AGRICULTURAL PRACTICE IN GREEK PREHISTORY

THIS paper is not concerned with geographical and temporal variation in crop utilization nor with the problems of plant domestication, whether an indigenous development or external introduction.[1] It is concerned rather with the process of crop production and consumption. Three aspects of this process are considered: (1) methods of crop cultivation, (2) processing of harvested crops for storage and consumption, and (3) patterns of crop storage. Crop husbandry practices, as revealed by the weeds associated with charred grain, are relevant to many current debates concerning social and economic change in prehistory, while storage patterns, as revealed by detailed spatial analysis of finds of processed grain, can shed light on internal settlement layout and aspects of social organization. The processing of crops for storage and consumption, in addition to its modest intrinsic interest, also has a direct effect on the weed associations and spatial distribution of grain samples and so studies of crop processing are vital as a preliminary to the investigation of both husbandry practices and storage patterns. These are subjects which until now have remained on the fringes of Greek archaeobotany but which should become increasingly mainstream in the future.

In order to investigate the crop processing activities represented on archaeological sites, it is first necessary to explore the effects of processing on the composition of harvested crops in the present-day. This can be done experimentally using crops and tools similar to those used by prehistoric farmers or by observing the activities of present-day farmers who still process their crops using traditional methods. Pioneering work of this kind was conducted by Hillman in Turkey where he observed the different processing sequences applied to glume wheats (einkorn—*Triticum monococcum*, emmer—*T. dicoccum*, and spelt—*T. spelta*) and free threshing cereals (e.g. bread wheat—*T. aestivum*, macaroni wheat—*T. durum*, and barley—*Hordeum* spp.).[2] When threshed, the ears of the latter break up in such a way as to release the grain from the ear while threshing of the former simply serves to break up the ear into individual spikelets each containing grains still enveloped in their protecting husks. These spikelets must then be pounded to release the grain. One of the results of this is that glume wheats may be stored in either of two different forms—as whole spikelets or as free grains. Hillman suggested that storage as spikelets is more likely in areas with wet summers where the final processing of spikelets takes place indoors throughout the year.

Some evidence for storage in this form comes from the site of Iolkos, Volos, where samples of emmer from a destruction episode associated with a Geometric floor contained large numbers of spikelet bases as well as grains.[3] The presence of just a few large weed seeds suggests that this crop had already been sieved—a process which should remove most of the glume bases in a fully threshed crop. The most likely explanation, then, is that these samples represent a crop stored as complete spikelets which subsequently fell apart during charring. This has implications for

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[1] See M. Hopf, 'Frühe Kulturpflanzen in Südeuropa', *Berichte der Deutschen Botanischen Gesellschaft* 91 (1978) 31–8; J. M. Renfrew, 'The First Farmers in South-east Europe', in U. Körber-Grohne (ed.), *Festschrift Maria Hopf*, Archaeo-Physika 8 (1979) 243–65; J. Hansen (paper presented at the AIA meeting) for reviews of this information.

[2] G. C. Hillman, 'Reconstructing Crop Husbandry Practices from Charred Remains of Crops', in R. J. Mercer (ed.), *Farming Practice in British Prehistory* (Edinburgh 1981).

[3] G. Jones, 'Cereal and Pulse Remains from Protogeometric and Geometric Iolkos, Thessaly', *Anthropologika* 3 (1982) 75–8.

attempts to estimate the storage capacity of vessels or rooms since spikelets are far more bulky than free grains. For this reason it is important to know in what form glume wheats were most usually stored. Unfortunately, the three samples from Iolkos are the only Geometric plant remains yet studied—clearly, further work is needed.

Little more is known about Bronze Age practices though storage of glume wheat spikelets can be demonstrated at the Late Bronze Age site of Assiros Toumba in Macedonia.[4] Here samples of grain were found in rooms which also contained mixtures of spikelet bases and grains, and intact spikelets were occasionally observed though they disintegrated on handling. Although at first this seemed to indicate storage at both levels, it soon became apparent that spikelet bases were most infrequent where the grain itself was least well preserved. Apparently, in some areas, the fire reduced the chaff (including the spikelet bases) to unrecognizable ash while preserving the grain in a charred condition.

