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# A COMPANION TO ANCIENT AGRICULTURE

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## CHAPTER ONE

# Introduction

*David Hollander and Timothy Howe*

In 1970, introducing his *Roman Farming*, K.D. White justly lamented the lack of attention being paid to Greco-Roman agriculture. Nearly fifty years later, he would presumably be quite pleased with how the field has developed. Beginning in the 1970s (and no doubt in part due to White's own work), there has been steady growth in the number of monographs and articles on aspects of Greek and Roman agriculture as well as new commentaries on, and translations of, the most important ancient texts. Furthermore, instead of a largely text-driven approach, ancient agricultural history now employs an array of archaeological evidence (e.g. botanical and faunal remains) and methodologies (e.g. field survey, isotopic analysis). Students of the agricultural history of ancient Italy, to cite one regional example, now have new editions, translations, and commentaries on the fundamental literary texts (e.g. Goujard 1975 for Cato's *De agricultura* and Heurgon 1978 for Varro's *Res rusticae*), monographs, edited volumes, and articles putting those writers' works and lives into the broader context of Republican history (e.g. Reay 2005 and many of the chapters in Becker and Terrenato 2012) and literature (e.g. Kronenberg 2009). Archaeologists have published the results of fields surveys, new excavations of rural sites (including exciting recent work on small, non-elite sites by the Roman Peasant Project, Ghisleni et al. 2011), a synthesis of the survey data (Launaro 2011), a catalog of the villas in central Italy (Marzano 2007), and important overviews (e.g. Forni and Marcone 2002). In the Greek world, archaeological survey in particular has spawned a generation of multidisciplinary studies on the interactions between landscape and people, between rural and urban (Halstead and Frederick 2000; Adam-Veleni, Poulaki, and Tzanavari 2003; Alcock and Cherry 2004; Bresson 2016).

What accounts for this astonishing development in what many outsiders probably regard as a fairly dry subject? Undoubtedly one cause is the increased interest in the ancient economy. Since ancient economies were overwhelmingly agricultural, the farming sector demands serious attention. Environmental and demographic research as well as growing interest in foodways have also prompted more work on rural life in antiquity. Efforts to better estimate the population of Roman Italy have led, for example, to interest in the land's carrying capacity and thus more attention to issues of agricultural yields (on modeling Roman production, see Goodchild 2013; for Seleukid Mesopotamia, see Jursa 2010). The need to take stock of all

these developments inspired us to develop this Companion, which we hope offers an entrée into a field now so rich in research as to be perhaps somewhat intimidating.

## Structure of the Volume

The chapters in Part I of this volume examine fundamental aspects of the study of ancient agriculture: the roles of paleoethnobotany, zooarchaeology, and isotopic analysis as well as the plants and animals themselves. The chapters in Parts II through IV show some of the ways in which agriculture developed over the course of about four thousand years from the Neolithic to the Roman period. We asked the authors of these chapters to discuss their regions' sources (archaeological and textual); geography, climate, crops, and livestock as well as the agricultural calendar, tools and technology of cultivation, any major political, social and economic aspects of agriculture, and changes in the practice of farming during the period. (The reader will also find guides to further reading at the end of each chapter.) The greater attention paid to regional developments in the Ancient Near East and classical Mediterranean betray, of course, our training but also reflect our desire to help Classicists, Biblical scholars, and other students of the ancient world (broadly construed) understand the agricultural context of early Mediterranean societies. However, knowing the importance of comparative approaches, we have included chapters on ancient India and China. The concluding chapter, by an agricultural historian of the modern United States, is also offered in the hope of greater engagement with the broader field. As its author, Pamela Riney-Kehrberg, notes, "the agricultural world has not changed as much as we might think." Of course, we have not been able to include chapters on every period or region even of Greco-Roman antiquity (nor indeed every useful analytical approach). While we regret the omissions, they also made the project feasible.

