several pourings a sufficient amount of salt had settled in the vessel, the surplus mother-liquor was poured away and the strongly porous rectangular dishes were filled with the crystalline salt (Riehm 1961:186-187).

The above process undoubtedly explains the formation of the Essex Red Hills in England, and it was probably also responsible for the tremendous red hills observed along the coast of Upper Guinea in West Africa (Ibid.:191).

As in Eastern North America, interior salines were a common source of salt throughout the world. Salines were quite numerous in France, Germany, Austria, and Hungary (Multhauf 1978:xiv-xv), and the remains of salt production activities typically are found at most of these salines. Some of the more important ones were the Carpathian and Alpine springs. A principal operation existed at Wieliczka in southern Poland. Other important brine spring operations were at Reichenhall in Bavaria and Hall in Tyrol. Salines worked in Upper Austria include Hallstatt, Hallein, Isch, and Ausee (Ibid.: 39). Nenquin (1961:39-63) listed a total of 29 interior locales in Germany and Austria where salt was produced. In north Germany it was made at Stassfurt, Frankenhausen, Sooden, Nauheim, Luneburg and, most importantly, in the Saale Valley. The principal center in the latter area was at the town of Halle (Multhauf 1978:39; Nenquin 1961:45-49). Twenty-five salines have been recorded in France (Nenquin 1961:22-39). In England the principal interior salt production areas were in Cheshire, Worcestershire, Northwich, Nantwich, and Droitwich (Multhauf 1978:39).

In the Middle Ages in England seawater boiling was giving way to salt production at salines. In Cheshire at this time, brine was poured on burning faggots or charcoal, the crystallized salt then being scraped off (Ibid.:9,55). A similar technique was practiced in Bucovina in the late

eighteenth century AD, a central European district adjacent to the salt mines of Hungary and Transylvania (*Ibid.*:20). More sophisticated techniques were used in other areas. In Guinea a series of small earthen pots were cemented together on supports over a fire, brine then being poured into the pots and evaporated (Bosman 1705:309; Multhauf 1978:21). A similar process is still occurring in the Manga district of Niger, immediately west of Lake Chad (Gouletquer 1975), and it was also characteristic of the New Granada saltworks of Zipaquira in Colombia (Gibbon 1837:91-92; Multhauf 1978:21). By the mid-nineteenth century, most of the salt production industries based on salines in England had given away to salt mining. Those on the Continent had, by this time, already been converted to healing baths and/or tourist centers (Multhauf 1978:116). Salt mines were known in prehistoric and early historic times, and their use could have effectively put an end to a reliance upon sea water and salines at most any time. The replacement, however, did not occur until the industrial revolution. It is true that access to the rock salt was often difficult, but more often than not, in Europe at least, the rock salt sources were left untapped because their use would have destroyed existing salt industries based on the sea or salines. Some governments even went so far as to guard the unused rock salt, to protect it from being worked by private commercial enterprises (*Ibid.*:28-29). In certain areas of the world, however, salt mining was an important industry. It was common in India, Saudi Arabia, and North Africa, primarily in Libya and Egypt (Multhauf 1978:34; Nenquin 1961:102; W. Phillips 1955: 76-78). The mines at Toudeni in the Sahara supplied Timbuktu with salt in the early nineteenth century (Caillié 1830,II:119; Multhauf 1978:27).

Two principal early salt mining locales in Europe, Hallstatt in Austria and Hallein-Dürrenberg in Germany, were flooded in antiquity as a result of climatic changes. A transition occurred in the archaeological materials because of the shift from mining to brine-working industries. Overall, pottery and other ceramic debris are much more frequent at salines than at salt mines (Multhauf 1978:39; Nenquin 1961:53-60). The typical tools used in salt mining were picks with metal wings and wooden handles, large leather bags to remove salt from the mines, numerous ground pebbles believed to have been whet-stones for sharpening the picks, and sometimes perforated stone hammers and axes from even earlier times. These materials have been found at Hallein-Dürrenberg, Hallstatt, and at salt mining sites in the southern Caucasus and in Morocco (Nenquin 1961:49-57,98). Similar stone tools have been found on salt mining sites in western North America,

particularly in Nevada and Arizona (Harrington 1925; 1926a-b; 1927a-c; 1945; Morris 1928; Multhauf 1978:28; Nenquin 1961:113).

Man has obtained salt in a number of other ways. Some methods were rather simplistic and the end products were not too satisfying. One technique was to merely scrape the impure salt spray off of rocks along the seashore (Nenquin 1961:101). Another method, practiced in Siberia and no doubt in other northern regions, was to collect salt spray from ice floes (*Ibid.*:115). One very common method, practiced particularly in the Low Countries in the Middle Ages, was to extract salt from salt-impregnated turf (Multhauf 1978:9,25):

Turves are cut at low tide. These turves are dried on a prepared clay-floor and broken into small pieces, which are then put in heaps, mixed with sea-water and kneaded into a firm mass. This material is then thrown into vats, which are already half-filled with branches. Sea-water is poured into them, and collected at the base. This operation is repeated in several other vats, until a sufficiently concentrated solution is obtained, which is then boiled in iron basins. The salt crystallizes (Nenquin 1961:111).

Another technique was to collect salt-impregnated sand and wash and boil it, a process which was also conducted historically in North America (see p. 10). This technique was quite laborious, but it was typical of many areas, especially the North Sea coast from Normandy in France to Denmark (Multhauf 1978:25; Nenquin 1961:111). It was also practiced in Japan and China during the nineteenth century (Multhauf 1978:26,31,34; Willeman 1889:13,15). It is still a common salt production technique in Niger in the African Sahara. In the latter area, baskets are used to filter out the sand and other impurities from the brackish water. It will be remembered that the DeSoto entrada observed a similar use of baskets in the Lower Mississippi Valley. The brackish water is then boiled in pots and molded in palm leaves. The only evidence of the production process left for the archaeologists to find are heaps of washed earth (Gouletquer 1975:49).

As mentioned earlier, another analogy with certain Eastern North American finds is the use of wood or pottery containers bearing perforated holes to strain the sand and other impurities from the brackish water (Nenquin 1961:122-123). Pots with perforated bases were also used to leach salt from the ashes of plants in Africa (*Ibid.*:117; Stanley 1878,II:175-176, 266). Salt-plants have commonly been used as a source of salt throughout the world, and in some places they are still being used today (Gayton 1948:181, 222; Gouletquer 1975:51; Kroeber 1941:2-4; Morse and Million 1977:15(11);

Nenquin 1961:106,116-117; H. Schultz 1962:126,128).

In this section I have reviewed the basic methods of salt production throughout the world. Salt has been extracted directly and indirectly from the sea. It has been mined, boiled at salines, and leached from the ashes of salt-plants. Both natural and artificial evaporating techniques have been used, often combining a number of techniques in the process of producing salt. In Eastern North America the use of the sea as a salt source was, to my knowledge, a relatively rare event. Salt-plants were occasionally used historically and, no doubt, were also significant prehistorically, but the interior salines of the Midwest and Southeast were the most readily available sources of salt for the Indians. For this reason, we will examine in somewhat more detail the salt production techniques and the resulting debitage at European salines, where salt production has been given considerable attention archaeologically.

