Comment: Rethinking the Origins of Agriculture

# A Conversation on Agricultural Origins

## Talking Past Each Other in a Crowded Room

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Placed within a relatively informal and free-flowing context of "conversation," this issue of *Current Anthropology* offers an opportunity to step outside of the strictures of formal scholarly discourse, with its requirements of lengthy supporting arguments and exhaustive literature citation and to debate, in a more relaxed fashion, what general form our explanations for agricultural origins should take. Our basic position as we join in this dialogue is that because of the rapid and still accelerating accumulation of relevant new information over the past quarter-century, many of the extant universalist explanations for agricultural origins now represent more of a distraction than an advance in understanding of what is increasingly recognized as a set of long, complex, and independent developmental trajectories in different regions of the world.

Universal explanations for major transitions in human history that draw much of their support or authority from overarching theoretical covering laws or assumptions about how the world works tend to flourish in contexts of limited relevant information. But as the amount of available information increases and our view of the past comes into clearer focus, such universal explanations are unable to accommodate a wealth of new data that run counter to their predictions. In this discussion, we focus on what appears to be an ever-widening disjuncture between a number of the most popular universal explanatory models for agricultural origins and the steadily growing empirical record of relevant information. Rather than proposing any particular all-encompassing alternative theoretical model or covering laws of our own, our purpose here is to encourage frameworks of explanation that pay close and careful attention to existing relevant archaeological information, that are scaled at the regional level, and that focus on the complex interplay of a range of different environmental and social preconditions, prompts, and factors of various kinds.

The essays in this special section provide a comprehensive sampling of the various prime-mover forces championed as universal levers of agricultural emergence. Mark Cohen, the convener of this conversation, began his discourse on this topic in the early 1970s with his book *The Food Crisis in Prehistory* (Cohen 1977). In that influential book, Cohen argued that because the transition from hunting and gathering to agriculture occurred at roughly the same time in many different world regions, there must be a single universal cause for this major turning point in human history. He maintained that during the Early Holocene a worldwide demographic threshold was crossed, resulting in an imbalance between human populations and their chosen subsistence base. Agriculture arose in areas where the pressure was most acute (and where there were domesticable plants and animals) as a means of resolving this demographically induced resource pressure. Cohen (2009) and others in this issue (i.e., Bellwood 2009; Gage and DeWitte 2009; Lambert 2009) revisit the role of demography in the origin and dispersal of agriculture, demonstrating that population pressure continues to hold strong appeal as a universal explanatory lever for agricultural origins.

Other voices advocating different universal prime-mover forces have also been heard from in the 30 years since the publication of Cohen's book, several of which contribute to the conversation taking place in this collection of papers. Climate change, a deus ex machina of agricultural origins since Childe formulated his Oasis Hypothesis in the 1930s, has resurfaced in the intervening years as a prime candidate for causation in agricultural origins. The ice age flashback that occurred during the Younger Dryas at about 12,500–11,500 cal. BP has been featured as a primary causal agent in agricultural origins in both the Near East and in China (Bar-Yosef 2002; Bettinger et al. 2007; Harris 2003; Moore and Hillman 1992), while the climatic amelioration that followed in the Early Holocene and the accompanying rise in $CO^2$ have been argued to have made the origin of agriculture "compulsory" (Richerson, Boyd, and Bettinger 2001). Snippets of this part of the ongoing conversation can be heard in Bettinger, Richerson, and Boyd's (2009) contribution to this issue.

More recently, a number of researchers working within the

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framework of human behavioral ecology (HBE) have proposed that HBE provides overarching principles of sufficient power and universality to account for the transition from foraging to farming wherever it occurred (see chapters in Kennett and Winterhalder 2006). Often married to stress-based models that view agricultural origins in terms of solutions to resource imbalances (caused by factors such as population growth or climate change), HBE explanatory models are grounded in optimizing principles held to universally shape human resource choices and have been offered as frameworks for predicting how people will respond to both resource constraints and opportunities in ways that result in the domestication of certain species and the development of agricultural economies based on domesticates. This new HBE perspective is clearly articulated in the Plattsburgh Conversation in the contributions to this issue by Winterhalder and Kennett (2009), Gremillion and Piperno (2009), and Bettinger, Richerson, and Boyd (2009).

