

## **Multiple Pathways to Farming in Precontact Eastern North America**

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*Hunter-gatherers in eastern North America utilized gourds at least 7000 years ago, operating at the early end of a sequence that ended with maize-based agriculture across most of the area. Various subregions differed from each other in timing and degree of participation in premaize crop production. A Midwestern record of native seed plant domestication preceding the adoption of maize is documented, and the significance of this phenomenon is now recognized. Recent archaeobotanical information highlights the amount of geographic variability, limiting the utility of earlier broad-scale interpretations. This paper includes a comparison of sequences in selected subregions: the Midwest/Midsouth, the Southeast, the Lower Mississippi Valley, the Trans-Mississippi South, and the Northeast.*

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**KEY WORDS:** eastern North America; agricultural origins; subsistence change; maize; chenopod; paleoethnobotany.

### **INTRODUCTION**

The 1980s witnessed a transformation of evidence and ideas pertaining to the development of agriculture in precontact Eastern North America. As the decade began, the most widely accepted scenario credited crops domesticated in Mesoamerica—maize, beans, and squash—as dominating the only farming systems to achieve economic significance. Debate continued over the status of several poorly understood native plants included in the Eastern Agricultural Complex, but few archaeologists viewed them as more than minor supplements to a diet centered on wild foods before maize-based

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**Table I.** General Chronological Sequence of Relevant Periods in Eastern North America

Period	Age
Contact	400 B.P.
Mississippi	1000 B.P.
Late Woodland	1600 B.P.
Middle Woodland	2300 B.P.
Early Woodland	3000 B.P.
Late Archaic	5000 B.P.
Middle Archaic	8000 B.P.

Mississippian agriculture, which began around 1100–1000 B.P. (Table I), or minor crops in maize-based systems after 1000 B.P. By the end of the 1980s, the native plants had earned the position of major crops for some food producing societies of the Woodland period (circa 3000–1100 B.P.). Evidence that members of the squash family, both pepo (*Cucurbita pepo*) and bottle gourd (*Lagenaria siceraria*), were encountered early as wild or feral plants and subsequently domesticated by native eastern North Americans further eroded previous belief in the supremacy of Mesoamerican crops.

Several recent articles and volumes have been devoted to the evidence for accepting a new version of agricultural evolution in the East. Overviews by Smith (1987, 1989), Watson (1985, 1989), and Yarnell (1983, 1986, 1988), and papers by authors in volumes edited by Ford (1985) and by Keegan (1987a), to name only the most easily accessible publications since 1983, ably cover archaeobotanical data, archaeological contexts, and theoretical implications. Two additional groups of even more recent papers are currently being prepared for publication: the proceedings of the 1988 Southeastern Archaeological Conference symposium entitled “The Influence of Paleoethnobotany on Archaeology over the Past Fifty Years,” organized by Donna Ruhl and Margaret Scarry, and the plenary session at the 1989 Midwest Archaeological Conference entitled “Native American Agriculture: The Origins, Development, and Significance of Prehistoric Farming,” organized by William Green.

So much literature on the subject has bombarded the archaeological readership in the past few years, in fact, one might well wonder why it is

necessary to present an additional overview of prehistoric food production in the Eastern Woodlands. My justifications are as follows.

(1) The processes and problems involved in the study of plant domestication are complex. Revisions of botanical nomenclature and frequent additions to the archaeobotanical record have been difficult to follow. Moreover, the notion of eastern North America as nothing more than a recipient area for crops domesticated elsewhere is tenacious. In spite of the excellent summary articles by eminent anthropologists cited above, a number of archaeologists have yet to absorb the new archaeobotanical consensus. Researchers who do not concentrate on North America seem largely unaware or unconvinced. This paper, then, is an opportunity to reach a wider audience and an attempt to clarify some of the more confusing issues.

(2) Previous overviews rightly emphasized the most pressing issues of the day, the major concerns of the respective authors, and the topics those individuals were best qualified to address. In this rapidly evolving research environment, it is impossible to write a definitive statement or to cover all aspects and geographical areas of the East thoroughly in one journal article. I take advantage of the maturing body of evidence to contrast agricultural developments in selected subregions of the Eastern Woodlands. It is now clear that different trajectories characterized different parts of the East and that processes involved in the shift towards farming were not consecutive or parallel across space.

After clarification of terminology, I begin by outlining the chronological sequences for domestication as they are currently documented archaeobotanically. The next section is a historical review of research prior to 1980, with emphasis on the perspectives and biases of contributing archaeologists and botanists. Next I summarize the ethnobotanical revolution of the 1980s—a decade that capitalized on the methodology of the 1960s and 1970s, but one in which many basic notions were challenged or overturned. This leads to a description of current perspectives and theoretical frameworks. Finally, I compare sequences for selected regions—the Midwest/Midsouth, the Southeast, the Lower Mississippi Valley, the Trans-Mississippi South, and the Northeast—and discuss the multiple pathways to farming taken by prehistoric eastern North American societies.

## TERMINOLOGY

Some terms used in literature dealing with agricultural evolution in the Eastern Woodlands may be perplexing to non-North Americanists because they are applied slightly differently by different scholars. One long-standing tradition has been the restriction of the term “agriculture” to field-scale

maize systems as manifested during the Mississippi period. Premaize, presumably smaller-scale food producers are classified as “horticultural” rather than agricultural. Their plots are usually referred to as gardens rather than fields, and they are called gardeners rather than farmers.

Application of the term “agriculture” to late prehistoric maize farming is not consistent with definitions in anthropological textbooks that would classify *all* prehistoric cultivation practices in the East as horticultural because they were extensive rather than intensive. Irrigation was not known, and tools were limited to hand-powered hoes or digging sticks. An argument can be made that ridged field systems were sufficiently labor intensive to be labeled as agricultural, but it is currently doubtful that ridging was a general practice outside the northern Midwest [see Riley (1987), however, for an argument in favor of ridging as a general Mississippian practice]. The well-described Iroquois and Huron farming systems are classic examples of shifting horticulture. Many Mississippian groups were less aggregated and seemingly less dependent on domesticated plants than were the Iroquoian groups. Therefore, the agricultural vs horticultural dichotomy used to differentiate Mississippi period from Woodland period groups is idiosyncratic to the region and potentially confusing.

This dichotomy can be challenged on theoretical grounds as well. Domestication occurred over a period of thousands of years in eastern North America. In some areas, native plants became linked with native people in increasingly symbiotic relationships. Nonindigenous crops were later incorporated into the complex, but mixed cropping continued across much of the East, with breeding evidently focused on native crops as well as on maize, gourds, pumpkins, and beans. Maize and beans were also adopted by those groups who had not previously practiced food production. Differences in timing, demographic factors, environmental constraints, social relations, and political histories introduced considerable variations, resulting in significant regional diversity. Therefore, I use the term *agriculture* in a broad evolutionary sense to include all domesticatory behavior and response. Those societies included here as agricultural are not being singled out as practitioners of labor intensive cultivation.

Another potentially troublesome distinction commonly made by paleoethnobotanists and archaeologists results from the problem of identifying alterations—genetic or otherwise—marking full domestication. Seeds from plants such as maygrass (*Phalaris caroliniana*), little barley (*Hordeum pusillum*), and pre-Mississippi period erect knotweed (*Polygonum erectum*) have not been recognized as morphologically different from their modern wild counter-parts, yet considerable numbers of these species occur repeatedly in association with seeds of domesticates, and in the case of maygrass, the seeds occur archaeologically in geographic zones outside the modern

range. Archaeologists have adopted the terminology of Harlan (1975) and refer to a "cultivated" plant as intentionally propagated but not recognizably altered. If phenotypic signs of alteration are observed, as in the case of sumpweed (*Iva annua* var. *macrocarpa*) and chenopod (*Chenopodium berlandieri* ssp. *jonesianum*), the plant is said to be "domesticated."

Some researchers extend the adjectival forms to noun forms, labeling a domesticated plant as a "domesticate" and a cultivated plant as either a "cultigen" or a "cultivar." Since the terms cultigen and domesticate are usually synonymous outside the archaeobotanical literature, I say "cultivated plant" when phenotypic alteration is in doubt and avoid the word "cultigen" altogether. Furthermore, in this paper, "cultivar" is not synonymous with either "domesticate" or "cultivated plant" but refers to a lower taxonomic level than species. For example, summer crookneck and pattypan squash types are different "cultivars" of the domesticated squash species circumscribed as *Cucurbita pepo* ssp. *ovifera* var. *ovifera*.

## CHRONOLOGY OF DOMESTICATION AND CROP ACQUISITION

The temporal sequence of food production in the Eastern Woodlands as currently documented is well summarized elsewhere (e.g., Smith, 1987; Watson, 1989; Yarnell, 1986) and needs only to be briefly outlined here. Table I outlines the temporal periods, and Table II presents the locations, contexts, and ages of early crops. The locations of important sites or project areas are shown in Fig. 1. Beginning at 7000 B.P., rind fragments of *Cucurbita pepo* ssp. *ovifera* (pepo gourd) in Illinois (Asch and Asch, 1985) and of *Lagenaria siceraria* (bottle gourd) in Florida (Doran *et al.*, 1990; Newson, 1988) are present in archaeological contexts indicating use of gourds, but not necessarily domesticated gourds. The presence of these plants in Middle Archaic archaeological components is crucial to the argument for independent domestication rather than acquisition of domesticated gourds and squashes from Mesoamerica (Decker, 1988; Decker-Walters, 1988; Heiser, 1989; Smith, 1989; Yarnell, 1988). This issue is discussed in greater depth below.

By the end of the Middle Archaic (circa 5000 B.P.), there is evidence for increased use of phenotypically wild sumpweed (*Iva annua* var. *annua*) seeds in westcentral Illinois, and by the end of the following millennium (4000 B.P.), the mean size of archaeological sumpweed fruits surpassed that of modern wild populations (Asch and Asch, 1985). The number of chenopod seeds also rises at this time in westcentral Illinois, showing an increase in harvesting but not visible morphological change.

