THE AGRICULTURAL ECONOMY AND PRACTICE OF AN EGYPTIAN LATE ANTIQUE MONASTERY: AN ARCHAEOBOTANICAL CASE STUDY

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Abstract

This thesis explores the extent to which archaeobotany can contribute to the largely historically-based discussion of the role monasteries played in the Late Antique (4^{th} - 7^{th} centuries AD) agricultural economy in Egypt. The archaeobotanical assemblage collected from the excavations of a Late Antique monastery at Kom el-Nana, Middle Egypt (AD 400 - 750) is used for this purpose.

The methodology employed in the field, laboratory and statistical analysis of this assemblage follows that already established in northern Europe. The possible uses of the economic and weed / wild plants recovered are fully discussed. By-products of crop processing or food production are abundant in these samples, suggesting that they are also of economic value at this site, most likely as fodder, fuel or temper. This result was confirmed by a study of the weed / wild taxa which showed that samples had evidence for a low harvesting height, indicating the intentional collection of plant stalks during harvests. A wide range of economic plants, including many condiments, were recovered at Kom el-Nana suggesting a more varied monastic diet than indicated by historical records.

The use of multivariate statistical analysis establishes that although there may be some post-deposition contamination (i.e. abandonment debris, decaying mudbrick, etc.) these are not major contributing factors to the formation of these deposits.

The differences or similarities between carbonized and desiccated components of the Kom el-Nana assemblage are explored. Oven samples are the primary source of carbonized remains on site and many of the taxa identified in the desiccated component, especially fruit and condiments, are not recovered in the carbonized component.

In Late Antique Egypt cereal chaff is documented as a traded agricultural good and, therefore, it is argued that the use of cereal producer / consumer models is inappropriate in the Late Antique Egyptian context. Historical evidence is used to explain the absence of cereal grain and pulses from the Kom el-Nana assemblage. The archaeobotanical data from the Kom el-Nana oven samples indicate how different traditional fuels (i.e. crop processing by-products and animal dung) were used as fuel. These results demonstrate that integrating archaeobotanical and historical evidence is a successful method to address issues on agricultural economy and practice in this or any other historical period.

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Guidance Notes

A few notes of guidance may be of help to the reader. This thesis is written by an American and, therefore, employs American English spelling and usage. Definitions for terms are provided within the text, on the first use of a term. Figures, tables and plates are integrated within the text of each chapter. If they are not placed on the page where they are first mentioned, they are placed on the following page or pages. One exception to this, however, is Appendix 3, where all plates are placed at the end of this section in order of mention.

Chapter 1. Introduction

Since 1988 the Egypt Exploration Society excavations at Tell el-Amarna have focused on an area called Kom el-Nana, located to the south of the main city, the ancient capital of the Pharaoh Akhenaten (Kemp 1993; 1995a; 1995b; forthcoming).[1] During the 1989 excavations of a New Kingdom, Pharaonic temple (dating to *ca.* 1350 BC) at the Kom el-Nana enclosure, a midden dating to a much later period, the fifth through seventh centuries AD or Late Antiquity, was revealed. The discovery of Late Antique remains at Kom el-Nana is not entirely unexpected. Indeed, this very area of Amarna was identified as a Roman camp in the late nineteenth century by Petrie (1894). Archaeobotanical samples collected from the midden proved to contain a rich and well preserved assemblage of desiccated plant remains. In addition, small amounts of well preserved carbonized remains also were found. Further excavations of the Late Antique settlement at Kom el-Nana in 1993 and 1994 incorporated archaeobotanical sampling and, in total, 152 archaeobotanical samples and the contents of 39 vessels have been collected from all three seasons of excavation at the site. It was obvious that the archaeobotanical remains would require a great deal of time to sort, identify and quantify and, as a result, it would not be possible to fully examine all of the samples collected.[2] Consequently, fifty-two samples were selected to form a case study of the archaeobotanical remains of this settlement. In total, over 27,500 identifications have been made from these case study samples, forming a substantial data set for the study of agricultural practice and economy at Kom el-Nana.

At first the exact nature of the settlement was not clear (Kemp 1993). In part this reflected the limited area of excavations at the site; but also the results of the recent excavations did not obviously support the conclusions of previous work, which suggested that the 'Roman' settlement at Amarna was military in character (Frankfort and Pendlebury 1933; Petrie 1894). In spite of this contradictory archaeological evidence, a new papyrological study of the Roman military in Egypt still claims that a tower found in the 'Main City' (area T34.3) and the settlement at Kom el-Nana are forts (Alston 1995: 33). Recent translations of three ostraca and graffiti found at Kom el-Nana during the 1994 excavations show such conclusions about the military character of the settlement at Kom el-Nana are unfounded and, furthermore, securely establish that these plant remains are from a monastery (Clackson 1997 and forthcoming; Kemp 1995a). Although many monastic sites have been excavated in Egypt, only two have had any form of archaeobotanical analysis conducted; however, the plant remains discussed in these reports were not quantified and were without context (Täckholm 1961; Winlock and Crum 1973). The present study applies modern methodologies of archaeobotany to plant remains from a monastery for the first time in Egypt,

[1] A full description of the site of Kom el-Nana and a location map (Figure 3.5) are presented in Chapter 3 §3.3. This introduction is only intended to present the history of excavation at Kom el-Nana and, in particular, the problems in identifying the precise nature of the Late Antique settlement at this site. I am grateful to Barry Kemp for discussing previous archaeological research at Kom el-Nana with me. This has also been published in detail in Kemp 1995b.

[2] The methodology used in the field and the laboratory will be described in detail in Chapter 4. The archaeobotanical results and analysis will be discussed in Chapters 5-8.

providing an unprecedented opportunity to explore the agricultural practice and economy of an Early Christian monastery.

The form of communal monasticism which developed in Egypt during the fourth century AD served as a prototype for monastic communities in the Late Antique and Early Mediaeval world (Bagnall 1993a: 295). Historical records of monasteries provide abundant accounts of monastic life, but problems of bias in hagiographies (stories of saintly lives) or the brevity of records, such as ostraca, mean that much of the minutiae of daily monastic life is poorly understood. The archaeobotanical remains from these monasteries can add to our historically-based understanding of the agricultural practice and economy of these institutions, elucidating the nature of their participation in the agricultural economy of Late Antique Egypt. Thousands of Egyptian men and women are said to have lived as monks in Late Antiquity (*Historia Monachorum in Aegypto. Édition critique du texte grec et traduction annotée* by A. -J. Festugière (Subsidia Hagiographica 53, Brussels 1971) cited in Bagnall 1993a: 301 footnote 238). In the Oxyrhynchite and Arsinoite nomes alone, some 70 monasteries are recorded (Badawy 1978 : 40). At least 36 monasteries and anchorite sites are known in Western Thebes in the seventh through eighth centuries AD (Wilfong 1989: 118-129); and at least 29 monasteries are documented in the Hermopolite nome at the beginning of the seventh century (Kemp forthcoming, citing J. Gascou (1994) *Un codex fiscal hermopolite* (P. Sorb. II 69) American Studies in Papyrology 32). Potentially, hundreds of monastic sites were constructed in Egypt during Late Antiquity. Palladius also records that their inhabitants carried out diverse economic activities (English translation R. Meyer 1965). We know that in the Mediaeval world, monasteries were economically powerful institutions whose wealth was agriculturally-based (Fossier 1990: 33, 483-484; Morris 1995). This study explores the nature of the economic role of these early Egyptian monasteries and the extent to which they can be regarded as the forerunners to Mediaeval monastic estates (Bagnall 1993a: 295).[3]

1.1 The Archaeological Record for Egypt in the Period 332 BC - AD 642

The period of foreign rule in Egypt after the Pharaohs could be described as Graeco-Roman. Egypt gradually lost power to the 'new empires' of the Mediterranean (Bowman 1986). First falling to Alexander the Great and rule by the Ptolemies (the Macedonian dynasty started by Alexander's general Ptolemy in 332 BC which ended with the death of Cleopatra VII in 31 BC), then by Rome, and finally by Constantinople under the Byzantine emperors until the Islamic invasions of AD 640-642.[4]

Nearly a decade ago, in concluding his review of Alan Bowman's (1986) book, *Egypt after the Pharaohs*, Roger Bagnall (1988: 201) stated:

[3] These issues will be addressed in Chapter 2 and Chapter 9.
[4] This will be discussed in more detail in Chapter 2 §2.3.1.