Proponents of universal stress-free models of agricultural origins have also spoken up in the 3 decades since the publication of Cohen's book. Advocates of these models promote universal levers that lie deeply embedded within human social behavior and are unleashed under conditions of relative plenty. Structuralist models that attribute agricultural origins to a deep-seated shift in human mentality (Cauvin 2000) or to an innate human propensity for self-aggrandizement and greed (Hayden 1992, 1995, 2003), while diametrically opposed to universalist stress-based causal scenarios, still envision agricultural origins as the product of a sole-source prime mover that accounts for all instances of agricultural emergence. This conversational thread is spun out again in this issue by Hayden (2009; see also Hayden 2004), who offers a new gloss on his widely debated retelling of the story of resource intensification that led to agricultural origins in the Near East and other world areas.

Interwoven with these more abstract conversational threads on the potential primary forces driving agricultural origins has been the work of numerous researchers (many of whom have actively and productively contributed to the conversation) who are engaged in piecing together increasingly fine-grained regional developmental sequences of the transition from hunting and gathering to agriculture. These close-to-the-data scholars have been aided in their efforts by both the explosion of new empirical data on agricultural origins from many world areas and the development of a range of new techniques and analytical approaches for the documentation of domestication in both plants and animals (see discussions in Zeder et al. 2006*a*, 2006*b*). The increasing temporal, spatial, and developmental resolution that this work has brought to our understanding of this transition in multiple world regions presents a real challenge to universal scenarios that promote a one-size-fits-all approach to the explanation of agricultural emergence and dispersal. Nowhere is the deficiency of such prime-mover explanatory approaches more apparent than in the Near East and in eastern North America—the two regions of the world that provide the most detailed and well-documented records of this major evolutionary transition.[1]

## The Near East

Given its prominence as a source of many of the worlds' major crop plants and livestock species, its great time depth, and its rich history of archaeological research, the Near East has long been the favorite target for those seeking to advance prime-mover explanations of agricultural emergence. Prime-mover models imposed on the Near Eastern record include both stress-based models that attribute the transition to food production to external forcing factors, as well as stress-free models that look to internal causes within human society and the human psyche. None of these prime-mover models, however, can comfortably or adequately accommodate or explain the increasingly richly detailed record now available from multiple parts of the broad arc of territory that stretches from the southern to the northern Levant across the Taurus and down through the Zagros Mountains to the Persian Gulf (see discussions in Zeder 2006, 2008, 2009*a*, and 2009*b*).

Climate change, for example, while clearly providing an important backdrop as a prompt or precondition for the transition to agriculture in the Near East, should not be miscast as a center-stage protagonist in the unfolding drama. The increase in rainfall and temperature that followed the Late Glacial Maximum at about 15,000 cal. BP (and the associated rebound of biotic communities previously restricted to sheltered refugia) certainly set the stage for the emergence of less mobile and more territorially focused Early Natufian subsistence strategies of 14,600–12,500 cal. BP (Byrd 2005). But significantly, when faced with the abrupt return to more glacial conditions during the Younger Dryas (12,900–11,600 BP), the more or less sedentary Early Natufian hunting and gathering societies did not adaptively respond by domesticating promising plant and animal species. Instead, in the southern Levant, groups returned to more mobile adaptations that allowed for the sustained exploitation of more or less the same complement of wild resources (Munro 2004). At the same time, societies to the north and east, in both the Middle and Upper Euphrates valley (Rosenberg and Redding 2000) and the Zagros (Solecki 1981), were able to maintain relatively sedentary settlements and stable resource catchment zones during the Younger Dryas. And yet with the exception of the possible fleeting appearance of domesticated rye at Abu Hureyra (Hillman 2000), there is no compelling evidence for domestication during this climatic downturn in the Near East.

The amelioration of climate that followed the Younger Dryas and the associated atmospheric changes that may have proven particularly advantageous for annual cereals (Mc-

1. In the interest of maintaining the conversational flow of this comment, we are limiting our references whenever possible to major summary papers that contain extensive bibliographies of the primary literature.

