Ancient farming in eastern North America

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Answers to one of the great archaeological questions are changing. The origins of agriculture have been a centerpiece of research for many years. Specific where, when, and why questions are being resolved. Recent years have seen an extraordinary burst of new information about this fascinating subject (1–3). Today, there are at least 10 recognized regions in the world where different species of plants and animals were first domesticated (Fig. 1). Various theories have arisen over the last century and a half to explain how and why this happened, but no consensus has emerged. A variety of causal factors have been explored as potential drivers for domestication: climate change, carbon dioxide increases, population growth, developments in human cognition, ideology, and increasing social complexity and differentiation (4–8).

New information from the eastern United States in the article by Smith and Yarnell in this issue of PNAS (9) provides much food for thought.

Advances in our knowledge about the first farmers are caused in large part by new technology and development. Accelerator mass spectrometry (AMS) radiocarbon dating permits the measurement of very small samples and now has been used to directly date many early crops. The antiquity of domestication has been pushed deeper into the past in many areas. Today, an eerie synchronicity in the timing of the first domesticates around the end of the Pleistocene is emerging. Genetic studies of modern and ancient DNA in domesticated plants and animals are providing remarkable information on species distribution and evolution (10, 11). Genetic markers for domestication are starting to be identified (12). In addition, the number of archaeological excavations around the world has increased by an order of magnitude in recent years because of development and construction as legislated assessment and salvage of threatened historical and archaeological materials has been enforced. Lots of new data are available in some areas.

In the last 20 years, these advances and some excellent archaeological detective work have added the eastern United States to the list of agricultural cradles (13, 14). A series of original domesticates has been identified and radiocarbon-dated. Squash (Cucurbita pepo) is the first recognized domesticated plant from 5025 years B.P. (only calibrated dates are used here). Subsequent modified species include sunflower (Helianthus annuus var. macrocarpus) at 4840 B.P. (Fig. 2) and marsh elder (Iva annua) at 4300 B.P. Three other seed plants have been identified as potential crops, the subject of deliberate planting and harvesting of stored seed stock, based on their abundance in seed assemblages before 2000 B.P.: erect knotweed (Polygonum erectum), little barley (Hordeum pusillum), and maygrass (Phalaris caroliniana). Maize (Zea mays), the most important crop plant in this region in later years, does not arrive until 2150 B.P.

Smith and Yarnell (9) identify the emergence of a “crop complex” in eastern North America, as more domesticates are added to the diet and can be identified as part of an important set of foods. The essential evidence comes from the Riverton site in southeastern Illinois, dating to 3800 B.P. Unusual conditions of preservation, large-scale archaeological excavation, and a deliberate search for plant remains provided documentation of the utilization of a rich diet and the cultivation of at least 5 (and perhaps as many as 7) different crop plants. In addition to the species listed above, 2 varieties of chenopod (Chenopodium berlandieri) were abundant in the archaeobotanical remains from the site.

A crop complex (or plant and animal complex) represents the end result of long experiments with different combinations of domestications and wild foods to find a coherent whole in terms of reliable food supply. In various parts of the world, as the last cold cycle of the Pleistocene was ending, human societies began to add more plant species to their diet (15–17). The transition from hunting and gathering to full agriculture was a long process, spanning thousands of years. The initial domestication of plants and animals began within a larger context of increasing manipulation and management of a wide range of wild species. The individual domesticates of a particular region were not created all at once in one place, but apparently over time, in a number of different locales, by small, interacting societies. Eventually these different crops and/or herd animals coalesced into a set of species, or complex, that provided the majority of the human diet.

This scenario appears to fit the areas for which we have data. We have substantial information from the early agricultural cradle of Southwest Asia. The picture in eastern North America is becoming clearer. Much new data are coming from China and South America. We know very little about Mexico, Africa, Southeast, and Insular Asia. As the Smith and Yarnell study (9) indicates,

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Fig. 1. The major centers of primary domestication and dates for the earliest domestication of various plant and animal species. Illustration by Marcia Bakry.

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investigations and often have conditions of less than ideal preservation. To enhance our understanding of the origins of agriculture, archaeologists will have to spend more time in the field opening big holes looking for the seeds, bones, and other evidence of domesticated species. The need for more and better information is huge.

The growing body of information from eastern North America does provide insight on this process of domestication and the origins of farming in other parts of the world. At the same time, like all new research, it raises many questions. The evidence for this region documents a situation some 4,000 years ago where hunter-gatherer groups, living in abundant environments and spending substantial periods in sedentary residences, were changing nature, domesticking a variety of plant species that increased their food supply. Why? And why here? There are numerous locations in North America, and elsewhere, where there are many species of wild plants growing in rich environments inhabited by hunter-gatherer societies where domestication does not appear to have resulted.

The archaeological remains from sites like Riverton yield evidence of utilization of a wide range of aquatic resources, including fish, bivalves, and snails, while the white-tailed deer, turkey, raccoon, rabbits, and squirrels (18) provided the terrestrial animal protein. The nuts of hickory, walnut, and oak invariably dominate the plant remains, reflecting the minor importance of the seeds of wild, annual plants. One of the more intriguing questions about the origins of agriculture is raised by the low incidence of the domesticated species and the abundance of wild foods in general. Why did these societies with successful, long-term adaptations to resource-rich river valleys begin to manipulate plants in the first place?

The initial domestication of crop plants takes place at the beginning of the Holocene, ~8,000–10,000 years ago, in Southwest Asia, China, Mexico (19, 20), and South America. In a few areas, the first species to be changed appear much later, however, <5,000 years ago. Another question requiring an answer then is why are these later regions delayed in the process of agricultural origins. What differences or distinctions are involved in this gap?

As the evidence surrounding the origins of agriculture continues to expand, answers to basic questions are gradually being discovered. The future of archaeological research is exciting in part because it will involve the continuing resolution of this issue. At the same time, we still do not understand why these changes were initiated, nor why agriculture expanded to become the preeminent mode of human subsistence across the globe. Answers to these mysteries may require completely new questions about human society and adaptation.