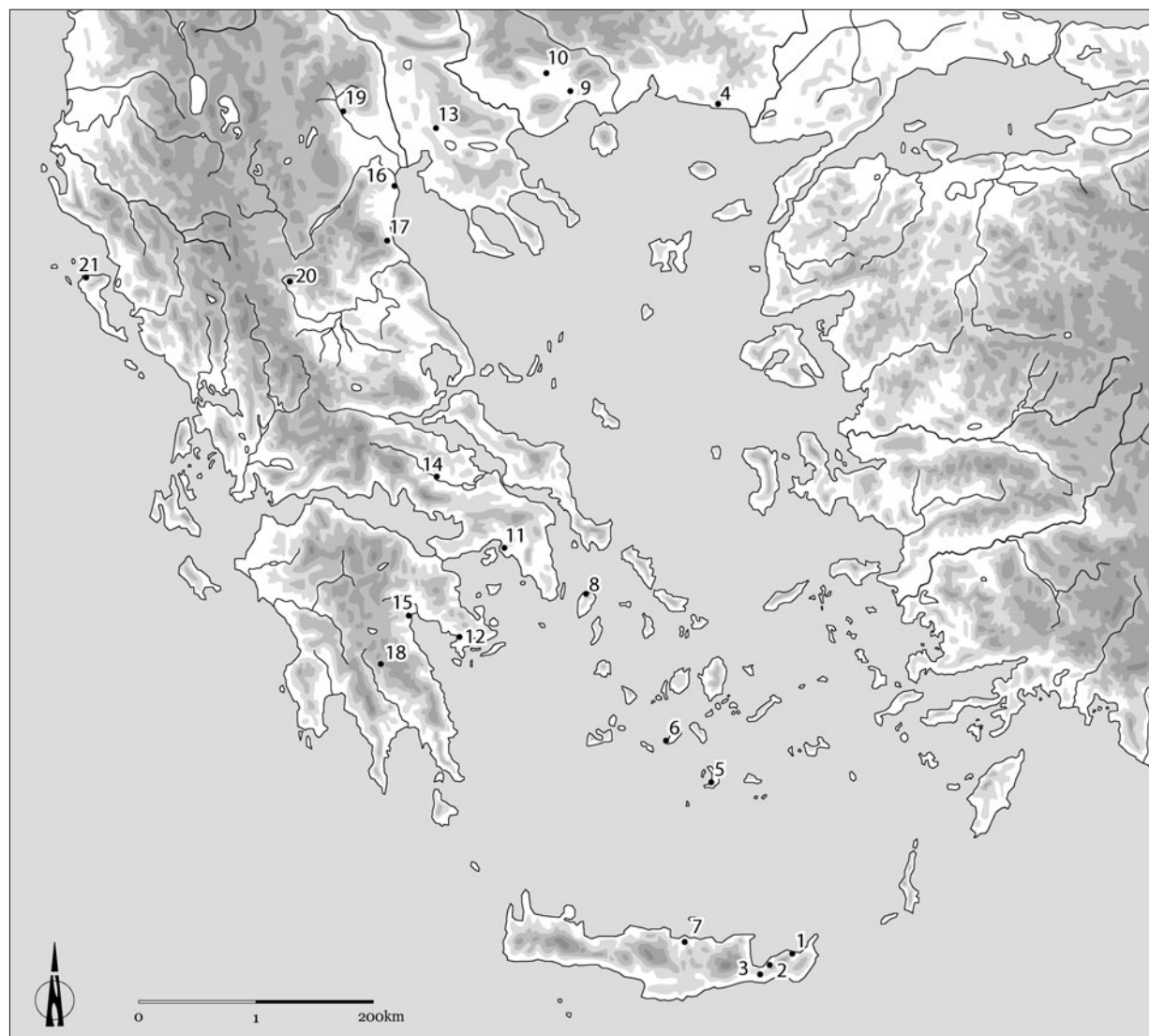


ARCHAEOLOGY IN GREECE 2013–2014

Archaeobotany in Greece

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Map 7. Map of sites in Greece referred to in the text. © BSA.

(1) Kephala Petras; (2) Azoria; (3) Vasiliki Ierapetras; (4) Makri; (5) Santorini (Thera); (6) Saliagos; (7) Knossos; (8) Keos/Kephala; (9) Dikili Tash; (10) Arkadikos; (11) Schisto Cave; (12) Franchthi Cave; (13) Assiros Toumba; (14) Toumba Balomenou; (15) Lerna; (16) Makriyalos; (17) Tria Platania; (18) Kouphovouno; (19) Mandalo; (20) Theopetra Cave; (21) Sidari.

This paper provides a brief overview of the history and main achievements of archaeobotanical work in Greece to date, with the aim of highlighting its potential and creating a framework in which future work can be contextualized. The term ‘archaeobotany’ is used here in its narrow sense, referring to the study of plant macroremains, such as seeds, fruits and other plant parts, and excluding charcoal studies or ‘anthracology’ and analyses of microremains (for example pollen, phytoliths), which have developed to become separate subdisciplines.