The same may be true for the emmer stored in a Late Bronze Age storeroom at the Unexplored Mansion, Knossos.[5] Though the numbers of spikelet bases are fewer than expected for whole spikelets, they are present in large numbers and some may have been lost during destruction. At other Bronze Age sites, small samples[6] or lack of contextual detail[7] prevents the identification of storage stage. Caution is necessary too when interpreting some Neolithic finds where the method of recovery is often not described,[8] as picking out of plant remains by hand or the use of inappropriate sieves may fail to recover small spikelet bases and weed seeds. It has been suggested[9] that incomplete recovery may account for the absence of spikelet bases at the Neolithic site of Nea Nikomedeia.

Detailed sampling of storerooms can yield even more information and, in this context, it is interesting to compare the storerooms at Assiros with that at the Unexplored Mansion. At Assiros, crop remains were found widely distributed throughout three different rooms, though careful excavation revealed concentrations of different species within the destruction debris.[10] At the Unexplored Mansion, concentrations of plant remains were more discrete and often still contained in jars ranged along the walls at one end of a single room (FIG. 1*a*).[11] The Assiros grain storerooms are the only ones in Greece for which the spatial distribution of samples is reported,[12] though the position of most of the Unexplored Mansion samples is known indirectly because of their association with particular pots.[13]

A frequent problem with crop storerooms is to decide which species were deliberately stored and which were present as contaminants of other crops. So, at the Unexplored Mansion, einkorn, lentil (*Lens* sp.), and bitter vetch (*Vicia ervilia*) were present only as minor contaminants in samples of other crops while emmer, bread or macaroni wheat, hulled barley, peas (*Pisum sativum*), grass peas (*Lathyrus sativus*), Celtic beans (*Vicia faba*), and figs (*Ficus carica*) were all present as more or less pure samples and were therefore presumably deliberately stored. At

[4] G. Jones, K. A. Wardle, P. Halstead, and D. Wardle, 'Crop Storage at Assiros', *Scientific American* 254 (1986) 96–103.

[5] Jones, 'The LM II Plant Remains', in M. R. Popham, *The Minoan Unexplored Mansion, Knossos*, BSA supplementary volume (London 1984).

[6] As at Lerna—Hopf, 'Pflanzenfunde aus Lerna/Argolis', *der Züchter* 31 (1961) 239–47.

[7] As at Kastanas in Macedonia—H. Kroll, *Kastanas: Ausgrabungen in einem Siedlungshügel der Bronze- und Eisenzeit Makedoniens 1975–1979: die Pflanzenfunde* (Berlin 1983).

[8] As at Sesklo—Renfrew, 'A Report on Recent Finds of Carbonised Cereal Grains and Seeds from Prehistoric Thessaly', *Thessalika* 5 (1966) 21–36; and at Dimini—Kroll, 'Kulturpflanzen aus Dimini', in U. Körber-Grohne (ed.), *Festschrift Maria Hopf*, Archaeo-Physika 8 (1979) 173–89.

[9] W. van Zeist and S. Bottema, 'Plant Husbandry in Early Neolithic Nea Nikomedeia, Greece', *Acta Botanica Neerlandica* 20 (1971) 524–38.

[10] See Jones *et al.*, op. cit. (n. 4 above) 100–1.

[11] For a more detailed plan and account of the excavation, see Popham, *The Minoan Unexplored Mansion, Knossos*, BSA supplementary volume (London 1984).

[12] Jones *et al.* op. cit. (see n. 4 above).

[13] Jones, op. cit. (see n. 5 above). This lamentable lack of spatial information for grain storerooms is now being remedied to some extent by work such as that of Anaya Sarpaki on Thera and others in northern Greece.