Pepo and bottle gourds were both in more general use at sites in the East by 4000 B.P. The few pepo seeds and small rind specimens from late Archaic

Table II. Early Records of Eastern North American Crops

Years B.P.	Crop type	Description	Status	Site/state	Ref. <sup>a</sup>
7000–5000	<i>Cucurbita pepo</i>	Thin rind fragments, carbonized	No firm sign of domestication	Koster and Napoleon Hollow, IL;	1
				Hayes, TN;	2
				Carlston Annis, KY	3
	<i>Lagenaria siceraria</i>	Rind of gourd in wet site burial	Indeterminate	Windover, FL	4
	<i>Iva annua</i>	Small seeds, carbonized	Not larger than wild	Koster, IL	1
5000–4000	<i>C. pepo</i>	Small seeds	No firm sign of domestication	Cloudsplitter, KY	3, 5
		Thin rind fragments, carbonized	No firm sign of domestication	Bacon Bend, TN;	6
				Carlston Annis & Bowles, KY;	3
				Lagoon, Kuhlman, & Napoleon Hollow, IL	1
		Rind & seeds, uncarbonized (wet site)	No firm sign of domestication	Phillips Spring, MO	5
		<i>Lagenaria siceraria</i>	Seeds and rind fragments, (wet) uncarbonized	Indeterminate	Phillips Spring, MO
<i>I. annua</i> v. <i>macrocarpa</i>	Seeds, carbonized	Domesticated	Napoleon Hollow, IL	1	
<i>Chenopodium berlandieri</i>	Seeds, carbonized	Thick seed coats, no sign of domestication	Napoleon Hollow & Lagoon & Koster, IL	1	
4000–3000	<i>C. pepo</i>	Seeds, carbonized	Presumed domesticated	Copes, LA;	7
		Rind, carbonized	Presumed domesticated	Marble Bluff, AR	8
				Jernigan II & Iddins, TN;	9
				Peter Cave, KY	6
	<i>Lagenaria siceraria</i>	Rind, carbonized	Presumed domesticated	Jernigan II, TN	3
	<i>Chenopodium berlandieri</i> ssp. <i>jonesianum</i>	Seeds, desiccated	Thin-testa, domesticated	Newt Kash & Cloudsplitter, KY	9
		Seeds, carbonized	Thin-testa	Marble Bluff, AR	10
	<i>Iva annua</i> var. <i>macrocarpa</i>	Carbonized, storage context	Domesticated	Marble Bluff, AR	8
	<i>Helianthus annuus</i> var. <i>macrocarpus</i>	Carbonized, storage context	Domesticated	Marble Bluff, AR	8

Table II. Continued

Years B.P.	Crop type	Description	Status	Site/state	Ref. <sup>a</sup>
	<i>Phalaris caroliniana</i>	Seeds, carbonized	Presumed cultivated	Bacon Bend, TN	6
	<i>Ambrosia trifida</i>	High counts of seeds in middens, caches	Uncertain	Cahokia ICT, Koster, & Napoleon Hollow, IL; Cloudsplitter, KY; Marble Bluff, AR	11 1 12 8
3000–2000	<i>C. pepo</i> & <i>Lagenaria siceraria</i>	Desiccated seeds & rind, including whole fruits & bowls	Domesticated	Salts Cave & Cloudsplitter, KY	13 12
		Carbonized rind fragments	Domesticated	Salts Cave & other sites	3, 14
	<i>C. berl.</i> ssp. <i>jonesianum</i>	Desiccated & carbonized seeds stored in bags & pits	Thin-testa	Cold Oak & Cloudsplitter, KY; Russell Cave, AL; Ozark Sites, AR	15 12 16 8 13
		Seeds in paleofeces	Thin-testa	Salts Cave, KY	13
	<i>Iva annua</i> var. <i>macrocarpa</i>	In paleofeces and in middens	Domesticated	Cloudsplitter, Salts Cave, & Newt Kash, KY; Collins, MO	12 13 17 18
	<i>Helianthus annuus</i> var. <i>macrocarpus</i>	Carbonized; desiccated: in paleofeces & in storage	Domesticated Domesticated Domesticated	Higgs, TN Salts Cave, KY Cloudsplitter, KY	19 13 12
	<i>Polygonum erectum</i>	Desiccated, in storage	Uncertain	Cloudsplitter, KY	12
	<i>Phalaris caroliniana</i>	Desiccated: in paleofeces & in storage	Presumed cultivated	Salts Cave & Cloudsplitter, KY	13 12
2000–1000	<i>C. pepo</i> & <i>Lagenaria siceraria</i>	Widely distributed	Domesticated	Many sites	
	<i>Chenopodium</i> (a) Thin coat	Widely distributed	Domesticated	Many sites	1, 20
	(b) Pale seed	Distribution uncertain	Domesticated	Cow Ford, Holman, AR; Montgomery, MO; Smiling Dan & Newbridge, IL; Cahokia, IL	8 1 21
	<i>Iva</i> & <i>Helianthus</i>	Widely distributed	Domesticated	Many sites	22, 23

Table II. Continued

Years B.P.	Crop type	Description	Status	Site/state	Ref. <sup>a</sup>
	<i>Polygonum erectum</i>	Widely distributed	Probably cultivated	Many sites in Midwest	1, 24
	<i>Phalaris caroliniana</i>	Widely distributed	Presumed cultivated	Many sites in Midwest	1, 9, 25, 26
	<i>Hordeum pusillum</i>	Widely distributed	Presumed cultivated	Many sites in Midwest	1, 26
	<i>Zea mays</i> ssp. <i>mays</i>	Carbonized cupules, kernels & glumes	Domesticated (acquired from SW)	Icehouse Bottom, TN; Harness Mound, OH <sup>b</sup>	27, 28
	<i>Nicotiana</i> sp. (likely <i>N. rustica</i> )	Carbonized seeds	Domesticated	Smiling Dan & Meridian Hills, IL <sup>c</sup>	1, 29
1000–500 (new crops)	<i>Phaseolus vulgaris</i>	Cotyledons, usually carbonized	Domesticated (acquired from SW)	Many sites, esp. after 700 B.P.	30
	<i>Amaranthus hypochondriacus</i>	Desiccated seeds, stems, flower parts	Domesticated (acquired from SW?)	Holman Shelter, Putnam Shelter, Cow Ford, & Alum Creek, AR	8
	<i>Cucurbita argyrosperma</i>	Desiccated peduncles	Domesticated (acquired from SW)	Putnam Shelter, Edens Bluff, & Cob Cave, AR	8

<sup>a</sup>(1) Asch and Asch (1982, 1985); (2) Crites (1987b); (3) Watson (1985); (4) Doran *et al.* (1990); (5) King (1985); (6) Chapman and Shea (1981); (7) Jackson (1989); (8) Fritz (1986); (9) Crites (1978); (10) Smith and Cowan (1987); (11) Lopinot (1983a); (12) Cowan (1985); Cowan *et al.* (1981); (13) Yarnell (1969, 1974); (14) Gardner (1987); (15) Gremillion and Ison (1989); (16) Smith (1985a); (17) Jones (1936); (18) Klippel (1972); (19) Brewer (1973); (20) Fritz and Smith (1988); (21) Lopinot (1988); (22) Yarnell (1978, 1981); (23) Asch and Asch (1978); (24) Fritz (1987); (25) Cowan (1978); (26) Johannessen (1984, 1988); (27) Chapman and Crites (1987); (28) Ford (1987); (29) K. E. Parker (personal communication, 1990); (30) Yarnell (1986).

<sup>b</sup>Earliest substantiated records; other Middle Woodland sites may have maize in good context, but not verified by direct dating. After 1350 B.P., maize found at many additional sites.

<sup>c</sup>Earliest records; after 1400 B.P., tobacco found at several additional sites.

sites in Louisiana, Missouri, and Kentucky cannot be confidently differentiated from the native wild gourd, *Cucurbita pepo* ssp. *ovifera* var. *texana*, but I suspect that plants were established as domesticates or at least as encouraged, camp-following weed-crops. Archaeological bottle gourds are not known to exist outside cultivation anywhere in the world (Heiser, 1989), but it is difficult to envision the spread of this plant into Missouri by 4000 B.P. without humans acting as dispersal agents.

The 1000 year period before 3000 B.P. was a time of increased use of the starchy and oily seeds, several of which exhibited clear morphological indications of domestication. Chenopod seeds directly dated to circa 3500 B.P. from Newt Kash and Cloudsplitter rockshelters in Kentucky have thin seed





Fig. 1. Map of eastern North America with locations of sites and project areas yielding information on agricultural developments.

coats and truncate margins marking them as the domesticated taxon *C. berlandieri* ssp. *jonesianum* (Smith and Cowan, 1987). One of three carbonized, twined bags of thin-testa chenopod seeds found at Marble Bluff rockshelter in the Arkansas Ozarks has been directly dated to 2926 B.P.  $\pm$  40 years (SMU-1682), representing a clear-cut incidence of storage (Fritz, 1986). Also by this time, sunflower achenes from Marble Bluff as well

as from the Higgs site in Tennessee are larger than those found in wild or weedy populations, adding the taxon *Helianthus annuus* var. *macrocarpus* to the growing list of native crops (Fritz, 1986; Brewer, 1973).

Giant ragweed (*Ambrosia trifida*) achenes repeatedly occur in seed assemblages dating to the fourth and third millennia B.P., sometimes associated with chenopod, sunflower, sumpweed, and gourd in contexts implicating ragweed as a cultivated plant or at least a tolerated and utilized garden weed (Asch and Asch, 1982; Cowan, 1985; Fritz, 1986; Lopinot, 1983a). At Marble Bluff, ragweed was the dominant seed type by bulk and the second most abundant by count in a large mixed seed cache. A radiocarbon determination of 2843 B.P.  $\pm$  44 years (SMU-1681) on ragweed specimens shows them to be about the same age as the bags of thin-testa chenopod lying nearby, perhaps exactly the same age (Fritz, 1986).

Cave and rockshelter sites in central and eastern Kentucky have yielded unequivocal evidence for diets high in seeds of the native crop group by 2500 B.P., primarily sunflower, sumpweed, chenopod, and pepo squash, but with a few additions. Maygrass appears to be newly acquired as a common food, having been recovered in relative abundance from only one earlier site—the Late Archaic component at Bacon Bend, Tennessee (Chapman and Shea, 1981). Its occurrence at Early Woodland sites in Kentucky is outside the modern natural distribution (see Cowan, 1978), one of the key factors leading to the classification of maygrass as a cultivated plant by this time.

Knotweed was evidently not yet as common as the other starchy seeds before 2000 B.P., but its inclusion in an Early Woodland period pit at Cloudsplitter Rockshelter in eastern Kentucky and as a minor element in Salts Cave, Kentucky, paleofeces is significant as early evidence of a plant food that was to become more abundant later. Carbonized *Polygonum* sp. achenes in the 3000-year-old mixed seed cache at Marble Bluff, Arkansas, do not conform morphologically to either of the two achene morphs of *Polygonum erectum* and may belong to a different species. Woodland period knotweed cannot be classified as domesticated on the basis of either achene size or fruit wall thickness (Asch and Asch, 1985; Fritz, 1987).

By the first few centuries of the second millennium B.P., the domesticated plants (bottle gourds, pepo gourds and squashes, chenopod, sunflower, and sumpweed) and the associated, probably cultivated crops (knotweed, maygrass, and another early-season grass—little barley) had become sufficiently abundant to be deposited as accidentally charred seeds and fruits ending up as refuse in Middle Woodland middens, pits, postmolds, and other features along with hickory nut, walnut, acorn, and hazelnut remains and the seeds of fleshy fruits and weeds. Direct AMS dating of thin-testa chenopod from bags, gourds, and storage pits found at rockshelter sites in the Arkansas Ozarks, northern Alabama, and central Ohio has documented the practice of

storing this crop across a sizeable geographic range at the beginning of the Christian era. Added to the flotation data from open sites, especially in western Illinois and central Tennessee, it has become evident that the agricultural component of the mixed subsistence system was well established in parts of the Eastern Woodlands before 1600 B.P. The most intense food production appears to have been limited to a broad midlatitude section.

The earliest firmly dated maize in the East belongs to this period (1750–1850 B.P.), bringing maize onto the scene as another starchy grain added to maturing agricultural systems. No immediate impact on general subsistence is perceivable using today's archaeological methods. The present evidence from stable carbon isotope studies on human bone indicates little or no use of any C-4 pathway plant until toward the end of the second millennium B.P. (Ambrose, 1987; Bender *et al.*, 1981; Lynott *et al.*, 1986; Vogel and Van Der Merwe, 1977; Wagner, 1987).