## The Trajectory of Ancient Agricultural History

We asked our contributors to note important ongoing debates and suggest avenues for future investigation in their areas. While different regions have different stories – both in terms of ancient agricultural developments and modern research trajectories (driven as much by warfare and politics as by academic trends) – similar comments appear across many chapters. In antiquity, changes in ancient agricultural practice often happened slowly, but, as Christophe Chandezon (this volume) puts it, "nothing was ever static." The biggest challenge to understanding this flux is now probably the mountains of data available to researchers, from literary, epigraphical and papyrological texts, and the results of field survey, to faunal and botanical evidence, as well as the insights offered by palynology, paleopathology, paleoclimatology, dendrochronology, and geology. Integrating all this material is no simple task, and we expect large, collaborative projects to become even more common in the future. There are also, of course, many specialized topics on which further research is needed. In certain areas, more study of particular tools, crops, art, or texts will improve our knowledge of local developments and practices. More excavations of smaller rural sites would be extremely helpful in most regions, and indeed this has been a common refrain throughout the studies collected here.

Six key developments are central to the recent and future development of ancient agricultural history. First, there is the continuing reevaluation of the fundamental ancient texts, particularly the agricultural writers. For the Roman world, one might note the work

of Thibodeau (2011) on Virgil or Henderson (2002) on Columella; for Greece that of Edwards (2004) on Hesiod and his world and Pomeroy (1994) on Xenophon; and for the Ancient Near East that of Wunsch (1999; 2000; 2003) on the archives of the Egibi family of Babylon and that of Pearce and Wunsch (2014) on the archives of the Judeans in Mesopotamia. Second, the field survey, vastly expanded in use since the 1970s and considerably refined in terms of methodology (though problems remain), is greatly enhancing our knowledge of the ancient countryside. Third, the scientific analysis of biological remains from excavations has enriched our understanding of both arable farming and animal husbandry though, as several of our contributors note, we need more systematic collection of a wider range of botanical, faunal, and environmental evidence. Fourth, the study of ancient forests and forest management holds great promise (see, e.g. discussion of Mediterranean deforestation in Harris 2013). As Robyn Veal notes (2017, 388), “[wood] ... was substantially part of the agricultural economy” and the remains of charred wood, if properly collected and analyzed, can tell us much. Fifth, agricultural historians of antiquity can profit from adopting a range of approaches from other fields of history. A number of our contributors suggest that we will profit by considering agriculture from an economic, religious, social, or gender perspective. Comparative history is also providing new insights into old problems. For example, Halstead’s *Two Oxen Ahead*, drawing on “first-hand observation of and interviews with residents of the Mediterranean countryside” (2014, x), has much to offer the historian of the premodern Mediterranean on a variety of agricultural topics. Haug (this volume) notes the value of Alan Mikhail’s environmental history of Ottoman Egypt “for historians of Egypt in any period.” Environmental histories with a *longue durée* approach also tend to foreground interesting continuities. Horden and Purcell’s *The Corrupting Sea* (2000) stands out in this regard, brimming as it is with important observations on ancient agriculture. Sixth, and finally, paleoclimatology is perhaps the most exciting new direction in the study of ancient agriculture. The reconstruction of ancient climates is beginning to clarify the conditions in which ancient farmers operated (for the Roman period see, e.g. Manning 2013). These avenues of research suggest that the field of ancient agricultural history has the potential to yield many more exciting developments in the near future.

## REFERENCES

- Adam-Veleni, P., Effie P., and Katerina T. (2003). *Ancient Country Houses on Modern Roads*. Athens: TAPA.
- Alcock, S. and John F.C. (eds.) (2004). *Side by Side Survey. Comparative Regional Studies in the Mediterranean World*. Oxford: Oxford University Press.
- Becker, J.A. and Nicola, T. (2012). *Roman Republican Villas: Architecture, Context, and Ideology, Papers and Monographs of the American Academy in Rome*. Ann Arbor: University of Michigan Press.
- Bresson, A. (2016). *The Making of the Ancient Greek Economy. Institutions, Markets, and Growth in the City-State*. English translation by S. Rendall. Princeton and Oxford: Princeton University Press.
- Edwards, A.T. (2004). *Hesiod’s Askra*. Berkeley: University of California Press.
- Forni, G. and Arnaldo M. (2002). *Storia dell’agricoltura italiana*. Firenze: Edizioni Polistampa.
- Ghisleni, M., Emanuele V., Kim B., Antonia A. et al. (2011). Excavating the Roman Peasant I: Excavations at Pievina (GR). *Papers of the British School at Rome* 79:95–145.
- Goodchild, H. (2013). GIS models of Roman agricultural production. In: *The Roman Agricultural Economy: Organization, Investment, and Production* (ed. A.K. Bowman and A.J.N. Wilson), 55–83. Oxford: Oxford University Press.
- Goujard, R. (1975). *Caton: De agricultura*. Paris: Les Belles lettres.