> Calls for an archaeology directed to increasing knowledge and answering questions have been around for quite some time now; it is discouraging to see how limited the results for Egypt have been up to the present. Much of what might have been studied three quarters of a century ago is now lost forever; but even now more is being lost each year. It is a bitter irony that the only land of the ancient Mediterranean where enough documents have survived to offer a real chance for the meeting of philology and archaeology should be that for which archaeology has the least to bring to that meeting.

Most agree that the contribution archaeology makes to studies of Egypt from Ptolemaic times to the Islamic invasions (332 BC - AD 642) is extremely limited. This criticism is not only applicable to Egypt, but to studies of Late Antiquity in the Near East as a whole (e.g. King 1994). There are many questions still to explore; ranging from establishing more secure chronologies for pottery types, understanding changing settlement patterns or the layout of cities, to finding evidence for long distance trade and changes in the plants cultivated. Archaeological investigation of Egypt 'after the Pharaohs' should be viewed as part of a growing body of studies on the first millennium AD, which is now seen as a new and exciting period for archaeological research throughout much of the 'Old World' (e.g. Randsborg 1991).

Archaeological surveys conducted in the Mediterranean and the Near East since the late 1970's have generated useful information about the extent of settlement and, in some cases, trade links (e.g. Cameron 1993a: 152-154). Survey, as an archaeological technique, is relatively new to Egypt but is beginning to be practiced there. Part of the Fayum (Rathbone 1996), the hinterland of the Red Sea port of Berenike (Sidebotham and Wendrich 1995: 85-101) and the area around Bir Umm Fawakhir in the Eastern Desert (C. Meyer 1995) have been partially surveyed, greatly enhancing our understanding of the settlement pattern in these regions. These studies demonstrate that a number of Roman and Late Antique settlements endured the hardships of life in the Eastern Desert in order to exploit the mineral resources in the area; and, in the case of the Fayum, survey work was used to clarify the precise location of settlements previously only known from the papyrological record.

Excavations of archaeological sites dating from Ptolemaic through Late Antique times in Egypt have many limitations. Some were conducted solely for the recovery of papyri and, as a result, have produced little of archaeological worth (e.g. the excavations at Medinet Madi in the Fayum during the late 1960's cited in Bagnall 1988: 200 or Oxyrhynchus cited in Bagnall 1993a: 46). Only a few villages with Late Antique remains are excavated, and none of the nome capitals (the main urban settlements and administrative centers in the various regions of Egypt) have been completely excavated (Bagnall 1993a: 6).

Much of the current archaeological research conducted in Egypt is based outside the Nile valley. Direct archaeological evidence of sites within the flood plain of the Nile is elusive. It generally is accepted (e.g. Bagnall 1993a; Rowlandson 1996) that many sites along the east bank were and are lost as the course of the Nile shifts eastward over time (Butzer 1976: 35). Other sites are likely to remain hidden beneath modern settlement, to be destroyed already by *sebbakh* digging (stripping sites of the soft soil, primarily highly broken down organic midden material, which built up around and between mudbrick walls and using it for fertilizer), or to be damaged if not destroyed by the expansion of modern agriculture. In any period of Egypt's history, sites in the 'black land' or flood plain are under-represented in the archaeological record (H. S. Smith 1972: 705; Hassan 1997).

However, sites can still be found along the edges of the modern cultivation strip, in the desert oases and on the Red Sea coast. There is a growing body of new archaeological research on sites dating from the Ptolemaic through the Late Antique period in these areas of Egypt (e.g. Bailey 1996; Sidebotham and Wendrich 1995 and 1996). Such excavations are beginning to address the imbalance between the archaeological and papyrological record in Egypt during the period. The archaeological project which has resulted in this present study should be viewed as part of the wider effort to increase our understanding of Egyptian life in the period between 332 BC and AD 642.

1.2 Aims and Organization of the Study

Many basic issues about monastic agricultural practice and economy are poorly understood. The archaeobotanical assemblage from the Late Antique monastery at Kom el-Nana is ideally suited to examine fundamental questions about monastic life in the period. Two questions are central to this study. First, the historical sources suggest monastic diet was limited.[5] The plant remains from Kom el-Nana can be used to test this premise.[6] Second, it is not clear whether monasteries used a much more limited range of plants than other non-religious settlements. Although archaeobotanical research at many sites often does not produce fully quantified data, it is possible to compare the range of plants found at Kom el-Nana with these other sites on the general level of presence, in order to explore this question.[7]

This study is designed to address these over-arching questions by pursuing three main research aims. First, to establish what crops were in use at Kom el-Nana and, where possible, how they were used. These first archaeobotanical results will be used to directly compare Kom el-Nana's plant remains with archaeobotanical assemblages from elsewhere in Egypt and with the historical record. Second, where possible, an interpretation of the agricultural practice and economy of the site will be put forward based on the archaeobotanical evidence. Finally, the archaeobotanical evidence from Kom el-Nana will be integrated with historical sources to enhance our understanding of monastic agriculture and economy in Late Antique Egypt.

The thesis is made up of three parts: the background to the study, the core archaeobotanical case study, and the integration of archaeobotanical results with papyrological evidence for agriculture, particularly with

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[5] This will be discussed in detail in Chapter 2 §2.5.3.
[6] See Chapter 9 § 9.4
[7] See Chapter 5 §5.5

papyri (in the widest sense) from monastic institutions. The following two chapters will introduce the historical and archaeological background to the case study. Chapter 2 defines the period of Late Antiquity and, in particular, focuses on some of the transitions occurring at the Mediterranean scale in the period. The historical evidence on land tenure and monasticism in Late Antique Egypt will be discussed in some detail in this Chapter as well. Chapter 3 focuses on the historical and archaeological evidence from the Hermopolite nome (the ancient province the site of Kom el-Nana is situated in) as well as briefly surveying the archaeological record for monasteries. This chapter also presents the archaeological background to the site of Kom el-Nana and a description of sampled contexts.

The next section of the thesis focuses on the archaeobotanical case study from Kom el-Nana. Chapter 4 describes the methodology employed during fieldwork, laboratory research, and statistical analysis of the data. Chapter 5 presents a summary of the economic plants found at Kom el-Nana and compares this assemblage with results from other sites dating between 332 BC - AD 1000. Chapter 6 presents the evidence for agricultural practice at Kom el-Nana. Chapter 7 summarizes the archaeobotanical results. The first half of the chapter will identify the dominant plant categories and individual plants in the Kom el-Nana assemblage. The final part of the chapter will address one taphonomic issue; namely are the Kom el-Nana archaeobotanical samples from 'near primary' deposits or do they represent contaminated (or mixed) deposits? Most archaeological sites in the Mediterranean and Near East only have carbonized plant remains; however the Kom el-Nana assemblage contains both carbonized and desiccated plant remains. It is widely known that carbonization is biased against certain types of plant remains (Boardman and Jones 1990; Green 1982; Wilson 1984). Chapter 8 sets out the similarities and / or differences between the two different preservation components of the Kom el-Nana assemblage in order to explore the extent of information loss which may have occurred if only carbonized plants survived at Kom el-Nana. The penultimate chapter of the thesis, Chapter 9, will attempt to integrate the historical record for agricultural practice and economy in Late Antique Egypt, especially at monasteries, with the new archaeobotanical results from Kom el-Nana and pre-existing archaeobotanical data from other monasteries. Chapter 10, the concluding chapter of this thesis, will not only highlight the results generated from this study, but also will consider possible areas for future research.

1.3 Limitations of the Study

The archaeobotanical and historical evidence used in this study have certain limitations. Both forms of evidence are geographically biased to areas away from the cultivation strip (the fertile strip of land along the Nile, which received inundation in the past). Furthermore, the papyri are predominantly metropolitan (i.e. urban), whereas, the archaeobotanical data are predominantly from rural settlements. As a result, the different sources of agricultural information for the period often force philologists, archaeologists, and historians alike to integrate data which are not strictly compatible. In addition, the archaeobotanical and papyrological evidence demonstrate different aspects of the agricultural economy. Papyri typically are concerned with the administration of agricultural crops and land, in particular their sale, rent and taxation; however, archaeobotanical remains are simply direct evidence of those crops and weeds intentionally and, sometimes unintentionally, brought to a site. It may be that all of the crops found are well known in the historical record, but it is equally possible that certain plants found in archaeobotanical sampling are little known or unrecorded. In addition, the archaeological context of the plant remains may provide insight into agricultural practice (i.e. threshing or crop processing) or other economic activities (i.e. weaving, basketry, dying).