Corriston and Hole 1991) made a return, and indeed a proliferation, of sedentary settlement across the Fertile Crescent possible. And it is true that this period of climatic improvement coincides with a period of experimentation with a wide range of plant and animal resources that eventually became domesticated crops and livestock. But these on-deck domesticates initially were only relatively minor components of the diverse subsistence base of Pre-Pottery Neolithic A (PPNA, ca. 12,000–10,500) villages (Willcox, Fornite, and Herveux 2008). Morphologically domesticated cereals do not appear in the archaeological record until the following Early Pre-Pottery Neolithic B (PPNB, 10,500–10,000 cal. BP), where they still represent only minor components of the subsistence economy. Fully developed agricultural economies based primarily on plant and animal domesticates do not emerge in the region until the Mid to Late PPNB periods (10,000–8,700 cal. BP), which saw relatively stable climatic conditions (Nesbitt 2002). Thus, while climate certainly set the stage for agricultural emergence in the region, it did not cause these developments in the more purely stimulus-response manner that is required in climate-forcing models. Instead, climate change alternatively helped push and pull societies along the pathway to domestication and agriculture, providing both opportunities and challenges that people across the broad arc of the Fertile Crescent responded to in a variety of ways, depending on their local cultural and environmental settings—forming a rich mosaic of alternative adaptive solutions.

Like climate change, human population growth does not gain much support as a primary causal factor for the transition to agriculture in the Near East if recent high-resolution archaeological evidence is considered. Stress-based models that spotlight human demographic pressure and resultant resource imbalance as the main cause in agricultural origins in the Near East almost invariably employ increasing sedentism, increased storage, and resource intensification as proxy measures of population growth and resource pressure (Rosenberg 1998; Stiner 2001). And while sedentism, storage, and changes in subsistence patterns might result from an increase in human population density and landscape packing, they can just as easily develop in an absence of demographic pressure—a possibility that is often ignored by those advancing the case for population pressure as a prime mover in Near Eastern agricultural origins. Proposing that population pressure causes sedentism and resource intensification and then using evidence of sedentism and resource intensification as evidence for population pressure incurs a certain tautological burden. Defining the transition from foraging to farming as a "Neolithic demographic transition" and then finding that population was both "the cause and effect" of this demographic shift (Bocquet-Appel 2008), while certainly a tidy approach to the problem, goes one step further in creating a logical box that does little to advance our understanding of agricultural origins. If, in contrast, other more appropriate demographic proxies are considered (i.e., the number, size, and distribution of sites and their duration of occupation), demographic models of agricultural origins in the Near East find little support (Henry 2002; Kuijt and Goring-Morris 2002). Even if an increase in the number and intensity of occupation of sites in the southern Levant during the PPNA (10,500–10,000 cal. BP), and their proximity to each other, is accepted as evidence of population packing during this period (Bar-Yosef and Belfer-Cohen 1991), this region does not appear to have been the ground-zero heartland of initial domestication in the Near East. Significantly, there is no comparable evidence for population packing in the northern Levant, especially in the upper reaches of the Euphrates River Valley, where recent excavations are producing the earliest evidence of plant and animal domestication in the Near East (Pasternak 1998). Moreover, archaeological and genetic evidence is increasingly pointing to different species being initially brought under domestication in different parts of the arc of the Fertile Crescent. While sheep were probably domesticated in the Eastern Taurus Mountains at the apex of the Fertile Crescent, goats were probably domesticated in the northwestern or central Zagros in its eastern arm (Zeder 2008, 2009*b*). Emmer wheat may have been domesticated in both the southern and northern Levant, and barley was probably domesticated in both the southern Levant and the Zagros (Willcox 2002; Zeder 2009*b*). Thus, while an argument might be made for demographic pressure in the southern Levant during the period of initial domestication of plants and animals in the Near East, most, if not all, of the currently available evidence indicates that the initial domestication of both plants and animals occurred in other regions of the Fertile Crescent, where people appear to have been auditioning a wide variety of region-specific plants and animals for leading roles as domesticated resources in the absence of population increase or resource imbalance and where a case for population packing and resource pressure simply cannot be made.

Principles of human behavioral ecology (especially those derived from optimal foraging theory) are often invoked in stress-based models as providing the guidelines that direct decision making under conditions of resource pressure (whether induced by climate change or demographic factors; Layton, Foley, and Williams 1991; Stiner and Kuhn 2006). Viewed from this perspective, the reduced availability of higher-ranked prey and plant species is a prerequisite for the broadening of the resource base to include lower-ranking resources such as wild cereals and pulses with their low return rates and higher handling costs (see Gremillion and Piperno 2009). Even if such low-ranking resources are relatively abundant in the environment, correct application of a diet-breadth model to explain the emergence of agriculture in the Near East predicts that such low-ranking resources will be avoided as long as higher-ranked resources may be reasonably expected to be encountered and captured or collected (Hawkes and O'Connell 1992). And yet the dramatically improved Near Eastern archaeobotanical record suggests that plants were a prominent part of the resource base far back into the Pleistocene, well before any population- or climate-induced

pressure on higher-ranking resources has been proposed as having occurred (Piperno et al. 2004; Weiss et al. 2004).