From the first finds to a science

Plant remains in the form of large concentrations of seeds or individual finds of large specimens (known as spot finds), such as fruit stones, have been reported in the archaeological literature since the end of the 19th century. Botanical specimens that were occasionally unearthed caught the attention of archaeologists and site directors, who would either invite botanists or other experts to identify the species, or would simply rely on the expertise of the archaeological team, including that of local workers. A rather widely reported case is that of the early excavations at Knossos, where local workmen identified seeds found in a pithos as ‘Egyptian beans’, a variety of small fava beans imported to Crete from Alexandria at the end of the 19th (Evans 1901: 20–21). At the other end of the spectrum, Heinrich Schliemann (1886: 93) sent samples of the masses of burnt grains encountered in the early levels of Tiryns to an expert, Professor L. Witmack, who securely identified them as grape pips albeit of ‘unusual size’. Kenton Vickery was the first to review plant finds, among other forms of evidence, in his book *Food in Early Greece* (1936), in his attempt to reconstruct past diets. Archaeobotanical spot finds continued to be reported in the archaeological literature until relatively recently, with Antonis Zois’ (1992) publication on Early Minoan Vasiliki Ierapetras providing the last such report from Crete (see Livarda and Kotzamani 2014: 7). A reference list of several spot finds was compiled by Fragkiska Megaloudi (2006: 5) in the publication of her PhD thesis. More recently Georgia Kotzamani and I (2014: 5–7) have analysed and reviewed all spot finds from Neolithic and Bronze Age Crete by phase and publication date, drawing attention to the potential problems, and often unreliability, of these early reports. Despite such potential problems, early plant finds visible to the naked eye aroused curiosity and paved the way towards their more systematic collection in the following decades.

Archaeobotany, the study of plants in cultural settings, along with all other bioarchaeological subdisciplines, became a recognized field in archaeology with the emergence of the ‘New Archaeology’ in the 1970s. In this context, new methodologies and analytical tools were developed for the recovery and interpretation of botanical remains, which allowed their potential application in the search for answers to research questions, instead of species merely being listed in reports. The development of the flotation machine for the bulk recovery of organic remains was perhaps the first important step in this direction. Based on the water-separation principle, David French (1971) devised a machine, commonly known as the ‘Ankara machine’, during the excavation of Can Hasan III in Turkey, of which several variations exist nowadays (**Fig. 120**). Julie Hansen was the first to employ this technique in archaeology in Greece, for the recovery of plant remains at Franchthi Cave in the 1970s (see, for example, Hansen 1991), although Jane Renfrew had already employed bucket flotation for the same purpose in the 1960s. Since then, the employment of archaeobotanists in research projects and in the field, the incorporation of targeted sampling strategies and the more efficient recovery of plant remains have allowed the accumulation of a reliable and controlled corpus of plant finds from archaeological sites in Greece, which has contributed to the illumination of several aspects of life in the past.



120. Example of a flotation machine designed for water recycling. © A. Livarda.

The interdisciplinary basis

Archaeobotany, as implied by its name, is inherently interdisciplinary. Botany, however, is but one of the several disciplines which come together in the study of plants in past societies. Ethnographic and experimental investigations have been two of the foundation stones of archaeobotany. More recently, genetics, stable isotope analysis and GIS modelling have added to and enriched its interpretative potential. Whilst a full review of archaeobotanical practice is beyond the scope of this essay, some reference to seminal interdisciplinary work conducted in Greece, within the context of archaeobotany, is necessary to understand current research directions.

Greece still hosts pockets of rural communities that operate within largely traditional agricultural systems, and are thus conducive to ethnographic work. The Aegean islands of Amorgos and Karpathos host examples of such communities, and this is where early research undertaken by Glynis Jones and Paul Halstead was focused. Careful observations, discussions with local people and collection of plant material from different agricultural activities, and their separate stages, helped formulate models for the interpretation of archaeobotanical assemblages. In order to decipher what plant remains ‘mean’, it was first crucial to understand how plants came to be together in one sample. The premise was that, without modern machinery, cereals and legumes, after harvesting, need to pass through a series of stages, such as threshing, winnowing, coarse and fine sieving, and hand cleaning, in various combinations, to be made ready for consumption/usage (for example Hillman 1981). By studying the relative proportions of modern free-threshing grains, chaff and weeds from each step in this process, models were developed that allowed the identification of the crop-processing stage from which an archaeological plant assemblage was derived (for example Jones 1990). This method could only be applied, however, to the same kind of crop, i.e. free-threshing, as different types of cereals, such as glume wheats, require a different set of stages for their processing. Analogies, therefore, to non-free-threshing crops are not valid.

To overcome this problem, Jones (1984; 1987a) resorted to the qualities of the weed species, and found that the most relevant factors in the processing of crop grains was their size (small or big), their tendency to remain in heads or not (free or headed) and their aerodynamic properties (light or heavy). After collecting weeds from both the product and the by-product of each crop-processing stage, Jones classified them into groups according to the qualities mentioned above in order to indicate which processing stage they belonged to. In this manner, she managed to avoid the inclusion of chaff in the model, which dictates the processing of particular types of crops and, thus, in the previous model, prevented analogies from being drawn with other types of crops. The application of this method of analysis to archaeological plant material opened new possibilities for the disentangling of all types of past crop assemblages. The combined importance of both models for the identification of crop-processing stage is that together they provide a better understanding of agricultural formation processes and allow comparisons of material from the same stage, without obscuring other patterns (see Jones 1991).