In Late Antiquity there are two factors which impair our understanding of agriculture and suggest that archaeobotanical evidence is essential for expanding our knowledge of agricultural practice and economy in Egypt. First, the records are overwhelmingly dominated by wheat (Bagnall 1993a: 23-24; Rowlandson 1996: 236-238) and, in terms of records of foodstuffs from monasteries, only a few other crops are mentioned (Bagnall 1993a: 300; Winlock and Crum 1973: 145-149). Second, in the Ptolemaic period contracts stipulated which crop(s) must be grown by the tenant; however, from the first century AD onwards, a growing number of contracts allow the tenant free choice of the crop(s) to be planted. For example in the fifth through sixth century records from Oxyrhynchus, 76% of the land contracts do not specify the crop to be planted (Rowlandson 1996: 236-240). Since historical records do not reliably reflect the crops grown, archaeobotany is the only source of primary evidence available to provide such agricultural information.

In terms of monasteries, there are still many problems inherent in the direct comparison of plant remains with the historical record. For example, with only three ostraca and a few walls with graffiti found to date, the monastery at Kom el-Nana seems unlikely to make a major contribution to the historical record of monasteries. The Coptic place name for the site is otherwise unattested (Clackson 1997; forthcoming) and if excavations at Kom el-Nana had been restricted to only the Pharaonic period (fourteenth century BC) levels, the monastery would have remained unknown. In essence the plant remains from a relatively small and unknown monastery will be compared with records from other monastic institutions, which are located in different regions of Egypt and may have experienced different agricultural and economic circumstances. In fact, there only are rare cases where archaeobotanical evidence can be compared directly with the papyrological record (in the widest sense) from the same site, such as at Mons Claudianus (van der Veen 1996: 137). The majority of Egyptian archaeological and papyrological finds do not converge in this way. As a result, at present, integration only can be attempted with primary evidence which is not easily or directly comparable.

Aside from the difficulties inherent in the comparison of archaeobotanical results with the papyrological results, the archaeobotanical information currently available also has definite limitations. Published archaeobotanical results from Roman and Late Antique Egypt often are not quantified and most do not specify context. This means that current archaeobotanists only can compare their results with previous work on the very general level of presence. Although it is useful to know that safflower also has been found at Karanis (Bartlett 1933), for example, without specific information on the state of preservation, the context, and quantification, it is not possible to know whether the crop was important at Karanis, if it was in storage or if it was used as fodder. It may be that the careful collection of samples from specific contexts ultimately will not produce information on agricultural practice, but lack of context means that most archaeobotanical objectives cannot be attempted at all now or in the future.

The reality is, of course, that we all must work with the evidence available. Egypt's ancient agricultural history may suffer from limitations, but many areas of the world have far fewer primary historical documents from the period and much more archaeobotanical evidence (Zahran and Willis 1992: 373). The limited contribution of archaeobotanical evidence to our historical understanding of ancient agriculture in Egypt must be rectified. The only sure way of increasing our knowledge of agricultural practice in Egypt is to incorporate archaeobotanical sampling within the wider framework of current archaeological, historical and philological studies of the period. This study aims to increase our understanding of monastic agriculture in Late Antique Egypt by integrating new archaeobotanical results with the current papyrological evidence.[8]

[8] See Chapter 9.

Chapter 2. The Wider Historical Setting

The archaeobotanical remains used in this case study are not isolated finds without historical or social meaning. Many of the changes which took place in the Mediterranean and Egypt during Late Antiquity are likely to have had an impact on the agricultural economy of the Kom el-Nana monastery. In particular, during the course of the period Christian institutions in Egypt and the Mediterranean were gaining religious, political and economic power (Bagnall 1993a; Cameron 1993a). The traditional view (e.g. A.H.M. Jones 1973) that the ancient economy in the Mediterranean was in decline is now widely accepted to have been overly pessimistic, especially in the case of the eastern Mediterranean (e.g. Cameron 1993a: 83-85). Recently, Alcock (1995: 220-221) suggested that it is "closer to the truth" to view the Roman Empire as a "patchwork composition" incorporating a diversity of regions and allowing for different responses in each of these regions to annexation and foreign rule by Rome and, later, Constantinople. Egypt's role in the Mediterranean in the Roman and Late Antique periods often has been left out of discussions on the ancient economy and other archaeological or historical studies on the basis that Egypt was somehow different from the rest of North Africa or the Mediterranean (e.g. Finley 1985: 27-28; Roskams 1996: 159). This view is now widely seen to be unfounded (e.g. Bagnall 1995: 2; Rathbone 1989).

2.1 Late Antiquity

The defining characteristic of the Late Antique period is that it marks the transition from the Classical to the Mediaeval world in the Mediterranean, and somewhat beyond (e.g. Northern Europe). In the eastern Mediterranean, this transition was gradual, occurring over several hundred years. As a result it is difficult to pinpoint precise start and end points for Late Antiquity. Assigning dates for the period is dependent on the perspective and scope of the research undertaken. For example, Brown (1991) dates the period to AD 200 - 700 for the Mediterranean; whereas, Cameron (1993a) assigns it to AD 395 - 600. In Egypt, Bagnall (1993a) dates the period from the end of the third century to the mid-fifth century AD. In part, the variety of dates reflects the need to recognize other periods. For instance, Cameron views the Late Roman period as something distinct from Late Antiquity in the Mediterranean as a whole (Cameron 1993a: 1-4; 1993b: 1-12). Alternatively, Bagnall (1993a:ix) organizes the chronology of Late Antique Egypt in such a way that it subsumes the Late Roman period, but does allow for a distinct Byzantine period, dating from the mid-fifth century until the Islamic invasion (AD 640-2). In effect, any research in the Mediterranean during the third through eighth centuries AD could be assigned to a variety of periods (i.e. Late Roman, Late Antique, Early Byzantine, Early Islamic or Early Mediaeval) depending on the perspective of the researcher and the region of the study. The complexity of the Late Antique period is largely due to major changes in the socio-political and socio-economic character of many provinces or former provinces of the Roman Empire.

In Egypt, there is a difference of opinion on how to date the Byzantine period. Bowman (1986: 45-46) starts the Byzantine period with the reign of Constantine in AD 312 while Bagnall (1993a: ix) argues that the Byzantine period begins in the mid-fifth century AD on the basis of a change in contract types observed in the papyrological evidence. Although the character of fourth century Egypt may be different from that of the seventh century, to determine exactly where this change begins, and more practically, to identify sites which clearly date to Late Roman or Early Byzantine periods in Egypt is not possible in practice. Certainly, there is no major watershed in the mid-fifth century which is widely recognized archaeologically. Moreover, at the scale of the Mediterranean as a whole, the Early Byzantine period is subsumed by Late Antiquity (e.g. Brown 1991; Cameron 1993a).

For the purposes of this study, 'Late Antiquity' will begin with the Late Roman period, effectively at AD 284 and the ascension of Diocletian, following Bagnall (1993a) and Cameron (1993b). It will include the Early Byzantine period and come to an end with the Islamic invasion of AD 640 - 642, broadly following the criteria outlined by Cameron (1993a: 2).

2.2 Late Antique Transitions in the Mediterranean

The Mediterranean basin at the start of the Late Antique period was unified under the Roman Empire but on the brink of major change. The Empire, at this point, was officially split into eastern and western administrative units under the tetrarchs (Diocletian, Maximinus, Constantius and Galerius divided imperial rule between themselves). The instability caused by the continual change in emperors during the preceding century was brought to an end by Diocletian. Reforms instituted by Diocletian somewhat helped to stabilize the political turmoil of the Empire, but inflation was left uncured by these reforms, and remained a problem in Late Antiquity (Cameron 1993b: 113). Cameron (1993a) has strongly argued that during this period the east continued to prosper as the west experienced decline, contrary to the traditional model of economic decline (A. H. M. Jones 1973). Fundamental to this revision is the view that the whole of the Late Antique world experienced the same changes, but the eastern Mediterranean experienced such change at a much slower pace than in the western Mediterranean and at different rates on a regional and local level (Cameron 1993a: 84-85).

2.2.1 The emergence of new powers

In the west, mismanagement, if not mistrust, of the barbarian tribes led to a policy of avoiding the incorporation of these groups into Roman life (Cameron 1993b: 151). Ultimately, relations with various barbarian tribes broke down and many cities and provinces in the west were attacked, held for ransom or conquered. From the late fifth century onwards, we see the emergence of small kingdoms such as the

Ostrogoths in Italy, the Franks or Merovingians in France, the Vandals in North Africa (excluding Egypt) and the Visigoths in Spain. Whether these societies are best considered as 'sub-Roman' or as emerging Mediaeval kingdoms is debatable, but continuation of some Roman features is evident in the west (Cameron 1993b: 187-188).