A difficulty of similar magnitude exists for any application of HBE expectations to animal domestication. According to the expectations of HBE models, animal domestication can only occur in a context of diminished prey returns, which forces humans to shift from immediate to delayed reward schedules (Alvard and Kuznar 2001). According to this perspective, animal domestication can only come about when people are forced to suppress the urge to immediately kill and eat a passing animal long enough to allow a herd of managed animals to achieve a size that would allow sustainable culling. This model, however, avoids acknowledging that herders continually cull and eat animals from managed herds. While the hunter may kill an animal following a strategy that maximizes immediate return (i.e., a focus on prime-age males) and a herder employs a strategy that maximizes herd growth when he or she culls an animal from the herd (i.e., harvesting young males and older females), both the hunter and herder kill animals and consume animal flesh on a continual basis. In addition, the deferred-harvest notion of animal domestication certainly has no resonance with the initial phases of animal domestication in which people probably mixed hunting and herding and continually recruited wild animals to replenish managed herds. In fact, the general HBE dictum that farming and herding requires a shift from the immediate gratification of hunting and collecting of wild resources to a willingness to risk waiting for delayed returns of domesticated resources (as discussed in Winterhalder and Kennett's contribution [2009]) is at odds with growing evidence from the Near East. Well before domestic plants and animals ever arrived on the scene, people in this region were engaging in deferred-return strategies involving long-term investments in landscapes and associated plant communities and in hunting strategies that were intended to increase and enhance the supply of critical wild resources on a sustained long-term basis (Colledge 2002; Weiss, Kislev, and Hartmann 2006; Willcox, Fornite, and Herveux 2008; Zeder 2009*b*). Rather than being forced into broadening their diet to include lower-ranking resources, as required in an HBE view of the world, the record from the Near East instead suggests that whenever and wherever conditions permitted, people seem to have been drawn to resource-rich areas where they could establish a subsistence base that, while perhaps not optimal from a strict kilocalorie-energetic point of view, could still sustain an aggregation of people for longer periods of time—a record that suggests that resource decisions may have been guided by principles other than energetic returns and economic self-interest (see Bettinger 2006).

Stress-free single-factor models do not fare much better when compared to the rapidly expanding empirical record of agricultural emergence in the Near East. The structuralist-inspired model of Cauvin (2000) casts agricultural emergence and dispersal in terms of a shift in human mentality from seeing oneself as part of nature to nature's master. Cauvin's model credits this mentalist shift with providing people the chutzpah and hubris needed to attempt to bring wild plants and animals under their control. This same mental shift is also seen as the driving force behind the spread of agriculture out of its birthplace in the middle Euphrates Valley in two evangelizing waves, first on the backs of mother-goddess proselytizers who carried cereal agriculture throughout the region and later by the even more potent, testosterone-pumped bull worshipers who carried a fully developed Neolithic package based on both plant and animal domesticates throughout the Near East and beyond. This imaginative model, which has found its critics in both postmodernist (Hodder 2001) and processualist (Rollefson 2001) circles, has little support in the archaeological record for the region. Instead of two expansionist pulses of Neolithic lifestyles out of a single center, there now seem to have been multiple centers of domestication across the Fertile Crescent, a high degree of regionalization evident in the incorporation of symbols into localized ideological systems, and a progressive narrowing in the gap between the timing of initial plant and animal domestication.

Over the years, Hayden has frequently turned to the Near East to make his case for agricultural emergence as being an outgrowth of an innate human propensity for self-aggrandizement and self-promotion at the expense of others (Hayden 1992, 1995, 2003). Hayden has remained blithely committed to this model, seemingly oblivious to the repeated drubbing it has taken in the literature for the discordance between its basic premises and predictions and the empirical record from the Near East and other world regions (Smith 2001; Winterhalder and Kennett 2006). As pointed out by numerous scholars familiar with the Near Eastern empirical record, the initial crop domesticates—cereals, pulses, and even figs—cannot be reasonably characterized as anything other than widely available, easily grown staples, not exotic, limited-access delicacies, as called for in Hayden's model. And although there is some evidence for communal consumption at sites like Hallan Çemi and Zawi Chemi Shanidar (Rosenberg and Redding 2000; Solecki 1981), the archaeological record from this region clearly finds no support for Hayden's blanket assertion that animals were only eaten in ritual contexts controlled by aggrandizing individuals within these small communities (Hayden 2003). Hayden's current attempt (2009) to impose his version of reality on the Near East, as outlined in this issue (and in Hayden 2004), in which he pushes a model of unequal access for surplused resources in the Early Natufian period, not surprisingly again gains no support from the archaeological record. As Kuijt points out in his contribution to this issue (2009), there is no evidence for either large-scale storage or the accumulation of surplus, let alone unequal access, during this early part of the sequence.