Briquetage - Salt Production Debris

In the late nineteenth/early twentieth centuries, a debate raged in the scholarly journals of England over the significance of a strange phenomenon on the Essex coast. Dotting the landscape in this area were numerous mounds of red earth, the whole being referred to as the Red Hills of Essex. The debate was over the function of these hills prehistorically, as historic records could not account for their existence. It was noted that, along with the red earth were hundreds of burnt clay objects, generally in the form of cylindrical bars and various angular shapes. The clay was mixed with chaff and other vegetable matter, indicating the objects were actually made for some specific purpose (Miles 1975:28; Nenquin 1961: 20; Reader 1908a-b; 1910a-b; Riehm 1961:181; R. Smith 1918; Stopes 1879).

Reginald Smith (1918) was one of the first individuals to draw comparisons between the clay objects at Essex and identical materials occurring along the coast of Europe and around Continental salines (Riehm 1961:182-183). Their provenience around salines naturally led to the suggestion they were used in salt production. On the European Continent, this material was called briquetage, a French term used to describe any clay

objects used in salt production (Kleinmann 1975:45). The basic equipment on nearly all briquetage sites consists of large boiling pans, various ceramic molds, and cylindrical clay objects. The latter supported the molds when the salt was being dried (Riehm 1961:185).

Briquetage sites occur as early as the Bronze Age in England (Jones 1977), but the salt industry itself probably extends much farther back in time in this country (Bradley 1975). Briquetage occurs primarily along the southwestern, southern, and southeastern coast of England (Nenquin 1961; Riehm 1961:182). I have already mentioned the Essex Red Hills. The Mucking locality of Essex appears to have been particularly important (Jones 1977). A total of 175 briquetage sites have now been recorded in this county (De Brisay 1975:fig.1). Two sites, Peldon and Osea Road, have been described in some detail. Both were of Iron Age and Belgic association, with Osea Road having been used as late as the 1st century AD (Ibid.). Briquetage sites have also been reported in counties north of Essex. Those found in Kent were of Romano-British occupations, dating between the 1st and 3rd centuries AD. Their abandonment appears to have been the result of a rising sea level destroying the marsh (Miles 1975; Noël Hume 1954; Riehm 1961:182). In Sussex and Hampshire briquetage sites date at least to the Iron Age, but salt production itself is believed to have also occurred much earlier (Bradley 1975; Riehm 1961:182). Briquetage sites have been recorded in Dorset, especially in the Kimmeridge locality, where they date to Iron Age and Roman times (Farrar 1975; Nenquin 1961:86; Riehm 1961:182). They have also been found in Somerset and on the Channel Islands (Nenquin 1961:23; Riehm 1961:182). Numerous sites have been listed in Lincolnshire. There are now 27 Iron Age and Romano-British briquetage sites known in the Fens. The Ingoldmells district in northeast Lincolnshire is one of the best known briquetage areas (Baker 1975; Kirkham 1975; Nenquin 1961:85; Simmons 1975).

Briquetage sites are also common in France. They have been observed in Morbihan, Nalliers (Vendée), and Bourtecourt in western and northwestern France (Nenquin 1961:24-25). They are particularly frequent along the Atlantic coast, especially in southwest Brittany, where they were the product of Celtic populations (Riehm 1961:182,188-189). Another important briquetage region occurs south of the Loire River mouth in the Pointe-Saint-Gildas district (Ibid.:188-189; Tessier 1975). The brine springs of the Seille Valley in Lorraine are also characterized by tremendous heaps of briquetage (Multhauf 1978:49; Nenquin 1961:46; Riehm 1961:181).

Briquetage has similarly been recognized in Holland and Belgium

(Riehm 1961:182,188-189). Such materials are quite common in Germany where they date from the Early Bronze Age to Hallstatt times (Jones 1977; Kleinmann 1975; Multhauf 1978:54). In fact, the earliest employed saline in Europe is believed to have been in the Halle area. A total of 126 briquetage sites have been reported in the vicinity of Halle (Multhauf 1978:46; Nenquin 1961:46; Riehm 1961:182). Briquetage has also been detected along the Black Sea coast in West Grusnia and around the resort of Suchumi, over 2,000 miles (3,218 km) distant from the Essex Red Hills of England (Nenquin 1961:98-99; Riehm 1961:182,190). It has also been observed in Thailand (Reader 1908b:196-197), and nearly identical forms of briquetage have turned up in vast quantities in Africa and in Japan (Jones 1977; Kondo 1975; Nenquin 1961:114; Riehm 1961:191).

In all of the above areas there are remarkable similarities in the briquetage employed in salt production. Nenquin (1961:156-157) has admitted that it is sometimes very difficult to distinguish between the briquetage of Germany, France, and England. The similarities are not thought to have been the result of any form of migration, nor necessarily a product of diffusion. Using primitive technologies, there were just so many ways to get salt out of solution. To obtain a dry solid mass of salt which, in turn, was easily transportable, the producers had to follow certain similar procedures.

At most sites, numerous hearths and vast quantities of ashes accompany the briquetage. The basic technique is described by Nenquin (1961:75,120-122). A clay floor of narrow width was first constructed on a level area. Upright clay cylindrical supports were placed on top of this floor at regular intervals. These pedestals were sometimes supported at the top by lumps of clay. Flat shallow evaporating pans or ordinary cooking pots were placed on top of these supports and filled with brine. A fire was then lit between the supports to evaporate the brine. The pans were removed from the supports (which had been fused together because of the heat) and the crystallized salt was knocked loose from the sides and bottom of the pans into small conical beakers (salt molds). The latter were again put on pedestals over a low fire so that the salt could dry. The salt molds were regular in size because they not only served as containers for transport, but also as a unit of currency. Very small salt molds have been referred to as augets.

The above technique (or variations of it) apparently was employed throughout Europe. In the Early Bronze Age in the Saale Valley of Germany, the large evaporating basins were thought to have been supported by two oval

pillars, the crystallized salt again being put into augets for drying, shaping, and shipping (Kleinmann 1975). Recent excavations at Osea Road and Peldon in Essex have also revealed the presence of clay floors, pedestals, and fires. Two methods, resulting in slightly varying forms of briquetage have been proposed (De Brisay 1975). The first consisted of using clay floors, pedestals, and firebars, while the second employed only firebars and trenches dug in the ground. In the first technique, which seems to have been the oldest in Essex, a floor was first produced by roughly leveling raw clay over the ground (Figure 14a). Cylindrical clay pedestals were stuck into this floor, presumably in pairs. Triangular-shaped clay objects, known as firebars, were then laid across the paired pedestals, with their flat side up. Large brine containers were subsequently set on top of the firebars. The height of the containers above the floor was apparently important. Experiments have demonstrated that the best salt is produced by a gentle heat, rather than by boiling. To prevent boiling, the containers needed to be placed at a sufficient height above the fire. Augets were then used for the final drying process.

On some of the briquetage sites in Essex the clay platforms, pedestals, and triangular firebars are absent. In these cases, the only items found are trapezoidal firebars, brine containers, and narrow trenches dug in the ground (Figure 14b). In this technique, it is believed that the fire was actually set within the trench. The two ends of each firebar were wedged into the walls of the trench and the brine containers were set on top. This procedure occurred later in time in Essex. It apparently was a refinement over the clay platform/pedestal technique, because there was a reduction in the amount of briquetage needed.

