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Human Ecology and the Classical Landscape

The Greek and Roman Worlds

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The classical world brings together two societies linked by text and ideas, and the considerable influence of one upon the other. This chapter looks at human ecology—the modes of engagement of Greek and Roman societies with their respective environments. We are here using "ecology" in its precise sense as the study of the interaction between an organism and its environment, in other words, not the direct study of an external world of nature, but more specifically of modes of engagement with that world. The texts that survive from both Greek and Roman sources portray an ecological stance that has persisted in subsequent western intellectual traditions. It is one in which control and mastery of nature are emphasized, and these in turn underpin the central notion of "civilization": aspects of the environment over which humans could not exercise control, such as weather conditions were conceptually allocated to the realm of the supernatural, being associated with the gods.

These two societies brought that notion of control and mastery to a common environmental context, the "Mediterranean region," a region whose ample ecological resources are fragmented through space and time by abrupt topography and marked seasonality. Much of their means of controlling nature entailed the connecting and combining of these fragments to form a coherent whole as the annual agrarian cycle unfolded. It involved ameliorating, containing and slowing down the abrupt distribution of rainfall on the ground by careful management of soil and small plots, and judicious use of trees. It entailed an exploitation of altitudinal variation for crops, different forms of woodland, and different seasons of grazing. It required a selection of plant and animal domesticates which themselves were adapted to the spatially and temporally fragmented nature of Mediterranean ecology.

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However, the two cultures also display marked ecological differences. This is immediately evident from the geography of their sites. Classical Greek sites are concentrated in regions that would, in broad climatic and topographic terms, be described as "Mediterranean." It has been observed that the florescence of Greek society and the olive tree, a species often used to delineate the Mediterranean region, are broadly coincident. Roman settlements also have a strong Mediterranean epicenter, but their range is quite different. During the imperial period they spread extensively across Atlantic Europe in modern-day Spain, France, and Britain, and in the south and east, penetrated into desert regions of Africa and the Near East. The political and military dimensions of these differences in pattern are well known; the ecological dimension is becoming clearer as textual evidence is increasingly being augmented by environmental archaeology. In this chapter we explore that ecological dimension, and in particular the contrast between a Greek society whose mastery of nature entailed the negotiation primarily with one particular environmental region, the Mediterranean, and Roman society, whose style of mastery was in part transferable to some quite contrasting environmental zones.

The Mediterranean Context of Greek Society

By the beginning of the fifth century B.C., the Greek heartland, the territory which now comprises mainland and island Greece and the west coast of modern Turkey, was only a small portion of the Greek world. From the eighth century onward Greeks had established communities spreading east–west across the Mediterranean from the Levant to southern France and Spain, and north–south from southern Russia to North Africa. In the course of this great diaspora, Greeks encountered numerous other cultures, from which they borrowed some elements and to which they donated others in the course of adapting to these new places. Although most of these Greek communities, especially those which had dispersed from the Greek heartland, were set in environments which were broadly "Mediterranean" in terms of their climate, geography, and vegetation, and Greek culture only rarely ranged beyond this zone, there is a huge range of local variation even over very short distances. The consequence is that though some practices were common over a wide area, Greeks exploited the environments they inhabited in many different ways, depending on both local traditions and local conditions.

In both the northern and southern hemispheres, all areas with Mediterranean-type climates are on or close to the 35° latitude lines and bordering the sea (Grove and Rackham 2001:11 and figure 1.2). Ancient Greek settlement in fact ranged somewhat beyond the fringe of land surrounding the Mediterranean Sea. Often the limits of the olive's cold tolerance are perceived as defining the extent of the Mediterranean zone, though this is something of an over-simplification (Grove and Rackham 2001:11). Certainly it is true that the olive and Greek culture have flourished in most of the same places, but areas of inland mountain zone beyond the range of olive cultivation were also exploited in antiquity. Although Mediterranean

climates are often said to be characterized by cool, wet winters and hot, dry summers, variability is its most obvious characteristic: Europe's driest and wettest places are both found in this zone. Landforms are equally varied, but a rugged, often mountainous topography in conjunction with a diverse land–sea interface is particularly characteristic. Areas of flat plains land are limited. This is primarily the result of recent tectonic activity, which has also been responsible for the relative fertility of soils in comparison to those of other Mediterranean-type environments. Although frost-free areas are the exception, at least in Mediterranean Europe, only the high mountains regularly experience intense frosts (Grove and Rackham 2001:25, 28, 37–44, 47). The combined effect is that—while the basic ingredients of life (sunshine, water, and soil-nutrients) are for the most part plentifully available—they are discretely packaged in space (altitude) and time (seasons). Negotiation with altitude and season has thus been central to Mediterranean ecological strategies. Summers are largely sunny with temperatures often over 30°C, and in many areas at altitudes under 200 meters above sea level even dew is rare. Summer temperatures are generally cooler at higher altitudes, and places only a few kilometers distant from each other but differing by several hundred meters in altitude can differ perceptibly in temperature.

Precipitation in the Mediterranean is characterized by its unpredictability, and this has important implications for agriculture in the region. Generally the bulk of the year's rainfall occurs between mid-September and April and rainfall events may be very unevenly distributed over this time. Even over the summer, occasionally a sudden, violent thunderstorm may result in flash floods or damaging hailstorms. In addition, rainfall in any particular area may vary dramatically from year to year. And, often over short distances, especially over changes in altitude and aspect (the direction a place faces and to which it is exposed), rainfall can vary quite substantially from one place to another. Generally, precipitation increases (and the length of the dry season decreases) with altitude, although the degree of increase with altitude varies greatly according to other factors (Grove and Rackham 2001:26). It also varies in relation to rain-bearing winds. West-facing locations such as the island of Kerkyra (modern Corfu) are usually wetter than east-facing ones such as Attica and the Cyclades because of the rain-shadow effect. Absolute amounts of annual precipitation rarely exceed 1000 mm except in the more northerly parts of the region, and at high altitudes. In most parts of southern Greece, Italy, and Spain, average annual rainfall ranges between 400 and 650 mm, though in some significant places this figure is lower. Athens averages 385 mm per year, Thera (modern Santorini) in the Cyclades, 357 mm (Grove and Rackham 2001:24–28). These low rainfall figures place Attica and the Cyclades close to the limits for non-irrigated cereal cultivation. In addition, areas with the lowest average precipitation have the greatest inter-annual variability, hence the greatest risk of serious crop failure. In these areas, therefore, cereal agriculture depended particularly heavily on drought-tolerant barley, rather than wheat (see below, p. 104).

Having a rainfall regime characterized for the most part by relatively low annual rainfall and a prolonged summer drought, the Mediterranean basin contains few substantial permanently flowing rivers. Some of the exceptions to this rule include

the Tagus in Iberia, the Tiber and Po in Italy and the Eurotas and Strymon in Greece. Many so-called rivers and streams in the region have always been at best seasonal, flowing only through the winter months. Others only flow during, and immediately following, storms. Small springs, therefore, tend to be particularly important as reliable sources of water. Since these are heavily dependent on the existence of suitable impermeable strata in the geology, their distribution is highly irregular.

Where permanent rivers or springs do not exist, an area's inhabitants have been dependent on underground supplies of water. The history of well-digging in the Mediterranean has been little studied. In the Athenian Agora wells went in and out of use from the Mycenaean period onwards, although extravagant claims have sometimes been made about the significance of well-digging activity (Camp 1979, 1982) and two fountain houses there, one built in the sixth century B.C. and one in the fourth century B.C., exploited water piped in from nearby springs for public use. The origins and development of underground cisterns as a means of storing winter rainwater are even less well understood, but both were known by the Archaic and Classical periods in Greece and the bottle-shaped cistern became an established feature of Athenian houses by the fourth century B.C. (Camp 1982:12).

The lack of large, permanently flowing rivers comparable to the Nile in Egypt or the Tigris and Euphrates in the Middle East meant that virtually all agriculture in the ancient Greek world was rainfall-dependent: only after the establishment of their rule in Egypt in the late fourth century B.C. did Greeks become seriously interested in irrigation agriculture (Krasilnikoff 2010). At least one large scale drainage and irrigation project was proposed at Eretria in Euboea during the fourth century, documented by a long inscription (IG XII.9.191), but we do not know if it was ever implemented (Foxhall 2007:69–71; Krasilnikoff 2010:116). Tree crops, vines, and even summer field crops (see below) were, therefore, dependent on the application of careful cultivation techniques to ensure effective rainwater penetration of the soil during the winter, and to minimize soil moisture losses during the summer. Unlike the Romans, the Greeks do not seem to have had a developed technology for raising water from lower levels for irrigation, at best only using a swipe (*shaduf*)—a counterbalanced lever—to ease the lifting of buckets from shallow wells. Irrigation therefore tended to depend on diverting water from springs where this could be managed, or to be very small-scale pot-irrigation from wells or even cisterns, probably only useful for small gardens.