In fact, as demonstrated by Kuijt and others over the years, Hayden's markers of social inequality have been more convincingly shown to be vestiges of social mechanisms aimed at counterbalancing the centrifugal tendencies working against egalitarianism that were promoted by increasing con-

trol over managed resources (Belfer-Cohen 1995; Kuijt 2000*a*; Kuijt and Goring-Morris 2001). Social mechanisms like skull caching, feasting, and long-distance trade in exotic items can more appropriately be interpreted as parts of a safety net intended to minimize distinctions among households and create a sense of community cohesion in order to preserve an egalitarian ethos in communities supported by subsistence strategies that naturally promote inequalities in resource production and access, rather than as evidence of efforts by a few greedy people to enhance and promote their social standing.

Based on an apparent lack of synchronicity between periods of major social change in the region and the appearance of morphological plant and animal domesticates, Kuijt has also argued that that social change in the southern Levant is independent of changes in subsistence (Kuijt 2000*b*). This divorce of the social component of the Neolithic emergence from the economic, however, also has problems, primarily related to the timing of initial domestication of plants and animals and, more interestingly, how one defines or identifies domestication. Kuijt's identification of initial domestication based on the earliest appearance of distinct morphological changes is increasingly at odds with recent research that has shown that morphological changes (i.e., the development of a tough rachis in domestic cereals or the changes in horn size and shape in domestic sheep and goat) appear only in the later phases of the domestication process—a process that now seems to have extended back prior to the appearance of any morphological markers for hundreds, if not thousands, of years of increasing human investment in the management of key resources.

Kuijt is not alone in using morphological change as a threshold marker of domestication in framing temporal precedent arguments that make the case for a variety of different factors as causal agents in Near Eastern agricultural emergence. In fact, the late appearance of morphological markers of domestication in the Near Eastern record has given relatively free license to people wishing to advance a wide variety of prime-mover models to account for this transition in the Near East and, by extension, all other instances of agricultural emergence worldwide. The recognition that such morphological markers are not threshold indicators of the transition from foraging to farming but, rather, scattered signposts along a lengthy trajectory of increasing, coevolutionary interaction between humans and plants and animals, makes it difficult, if not impossible, to support any of these prime-mover scenarios. Instead, the increasingly high-resolution archaeological record of the Near East both requires and allows for the development of more complex and nuanced multivariable frameworks of explanation.

Such an explanatory narrative could begin at the height of the Late Glacial Maximum in the Near East, when people congregated, perhaps on a year-round basis, in sheltered resource-rich areas like Ohalo II, where they exploited a rich array of plant and animals species (Nadel 2004). Climatic amelioration after the Late Glacial Maximum and the associated expansion of biotic communities, including people, out of restricted refugia made it possible for more people to congregate in more places for longer periods of time. The sudden 14.6 k warming event can be characterized as catalytic in allowing the development of more or less sedentary communities in the Early Natufian period, where we see an elaboration of social mechanisms and ritual practice accompanied by an intensification of resource strategies to mitigate the local environmental impact of longer-term settlement (Byrd 2005). The strong bonds of community that knit these egalitarian communities together may account for the use of these abandoned base camps as secondary burial sites for Late Natufian people of the southern Levant who exploited much the same range of resources in a more mobile way during the Younger Dryas climatic downturn.