In the east, political power was consolidated by the emergence of rule by an emperor with a civilian civil service (Cameron 1993b: 103-104). Like the west, the eastern Empire was threatened by recurring barbarian attacks and invasions throughout Late Antiquity. Unlike the west, the east was, at first, successful in buying off or vanquishing such invaders (Cameron 1993a: 17). Eventually, the eastern Mediterranean did succumb to Persian and, later, Islamic invasions; losing control of Syria, Palestine, Jordan and Egypt. At the beginning of the eighth century AD, the Byzantine Empire was reduced to territories in Turkey (Anatolia), Greece and parts of the Balkans and Italy. From the eighth century onwards the Byzantine Empire was effectively just one player amongst many other powerful kingdoms which emerged in the former territories of the Roman Empire.

2.2.2 The emergence of a new kind of city

The Late Antique 'city' is on a very different scale from today's cities. Only a few cities (Constantinople, Rome, Alexandria and Antioch) approached the population size (from *ca.* 100,000 to a maximum of one million) of some of our modern cities (Cameron 1993a: 153). The evidence suggests that the majority of settlement was on a smaller scale, forming a dense network of towns in the countryside (Brown 1991: 84; Liebeschuetz 1996: 9). Population alone was not the defining criterion for a city in antiquity. In the Roman period the presence of a council defined a 'city' (Liebeschuetz 1996: 2), but by the end of Late Antiquity the presence of a Bishop meant that a settlement, regardless of size, was a 'city' (King 1994: 3).

The number of cities does not appear to diminish in the eastern Mediterranean during the period, but their character was transformed. Such urban change was not due to any one particular reason (Cameron 1993a: 158). The responsibilities imposed on the ruling elite (the curiales) appear to have increased during Late Antiquity, eroding the power of town councils and the benefits of curial status for the city rulers. In parts of North Africa, reduction of income to cities and private individuals coincided with breakdown in the municipal system (Lepelley 1996: 68). These changes also appear to correspond with a decrease in the number of landed estates, which some consider an indication of recession (e.g. Randsborg 1991) but alternatively could indicate that most of the available land was now controlled by a small group of wealthy landlords. Aside from changes in the existing system, during the fourth through sixth centuries the urban and rural landscape was altered by a new political and economic force: the Church (Cameron 1993a: 166-168; Liebeschuetz 1996: 14). Christian churches became the new municipal architecture in the urban context in Late Antiquity. Monasteries also exerted influence over the rural landscape of the Mediterranean. Some (King 1994: 5) have questioned whether church building and the foundation of monasteries should be viewed as evidence for economic stability, or indeed boom; regardless of what these building activities meant economically, they represented a substantial capital investment by the Church. In addition to demonstrations of economic power, the Church also grew in political power. As cities developed a Christian identity, the administrative structure of the Church and the presence of a Bishop elected by the laymen of a city provided the natural inheritors of civic rule in many provinces (e.g. Liebeschuetz 1996).

Physically, cities were transformed during the course of Late Antiquity. Throughout the former Roman Empire, cities began to take on the role of military garrison and refuge in the face of barbarian invasions (Liebeschuetz 1996: 16). One of the most obvious changes was the emergence of city walls. After the sack of Rome in AD 410, Theodosius II ensured that Constantinople was protected with the construction of massive fortification walls around the capital of the eastern Empire. Many of the cities of Greece and the Balkans developed a fortified acropolis at this time (Cameron 1993a: 159). Certain cities also lost dominance in this period, either through the creation of new cities (i.e. Egyptian military stations developed into their own cities), or the change of ruling power (i.e. power shifted east and south from Antioch to Aleppo and Damascus under Arab rule) (Liebeschuetz 1996: 33-35). The layout of established cities began to alter. The most obvious change is the abandonment of temples accompanied by an increase in churches. Other facets of Roman cities, such as the large buildings and colonnaded streets, were transformed. In Greece and North Africa, rooms within large buildings were subdivided during Late Antiquity, suggesting a major change in the function of these buildings (Cameron 1993a: 160). Public places in the city, such as streets and *fora*, began to exhibit evidence of encroachment. In some areas this seems to be the forerunner to the Mediaeval '*suq*', or market place, common to Arab cities (Carver 1996: 189; Ward-Perkins 1996: 11). These changes to urban space are not necessarily evidence of economic decline; it is equally likely that population pressure and continued economic stability, if not prosperity, also could have facilitated such change.

2.2.3 The rural landscape

Recent archaeological surveys suggest that settlement expansion occurred in many rural areas of the eastern Mediterranean and the Near East in Late Antiquity (Alcock 1993; Cameron 1993a; Foss 1995; Randsborg 1991). In some regions of Greece, survey work has suggested that Late Roman / Late Antique settlement becomes more nucleated (Alcock 1993: 105-113). In other parts of the Mediterranean when reduction in settlement numbers occurs, it appears to have been gradual (Randsborg 1991: 45). Randsborg (1991: 44-47) suggests that certain areas such as North Africa, Sicily and Sardinia show stability in the number of rural settlements from the preceding Roman period. Whether continuity of rural settlement into Late Antique and Early Islamic times is evidence for economic stability or stagnation remains a debated point in archaeological and historical studies (e.g. Cameron 1993a: 177-182). The number of settlements in places such as Syria and the Negev strongly suggests that these regions were utilized to their optimum, supporting a dense population in these areas throughout Late Antiquity and into the first decades of Islamic rule (e.g. Foss 1995: 229; Liebeschuetz 1996: 25-26).

Possible reasons for such density in settlement patterns include defensive needs; development of large estates; specialization of agricultural production necessitating access to markets and other forms of income; and possible non-agricultural specialization (e.g. mining or pottery production). The adoption of specialized agricultural production (predominantly livestock and olive orchards in this case) is evident in the hills of Northern Syria (Foss 1995: 220). Recent survey work in the Eastern Desert of Egypt (Meyer 1995; Sidebotham and Wendrich 1995) also suggests that settlements developed in order to exploit mineral resources (e.g. stone quarries and gold mines) in the Roman and Late Antique periods. Along with the expansion of agricultural lands, in the Roman period areas of the rural landscape often are controlled by large landed estates which may have persisted into Late Antiquity (Liebescheutz 1996: 28). Absentee landlords, who were normally resident in the urban centers of the Romano-Byzantine Empire, became increasingly evident in the Mediterranean, in regions such as in Greece (e.g. Alcock 1993: 84) and Egypt (e.g. Bagnall 1993a: 316). Foxhall (1990) has hypothesized that in pre-industrial societies even when land is owned on a large scale, it is best exploited on a small scale basis, and most effectively through the hire of tenants or share-croppers. Modern studies of similar agricultural systems in the less developed regions of the world do indicate that higher crop yields are achieved by tenant farmers than by waged labourers (Foxhall 1990: 102). The Egyptian papyrological evidence from Roman and Late Antique Oxyrhynchus demonstrates that hired tenants commonly worked landholdings of urban landowners. This papyrological evidence also establishes that small areas of land were farmed by tenants in the Oxyrhynchite nome of Egypt in the Roman and Late Antique period. Although not all of the lease agreements preserve or record the area of land cultivated, the largest recorded area of private land leased was 40 arouras or 11 hectares, but the vast majority were under 13 auroras or 3.75 hectares, most often occurring in the range between one and five auroras (Rowlandson 1996). Bagnall (1993a: 117) predicts that landholdings of between 10 to 39 arouras might be sufficient for the needs of one family and could be managed by that family alone; based on this the Oxyrhynchite leases suggest that tenants were often working units of land that were not of sufficient size for them to survive on alone.

The trend of rural tenants leasing small parcels of land does not necessarily mean that all tenant farmers of Roman and Late Antique Egypt only eked out a meagre existence. Accounts of the land the rural tenants might own themselves are under-represented in the papyrological record and leases of public lands were generally not recorded (Rowlandson 1995: 71 and 203). We also have no way of assessing how much imperial land was held in any region, but from the evidence which is available, imperial lands seem to be managed in much the same way as large estates (Rowlandson 1995: 55-61 and 280). Although tenants of rich landlords are well documented, there is plenty of evidence for small scale land ownership in Egypt (Gagos and van Minnen 1992; Rowlandson 1995: 281) and limited evidence for waged labour (Bagnall 1993a: 121-123; Rowlandson 1995: 205-208). This suggests that a variety of patterns of landholding and land management were in operation in Late Antique Egypt and that the land in one region most likely was managed differently from that in another area of Egypt.