Only a few Middle Woodland components have yielded maize in firm context, and the quantities are minute compared to those of native crops and remains of wild plant foods. Three whole cupules, 21 cupule fragments, 81 kernel fragments, and two glume fragments were recovered from the Connestee-phase component at the Icehouse Bottom site in eastern Tennessee, with fragments submitted for a direct AMS radiocarbon date of 1775 B.P.  $\pm$  100 years (Beta-16576) (Chapman and Crites, 1987). Two recognizable kernel fragments from separate features and smaller fragments of possible kernels came from the Edwin Harness mound near Chillicothe, Ohio. The identifiable fragments were used for AMS dates of 1730 B.P.  $\pm$  85 years (Beta-18290) and 1720 B.P.  $\pm$  105 years (Beta-18291) (Ford, 1987). Maize fragments from apparently good Middle Woodland contexts have recently been found at the Walling site, a Copena mound in northern Alabama (Scarry, 1990). No whole cobs or cob segments are known from reliable Middle Woodland contexts, making it impossible to classify early maize in the Eastern Woodlands by type or race (Fritz, 1988b, c).

Tobacco also emerges for the first time at about 1800 B.P., a few seeds having been recovered from the Smiling Dan site in westcentral Illinois (Asch and Asch, 1985) and from the Meridian Hills site in the American Bottom area (Katie Parker, personal communication, 1990). Prehistoric tobacco seeds in the East are not firmly classifiable to species on the basis of micromorphology but are generally assumed to be *Nicotiana rustica*, since that was the only taxon recognized east of the Great Plains at the time of European contact.

Although maize and tobacco appear at approximately the same time in the archaeological record, they do not occur at the same Middle Woodland period sites nor would they necessarily have been acquired through common routes of transmission. Most archaeologists believe that all prehistoric eastern maize was probably imported from the Southwest, where it had been subjected

to more than 1000 years of cultural and natural selection after introduction from Mexico. *Nicotiana rustica*, however, has not been recovered from early agricultural components in the Southwest. In fact, that species is not securely documented before the Spanish Entrada (Ford, 1981), although a claim has recently been made for a few seeds from Sedentary period (ca. 1000 B.P.) Hohokam sites in southern Arizona [three reports by Charles Miksicek cited by Bohrer (1988)]. Currently lacking a good Southwestern source, the path of *N. rustica* from its South American point of origin would likely be through eastern Mexico or across the Caribbean.

By 1500 B.P., knotweed was often an abundant component of seed assemblages. It is the most common seed at 14 of 28 Middle and Late Woodland period components (1950–1050 B.P.) and the second or third most abundant type at the remaining components in west-central Illinois analyzed by Asch and Asch (1985). Flotation samples from sites in Tennessee (Chapman and Shea, 1981; Crites, 1978), southern Illinois (Dunavan, 1988), and the American Bottom area (Johannessen, 1984; Fritz, 1987) have also yielded numerous knotweed seeds dating to this time period. Archaeological specimens are within or very close to the range of variation of modern wild populations, but high frequencies of the smooth-coated subtype common only late in the growing season and the consistent association of knotweed with domesticated chenopod and other crops indicate its presence in the agricultural ecosystem.

A development in chenopod husbandry is recognizable at about 1500 B.P.: the appearance of samples dominated by specimens with seed coats reduced to the point of transparency, rendering them a pale yellow or golden color rather than black. Uncarbonized pale-seeded chenopod plants from two dry Ozark rockshelters have been directly dated to this time (Fritz, 1986). Specimens in early Late Woodland period samples from westcentral Illinois (Asch and Asch, 1985) and in Late Woodland and early Mississippi period samples from the American Bottom area (Lopinot, 1988; Fritz, 1987) are also believed to belong to this type, although carbonization usually reduces distinction between formerly pale and formerly black chenopod seeds. Thin-testa chenopod continued to be widely distributed across the midcontinent, sometimes apparently mixed with pale chenopod and frequently in association with maygrass, little barley, and knotweed.

At around 1000 B.P. (1200–800 B.P., depending on geographical area), the intensification of maize production led to more extensive field agriculture, with maize becoming the dominant crop. The most significant addition to the inventory of domesticates at this time was the common bean, *Phaseolus vulgaris*, probably acquired from the Southwest. Beans are less likely than maize and other starchy seeds to be carbonized and thereby enter the archaeological record, but their conspicuous rarity before 600 or 700 B.P. except in the Northeast and central Ohio River region indicates a minor subsistence role for beans in the Mississippian diet until just before European

Contact. Two samples of erect knotweed, one from westcentral Illinois and one from the Ozarks, both dating to approximately 700–800 B.P., are distinctive by having larger average achene lengths than known wild populations and including none of the thick-pericarp morph that is dominant in the wild. These characteristics may have been caused by domestication (Fritz, 1986, 1987; Asch and Asch, 1985).

Two additional crops, pale-seeded amaranth (*Amaranthus hypochondriacus*) and cushaw squash (*Cucurbita argyrosperma*, formerly classified as *C. mixta*), entered the Eastern Woodlands in the prehistoric era, each probably coming across the southern or central Plains at a relatively late date. Domesticated amaranth has been positively identified only in the desiccated state as preserved in dry Ozark shelters (Fritz, 1984, 1986). It was clearly not a major crop in the central riverine Eastern Woodlands, contrary to early notions concerning the “Eastern Agricultural Complex” (Fowler, 1971; Struever and Vickery, 1973). It might, however, have been somewhat important in the Trans-Mississippi South and in the as yet poorly studied Lower Mississippi Valley. The single direct date on domesticated amaranth from the Ozarks is 920 B.P.  $\pm$  109 years (SMU-1632) (Fritz, 1986).

*Cucurbita argyrosperma* (*C. mixta*), most commonly known by its green striped cushaw cultivar, has been identified in six Ozark rockshelters on the basis of its distinctive, bulbous, corky fruiting stem. A single direct AMS date of 520 B.P.  $\pm$  75 years (Beta-14589) indicates that this species was brought eastward by the process of aboriginal rather than European exchange (Fritz, 1986). Cushaw squash was popular among Southwestern farmers at Contact and has been recovered archaeologically in the Southwest as early as 1150 B.P. (Ford, 1981). Unless a method is found for distinguishing between charred fragments of cushaw and pepo rind, the archaeobotanical record will make it difficult if not impossible to trace the spread of cushaw squash beyond the Ozark Highlands.

The record clearly shows that various processes were operating in the formation of agricultural systems in the East. Some plants became domesticated from indigenous wild progenitors. At least one crop—the sunflower—seems to have been domesticated in the East from an ancestor originally native to the western part of the continent (Heiser, 1985). Tobacco may have entered the Eastern Woodlands by a route unlike that of any of the food plants, with separate social and ritual mechanisms operating. Maize, beans, amaranth, and cushaw squash were probably introduced via the Southwest, but evidently at different times, with some parts of the East more likely than others to accept intermittent introductions. Breeding did not stop with acquisition of the tropical seed stock, and new varieties, most notably of maize, were developed by the eastern North American Indians. Independent plant domestication processes and diffusion both contributed to the complex and dynamic prehistoric agricultural systems of the Eastern Woodlands.

## HISTORY OF RESEARCH BEFORE 1980

Attempts to understand the beginnings and amplification of food production in Eastern North America have been complicated by questions concerning a possible "Eastern Agricultural Complex," although that term was apparently not used in print until 1962 (see discussion by Smith, 1987). Although some archaeologists discounted or ignored the possibility that indigenous seed crops could have made a difference in the region's culture history, the issue of independent agricultural origins has repeatedly surfaced, and for very good reasons (Linton, 1924, 1955; Jones, 1936; Carter, 1945; Quimby, 1946; Fowler, 1957; Struever and Vickery, 1973; Yarnell, 1969, 1974, 1989).

Enigmatic archaeological plant remains from dry rockshelters in Ohio, eastern Kentucky, and the Ozark Highlands were recovered as early as 1876 (Andrews, 1877), receiving well-deserved attention during the 1920s and 1930s (Harrington, 1924; Gilmore, 1931; Jones, 1936; Blake, 1939) in brief publications cited frequently ever since. With the incorporation of flotation recovery into excavation procedures beginning in the 1960s, the same types of seeds along with a few new ones became the focus of renewed research efforts. In hindsight, it appears that it would have been impossible to bypass the native crop "complex" because of the ubiquity of these species in regional assemblages and, especially, because their abundance in temporally critical components affects the social, technological, and ecological factors considered pertinent in models of maize acquisition. Two major questions have surrounded the native crop group beyond the central issue of whether or not the plants involved were actually domesticated: first, whether they preceded or followed the introduction of tropical domesticates; and second, whether they had a significant impact on the subsistence-settlement system.

Before 1980, only sunflower and sumpweed were recognized as true locally domesticated plants. S. F. Blake's (1939) early designation of a taxonomic level for the extinct large-seeded sumpweed from Ozark and Kentucky rockshelters was followed by decades of little research progress and much speculation divorced from direct ethnobotanical attention. An exception was Heiser's (1951, 1954, 1976) research on sunflowers, which, although crucial to models of domestication, primarily dealt with modern plants rather than archaeological specimens. Another exception, the measurements of prehistoric and modern giant ragweed seeds by Payne and Jones (1962), concluded that the rockshelter deposits contained wild rather than domesticated ragweed. This interpretation is currently being questioned (Asch and Asch, 1982; Fritz, 1986). The work of Yarnell (1972, 1978) and the Asches (Asch and Asch, 1978) on sumpweed and sunflower signaled a resurgence of direct interest in the archaeobotanical remains.

The first close inspection of prehistoric chenopod north of Mexico was published by Asch and Asch in 1977. Ironically, the discovery that correctly identified archaeological specimens from old collections were no larger than modern wild counterparts became widely interpreted as proof that all prehistoric chenopod seeds represented harvests from wild or weedy stands. The Asches (Asch and Asch, 1978) published a statement the following year in which they included chenopod, knotweed, and maygrass as probable agricultural complex members, but this statement was ignored by those preferring a negative resolution to the long standing question of indigenous plant domestication.

Cowan's (1978) study of maygrass, which placed that plant in the cultivated but not necessarily domesticated category, allowed archaeologists to envision a low level of management of essentially wild plant populations, probably a casual tending of plots in clearings, mixed with small-scale propagation of sunflower and sumpweed.

Micromorphological inspection of chenopod seeds—conclusively establishing their domesticated status—was finally conducted in the early 1980s (Smith, 1984, 1985a, b; Smith and Funk, 1985; Wilson, 1981). This research and the contemporaneous reporting of high seed frequencies in flotation samples are discussed in the following section. It is important to remember that articles and books written before 1977 reflect a general lack of detailed information about archaeological plant types other than sumpweed and sunflower and that most written in the late 1970s and early 1980s operate under the assumption that chenopod was not domesticated and that maygrass, while probably cultivated beyond its natural range, was unlikely to have been economically important.

During the period of speculation between 1924 and 1977, when belief in the existence of an Eastern Agricultural Complex was based on large-seeded archaeological sunflower and sumpweed and on poorly understood caches of chenopod and maygrass, the burning question was, Which came first—tropical crops or native ones? [For an excellent discussion, see Smith (1987).] Reports of cucurbit rind fragments in contexts dating back to 4300 B.P. temporarily tilted the balance in favor of Mesoamerican domesticates, and the standard scenario became one in which the concept of agriculture had been introduced from the south along with squash and gourd seeds, setting the stage for eventual domestication of indigenous plants (Chomko and Crawford, 1978; Kay *et al.*, 1980; Ford, 1981). Although the geographer George Carter (1945) had suggested an independent domestication of pepo squash in Eastern North America, that possibility was either forgotten or dismissed by archaeologists until Decker's (1986, 1988) isozyme research introduced hard evidence in its support. During the intervening decades and until the past few years, a claim for primary, independent agricultural evolution in the East has been

either weakly supported (e.g., Jones, 1936; Carter, 1945) or short-lived (Yarnell, 1974), with most reports written between 1978 and 1986 confident that the which-came-first debate had been settled in favor of tropical crops.