Climatic amelioration and stabilization in the Early Holocene can be seen as providing conditions that once again allowed increasingly sedentary communities of people to form in resource-rich areas. The commitment to this way of life, in concert with climate stabilization and the development of high enough population densities to allow for mate acquisition from neighboring communities, spurred the intensification of resource manipulation and led to, in certain malleable species, their domestication. At the same time, the resources that permitted egalitarian communities to form and grow also sowed seeds of social inequality, leading to an amplification of leveling mechanisms and an elaboration of ritual and ideological symbolism that helped people legitimize the new social and economic order they were creating. Increased channels of interaction among communities in an ever-expanding array of trade networks that brought trade items, mates, subsistence technologies and resources, and new ways of interpreting one's place in the cosmos provided additional buffers against resource shortfalls, and helped mitigate growing social and ideological tensions that were developing in nascent farming communities. We see this system collapse under its own weight in the southern Levant at the end of the Final PPNB (8700–8300 cal. BP) during another climatic downturn ending with the 8.2 k drying event, when large village communities, no longer able to maintain the delicate balance between competing centrifugal and centripetal social and economic forces, fragmented into an array of smaller groups following a mixed array of sedentary and more mobile agropastoralist and hunter-gatherer adaptations (Gopher and Gophna 1993).

Climate, demography, rational economically motivated decision making, biological responses of plants and animals to human intervention, social opportunities and tensions, as well as a recasting of humankind's place in the universe through ritual and religion, all certainly contribute to this complex story. But they do so in such a tightly interconnected way that it is not possible to single any one factor out as playing a dominant role. Rather than involving a single key cause, a central character, the emerging picture of agricultural tran-

sition in the Near East can be more appropriately viewed as being an ensemble piece, with cameo roles being played by climate change, demography, optimization, society, and religion, each stepping in at different plot points to move the story along. At the same time, a number of lesser-known regional actors (localized resource distribution, historical demography, individuals trying to feed their families and their communities) carry the major story lines and shape the dominant themes and overall trajectory of the developmental transition from foraging to farming in the Near East. Concentrating on only one or even a few of the high-profile cameo actors not only ignores the rich complexity of the story but represents a major distraction from ongoing efforts to gain a better understanding of this major evolutionary episode in human history.

## Eastern North America

Eastern North America, like the Near East, offers a high-resolution regional-scale archaeological record of the transition from hunting and gathering to food-production economies and represents another case-study opportunity to examine how well various universal explanations for agricultural origins are either supported or contradicted by currently available information. As was the case with the Near East, the archaeological record of the deciduous woodlands of eastern North America offers little support for universal explanations that cast end-Pleistocene climate change, population growth and resource imbalance, or competitive feasting in central causal roles.

Five different cultivated varieties of crop plants were brought under domestication in eastern North America between 5000 and 3800 cal. BP: squash *Cucurbita pepo*, sunflower *Helianthus annuus* var. *macrocarpus*, marsh elder *Iva annua* var. *macrocarpa*, and two cultivated varieties of chenopod *Chenopodium berlandieri* (Smith 2006). Clear evidence of the development of a crop complex based on these indigenous eastern seed plants is present by 3800 cal. BP (Smith and Yarnell 2009), but indications of a dominant subsistence role for any crop plant do not appear until after AD 700, when a widespread shift to maize-centered agriculture is documented by a dramatic change in stable carbon isotope values in human burial populations (Smith 1990).

Because the end-Pleistocene climatic amelioration and its associated increase in $CO^2$ levels at ca. 11,000–10,000 precedes both the initial domestication of eastern seed plants and the subsequent development of a crop complex, as well as the shift to maize agriculture, an argument might be made that it provides a sufficient causal explanation for their occurrence. The substantial temporal separation or time lag of 5,000, 6,200, and 8,500 years, respectively, between the end of the Pleistocene and each of these three developmental landmarks in the long transition to food production, however, effectively underscores the role of the Pleistocene-Holocene boundary as a necessary precondition rather than as a central causal variable. In fact, subsequent mid-Holocene climatic and environmental changes played a much more important role than the end-Pleistocene changes in setting the stage for the transition from hunting and gathering to agriculture in eastern North America. By 7,000–6,500 years ago, a shift in climate across the interior midlatitude oak-savannah and oak-hickory forest zones resulted in the development of meandering river valley regimes and an associated enrichment of floodplain environments, which in turn presented new opportunities for the development of more stable and sustainable long-term subsistence economies by Late Archaic societies across the region.