Greeks used large amounts of water for some industrial processes, such as in the ore-washeries at Laurion in Attica (Conophagos 1980), but they did not use the force of running water to power machinery such as grain mills or olive mills. Their failure to do so was probably one of outlook, not simply a result of the lack of suitable water supplies: in medieval and later Greece, seasonal streams were used to provide the motive force for a variety of operations, milling grain, processing olives and processing textiles included. By contrast, the Romans were prepared to exploit the natural force of running water in a number of ways (Wilson 1995,; 2000; 2008). Water mills for grinding cereals, sawing timber, and even processing oak bark for tannin are well attested (Brun 2007), and the Roman writer Vitruvius (10.5.1)

mentions a water-powered machine for lifting water for use in irrigation on a substantial scale, perhaps the equivalent of the Arabic *noria*. The latter may well have been initially developed by Middle Eastern societies, but as with the moldboard plow (see below), the Romans saw its potential and introduced it elsewhere. The Romans' predilection for machinery to replace human-powered operations also led to their use of the *saqiya*—an animal-powered water-lifting device used for irrigation—and to the development of the donkey-mill, as seen at Pompeii, for grinding grain. In their attitudes towards the forces of nature, there seems to have been a fundamental difference between the Greeks and the Romans: Greeks attempted to domesticate them while the Romans tried to subjugate and harness them. This may be related to the much larger scale of some Roman agricultural and industrial enterprises, although it is hard to ascertain if the very different Roman perspective on the forces of nature is a cause or effect of this augmented scale (Foxhall 2007:251–255.

The present Mediterranean climate has existed barely longer than the first appearance of agricultural communities some 10,000 years ago, so it is incorrect to consider present plant communities as highly climatically adapted (Grove and Rackham 2001:45). Even before this time, environments were exploited by hunters and gatherers, and by 6,000 years ago agriculture was widespread. Hence, the Mediterranean ecosystems that we observe today are, for the most part, creations of human culture. It is, therefore, impossible to point to pristine "natural" environments unaffected by human activities. Plant communities are highly diverse, with a key variable being the ability to withstand conditions of drought, high evaporation levels, and thin soils. It is, nonetheless, still possible to discern an altitudinal zonation that would broadly correspond to climatic "climax vegetation," insofar as such a term is appropriate in such an intensely modified landscape. Along coasts and at lower altitudes, evergreen woodland of Aleppo pines and evergreen oaks persist in those few areas not entirely transformed by clearance, settlement, and agriculture. Above the Mediterranean "olive line," the sharp Mediterranean seasonality is in places ameliorated so that a range of deciduous trees can flourish, such as chestnut, ash, and deciduous oak. These deciduous woodlands tend to have a long history of economic exploitation. At higher altitudes still, beechwoods may flourish, and in many places the constrained growing season once again favors evergreen woodland; fir and pine prevail up to the tree line.

Millennia of human action have modified this altitudinal zonation in four principal ways. First, it may have completely cleared and replaced it with settlement and farmland, particularly at lower altitudes. Second, the deciduous woodlands in particular have been continuously managed for nuts, leafy fodder, building material, and fuel, transforming both their composition and form. Third, a range of extensive forms of exploitation, particularly grazing, has shifted the altitudinal positions of each of the zone transitions, up to and including the tree line. Fourth, a similar range of exploitation, and also cycles of abandonment, have stimulated a distinct range of vegetation forms, variously described around the Mediterranean as *maquis* and *garrigue* (France), *macchia* and *garriga* (Italy), *thamnoi* and *phrygana* (Greece). *Maquis/macchia* refers to a diverse composition of low growing, mostly evergreen

shrubs, which are primarily tree species reduced to a low height via anthropogenic factors such as cutting and grazing. *Garrigue/garriga* refers to an equally diverse community of low-growing, tough, and often spiny aromatic herbs, generally determined by low rainfall, thin soil, and largely impenetrable bedrock (Grove and Rackham 2001:48–59).

The Mediterranean zone has probably never seen a simple altitudinal zonation of climatically determined woodlands, as both the diversity of bedrock types, and the contingencies of rapid climatic and tectonic events in a rugged terrain have always ensured a complex mosaic of woodland, scrubby vegetation, and bare rock. However, the complexity of that variation has undoubtedly been enhanced, and exploited by human action.

Adaptations to the Mediterranean in the Classical Greek World

In the Greek texts, as in the later Roman texts, the land holdings of wealthy farmers are inevitably far better attested than those of small-scale farmers. One of our most important documents for demonstrating the scattered landholdings of rich Greek men is the so-called "Attic Stelae" of fifth-century B.C. Athens. These Athenian inscriptions (*Inscriptiones Graecae*, I^3 420–430; Pritchett 1956; Amyx 1958) record the auctioning of the property of some of Athens' wealthiest and most eminent citizens and metics (resident aliens) implicated in the major religious and political scandals of 415 B.C. (Thucydides 6.27–29, 60–61). The culprits had ample warning of their impending arrest and most appear to have disposed of or hidden as much of their property as possible before they fled Attica. Therefore, it is likely that the imperfectly preserved lists represent only the relatively worthless items or property which they could not hide (some of which is plainly quite valuable), not the full extent of their estates. Even so, it is possible to catch a glimpse of the wide range of agricultural and other property which a wealthy citizen might own, and its geographical spread.

The texts summarized in Tables 3.1 and 3.2 show the property listed under the names of two different men, Adeimantos, son of Leukolophides of Skambonidai, and Axiochos, son of Alcibiades of Skambonidai. Adeimantos owned land in at least two different parts of Attica, and it appears to have been divided into a minimum of six different plots. He also owned land abroad in Thasos, which itself may well have been divided into smaller plots. Axiochos owned land in at least seven different places in Attica (and some of these holdings must have consisted of several separate plots), as well as land overseas in Abydos, Klazomenai, and elsewhere. However imperfect our knowledge of the full range of their property, it is clear that in both these estates, agricultural land and enterprises were extremely important sources of wealth and income for these men, and that the range of their agricultural activities was diverse, and covered a wide range of different environments. But, despite the fact that these were some of the richest men in Athens, their properties are minuscule in scale compared to the vast provincial estates of wealthy Romans.

Table 3.1 Surviving possessions in the Attic Stelae: Adeimantos son of Leukolophides of Skambonidai

Source		Possessions
IG I^3 422	187–190	4 shadufs and a large trough on land in Xypete
	182–186	land (specifications and location lost)
	178–181	land (specifications and location lost)
IG I^3 426		[skilled slaves and equipment—prices missing]
	10–39	Phrygian man
		a man, Apollophanes
		Charias, *obeliskopoios* [spit or nail maker]
		Aristarchos, *skutotomos* [leather worker]
		his equipment: small table, 2 couches, table, sleeping pallets, building timber, and 8 unpreserved and unidentified items
		Satyros, *skutotomos* [leather worker]
		[3 lines missing and 3 lines that seem to have been equipment]
	44–51	[Thasian farm specializing in vines]
	44	man, Aristomachos [bailiff?]
	45–46	land and *oikia* in Thasos in I–
		large numbers of good and bad pithoi with lids
		590 (?) amphoras of wine (capacity: 3 *choai*) = 8.64 liters each = 5,098 liters of wine total
	106–107	income from rents on land that had been owned by Adeimantos (cf. line 100): 1632 dr., 4 ob. [if a rent of around 8% of the capital value is assumed, this makes for a capital value of about 3 T, 2408 dr]
	142	something unidentifiable worth 520+ dr.
IG I^3 430 a	1–4	"oakery" and "pinery" and *oikia* in B–, 8 pithoi in the *oikia*, and Kudimachos, slave of Adeimantos [who presumably managed the "oakery" and "pinery"]
	10–12	harvested crops [cereals or other arable?], worth 50 dr., from land in Ophryneion
	27–28	Satyros [slave], 170 dr.

Note: T = talents, dr. = drachma, ob. = obol.

Managing Soils: Terracing and Drainage

In ancient Greek, the word *chora* meant a piece of land of any size from the entire territory of a *polis* to a tiny field. Today and in the recent past, the agrarian landscapes of Greece and many other parts of the Mediterranean are characterized by fields in small areas of plains land, combined with a patchwork of terraces on the hill slopes (Figure 3.1). However, it is not clear that the fields of classical Greece were farmed in the same way. Among the few descriptions that we have in ancient literature and inscriptions of ancient fields, there are no unambiguous references to terraces or terrace walls (Foxhall 1996; 2007:121–124). In contrast, there are numerous references to other techniques for soil management on steep slopes.