The clay platform/pedestal technique was costly in terms of human effort, because the floor was useless after a single salt production cycle. The clay pedestals, located close to the fire, were fused together by green slag, a byproduct of the salt industry. The basins, wedges, and pedestals were also often fused together. Because the producers tended to destroy the lot when removing the basins from the work area, complete pedestals are rarely preserved in the salt production process (Baker 1975:31; De Brisay and Evans 1975:56; Goodyear 1971:76; Jenkins 1910; Kirkham 1975; Miles 1975: 27; Petrie 1910; R. Smith 1918). The methods described above have also been observed in Dorset (Farrar 1975:19-20), in Lincolnshire (Kirkham 1975), in north Kent (Miles 1975; Roach Smith 1848-1880, VI:184; Spurrell 1885), and on the Channel Islands at Guernsey (Nenquin 1961:23).

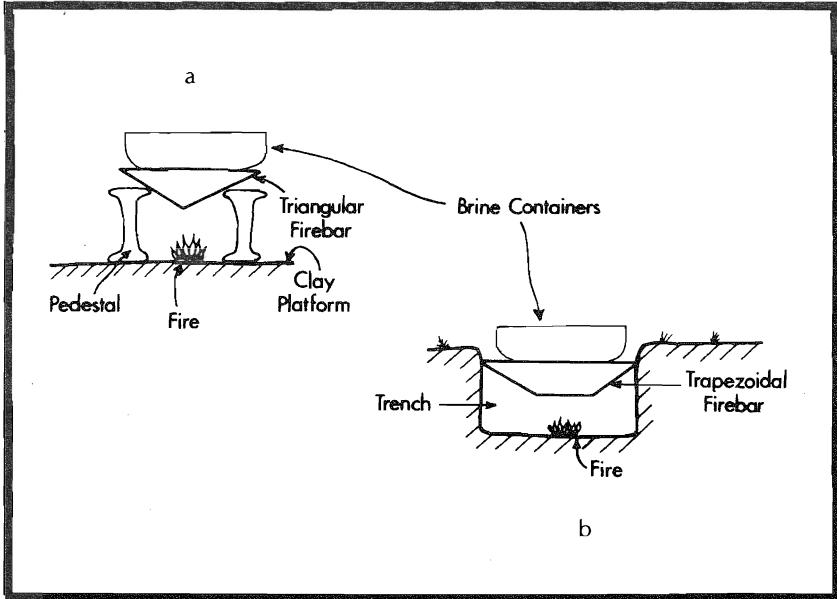


FIGURE 14. Techniques of Prehistoric Salt Production in Essex, England (reconstructed from De Brisay 1975).

Recent ethnoarchaeological work on salt production in the African Sahara has advanced some exciting new directions for prehistoric salt research. Briquetage is still being formed in the Manga district of Niger, as described by Gouletquer (1975:51, fig. 30). Initially, salted-earth is washed in baskets, the brine being collected in storage basins. A kiln is then made to evaporate the brine. Coarse clay pedestals are made, with the lower extremities being pointed and the upper ends "trumpet-shaped." Hemispherical clay salt molds are shaped on a calabash and then placed on top of the pedestals. The molds are joined to each other, and to the walls of the kiln, by using soft clay balls. Prior to evaporating the brine, the hot molds are wetted with a mixture of brine and cow dung. This concoction makes the molds waterproof. A full non-stop 24 hours is required for the evaporation process. Brine is continually poured into the molds in small quantities. The salt deposits in thin hard layers forming more or less pure salt cakes. At the end of the procedure the kiln is destroyed and the hot blocks of salt are removed. They are then transported within their containers. All that is left are heaps of rubbish, including washed earth, ashes, and concentrations of pedestal fragments. The principal variation between this particular technique and prehistoric European salt production methods is that the evaporating, molding, and the drying is conducted in one rather than two vessels. Similarly, there is no evidence for salt molds on Japanese briquetage sites. The ceramic containers appear to have been used solely to evaporate brine (Kondo 1975:63).

Having discussed some of the methods leading up to briquetage formation, let us now look a bit more closely at the briquetage itself. There is, unfortunately, very little information on the evaporation basins, most attention having been concentrated on molds and supports. In Lincolnshire, the pans are described as large flat shallow dishes, the largest vessel being about 16 in (40.64 cm) in diameter (Baker 1975; Nenquin 1961:85). At Halle, in Germany, the boiling pans are described as having been large, shallow, coarse, thick-sided, impermeable vessels (Nenquin 1961:46; Riehm 1961:183). Of some interest was the discovery of large fabric-impressed pans along the Black Sea coast. These rectangular vessels, supposedly made by placing a cloth over a wooden mold, are of two different sizes. They each have a height of 10 to 12 cm, but one form is 25 by 40 cm at the top while the other is 20 by 30 cm (Riehm 1961:190). Fabric-impressed pottery has also been found at Iron Age salt production sites in the Ingoldmells locality in northeast Lincolnshire (Henshall 1950:135;

Kirkham 1975:42).

There is a bit more information on ceramic pedestals and other support forms. One of the most common features of briquetage sites are hundreds of short clay rods. They are usually roughly-squeezed objects, sometimes having been twisted spirally. They have been recorded in Dorset, Essex, and Lincolnshire in England. Those found in the Ingoldmells locality are 10 cm long, 2 cm in diameter, and have two grooves across one end which sometimes contain the edge of broken vessels (Baker 1975; De Brisay 1975:8, fig.4k; Farrar 1975:18, fig. 8b(15-24); Kirkham 1975). In France, at Nalliers, these rods are reported to be up to 12 in (30.48 cm) long. At Bourtecourt they have been observed as large as 27 in (68.58 cm) long and 2 in (5.08 cm) in diameter (Nenquin 1961:28-29). At Schwabisch Hall in Germany, porous clay rods were often used in historic times as wicks to absorb brine and make the solution more concentrated (Multhauf 1978:54). This last mentioned function may also account for some of the clay rods found on archaeological sites, but it is probable that most of the cylinders are merely broken portions of clay pedestals.

Pedestals, or rather supports for boiling pans and/or salt molds (including augets), are frequently found on salt production sites, but whole ones are relatively rare. Few survived the destruction of the kiln or work area after the completion of the salt production cycle. Many of the fragmentary clay rods are probably portions of pedestals. They have been found on briquetage sites in Dorset, England (Figure 15a). Those found in Essex are described as being cupped on one end (approximately 5.6 cm in diameter) and generally spatulate-shaped on the other (De Brisay 1975:7; Jones 1977:317) (Figure 15b-c). Cupped pedestals, with approximately the same dimensions, have also been observed in Kent (Miles 1975:26) and in Lincolnshire (Figure 15d). In France, pedestals with "trumpet-shaped" ends have been found in some frequency on Middle Bronze Age sites at the mouth of the Loire River (Tessier 1975).