- Halstead, P. (2014). *Two Oxen Ahead: Pre-Mechanized Farming in the Mediterranean*. Malden, MA: Wiley Blackwell.
- Halstead, P. and Charles F. (2000). *Landscape and Land use in Postglacial Greece*. Sheffield: Sheffield Academic Press.
- Harris, W.V. (2013). Defining and detecting Mediterranean deforestation, 800 BCE to 700 CE. In: *The Ancient Mediterranean Environment between Science and History* (ed. W.V. Harris), 173–194. Brill: Leiden.
- Henderson, J. (2002). Columella's living hedge: The Roman gardening book. *Journal of Roman Studies* 92:110–133.
- Heurgon, J. (1978). *Varron, Economie rurale. Livre premier*. Paris: Les Belles lettres.
- Horden, P. and Nicholas P. (2000). *The Corrupting Sea: A Study of Mediterranean History*. Oxford: Blackwell.
- Jursa, M. (2010). *Aspects of the Economic History of Babylonia in the First Millennium BC. Economic Geography, Economic Mentalities, Agriculture, the Use of Money and the Problem of Economic Growth*. Münster: Ugarit Verlag.
- Kronenberg, L. (2009). *Allegories of Farming from Greece and Rome: Philosophical Satire in Xenophon, Varro, and Virgil*. Cambridge: Cambridge University Press.
- Launaro, A. (2011). *Peasants and Slaves: The Rural Population of Roman Italy (200 BC to AD 100)*. Cambridge: Cambridge University Press.
- Manning, S.W. (2013). The Roman world and climate: context, relevance of climate change, and some issues. In: *The Ancient Mediterranean Environment between Science and History* (ed. W.V. Harris), 103–170. Leiden: Brill.
- Marzano, A. (2007). *Roman Villas in Central Italy. A Social and Economic History*. Leiden: Brill.
- Pearce, L.E. and Cornelia W. (2014). *Documents of Judean Exiles and West Semites in Babylonia in the Collection of David Sofer*. Bethesda: CDL Press.
- Pomeroy, S.B. (1994). *Xenophon, Oeconomicus: A Social and Historical Commentary*. Oxford: Clarendon Press.
- Reay, B. (2005). Agriculture, writing, and Cato's aristocratic self-fashioning. *Classical Antiquity* 24: 331–361.
- Thibodeau, P. (2011). *Playing the Farmer: Representations of Rural Life in Vergil's Georgics*. Berkeley: University of California Press.
- Veal, R. (2017). Wood and charcoal for Rome: Towards an understanding of ancient regional fuel economics. In: *The Economic Integration of Roman Italy: Rural Communities in a Globalizing World* (ed. T. de Haas and G.W. Tol), 388–406. Leiden: Brill.
- White, K.D. (1970). *Roman Farming*. Ithaca, New York: Cornell University Press.
- Wunsch, C. (1999). The Egibi family's real estate in Babylon (6th century BC). In: *Land Tenure and Urbanization in the Ancient Near East* (ed. M. Hudson and B. Levine), 391–413. Cambridge, MA: Harvard University Press.
- Wunsch, C. (2000). *Das Egibi-Archiv I: Die Felder und Gärten*. Groningen: Styx.
- Wunsch, C. (2003). The Egibi family. In: *The Babylonians: An Introduction* (ed. G. Leick), 236–247. London and New York: Routledge. DOI:10.4324/9780203946237.ch16.