In response to this emergence of resource-rich river valley environments, human societies in a number of areas of eastern North America shifted to settlement and subsistence systems incorporating more sedentary base camp settlements situated within or adjacent to floodplain resource zones and occupied throughout the growing season (Smith 1986, 2009*b*). Showing evidence of reoccupation, probably on an annual basis, over very long spans of time, these deeply stratified river valley shell mound and midden mound sites, along with sometimes associated cemeteries, are often interpreted as reflecting sustained long-term utilization and "ownership" of resource catchment areas by small societies of perhaps a half-dozen households. Although these Late Archaic river valley base camp settlements are both more visible and more numerous than habitation sites in the preceding Middle Archaic Period, there currently is no compelling evidence that landscape packing of river valley corridors, demographic pressure, or resource imbalance occurred in advance of, or along with, the initial domestication of plants and the initial formation of a crop complex (Smith and Yarnell 2009). While it does appear that the apparent demographic growth in some river valley corridors of the East represented an adaptive response to and radiation into resource-rich floodplain habitat zones having increased carrying capacity, this does not appear to have resulted in resource imbalance or resource depression.

Like other stress-based models, human behavioral ecology (HBE) explanations of initial domestication that view resource imbalance as forcing individuals in their decision making to work down the priority list of resources and to develop a greater reliance on lower-ranking species such as seed plants also gain little support from the archaeological record for the Late Archaic period in eastern North America. Plant and animal assemblages recovered from a substantial sample of ca. 5000–3000 BP floodplain base camp settlements located across the oak-savannah and oak-hickory forest zones of eastern North America indicate a predictable and unvarying profile of subsistence. An emphasis on the nuts of a number of hickory, walnut, and oak species with a lesser use of seed-bearing annuals was combined with a major reliance on white-tailed deer along with several smaller terrestrial mammals as well as a rich variety of aquatic species of waterfowl, fish, and bivalves (Emerson, McElrath, and Fortier 2009). There is no

evidence over this 2-millennium span, which brackets the initial domestication of eastern seed plants and the initial formation of a crop complex, of these Late Archaic societies experiencing resource depression or being forced to move down their priority list of resources. In many respects, the primary faunal resources these groups relied on (i.e., white-tailed deer, migratory waterfowl, fish) would have been resilient in the face of increased human predation pressure and had the potential to sustain much higher harvest rates than these human societies were capable of imposing (Smith 2010). Rather than responding to population packing of river valley corridors or resource depression, currently available archaeological evidence indicates that these Late Archaic societies appear to have initially domesticated local seed plants and developed a crop complex within a context of resource richness and stable and sustained long-term adaptations, in the absence of external stress (Smith and Yarnell 2009).

At the same time, these Late Archaic settlements and associated cemeteries provide no evidence that internal social stress or within-group competition played a role in the initial domestication of plants and the formation of a crop complex. Burial populations currently provide no evidence of social differentiation beyond expected age and gender roles. Settlements have yet to yield any evidence of internal differentiation of households in terms of structure size or placement, storage or food-processing features, or variation in material culture assemblages. At the same time, there is a complete lack of any evidence of communal consumption or feasting, whether intended to increase social group cohesion or to enhance the status of individuals or particular family units. There is no indication of food of any kind playing a role in any form of social competition.

So, rather than offering support for universal explanatory frameworks that rely on external environmental stress, population growth, landscape packing, constricted resource zones, carrying capacity imbalance, and social competition in explaining initial domestication or the subsequent coalescence of domesticate complexes, eastern North America suggests just the opposite. It does not appear that the initial domestication of local seed plants and the subsequent formation of a crop complex occurred because of any carrying-capacity challenges or seriously compressed and compromised resource catchment areas but, rather, took place within a context of stable long-term adaptations to resource-rich environmental settings. In addition, the initial coalescence of crop plants into a coherent complex and the associated emergence of low-level food production economies do not appear to have marked an abrupt developmental break but, rather, to have initially represented an integrated additive expansion and enhancement of preexisting hunting and gathering economies.

In the absence of any compelling evidence for either external stress or internal competition, the concept of niche construction provides a useful alternative perspective for considering the initial domestication of plants in the resource-rich river valley settings in eastern North America (Smith 2007*a*, 2007*b*, 2009*a*). Such a rich environmental context for initial human domestication of plants fits comfortably within the expectations of niche-construction theory (Odling-Smee, Laland, and Feldman 2003). Local habitat settings that were rich in biotic resources (species abundance and diversity, as well as species with high biotic potential) would have provided the greatest opportunity for human societies to expand and enrich their overall integrated resource-management strategies. The greater the range of species included in human efforts at intervention, and the wider the range of different potential forms of intervention that could be attempted, the greater the possibility that relationships of domestication would be successful and sustained.