The issue of whether or not certain native seed crops were important foods in the diets of prehistoric Eastern North Americans is closely connected to research tracing the introduction of maize. Many archaeologists before the mid-1970s held that Middle Woodland societies (ca. 2300–1600 B.P.), especially those involved in the Hopewell interaction sphere, must have practiced some maize agriculture (Griffin, 1960, 1967), and cobs from a few sites seemed to provide support (Yarnell, 1964; Struever and Vickery, 1973; Ford, 1978). However, flotation efforts and stable carbon isotope studies on human bone indicated that maize was simply not an important component of the Middle or early Late Woodland diet. In the absence of strong corroboration of native seed domestication, and in a research environment newly alerted to the diversity and flexibility of foraging societies, an absence of maize agriculture became equated with hunting and gathering as the mode of food procurement in the pre-Mississippi period Eastern Woodlands. Most papers presented at the 1978 Chillicothe Conference and published in the volume edited by Brose and Greber (1979) strongly reflect this perspective, although the chapter by Asch *et al.* (1979) does treat the mounting evidence for seed husbandry with due respect.

The food collecting as opposed to food production perspective continues to be strong today, partly because wild plants and animals *were* clearly important to all Woodland period groups and partly because premaize food production was apparently restricted to midlatitude, interior portions of the East. By the end of the 1970s, however, researchers were finding it impossible to ignore the role of the burgeoning Late Archaic and Woodland period agricultural systems.

### ETHNOBOTANICAL REVISIONS OF THE 1980s

Of the several catalysts stimulating revisions of subsistence-related interpretations in the Eastern Woodlands, the most compelling may have been the newly tabulated seed masses consistently recovered by large projects in the lower Illinois River valley, the American Bottom area surrounding the great Cahokia site, the Normandy Reservoir in central Tennessee, and the Tellico Reservoir in eastern Tennessee (Asch and Asch, 1985; Johannessen, 1984; Crites, 1978, 1987a; Chapman and Shea, 1981). Flotation systems pioneered by Struever (1968), Watson (1976), and others added a new dimension to the archaeological record in the form of billions of tiny, charred fragments, requiring low-power microscopic analysis. Archaic period components



reflected dominance of nut collecting, but seed harvesting increased at certain sites before 3000 B.P. More intensive seed use began during the third millennium B.P. in some areas, but not until the early or middle second millennium B.P. elsewhere. A dramatic rise in seed-to-nutshell ratio is evident for sites postdating 1900 B.P. across the Midwest and Midsouth, and the overwhelmingly dominant seed types were chenopod, maygrass, erect knotweed, and little barley. These four taxa are frequently lumped into a group labeled the "starchy seeds," and they are assumed by researchers in the United States to have been valued for their relatively high carbohydrate contents.

Earlier explanations of intensified seed harvesting, such as Struever's (1964) mudflat hypothesis in which large quantities of these seeds were available in natural stands, became untenable in light of phytoecological studies (Asch and Asch, 1982). The people themselves most likely created the openings and eventually maintained stands of particular plants because they valued them as food resources. Domestication occurred and agricultural systems evolved within this context.

### **Assessing the Importance of the Native Seed Crops**

The dietary importance of native seed crops appeared greater after quantifications of flotation-recovered plant remains from large projects were published during the 1980s. Paleofecal evidence had earlier showed conclusively that the Salts cavers were eating large amounts of sumpweed, sunflower, and squash seeds along with members of the starchy seed group at approximately 2700-2400 B.P. (Yarnell, 1969, 1974). Before the implementation of fine-mesh recovery, however, this could be interpreted as an aberrant, special activity type of diet. After analysis of many assemblages from open sites, it became apparent that middens and refuse-filled pits in Illinois, Ohio, Tennessee, Missouri, and northern Arkansas had become depositories for seeds that were probably charred accidentally while being parched to prevent infestation by vermin and to facilitate further processing.

A pattern has emerged of high starchy seed counts and frequencies at site after site, especially those dating to the Middle and Late Woodland periods. Seed-to-nutshell ratios in the Southeast rise from 19 seeds per 1000 g of nutshell in the Late Archaic to 85 seeds per 1000 g of nutshell in the Middle Woodland, with small grains increasing from below 30% of total seeds during the Archaic to 90% during the middle Woodland (Yarnell and Black, 1985, p. 99). In Illinois, features yielding tens of thousands of starchy seeds most commonly date to the early Late Woodland period (Johannessen, 1984; Asch and Asch, 1985). Radiocarbon dates on rockshelter chenopod, maygrass,

and sumpweed show that these crops were being stored during the Woodland period in Arkansas, Missouri, Alabama, Kentucky, and Ohio.

On the basis of wood charcoal and pollen studies, researchers have recently recognized evidence for alteration of river terrace plant communities during the Woodland period. Clearing for more permanent settlements and associated garden plants is proposed as the cause of the vegetation change. Late Archaic wood charcoal assemblages in the American Bottom are dominated by floodplain taxa, but these types drop to 10% of identifiable wood fragments by the end of the Middle Woodland (Johannessen, 1984). Frequencies of bottomland taxa also decline during this time in the lower Little Tennessee River Valley, with indications beginning in the Late Archaic. Percentages of disturbance-favored taxa such as pine, redcedar, tuliptree, and giant cane rise from less than 10% in the Middle Archaic to nearly 50% in the Middle Woodland, a trend interpreted as reflecting an increase in land under cultivation (Chapman *et al.*, 1982). Pollen curves from Tuskegee Pond near the Icehouse Bottom site in eastern Tennessee are marked by high percentages of ragweed and chenopod-type pollen by 1500 B.P., indicating that the stream terrace had been cleared and was being maintained at an early successional level typical of horticultural and old field communities (Delcourt, 1987).

Because these types of evidence have accumulated, premaize agriculture is more likely to be treated as making a difference in the total scheme of things by archaeologists concerned with broader aspects than subsistence. Braun (1987) makes a connection between seed boiling and improvements in ceramic technology. Buikstra *et al.* (1986) view the increased food supply as having an impact on Late Woodland population growth. Fewer overviews of North American prehistory now classify pre-Mississippi period societies as quintessentially nonagricultural.

### Documenting the Domestication of Chenopod

As reports of archaeological assemblages dominated by a few key seed types accumulated, it became more important to understand their taxonomic statuses. The status of *Chenopodium*, in particular, proved critical. Hugh Wilson (1981) was the first to recognize that old collections from Ozark rockshelters included well preserved, undamaged fruits (seeds with papery pericarps adhering) that were pale in color due to drastic reduction of the outer seed coat. Wilson pointed out that this condition was an unambiguous indicator of domestication. He reported no characters distinguishing the Ozark specimens from the domesticated Mexican taxon *Chenopodium berlandieri* ssp. *nuttalliae*.

This revelation did not clarify the status of *carbonized* chenopod seeds and fruits from open sites or that of desiccated *black-seeded* chenopod from

the Ozarks and other eastern rockshelters. Applying scanning electron microscopy to desiccated fruits from Ash Cave, Ohio, and to carbonized specimens from Russell Cave, Alabama, Bruce Smith (1984, 1985a, b) demonstrated that seed coat reduction was significant enough to enable these caches to be distinguished from wild chenopod populations. Truncate margins and smooth rather than pitted seed coat surfaces also characterized the prehistoric black, thin-testa domesticate. The taxon was formally classified by Smith and Funk (1985) as *C. berlandieri* ssp. *jonesianum*. Direct AMS radiocarbon dates on seeds from Newt Kash and Cloudsplitter rockshelters in eastern Kentucky demonstrated that thin-testa chenopod was available as early as 3500 B.P. (Smith and Cowan, 1987), and direct dates on specimens from Russell Cave, Ash Cave, and four Ozark rockshelters showed continued use of the crop between 3000 and 800 B.P. (Fritz and Smith, 1988).

It is not impossible that this black, thin-testa chenopod cultivar as well as the pale one—or, alternatively, only the pale type, and not the black one—originated in Mesoamerica, but most eastern North American archaeologists currently find it more plausible that both were indigenously domesticated. Late Archaic sites dating to approximately 4000 B.P. in west-central Illinois show increased harvesting of morphologically wild-looking specimens having thick, pitted seed coats and round margins (Asch and Asch, 1985). The Newt Kash and Cloudsplitter specimens cited above are currently the earliest known thin-testa chenopod. They are followed by caches put away for storage at the Marble Bluff site in northwest Arkansas that date to approximately 3000 B.P. (Fritz, 1986). Paleofeces from Salts Cave in Kentucky confirm the dietary importance of thin-testa chenopod in the middle of the third millennium B.P., and numerous well-dated samples from open sites as well as rockshelters span the period from 2300 to 800 B.P. One mid-third millennium B.P. rock-lined pit at Cloudsplitter, Feature 71, contained 7 liters of seeds—primarily chenopod, sumpweed, sunflower, maygrass, erect knotweed, and the tick trefoil, *Desmodium* sp. (Cowan, 1985, p. 240). Although most of the chenopod seeds are the black, thin-testa type, a small percentage is pale, indicating possible changes in gene frequencies due to selection pressures within the Early Woodland period agricultural ecosystem. These developments across the East are not correlated with introductions of other tropical domesticates, and the general cultural developments are clearly independent and local.

### The Case for Independent Cucurbit Domestication

The substantiation of Middle Archaic (7000 B.P.) *Cucurbita* rind in the Midwest (Conard *et al.*, 1984) spurred archaeologists to rethink the role of

squash in agricultural developments, and some began to question how much of an impact the contemporaneous Mesoamerican concept of agriculture could have had on eastern North American societies. Cowan *et al.* (1981, p. 71) were among the first since Carter (1945) to refer in print to *C. texana* as a possible native progenitor of prehistoric eastern gourds and squashes. Yarnell (1983) cautioned against viewing the Archaic period archaeological specimens as fully domesticated. The Texas wild gourd was given renewed attention in overviews of archaeological cucurbits by both King (1985a) and Heiser (1985). Smith (1987) argued at length for a Middle Holocene time frame for the beginnings of a mutualistic relationship between eastern North Americans and a native species of wild gourd.

Fortunately, the botanical studies by Deena Decker (1986, 1988) were presented at this time. Decker's research combined allozyme analysis with numerical taxonomy, demonstrating the close affinities of squash and gourd types grown by the eastern North American Indians with *C. texana*. This group, which includes the ornamental gourd, was reclassified as *C. pepo* ssp. *ovifera*. Mexican pepo pumpkins and orange gourds were grouped into the subspecies *C. pepo* ssp. *pepo*, which differs from the *ovifera* group in allozyme frequencies as well as morphological character states. Wild populations of *C. texana*, reclassified as *C. pepo* ssp. *ovifera* var. *texana*, in Texas were clearly distinguishable from the *ovifera* group domesticates (*C. pepo* ssp. *ovifera* var. *ovifera*), leading Decker to favor the interpretation that the Texas gourd is not a feral *C. pepo* escape. This evidence strengthens the case for indigenous domestication in temperate North America, although the observed genetic divergence of crops in the *ovifera* group from Mexican cultivars may still have postdated an early arrival of domesticated plants in the East. Botanists such as Heiser are now willing to state,

Although a single domestication in Mexico cannot be ruled out, separate domestications in the United States and Mexico appear far more likely. The old idea that a domesticate had but a single origin can no longer be accepted for a number of other domesticated species . . . (Heiser, 1989, p. 474)

This position is, however, not unanimous. Kirkpatrick and Wilson (1988) persist in the interpretation that the 4000 B.P. rind fragments represent introduction of a domesticate from Mesoamerica. Asch (1989) believes that wild pepo gourds were probably not distributed across the Midwest before the present century and, therefore, doubts that independent domestication occurred.