The management of estates and the nature of the relationship between tenant and landlord is an area of active research in the Roman and Late Antique Mediterranean world (e.g. Kehoe 1996). In Egypt, Bagnall (1993a: 115) suggests that the relationship between tenant and landlord was not 'feudal' in nature. In addition, the traditional view that Late Roman or Late Antique patterns of tenancy are the precursors to the Mediaeval feudal system has now been rejected in the eastern Mediterranean (Kaplan 1986). It may, therefore, be likely that a combination of working one's own landholding and additional land as a tenant farmer would be the norm in Egypt (e.g. Rowlandson 1996) and elsewhere in the Mediterranean (e.g. Greece see Alcock 1995: 112).

2.2.4 The Late Antique economy

Was the economy affected by the changing nature of society in the Late Antique Mediterranean? Most agree with Finley (1985) that agriculture was fundamental to the ancient economy. In addition, material evidence such as pottery, art work and monumental architecture often are seen to indicate a prosperous society. The difficulty with the traditional view that the Late Antique economy was in decline (A.H.M. Jones 1973) is that, in spite of significant changes in this period, archaeological and documentary evidence for continued economic production does not disappear in the Mediterranean. Cameron (1993a: 81) suggests that traditional models of major economic collapse after the Roman period are "more a convenient myth than a realistic analysis."

In the Mediterranean, documentation of deserted lands or agricultural crisis was initially taken at face value. Whittaker (1993: Chapter III) argues that abandoned lands represent areas of marginal agricultural production and that the amount of land out of production in places such as North Africa and Syria is in keeping with traditional Mediaeval and modern land use in these areas. In reference to records of land crisis from the Fayum in Egypt, Whittaker (1993: III, 153) suggests that this was "a perpetually recurring state in a land whose productivity was poised on a fine edge between underflooding and overflooding every year."

There also is a growing body of archaeological evidence for settlement expansion in many parts of the eastern Mediterranean and North Africa during Late Antiquity (Cameron 1993a; King and Cameron 1994; Foss 1995: 221; Whittaker 1993: III). In the west, it appears that there is no increase in settlements, but this alone is not sufficient evidence to support the view of economic collapse. Study of the pattern of barbarian invasions has shown that they were concentrated on major cities (Whittaker 1993: III, 154 and 157), and generally overlooked the rural countryside where the majority of the population lived. Invasion obviously disrupted land-based wealth, but there is some evidence for the continuation of Roman landowners under barbarian rule in the west (Brown 1991: 129). As Whittaker (1993: III, 157) advises, "a villa destroyed is not the same as land abandoned." It now seems likely that the economy in the western Mediterranean was shaped by powerful landlords who benefited from the weakened state of central government (Cameron 1993a: 84). Major building projects, in particular the construction of churches and monasteries, occur throughout this period in the Mediterranean.

Whether we can interpret the evidence for expansion of settlement in the eastern Mediterranean in Late Antiquity as an 'economic boom' is questionable. As Cameron (1993a: 182) warns, "[i]t is not obvious that this increased settlement implies economic growth in the modern sense[.]" It is likely that the change of ruling power in Late Antiquity would not have been immediately noticeable to the population as a whole (Bowman 1986: 88; Cameron 1993a: 33). Although urban life may have been altered, the first century of Arab rule in the east does not seem to have disrupted the economy (Cameron 1993a: 188).

2.3 Egyptian Late Antiquity

In Late Antiquity, Egypt was influenced by the changes occurring throughout the Empire, but appears to have maintained a thriving economy. Like many areas, Egypt suffered incursions and, eventually, invasion; yet, in spite of these major changes economic activity continued uninterrupted. In addition, the emergence of the monastic movement in Egypt became a major influence on Christian communities throughout the 'Old World' in Late Antiquity.

2.3.1 Romano-Byzantine rule in Egypt

Like many parts of the eastern Mediterranean, Roman rule in Egypt built on Hellenistic rule. The Ptolemies, a Macedonian dynasty founded by Alexander the Great's general, Ptolemy, in 332 BC, gradually lost power to the Roman Empire. From 168 BC, Egypt was effectively a client state of the Roman Empire, although ruled by Ptolemaic kings (Bowman 1986: 32). By the time of the defeat of Cleopatra VII and Marcus Antonius at Actium in 31 BC, the inclusion of Egypt as a province of the Roman Empire was, in effect, a formality. "[T]he passing of Ptolemaic rule was probably unmourned, perhaps even largely unnoticed, by the majority of the inhabitants of the Nile valley for whom the replacement of a Macedonian monarch by a Roman emperor heralded no obvious or dramatic change" (Bowman 1986: 37). What was unique about Roman rule in Egypt, unlike any other province in the Empire, was that Egypt was treated as the personal property of the emperor (Bowman 1986:37). Augustus ensured that Egypt was never ruled by Romans of senatorial class, but by a prefect of equestrian rank who was directly responsible to the emperor and less likely to be in a position to usurp imperial power. Securing the wealth of Egypt for the emperor was so important that senators and powerful equestrians were forbidden to enter the province without imperial permission (Bowman 1986: 38). Thus protected, Egypt's resources were exploited by Rome for just over 300 years. The grain supply was a major source of wealth in Egypt, but Egypt also offered exotic animals, mineral deposits, and other luxury goods as well as access to valuable trade routes with such regions as sub-Saharan Africa, Arabia and India. In addition, the Nile ensured the efficient transport of goods from Egypt to any Mediterranean port of the Empire.

2.3.2 Historical background of land ownership in Egypt

The organization of Ptolemaic lands only slightly modified the previous Pharaonic and Saite organization of land tenure in Egypt (Rowlandson 1996: 27). In the Ptolemaic period land was categorized as royal land, temple land or 'cleruch' land (royal land grants to soldiers, officials, and even prisoners of war) (Crawford 1971: 55). Although the Ptolemaic state generally prevented private inheritance (Bowman and Rathbone 1992: 109), some tenants of temple lands are known to have had free rights of inheritance and sale (Rowlandson 1996: 29). Eventually, many of the Ptolemaic land grants gradually evolved into privately owned land, with rights of inheritance (Rowlandson 1996: 29).

One of the major changes in land ownership of the Roman period is the emergence of a substantial sector of privately owned estates (Bowman and Rathbone 1992: 112). In part this was due to gradual changes prior to the re-organization of land in the Roman period, but it also was aided greatly by the sale of imperial landholdings to private landowners in Egypt in the fourth century (Bowman 1986: 86). Rathbone's (1991) recent study of the third century Appianus estate in the Antonoite nome (the Fayum) suggests that this estate was highly monetized and intentionally run to produce surplus. Although owned by a wealthy Alexandrian of possible equestrian rank; the estate was controlled by a local, resident estate manager, Heroninos, and had many economic links to city councillors at Arsinoe (the nome capital), to other local elites and to local labourers. As Bagnall (1993b: 256) notes in his review of Rathbone's book, this is a single archive of some 450 published and possibly 600 unpublished papyri which might not be representative of the whole of Egypt. The presence of other large, private estates, however, is known in Late Antique Egypt (e.g. Hardy 1931) and elsewhere in the eastern Empire (e.g. Alcock 1993: 72-80; Foxhall 1990).

Egypt had a variety of landholdings ranging from substantial estates to more modest parcels of land (e.g. Rowlandson 1996). Inequality in land ownership seems likely and certainly is strongly evident in the fourth century land registers from the Hermopolite nome, where the majority of land is held by a minority of owners (Bagnall 1992; Bowman 1995). Complete accounts of land ownership are not available for all regions or periods in Egypt, but both Bagnall (1992) and Bowman (1995) have strongly argued that the uneven pattern of land distribution is known prior to the Roman period in Egypt and also is paralleled in modern examples of less developed agricultural societies.

In Egypt, records of land transactions suffer from lacunae in the documentation in the period between the reign of Theodosius (AD 379) and the reign of Justinian (AD 527) (Bagnall and Worp 1980). Studies of those documents which date to immediately after the transition from Roman to Byzantine rule, however, do suggest a continuity in land ownership relations between the Roman and Late Antique periods (Gagos and van Minnen 1992: 186-187). Although sixth and seventh century documentation is dominated by records of large estates with absentee landlords from the Oxyrhynchite nome (e.g. Hardy 1931; Rowlandson 1996); this pattern of land ownership does not reflect the rural economy as a whole. Evidence from Alabastrine (Gagos and van Minnen 1992) and Hermopolis (Bowman 1985) demonstrate that in some regions the rural landscape was essentially made up of locally owned smallholdings. It now seems likely that during Late Antiquity different patterns of land ownership were present in the various regions of Egypt, such that some areas, perhaps entire nomes, would be dominated by large estates and others would be predominantly made up of smallholdings (Gagos and van Minnen 1992).