The pedestals in the La Panne area of Belgium do not have flat bases. They are long (18 cm) nail-like objects, apparently an adaptation to sandy soil conditions. These pedestals, called spijkers, had to be driven into the soil. Soft balls of clay were put on top of the spijkers to support the pans (Riehm 1961:188-189), a process similar to what is presently occurring in Niger (Figure 15e). This same technique also seems to have been in use in the Pointe-Saint-Gildas region at the mouth of the Loire River (Ibid.), and on the Caucasian Black Sea coast, where sandy soil again

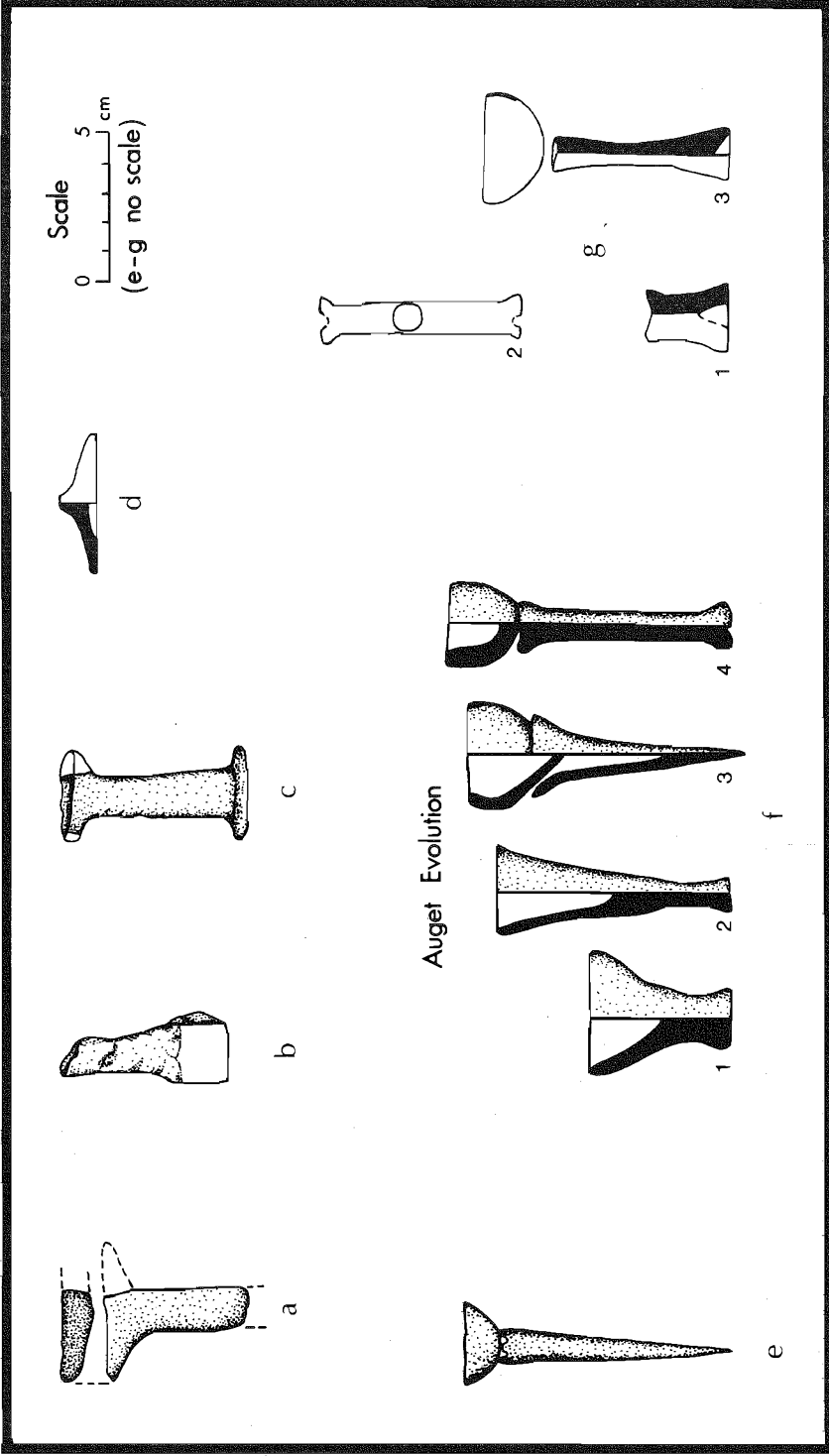


FIGURE 15. *Briquetage* on Salt Production Sites in the Old World. Provenience: a, Dorset, England (Farrar 1975:fig.8b,no. 18); b-c Essex, England (De Brisay 1975:fig.3g,j); d, Lincolnshire, England (Baker 1975:fig.16,no.5); e, Manga, Niger (Gouletquer 1975:fig.30); f, Saale Valley, Germany (Kleinmann 1975:fig.26; Riehm 1961:fig.1); g1, Tsurube; g2, Magi; g3, Yunowaki, Japan (Kondo 1978:fig.38,nos.40-42.58).

resulted in stability problems. All of the pedestals in the latter area have pointed feet. The upper portion of these pedestals have two horns to support the pans and/or salt molds (Nenquin 1961:98-99; Riehm 1961:190). In Germany, at Halle, the pedestals sometimes have three horns on one extremity. The rods are either round or square in cross-section (Nenquin 1961:46).

In almost all areas where briquetage occurs, the pedestals are basically the same size and shape. Their upper ends are either cupped or have two or three horns, and the lower ends are either flat or pointed. The formal similarities are believed to have functional significance. The pedestals had to either sit on the ground or stick in the ground, and they had to support other objects. The size parallels are thought to have been the result of optimum evaporating temperatures. To evaporate or dry the salt correctly, the containers have to be a certain height above the fire. If intensive heat is used, violent evaporation of the salt blisters it and loosens it. An oven temperature of 60^o - 70^o C is ideal for drying salt, and this heat is obtained best when the vessels are elevated to a height of between 20 and 30 cm (Kleinmann 1975:45; Riehm 1961:184).

After the salt crystallized on the surface of the large evaporating pans, it had to be scraped into molds and dried. Ceramic molds, primarily the large forms, have been found in abundance at salines, but pottery was not the only material used to mold salt. Certain molds would have left no trace in the archaeological record. Wooden molds were sometimes used in certain parts of Africa. Large leaves, pasted with bast or a mixture of clay and cow dung, also were commonly used to mold the salt (Riehm 1961:191). In Medieval times, baskets were frequently employed in drying the salt (Nenquin 1961:107-108). Prior to the construction of standard-sized ceramic salt molds, it is probable that in most of Europe small utilitarian bowls were used to both make and transport salt. As such, the salt industry in early prehistoric times has largely gone unrecognized. Only when salt became an important form of currency, when there was the need to make uniform-sized molds to serve as standard measures, was the salt industry highlighted in the archaeological record (Bradley 1975; Riehm 1961:184).

Large salt molds are found on most briquetage sites. Small salt cake molds (augets) are also occasionally observed. The latter are believed to have served as "small change" (Nenquin 1961:125; Riehm 1961:186-187).

It is probable that the salt made by evaporation of sea-water, was pressed into these augets when still in a wet condition, and that they served as moulds for the fabrication of salt-cakes. We think it even possible, that they were used for packing during the transport of these saltcakes (Nenquin 1961:27).