PART I

# **PLANTS & ANIMALS**



## CHAPTER TWO

# Paleoethnobotany and Ancient Agriculture

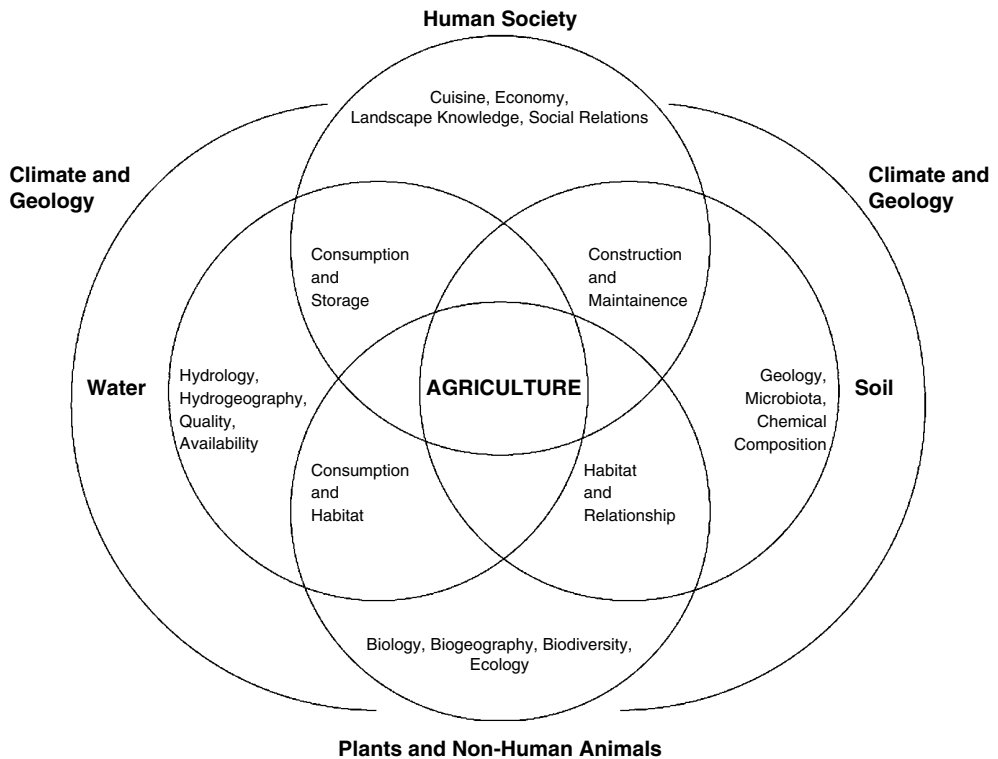
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*Alan Farahani*

### Introduction

The archaeological study of ancient agriculture, like the topic itself, is a multidisciplinary enterprise that requires different natural and social scientific techniques to build a more complete picture of it. Like the proverbial blind wise men who touch different parts of an elephant and hence come to different conclusions about the shape of the organism, so too do the various techniques offered by archaeological science present complementary but distinct insights into the same phenomenon of “agriculture” in the human past (Reitz and Shackley 2012, pp. 1–6). As the contributions in this volume invariably show, agriculture is not, echoing agro-ecologist John Vandermeer (2011, p. 26), “planting a seed and harvesting a crop. Agriculture is making a contract among people to provide for one another, using seeds and harvests to do so.” In short, agriculture is as much of a social endeavor, in that people need to coordinate their labor and create new artifacts to assist in almost every stage of the planting, harvesting, and storage of desired plants (e.g. Asouti and Fuller 2013, pp. 318–321; Fuller et al. 2014b), as it is one that is embedded in and dependent on local environments and ecologies (Ingold 2000a). Archaeological investigations of ancient agriculture, therefore, must juggle both the biophysical (seeds, soils, climate, water) and social (cuisine, economy, gender) factors that are attendant to any understanding of how people in the past came together to plant seeds in the ground, or coppice trees, or use plants to clothe, shelter, and provide medicine for the human and nonhuman animals in their communities (Ingold 2000b) (Figure 2.1).

A distinction can therefore be made between the two major, interrelated archaeological approaches used to investigate and interpret the physical residues of ancient agriculture. Typically, the subdiscipline of archaeology concerned with “the *recovery* and *identification* of plants by specialists regardless of discipline” (Ford 1979, p. 299, italics in original) is referred to as “archaeobotany.” At times, another term for the analysis of the same material is “paleoethnobotany,” and for many practitioners the two words can be used interchangeably (VanDerwarker et al. 2016, p. 126). Alternatively, paleoethnobotany can be envisioned specifically as “the study of past cultures by an examination of human populations’ interactions with the plant world” (Popper and Hastorf 1988, p. 1). The emphasis in the latter is on past cultures, that is the



**Figure 2.1** Model of the intersecting biophysical and social factors that constitute agriculture, and which thus form an essential component of establishing a research motivation for the interpretation of paleoethnobotanical data (Farahani 2018: Fig. 1). Source: Illustration by Alan Farahani.