Following a similar rationale, Evi Margaritis and Martin Jones (2008a), prompted by the sheer quantities of charred olive remains recovered at the Hellenistic (fourth- to second-century BC) farmhouse of Tria Platania in Pieria, combined experimental and ethnographic studies to suggest how olives were consumed (as fruits or olive oil) and how to identify the different processing stages of this crop. In the same study they also offer insights into possible crushing techniques for the extraction of oil. The authors indicate the different proportions of whole and fragmented olives, ‘pulp’, flesh and kernels that should be present in each processing stage, and propose a method of identifying whether olive stone fragments were broken before or after deposition in the archaeological layer. On the basis of this work, and of related evidence, olive-oil production using a technique that did not involve complete crushing of all olives during milling has been inferred at Tria Platania (Margaritis and Jones 2008b). Similarly, olive-oil production has been suggested for the Early Iron Age site North of the Little Palace, Knossos (Livarda 2008) and at the Archaic city of Azoria on Crete (Haggis *et al.* 2011), among other sites.

A good deal of ethnographic work has been carried out in Greece and has contributed significantly to our appreciation of the husbandry practices and agricultural regimes of the past (**Fig. 121**). Fundamental studies with direct relevance to archaeobotany include work by Jones and Halstead (1995) and Halstead and Jones (1989) which sheds light on the complexity of farmers’ choices regarding what to plant, how and when to process different crops and what to use as food or fodder, according to need and the success or failure of each year’s yield. This year (2014), Paul Halstead’s latest book, *Two Oxen Ahead*, was published; in it he summarizes more than 30 years of research, first-hand experience and deep knowledge of traditional farming systems in Greece and the wider Mediterranean. This excellent book is an invaluable tool for archaeobotanists and other interested readers. It demonstrates successfully how an in-depth understanding of current farming practices can be a key to deciphering the past.

Ethnographic work has been complemented by rigorous botanical research, including weed ecology (for example Bogaard 2002; Jones 1992a; 2002; Jones *et al.* 2010), which has contributed significantly to the ‘translation’ of archaeobotanical data into reconstructions of past crop-husbandry regimes. The premise is that although crops can adapt to different environments through human manipulation, weeds are sensitive ecological indicators that will colonize a field only when conditions are favourable to their particular requirements. Therefore, they can act as indirect indicators of specific soil conditions. It is, thus, possible to provide insights into irrigation regimes, the application or not of manuring (so as to increase soil fertility), fallow and crop-rotation practices, seasonality of cultivation, intensive or extensive agriculture regimes and so on. These practices are directly associated with the organization of life in the past and have implications for wider questions concerning different strategies, from self-sufficiency to surplus production and further redistribution of plant-based products, as well as other aspects of socio-cultural, economic and political relations and decisions. The application of weed ecology to the investigation of husbandry practices is regularly employed in Greek archaeobotany, albeit with varying results according to the presence, the quality and quantity of weeds in the assemblages.

Stable isotope studies are increasingly being employed in archaeobotanical research to address similar issues, using the crop itself instead of its weeds (for example Ferrio *et al.* 2005; Bogaard *et al.* 2007; Fraser *et al.* 2011). Two applications may illustrate how this method has added to our understanding of the prehistory of Greece. The first, by Tim Heaton and colleagues (2009), involved the study of carbon stable isotopes of modern and archaeological cereal remains from the storerooms unearthed at the Bronze Age site of Assiros Toumba in northern Greece. The results indicate that cereals were cultivated under an intensive horticultural regime, possibly with some watering. They verify that emmer and spelt were grown together as a maslin crop (i.e. grown intentionally together in one field) and indicate that, in all likelihood, the produce was stored after the pooling of a single year’s local harvests. This mobilization of resources is interpreted as indicative either of communal storage or of a central authority orchestrating the grain collection, which would be consistent with the rather localized settlement hierarchies of the period in that area.

The second study integrated carbon and nitrogen stable isotope analyses of plants and animals with collagen sequencing of sheep and goats to reconstruct farming practices at Kouphovouno, a Middle to Late Neolithic tell village in the Peloponnese, near Sparta (Vaiglova *et al.* 2014). A nuanced picture of Neolithic agricultural practices at the site was achieved, supporting the model of small-scale mixed agriculture and settlement organization, and highlighting changes to crop and animal practices through time, such as a reduction in the scale of ovicaprid management and a decrease in manuring and in the level of labour involved during the Late Neolithic phase.



121. Traditional threshing floor. © A. Livarda.

This brief overview has highlighted some of the basic current archaeobotanical approaches and methods, and their interdisciplinary nature, whilst also providing examples of their application in archaeology in Greece. The next section focuses on specific research themes in order to showcase research trends in the archaeobotany of Greece.

Selected research themes in the archaeobotany of Greece

Archaeobotanical research in Greece has largely focused on the prehistoric era, and it is only recently that some timid steps have been made towards its incorporation into the research of the later periods. The customary lack of sampling of all bioarchaeological remains in excavations of sites dating to historic periods complicates the situation further, as normally there is not a collection held in storage that can be revisited and studied. As a result, the bulk of the research themes addressed here refers mainly to earlier periods.

One of the most intensively researched topics worldwide is that of the emergence of agriculture and early farming communities. A long-standing debate with regard to this period in Greece focuses on whether agriculture and its associated lifestyle developed mainly through indigenous processes or was transferred from western Asia through the movement of people and/or ideas (see, for example, Kotsakis 2001). Also central to this debate is the investigation of the character of human habitation and lifestyles in the Palaeolithic and Mesolithic periods, which set the scene for the changes that followed in the Neolithic. Archaeobotany's contribution to this debate, although still relatively limited, is of particular significance, as it offers primary evidence for foraging and the emergence of an agricultural way of life (for a review, see Valamoti and Kotsakis 2007). The first site where targeted soil sampling for the recovery of plant remains from these early periods was conducted was Franchthi Cave in the Peloponnese, spanning the period from the Upper Palaeolithic to the Neolithic (for example Hansen 1991). The data from Franchthi Cave provided significant insights into early dietary regimes and foraging practices, and indicated the early use of wild barley and oat in the later phases of the Upper Palaeolithic period (Hansen 1991). On the basis of material from the whole time sequence, Julie Hansen (1991; 1999: 160–63) favours the idea of the introduction of fully domesticated plants through exogenous influences, with the settling of new people in the area, although she does not rule out the possibility of some earlier, indigenous wild plant cultivation through experimentation.