Table 3.2 Surviving possessions in the Attic Stelae: Axiochos son of Alcibiades of Skambonidai

Source		Possession
IG I³ 422	194–204	[slaves]
		Arete, Thracian woman (361 dr., for all 3?)
		Grulion, Thracian man
		Habrosune, Thracian woman
		Dionysios, Scythian bronze smith (155 dr.)
		income from rents on fields (*choria*) in Tho—which had been owned by Axiochos, 150 dr. [if a rent of around 8% of the capital value is assumed, this makes for a capital value of 1875 dr.]
IG I³ 424	10–16	apartment house
		total of houses [*oikiai*]—large sum of money not preserved
		foreign agricultural land—details not preserved
IG I³ 426	101–102	income from rents on land owned by Axiochos
	108–111	1633 dr. 2.5 ob. [if a rent of around 8% of the capital value is assumed, this makes for a capital value of about 3 T, 2417 dr.]
		item not preserved, more rents? 250 dr.
		item not preserved, more rents? 162 dr, 4 ob.
IG I³ 427	52–85	[equipment and fittings from a country house]
		5 *phidaknai* [small pithoi]: 9 dr; 11 dr.; 4 dr., 4 ob.; 4 dr., 3 ob; 4 dr.
		funnel [no price, goes with next item?]
		lead pipe 2 dr., 2 ob.
		written board/picture 60 dr.
		another small one 6 dr., 4 ob.
		painted (?) picture 5+ dr.
		land that had belonged to Axiochos . . . [further details missing]
		[poorly preserved entry] 2040 dr. (?)
		[poorly preserved entry] 1590 dr. (?)
		area of land (in *plethra*) with *oikia* in the country site, another at Emporia [no price]
		3 *plethra* arable land with vines 1900 dr. [goes with last item?]
		oikia in the countryside [*agroi*]
		another piece of arable land, with olives (?), 3 *plethra* 6100 dr.
		[something unidentifiable] with vines; [something unidentifiable] in Abydos 310 dr.
		[something unidentifiable] in Klazomenai 200 dr.
IG I³ 430	6–7	a man, Olas 195 dr.
	8–9	Messenian man 130 dr.
	24–25	Keph– [slave] 195 dr.
	33–35	crops in the field (?) 20 dr.

Note: T = talents, dr. = drachma, ob. = obol.

Figure 3.1 Terraced landscape in modern Methana. Photo: Hamish Forbes

Although several scholars claim to have discovered terraces dating to the classical period (Bradford 1956, 1957; Lohmann 1992; Brunet 1990; Price and Nixon 2005), the chronological evidence for most of these is insecure. The most convincing are the carefully excavated classical terraces on the island of Delos (Brunet 1999). Indeed, it is not certain, except in very unusual circumstances, that an agricultural terrace from classical times would easily survive to the present day. Mediterranean hillsides are landscapes which have been repeatedly re-sculpted by a combination of the people who worked the fields and natural forces such as tectonic activity, forest fires, floods, wind, erosion, and alluviation. Terraces are therefore inherently unstable anthropogenic features in an unstable landscape, which are continuously being built and re-built, even in more recent periods.

The main purposes of terracing are to get rid of the rocks, hold soil in place, create a level area for cultivation and, critically, both to ensure the drainage of the erratic rainfall into the soil and reduce the amount of potentially erosive run-off flowing downhill. Many of these aims can be achieved by other means. In the absence of terraces, many hill slopes were planted with trees and vines (Theophrastos, *De Causis Plantarum* 3.6.7). The trees themselves helped to hold the soil in place. Wealthy farmers who had slave labor available were able to dig trenches around trees, shaped like basins sloping in towards the trunk, which caught precious rainwater and kept it where it would most benefit the tree. In areas where drainage was a problem in winter, these basins around trees could be connected by ditches

dug across the slope (Theophrastos, *De Causis Plantarum* 3.6.3–4). Repeated digging around trees also removed weeds which would compete for moisture and nutrients, and kept the top layer of soil dry and crumbly, thus reducing the loss of water from lower soil levels via capillary action and evaporation. Theophrastos, writing about plants in the fourth century B.C., was clearly familiar with this practice and recommended a regime of regular digging around trees three times throughout the year (Theophrastos, *De Causis Plantarum* 3.12.2; 3.16.2, 3). The practice is also stipulated in land leases (Rhodes and Osborne 2003:no.59, from Amorgos; see also Osborne 1987:42–43). Indeed, repeated plowing and digging were considered the best way to work land for arable crops as well as for trees, though this would have needed much labor, possibly more than a poorer household could manage on its own without the help of slave labor.

Cultivation Technologies and Techniques: Plows and Plowing

The tools of ancient Greek farming were basic. Simple ard plows were appropriate for the shallow soils of the Mediterranean region: deep digging can be counter-productive and can damage the soil structure and the roots of crop trees in these environments. Harrows and wooden mallets were used for breaking up clods after plowing. Mattocks and wide-bladed hoes were important for digging on small plots and around trees (the Greeks did not have spades or shovels). With sickles, axes, and adzes, pruning knives, winnowing forks, and baskets, and sometimes basic threshing sledges, this comprised virtually the entire repertoire. Very little metal was used in their manufacture, and even implements such as plows might be almost entirely made of wood. Though sickle blades were sometimes made of metal, the teeth could also be triangular flakes of obsidian (volcanic glass) set in a wooden haft—even stone tools still had their place. Transport and other motive power were supplied by cattle, donkeys and mules. Much of the agricultural machinery of classical times, such as wine and oil presses, was simple and modular—assembled for the job in hand then taken apart so that the components could be used for other tasks (Figure 3.2) (Foxhall 2007:210).

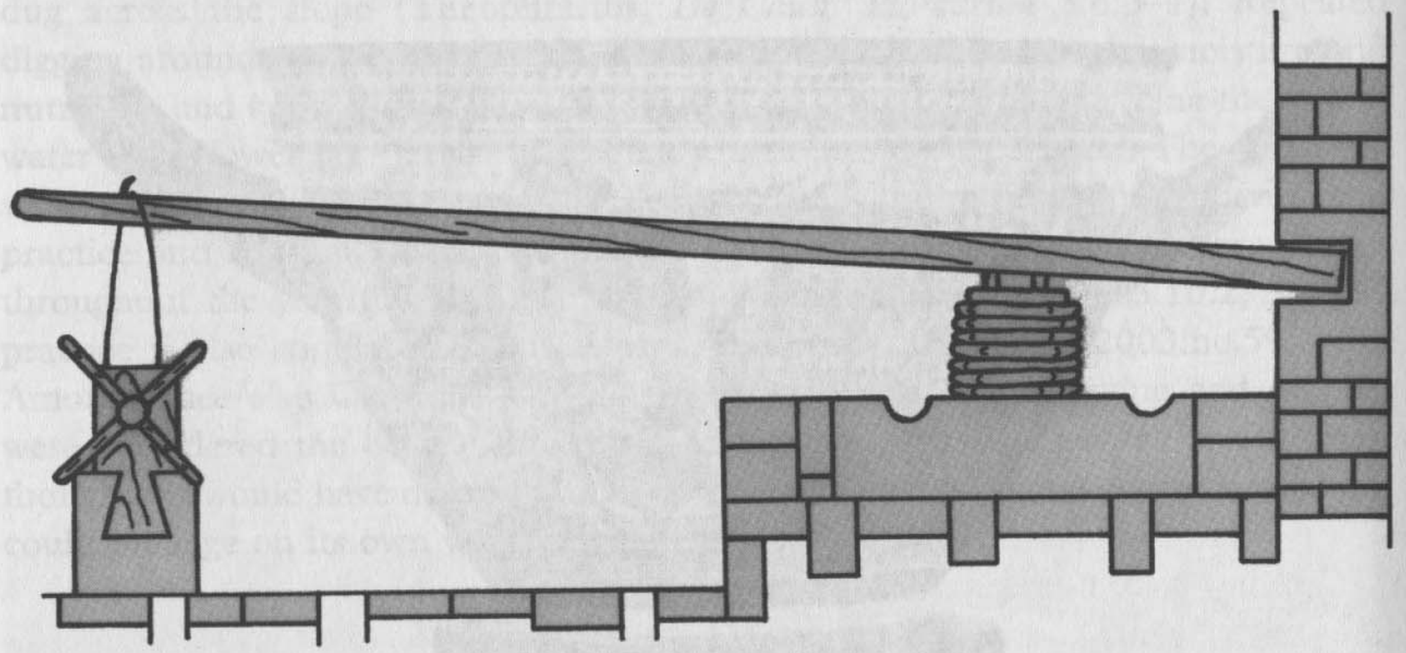
Crops were generally grown in a two-year rotation system: cereals were grown on the field in alternate years. It is generally assumed that in the year following a crop nothing was grown and the land was left fallow. In temperate regions, fallowing is used primarily to conserve and restore soil fertility, and to prevent the build-up of pests and diseases. This would also have been the case in the ancient Mediterranean, but in addition, fallow land with weeds growing on it could also be an important resource for grazing. In the dryer parts of the Mediterranean multiple plowing of fallow land in spring and summer was sometimes practiced to conserve soil moisture. Plowing ensured that weed growth did not consume moisture trapped in the soil from the winter rains, the broken top levels of soil acting as a blanket to stop the loss of water by capillary action and evaporation.