2.4 Agricultural History and Developments in Late Antique Egypt

In the past, the Nile provided an annual and fairly predictable flood. Each summer Egypt would suddenly receive extra water, produced from heavy rains in the Ethiopian highlands and around the 'Great African Lakes'. As early as 3400 BC, irrigation systems formed by artificial banks and basins controlled the flow of flood waters (Hamdan 1961: 121). Control of the Nile flood waters led to a distinctive agricultural system. A series of levees or basins were designed to catch the flood water and control its direction. These basins are filled successively from the south to north, until the whole valley is effectively a lake. Water was kept on the land between six to eight weeks and then was drained onto the next field(s) or back into the canal system. Crops were planted in the autumn and harvested in the spring. This basic system of growing a single crop on the land each winter in harmony with the natural cycle of the Nile does not appear to have altered much from Pharaonic practice (e.g. Eyre 1994; Rowlandson 1996: 19-20).

This pattern of winter cultivation of crops in Egypt has led some to suggest that the cultivation of artificially irrigated summer crops was an Islamic introduction (Watson 1983). Archaeobotanical evidence for summer crops in the Roman and Late Antique period, however, has been found at Qasr Ibrim, in Egyptian Nubia (Rowley-Conwy 1989; 1991), and suggests that agricultural innovations once thought to be Islamic (Watson 1983) occur at much earlier dates. There also is some papyrological evidence for the cultivation of a second, summer crop during the Ptolemaic period through hand irrigation; however, cultivation of a single crop per year was "the almost universal practice" (Bowman 1986: 103-104). Recent archaeobotanical evidence for the cultivation of summer crops in Egypt prior to the Islamic invasion will be discussed below in §2.4.2.

The main changes in agriculture occur with advances in water lifting equipment, in particular, the introduction and development of water lifting devices in the Ptolemaic and Roman periods such as the '*saqiya*' or water wheel and the '*tanbour*' or Archimedean screw (Bagnall 1993a: 17; Bowman 1986: 144; Butzer 1976: 48). Evidence for a number of summer crops from Qasr Ibrim in Egyptian Nubia in Roman and Late Antique deposits suggests that advances in irrigation must have been in place already to allow for the growth of a second crop during the summer season (Rowley-Conwy 1989). Although improvements to agriculture could be made by using water lifting devices, clearing canals, or raising the level of irrigation canals; unusually high or low floods could not be overcome by this system and, in some cases, resulted in a poor harvest and, ultimately, famine. Regardless of whether advances in agriculture in Egypt were solely due to improved irrigation or were influenced by other factors, in antiquity the area of cultivated lands in Egypt was at its maximum during the Ptolemaic and Roman periods (Bowman 1986: 13).

2.4.1 Historical change in crop husbandry regimes

Crops in the Ptolemaic period were classed into three categories: cereals, other crops and green fodder crops (Crawford 1971: 112). Surviving Ptolemaic land registers suggest that somewhere between one-half to two-thirds of the arable land was used for cereal production. Crawford (1971: 114) found that in one well documented area of the Fayum, 74.6% of the available land was cultivated for wheat and a further 14.5% was cultivated for barley. More typically, however, a ten year register of land use in the Fayum during the Ptolemaic period shows wheat cultivation at levels of around 55% (Crawford 1979: 142). These Ptolemaic records do seem to correlate with nineteenth century records of crop production, when agriculture was not highly mechanized and was still dependent on inundation. Records of crop production from 1844 and 1885 establish that the area devoted to cereal production (including maize and sorghum) ranged from between 60% and 70% of arable land in the Delta region (modern Daqahliya province) and in the Minya province region of the Nile (roughly equivalent to the area of the ancient Hermopolite nome) (Ruf 1993: 196-197). Even without the sorghum and maize, wheat and barley accounted for between 40% and 50% of the arable land under cultivation.

It is difficult to assess whether evidence on sectors of the Egyptian agricultural landscape in Ptolemaic and pre-industrial times are representative of the wider picture in Egypt as a whole; however, it does suggest that certain regions of Egypt were devoted to cereal production on a large scale. Specialization of agricultural production to just one main crop must mean that the tenants or free farm workers had access to markets in order to supplement their diet or could acquire fruit and vegetables in some other way. One possibility may be that farmers had access to small, private gardens which were largely unregulated, and therefore unrecorded (Bagnall 1993a: 115-116). The precise location of these gardens can only be theorized, but gardens seem likely to occur in and around settlements and in other areas of the flood plain which would not receive inundation. Such gardens would have supplied vegetables and fruit that cannot be successfully grown on a large scale in Egypt's climate without a major investment in irrigation. Growing vegetable and fruit crops still is an expensive and difficult undertaking in Egypt today (Antle 1993: 186). In addition, the modern practice of planting fruit trees on the boundaries of agricultural fields in Egypt may have occurred in antiquity.

Papyrological records of crop production from Oxyrhynchus suggest that cereal crops were often the dominant crop grown in the Roman period (Rowlandson 1996: 237-238). Lease agreements from the first century onwards, however, increasingly do not specify the crop grown, but allow the tenant a free choice of the crop(s). Rowlandson (1996: 239) suggests that even given choice, a tenant will most likely grow wheat; she cites one lease which implies that the landowner fully expects the tenant will grow wheat, although the contract formally offers the tenant a free choice of the crop to be sown. Without specific reference to a crop, there is no way of knowing from the papyrological sources precisely what was grown or which crops dominated agricultural production. In addition, other components of the agricultural landscape are highly under-represented in the papyri. Records of rural landowners are limited, and tenancy agreements for public or imperial lands do not appear to survive (Rowlandson 1996: 71, 203 and 280). As a result, the historically-based study of land tenure and agricultural practice in Late Antique Egypt is biased, over-emphasizing the role of privately owned lands, particularly those lands controlled by urban landowners.

2.4.2 Evidence for traditional and new crops

The most obvious agricultural change in Egypt, according to the documentary evidence, is the introduction by the Ptolemies of free threshing wheat (most likely *Triticum durum* L.) which replaced emmer wheat (*Triticum dicoccum* L.) (Crawford 1979: 140).[1] The Ptolemies also experimented with crops in Egypt sometimes introducing new crops such as chick peas, figs[2], walnuts, peaches, apricots, plums, olives and a new strain of garlic (Crawford 1979: 140). In the Fayum, Ptolemaic experimentation established new fields of 'cash crops' such as garlic (Crawford 1973a) and opium poppy (Crawford 1973b).

Historical research does not suggest any further crop introductions until the Islamic period (e.g. Bagnall 1993a; Watson 1983). In particular, Watson (1983) has argued, based on his study of the historical record that crops such as, sorghum[3], 'Asiatic rice', 'Old World cotton', coconut, watermelon and artichoke were

[1] Although Watson (1983: 20) does consider hard wheat (*Triticum durum* Desf.) an Islamic introduction, he does acknowledge finds of hard wheat in Egypt in the preceding Byzantine period. Nesbitt and Samuel (1996: 87) have recently argued that in the first millennium AD tetraploid (including *T. durum*) and hexaploid (including *T. aestivum* L.) free threshing wheats gradually replaced hulled wheat; although hulled wheat did not entirely disappear from use.

[2] Figs are known from Pharaonic artistic depictions and papyri, but rarely found archaeobotanically prior to the Ptolemaic period (Murray forthcoming b). Crawford (1979: 140) argues that orchards of fig trees are planted in the Ptolemaic period and certainly seeds and whole fruits of fig frequently are recovered from Ptolemaic through Late Antique period sites (see Chapter 5 §5.5). Although fig may not strictly be a Ptolemaic introduction, its extensive cultivation does appear to first occur from the Ptolemaic period in Egypt.

[3] Watson (1983: 11) seems to have incorrectly 'translated' Schweinfuth's identification of *Andropogon sorghum* (Winlock and Crum 1973: 61) as cultivated sorghum (*Sorghum bicolor* L.). According to Boulos (1995: 206) *Andropogon sorghum* (L.) Brot. is a synonym for *Sorghum virgatum* (Hack.) Stapf, which is not cultivated but is, instead, a common weed in most regions of Egypt, except the Red Sea Coast (Täckholm 1974: 762). No details of the quantity, specific plant parts or suggested use were provided in the Winlock and Crum (1973: 61) report.