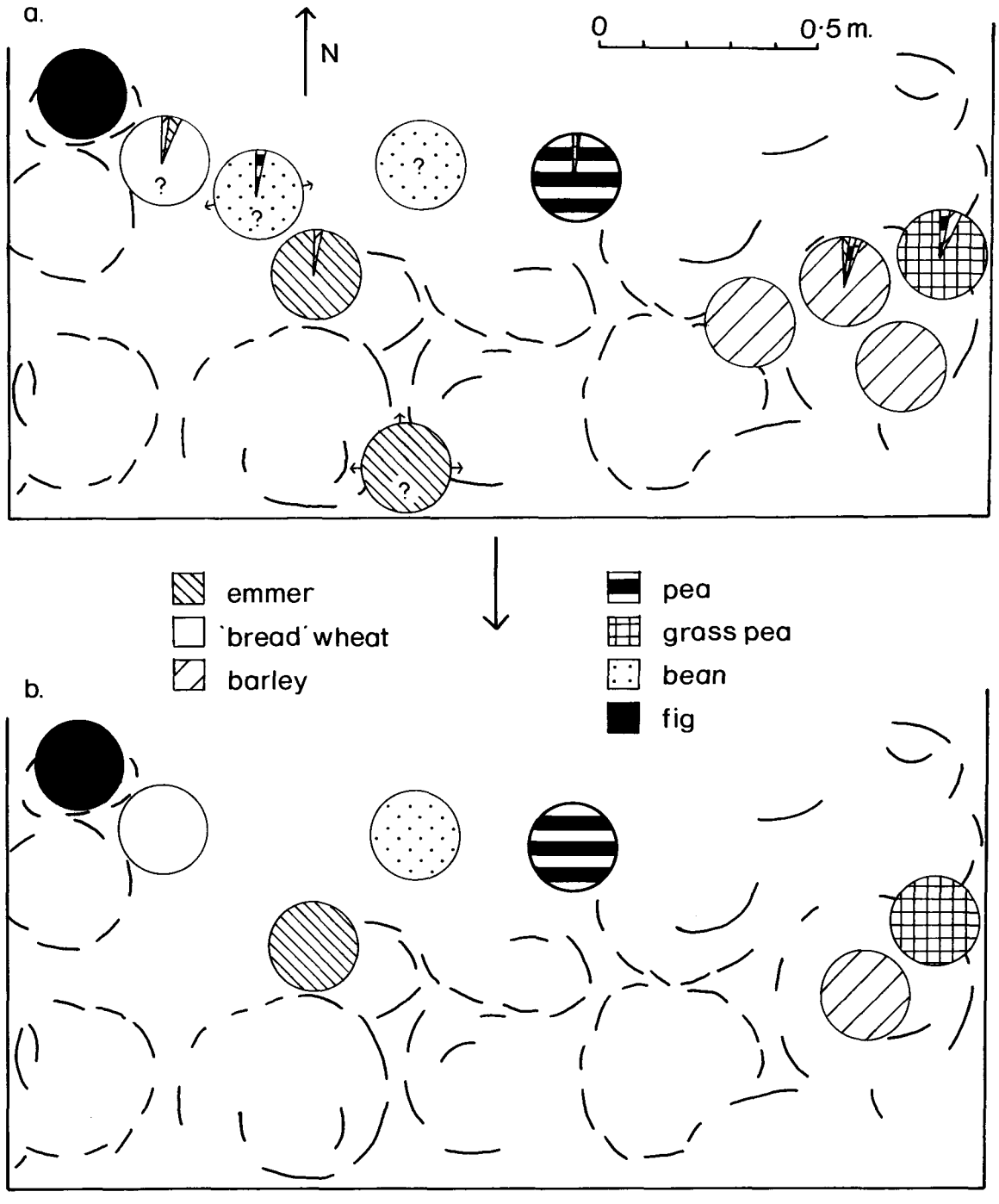

FIG. 1. Plan of South Part of Room P at the Unexplored Mansion, Knossos, showing (*a*) the position and composition of individual samples, and (*b*) the likely number and position of original stored crops. (Interrupted lines indicate broken storage jars; question marks indicate samples of uncertain location.)

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Assiros, where mixing of samples during destruction was greater, only einkorn, broomcorn millet (*Panicum miliaceum*), and bitter vetch were found as more or less pure samples. Careful sampling, however, showed that bread or macaroni wheat and hulled barley also predominate in some samples while emmer and spelt, which consistently occur together, seem to represent a mixed crop.

By detailed spatial analysis of these storerooms, an estimate can be made of the number of containers of each crop, the significance of which will become apparent shortly. If adjacent samples of the same crop represent a single stored product, the Assiros storerooms held a minimum of seven containers of einkorn, five of emmer and spelt, one of bread or macaroni wheat, two of hulled barley, four of broomcorn millet, and one of bitter vetch (FIG. 2). At the Unexplored Mansion, however, it seems that each storage jar in use at the time of destruction contained a different crop, though imprecise spatial information for some samples leaves a degree of uncertainty (FIG. 1*b*).