On occasions, however, land was not left fallow in the year following a wheat or barley crop. A number of types of winter-sown leguminous (pulse) crops

(a)

(b)

Figure 3.2 (a) Black Figure Skyphos featuring Beam press, probably for wine, ca 520–510 B.C., Greece, Athens. Henry Lillie Pierce Fund. Photograph © Museum of Fine Arts, Boston; (b) Installation for treading grapes located in the Methana countryside. Photo by Lin Foxhall; (c) (Overleaf) Reconstruction of an ancient olive press. Drawing: Hamish Forbes; (d) Wine presses from the imperial Roman villa at Settefinestre, Toscana



(c)

(d)

Figure 3.2 *Continued*

were known in antiquity (Isager and Skydsgaard 1992:42). It is likely that these were sometimes alternated with cereals. Greeks and Romans recognized the abilities of some leguminous crops to replace nitrogen in the soil. In addition, a range of spring-sown crops, such as chick peas and millet (see below, p. 103) could be grown unirrigated in plowed fallow land as well as a limited range of summer vegetables.

The most important cereal in much of the Greek world was barley. It is more tolerant of drought, alkaline and slightly saline conditions than wheat. Although it

is sensitive to frost, this is not generally a relevant factor in lowland Mediterranean environments where low rainfall is commonest. The drawbacks are, first, that most types of barley grown in classical Greece had hulls which took considerable pounding to remove (although they protected the kernel from pests in storage) and second that it is not well suited to bread-making, at least to the styles of bread becoming popular. Wheat was considered a much more desirable cereal by Greeks, because of its bread-making qualities, and many varieties were grown in classical antiquity. Because it does not produce as prolifically in less than optimal conditions, it was something of a "luxury" cereal—perhaps not eaten as an everyday food by poorer people. One variety of wheat was spring sown, and was sometimes used as an emergency crop if the autumn rains had been inadequate. In areas with deep, water-retentive soils, broomcorn and foxtail millets (sown in the spring) were also grown, though they were not as important as wheat and barley. In addition to winter- and spring-sown legumes (see above, p. 102), other field crops regularly grown included sesame, fenugreek, and in damp areas with good soil, flax for both linseed and for rope and textiles.

For arable crops the field was plowed and sown in the autumn, after the onset of the winter rains had sufficiently softened the ground. The sower would walk in front of the plowman scattering the seed broadcast, while the plow breaks up the soil and covers it over. Cereals sown at higher altitudes and/or in colder locations need up to two months more growing time than those planted at lower altitudes and/or in warmer locations. This is where the Greek habit of holding fragmented plots could be advantageous: farmers could spread out the work of the busy sowing and harvest seasons by having plots in both cooler, wetter, higher places and warmer, dryer lower ones. This also incidentally spread the risks of crop failure: in dry years grain on damper plots grew better, while in wet years dryer plots might produce more.

Important by-products of arable crops included chaff and straw which were used for animal fodder, and in the latter case also for stable bedding. Grain was normally harvested close to the ear (e,g, Hesiod, *Works and Days* 478–480), so the straw left in the field was generally quite long. This could be gathered separately, or it could have been used for grazing as stubble. The haulms (stalks) of leguminous crops also made nutritious fodder. Unsuccessful crops of cereals or legumes might be harvested early for fodder or hay, though sometimes crops such as vetch were grown specifically for hay.

Arboriculture

Although polycropping, growing trees with arable crops in between, has regularly been practiced in the recent past in the Mediterranean, it may have been less common in classical antiquity, at least on the plots of wealthy farmers, because of the habit of trenching around trees (Foxhall 2007:113–114). Theophrastos certainly understood that repeated digging around trees throughout the year, to direct water to the roots, retained soil moisture and eliminated weed growth, improving

the productivity of the tree. In consequence, he did not generally recommend polycropping.

Olives, vines, and figs, like most fruit trees, do not grow true to type from seed. The Greeks propagated them vegetatively using cuttings, ovules (growths at the bases of old olive trees), and grafting. Theophrastos (*De Causis Plantarum* 1.6.1–10) has a long and detailed discussion of grafting techniques, which farmers clearly used with considerable sophistication. Sometimes farmers used the wild forms of olives, figs, or pears as rootstock because they were vigorous and well adapted to drought conditions, and grafted choice domestic varieties onto them.

Beyond the primary output of fruit, there were many important by-products of arboriculture. Branches pruned, or leaves collected from, olives, vines, and other fruit trees were an important source of fodder for animals (Foxhall 1998). When all the leaves had been eaten, the branches could then be cut and stored for fuel. Vine prunings in particular made excellent fuel for kilns and ovens. Fallen fruit (e.g., maggot-infested figs, olives which fell prematurely) and almond husks were also important supplements for animals in late summer and early autumn when grazing was scarce. The residue from the pressing of grapes made nutritious fodder, and the residue from olive pressing could be used for either fodder or fuel. Details of arboricultural and crop-processing practices (e.g., the production of raisins from grapes) are now coming to light through extensive archaeobotanical analyses of such sites as the Hellenistic farmsteads at Kompoloi and Tria Platania in Southern Macedonia (Margaritis and Jones 2006; 2008a,; 2008b).

Gardens

The Greeks were enamored of plants and flowers, and grew them ornamentally in gardens (Osborne 1992). Unlike Roman or modern gardens, Greek gardens were not attached to houses, but were simply small, accessible plots of land, often situated along roads and surrounded by trees. They also differed from our gardens in that they were based on trees and contained mostly "economic" plants, but grown in an ornamental way. Just as Greeks were partial to grid-planned towns and rural landscapes where this was possible, they also preferred grid-planned gardens: timber or fruit trees arranged in orderly rows, sometimes with vines or other climbing plants growing up them and flowers growing in between, protected by the shade from the burning summer sun. Flowers, such as roses, violets, and lilies, also had economic uses, for perfume, garlands, and flavoring.

Small garden plots were one of the few settings in which small-scale irrigation might have been possible, using a spring, well, or cistern, perhaps in combination with some kind of water-lifting device, such as the *shadufs* mentioned in the Attic Stelae (Krasilnikoff 2010). This would have allowed the cultivation of cucumbers, flax, greens, and other vegetable crops over the hot summer. However, judicious use of plowed fallow on deep soils would allow the summer vegetables to exploit two years of rainfall, if planted far apart and constantly weeded (Figure 3.3). Theophrastos (*Historia Plantarum* 2.7.5; *De Causis Plantarum* 3.16.3, 4) describes the