Islamic introductions. Recent archaeobotanical research, however, has overturned this historically-based theory. For example, archaeobotanical finds of cultivated varieties of sorghum at Qasr Ibrim pre-date the Islamic invasion by over 500 years (Rowley-Conwy 1989; 1991). Recent archaeobotanical research at the Romano-Byzantine Red Sea port of Berenike also has produced identifications of sorghum well before the Islamic invasion (Cappers 1996). Archaeobotanical finds of Asiatic rice (*Oryza sativa* L.) from Berenike (Cappers 1996: 322 and 330), watermelon (*Citrullus lanatus* (Thunb.) Mats. & Nakai) from Berenike (Cappers 1996: 322 and 325), Ptolemaic El-Hibeh (Wetterstrom 1981), Roman period Mons Claudianus (van der Veen 1996: 139), and Late Pharaonic (*ca.* Dynasty XXV) Qasr Ibrim (Rowley-Conwy 1989: 134), and artichoke (*Cynara scolymus* L.) from Mons Claudianus (van der Veen 1996: 139) also pre-date the Islamic invasion. Archaeobotanical finds of cotton (*Gossypium herbacium* L.) seed and capsule from Romano-Byzantine levels at Qasr Ibrim (Rowley-Conwy 1989: 134) as well as archaeological finds of cotton textiles (Wild 1997) in Egypt also suggest that cotton was introduced well before the Islamic invasion. Future archaeobotanical work in Egypt may shed light on the precise date for the introduction of aubergine (or eggplant), banana, colocasia, lemon, lime, mango, plantain, shaddock, sugar cane, sour orange, and spinach, which are all identified as Islamic introductions by Watson (1983).

Clearly, much of the historical evidence Watson (1983) uses is not a reliable indicator for crop diffusion, although these same sources may be more precise on the wide-scale adoption of these crops in the Near East and Mediterranean and, perhaps, on the identification of changing consumption patterns. Archaeobotanical research already has shown that many crops considered to be Islamic introductions were known from at least the Roman period, and such archaeobotanical evidence clearly should be included in any discussion of crop diffusion. A convenient bibliography of archaeobotanical research in Egypt, unfortunately, is not available and, as a result, many archaeobotanists are unaware of previous research on sites from similar periods. Recent synthetic works on Egyptian agriculture (Brewer *et al.* 1994; Germer 1985) do bring together a great deal of disparate sources, but provide surprisingly incomplete or unclear bibliographical referencing (e.g. MacDonald *et al.* 1995; Wetterstrom 1987) and do not give much attention to post-Pharaonic period material. In part, this simply may reflect the limited amount of archaeological research on this period of Egypt's history. Every attempt has been made here to discover previous archaeobotanical reports on material from Egyptian sites in the period 332 BC to AD 1000, but I am only aware of fourteen excavations which have published their archaeobotanical finds. These reports will be discussed in detail in Chapter 5 §5.5.

In some cases they only present the haphazard collection of archaeobotanical material and provide no quantification or details of context (e.g. Bartlett 1933; Bonnet 1902 and 1905; El-Hadidi and Amer 1996; Hepper 1981; Leighty 1933; Newberry 1889 and 1890; Täckholm 1961; Willerding and Wolf 1991; Winlock and Crum 1973). Other reports are preliminary in nature, and more precise or further identifications and / or quantification have yet to be made (e.g. Cappers 1996; Rowley-Conwy 1989; van der

Veen 1996). Those reports which present full archaeobotanical results, therefore, are limited (e.g. Barakat and Baum 1992; Wetterstrom 1982 and 1984).

With only fourteen archaeobotanical reports from sites dating between 332 BC and AD 1000 currently available, one site is often the only source of archaeobotanical finds for a particular period. This is likely to produce a biased view of agricultural practice in Egypt, but can only be rectified by the incorporation of archaeobotanical sampling at future excavations. Further work is underway on the Roman / Late Antique material from Berenike (*pers. comm.* René Cappers) and Mons Claudianus (van der Veen forthcoming), and new archaeobotanical research at places such as Roman / Late Antique period Kellis (*pers. comm.* Ursula Thanheiser) and Roman / Late Antique period Mons Porphyrites (*pers. comm.* Marijke van der Veen) will add more archaeobotanical data to the agricultural history of post-Pharaonic period Egypt.

The archaeobotanical case study presented here also adds to this body of evidence. Moreover, the site of Kom el-Nana is located in a region of Egypt which has not had any research conducted on ancient plant remains from this period and, therefore, will provide the first archaeobotanical evidence of Late Antique agricultural practice and economy in the area. The full quantification of plant remains found on the site, as well as knowledge of their archaeological context, will facilitate comparison of future archaeobotanical research with these results. In addition, the monastic context of this archaeobotanical assemblage will provide an independent source of primary evidence on the agricultural activities of such religious institutions which can be contrasted with our present historical understanding of their agricultural role.

2.5 Monastic Egypt

The origins of Christianity in Egypt are not clear. The first definitive record of a Christian community in Egypt comes from a letter dating to the second century AD which records a theological debate between Christians and Jews in Alexandria (Frend 1978: 414). Christians appear to be converts from the local population, and possibly first grew out of the Jewish quarters of cities, such as Alexandria. The initial tolerance of the Christian cult by Pagan Emperors ceased, and in the mid-third century AD the systematic persecution of Christians began in Egypt and elsewhere in North Africa. Throughout Egypt, commissions were established to ensure pagan sacrifices were made by citizens. *Libelli* recording such enforced pagan sacrifices dating between 250 and 251 were found in the Fayum (Frend 1978: 419). Like other regions in North Africa, Egyptian Christianity was predominantly urban at this time and few incidents in the countryside are recorded (Frend 1978: 420). The second wave of persecutions, sometimes called the Great Persecutions, dating between AD 303 and 311, was instituted by the emperors Diocletian and Maximin in Egypt. These persecutions were far more severe than the first and many Christians were killed for their beliefs. Eusebius recorded some of the events which took place in Egypt at this time:

> And we ourselves also beheld, when we were at these places, many all at once in a single day, some of whom suffered decapitation, others the punishment of fire; so that the murderous axe was dulled and, worn out, was broken in pieces, while the executioners themselves grew utterly weary and took it in turns to succeed one another.
>
> Eusebius' *Ecclesiastical History* VIII 9.4-5 cited in Frend 1978: 426

The Great Persecutions were culminated by the death of Peter, Bishop of Alexandria in 311. Two years later, the 'Edict of Milan' issued by the Emperor Constantine allowed Christians to freely practice their faith anywhere in the Empire and the Church moved into a new and more open existence.

2.5.1 Anchorite, laurite and coenobite communities

Three forms of monasticism developed in Egypt in the first half of the fourth century AD (Badawy 1978: 33-41; Bagnall 1993a: 293-303; Watterson 1988: 54-71). In part, monastic ways of life were shaped by major religious personalities, but the precise reasons why the monastic communities developed in Late Antique Egypt remains unclear. During the persecutions, some Christians retreated to the desert to live as hermits or anchorites. The most famous of these was Saint Antony. Bishop Athanasius' record of his life inspired other Christians in Egypt, Syria and elsewhere to emulate his deeds. These monks chose to live in near-total isolation, far out in the desert, often re-using Pharaonic to Roman period rock cut tombs (e.g. Davies 1901; 1903; 1905). This anchorite lifestyle, was slightly modified to create communities called *laurai* which allowed hermits to live in isolation during the week but join the community for the *agape* and religious service on holy days.

Religious life in isolation out in the deserts of Egypt did not appeal to all Christian holy men and women. Pachomius is credited with the development of communal or coenobitic monasticism, which later was widely adopted in the Mediterranean in Late Antiquity (Walters 1974: 3). Some argue that Pachomius' personal experience in the Roman army may have influenced his organization of such communities (Watterson 1988: 62); however, Rousseau's (1985: 57-76) thorough study of the source material on Pachomius strongly suggests that communal monasticism was the result of a ten to fifteen year experiment that sought to modify anchorite life into a community life based on mutual respect, which ideally was self-sufficient and of service to others. Pachomian monasteries were built in the Nile valley, and interacted with neighbouring, non-religious communities although these monasteries were intentionally located away from the cultivation strip and towns (Rousseau 1985: 149-173). In reality, the separation of most monasteries or anchorite dwellings from villages or cities did not amount to great distances by modern standards and would only have resulted in, at most, two days walk from the cultivation strip, villages and / or cities (Bagnall 1993a: 295). The reputed isolation of monastic dwellings is also dispelled by many accounts of villagers visiting monk or anchorites in the period (Gould 1993: 88-106 and 139-182; Rousseau 1985: 149-173) Monks, whether anchorite, laurite or coenobite, were highly involved in economic activities as well as pursuing religious practice (e.g. Gould 1993; *Lausiac History* trans. R. Meyer 1965; Rousseau 1985). Although these three types of monastic life are distinct, it is likely that during a religious career a monk, or even a Bishop, would participate in some or all of these different Christian communities. Indeed, Palladius (AD 364 - ca. AD 431), author of the *Lausiac History* which documents Egyptian monastic life in the period, spent time as an anchorite before taking up Church positions in various cities of Egypt and Palestine (*Lausiac History* 1 and 2 trans. and introduction pp. 5-6, trans. R. Meyer 1965).

