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Review of *Early Prehistoric Agriculture in the American Southwest*, by W. H. Wills. Santa Fe, New Mexico: School of American Research Press, 1988. 196 pages.

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Early Prehistoric Agriculture in the American Southwest. By W. H. Wills. Santa Fe, New Mexico: School of American Research Press, 1988. 196 pages. $27.50 Cloth.

W. H. Wills's objective is to explain why and how hunter-gatherers in the American Southwest expanded their wild food diets about three thousand years ago to include domesticated maize, beans, and squash. Archeologists have usually interpreted the transition from foraging to food production in the greater Southwest as a historical event, e.g., innovation diffusion or migration or a process of gradual familiarization. Perhaps Meso-American farmers and their new and improved plants drifted northward through a moist, arable "highland corridor" from Mexico to southeastern Arizona and west-central New Mexico. Or, on the other hand, maybe small groups of conservative hunter-gatherers remained casual users of maize for several millenia following its introduction circa 6000–5600 B.P. at Bat Cave in

the Mogollon highlands. Prehistorians have assumed that indigenous groups were reluctant to become horticulturalists, based on an apparent thirty-five-hundred-year lapse between the earliest dates for maize at Bat Cave and its later appearance at other sites in the region.

Recent archeological studies of food remains, coprolites, pollen, paleopathologies, and stable isotope and trace element composition of human remains have produced new facts that challenge old ideas about prehistoric agriculture. Relatively few investigators, however, have reassessed the conditions that require a shift toward consumption of domesticated plants. Extant explanations for early agriculture include "models of necessity" and "models of opportunity" (see Paul Minnis, "Domesticating People and Plants in the Great Southwest," *Anthropological Papers* 75, Museum of Anthropology, University of Michigan [1985]: 309–340). These very general models, however, have not been adequately developed, operationalized, or tested in the American Southwest. Other current studies of prehistoric agriculture in this region avoid any discussion of the causal processes (see Richard I. Ford, "Patterns of Prehistoric Food Production in North America," *Anthropological Papers* 75: 341–64).

Wills's explanation of agricultural origins in the Mogollon highlands questions traditional views about when early domesticates appeared and how they were introduced into the region. His model must also account for archeologists' revised views about the rate for the adoption of food production. This reassessment is now necessary, because the earliest dates for domesticated plants in the American Southwest have been questioned recently by Michael S. Berry in *Time, Space and Transition in Anasazi Prehistory* (1982). Berry has argued that the 6000–5600 B.P. dates for maize at Bat Cave are unreliable, given the problems associated with the ambiguous archeological contexts, methods for collecting carbon samples, and discrepancies between solid and gas-based radiometric determinations. Now the earliest dates for maize in the American Southwest are circa 750 to 500 B.C. for west-central new Mexico and circa 200 B.C. for the Colorado plateau. Furthermore, unlike Emil Haury and others, Wills proposes that early maize farming occurred along streams and terraces in the lowland arid areas of the American Southwest instead of along a more mesic highland route that stretched from the Sierra Madre Occidental in northern Mexico to the Mogollon highlands.

Wills's model of the adoption and subsequent increase in domesticated plant production and consumption is closely linked to climatic and biotic changes during the Holocene. By the late Holocene (ca. 4000 B.P.), vegetative communities throughout the American Southwest closely approximated their present-day distributions. Annual precipitation increased during this time, and both alpine forests and pinyon-juniper woodlands expanded considerably. Also, contrasts between highland and lowland biotic zones became more pronounced throughout the Holocene. Consequently, hunting and gathering peoples adopted seasonal mobility patterns similar to those of the historic Great Basin Shoshone or the Western Apache. Desert plants and animals were procured at lower elevations during the winter and spring. And, pinyon seeds, nuts, and forest animals were exploited in the uplands during the late summer and fall.

Wills argues that environmental change during the late Holocene triggered population growth for hunter-gatherers in the uplands. This growth is attributed to the abundant wild food resources found primarily within the pinyon-juniper woodlands. Wills's assumption about the productivity of the pinyon-juniper woodlands must be questioned. It is true that mature stands of pinyon trees may provide about one-half million kilocalories per hectare and roughly 2,400–9,600 kilocalories per harvest hour. Yet these productivity estimates for pinyon seeds are misleading. Once total handling costs are subtracted, the return rate for this food resource equals about 841–1,400 kilocalories per harvest hour. Given their high handling costs, many plant resources, including pinyon seeds, are low-ranked food items (Steven Simms, "Aboriginal Great Basin Foraging Strategies: An Evolutionary Analysis," Ph.D. dissertation, 1984).

Wills, like many archeologists and anthropologists, underestimates the potential of higher-ranked food resources—especially ungulates, e.g., mule deer, elk, and bighorn sheep, for prehistoric hunter-gatherers in the montane areas of the greater Southwest. Archeologists have frequently utilized ethnographic analogies based on Great Basin or Southwestern foragers and collectors who did not have access to populations of large mammals, e.g., mule deer, elk, and bighorn sheep, due to unsuitable habitat or game depletion. Consequently, Wills's use of historic Great Basin Shoshone and Western Apache as analog models for prehistoric hunter-gatherers may be inappropriate.

Alternately, aboriginal populations in the northern Rio Grande

and the Mogollon highlands most probably exploited resident herds of ungulates in the uplands during the fall and winter. Their meat-based diet could then have been supplemented with wild seeds and nuts that had been cached at lower elevations. In late spring and summer, many of these foragers would have expanded their home ranges to cover vast areas of the arid lowlands. If prehistoric hunter-gatherers overwintered in the uplands and depended heavily on ungulates, Wills's model and the existing explanations of aboriginal life in this region must be modified.

