Evidence of early rice domestication found in southern China

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Recently reported research by a team of Chinese scientists, published in the Proceedings of the National Academy of Sciences, demonstrates the presence of rice undergoing domestication 9,400 years ago at an archaeological site known as Shangshan near the Yangtze River in southern China. This is the earliest evidence yet found of rice in transition from wild grass to cultivar.

Excavations at Shangshan by Chinese archaeologists, beginning in the early 2000s, uncovered evidence, such as impressions of rice husks in pottery and stone milling tools, that rice was being used by the inhabitants. However, these do not provide indication of whether the rice was wild or domesticated.

The data used to identify domestication come from the examination of microscopic silica crystals, known as phytoliths, which form in plants and survive even when all of the organic components have degraded and disappeared. These crystals not only are unique to each plant species, but bear distinctive patterns reflecting changes within the species which, among other things, can be used to track the difference between wild and domesticated varieties.

Phytoliths, as well as a variety of artifacts and other evidence of human activity, were recovered from a series of superimposed layers, or strata, at the Shangshan site; each higher strata representing successively younger time periods. These strata were dated using the carbon-14 radiometric method. The oldest layer was found to date back 9,400 years ago.

By comparing the rice phytoliths from successively younger strata, changes were observed indicating the gradual transition from wild to domestic forms. Rice phytoliths have characteristic features termed “fish scales” due to their appearance. While modern rice phytoliths have more than nine such fish scales, the number on ancient rice phytoliths varies. What the researchers found was that through time the proportion of phytoliths with more than nine scales increased, gradually approaching the modern condition. This greater uniformity indicates selection for consistency, presumably in other, more important characteristics that were useful to the inhabitants of the site.

In terms of human generations, this was a long, slow process, not a ‘eureka’ moment of instant invention. It involved not only the gradual genetic modification of the rice itself, but a whole range of social and technological adjustments associated with increasing investment and reliance on a particular food source. These changes, such as increased sedentism, territoriality, storage and distribution of food surpluses, and growing division of labor, eventually lead to fundamentally new cultural patterns. On the evolutionary time scale of human existence these changes resulted in a revolution.

Anatomically modern humans, *Homo sapiens*, presumably with more or less the same mental and physical capabilities as we now have, evolved at least 200,000 years ago. Yet, until only about ten to twelve thousand years ago, at the end of the last Ice Age, known as the Pleistocene, there is no known evidence that humans subsisted on anything but naturally available wild plants and animals. What brought about this seemingly abrupt change?

The questions of where, when, how, and why the domestication of plants and animals by humans took place is of key importance in understanding the dynamics that lead to the many transitions from egalitarian hunter-gatherers to class society and civilization that took place in multiple regions of the world.

Rice, along with other cereal grains, such as wheat

and maize, are among the principal plant foods on which early agricultural communities in the Near East, Asia, and the Americas depended. Thus, the study of rice domestication is of central importance in understanding what is known as the agricultural revolution.

Although Shangshan has yielded the earliest evidence of the process of rice domestication so far discovered, this does not necessarily mean that this was the sole location where this process originated. Indeed, genetic evidence points to at least three areas of early rice domestication. Aside from China, these include an area between India and Indochina and India and Bangladesh, each producing a different variety of domesticated rice.

Rice, wheat, and maize are not the only early plant domesticates. Many others, such as beans, squash, oats, barley, millet, sorghum, amaranth, and chenopod (the latter two in Precontact North America), to name but a few, were brought under cultivation with resulting genetic changes producing domesticated varieties. For some, at least, evidence exists of multiple, independent centers of domestication.

The widespread nature of this process, occurring independently across continents, and in the relative 'blink of an eye' compared to the span of *Homo sapiens*' existence, strongly indicates that some common factor was at play, perhaps environmental changes occurring at the end of the Ice Age. However, there is evidence that at least some of wild progenitors of these future domesticates were already part of the diet of some human groups thousands of years earlier. These were not new foods, but rather the result of a new approach toward obtaining food.

Whatever the cause, and this is a subject of intense interest, it appears that beginning around ten to twelve thousand years ago, when modern humans inhabited areas with suitable potential domesticates the process was repeated time and time again, sometimes with the same species being domesticated independently at different locations.