Since this research was carried out, a few more sites have yielded archaeobotanical material dated to these early periods. In 2010, Georgia Kotzamani completed her PhD thesis, *From Gathering to Cultivation*, which added significant new data and interpretations of the elusive Palaeolithic, Mesolithic and Early Neolithic periods, presenting the archaeobotanical assemblages from the sites of Theopetra Cave in Thessaly, Schisto Cave in Attica, Revenia in Macedonia and Sidari on Corfu. The archaeobotanical data from Theopetra, the study of which was initiated by Maria Mangafa (whose demise has been a great loss), are particularly important as they provide the first evidence of human-plant interactions during the end of the Middle Palaeolithic period. Kotzamani's study contributes to the delineation of a much more nuanced picture of early plant use in Greece and shows that the pattern of the adoption of agriculture was heterogeneous. She argues against the sudden introduction of all domesticates as a package from the Near East and suggests that, although certain introductions seem to have taken place (for example emmer wheat), local, long-term knowledge of several available wild-plant progenitors (for example of barley and vetchling) could also have contributed to cultivation, and the eventual domestication, of some of these. Her study thus approaches the transition to agriculture as a multifaceted process that involved the incorporation of different elements towards the domestication of the landscape and moves away from one-dimensional explanations for the emergence of agriculture in the space of modern Greece. More studies of these periods are gradually being published; these will fill in the gaps towards a better understanding of early human lifestyles.

Much more archaeobotanical work has been conducted on the ensuing Neolithic phases and the Bronze Age period. The work of Anaya Sarpaki, the first professionally-trained Greek archaeobotanist, and of Soutana-Maria Valamoti has been key to the investigation of these periods in southern (mainly Crete)

and northern Greece respectively. For northern Greece, the publication of Valamoti's first monograph (2004), which presents an archaeobotanical analysis of five Late Neolithic and Early Bronze Age sites from the area, was a significant milestone. The material subjected to analysis was drawn from the extensive sites of Makriyalos and Arkadikos, and the tells of Mandalo, Dikili Tash and Makri. Her careful examination indicates that the plant remains did not cluster according to settlement type (whether of the extensive or tell forms), but that the observed patterns are instead related to the type of deposit (refuse *versus* storage). At each site different practices were identified, delineating a rich mosaic of dietary regimes, plant selection, animal feeding strategies, certain fuel choices and other aspects of crop and animal husbandry practices. Several other archaeobotanical studies have been conducted in northern and central Greece which have helped shape our understanding of the character of prehistoric economies and societies in the area. As far as the Neolithic period is concerned, most studies refer to the Late Neolithic phase, but there is also a substantial dataset for the Middle Neolithic.

At the opposite end of the Balkan peninsula, in southern Greece, far fewer studies of Neolithic archaeobotanical assemblages have been assembled and most of these emanate from older excavations (for example Lerna: Hopf 1961; Saliagos: Renfrew 1968; Keos/Kephala: Renfrew 1977). Apart from that from Knossos (see below), the only other Neolithic archaeobotanical assemblage available to date from the island is that from the site of Kephala Petras in eastern Crete, dated to the Final Neolithic, which is currently being studied by Kotzamani (reported in Livarda and Kotzamani 2014). The material from Neolithic Knossos is of particular interest, as it constitutes the earliest and the richest assemblage from Crete, covering all the Neolithic phases starting with the Aceramic. The Knossos assemblage was first studied by Hans Helbæk and later revisited by Anaya Sarpaki, who published the full study in 2009. Sarpaki (2009) suggests that the people who settled at Neolithic Knossos were fully-fledged farmers, well acquainted with agricultural practices; they used a wide range of crops, including various cereals, legumes, fruits and oil-producing plants, in a mixed agricultural, horticultural and probably arboricultural regime. Of significance also has been the identification of free-threshing wheat in substantial quantities already in Aceramic levels, rendering this one of the earliest finds in Greece. Taking into account its limited occurrence in northern Greece (see below), this find is interpreted as an indication of eastern connections and of the importation of free-threshing varieties of wheat from western Asia.

Overall, the archaeobotanical studies now available for the Neolithic period across Greece have highlighted variability between sites and also reflect certain patterns across sites, including a geographical distinction between north and south. Although most data currently derive from northern Greece, it seems that einkorn wheat predominated in the north with emmer and possibly free-threshing wheat dominating in the south. This pattern continued into the Bronze Age, although free-threshing wheat became more common in the north too (see, for example, Valamoti 2009: 120–21). The prevalence of einkorn in northern Greece has been explained by Sarpaki, prompted by her work on the Neolithic Toumba Balomenou in Chaironeia (1995), as some form of cultural traditionalism. Valamoti (2004: 111–15; 2009: 50–51) concurs that it could be related to cultural preferences and to the identity of local people.