## Conclusion

The inadequacies of single-factor, universalist explanatory frameworks for the agricultural emergence are underscored in the foregoing discussion of two quite different, and quite well-documented, independent centers of domestication. In both the Near East and eastern North America the process of agricultural emergence was clearly shaped both by multiple factors operating at a very general macroscale and by a number of microscale factors specific to each region.

At the broadest, most macrolevel, the trajectory toward agriculture in each region was shaped by the combination of very general economic goals oriented toward ensuring a predictable and secure resource base that interlaced with and complimented social goals oriented toward binding larger groups of people together for increasingly longer periods of time, with both economic and social goals pursued within frameworks of environmental variability and climate change. In both the Near East and eastern North America, agricultural emergence was shaped by efforts directed at meeting these overarching goals through the engineering of local ecosystems and the manipulation of targeted resources within local biotic communities. Isolating and selectively emphasizing any of these very general, macrolevel overarching factors, however, does not explain very much about how the process unfolded on the ground in either region. Instead, the solutions that people in both regions found to meet these overarching economic and social goals in large part were shaped by highly localized parameters and constraints. The variable responses of the regions, and subregions within them, to global climate shifts; the differential density and diversity of plant and animal resources in different parts of these regions; the demographic history of population growth and movement within the regions; the ways in which people during times of transition negotiated their interactions with each other and with the cosmos—all of these very localized factors imparted a unique regional flavor to the long developmental trajectory from hunting and gathering to agriculture, not only in these two world regions but wherever this transition occurred.

By recognizing the importance of local factors in shaping

unique trajectories toward agriculture in multiple world areas we do not mean to endorse the particularistic selectionist view of agricultural emergence advanced in the 1980s and 1990s by Rindos (1984), a lively contributor to the conversation on agricultural origins whose views are only referenced in passing in the present conversation (see Cohen's contribution [2009]). The coevolutionary model of mutual interdependence between humans and target plant and animal species that Rindos championed in his influential work certainly plays an important role in our conception of domestication, especially in the responses of target plant and animal species to increasing human efforts at shaping their environments and their life cycles. However, the neo-Darwinian notion advanced by Rindos that all agricultural origins are driven by immutable forces of selection and drift operating on randomly generated behavioral variability is entirely at odds with our own views that emphasize the sentient role of humans who were actively, and with deliberate intent, shaping adaptive niches with the conscious goal of enhancing the density and productivity of desired resources. Indeed, it is this element of conscious human intent—or agency, to use a fashionable term—that we believe serves as the interface between the overarching macroforces behind agricultural emergence as a general cultural phenomenon, on the one hand, and the particular, highly localized ways agricultural economies developed in different world areas, on the other. And while we differ with HBE enthusiasts on the role of energy optimization in guiding these decisions, we do believe that the deliberative, rational (though perhaps sometimes ill-informed or misdirected) actions of humans seeking to achieve certain basic social and economic goals provide the linkage for translating the macroforces behind the origins of agriculture into their particular expression in different regional settings, worldwide.

The challenge for anyone interested in developing a satisfactory explanation of agricultural origins is to avoid the easy emphasis on broad-brush single—or even multiple—macrofactor accounts that, while perhaps generally applicable, do not explain much about how the transition unfolded in any particular case. At the same time, however, explanatory approaches should not concentrate exclusively on telling the stories of individual stand-alone instances of agricultural emergence, for all their interesting detail and complexity. More than 30 years of discussion and debate regarding prime-mover models has succeeded in isolating a set of universal factors that, in their most general sense, are relevant in many, if not all, instances of agricultural emergence. In more recent years, dramatic improvements in recovering and analyzing the empirical record of agricultural origins have also provided a much higher-resolution view of the details of this complex transition in many different areas of the world.

The real challenge now in approaching a better understanding of agricultural origins, in all their complexity and regional variation, rests in the integration of these two parallel lines of inquiry—constructing and comparing detailed regional scenarios of how people in different world areas worked with what was locally available, within the context of broad, interacting forces of economy, society, and environment. Taking up this challenge will ensure that the ongoing conversation on this enduring topic remains lively and productive, if occasionally heated—a conversation conducted in a crowded room populated by people able to offer a wide range of different perspectives and insights into this major transition in human history. Single-lever scenarios will, of course, continue to be discussed, but as the amount of relevant empirical information continues to increase worldwide, their proponents will increasingly find themselves isolated in a corner of the room, talking primarily to themselves.

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