The discovery of bottle gourd rind at the Windover site in Florida and direct dating of rind fragments to 7000 B.P. (Doran *et al.*, 1990; Newsom, 1988) continues the trend of making direct Mesoamerican influence appear more remote. Because *Lagenaria siceraria* is known only in the domesticated state, it is impossible to distinguish between an early domesticated bottle gourd and

a wild one. The Windover bottle gourds are likely to have been derived from fruits that floated to the coast of Florida, either from tropical America or from Africa. They could have been utilized by Middle Archaic foragers in Florida with or without intentional cultivation.

### Perspectives on Maize

Most North Americal prehistorians think maize diffused across the Plains into Eastern North America from the Southwest. Lathrap (1987), however, following Sears (1982), recently proposed that certain "early" maize populations in the East were transported northward from the Caribbean coast of South America. Lathrap's argument hinges on acceptance of maize pollen at approximately 2500 B.P. at the Fort Center site in Florida. There are good reasons to doubt that the pollen evidence found at Fort Center actually came from maize grown during the third millennium B.P. (Keegan, 1987; Smith, 1986). Even if maize as old as 2500 B.P. is verified in the future in Florida or elsewhere along the Gulf Coast, it will be necessary to account for the absence of genetic traits suggesting relatedness between South American and aboriginal North American maize populations (McClintock *et al.*, 1981).

Once seen as *the* central crop for all significant eastern North American agricultural systems, maize has become somewhat less of a key factor as a result of research on the native crops during the 1980s. Recent maize research has focused on early time and space distributions and on the social processes involved in its adoption and intensification. Interpretations concerning the shift to maize agriculture are obviously affected by revisions in timing and localized geographic patterning, and these factors are not yet resolved.

Accelerator radiocarbon dating has invalidated cobs from the Jasper-Newman, Daines II, and McGraw sites, previously believed to be Early to Middle Woodland in age, but direct dating confirmed that maize was indeed present at two Hopewellian sites—Edwin Harness in Ohio and Icehouse Bottom in Tennessee (Chapman and Crites, 1987; Conard *et al.*, 1984; Ford, 1987). Even with limited quantities present at these and probably at other contemporaneous sites, accumulating carbon isotope values verify the minimal dietary role of pre-Mississippi period maize. However, the revised chronology, when meshed with the new flotation data, makes it necessary to question seriously at least one popular model that has dominated textbook discussions: the notion that availability of a new or improved eight-rowed maize type was responsible for the intensification that occurred at around 1000 B.P. in the regions of the Central Mississippi Valley and the southeastern United States, where Mississippian chiefdoms developed.

It has become more difficult to describe genuinely early eastern maize in terms of size, cob or kernel shape, endosperm type, or potential productivity. Traditional scenarios, based partly on cobs now known to be relatively recent, have depicted early maize as conforming to a Chapalote-like type labeled North American Pop by Cutler and Blake (1973a), with 12 to 16 rows of narrow kernels on small, cigar-shaped cobs. Dated early specimens, however, are too fragmentary for reconstruction of ear morphology, since they consist only of loose cupules, kernels, or more frequently, fragments thereof (Fritz, 1988c). Although the ubiquity indices of maize increase for sites dating after 1300 B.P., most specimens predating 900 B.P. are still too fragmentary to be classified into any previously proposed maize complex.

Ford (1981) followed Volney Jones (1968) in cautioning against scenarios that invoked the introduction from outside eastern North America of an evolved "race" such as proto-Northern Flint that could account for the transition to Mississippi period field agriculture. Nevertheless, many accounts of this transition accept the arrival of a high yield, low row numbered type as affording a source of increased productivity (Galinat and Gunnerson, 1963; Galinat and Campbell, 1967; Fowler, 1974; Lathrap, 1987). Other authors who infer that the eight-rowed type probably evolved in the East rather than having been imported from elsewhere have still given it a prominent role across the entire Eastern Woodlands in late prehistoric agricultural systems (Blake, 1986; Cutler and Blake, 1973a, b; Fiedel, 1987). This view, however, is untenable in light of the scarcity of good eight-rowed assemblages outside the central Ohio Valley and northeastern states at the early end of the Mississippi period.

The old scenario of this superior type of maize called Maiz de Ocho, Eastern Eight-row, or Northern Flint (after its modern landrace) playing a causal role in agricultural transformations of the Mississippi period is unsubstantiated. Emergent Mississippian and Early Mississippian maize from the American Bottom area is, as far as can be inferred from fragmentary evidence, not discernibly different from Late Woodland maize in the region. Parker (1986, p. 8) interprets the Emergent Mississippian maize at the Range site, with indications of 10 and 12 row cobs, as evidence for "more intensive cultivation of existing varieties rather than adoption of more productive strains."

The Moundville I phase (900–700 B.P.) maize assemblage from the Moundville site in west-central Alabama includes only five eight-rowed cobs out of 24 cob segments, although many loose cupules and kernel fragments were also recovered. The mean row number of 11.0 and high proportion of 12 and 14 row cobs are clearly not typical of the Eastern Eight-row complex, yet this is the time period that reflects dramatic intensification of maize agriculture and all the trappings of Mississippian culture that accompanied

it (Scarry, 1986; Steponaitis, 1983). Even for the subsequent Moundville II/III period (700–500 B.P.), eight-rowed cobs at Moundville constitute less than 30% of the assemblage (Scarry, 1986).

The central Mississippi Valley region has been viewed as somehow aberrant, in that prehistoric maize samples typically have higher mean row numbers and fewer classic Eastern Eight-row specimens (Yarnell, 1964; Cutler and Blake, 1973a). The type designation “Midwestern Twelve Row” was coined to describe these populations. Although usually not specified, the midwestern type has been viewed as conservative or transitional, retaining the high row numbers and other traits of a putative, primitive Chapalote/North American Pop ancestor. Now, however, it is advisable to view the central Mississippi Valley as probably typical of most of the Eastern Woodlands outside of the Fort Ancient and Owasco regions in following a path of successful maize agriculture based on primarily 10- and 12-rowed ears.

The initial gene pool *was* probably derived from the developed and diversifying Chapalote series in the Southwest, but Basketmaker II (1850–1450 B.P.) populations in the source area were no longer primitive or poorly adapted to temperate zones. Cobs had row numbers between 8 and 18 and were as long as 14.8 cm in length (Jones and Fonner, 1954). Maize had been grown north of Mexico for more than 1000 years by this time (Wills, 1988), and it was adapted to latitudes as far north as southern Colorado. Day-length sensitivity would not have been a problem for maize transported to the midlatitudinal Eastern Woodlands during the Middle Woodland period, and the available types would have been storable rather than genetically limited to use as “green corn.”

The late prehistoric Fort Ancient archaeological region of the central Ohio River valley is one area from which a great deal of Eastern Eight-row maize *has* been recovered. Wagner’s (1986, 1987) studies of Fort Ancient maize show that a strong Eastern Eight-row population was established in the region by 900 B.P. Mean row numbers of individual site assemblages are consistently under 10; 85–90% of the cobs from most samples have eight rows, distinct row pairing is exhibited, and the cobs have expanded bases and wide shanks. This pattern extends across the Northeastern states, and it now appears likely that the Eastern Eight-row/Northern Flint maize type evolved somewhere in the northern Midwest or Northeast area (Doebley *et al.*, 1986; Wagner, 1986, 1987). It eventually came to dominate the Atlantic seaboard as far south as the Carolinas (Gremillion, 1987) and the upper Midwest.

The Northern Flint aboriginal landrace became economically important for white farmers in historic times, and it is one of the two primary ancestors of modern Corn Belt Dent hybrids (Galinat, 1985). The economic and symbolic significance of Northern Flint maize for modern Americans may,

however, have been overenthusiastically projected into the past. It was clearly the dominant type in northern latitudes from the beginnings there of aboriginal food production but does not appear to have been connected with the emergence or success of Mississippian culture. In fact, most societies classifiable as chiefdoms on the basis of hierarchical settlement patterns and the existence of exceptionally lavish burials placed in special locations grew different types of maize. Statements such as Lathrap's (1987, p. 359) that the high-yield eight-row maize type "is the corn that revolutionized Cahokia" are not supported by the archaeobotanical data base. If introduction or breeding of a morphologically distinctive type played a role in Mississippian emergence, the direct evidence for it has not yet been published.

The current pattern of maize distribution in Eastern North America begins at approximately 1800 B.P. with meager quantities of small fragments present at a few widely scattered sites. As stated above, direct AMS dates confirm the Middle Woodland ages of maize fragments from the Icehouse Bottom site in eastern Tennessee and from the Edwin Harness mound in Ohio. Maize has also been found in apparently good Middle Woodland context at the Walling site, a Copena mound in northern Alabama (Scarry, 1990), the Trowbridge site near Kansas City (Johnson, 1976; Adair, 1990), and the Hopeton Square earthworks near Mound City Group, Ohio (Ford, 1981), as well as late Middle Woodland components in central Tennessee (Crites, 1978). Specimens associated with Middle Woodland features at the Holding site in the American Bottom and at several sites in west-central Illinois are possibly intrusive from more recent occupations at those sites (Parker, 1989; Asch and Asch, 1985). All suspected Middle Woodland maize should ideally be tested by direct AMS radiocarbon dating, since postdepositional disturbance has proved to be a serious problem (Conard *et al.*, 1984; Ford, 1987).

In western Illinois and elsewhere, the ubiquity indices (percentages of samples containing the item) of maize increase in flotation-recovered assemblages of components postdating 1300 B.P. The Late Woodland period component at the Sponemann site in the American Bottom area is highly unusual in yielding maize fragments totalling in the hundreds (cupules, kernels, glumes, embryos, and fragments thereof, but no whole cobs or cob segments with complete diameters) from 30% of the features studied (Parker 1988). Fewer specimens, all highly fragmented, have been found at 12 other Late Woodland sites in Illinois (Johannessen, 1984, 1997; Asch and Asch, 1985; Lopinot, 1982, 1983b; Kuttruff, 1974). Maize has been recovered from eight Late Woodland sites in Missouri, the earliest dating to 1230 B.P. (Voigt, 1986, p. 213 and Table 3), and from contemporaneous sites in Ohio (Wymer, 1988) and in the Central Plains (Adair, 1990). It was found in a late Weeden Island site in Florida (Milanich, 1974) and was recently recovered from a Late Woodland feature at the Dirst Site in northern



Arkansas (Fritz, 1990b). Researchers across much of eastern North America should not be surprised by the occurrence of maize in samples immediately preceding 1000 B.P. in quantities just above the level of archaeological visibility.

A dramatic rise in abundance occurs for Emergent Mississippian (1150–950 B.P.) sites in the American Bottom area (Johannessen, 1984, 1988), an increase reflected at other central Mississippi Valley sites (Voigt, 1986). There, the greater importance of maize in the diet at that time was evidently *not* correlated with a declining role for the native seed crops (Johannessen, 1988; Lopinot, 1988). Maize became relatively common at sites of the roughly contemporaneous West Jefferson phase in west-central Alabama and the Late Miller III phase in Mississippi, but little evidence is present there for a multicropping type of system including native seeds (Caddell, 1983; Scarry, 1986).