The large salt cake molds observed at Nauheim and Schwabisch Hall in Germany are in the shape of truncated cones. They had been built into furnaces (Multhauf 1978:54). The rectangular form, however, appears to have been the most common form. Rectangular molds have been recorded on sites along the Black Sea (Nenquin 1961:98-99), and in Lincolnshire (Riehm 1961:186-187), and Essex, England (Jones 1977). These large molds often have small openings in one of the corners, presumably for draining off excess liquid (Nenquin 1961:125). Vertical clefts often occur in what are thought to have been large molds found near Leiden in Holland. These incisions are believed by some to have been made for draining liquid, but it has also been proposed they were designed to facilitate the splitting of the mold when the salt got to its final destination (Riehm 1961:188-189). The idea of splitting the mold is an attractive one, but it does not satisfactorily explain why so many of the large molds in Dorset were completely severed prior to having been fired. Had they actually been used as salt cake molds, they should not have been split apart until after they were fired. Farrar (1975:18) believed these "molds" were actually evaporating troughs themselves, but he had no explanation for how the open ends were closed.

It is probable that the small incisions frequently observed on augets were indeed used to split them apart. Some augets of sugar bowl shape have an inch-size hole in their side walls for draining off the remaining liquid. Those found in Kimmeridge, Dorset, typically have very deep incisions, again presumably for mold separation. A mere tap was sufficient to break the mold (Nenquin 1961:86; Riehm 1961:185-187). In Lincolnshire, augets were formerly referred to as "pygmy cups or crucibles" (Baker 1975:fig.16,nos.6-9). Those found in the Ingoldmells locality are described as small rough-sided bowls, 5 in (12.7 cm) in both height and diameter (Nenquin 1961:85). In Belgium, at La Panne, the augets are 9 cm tall (Riehm 1961:188-189). Those in the province of Brittany in France are described as small thin-walled rectangular dishes, 4 to 5 cm tall (*Ibid.*). At Morbihan, also in France, the augets are four-sided truncated pyramids, with heights ranging between 8 and 8.5 cm (Nenquin 1961:24-25). This same type has been found in the thousands at Nalliers (Vendée) (*Ibid.*:28-29).

In Germany, the augets are described as being very porous, thin-sided, badly-fired beakers (Ibid.:46). A full evolutionary sequence of augets has been observed stratigraphically at Halle in north Germany. These small vessels could not have been used in boiling salt, as their walls are too porous. When brine is poured in them, it is immediately soaked up like a sponge, and the containers break if too much heat is applied. They are therefore thought to have been salt cake molds. The first form, the "goblet," was in use at the end of the Bronze Age (Figure 15f,no.1). They were made by using wooden molds of different sizes. The pillar-shaped foot had to be knocked off before it was traded. The second form, called the "chalice" because of its narrow champagne glass shape, was much more frequent and more widespread than the goblet mold (Figure 15f,no.2). The thin walls resulted in a reduced weight and permitted easier transportation. The chalice form also took up less space around the hearth during the drying process, a distinct improvement over the goblet form. The next development was the "hollow cone on quiver" (Figure 15f,no.3). In this form, the pedestal and the mold were no longer the same unit. The foot did not have to be broken off, as in the earlier forms, but could be reused many times. The last stage in the evolution was the "cylinder pillar with the thick-walled hemispherical jar" (Figure 15f,no.4). Unlike the previous molds, this jar did not need to be fired. The clay was merely shaped over a gauge. The thick walls and great porosity facilitated the absorption of excess liquid, and the brittleness of the unfired clay mold made it relatively easy to separate the hardened salt from its container. These thick hemispherical bowls have only recently been identified as having had an association with salt production, as they are rarely found at salines (Kleinmann 1975; Riehm 1961:183-185). The same sequence of short stubby pedestals changing to cylinders with small bowls, has been observed at salt production sites along the coast of Japan (Figure 15g).

Although the findings at Halle suggest that small bowls were not used directly in the salt evaporation process, in other parts of the world they were. In Niger, for example, the interior of the small bowls is made impermeable and brine is slowly poured in over a low fire. Unlike at Halle, these vessels also serve as molds. They are seldom found on salt production sites in Niger, because they are used to transport the finished product (Gouletquer 1975:51,fig.30; Riehm 1961:191). Augets, in fact, are only occasionally found in areas where salt was produced. In both Sussex and Hampshire in England, augets are generally found on inland sites far from

the production sites along the coast (Bradley 1975). Sometimes, all forms of briquetage have been found far from salines, the wet salt apparently having been transported to the working installations (Kleinmann 1975:45). The same situation has also been observed at Mucking in Essex. Jones (1977) felt that briquetage was sometimes made at sites which differed from where it was to be used, but it is also possible that accessibility to fuel could account for the separation. Salt production requires great quantities of fuel (not to mention clay), and it would not have been long before adequate resources would have diminished along the coast or in the vicinity of salines. Perhaps as the fuel receded, it became easier to move the brine to the fuel (Myers 1921:341-342; C. Schultz 1810,I:31-32; G. Smith 1904:254).

It can clearly be seen that briquetage is remarkably similar throughout the Old World. The technique undoubtedly diffused in some areas, but it is not necessary to advocate theories of widespread movements of people. Having discussed in some detail the briquetage found in the Old World, we are now in a position to reexamine the Eastern North American data. Although the research is still in its infancy, there is some evidence to support the notion that late prehistoric Indians in portions of the Midwest and Southeast may have evolved techniques of salt production which were in many ways similar to methods developed in the Old World.

CHAPTER 8

Some New Perspectives on Prehistoric Salt Production in Eastern North America

The Avery Island Problem

My investigation of salt production in Eastern North America and the Old World began as a result of archaeological research on Avery Island in southwestern Louisiana. Excavations conducted at Salt Mine Valley (33-I-5), the location of a major prehistoric and historic saline (see p. 11), revealed two principal aboriginal components, one occupation by peoples of the Plaquemine culture (c. AD 1000 - 1200), and another more intensive utilization by peoples of the late Mississippian cultural tradition (c. AD 1550 - 1650). Due to close material similarities with archaeological complexes in the Yazoo Basin, the Mississippian producers of salt on Avery Island are thought to have traveled a considerable distance to obtain this resource (Brown 1979; 1980a; Brown and Lambert-Brown 1979).

Curiously absent at Salt Mine Valley are the typical thick-walled salt pans. Instead, thousands of medium to large, thin-walled bowl fragments were found, suggestive of a rather different process of salt production. Fired clay, ashes, and charcoal are abundant at the saline, but other artifacts (besides the ceramic vessels) are scarce. A number of small poorly-fired clay objects survived the humid Louisiana environment. The specimen depicted in Figure 16b is a cupped portion of a larger artifact. Three of these artifacts have turned up in the excavations. The object in Figure 16a is a complete miniature vessel, the only one of its kind at Salt Mine Valley. It is in the shape of a truncated cone, measuring 3.5 cm in height and 4.2 cm in diameter at the mouth. My problem was how to explain the salt production processes at Avery Island, when the only objects found there had never before been reported in this country as being prehistoric salt-making equipment.