The storage capacity at the two sites also differs with the Unexplored Mansion storeroom having a capacity capable of feeding, say, two to three individuals for a year while the Assiros storerooms could have supported perhaps twenty people for that time. Finally, the Unexplored Mansion material appears to be at a later stage of processing than that at Assiros. Only one weed seed was found in the Unexplored Mansion storeroom suggesting that the crops had been hand sorted for weed seeds as well as sieved. The Assiros crops, on the other hand, contained a range of weed species, some samples having only large weed seeds suggesting that they had been sieved but not hand cleaned and others containing some smaller seeds too suggesting that, at best, they had only been partially sieved.

In the past, such differences would probably have been interpreted as reflecting changes through time in storage practices or differences between north and south Greece in the care with which crops were stored. It is difficult to interpret two examples only, but the most likely explanation is that the storerooms served rather different purposes. The size of the Unexplored Mansion itself suggests that it catered for more than two to three people and indeed the Unexplored Mansion may have been only part of a larger complex. The storeroom may therefore have been used for the storage of small quantities of the full range of fully processed crops just prior to their preparation as food. In other words, it may have functioned as a larder with long-term, bulk storage taking place elsewhere. This would mean, of course, that the Unexplored Mansion was dependent on the Little Palace or the main palace itself for its food supplies.

The Assiros storerooms, on the other hand, are much more characteristic of long-term storage, but two possibilities still remain. The three storerooms could either belong to different households or together represent a communal storage area. In this context, it is of interest to note that each storeroom housed a different range of crops. Barley, broomcorn millet, and bitter vetch are among the crops missing from one room or another. These are all crops which would be particularly beneficial. Bitter vetch is a pulse crop particularly useful in rotation schemes and as a dietary complement to cereals, barley is a useful low risk crop for bad years, and broomcorn millet has a short growing season and so would be useful for spreading labour throughout the year. It seems unlikely that individual households would choose to omit any of these crops, given that they were available. It is more likely that these storerooms represent communal storage, though whether under the control of a local leader or as a truly co-operative venture is hard to say.

The storerooms at Assiros and the Unexplored Mansion also exhibit some similarity. In both cases, a wide range of crop species was stored, each of which is likely to have had somewhat