Not all parts of the Eastern Woodlands experienced a similar pattern of agricultural intensification at or just before 1000 B.P., at least, not one that included maize as one of the important crops. Maize was rare—clearly a very minor element—among foods deposited at the Toltec Mounds site, a Plum Bayou Culture (1250–1050 B.P.) ceremonial center in the Arkansas River Valley near present-day Little Rock (Fritz, 1988a), and similarly scarce in flotation samples undergoing analysis from the Coles Creek Culture (circa 1250–850 B.P.) Osceola site in northeastern Louisiana. It now appears unlikely that Lower Mississippi Valley populations were eating much maize before 700 or 800 B.P. (Kidder, 1990). Starchy seeds of the eastern crop complex are abundant at Toltec but appear to be far less common to the south at Osceola. This type of variation will not be observable elsewhere or understandable regionwide until standard fine-mesh flotation is practiced across the Eastern Woodlands.

Obviously, we have much left to learn about the multiple pathways to maize agriculture in eastern North America. There is unexplored variability even after 700 B.P., when the subsistence system that supported Cahokia and other American Bottom communities had already declined drastically (Lopinot, 1988; Johannessen, 1984, 1988). Despite Cahokia's demise, or perhaps partly because of it, chiefdoms based on field agriculture flourished elsewhere along the Mississippi River and its tributaries and along rivers draining the Piedmont and Gulf Coastal Plain. The agricultural dynamics operating in specific Mississippian societies have been explored in several areas, including southern Illinois (Muller, 1987), southeast Missouri (Smith, 1978), west-central Alabama (Caddell, 1983; Scarry, 1986; Steponaitis, 1983), and northern Georgia (Hally, 1981; Gardner, 1984). Wagner (1986, 1987) and Rossen and Edging (1987) have detailed the significant differences between Fort Ancient and Mississippian agriculture, and progress has been

made in understanding Caddoan agricultural patterns in northeast Texas, eastern Oklahoma, and western Arkansas (Perttula *et al.*, 1982, Early, 1988; Fritz, 1989, 1990a).

## CURRENT PERSPECTIVES

The newly substantiated significance of premaize agriculture in the midlatitudinal Midwest and Midsouth, along with recently recognized regional variability in both premaize and maize-based subsistence systems, has made it necessary to revise explanations of the evolution of eastern North American food production. General models should now be sufficiently broad-based to encompass indigenous domestication in areas where that occurred as well as primary crop acquisition in the regions where maize agriculture directly supplanted a food collecting subsistence system. Although recent contributions have been successful in elucidating processes operating in some areas, it is probably safe to say that no adequate overall theoretical treatise exists.

### Indigenous Agricultural Evolution

Currently popular perspectives on the evolution of food production in the Midwest/Midsouth region have roots in the hypothesis of Fowler (1971), presented as a paper in 1957, in which the origins of indigenous plant domestication were projected back into the Late Archaic period. Sumpweed, sunflower, and amaranth were listed as some of the native seed crops that provided “a local prelude to the introduction of the exotic cultigens from the south” (Fowler, 1971, p. 393). Edgar Anderson’s “dump heap” mechanism was proposed as the underlying process for plant cultivation. Late Archaic groups were in close association with seed plants when they occupied established base camps beside rivers, and “their extensive middens provided ideal open habitats for these nitrogen feeding plants” (Fowler, 1971, p. 393).

A similar theme was echoed in Struever’s mudflat hypothesis. In this model the seasonally exposed flats of the major valleys were seen as the locale for “the early manipulation of commensal plants” that “played an important role prehistorically in the development of higher levels of economic productivity” (Struever, 1964, pp. 102–103). Struever broke with earlier researchers such as Caldwell (1958) by suggesting that intensification of food production was an important factor in the development of Middle Woodland societies, and he believed that Hopewellian centers were restricted to broad river valleys because of the increased productivity made possible by mudflat agriculture. Struever was at this time becoming aware and making others

aware of the large numbers of small, carbonized seeds recoverable by flotation from the Illinois Hopewell sites he was studying, but general appreciation of their potential significance was not achieved until the middle 1980s.

Population pressure gained prominence during the 1970s as the primary impetus for the shift to agriculture (Asch *et al.*, 1972; Ford, 1974; Christenson, 1980; Cowan, 1985). Demographic stress models could of course be applied to premaize as well as maize agriculture, but the years of maximum popularity for this approach corresponded to the period discussed above when Woodland period groups were viewed primarily as hunter-gatherers and the native seed crops seen as unimportant (but exceptions include Yarnell, 1974; Cleland, 1976; Asch *et al.*, 1979).

Stress models have largely fallen from favor in recent years. Newer interpretations favor the Darwinian approach detailed by Rindos (1984) that sees a mutualistic, obligate dispersal relationship between crops and people resulting from responses to selection pressures that increase the fitness of both. In these recent schemes, the creation of anthropogenic environments is again a critical factor. Smith (1987) and O'Brien (1987) have published the most thorough recent treatments of eastern North American native plant domestication as a process, but similar perspectives are reflected in works by Crites (1987), Johannessen (1988), Gremillion (1989), and Fritz (1986).

Smith (1987) begins with the Middle Archaic (8000–5000 B.P.), reconstructing the stabilization of stream channels and floodplain ecosystems and the development there of enriched, fixed-place resource concentrations in the form of shoal area aquatic habitats. Dry-season base camps at the most favorable locations came to be occupied repeatedly and probably for longer periods than before, as reflected archaeologically by Middle and Late Archaic shell mounds and midden concentrations. Continually disturbed anthropogenic habitats were created, where available sunlight and soil fertility increased, the soil was exposed, and harvested seeds were dispersed. Initial domestication is seen as having occurred in these localities, where heightened competition among seedlings gave the advantage to those that germinated rapidly and grew quickly. The intentional sowing of seeds, seen by many (Flannery, 1986; Heiser, 1988; King, 1987) as a crucial step, would have further intensified competition of this sort. Plants lost seed dormancy and natural shattering mechanisms, produced mature fruits simultaneously rather than sequentially, formed compact, more easily harvestable inflorescences, and, in some cases, produced larger seeds or more seeds per plant.

The basic coevolutionary model provides a reasonably good fit between Midwestern archaeological and archaeobotanical data as they are currently perceived. Relationships between gourds and people began early in the sequence, and chenopod, sumpweed, and sunflower exhibit the predicted responses by 3000 B.P. The timing and the intensity of selection pressures

favoring domestication are seen as varying according to drainage system. Adding the factor of interactions between groups, the result is described as a “complex mosaic of occasionally linked, generally parallel, but distinct coevolutionary histories of different areas of the mid-latitude Eastern Woodlands” (Smith, 1987, p. 37).

Anthropological archaeologists have objected to Rindos’ general model on the grounds that it omits the most interesting and/or most important factors, those involving decisions made by fully aware human actors with strong ideas about food and food procuring behavior (e.g., Watson and Kennedy, 1991). Applications to eastern North America tend to suffer also in this respect, although Johannessen (1988) incorporates social considerations into her discussions of dietary change in the American Bottom area. Transmissions of native crops from group to group, or geographic movements of groups who practiced some degree of agriculture to regions where crops were not previously grown, are dealt with only superficially in the literature. Tracing the trajectory of agricultural developments is more difficult because no single region affords a continuous sequence of domestication, interaction, and intensification that spans the Archaic to late prehistoric eras. Many questions about the histories of individual crop types and their associations with other crops cannot yet be addressed beyond statements of earliest occurrences and ultimate distributions.

### **Uplands and Lowlands**

Smith’s scheme explicitly places initial agricultural developments in the major midcontinental stream valleys. It is true that the earliest pepo gourd and sumpweed finds are from the lower Illinois River Valley, but Watson (1985) has pointed out that the combined starchy and oily seed crop complex might have developed in hilly lands above the major river valleys. Late Archaic and Early Woodland seed deposits are best represented from rockshelter sites in the uplands of central and eastern Kentucky and northwest Arkansas, and they are notably absent from westcentral Illinois and the American Bottom area. I suspect that exceptional rockshelter preservation partially accounts for currently observed distributions, and think it likely that some lowland groups, perhaps those in central and eastern Tennessee, were as actively involved in food production as those who stored seeds in the upland rockshelter pits. Currently, we are simply unable to isolate any given geographical area as the locus of *the* earliest agriculture.

There are good reasons to question that lowland floodplain terraces were exclusively the hearths of domestication. Munson (1986) describes how intensive management of hickory nut trees in stream valleys through girdling

and thinning of groves could trigger coevolutionary processes between people and seed plants with similar results to those projected by Smith. Oak-hickory forests covered upland terraces such as those along rivers in the Ozarks, and the creation of anthropogenic environments along some of these probably began relatively early. A vast floodplain with hot spots of rich aquatic resources is not the only place where symbiotic relationships between plants and people could evolve, and there is no convincing evidence that societies in lowland rather than upland areas were responsible for most of the domestication that occurred in the East. As Watson (1985, p. 146) states, the process of native plant domestication possibly "occurred in both places at various times in various ways."

### The Adoption of Maize

The adoption of maize is not explained particularly well by the coevolutionary model for domestication, although population levels would be expected to increase in areas where premaize agriculture flourished due to the rise in carrying capacity afforded by the indigenous crops. According to Rindos (1984), selection pressures in agricultural systems favor means of increasing productivity. More and more energy would be invested in the production of maize if its food yield surpassed that of the older crop types.

This would be irrelevant in previously nonagricultural regions such as the Northeast, Great Lakes, much of the South, and the Atlantic Piedmont and coastal plain. Population levels might have been increasing because of other social and ecological dynamics, of course, but this should be argued on specific empirical grounds, as it has been in Alabama (Welch, 1990), rather than based on a *priori* assumptions.

The literature currently includes "a broad range of alternative explanations" for the shift to maize-based field agriculture:

... Maize has been variously cast as an adaptive response to growing problems of imbalance between demographics and resources, an opportunistic effort to buffer social and economic uncertainty in the absence of external stress, and as a lever of social inequality for an emerging elite. (Smith, 1989, p. 246)

Simple models that cover the entire Eastern Woodlands have become obsolete, especially those invoking the introduction or regionwide development of a particularly productive strain of maize.

A good discussion of the relationship between maize agriculture and complex social organization has recently been offered by Scarry (1988). The common factor of intensified crop production is stressed, whether or not the system initially included native seed crops. A second common element is that across eastern North America, late prehistoric agriculture eventually came to

be dominated by maize. Scarry questions the causality of subsistence stress induced by population growth and/or climatic deterioration across the whole Midsouth and Southeast because of the many diverse social, economic, and demographic patterns. Furthermore, she doubts the need for a hierarchical political organization of office holders led by a hereditary chief to monitor intrasocietal imbalances in available food resources and alleviate them through redistribution. Taking a symbolic rather than a materialistic perspective, she suggests that the status of maize during the Middle Woodland period was primarily sacred. Emerging Mississippian elites, then, might have promoted maize production in order to associate themselves more closely with supernatural powers or successful high-status individuals in neighboring societies.