Using the reconstructed methods of salt production in Europe, Africa, and Asia as a guide, I tentatively offer an interpretation of late

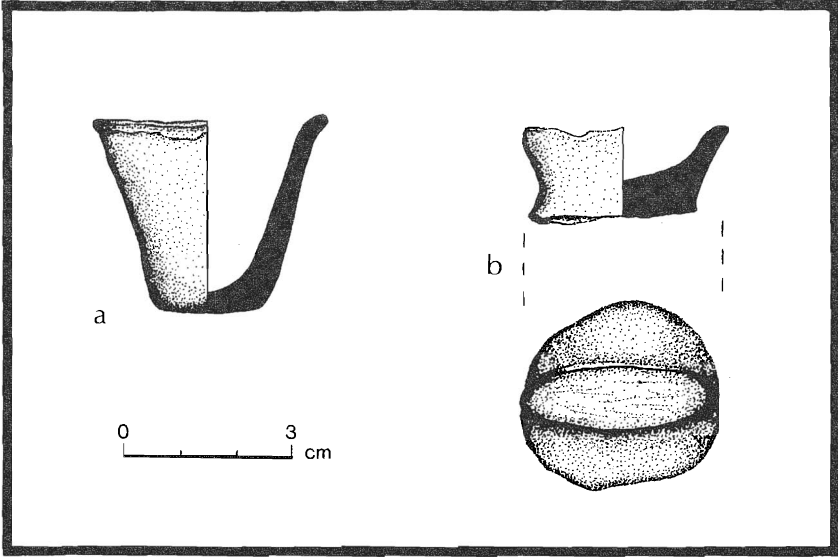


FIGURE 16. Salt Mine Valley (33-1-5) -*Briquetage*? Provenience: a, PM LMS cat.# P555C; b, PM LMS cat.# P558C.

Mississippian salt technology on Avery Island. I believe that the medium to large-sized bowls were manufactured at or in the vicinity of the saline (see Le Page du Pratz 1774:153). To produce the salt, these bowls were supported on ceramic objects above a fire which burned at a relatively low heat. Brine was poured into these vessels and evaporated. The salt crystallized on the interior walls and bases. The moist salt was then scraped off these bowls and packed into miniature pots, such as the one depicted in Figure 16a. In the process of scraping, numerous bowls were broken. The miniature vessels, which served as molds, were elevated on ceramic pedestals, like the one illustrated in Figure 16b. They too were placed at a certain standard height above a very low fire to prevent rapid drying (see p. 73). The salt was then transported within its containers along established trade routes throughout the Mississippi Valley and the Southeast. Evidence for molds are scanty at Salt Mine Valley, because very few were left behind. The evaporating bowls were used and abandoned at the site, and are thus found in the hundreds. The highly porous under-fired pedestals were, through time, reduced to abundant fired clay fragments and a number of cylindrically-shaped objects, the latter sometimes having cupped extremities.

The idea is an attractive one, but cannot be accepted using the Avery Island data alone. Such an advanced technique certainly could not have existed in isolation on the coast of Louisiana. If the thin evaporating pans, pedestals, and salt molds actually were used in late prehistoric times in the Lower Mississippi Valley, the remains of such an industry should have been manifested in the archaeological record by now. The problem is of course in identifying the association between the form of the materials and their function. The evaporating pans found at Salt Mine Valley are, unfortunately, identical to typical late Mississippian bowls found on village sites. In the search for salt production techniques similar to that proposed for Salt Mine Valley, I therefore had to examine the archaeological literature for associations between pedestal-like objects, miniature vessels, and salines. Southeast Missouri/northeast Arkansas was a logical place to start the research because, as suggested earlier, it was in this area that salt pans, and perhaps salt production, were declining in late Mississippian times. This was a region which seems to have first evolved the use of smooth-surfaced pans. Perhaps it was also the area where a more evolved technique of salt production developed.

Briquetage in the East?

The archaeological evidence for briquetage in Eastern North America has not yet been sought, but several authors have suggested the existence of such an industry among the prehistoric Indians. Both Driver (1961:237) and Wentowski (1970:35,42,54) felt that salt was dried and traded within small molds, a process also characteristic of certain parts of Mesoamerica, but they offered no proof for their beliefs. Many interpretations presented below are, admittedly, highly speculative. With the exception of Salt Mine Valley (33-I-5) on Avery Island, a direct association between salines and briquetage has not yet been established. I hope, however, that the formal parallels will arouse enough interest that the associations will at least be looked for in the future. They may not, in actuality, exist, but we do need to develop some explanation to account for the gap occurring in our knowledge of salt production in late prehistoric times.

Let us first turn to southeast Missouri/northeast Arkansas, a region where the gap in salt production appears widest. In 1857, G. C. Swallow, the State Archaeologist of Missouri, excavated two mounds at the Lilbourn site (6-R-1). This site is located in New Madrid County in the Cairo Lowlands (Figure 9). One object recovered, and subsequently bought by Harvard's Peabody Museum of Archaeology and Ethnology, was a small "earthen cup" (Figure 17a) (Adams and Walker 1942:5,7; Putnam 1875:404; Swallow 1875: 44). It can clearly be seen that the object bears striking resemblances to the "goblet" auget form of north Germany (Figure 15f,no.1). It has a circular concave cup supported by a cylindrical stem. The base is flared, circular, and flat. The vessel is approximately 6 cm tall and is 6 cm in diameter at the cup. Traces of a dark stain occur in the concavity.

The Lilbourn earthen cup may or may not be briquetage. I have thus far been unable to find other traces of briquetage in the Cairo Lowlands, but there is some evidence for it in the Malden Plain region, where the use of thick salt pan ware was declining in Late Mississippian times. A significant portion of the materials recovered at the Lawhorn site (9-0-4) consists of pedestal-like objects bearing conical shapes. Also found in some quantity were cylindrical clay objects, and objects described as rectangular brickettes, sometimes bearing a central hole. Moselage (1962: 58-63,fig.27,no.1-3) offered no function for these artifacts, but noted they had some utilitarian purpose, as some were found associated with

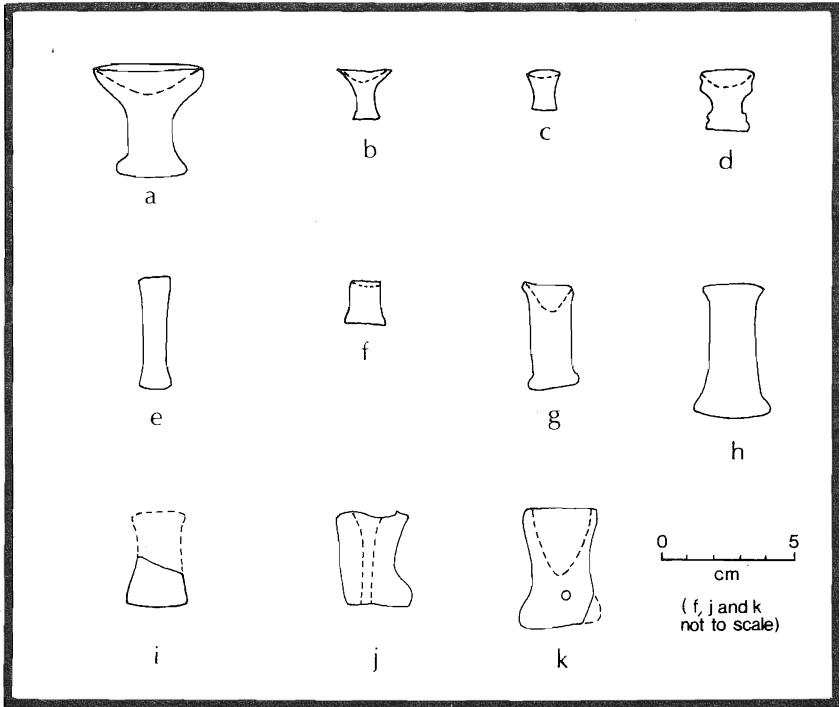


FIGURE 17. *Briquetage* in Eastern North America? Provenience: a, Lilbourn (6-R-1), Missouri (PM cat.# 7756); b-e, Banks Village (11-P-8), Arkansas (Perino 1966:figs.23,31); f, Williams, Kentucky (Webb and Funkhouser 1929:fig.24); g, Hardin, Kentucky (Hanson 1966:fig.45); h, Clover, West Virginia (Mayer-Oakes 1955:pl.108); i, Waterworks, Ohio (McMichael 1960: pl.1); j-k, Cahokia, Illinois (Titterington 1938a:fig.44).

house floors.