*ethno-*, or the human factor. In this case, archaeological plant remains are a *means* to understand those phenomena that directly touch upon the human experience, rather than the final object of analysis themselves. The approach is thus anthropological in origin and orientation (Ford 1979, pp. 286–287; Ford 1985a), and draws from anthropological traditions that are concerned explicitly with the ecological (Kottak 1999; Scoones 1999; Orr et al. 2015).

The questions that motivate this research range from explorations of ritual to the political economy (Morehart and Morell-Hart 2015, pp. 485–487). In contrast, archaeobotany can, though may not necessarily, adopt a “plant-based” perspective in which research is aimed specifically at the archaeological plant remains themselves (cf. Dennell 1976, pp. 229–230), such as morphological changes to seeds and other plant parts, as well as vegetation history (e.g. Behre and Jacomet 1991). Paleobotany (another frequently encountered term), on the other hand, is concerned with plant remains typically *before* the emergence of anatomically modern humans or up to the end of the Pleistocene, often using fossil evidence and the methods of paleontology. These data more often address plant evolution, systematics, paleoenvironment, and paleoecology, independent of humans (Taylor et al. 2009, pp. 1–9). Paleoethnobotany and paleobotany are therefore quite distinct when seen through the lens of these operating definitions.

This chapter leans more toward the paleoethnobotanical rather than the strictly archaeobotanical since it emphasizes how archaeological plant remains can answer fundamental anthropological, historical, economic, and ecological questions regarding ancient agriculture, and the ways in which archaeological science can contribute to and enhance this knowledge.

Nonetheless, basic archaeobotanical research is still fundamental to this enterprise, as it provides the plant-focused methodological foundation upon which the analysis and interpretations of these remains are made (e.g. Fuller and Harvey 2006).

The foregoing discussion will also concentrate primarily on the kinds of agriculture that are and were practiced across Eurasia, albeit with some inclusion of other areas of the world. Despite this more restricted geographic focus, paleoethnobotany is very much an international, cooperative enterprise that utilizes methods and interpretive frameworks developed in nearly all times and places (e.g. VanDerwarker et al. 2016, p.126). Techniques used to identify root crops in the Pacific c. 1000 CE (Hather 1992) may serve as an inspiration for those seeking to explore the very same issue in the communities of southwest Asia and Europe c. 1000 BCE (Hather 1994). One of the aspects that unites paleoethnobotanical practice across the world, then, and in particular those studying ancient agriculture, is this specific variety of methods needed to explore and identify past human plant use (Hastorf 1999; Marston et al. 2014; VanDerwarker et al. 2016).

So what does paleoethnobotany entail? In brief, paleoethnobotanists seek the physical residues of past human–plant interactions to make empirically informed inferences about them. Researchers design strategies to recover from archaeological sites the preserved plant parts (seeds, wood, fruits, etc.) and microscopic components of these plant parts (starch grains, phytoliths, etc.) that serve as indicators, or proxies, of a plant’s prior presence. By carefully sampling for these remains, analyzing them in laboratories purpose-made for their investigation, and then quantifying them, it is possible to address the many research questions that one might ask of past agricultural practices.

Many paleoethnobotanical pursuits of ancient agriculture can be placed into two broad conceptual categories: *synchronic*, that is, the analysis of agricultural practice within a given period of time, or *diachronic*, that is, an analysis of change through time. For example, synchronic questions may include, “are certain parts of an archaeological site dating to a specific period used for particular plant processing activities, and not others?” Diachronic questions include, “how does long-term plant-food access change at a particular site with known shifts in human sociopolitical organization?” Many of these questions are virtually unanswerable without the data generated by paleoethnobotanical methods.