Several culinary changes, among other plant-related activities, have been observed for the Bronze Age of Greece. The Bronze Age is in fact one of the best-documented periods across Greece in terms of archaeobotanical research. Various new food plants were added to the dietary repertoire during this period. Further research and the careful examination of plant material by Glynis Jones and Anaya Sarpaki, for instance, indicate the occurrence of two new species in Greece in Bronze Age assemblages: Cyprus vetch (*Lathyrus ochrus*) (Jones 1992b) and Spanish vetchling (*Lathyrus clymenum*) (Sarpaki and Jones 1990). The former was identified at the Unexplored Mansion at Knossos and the latter at Akrotiri on Thera. More finds of these legumes have been unearthed since their first identification, but so far they all derive from Crete, possibly another indication of their southern distribution and the tight links between this island and Santorini (Livarda and Kotzamani 2014: 12). Legumes in general constituted significant parts of prehistoric diet and agricultural activities. Their role (despite the apparent absence of relevant references in Linear B tablets) is stressed by several scholars, with Sarpaki (1992) arguing that legumes should be added to the traditional Mediterranean triad of cereals, olives and grapes.

Another change that crystallized in the Bronze Age was the establishment of two more cereals: spelt and broomcorn millet. Their exploitation is certain for northern Greece; only a few such finds have been reported from southern areas, where, in fact, the occurrence of millet is not fully verified (Valamoti 2009: 53; Livarda and Kotzamani 2014: 11). Valamoti (2013), combining archaeobotanical, zooarchaeological, artefactual and human isotopic data, pinpoints the establishment of millet to the Late Bronze Age and suggests that its consumption was restricted to specific regions, settlements or individuals. Notably, she further proposes a possible link between the introduction of millet and the horse in northern Greece, through contacts with horse-breeding cultures from the north and/or the northeast that based their subsistence on this crop. One of the most promising current research trends in archaeobotany is indeed the exploration of connectivity networks and their implications for the intertwining of people, their ideas and practices, as prompted by the analysis of plant remains. Another example of this trend is the work of Jones and Valamoti (2005), who have identified a new oil-producing plant of the genus *Lallemantia* in archaeobotanical assemblages of northern Greece and, as it is not native to the area, have investigated its origin and distribution. The two researchers conclude that *Lallemantia* seeds were probably introduced through an eastern or northern route during the Early Bronze Age and were taken up in local cultivation. On the basis of the timing of its introduction, a link has been suggested between the distribution networks of *Lallemantia* and those of the raw materials for metallurgy (for example Valamoti 2009: 124). This discovery opens up new possibilities for the combination of archaeobotanical and archaeometallurgical investigations, and potentially a better understanding of trade and the movement of people, products and ideas (Jones and Valamoti 2005).

Archaeobotanical research for the Bronze Age has identified the introduction of several other plants from different parts of the world that enriched life in different ways during this period. The culinary journey from the emergence of agriculture to the Bronze Age, identified on the basis of archaeobotanical remains, is summarized in Valamoti's second monograph, which was published in Greek in 2009. This is a very well written and well informed textbook, providing useful insights into prehistoric diet and cuisine in Greece, their development and changing roles in society; it concludes with a comprehensive bibliography and summary figures and tables of the available archaeobotanical data. Earlier (and briefer) studies on agriculture, plant management and their role in the socio-economic organization of prehistoric Greece were published by Glynis Jones (1987b) and Julie Hansen (1988). More recently, two accounts specifically covering the prehistory of Crete have been published: Sarpaki (2012a) focuses on the Neolithic and the role of certain fruits; Livarda and Kotzamani (2014) synthesize and assess all archaeobotanical remains to date.

Within the rich reservoir of prehistoric archaeobotanical research that has accumulated to date, a final theme to be highlighted has occupied substantial space in the publication record: the exploitation and roles of grapes, olives and their by-products. Debates around knowledge of them and about their use started in the 1970s, when Colin Renfrew (1972) introduced the idea that oleiculture and viticulture (along with cereal cultivation) created the conditions for the emergence of the Bronze Age palatial elite and the need for redistribution centres for these products and their by-products. Archaeobotanists and other archaeologists, employing plants among other lines of evidence, have contributed to the debate over more than 40 years. One of the most influential arguments has been put forward by Yannis Hamilakis (for example 1996; 1999), who, on the basis of plant, artefactual, documentary, ethnographic and historical evidence, suggests that wine and olive oil were employed and consumed in power negotiations by social elites (the reproduction and legitimization of authority). He also identifies their systematic exploitation in the First and Second Palace periods on Crete (the later Bronze Age) respectively, and argues that oil production intensified in the Postpalatial period (*contra* Renfrew 1972). In this context, the olive and vine were not seen as subsistence crops, but rather as luxury products.

Archaeobotanical data for olive cultivation indicates a very restricted presence in northern Greece and a more widespread occurrence in the south, where it seems to have been established sometime during the Bronze Age (see, for example, Hansen 1988; Sarpaki 2003; 2012a; Valamoti 2009: 88). The earliest archaeobotanical evidence for the production of olive oil derives from the Middle Minoan IA site at

Chamalevri on Crete (Sarpaki 1999). On the other hand, grapes (**Fig. 122**) are present across Greece from the Neolithic period onwards and there is good evidence for wine production already in this period in the north. Research by Valamoti and others (2007) on the Neolithic tell site of Dikili Tash in eastern Macedonia unearthed charred grape remains, dated to the second half of the fifth millennium BC, which are interpreted as related to the production of grape juice and/or wine pressings. These form the earliest such evidence in the Aegean to date. As more and more archaeobotanical data, along with other lines of evidence, have becoming available over recent years, interest in the role of these plants in past societies and economies has been maintained (for example Sarpaki 2012a; 2012b; Margaritis 2013; Livarda and Kotzamani 2014). The wealth of new data, resulting from new excavations and palaeoenvironmental projects, and the application of new methodologies, such as residue analysis, has brought optimism that new interpretations can be reached, but also some scepticism. Anaya Sarpaki, for instance, raises concerns about the potential misinterpretation of organic residue analyses, stressing that they often ‘indicate one of several substances, without being able to pinpoint exactly which one it is’ (2012a: 41). Despite the problems, the critical and careful employment of all the evidence has great potential for further positive contributions to these archaeological debates.