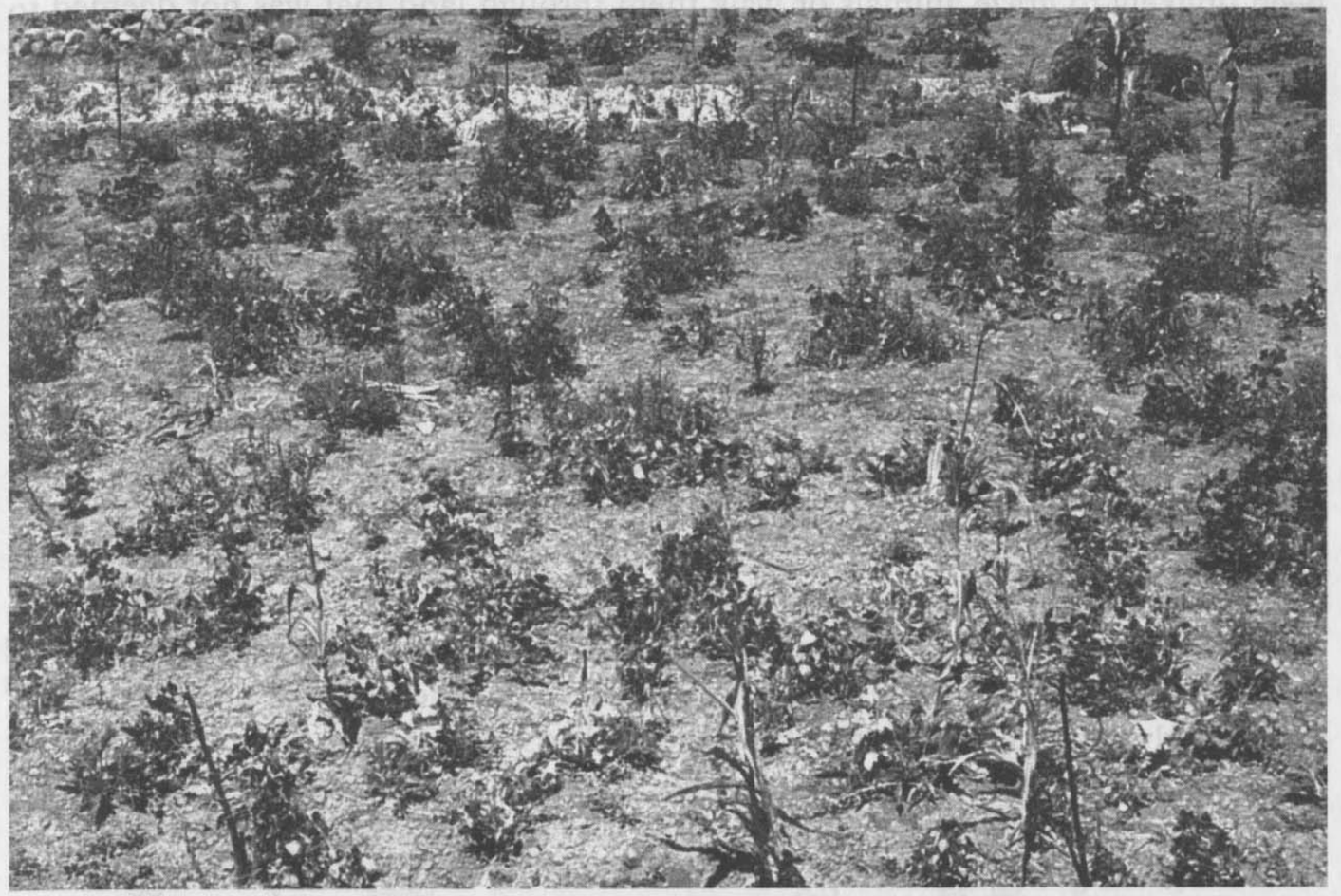


Figure 3.3 Dry garden (*xeriko bostani*) for summer vegetables in Methana, photo taken in the 1980s. Photo: Lin Foxhall

technique of "dusting" dry-farmed summer vegetables, which seems to be similar to the dry gardens (*xerika bostania*) of modern Greek farmers.

Pastoralism, Transhumance, and Seasonality

The role of livestock in Greek farming regimes has been much debated (Hodkinson 1988; Skydsgaard 1988; Forbes 1995; Howe 2008; McInerney 2010). Certainly it is clear that the keeping of animals was closely integrated with other agricultural activities, and animals exploited resources which humans could not otherwise use directly, such as plant growth on fallow and uncultivated land and agricultural by-products. The evidence is scanty for specialized transhumance, that is, the movement of flocks seasonally from one environmental and/or climatic zone to another, as subsequently described by the Latin author Marcus Varro for southern Italy in the first century B.C. Some scholars (Hodkinson 1988:51–58) think that it was not widely practiced in Classical Greece. Certainly the kinds of long-distance transhumance routes found in the medieval and later periods in some parts of the Mediterranean world seem inherently unlikely, given the territoriality of classical Greek *poleis*, and the relatively constrained sizes of their territories (Hodkinson 1988:53). In areas where borders were relatively clear-cut, shepherds would have

been unlikely to graze animals or walk them through land that was not deemed to be part of their own *polis*: epigraphic examples of the problems of shepherds and animals from one polis moving across boundaries into the territory of another exist (Osborne 1987:48, 50–52). In more mountainous areas, however, where territories might be less well defined, the situation might have been different (see below for a discussion of Tegea).

On the other hand, there are indications that the movement of flocks over short distances from winter lowland grazing to upland summer grazing was regularly practiced. The Vari House in southern Attica is one of only a few excavated rural houses, sited on the road up to a remote rural sanctuary (the Cave of Pan, a god special to shepherds and their flocks) on Mount Hymettos, above the ancient deme village of Vari (Figure 3.4; Jones et al. 1973; see chapter 4 [a], this volume). Though the main period of the house dates to the early fourth century B.C., there was earlier fifth-century occupation on the site. This is a relatively small courtyard house with a tiled roof, and there is some limited evidence for agrarian activities. The range of finds is close to those of the rural sites discovered in archaeological survey and is significantly different from the archaeological assemblages of urban houses. The house is set within a large enclosure wall, probably because livestock (most likely sheep or goats) were kept in the yard. The surrounding area is highly suitable for summer grazing. The beehive sherds found near the door in the yard suggest that the occupants kept bees on the thyme-covered slopes of Mount Hymettos, famous for its honey from antiquity to the present. Keeping bees by the back door seems highly unlikely and rather dangerous, and the broken beehives must have been thrown into the yard for the animals to lick once the honey had been removed. Grazing in the mountains and bee keeping are both summertime activities so it is probable that the occupants lived here only for part of the year, at the time when the sanctuary would have been most regularly visited. As is the case for many farmers today, tourists might have provided a welcome stream of customers for honey, cheese, and other farm products. In winter, the occupants probably moved themselves and their animals down to the coast to where the ancient village of Vari was located.

From the Temple of Athena Alea, located in the mountains of the central Peloponnese near Tegea, an early fourth-century B.C. inscription (*IG* V.2, see also Osborne 1987:49) lays out the regulations for grazing livestock on both the land owned by the sanctuary and land within the sacred precinct. Certain officials of the temple are allowed grazing rights for restricted numbers of animals. However, there also seems to be provision for people who are not citizens of Tegea, to stop overnight at the sanctuary with their flocks while moving animals from one area to another. This could imply that the sanctuary was located on a well-established transhumance route in the broken upland landscapes of Arkadia.

The animals most commonly kept were sheep and goats, well adapted as they are to the rugged landscapes and the harsh, dry conditions. Flocks were probably relatively small—generally 50 animals or fewer—because of limited grazing and high mortality rates from disease and parasites in the absence of modern veterinary medicine. They were versatile and were exploited for wool, milk, and meat, though