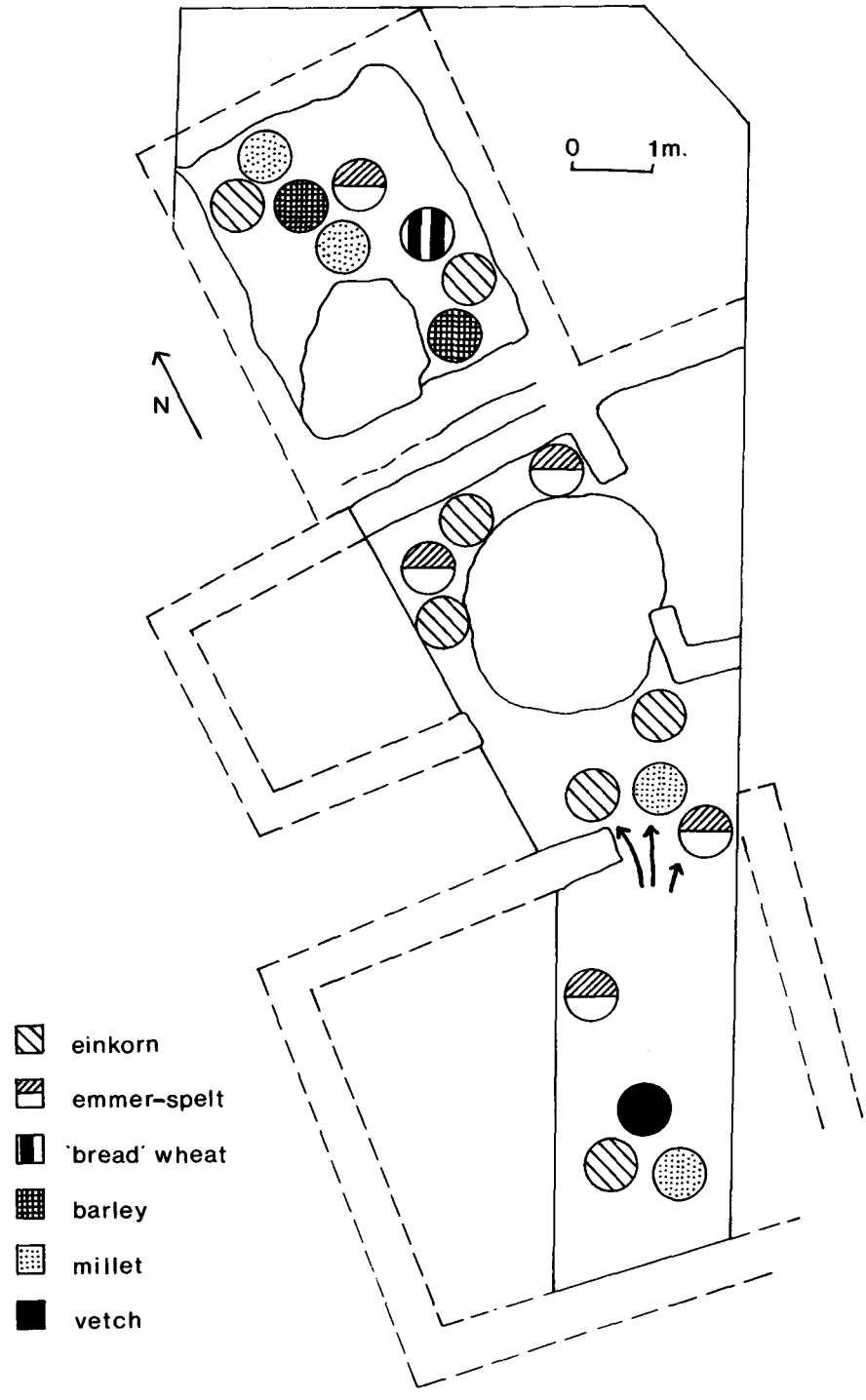

FIG. 2. Plan of Phase 9 at Assiros Toumba, Macedonia, showing the likely number and position of original stored crops. See G. Jones, K. A. Wardle, P. Halstead, and D. Wardle, 'Crop Storage at Assiros', *Scientific American* 254 (1986) 100–1 for the position and composition of individual samples. (Arrows indicate spillage into corridor; later pits are shown in the two northernmost rooms.)

different growth requirements. Agriculture in Greece is subject to a number of hazards, particularly drought, and the cultivation of a variety of crops would have reduced the risk of total crop failure.[14] Evidence from sites such as Dimini,[15] Lerna,[16] and Kastanas[17] suggest that such diversity may have been quite widespread. The storage of glume wheats as intact spikelets may also have been a risk-minimizing practice as, in this form, they are protected from insect and fungal attack.[18]

When large quantities of cleaned or semi-cleaned charred grains are found as part of a major destruction episode, it is reasonably clear that they result from the catastrophic loss of stored crops. The identification of other processing stages is not so easy. To do this, it is first necessary to establish whether the products and by-products of present-day crop processing can be distinguished by their composition. Sampling of crop processing stages by Hillman[19] in Turkey suggests that this is so and it is possible to test this statistically.

To this end, a similar ethnographic study of traditional agriculture was carried out on the Greek island of Amorgos.[20] Samples were taken of the products and by-products of the major crop processing stages. The products and by-products sampled were chosen on the basis of the likelihood of their being preserved archaeologically and included those which could be used as fuel or thrown away on fires and those which might go into store as food or fodder or which could be accidentally charred during food preparation. These were the by-products of winnowing (the light fraction carried aside by the breeze), of coarse sieving (the portion retained by a sieve which allows grain to pass through it), of fine sieving (that which passes through a sieve designed to retain the grain), and the cleaned grain product.

It proved possible to distinguish between these groups of samples on the basis of weed seeds alone. This is particularly useful for two reasons: first, because of the possibility that chaff may be less well preserved than seeds and secondly because the chaff of the glume wheats and free threshing cereals behave so differently while pulses rarely leave any recognizable 'chaff'. When the relative amounts of grain, chaff, and straw were also used, the distinction for cereals became even clearer. Not surprisingly, the characteristics of the weeds associated with each group were distinctive, so that light weed seeds were most associated with winnowing by-products, weeds with a tendency to stay in heads despite threshing were found mostly in coarse sieve by-products, small weed seeds with fine sieve by-products, and large weed seeds with sieved products. This makes it possible to compare archaeological samples (where the range of weed species may be rather different) with the ethnographic groups.

Such a comparison has been attempted for Assiros Toumba[21]—and it can be shown that virtually all the samples belonged to one of two processing groups—they were either cleaned crop products or by-products of fine sieving. The former category included samples from the storeroom complex previously discussed. Similar groupings were achieved when the archaeobotanical samples were considered alone, combining the previous weed characteristics with archaeological features such as density of remains in the ground, preservation, and distortion

[14] Cf. P. Halstead, 'From Determinism to Uncertainty: Social Storage and the Rise of the Minoan Palace', in A. Sheridan and G. N. Bailey (eds.), *Economic Archaeology: Towards an Integration of Ecological and Social Approaches*, British Archaeological Reports (International Series 96) (Oxford 1981).