Many more research topics have been addressed in the context of prehistoric archaeobotany, such as the identification of cooked food and different cooking methods, the identification and role of fodder and dung, and so on. In contrast, research conducted on subsequent periods of the past is less advanced. Megaloudi (2006) presents a list of sites and plant species in Greece from the Early Neolithic to the Classical period which includes dedicated sections on the Protogeometric, Geometric, Archaic and Classical periods. This study is very useful as a starting point in the investigation of what plants were available (although the reader is recommended to consult the original sources for fuller pictures of the individual studies and the quantified data cited in them). The Early Iron Age is somewhat better understood, and Helmut Kroll (2000) provides a useful overview of the archaeobotanical information on agriculture of this period for mainland Greece. One of the changes that Kroll observes is the overall predominance of free-threshing against glume wheat, which has several implications for contemporary patterns of socio-economic organization. More recently, I have reported on new plant evidence from Crete, dated to the Protogeometric period, and provided an overview of all archaeobotanical data from Greece for this phase (Livarda 2012). This study identifies contextual and spatial differences in the use of various plants and suggests that the character of the archaeobotanical data of the period, on current evidence, resembles Bronze Age assemblages more closely than those from later phases of the Early Iron Age, as described by Kroll (2000).

The evidence for later periods is more sporadic, and archaeobotanical work consists mainly of site-specific studies (for example Kroll 1993; Bookidis *et al.* 1999). Some interesting insights have nonetheless been obtained on plants in ritual practices. Megaloudi (2005), for instance, has studied the charred plant remains from a sacrificial enclosure inside a *heroon* at Messene in the Peloponnese, dated to the end of the third century BC, and reports the first macrobotanical evidence for the presence of the chestnut in Greece. In this study Megaloudi also reviews all other evidence of plant offerings from Classical and Hellenistic Greece, and compares them to those from Archaic and Roman Italy, central Europe and the Roman Empire in general. She concludes that, as in other areas where such research has been conducted, there were no significant differences between the food plants of the dead and of the living, and that chestnut and stone pine had a clear, although not exclusive, association with ritual practices.

Epilogue

This account of archaeobotanical work in Greece is by no means exhaustive. The body of work is very rich, particularly for the prehistoric periods, and here only a selection is reported in order to highlight the general history and main research directions of the field. Most individual studies, often published as parts of site reports, are cited and summarized in the various synthetic studies mentioned in the text.



122. Charred grape fruit and pip. © N. Valasiadis.

Archaeobotany has come far since its first applications. It is a subdiscipline that has now started to be recognized as an important aspect of archaeological research; an aspect that has great potential both to add to existing discussions and to commence new debates about life in the past. A great deal more data and archaeobotanical research are necessary in order to understand fully the complex nature of human-plant interactions throughout history. Such a task entails close collaboration and the integration of archaeobotany, as well as cognate lines of evidence, into the research design of excavation projects from their inception; a promising trend in this direction has started in the archaeology of Greece.