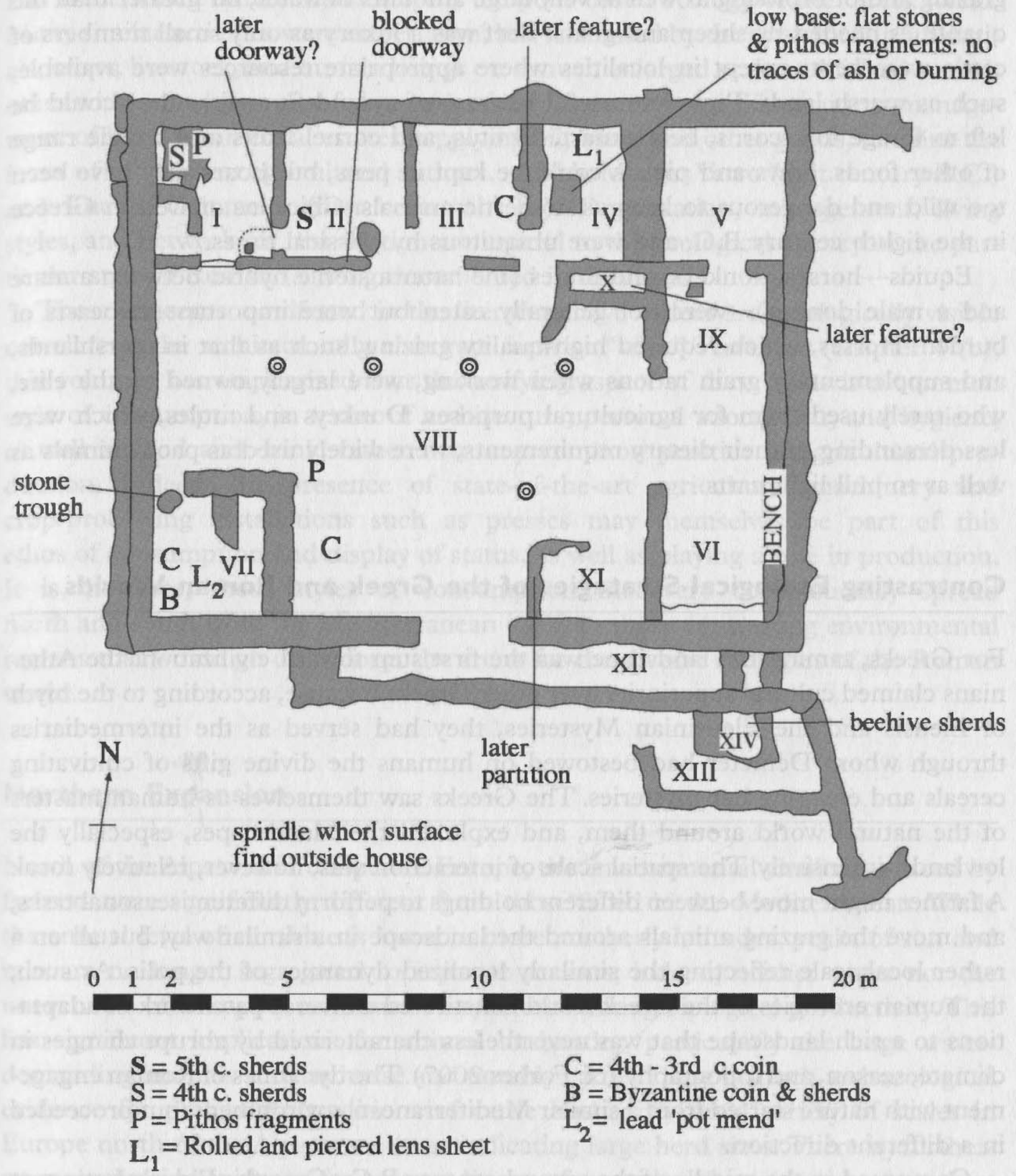


Figure 3.4 The Vari House, Attica. Drawing: Lin Foxhall

it is clear that a number of specific breeds were recognized. Contrary to popular belief, goats are particular about their diet, but both can survive on rough Mediterranean grazing when desperate in the dearth of mid-summer, even consuming desiccated, prickly thistles and the leathery leaves of shrubs. Nonetheless, they must have considerable amounts of water to survive.

Cattle were important as traction and transport animals, but are more difficult to maintain in the drier parts of the Mediterranean as they need good-quality

grazing and/or browsing as well as very large amounts of water, far greater than the quantities needed by sheep and goats. Beef was a luxury as only small numbers of cattle were kept, except in localities where appropriate resources were available, such as marsh lands. Pigs were useful in areas of upland forests, as they could be left to forage for acorns, beech mast, arbutus, and cornel fruits and a wide range of other foods. Sows and piglets could be kept in pens, but boars may have been too wild and dangerous to keep as domestic animals. Chickens arrived in Greece in the eighth century B.C. and were ubiquitous by classical times.

Equids—horses, donkeys, and mules (the latter a sterile hybrid between a mare and a male donkey)—were not generally eaten but were important as beasts of burden. Horses, which required high-quality grazing, such as that in marshlands, and supplementary grain rations when working, were largely owned by the elite, who rarely used them for agricultural purposes. Donkeys and mules, which were less demanding in their dietary requirements, were widely used as pack animals as well as to pull light carts.

Contrasting Ecological Strategies of the Greek and Roman Worlds

For Greeks, taming the landscape was the first step toward civilization: the Athenians claimed cultural superiority over other Greeks because, according to the myth of Eleusis and the Eleusinian Mysteries, they had served as the intermediaries through whom Demeter had bestowed on humans the divine gifts of cultivating cereals and enacting her mysteries. The Greeks saw themselves as human masters of the natural world around them, and exploited their landscapes, especially the lowlands, intensively. The spatial scale of interaction was, however, relatively local. A farmer might move between different holdings to perform different seasonal tasks, and move the grazing animals around the landscape in a similar way, but all on a rather local scale reflecting the similarly localized dynamics of the polis. As such, the human ecologies of the Greek world constituted a diverse patchwork of adaptations to a rich landscape that was nevertheless characterized by abrupt changes in climate, season, and topography (cf. Forbes 2007). The dynamics of Roman engagement with nature started from a similar Mediterranean environment, but proceeded in a different direction.

Composed in the middle of the second century B.C., Cato the Elder's Latin text *De Agri Cultura* incorporates many familiar elements of Mediterranean practice: cereals, olives, vines, timber cutting, manuring, milling, and fruit-pressing, perhaps drawn from contemporary practice in Latium and Northern Campania. White (1970) makes the observation that the most orderly and precise sections of the work are not those dealing with working the land directly, which in places are haphazard and incoherent. They are instead the sections dealing with the organization and management of the estate, and in particular, the technological requirements of a production line in oil and wine. The emphasis is on the profitable management of a slave-run estate, in which investment, sale, and export are key. The human ecology of the Roman world goes on to have a spatial reach, extended by imperial expansion

and trade which differentiates it from the polis-based ecology of the Greek world. Many similar activities were undertaken, but facilitated by the movement of materials, crops, livestock, and human beings on a much enlarged scale and linked to each other within the hierarchal framework of the Roman empire. The prudent management of large commercial estates supplying oil, wine, and other goods, remains the focus of subsequent agricultural authors, notably Marcus Varro (first century B.C.) and Lucius Columella (first century A.D.). Organization, management, living styles, and networks of distribution are central to the ecological agency of the particular style of Roman farming documented in these texts.

These concerns manifested in the literature have a clear archaeologically visible correlate in the architecturally elaborate farm or "villa." Terrenato (chapter 4 (b), this volume) has emphasized that the unifying aspect of these villas is a common style of consumption, in terms of architecture, personal adornment, and hygiene, as well as food and drink, rather than any common practice of agricultural production. Indeed, the presence of state-of-the-art agricultural machinery and crop-processing installations such as presses may themselves be part of this ethos of consumption and display of status, as well as playing a role in production. It is, however, those styles of consumption that very conspicuously spread north and south from the Mediterranean itself, to those contrasting environmental regions that would go on to form the arena for the diverse ecologies of the Roman world.

Northern Expansion

North of the Alps within temperate Europe, the environmental challenges faced by farmers were significantly different from those faced in the Mediterranean. While the annual level of sunshine is lower in more northerly latitudes, peaks of sun and rain are no longer segregated to separate seasons; indeed, neither water nor the unevenness of its supply continue to be factors limiting biological productivity. This has significant implications for animal husbandry, particularly the large water-demanding animals such as horse and notably cattle. There is much archaeological evidence for prehistoric traditions of cattle husbandry on a variety of scales in Europe north of the Alps, sometimes indicating large herd sizes. There is, furthermore, increasing evidence for long traditions of secondary bovine products such as milk and butter.

Temperate Europe is characterized by much larger expanses of plains and gently rolling topographies than the Mediterranean. Rather than gardens and terraces (van der Veen 2005), the emphasis was upon extensive fields, growing a diverse range of cereal and legume crops. While small enclosures and paddocks are widespread, we know of no clear evidence of what might be described as a "garden" in prehistoric temperate Europe. As we move north and east across Europe, the limiting factors to growth in these fields were depressed sunlight hours, and constraints upon either end of the growing season by late spring frosts and late summer storms. The winter and spring frosts in particular were ameliorated on the Atlantic face of Europe by

the Gulf Stream, and significantly, it was along the Atlantic face of Europe—in Spain, France, and Britain—that the Roman Empire proved ecologically able to extend furthest beyond the Mediterranean. There is now clear evidence that mixed farming with cattle and cereal agriculture is attested in many parts of prehistoric temperate Europe. However, the imperial *limes* only stabilized where cereals were not simply *grown*, but were already being *mobilized* as surplus on at least a local scale. Rather than being attached to a particular set of farming practices and environmental resources, the ecology of Roman farming was instead attached to a style of living and of agrarian management, and, critically, an exchange network to which these were attached. In Germany, the Netherlands, and Northern Britain, that ecological pattern fluctuated around the limits of its sustainability, ultimately settling along the Rhine Valley and the line of Hadrian's Wall (Van der Veen 1992; Zachariasse 2003).

The earliest indications of a Mediterranean engagement with these Northern Atlantic regions all concern styles of consumption, first of wine, bodily adornment, and hygiene (Hill 1995; Dietler 2005). It may also be that the Iron Age northern chieftains whose graves are well furnished with amphoras also consumed Mediterranean food. It is certainly the case of the first military elite to land in Britain, whose meals included figs, grapes, olives, and dates (Murphy 1992; Van der Veen 2008). Within a generation, Roman architectural styles are seen in the form of rural "villa" architecture. However, Hingley (1989) has argued that such architectural styles do not penetrate deep into the underlying structure of the traditional compounds of the local elite. Archaeobotanical evidence from this period of temperate Europe also suggests a continuity of traditional agrarian practice, of extensive field agriculture using the same crops that had been grown in the region for centuries, and the same farming techniques. Styles of consumption, networks of exchange, military appropriation, and rural villa architecture all spread north as part of imperial expansion, and expansion initially built on existing local traditions of ecological engagement, quite distinct from Mediterranean practice. With time, however, these styles of ecological engagement were themselves transformed.