[15] Kroll, op. cit. (see n. 8 above).

[16] Hopf, op. cit. (see n. 6 above).

[17] Kroll, op. cit. (see n. 7 above).

[18] Hillman, op. cit. (see n. 2 above).

[19] Ibid. and Hillman, 'Interpretation of Archaeological Plant Remains: the Application of Ethnographic Models from Turkey', in W. van Zeist and W. A. Casparie (eds.), *Plants and Ancient Man: Studies in Palaeoethnobotany* (Rotterdam 1984).

[20] Jones, 'Interpretation of Archaeological Plant Remains: Ethnographic Models from Greece', in van Zeist and Casparie (eds.), *Plants and Ancient Man: Studies in Palaeoethnobotany* (Rotterdam 1984).

[21] Id., 'A Statistical Approach to the Archaeological Identification of Crop Processing', *Journal of Archaeological Science*, 14 (1987) 311–23.

of grains. These help to separate fine sieve by-products, deliberately burnt and discarded, from cleaned products, accidentally burnt during storage or food preparation.

Failure to make this distinction in the past may account for the belief that there was an increase in crop purity in the Bronze Age.[22] Processing by-products of different crops are more likely to become mixed than stored products and they are also less likely to be noticed given their relatively low density in the ground. If recovery of plant remains in Greece has been more intensive at earlier sites, as has been suggested for animal bones,[23] the observed change from samples containing a range of crops to relatively pure samples could be an artefact of crop processing and archaeological recovery.

It should be noted that it is easier to identify a sample as a product or by-product of a particular stage than to identify the exact processing methods used. This can be an advantage when it comes to using weeds as indicators of husbandry practices in the field where the main objective is to filter out the variation in weed seeds due to crop processing. The simplest way to do this is to compare only those products and by-products that derive from similar stages in the processing sequence. It can be demonstrated, using the ethnographic samples, that some of the variation in weed seeds is due to the different soil types cultivated.[24] When all samples are considered together, these differences are not very clear but, when samples from a single processing group are compared, the two major soil types of the area can be distinguished clearly. This offers potential for determining which areas in the vicinity of an archaeological site were used for the cultivation of crops and is thus complementary to site location studies. Study of the Assiros weed species, for instance, suggests that the lighter, sandier soils were selected for cereal cultivation.[25]

The soil preferences of weed species have been the subject of considerable study though much of this work has been conducted in central Europe and is not directly applicable to the warmer Mediterranean zone. The potential of archaeological weed studies stretches beyond the identification of soil types, however, as the techniques farmers used for cultivating the soil and the treatments applied to the growing crop all have an effect on the weed species which grow in arable fields. Factors such as time of sowing, fallowing, rotation, irrigation, and manuring are all potentially identifiable from archaeological weed assemblages. In practice, there are two major difficulties. The first is that the details of weed species present in archaeological crop samples have rarely been reported for sites in Greece and the second is that modern studies of the effects of particular crop husbandry practices on weed floras are few and far between especially for the Mediterranean region.

For this reason, the investigation of husbandry practices at Assiros depended largely on relatively gross differences between broad weed categories.[26] None the less, some quite interesting features have emerged. For instance, the Assiros weed assemblage and that of the ethnographic samples from Amorgos were quite different, whether crop products were compared or the by-products of fine sieving. In particular, typical field weeds were commoner in the ethnographic samples, while garden weeds were more abundant in the archaeological samples.

There are a number of possible reasons for this since garden cultivation differs from field cultivation in a variety of ways. Gardens tend to be better watered and more heavily manured,

[22] Renfrew, op. cit. (see n. 8 above); id., *The Emergence of Civilisation: the Cyclades and the Aegean in the Third Millennium B.C.* (London 1972).

[23] S. Payne, 'Zoo-archaeology in Greece: a Reader's Guide', in N. C. Wilkie and W. D. E. Coulson (eds.), *Contributions to Aegean Archaeology: Studies in Honor of William A. McDonald* (Minneapolis 1985).