Bibliography

- Bogaard, A. (2002) 'Questioning the relevance of shifting cultivation to Neolithic farming in the loess belt of Europe: evidence from the Hambach Forest experiment', *Vegetation History and Archaeobotany* 11, 155–68
- Bogaard, A., Heaton, T.H.E., Poulton, P. and Merbach, I. (2007) 'The impact of manuring on nitrogen isotope ratios in cereals: archaeological implications for reconstruction of diet and crop management practices', *Journal of Archaeological Science* 34, 335–43
- Bookidis, N., Hansen, J., Snyder, L. and Goldberg, P. (1999) 'Dining in the Sanctuary of Demeter and Kore at Corinth', *Hesperia* 68, 1–54
- Evans, A.J. (1901) 'Knossos. Summary report of the excavations in 1900 I. The Palace', *BSA* 6, 3–70
- Ferrio, J.P., Araus, J.L., Buxó, R., Voltas, J. and Bort, J. (2005) 'Water management practices and climate in ancient agriculture: inference from the stable isotope composition of archaeobotanical remains', *Vegetation History and Archaeobotany* 14, 510–17
- Fraser, R.A., Bogaard, A., Heaton, T., Charles, M., Jones, G., Christensen, B.T., Halstead, P., Merbach, I., Poulton, P.R., Sparkes, D. and Styring, A.K. (2011) 'Manuring and stable nitrogen isotope ratios in cereals and pulses: towards a new archaeobotanical approach to the inference of land use and dietary practices', *Journal of Archaeological Science* 38, 2790–804
- French, D.H. (1971) 'An experiment in water sieving', *Anatolian Studies* 21, 59–64
- Haggis, D.C., Mook, M.S., Fitzsimons, R.D., Scarry, C.M., Snyder, L.M. and West III, W.C. (2011) 'Excavations in the Archaic civic buildings at Azoria in 2005–2006', *Hesperia* 80, 1–70
- Halstead, P. (2014) *Two Oxen Ahead. Pre-Mechanized Farming in the Mediterranean* (Chichester and Oxford)
- Halstead, P. and Jones, G. (1989) 'Agrarian ecology in the Greek islands: time stress, scale and risk', *Journal of Hellenic Studies* 109, 41–55
- Hamilakis, Y. (1996) 'Wine, oil and the dialectics of power in Bronze Age Crete: a review of the evidence', *Oxford Journal of Archaeology* 15, 1–32
- (1999) 'Food technologies/technologies of the body: the social context of wine and oil production and consumption in Bronze Age Crete', *World Archaeology* 31, 38–54
- Hansen, J.M. (1988) 'Agriculture in the prehistoric Aegean: data versus speculation', *American Journal of Archaeology* 92, 39–52
- (1991) *Excavations at Franchthi Cave 7. The Palaeoethnobotany of Franchthi Cave* (Bloomington and Indianapolis)
- (1999) 'Franchthi Cave and the beginnings of agriculture in Greece and the Aegean', in P.C. Anderson (ed.), *Prehistory of Agriculture. New Experimental and Ethnographic Approaches* (Los Angeles) 156–67
- Heaton, T.H., Jones, G., Halstead, P. and Tsipropoulos, T. (2009) 'Variations in the $^{13}\text{C}/^{12}\text{C}$ ratios of modern wheat grain, and implications for interpreting data from Bronze Age Assiros Toumba, Greece', *Journal of Archaeological Science* 36, 2224–33
- Hillman, G. (1981) 'Reconstructing crop husbandry practices from charred remains of crops', in R. Mercer (ed.), *Farming Practice in British Prehistory* (Edinburgh) 123–63
- Hopf, M. (1961) 'Pflanzenfunde aus Lerna/Argolis', *Der Züchter* 31.5, 239–47
- Jones, G. (1984) 'Interpretation of archaeological plant remains: ethnographic models from Greece', in W. van Zeist and W.A. Casparie (eds), *Plants and Ancient Man* (Rotterdam) 43–61

- (1987a) ‘A statistical approach to the identification of crop processing’, *Journal of Archaeological Science* 14, 311–23
- (1987b) ‘Agricultural practice in Greek prehistory’, *BSA* 82, 115–23
- (1990) ‘The application of present-day cereal processing studies to charred archaeobotanical remains’, *Circaea* 5, 91–96
- (1991) ‘Numerical analysis in archaeobotany’, in W. van Zeist, K. Wasylikowa and K.-E. Behre (eds), *Progress in Old World Palaeoethnobotany* (Rotterdam) 3–80
- (1992a) ‘Weed phytosociology and crop husbandry: identifying a contrast between ancient and modern practice’, *Review of Palaeobotany and Palynology* 73, 133–43
- (1992b) ‘Ancient and modern cultivation of *Lathyrus ochrus* (L.) DC. in the Greek islands’, *BSA* 87, 211–17
- (2002) ‘Weed ecology as a method for the archaeobotanical recognition of crop husbandry practices’, *Acta Palaeobotanica* 42, 185–93
- Jones, G., Charles, M., Bogaard, A. and Hodgson, J. (2010) ‘Crops and weeds: the role of weed functional ecology in the identification of crop husbandry methods’, *Journal of Archaeological Science* 37, 70–77
- Jones, G. and Halstead, P. (1995) ‘Maslins, mixtures and monocrops: on the interpretation of archaeobotanical crop samples of heterogenous composition’, *Journal of Archaeological Science* 22, 103–14
- Jones, G. and Valamoti, S.-M. (2005) ‘*Llalemantia*, an imported or introduced oil plant in Bronze Age northern Greece’, *Vegetation History and Archaeobotany* 14, 571–77
- Kotsakis, K. (2001) ‘Mesolithic to Neolithic in Greece. Continuity, discontinuity or change of course?’, *Documenta Praehistorica* 28, 63–73
- Kotzamani, G. (2010) *Από τη συλλογή στην καλλιέργεια: αρχαιοβοτανική διερεύνηση των πρώιμων σταδίων εκμετάλλευσης των φυτών και της αρχής της γεωργίας στον ελλαδικό χώρο (σπήλαιο Θεόπετρας, σπήλαιο Σχιστού, Σιδάρι, Πεβένια)*. Unpublished PhD thesis (Thessaloniki) <http://phdtheses.ekt.gr/eadd/handle/10442/19671>
- Kroll, H. (1993) ‘Kulturpflanzen von Kalapodi’, *Archäologischer Anzeiger*, 161–82
- (2000) ‘Agriculture and arboriculture in mainland Greece at the beginning of the first millennium BC’, *Pallas* 52, 61–68
- Livarda, A. (2008) ‘The archaeobotanical remains’, in E. Hatzaki, M. Prent, J.N. Coldstream, D. Evely and A. Livarda, ‘Knossos, the Little Palace North Project part I: the Early Greek periods’, *BSA* 103, 259–71
- (2012) ‘The archaeobotanical evidence of the Late Bronze Age and Protogeometric occupation under the Roman Villa Dionysus, Knossos, Crete, and an overview of the Protogeometric data of Greece’, *BSA* 107, 189–209
- Livarda, A. and Kotzamani, G. (2014) ‘The archaeobotany of Neolithic and Bronze Age Crete: synthesis and prospects’, *BSA* 108, 1–29
- Margaritis, E. (2013) ‘Distinguishing exploitation, domestication, cultivation and production: the olive in the third millennium Aegean’, *Antiquity* 87, 746–57
- Margaritis, E. and Jones, M. (2008a) ‘Crop processing of *Olea europaea* L.: an experimental approach for the interpretation of archaeobotanical olive remains’, *Vegetation History and Archaeobotany* 17, 381–92
- (2008b) ‘Olive oil production in Hellenistic Greece: the interpretation of charred olive remains from the site of Tria Platania, Macedonia, Greece (fourth–second century BC)’, *Vegetation History and Archaeobotany* 17, 393–401
- Megaloudi, F. (2005) ‘Burnt sacrificial plant offerings in Hellenistic times: an archaeobotanical case study from Messene, Peloponnese, Greece’, *Vegetation History and Archaeobotany* 14, 329–40
- (2006) *Plants and Diet in Greece from Neolithic to Classic Periods: The Archaeobotanical Remains* (British Archaeological Reports International Series 1516) (Oxford)