The first discernible transformation was in the use of metal. Iron production was greatly stimulated by the imperial process, and unprecedented quantities of the hitherto scarce resource were distributed around the imperial network. Some of that was used to fashion a new generation of harvesting tools, which have been interpreted as hay scythes (Rees 1979). The harvesting equipment attested in prehistory would have been poorly suited to gathering herbaceous hay, which can only be effectively harvested with a much longer blade than was available to prehistoric farmers. There is scattered evidence that branches of leafy fodder, that can be harvested with more modest blades, was the prevailing winter-feed of livestock (Jones 1991). The long iron blades that appear in the early Roman empire allowed the plant community we know as hay meadows to proliferate. They may even have led to their original genesis as distinct plant communities (Jones 1991). Although their first appearance seems linked to Roman expansion, the Roman favorites of pork, chicken, and oysters, are little augmented by the maintenance of hay meadows. This novel ecological product of metal technology, the hay meadow, was of more relevance in the sustenance (and especially the winter survival) of those essentially northern symbols of prestige and wealth, horses, and cattle.

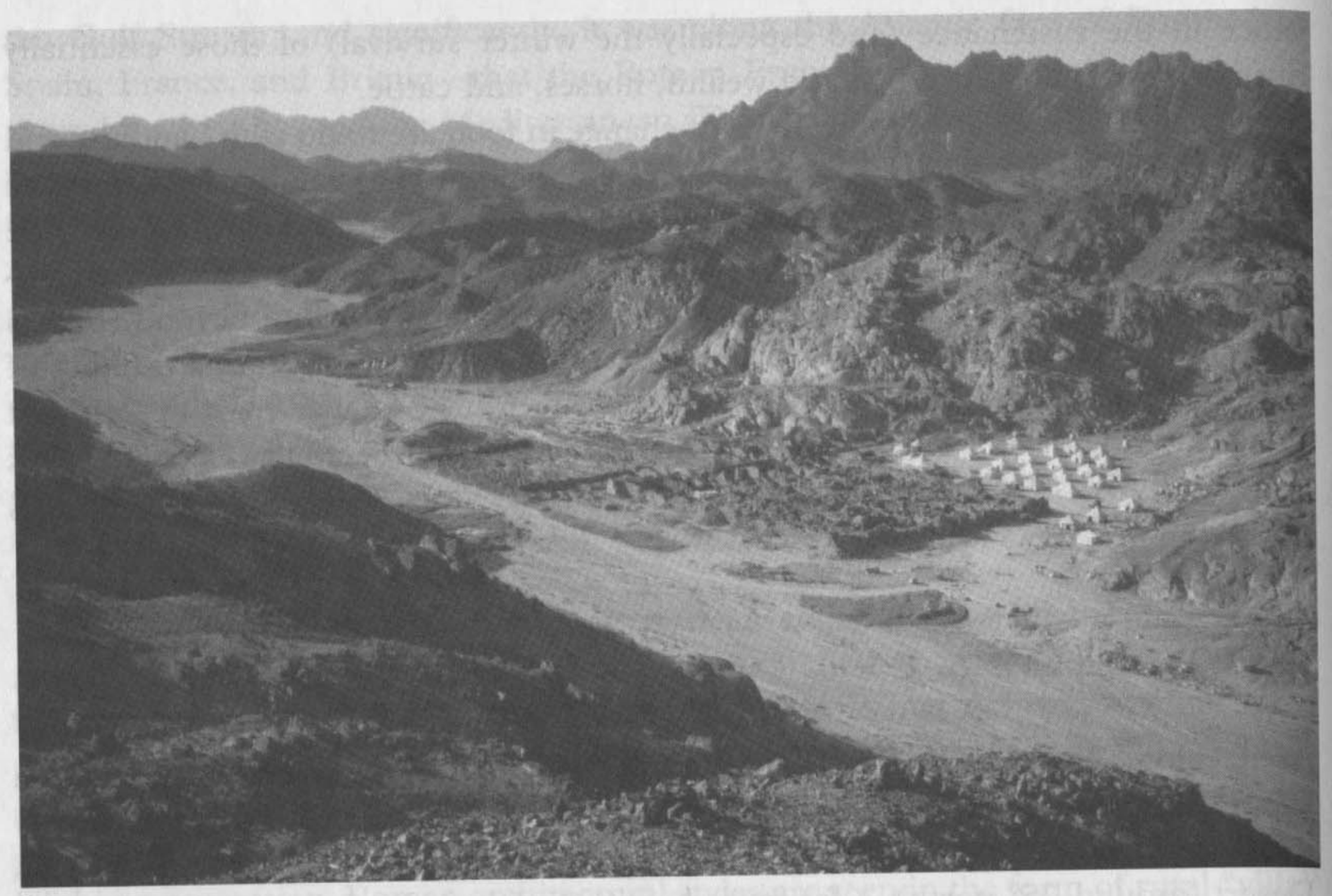
Otherwise, the clearest indications of change in food are to do with handling and mobilization on an unprecedented scale. Within the limes forts along Hadrian's Wall are a series of vast granaries storing cereals in unprecedented quantities, and the traces of mechanical mills that could transform their contents into flour. More valuable and transportable foods were traveling across the empire and beyond (Bakels and Jacomet 2003). The peppercorns that have been recovered from a number of sites in Roman Britain may well have traveled from the Malabar coast in southern India, entering the imperial network at the African ports of Berenice (Cappers 1999; 2006) and Myos Hormos (Quseir al-Qadim; Van der Veen 2011; see chapter 10 (b), this volume).

Southern Expansion

Archaeology has recently cast considerable light on the ecology of the Roman Empire in its most southerly reach. For example, Van der Veen's (1998; 1999; 2011) work has demonstrated that Roman settlement was possible in Egypt's Eastern Desert (around 25° north), a far more hostile environment than northern Britain, around 55° north. The Eastern Desert is best known as a trading route to the ports of Berenice and Myos Hormos, and a source of quarried stone, at Mons Claudianus and Mons Porphyrites. A combined study of textual fragments of ceramic *ostraca*, and archaeological analysis has allowed Van der Veen to construct an ecological picture of life within the parched stone quarries (Van der Veen 2001; Van der Veen and Tabinor 2007). She has shown that, not only did Roman styles of food consumption spread with the southern *limes* much as they did with the northern *limes*, but that some elements of small-scale production also traveled to this hostile region. The presence of such green vegetables as cabbage, chicory, cress, and lettuce bears witness to the vegetable gardens that flourished in this arid zone (Figure 3.5 [a–c]). The means of transferring ecological agency to this most hostile part of the empire was that ultimate symbol of classical mastery over nature—the *hortus*, or garden, the small plot in which every feature of the environment is closely managed, often in spite of the prevailing climate and topography. While in a field we see economic plants and animals arranged in harmony with the dynamics of nature, in a garden, we see them arranged in harmony with the aesthetics of culture. In Jericho, Herod the Great planted a Roman Garden in his Oasis Palace (Gleason 1993). Just as gardens had been a prominent feature of the Greek Mediterranean world, they became a recurrent mark of Romanization along the diverse *limes* of the empire.