[24] Jones, 'Phytosociology and the Archaeological Recognition of Crop Husbandry Practices', in H. Demiriz and D. Phitos (eds.), Proceedings of the 5th OPTIMA meeting (Istanbul, in press).

[25] Ibid.

[26] Ibid.

the soil tends to be more frequently cultivated, hoed, or weeded and the crops themselves are today usually spring rather than autumn sown with many casting a denser shade. It is difficult, therefore, to determine if all or only some of these factors are at work. Kroll, working at Bronze Age Kastanas also in Macedonia, has suggested that many of these species are present as weeds of broomcorn millet, a cultivar common to both Assiros and Kastanas.[27] This species is sown very late and would provide at least some of the conditions favourable to the growth of 'garden' weeds. Indeed, some of the garden weeds were statistically associated with broomcorn millet. Others, however, were not and so it is possible that cereals other than millet were cultivated under garden conditions.

Intensive garden type cultivation of cereals is quite unlike anything practised in Greece today. Its existence in prehistory would have important implications, therefore, for current debate concerning the part played in the development of hierarchical socio-political systems by control of scarce arable land or of capital items such as plough-teams.[28] Theories which depend on the competition for land or the need for plough animals would not be applicable to societies practising small-scale garden cultivation. It becomes vitally important, then, to know when the change-over from intensive to extensive land-use occurred.

To help resolve this question of garden cultivation, it would be interesting to examine the weed floras at other sites which, by virtue of their size, date, or location, may show differences in the range of crops grown (especially the presence or absence of broomcorn millet) and in the cultivation methods practised (extensive methods are more likely at larger settlements).[29] Unfortunately, apart from Kastanas, only one other archaeobotanical report from Greece lists wild species (other than fruits and nuts). This is a recent report on plant remains from Tiryns[30] where one might well expect extensive field cultivation at a time when small-scale garden cultivation was usual in more remote areas. There is in fact very little broomcorn millet at Tiryns though both classes of 'weeds' are present. As the plant remains are only tabulated by phase, however, it is not clear which species were associated with crop remains and which represent plants brought on to the site for other purposes (e.g. as food or for roofing material).

Clearly, more weed data will be needed from many more sites before any clear patterns emerge. Equally, detailed studies of present-day weed floras, where the treatment of the crops is known, could help differentiate between the effects of different features of 'garden' cultivation and reveal much about other practices too. One such study is currently underway in northern Spain where the aim is to investigate the effects of irrigation on weed floras while attempting to control for other factors such as soil type and fallowing.[31] Results from this study may, for example, help to elucidate the suggestion that many Neolithic sites in the Peloponnese were located near water sources suitable for irrigation.[32] But time is fast running out for this type of modern weed survey as the ravages of chemical weed killers have already taken their toll over most of Europe.

In assessing the past achievements and future potential of archaeobotanical research in prehistoric Greece, two important points must be made. First, although research to date has gained much from the study of small and often haphazardly collected assemblages of plant remains, widely distributed in time and space, investigation of the process of crop production

[27] Kroll, op. cit. (see n. 7 above).

[28] e.g. A. Gilman, 'The Development of Social Stratification in Bronze Age Europe', *Current Anthropology* 22 (1981) 1–23.

[29] Halstead, 'Counting Sheep in Neolithic and Bronze Age Greece', in I. Hodder, G. Isaac, and N. Hammond (eds.), *Pattern of the Past: Studies in Honour of David Clarke* (Cambridge 1981).

[30] Kroll, 'Kulturpflanzen von Tiryns', *AA* 32 (1982) 467–85.

[31] G. Jones, P. Halstead, M. Charles, and S. Colledge, 'The Effects of Irrigation on Weed Floras in N. Spain' (in prep.).

[32] T. van Andel (pers. comm.).

and consumption demands intensive retrieval of plant remains on a large scale, coupled with detailed consideration of depositional contexts. Secondly, the interpretation of such material requires studies of the present-day relationship between husbandry, processing, and storage activities and the composition of crop samples. The effects of crop processing and level of storage on sample composition have been investigated through ethnoarchaeological studies both in Greece and further afield and the results of such studies can now be applied to archaeobotanical material from prehistoric Greece. The effects of different husbandry practices on weed associations are only known in the most general terms, however, and detailed ecological studies of the weed communities of traditional Mediterranean crops are urgently needed as are the collection and study of ancient weed assemblages. The archaeobotanical investigation of husbandry practices is thus in its infancy, but preliminary results are quite promising.

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