- Renfrew, C. (1972) *The Emergence of Civilisation: The Cyclades and the Aegean in the Third Millennium BC* (London)
- Renfrew, J.M. (1968) ‘Appendix X: the cereal remains’, in J.D. Evans and C. Renfrew (eds), *Excavations at Saliagos, Near Antiparos* (London) 139–41
- (1977) ‘Appendix 3: seeds from area K’, in J.E. Coleman (ed.), *Kephala: A Late Neolithic Settlement and Cemetery* (Princeton) 127–28
- Sarpaki, A. (1992) ‘A palaeoethnobotanical approach. The Mediterranean triad or is it a quartet?’, in B. Wells (ed.), *Agriculture in Ancient Greece* (Stockholm) 61–76
- (1995) ‘Toumba Balomenou, Chaeronia: plant remains from the Early and Middle Neolithic levels’, in H. Kroll and R. Pasternak (eds), *Res Archaeobotanicae. International Workgroup for Palaeoethnobotany: Proceedings of the Ninth Symposium Kiel 1992* (Kiel) 281–300
- (1999) ‘The archaeobotanical study of Tzambakas House, Rethymno, Crete’, in Y. Tzedakis and H. Martlew (eds), *Minoans and Mycenaeans, Flavours of their Time* (Athens) 13–14, 50–51
- (2003) ‘Ανιχνεύοντας την παρουσία της ελιάς στην προϊστορική Κρήτη. Τα αιωνόβια δένδρα ζητούν προστασία’ in N. Michelakis (ed.), *Ελιά και Λάδι στην Κρήτη. Πολιτισμός, Περιβάλλον, Υγεία και Οικονομία (Proceedings of the International Symposium at Siteia, Crete, 23–25th May 2002, Herakleion)* (Chania) 44–52
- (2009) ‘Knossos, Crete: invaders, “seagoers”, or previously “invisible”, the Neolithic plant economy appears fully-fledged in 9000 BP’, in A. Fairburn and E. Weiss (eds), *From Foragers to Farmers* (Oxford) 220–34
- (2012a) ‘The taming of an island environment: Crete from dawn to noon (Neolithic to the end of the Bronze Age)’, in G. Cadogan, M. Iacovou, K. Kopaka and J. Whitley (eds), *Parallel Lives: Ancient Island Societies in Crete and Cyprus* (London) 35–45
- (2012b) ‘Re-visiting the visibility of the grape, grape products, by-products, and some insights of its organization from the prehistoric Aegean, as guided by new evidence from Monastiraki, Crete’, *Interdisciplinaria Archaeologica: Natural Sciences in Archaeology* 3.2, 211–20
- Sarpaki, A. and Jones, G. (1990) ‘Ancient and modern cultivation of *Lathyrus clymenum* L. in the Greek islands’, *BSA* 85, 363–68
- Schliemann, H. (1886) *Tiryns. Der Prähistorische Palast der Könige von Tiryns. Ergebnisse der Neuesten Ausgrabungen* (Leipzig)
- Vaiglova, P., Bogaard, A., Collins, M., Cavanagh, W., Mee, C., Renard, J., Lamb, A., Gardeisen, A. and Fraser, R. (2014) ‘An integrated stable isotope study of plants and animals from Kouphovouno, southern Greece: a new look at Neolithic farming’, *Journal of Archaeological Science* 42, 201–15
- Valamoti, S.-M. (2004) *Plants and People in Late Neolithic and Early Bronze Age Northern Greece: An Archaeobotanical Investigation* (Oxford)
- (2009) *Η Αρχαιοβοτανική Έρευνα της Διατροφής στην Προϊστορική Ελλάδα* (Thessaloniki)
- (2013) ‘Millet, the late comer: on the tracks of *Panicum miliaceum* in prehistoric Greece’, *Archaeological and Anthropological Sciences*. doi:10.1007/s12520-013-0152-5
- Valamoti, S.-M. and Kotsakis, K. (2007) ‘Transitions to agriculture in the Aegean: the archaeobotanical evidence’, in S. Colledge and J. Conolly (eds), *The Origins and Spread of Domestic Plants in Southeast Asia and Europe* (London) 75–91
- Valamoti, S.-M., Mangafa, M., Koukouli-Chrysanthaki, Ch. and Malamidou, D. (2007) ‘Grape-pressings from northern Greece: the earliest wine in the Aegean?’, *Antiquity* 81, 54–61
- Vickery, K.F. (1936) *Food in Early Greece* (Chicago)
- Zois, A. (1992) ‘Βασιλική Ιεράπετρας’, *Ergon* 1991, 109–10