Meadows, Gardens, and Moldboard Plows

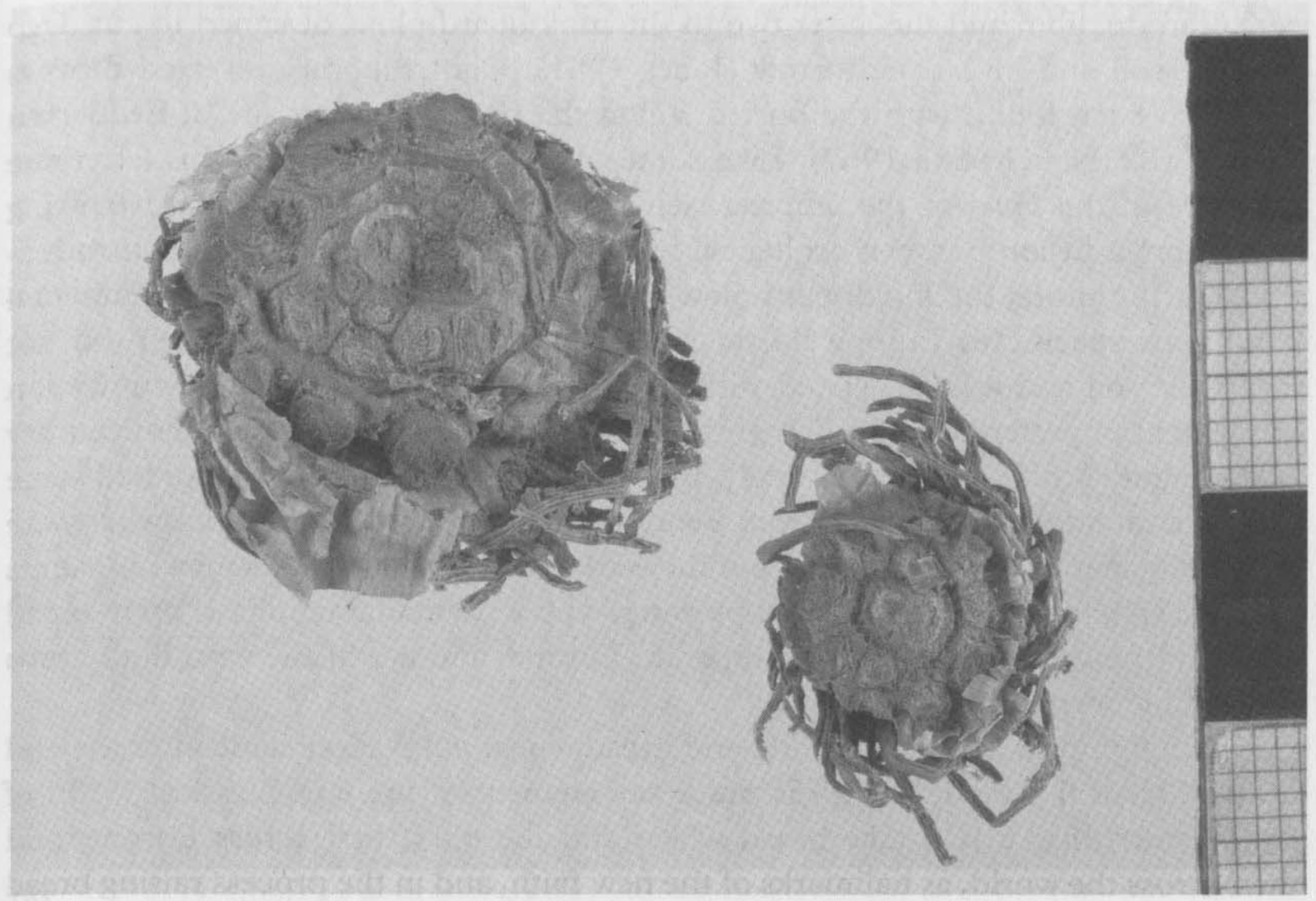
Ornamental gardens had appeared in conjunction with the earliest villas and "palaces" within the northern *limes*, notably attested at Fishbourne in Sussex



(a)

(b)

Figure 3.5 (a) View of the Roman site at Mons Claudianus, Egypt; (b) Remains of artichoke from the Roman site of Mons Claudianus; (c) Remains of garlic from the Roman site of Mons Porphyrites. All photos courtesy of Professor M. Van der Veen



(c)

Figure 3.5 *Continued*

(Cunliffe 1971). We are not sure to what extent, if at all, they had a strictly economic dimension, just as we are unclear whether the hay meadows attested by hay scythes and fragments of the hay itself were of widespread ecological significance or something specifically for raising prestigious animals. From the late third century A.D. onwards, however, there is recurrent evidence, from villa plans, planting pits, "dark earths," and the diversification of subsidiary food plants, that an economic garden was becoming a recurrent feature of the northwest provinces (Jones 1989). This was also a period in which the balance of investment between the town and the countryside was shifting; the imperial margins, both in the north and the south, were witnessing a surge in conspicuous rural wealth. In the northwest provinces, this provided the context for a highly significant ecological shift. This shift was the consequence of a fusion between the core elements of temperate European agriculture: adequate water, gentle topography, deep soils, and a long tradition of cattle management, and the core elements of Roman agrarian ecology, particularly the ease of mobilization and exchange of goods, materials, and investment. Just as with the earlier hay scythes, a crucial material that was mobilized was iron.

Three iron implements that recur on Romano-British sites of the late third and fourth centuries A.D. are the long harvesting scythe, the coulter, and the asymmetrical plowshare (Rees 1979). All three can be linked to the intensification of

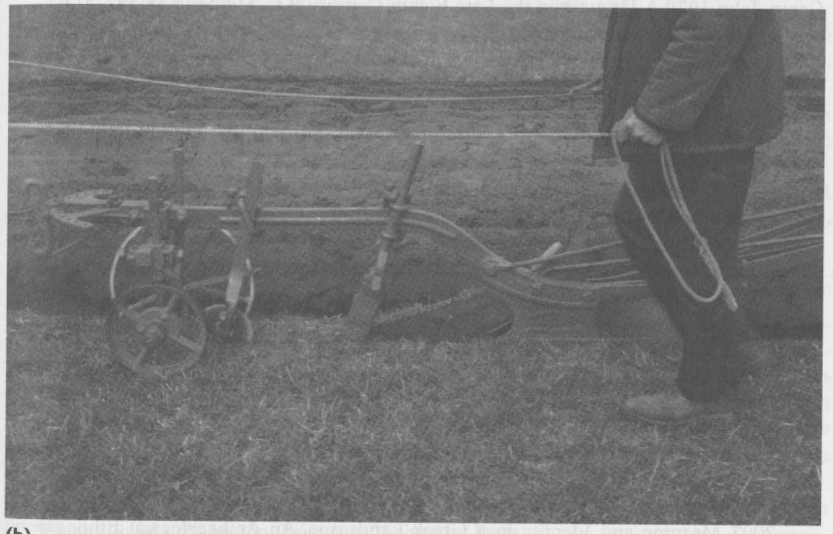
cereal production, and the latter two to the moldboard plow, designed to cut deep into the soil and invert the furrow (Jones 1981). Contemporary inverted furrows have also been found with the buried soil at the north German site of Feddersen Wierde (Körber-Grohne 1967). Like some of the metalwork finds, this latter site lies beyond the *limes* of the empire itself, an indication that moldboard plowing arose from a fusion between ecological traditions rather than as a simple introduction. Furthermore, the moldboard plow was developed to deal with environmental conditions specific to Europe north of the Alps—the simple ard, which did not invert the soil and was associated with shallow tillage, continued as the cultivation implement of preference in much of the Mediterranean until the twentieth century A.D. (Figure 3.6 [a, b]). Interestingly, Körber-Grohne (1967) has interpreted some of the economic plant remains from Feddersen Wierde as deriving from what were essentially managed "gardens" within the settlement. The crop repertoire also shifts with the spread of deep moldboard plowing, with a particular emphasis upon bread wheat in the western regions of temperate Europe, and rye in the east, both crops favored by deep cultivation.

The full impact of deep plowing and bread wheat cultivation came after the end of the Classical period, though it was a key element of the late Classical world of Christianity, that would take bread wheat and the plow, first across Europe, and then across the world, as hallmarks of the new faith, and in the process raising bread wheat to the status of the primary food source of the human species. The early roots of that process lie in a particular style of Roman ecology, that emphasized control, management, and distribution, rather than over-stamping or eradicating any existing agrarian practice.

Contrasts in the Ecology of the Classical World

Two literate and closely intertwined societies that emerged from a common Mediterranean environment ultimately proceeded along distinct ecological paths. The difference involved scale and a sense of place. Greek ecological practice embodied a wide diversity of detailed environmental knowledge about the Mediterranean region, the potential and challenges it offered. Those challenges were met by diverse practices and a certain degree of mobility, but mobility primarily on the local scale of the polis. Mobility beyond the polis was primarily focused on the widespread network of *poleis* scattered across the islands and the littoral zones of the Mediterranean. As a consequence, the Greek world displayed a patchwork mosaic of the diversity of responses to one particular topographic climatic region. Roman ecological practice also arose in the Mediterranean region, but was less grounded within it. The emphasis within a succession of agricultural authors is instead upon estate management, investment, and export, within a transferable model of farming that could follow imperial expansion to a succession of contrasting regions. Within those regions, there was a certain amount of introduction and agrarian imposition, but a substantial degree of exploitation and larger-scale mobilization of what was already there. It was the fusion between those new scales of mobilization, and existing

(a)



(b)

Figure 3.6 (a) Cross-cultivation with a wooden ard in contemporary Nepal. The bidirectional cultivation, while tearing up and aerating the weedy vegetation, does not invert it; (b) A recent moldboard plow, with cutting blade or "coulter" clearly visible in front of the metal edge of the moldboard itself, which completely overturns and inverts the weedy vegetation, leaving a deeply cultivated, plant-free surface. Photos: author.