Wills assumes that adaptive change is conservative and nondisruptive. He remarks that "foragers adopt domesticated plants not to become farmers but to remain effective foragers" (p. 36). Hunter-gatherers would, then, not be expected to use domesticated plants unless their mobility patterns, population structure, and economic organization could readily accommodate the constraints imposed by early agriculture. Such a gradualist view of evolutionary change can be questioned, because rates of organizational change can be highly variable.

Initial use of maize, beans, and squash is viewed as a density-dependent response to increased competition among hunter-gatherers for the productive food resources of the pinyon-juniper woodlands. According to Wills, domesticated plants were chosen not because they were productive but because they were predictable. This assertion regarding crop predictability can be seriously questioned for the American Southwest on both ecological and nutritional grounds (Wilma Wetterstrom's *Food, Diet, and Population at Prehistoric Arroyo Hondo, New Mexico,* 1986). Nevertheless, Wills argues that maize, beans, and squash were first cultivated by hunter-gatherers in southeastern Arizona and the Rio Grande valley to reduce the uncertainties associated with winter-spring resource procurement strategies. Like Minnis, Wills alludes to Western Apache ethnohistory and argues that earliest cultivation of domesticated plants at higher elevations is viewed as a means of reducing the environmental uncertainties associated with the procurement of wild plant and animal resources in the fall. This transfer of domesticates to the highlands coincided with a period of increased precipitation in portions of the American Southwest around 3000 B.P. Due to increased population density, logistical groups moved into the uplands to plant crops and to take advantage of this precipitation. In spring and summer, these task groups, perhaps young males, consumed caches of last year's

domesticated crops while they monitored critical wild foods, e.g., pinyon seeds, acorns, walnuts, grass seeds, chenopodium, and amaranth, as well as animals such as mule deer, elk, antelope, and rabbit.

Wills uses two data sets to evaluate his ideas about hunter-gatherer population growth, logistical organization, and social boundaries that were supposedly associated with early dependence on maize, beans, and squash. The first test makes use of 283 radiocarbon dates for Archaic sites from the Trans-Pecos, El Paso (lower Rio Grande), middle Rio Grande, northern Rio Grande, Mogollon highlands, and San Juan basin regions. Cumulative graphs reveal relatively consistent occupation and/or use of the lowlands throughout the Archaic. However, there is a marked increase in frequencies of dated sites after 5000 B.P. in the highlands, i.e., northern Rio Grande and the Mogollon areas. Wills suggests that cumulative frequency patterns for the uplands reflect increased population size and/or a shift to logistical land use strategies.

The second empirical test makes use of 251 Archaic projectile points from twelve sites in the Mogollon highlands and the Rio Grande valley. Increased population density in these areas would have caused greater competition for food resources. Wills suggests that hunting weapons might exhibit stylistic attributes that were used to convey information about social group membership and resource access. Such stylistic variation is equivalent to "emblemic style" (see Polly Wiessner, "Style and Social Information in Kalahari San Projectile Points," *American Antiquity* 48:2[1983]: 253–76). According to Wills, stylistic variation involves attributes that are nonfunctional.

Morphological or stylistic variation in weapons appears to have increased during the middle Archaic (ca. 7000–4000 B.P.) due to density-dependent competition. In the late Archaic (ca. 4000–2000 B.P.), projectile points exhibited very similar shapes but highly variable sizes. Wills thinks that such size variation is attributable to functional or technological considerations. Interestingly, Wiessner points out that the !Kung San of the Kalahari Desert in southern Africa use point size as a major component of emblemic style; whereas, the G/wi and !Xo use tip and body shape to convey information about linguistic group membership.

Wills's discussion and analysis of Archaic chipped stone projectile points and emblemic style raise a number of serious questions.

First, what theoretical and methodological means do archeologists use to recognize nonfunctional characteristics of projectile points? Second, under what conditions do we expect hunter-gatherers to use nonfunctional versus functional attributes to convey information? As Wiessner discovered, hunter-gatherers may arbitrarily utilize singular, multiple, or combined sets of functional and/or nonfunctional attributes to reflect emblemic or assertive style. Third, when might archeologists expect that stylistic variation would be reflected by other components of hafted tools and weapons? For the !Kung San, information is also conveyed by individualized markers' marks engraved on the link shafts and not the points of hunting arrows. These questions are not adequately addressed in Wills's study.

Wills's book provides archeologists with an innovative account of why and how past hunter-gatherers initially expanded their food-getting activities to include the cultivation of domesticated crops. His study makes use of a variety of subjects including r- and K-selection, density-dependent responses, risk minimization, the forager-collector continuum, maize phenology, Holocene environments, technological change, stylistic variation, social boundaries, and mating networks. Wills also offers new information and reassessments of the archeological record at Bat, Tularosa, Cordova, and Cienega Creek caves in the Mogollon highlands. He approaches the archeological literature for the American Southwest with healthy skepticism. And he challenges many basic assumptions and archeological "facts," including the reliability of radiocarbon dates for Southwestern and Mexican maize, cultural-historical classifications, and the severity of altithermal climate. His explanation for early use of domesticated plants in the Mogollon highlands is an interesting departure from other models. Wills's book offers ideas, insights, and questions that seriously challenge archeologists to reconsider contemporary thinking about prehistoric agriculture in the American Southwest.

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