Pedestal-like objects have turned up in considerable numbers at the Banks Village site (11-P-8) in Crittenden County, Arkansas. The stemmed clay objects at Banks Village have either single or double cups (Figure 17b-d). Some are plain, while others have nodes. They were found with adult burials and in ashpits located within house floors (Perino 1966:131-132). One burial had a pedestal wrapped in a robe. It was directly associated with 20 deer scapula, 32 small lenticular objects made of mussel shell with a drill hole on each end, and a single mussel shell gorget with serrated edges (Ibid.:15-16). Perino thought these pedestal-like objects were "medicine cups," but their common occurrence around the edges of fire basins (and in the ashes) in houses suggests a more utilitarian function. Similar ceramic cone-shaped objects, 7 in (17.78 cm) in diameter, were found in the vicinity of hearths at the Snodgrass site, a Powers phase site in the northern western Lowlands (Price and Griffin 1979:21).

Also found in the same context at Banks Village were large conical clay objects bearing a half-inch size hole halfway through their middle, quite similar to those observed at the Lawhorn site (9-0-4) on the Malden Plain. These same hearths were also characterized by a dense covering of potsherds (Perino 1966:30,64,69,133,fig.31). Long clay bars, generally cupped on one end and expanded on the other, are also typical of the Banks Village site (Figure 17e). Perino felt these objects were figurines, and one specimen does indeed appear to have been modeled into such a form (Ibid.: fig.23), but all of the others are unmodified and may have been some sort of briquetage. It should be noted though that, at least to my knowledge, salines have not been discovered in the Banks Village area. Nor have salt pans been found at this site.

Pedestal-like objects, similar to the medicine cups from Banks Village, have turned up at the Notgrass site (10-P-4) (also called Nodgrass Place) in Mississippi County, Arkansas (Perino 1966:131-132,139), and clay bars identical to that depicted in Figure 17e have been recovered at the Barton Ranch site (11-0-10), located near Banks Village (Ibid.:58). Large kidney-shaped clay forms were also commonly found around house hearths at the Banks Village site. Perino (Ibid.:64,69,fig.32) felt these objects were pottery supports for round-bottomed cooking jars, an interpretation which is strengthened by finds at the Madisonville site in Ohio (Griffin 1943:pl.LXVI, no.4). But why the sudden desire to get pottery vessels above the fire, and why at a rather consistent height? Salt production might be another

alternative. It is at least a hypothesis worthy of further investigation, especially as these strange forms started to appear in southeast Missouri/northeast Arkansas just as the typical salt pans were disappearing.

The Banks Village site shares artifactual similarities with a number of different phases. Phillips (1970:934) only reluctantly included it under the Nodena phase. Perino (1966:137-141) favored a sixteenth century date, and noted the site had strong parallels with the Lower Cumberland region. He even suggested a migration from the latter region to the Banks Village site, but there is little evidence for such a possibility. The only evidence I have thus far been able to find for the possible occurrence of briquetage in the Lower Cumberland region is at the Williams site (Figure 17f) and at Tolu. A cupped object, similar to the specimens from Banks Village and Lilbourn (6-R-1) was classified under problematical artifacts at Tolu (Webb and Funkhouser 1931:fig.75).

Evidence for briquetage in other portions of the East is scarce, but it does occur. It is possible that certain pottery objects found at the Kimmswick saline in Jefferson County, Missouri, were pedestals. Bushnell (1907:3) described them as being "lids" for ceramic vessels. They are small cupped-shaped objects, averaging 6 in (15.24 cm) high and 6 in in diameter. A small knob or handle occurs in their center. Excepting the rather attenuated stems, these objects are quite similar to pedestals found on European sites.

Pedestal-like objects have also been found in northeast Kentucky, well within the saline region. A total of 42 pedestal-like objects were found at Hardin, a late Fort Ancient settlement occupied between the sixteenth and late seventeenth centuries AD (Hanson 1966:103). All of these objects have flat flaring ends exhibiting heavy abuse. Their length is approximately 16 cm and the ends range between 5 and 12 cm in diameter, all relatively small (Figure 17g). Hanson reluctantly described these objects as "pottery pestles." It should be pointed out though, that pestles made of coarse pottery are a rather poor substitute for the stone pestles which occur so frequently at Hardin and at other Fort Ancient sites.

Additional pedestal-like objects have turned up in the Upper Ohio Valley. The Clover site, located in Cabell County, West Virginia, produced a couple of specimens (Figure 17h). The Clover phase itself, believed to date to early historic times, has smooth-surfaced salt pans as a rare trait (Griffin 1943:244; Mayer-Oakes 1955:164-174). The Waterworks site, in Hamilton County, Ohio, also produced a pedestal-like object (Figure 17i).

This site was once located just east of Cincinnati. The object was dug up in 1885, along with a large collection of Fort Ancient material of the Madisonville phase. Smooth-surfaced salt pan sherds were also included in this collection (McMichael 1960). Seven pedestal-like objects were found, along with smooth-surfaced salt pans, at the Buffalo Indian Village site in West Virginia. This site is located in Putnam County on the east bank of the Kanawha River. It is of late Fort Ancient cultural affinity, dating between AD 1600 and 1700 (P. Essenpreis-pers. comm.; McMichael 1963).

One of the pedestal-like objects at the Hardin site has a small perforation running perpendicular to the long axis of the stem (Hanson 1966: fig.45). Perforated grog-grit (occasionally shell) tempered clay objects of similar pedestal-like form have been a recurring mysterious feature at and in the general vicinity of the Cahokia site in the American Bottoms of Illinois (Figure 17j-k). These unusual clay objects, often referred to as "stumpware" or "Cahokia Crud," date to the Fairmount phase around AD 850 - 900 (James B. Griffin-pers. comm.; O'Brien 1972:47,79-81,figs.63-64; Titterington 1938a-b; Wray 1941). Stumpware has also been observed at the Meyer's Mound (5-S-6) in the Cairo Lowlands of southeast Missouri (S. Williams-pers. comm.). They often have small holes at the base of the cone-shaped openings. Similar holes in European augets are believed to have served in draining excess liquid as the salt was drying.

Other problematical artifacts, so often associated with Mississippian occupations, may also have some relation to salt technology. Ceramic "ladles," for example, are commonly found on Mississippian sites. Some were unquestionably used to draw and pour liquids, those discovered in eastern Arkansas often having elongated scoops with the lips drawn out. But others are quite small and rudimentary (Phillips 1939:50,622-624). One found at the Zebree site in northeast Arkansas is extremely small. It has a capacity of but 250 - 300 cc (Million 1977:18(30),fig.18(16c)). These very small ladles are thus commonly considered to have been toys. Toy ladles are reported for the Cairo Lowland phase (Phillips 1939:455), and they have also been found at Aztalan in Wisconsin (Barrett 1933:pl.94,no.1; Phillips 1939: 144), and at the Kimmswick saline in Jefferson County, Missouri (Peabody Museum Collections-Harvard University). One such toy ladle has recently been illustrated from the Pulcher site, located in the American Bottoms just south of Cahokia (Griffin and Jones 1977:fig.6a). It is no doubt probable that ceramic ladles often did have this implied function. They probably also commonly served as toys, but it should be noted that the small ones,

when fragmentary, would be difficult to distinguish from the small pedestal-like fragments found at Salt Mine Valley (33-I-5) on Avery Island (Figure 15b).