Paleoethnobotany has blossomed as a subdiscipline of archaeology, and has made major contributions to our knowledge of agriculture across the world (Hather 1992; Hastorf 1999; Marshall and Hildebrand 2002; Marston et al. 2014; VanDerwarker et al. 2016). It has made particularly important contributions to our understandings of plant domestication, the origins of agricultural production, and the movement of plants by human hands over vast distances (Boivin et al. 2012; Miller et al. 2016; Stevens et al. 2016). The theoretical refinement that comes with new methodological advances, such as from molecular, isotopic, and microscopic paleoethnobotanical methods, has also opened new vistas in the study of ancient agriculture (see Chapter 4). All of these data have complicated unilineal narratives of agricultural development and attempts to portray agriculture, particularly in Eurasia, as stagnant, reactive, and unchanging over millennia, in a word, “timeless” (Knapp and Blake 2005; for a perspective from the Maya world, see Robin 2006).

## A Brief History of the Paleoethnobotanical Investigation of Ancient Agriculture

The use of plant remains to reconstruct ancient environments, foodways, or economies has a history that stretches back to at least the period of “antiquarian” archaeology, c. 1600–1800 CE, within European intellectual history (Trigger 1989 pp. 80–118). Much of the research

of these early antiquarians, and indeed some research well into the late 20th century, was characterized by “serendipitous finds” of plant remains preserved in or near archaeological sites (Miller, 1991, p. 133). The conditions of preservation at the sites of many of these early discoveries were usually highly amenable to the recovery of fragile remains susceptible to decomposition. For instance, in the 19th century the German botanist Carl Kunth (1826) examined extremely well-preserved plant remains, such as entire fig fruits, found inside the moisture-free Egyptian tombs of the Necropolis at Thebes, excavated by Egyptologist Giuseppe Passalacqua (Tedesco 2009). Likewise the Swiss botanist Oswald Heer (1866) identified various perfectly preserved seeds of barley, whole apples, cherry stones, and many other specimens, in early excavations of waterlogged prehistoric lake villages around Switzerland. In the Americas, the French doctor and botanist Charles Saffray (1876, p. 402) found plant remains within a Peruvian mummy bundle, made possible by the exceptional circumstances of preservation of the arid Peruvian coast.

The study of ancient plant remains followed this pattern of relatively unsystematic collection by professionally trained botanists in more favorable contexts of preservation well into the early half of the twentieth century. At that point, a series of intellectual developments occurred that laid the foundation for the systematic acquisition of plant remains at archaeological sites. One of the most important of these developments was the pioneering research of Australian archaeologist Vere Gordon Childe, who in a series of publications, notably his revision of Raphael Pumpelly’s “Oasis Theory” (Childe 1929) alongside his coining of the term “Neolithic Revolution” (Childe 1936), argued that the development of agriculture counted as one of the most transformational events in human social and economic history. Childe’s explanations, however, were light on their use of data; yet the explicit nature of his hypothesis permitted testability, and methods were thus sought in order to verify them (Trigger 1989, pp. 322–326).

Somewhat contemporaneously, the ethnobotanist Volney Jones began to argue for careful attention to the diverse uses of plants by then-contemporary nonindustrial communities, such as for medicine, for utilitarian ends such as food, clothing, and shelter, and to consider their role in music, literature, and oral history. He noted that “as man [sic] and plants are co-existent there is necessarily ecological interaction between them,” which meant that a new field of ethnobotany, which “infring[es] on the domain of some of the more established disciplines” was needed in order to understand “the interrelation of primitive man [sic] and plants” (Jones 1941, p. 220).

The intellectual conjunction of these two developments in an archaeological project in Eurasia was perhaps represented most clearly by Robert Braidwood and Bruce Howe’s excavation of the site of Jarmo, located in Iraqi Kurdistan on the hilly flanks of the Zagros mountain range. There the archaeological team sought to test the hypotheses of V.G. Childe with “field evidence” that “would need not only archaeological excavation oriented directly toward the problem, but also on-the-spot assistance of natural scientists” (Braidwood and Howe 1960, p. 2–4).

The Danish botanist Hans Helbaek was one such participant, and in turn he would establish the term paleoethnobotany as the subdiscipline of archaeology that “unravel[s] the complicated history of the plants upon which even modern civilization is ultimately dependent” (Helbaek 1959, p. 372). The results of Braidwood and Howe’s research thus cemented the importance of the collection and analysis of archaeological plant and animal remains at archaeological sites (Matthews 2003, p. 25). During this time, there was a proliferation of paleoethnobotanical research around the world, with many projects aimed specifically at the investigation of early agriculture, such as Richard MacNeish (1965) at