This kind of scenario would help account for the eventual replacement of most native seed crops by maize in spite of the high potential productivity of chenopod, sumpweed, and other members of the premaize complex. It may not, however, explain the shift from Hopewellian and Late Woodland native seed crop production to Fort Ancient maize field agriculture in the Ohio River Valley, because positions of high status seem, if anything, less important in the later societies than in the earlier. It would likewise not easily account for the adoption and often rapid intensification of maize in Michigan, southern Ontario, New York, or eastern seaboard states such as the Carolinas, where most of the late prehistoric agricultural groups had relatively egalitarian sociopolitical organizations.

## REGIONAL DIFFERENCES, MULTIPLE PATHWAYS

### Midwest and Midsouth

The midlatitude, midcontinental region has supplied convincing evidence for native crop domestication and intensification followed by the inclusion of maize in a multicropping farming system and, later, the shift to maize-dominated field agriculture. Because I discussed this research above, in this summary I dwell on its significance. As Watson (1989) and Smith (1989) have effectively stated, eastern North America can no longer be classified as a region where primary agricultural developments failed to take place. Instead, it is arguably a center of origins in Harlan's (1971) sense. The species domesticated here, with the exception of the sunflower, have little or no economic value today and they may never have surpassed wild resources in terms of total caloric intake if averaged over a period of 24 months or so. Still, the storable seed crop factor in the study of Woodland period archaeology is now seen as important by researchers concerned with paleodemography, ceramic

technology, degree of settledness, and development of exchange networks, ritual behaviour, social differentiation, and leadership positions connected with both the Hopewellian phenomenon and Mississippian emergence. As a process, this region contributes a valuable case study of agricultural evolution in a temperate environment.

The central Ohio River valley area of central and southern Ohio, north-east Kentucky, and northwest West Virginia is especially interesting because of evidence for a drastic subsistence change after 1000 B.P. The Middle Woodland and Late Woodland assemblages in Ohio conform to the basic midwestern premaize husbandry pattern, with relatively high densities of maygrass, chenopod, and knotweed and very few instances of maize (Wymer, 1987; Ford, 1979). Fort Ancient assemblages, from the onset at 1000 or 950 B.P., contain far fewer native starchy seed crops and high counts of maize and beans. Chenopod and maygrass are occasionally present, but sumac, purslane, bedstraw, nightshade, and other fruits or weedy plants are more likely to accompany maize and beans in Fort Ancient seed deposits. Eastern Eight-row maize is the dominant type, and stable carbon isotope ratios indicate that more maize may have been consumed by people in the Fort Ancient area than by mound-building Mississippian societies to the west. Villages are larger than before; in fact the degree of nucleation surpasses that of most Mississippian societies (Wagner, 1987; Rossen and Edging, 1987; Dunavan and Cowan, 1989).

Processes involved in this seemingly radical subsistence shift are not clear. There is a problematic gap of approximately 250 years in the archaeological record just before the start of the Fort Ancient tradition. Archaeologists disagree about whether or not actual movements of human populations into the central Ohio Valley were responsible for the new pattern, but most currently seem to accept developments out of previous Late Woodland traditions (Wagner, 1987). Still, the uniformity among Fort Ancient maize assemblages "points to a single general introduction of seed to the area rather than a series of isolated introductions from various genetic sources" (Wagner 1987, p. 2). Frequencies and densities of plant remains, along with stable carbon isotope ratios, indicate that maize was important from the beginning of the Mississippian period.

### **Lower Southeast**

For convenience, the "lower Southeast" here includes territory east of the Yazoo Basin in Mississippi and south of 35°N north latitude, at the southern boundary of Tennessee. The earliest evidence for domestication is from the northern part of this region. Chenopod dating to the Early or

Middle Woodland period was recovered from Russell Cave in northeast Alabama (Smith, 1985a). Maygrass seeds and maize fragments came from the Copena (Middle Woodland period) Walling Mound in northern Alabama (Scarry, 1990), and sunflower seeds were found in late Middle Woodland context at sites in northwest Alabama (Caddell, 1982a). Increased frequencies of disturbance-related taxa are present in Middle Woodland assemblages from the Cedar Creek and Bear Creek Reservoir areas and from Gainesville Lake on the central Tombigbee River in western Alabama (Caddell, 1982a, b). The presence of maize in flotation samples increases gradually throughout the Late Woodland period, along with seeds from ruderal plants such as maygrass, chenopod, amaranth, and wild beans that could have been encouraged or cultivated crops but tend, in this region, to be viewed as weeds.

The Mississippi period, which here begins at 950 B.P., is characterized by dramatic increases in maize agriculture. In the Black Warrior River Valley, intensification is seen as having occurred during the late West Jefferson phase (1050–900 B.P.), immediately prior to emergence of the Moundville chiefdom (Scarry, 1988; Welch, 1990). At the nearby Lubbub Creek site, intensification is viewed as closely following the formation of ranked Mississippian society (Welch, 1990). It will take major efforts combining flotation with fine-scale chronological control to determine whether one pattern is more general regionwide or whether individual drainages vary according to social and agricultural trajectories. Welch (1990) suggests that the critical factors are differing population density and resource availability, and these can be measured or, at least, roughly modeled.

The virtual absence of evidence for premaize agriculture south of 34°N (south of northern Alabama) is also difficult to explain. Repeated occupation of river terrace localities, whether for aquatic resources or for nut harvesting or both, would presumably have triggered the same selection pressures as farther north. Plants such as maygrass, little barley, and sumpweed would have been present to benefit from the situation. Perhaps, as Scarry (1988) speculates, the rich acorn masts of southern forests filled carbohydrate requirements to the point that seed resources were virtually ignored. The climate, with longer growing seasons and milder winters, was possibly also a factor, since the period during which wild plant foods were unavailable was short, reducing the need for storage to the point that acorns and other nuts could last until the following summer.

We cannot yet dismiss the possibility that depositional factors are responsible for the different patterns—that premaize agriculture was indeed practiced in the south but seeds rarely preserved due to different prehistoric processing and storage techniques. Archaeologists in Alabama have recovered relatively low counts of maygrass, chenopod, and knotweed in Woodland period components (Yarnell and Black, 1985), but it appears most likely at



this time that they do not reflect the intensity of food production practiced farther north.

In western Alabama, a strong case has been made for serious population stress in advance of the adoption of maize agriculture. Faunal remains during the Late Woodland period indicate a widening of diet breadth to include less desirable species and a downward shift in the size of fish and mammals that were procured. Bioarchaeological studies support an interpretation of stress, with skeletal remains indicating declining health status during the Late Woodland. This trend was reversed after Mississippian agriculture became established (Welch, 1990).

### Lower Mississippi Valley

The Mississippi River valley south of Memphis has been considered a likely region for early agricultural developments due to the seemingly favorable environment and apparently early evolution there of social complexity. Long-distance trade and the tradition of constructing mounds and other earthworks extend as far back as the Late Archaic in eastern Louisiana and western Mississippi. The enigmatic Poverty Point culture of the fourth millennium B.P. was once suspected of having an agricultural base (Ford and Webb, 1956), but recent views have shifted toward a substantially later time frame for the importance of domesticated plants. Although direct archaeological evidence has always been extremely rare, maize agriculture was assumed to be established by the beginning of Coles Creek times, circa 1250 B.P. (Williams and Brain, 1983). Coles Creek sites are situated on the best levee soils, and the plaza-oriented platform mound centers seem, at least superficially, to reflect a Mississippian type of social organization and subsistence system, i.e., chiefdoms with maize-based economies.

Research efforts targeting the study of subsistence change in the Lower Valley have intensified in recent years, and results challenge the notion that agriculture was important before the end of the Coles Creek period (ca. 850 B.P.). Excavations at the Copes site, a Poverty Point outlier, revealed the presence of pepo seeds and rind and a few seeds of other nonwoody taxa in deposits otherwise dominated by pecans, acorns, wild fruits, fish, and game (Jackson, 1986, 1989). Judging by paleopathological indicators, bioarchaeologists suggest that little maize was consumed in the Lower Mississippi Valley before 850–750 B.P. (Rose *et al.*, 1984). High rates of dental caries occur in individuals from Coles Creek components, but these might have resulted from consumption of native seed crops rather than maize (Rose and Marks, 1985; Fritz and Ramenofsky, 1989). No stable carbon isotope values have been published for eastern Louisiana or western

Mississippi, but an anxiously awaited series is in progress (Bruce Smith, personal communication, 1990). Flotation assemblages are also needed from a range of site sizes, functional types, and phases within the temporal span of Coles Creek.

Plants recovered from the Osceola site, a major mound group in Tensas Parish, Louisiana, are in the early stages of analysis. I have found very low counts of maize fragments in late Coles Creek deposits, but maize is absent so far from the early Coles Creek midden areas and features. Maygrass and wild-sized sumpweed seeds occur in early Coles Creek samples. Acorn shell fragments are abundant, and wild fruits such as persimmon, palmetto, and grape are well represented. The initial impression (subject to revision with further analysis) is that neither native seed crops nor maize was anywhere near as important at the time as they were in the Midwest.

Even for the later prehistoric societies in parts of the Lower Mississippi Valley, we lack evidence for agriculture on the scale observed historically. The Plaquemine component of the Josh Paulk site in Catahoula Parish, Louisiana, yielded only two maize cupules, both from a midden contaminated by modern pig bones. Acorn shell and persimmon seeds were relatively abundant, leading to the interpretation that agriculture, if practiced at all, was secondary to the procurement of wild plant and animal resources (Fritz and Ramenofsky, 1989). Plaquemine sites in locations more favorable for agriculture might yield more maize, but convincing archaeobotanical evidence for serious agriculture in eastern Louisiana has yet to be presented. However, Kidder's (1990) recent discussion of the evidence for agriculture in the Lower Mississippi Valley shows that there is a contrast between Coles Creek components, which lack substantial evidence of maize, and early Mississippi period components in the Yazoo Basin of northwest Mississippi, which have yielded significant quantities of maize.

The Plum Bayou culture in the Arkansas River Valley near Little Rock was contemporaneous with early Coles Creek societies (1250–1050 B.P.) and closely related in terms of material culture and site structures (Rolingson, 1982). At the Toltec Mounds site, 18 mounds are enclosed within a semi-circular embankment beside an oxbow lake. Flotation samples from midden and feature deposits in three of these mounds show heavy use of starchy seed crops, especially the early season little barley and maygrass. Pepo rind is also common, as is acorn shell, persimmon, grape, and a wide variety of other seed taxa. The only evidence of maize is four cupules, far fewer than typical of Emergent Mississippian sites in the central Mississippi River valley. Maize is more abundant at the nearby Ink Bayou site, but most (79 of the 97 fragments there) came from one pit (King, 1988), and this pit has questions surrounding its temporal placement. Maize was not recovered from contexts

that could be confidently assigned to Plum Bayou culture occupation at the Alexander site, to the northwest of Toltec Mounds (King, 1985b).

At this point, then, there are no grounds for correlating intensification of maize agriculture with the social changes that took place at the beginning of Coles Creek and Plum Bayou cultural development. Furthermore, there may be a latitudinal gradient or boundary for native seed crop production, with early Coles Creek societies to the south participating less in premaize agriculture than contemporaneous Plum Bayou societies to the north. If this pattern holds up, it will be interesting to focus on agricultural changes *during* the time span of Coles Creek culture. Even if maize became increasingly common after 1000 B.P., the dietary importance appears to have remained low until about 750 B.P. (Kidder, 1990), when Coles Creek evolved into Plaquemine on the southern end of its range and merged with Middle Mississippian on its northern end. Precontact Lower Valley societies closer to classic Mississippian centers reflect greater influence from them and currently exhibit more evidence of maize based agriculture.