Tracing salt molds, or augets, is a bit of a problem because, contrary to the prehistoric European economy, there is no evidence that salt ever served as a form of currency in North America. The practice of making standard size vessels for production and trade probably never occurred in the latter area, but the findings at Salt Mine Valley, and the presence of pedestal-like objects so widespread in the Mississippian cultural tradition, suggest that some miniature vessels were probably used as salt molds. Miniature vessels are quite common on Mississippian sites, but they are (like ladles) usually classified as toys. This identification is reasonable, as the vessels are often found with child burials (eg., Jones 1876:65; Phillips 1939:352-353,622-624; Webb and Funkhouser 1933:20-21; Zimmerman 1949). But there is some suggestion that miniature vessels served a number of additional functions. Phillips (1939:49) puzzled over the toy designation, because in some cultural traditions (such as Fort Ancient) whole and broken miniature vessels are frequently found in village site excavations. There is thus the implication of daily use. They are often found with adult burials (eg., Jones 1876:63-64,fig.33; Webb and Funkhouser 1929:22-23,figs.24,32). Toy vessels with adult interments are typical in St. Genevieve and Jefferson counties in east-central Missouri. The small "seed" bowls frequently found in the adult graves near the Kimmswick saline are reported to be less than 2 in (5.08 cm) in diameter (Adams 1941:pl.XIII,no.7; 1949:23,28; Adams et al. 1941:11-12,19-20; Bushnell 1907:3-4; 1920:53,58,figs.3,5).

Southeast Missouri is also rich in miniature bowls. Those found at the Lilbourn site (6-R-1), in the Cairo Lowlands, often have two holes in the rim which are believed to have been used for suspension (Conant 1878:358; Crosswell 1878:536). The miniature bowls at O'Byams Fort (6-T-3), another Cairo Lowlands phase site, are 2.5 in (6.35 cm) in diameter (Webb and Funkhouser 1933:20-21). Of some interest is the abundance of miniature bowls at sites on the Malden Plain in late Mississippian times. At the same time thick salt pans were disappearing, miniature vessels were occurring with some frequency at the Cockrum Landing (8-0-1) and Lawhorn (9-0-4) sites. At both of these sites the vessels were associated with house floors, and at Lawhorn they were even found within the fire basins (Marshall 1965b:34, fig.9g-h; Moselage 1962:41,69,73,table 5,fig.34). It should again be noted that pedestal-like objects and other forms thought to have been briquetage

were recovered in similar contexts at the Lawhorn site. Miniature bowls are also typical of the Banks Village site (11-P-8) in Arkansas. Twenty small bowls, approximately 2 in (5.08 cm) in diameter, were found at this site. They are either plain or noded, like the so-called medicine cups (Perino 1966:131-132, fig. 23).

It cannot, at this point, be proven that the miniature bowls described above are indeed augets. The fact that they have been found in a number of cases in direct association with pedestal-like objects does, I feel, strengthen the case. Ideally, it would be nice to find augets, pedestal-like objects, and evaporating bowls altogether at a saline. With the possible exception of Salt Mine Valley (33-I-5) on Avery Island, these associations have not yet been demonstrated. I do feel, however, that enough formal analogies exist to permit the hypothesis that typical utilitarian bowls, pedestals, and miniature bowls were used in salt production in certain portions of the Midwest and Southeast in late Mississippian times.

Outside of Avery Island, the strongest evidence for the new technique in salt production occurs in southeast Missouri and northeast Arkansas, I have proposed that the peoples of this area were the innovators of the smooth-surfaced salt pan, a type which was an improvement over the fabric-impressed salt pan. Salt production seems to have stopped in southeast Missouri/northeast Arkansas at the same time most other regions were picking up the smooth-surfaced salt pan. I feel the observed discontinuity is more a reflection of our archaeological perception than a reflection of cultural reality. It is more likely that a new salt production technique evolved in this area, a technology bearing strong resemblances to salt production developments in the Old World. The byproducts of this new technology have not, up to this point, been recognized by North American archaeologists.

CHAPTER 9

Conclusions

Prehistoric salt research in Eastern North America is still well within its infancy. The lack of concern has largely been due to the low archaeological visibility of this very important resource. But the study of salt should play a role in any research involved with the economy of late prehistoric peoples in the East. Wherever there was a heavy reliance on agricultural products, there was the need for salt. Either the people made it themselves, from the ashes of salt-plants, salines, the ocean, etc., or they traded it in from elsewhere. The byproducts of the industry and trade do exist in the archaeological record, but the problem has been in their recognition.

Archaeological visibility is considerably stronger in the early development of the salt industry. In this volume I have proposed three major developments in the evolution of Eastern Amerindian salt production. The first two stages involved the use of thick heavy salt pans. These vessels, believed to have been containers for the evaporation of brine, were first used in late Woodland/early Mississippian times at the principal salines of the Midwest. There are two basic salt pan types - fabric-impressed and smooth-surfaced. They both occurred in early Mississippian times, but in different regions. Fabric-impressed pans were, by far, more widely distributed at this time. The smooth-surfaced salt pan probably originated in east-central Missouri or southeast Missouri/northeast Arkansas, but by late Mississippian times, this type had spread throughout the Midwest and Southeast. It was a distinct improvement over the fabric-impressed type as textiles were no longer needed to construct the large vessels.

At the same time as the idea of smooth-surfaced salt pans was diffusing over a good portion of the East, this pan type was on the decline in southeast Missouri/northeast Arkansas. For some reason, the area which gave rise to this innovative type stopped producing it in the late Mississippi period. It is proposed that another innovation in salt production was occurring in southeast Missouri/northeast Arkansas at this time. I believe that a technology evolved which had parallels with salt

production methods employed in Europe, Africa, and Asia. The byproducts of this industry, called briquetage, have been found on numerous sites in the Midwest and Southeast. The new method involved the artificial evaporation of brine in typical utilitarian bowls over low fires. The bowls are thought to have been supported by short coarse clay pedestals. Once the salt crystallized, it was scraped into small miniature bowls (augets) for both drying and transporting.

It can clearly be seen that this last technique would have an extremely low archaeological visibility. The evaporating bowls would look like any other utilitarian cooking or serving containers, the miniature vessels would have been carried far from the salt sources, and the poorly-fired clay supports would have disintegrated through time. We cannot, however, propose a technology on the basis of negative evidence. I believe enough evidence has been presented in this volume to suggest that an industry involving briquetage (pedestals, augets, and evaporating pans) existed in Eastern North America, as it did in the Old World, in late prehistoric times. The hypothesis is certainly worthy of further testing. There are a limited number of ways to produce relatively pure salt that is both solid and readily transportable. The peoples of America, Europe, Africa, and Asia apparently learned the appropriate techniques independently.

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