### Trans-Mississippi South

French and Spanish explorers encountered Caddoan-speaking groups in northeast Texas, southwest Arkansas, and northwest Louisiana who practiced extensive river valley farming based on maize, beans, squashes, and sunflowers (Swanton, 1942). Archaeologists have assumed that adoption or intensification of maize and other crops was correlated with the early manifestation of prehistoric Caddoan cultural complexity—mound building, high-status burial, settlement hierarchy, etc.—appearing at approximately the same time, 1100 B.P., as in the Mississippian cultural area. Although some kind of general correlation still appears likely, we do not know whether or not Woodland period groups in the Red River and Ouachita River Caddoan regions grew native seed crops prior to maize. To date, archaeobotanical studies do not reflect premaize agricultural activities comparable to those in the Midwest (Story, 1990). However, archaeobotanical data from northeast Texas indicate a subsistence change *during* Caddoan prehistory, with a significant increase in maize after 700 B.P. and corresponding decline in proportions of nuts, fruits, and seeds of wild or husbanded native plants (Pertulla *et al.*, 1982).

A series of 32 stable carbon isotope ratios from Caddoan individuals and their Late Woodland period (Fouche Maline phase) predecessors shows considerable and consistent consumption of maize only after 650 B.P. Delta C-14 values from bones of people who lived during the earliest Mississippian period, Caddo I (1050–850 B.P.), show either no maize consumption or a very

slight level of enrichment, “not outside the range obtained from terminal Late Woodland samples from the Lower Illinois Valley where initial maize consumption has been established” (Rose and Hoffman, 1989). More samples should be analyzed, but it appears that early Caddoans may not have been eating a great deal of maize.

To the north, in the Arkansas River basin area known as the Northern Caddoan archaeological region, evidence for native starchy seed husbandry has been found. Deposits dating to 750 B.P. at the base of Copple Mound at the Spiro site in eastern Oklahoma yielded high counts of maygrass, little barley, chenopod, and knotweed. Maize was present in all Copple Mound flotation samples, but in small enough quantities to cast doubt on its dominance.

The mixed cropping system at Spiro appears to be a continuation and intensification of Woodland period premaize agriculture, with maize added (Fritz, 1989, 1990a). The dietary significance of maize at the time, however, is unknown. Mound contexts, especially those at a major ceremonial center such as Spiro, might not be representative of domestic behavior. Maygrass, chenopod, and knotweed have turned up in flotation samples taken during testing of Late Woodland components at nonceremonial habitation sites east of Spiro, and continuing efforts are being made to understand the dynamics of subsistence change—especially agricultural intensification—during the formation of ranked Arkansas Valley Caddoan societies (Albert, 1990).

The earliest evidence for prehistoric agriculture in the Trans-Mississippi South comes from the southern Ozark Highlands, where dry rockshelters were used for storage of wild and domesticated food plants. Although most of the good archaeobotanical collections were excavated during the 1920s and 1930s from undated rockshelter contexts, a recent series of 37 radiocarbon dates on plant remains curated by the University of Arkansas Museum documents agricultural developments beginning at least as early as 3000 B.P. with the storage of domesticated sumpweed, chenopod, and associated plants at Marble Bluff (Fritz, 1986). The standard Midwestern group of native crops, excepting little barley, was well represented in Ozark rockshelter caches dating to the Middle Woodland period. Utilization of these species continued into the early Mississippi period, but all except sunflower appear to have been dropped from the system after about 700 B.P., when maize became clearly dominant. Beans are common only in the latest deposits, where maize abounds.

The sequence of radiocarbon dates on plant remains from southern Ozark rockshelters synchronizes premaize agricultural developments in this region with those in the Midwest and Midsouth, at least after 3000 B.P. Ozark gardeners were growing essentially the same types of starchy and oily seeds and gourds at about the same time as gardeners in Ohio, Kentucky,

Tennessee, and Illinois. The first seeds planted in Ozark valleys may have been acquired from groups already practicing early food production or carried in by members of these groups as they spread out from lowland areas, but some participation in primary domesticatory behavior should not be ruled out.

The “myth of southern Ozark marginality” has been discredited in recent years (Brown, 1984; Trubowitz, 1983; Sabo *et al.*, 1982). People living in the river valleys in northwest Arkansas and southwest Missouri are now viewed as closely related economically, socially, and ritually to their neighbors in the main valley and large tributaries of the Arkansas River. It is likely, therefore, that the Ozark agricultural trajectory reflects subsistence changes occurring also during the Late Archaic and Woodland period in the Arkansas River Valley of eastern Oklahoma and western Arkansas, with native starchy and oily seed crops becoming significant food resources prior to maize acquisition and intensification. The flotation work needed to support or reject this supposition, however, has not been conducted.

### Northeast

The northeastern United States lacks a good, subsistence oriented regional synthesis. Recent summaries by McBride and Dewar (1987) and Bendremer and Dewar (1990) cover the lower Connecticut River Valley and New England in general. For those subregions, securely dated evidence for maize begins at ca. 1000 B.P. As in the Fort Ancient area, beans evidently accompanied early maize, and Eastern eight-row maize is dominant. Native seed crop agriculture has not been documented in the Northeast, but the harvesting of chenopod goes back as far as 3500 B.P. in the Connecticut River Valley:

Whether these native plants were ever cultivated in our area is an open question, but there is strong evidence that by the end of the preceding Tinkham phase (cf. Narrow-stemmed tradition, ca. 4200-3300 B.P.) the long-term storage of *Chenopodium* was part of the aboriginal economy. (McBride and Dewar, 1987, p. 308).

Substantiation of premaize agricultural systems in any part of the Northeast would be significant.

All archaeological indicators presently point to farming as an important part of the economy for the Owasco culture in New York and contemporary societies in southern Ontario after 1000 B.P. (Jennings, 1989; Vogel and Van Der Merwe, 1977). The social and agricultural systems crystallizing at this time are seen as the predecessors to those of historic Iroquoian-speaking groups, and agricultural practices can evidently be extended back to 500 years before contact.

Agriculture did not become a significant factor in Connecticut until later, however, with intensification occurring as late as 450 B.P.—near the beginning of the contact period—in the lower Connecticut River Valley. Aggregated and sedentary societies had developed earlier, but not as a result of the arrival of domesticated plants (McBride and Dewar, 1987). In north-central Connecticut, however, the Burnham-Shepard site has yielded abundant, direct archaeobotanical evidence for maize in grass-lined storage features dating to 600 B.P. (Bendremer and Dewar, 1990). Clearly, it is risky to extend regionwide scenarios for agricultural evolution to a subregion or portion thereof, whether the models be traditional or recently formulated and based on direct archaeobotanical evidence.

## CONCLUSION

The hunter-gatherers in eastern North America who utilized gourds 7000 years ago operated at the early end of a complex sequence that ended, at contact, with agricultural societies settled into most parts of the area. Maize, beans, and squashes had become the major food crops for all of these groups, with bottle gourds grown for use as containers, and tobacco for ritual purposes. The intervening millennia, however, witnessed different trajectories in the various subregions.

The first widely cultivated food plants that left traces in the archaeological record were native species bearing nutritious oily or starchy seeds. At least three of these plants were domesticated by 3000 B.P. and grown along with even more widely distributed cucurbits. The domesticated and cultivated seed taxa were deposited in sites across the midlatitudinal Midwest, Midsouth, and Ozark areas with a frequency and intensity now interpreted as reflecting dietary importance, especially between 2000 and 800 B.P. Maize was introduced no later than 1700 B.P., but not much was consumed by many members of eastern populations until after 1100 B.P. Maize frequencies in flotation samples are slightly elevated at some sites in Illinois at this time—and significantly elevated at one site, Sponemann—but not until after 1000 B.P. do we find a dramatic increase in maize consumption and deposition.

In the American Bottom area and elsewhere, the agricultural intensification that occurred early in the Mississippi period included native seed crops along with maize, but the newer crop altered the agroecological balance. The type of maize grown in the central Mississippi River valley and its tributaries had primarily 10 and 12 rows and appears directly descended from maize grown there earlier. Beans cannot be recognized as a factor in this subregional subsistence shift. The intensification of mixed maize agriculture accompanied,

in some fashion not fully understood, the political shift to societies led by chiefs born into their high-status positions.

To the east, however, in the central Ohio River Valley, the earliest maize-centered agriculture is associated with Fort Ancient societies that grew fewer native seed crops than their Woodland period predecessors or their ranked Middle Mississippian neighbors but included more beans than Mississippian groups. Fort Ancient maize is dominated by the Eastern Eight-row type.

Southeastern groups south of northern Alabama evidently did not grow native seed crops during the Woodland period, at least not to the extent that premaize agriculture is represented farther north. Maize agriculture, initially without beans, became important just before or along with the appearance of early Mississippian chiefdoms. Samples of early Mississippi period maize exhibit a high diversity and a lower percentage of eight-row cobs than later Mississippi period assemblages, making it unlikely that the Eastern Eight-row type is responsible for this subsistence change.

Although cucurbits were present in the lower Mississippi Valley before 3000 B.P., the native starchy and oily seed crop complex has not been documented below the northern end, in the area of the Coles Creek-related Plum Bayou Culture. Plum Bayou sites, especially Toltec Mounds, indicate that major mound-building activities beginning in the terminal Late Woodland period and signaling some new type of social complexity were not accompanied by maize-dominated agriculture but that native starchy seed husbandry had considerable economic importance. The core Coles Creek area to the south, however, may have gone through parallel social and ritual changes without maize *or* native seed crops, although maize had a slight presence by the end at about 900 B.P. Agricultural intensification apparently occurred in northwest Mississippi at about this time, but we do not yet have direct evidence for late prehistoric maize intensification in eastern Louisiana.

The Northern Caddoan archaeological area seems to follow the mid-western pattern, if Ozark assemblages are considered representative of subsistence change in the Arkansas River Valley of eastern Oklahoma. Maize intensification, however, may have occurred slightly later than in western Illinois, with early Mississippi period agricultural systems retaining a higher percentage of native crops. Chemical analyses of human bone may help resolve this issue. Beans are not common until late in the sequence. Domesticated amaranth and cushaw squash reflect agricultural influences from the Southwest not yet recognized farther east. The Southern Caddoan area has not yielded evidence for premaize agriculture, but more flotation is needed at Woodland period sites. Studies hint at a post-700 B.P. time frame for full development of the maize-based systems observed after contact.

Maize and beans entered the Northeast about 1000 years ago, and some but not all foraging societies there became agriculturalists in a relatively short time period. This is the only subregion other than the central Ohio River Valley where Eastern Eight-row was the primary type early in the maize agricultural sequence. As in the Fort Ancient area, these village farmers did not develop hierarchically ranked sociopolitical systems to redistribute surplus or otherwise balance out uneven crop yields.

With so many revisions, so much variability, and so many gaps in the available data, work for the 1990s is cut out for us. The field has come a long way since the era of speculation, but fuller understanding of site-by-site assemblages has made it more difficult to explain processes and describe general patterns on a regional scale. Full-coverage explanations may be lacking, but eastern North American archaeologists who appreciate and understand the complex archaeobotanical record are actively producing reports that at the same time contribute primary information from fieldwork and realign regional-scale interpretations and models. Archaeological plant remains are treated as critical factors in discussions of demography, mobility, degree of aggregation, technology, resource availability, political complexity, and social-group interaction and exchange. The eastern North American "laboratory" for research into the evolution of agricultural systems is extremely active, and prospects are bright for another decade of work that will make this overview obsolete before the year 2000.

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