2.5.2 Monastic agriculture and diet

The historical and archaeological sources leave more mundane aspects of daily monastic life clouded in obscurity. In particular, there are many unanswered questions regarding the diet of monks, monastic agricultural practice, and the economic role of monasteries. In many ways, our perception of the monastic diet and lifestyle is highly influenced by the hagiography of ascetic monks such as Saint Antony. For example, St. Antony is known for a diet of only bread and water. He apparently sustained this diet for many years on end. This does, however, seem highly unlikely given the nutritional requirements of the human body, and is further thrown into doubt by brief mentions of Antony gardening - growing wheat and vegetables (*Vita Antoni* 50 cited in Brakke 1995: 226 and 232-233).

The historical records from monasteries provide little evidence of agricultural practice and crops. Only a few crops are recorded, such as dates, lentils, grapes / raisins, olives, and oil (Bagnall 1993a: 300). Monasteries did receive donations of foodstuffs (Bagnall 1993a: 300; Johnson and West 1967: 70), but were not necessarily dependent on the receipt of such gifts. There are "records of monks working for cash wages, particularly at harvest time" (Bagnall 1993a: 300). We also know that monasteries owned large tracks of land which they leased (Wipszycka 1972: 35). Leasing may have resulted in crops coming into monasteries as payment for use of the land. Agricultural equipment such as sieves and threshing machines have been recovered archaeologically at monasteries (e.g. Winlock and Crum 1973). Food processing installations, such as oil presses and bakeries have also been found at monasteries (e.g. Badawy 1978: 43).

In many ways, what is disclosed in documentary evidence, for example fasting, is working to an agenda other than simple discussion of factual occurrence. It seems likely that much of the hagiography could be viewed as advertisement for styles of monastic life and religious belief. Brakke (1995) has recently argued that Bishop Athansius, the author of the Life of Saint Antony, was using his story of the life to address wider political and theological issues within the Church. Clearly, such religious documents cannot be taken at face value and do not provide a sound basis for understanding daily diet, agricultural practice and economic role of these monasteries. Non-religious texts which record transactions related to monastic agriculture, such as lease agreements or the receipt of goods, are found at Late Antique monasteries, but often do not include detailed information about the crop(s) grown or delivered (e.g. Quibell 1908, 1909 and 1912; Winlock and Crum 1973). The historical record is geographically limited, temporally biased, and often imprecise (e.g. Bagnall 1995). Moreover, the lack of well excavated monasteries currently limits our understanding of these institutions and, therefore, historical sources often form our only sources of evidence on monastic life. In terms of the agricultural role of these institutions, however, it is possible to examine a second and independent form of evidence, namely the archaeobotanical evidence, to enhance our understanding of this issue.

2.6 Historical Evidence for Landed Monastic Estates

Landowning by monastic institutions is well attested in the historical sources. Precisely how these monastic institutions were formed, however, is poorly understood. In addition, many of the economic activities of monks (or nuns) were dependent on agricultural production and by-products, strongly suggesting that monasteries were involved in a complex relationship with local farmers and landowners. This may mean that the self-sufficiency of these religious institutions needs re-examination.

2.6.1 Founding and funding monastic institutions

The origins of monasticism, in particular, how monastic institutions were founded and, indeed, funded is not clearly understood (Bagnall 1993a: 289). The *ad hoc* formation of communities around religious personalities, however, is attested (Rousseau 1985: 60-61; Watterson 1988: 59-60). The organic development of Christian communities may explain the absence of information on the foundation of monasteries in the historical record. There is some evidence for the personal foundation of monasteries (e.g. MacCoull 1993: II, 191), but it is not possible to judge how common or exceptional this may be in Late Antique Egypt. There also appears to be a lacuna in the historical evidence during the fourth and fifth centuries regarding the acquisition of wealth, especially land, by religious institutions (Bagnall 1993a: 289). By the sixth century, however, there is an abundance of records documenting the economic role of religious establishments, including monasteries (Bagnall 1993a: 289-293; Hardy 1968: 44-46; Johnson and West 1967: 69-71; Wipszycka 1972).

Bagnall (1993a: 290) suggests that donations of land to ecclesiastical institutions are from members of the curial classes and puts forward the theory that the redistribution of land-based wealth to the Church may have "weakened the base for civic liturgies." Some linguists (Johnson and West 1967: 73; MacCoull 1993: XVII, 498-499) have speculated that landowners seeking to avoid the burdens of ownership gave land to the church in return for a long-term lease of the donated land (an emphyteutic lease).[7] Alternatively, Clackson (1996: 40) recently has argued that emphyteutic leases benefited any landowner, since it was an effective

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[7] For example, P. Lond. 483. records "a lease in perpetuity of 12 ½ arouras [1 aurora = 0.275 hectares (Rowlandson 1996: 366)] of arable land for 18 ¼ carats and 5 arouras of dry land (i.e. land requiring artificial irrigation throughout the year) at 18 ¼ carats. The total of the *pactum* was 36 carats (or 36 ½ carats goldmith's standard). The tenant further agreed to pay two jars of wine for the right of pasturing his flock" (Johnson and West 1967: 73-74). According to MacCoull (1993: XVII, 498-499) such long-term leases were "nearly always extended by an ecclesiastical institution."

way to endow a religious institution and ensure its patronage, and rejects the theory that only those seeking to avoid liturgical obligations entered into such leases. If substantial numbers of landowners donated land in this way, this naturally would have resulted in the assumption of liturgical obligations (i.e. clearing canals or shipping grain) attached to these parcels of land by religious institutions and a major shift in power and influence in the Egyptian countryside. In fact, concomitant with the acquisition of property by the church at this time, members of the church (including monasteries) are documented to be increasingly taking on liturgical and political responsibilities in Egypt (e.g. Bagnall 1993a: 292 and 308; Hollerich 1982: 200; and Judge and Pickering 1977: 62-64).

Another possible source of wealth for monasteries were the monks (or nuns) themselves. There are many examples in the hagiographic sources for the acquisition of land as gifts from monks, as well as evidence for monks earning an income from their hired labor or their handiwork. For example, *The Life of Pachomius* mentions that the monastery of Thbew was founded by Petronius (a member of a wealthy Christian family) on his father's land (Rousseau 1985: 153). Later, other members of Petronius' family joined his monastery, and eventually the monastery inherited "part of the family estate, and also slaves...together with sheep, goats, cattle, camels, donkeys, carts, and all he possessed, including boats" (Rousseau 1985: 153). As Rousseau (1985: 153) points out, what is important is that the monastery receives "a viable agricultural unit" which it then could use.

The change in ownership of this estate from a wealthy private individual to a religious institution may not result in any recognizable archaeological evidence, other than the documentary record. It is well known that monasteries are difficult to recognize archaeologically (see Chapter 3 §3.2.3; Bagnall 1993a: 296 and footnote 208; Clackson forthcoming); monastic control of formerly private estates, smaller farms, or village / city businesses also would be hard to recognize archaeologically without documentary evidence. In fact, without the documentary evidence from Kom el-Nana (see Chapter 1 and Clackson forthcoming) it would not have been recognized that this settlement was actually a monastery.

A number of religious texts demonstrate how a monastery might acquire wealth or land. A story about Elias in *The Lausiac History* suggests that an 'ascetic' monk, while living a religious life, could still own land and use his personal wealth:

> He showed compassion on the order of women ascetics and, as he had income-property in Athribé, he built a large monastery and gathered together all those dispersed about into this monastery. He looked after them, providing them with every refreshment, gardens, household utensils, and everything their life required.
>
> (*The Lausiac History* 29: 1, trans. Meyer 1965: 88-89)

The tale of Apollonius from *The Lausiac History* establishes that monks could also remain active businessmen:

> There was a businessman named Apollonius who had renounced the world and lived on Mount Nitria. As he was too advanced in years to learn a craft or to work as a scribe, he lived on the mountain for twenty years engaged in this business: with his own money and his own efforts he would buy all kinds of medicines and groceries at Alexandria and provide for all the brethren in their sicknesses.
>
> (*The Lausiac History* 13: 1, trans. Meyer 1965: 48-49)

A story from the *Apophthegmata Patrum* on Isaac, priest of the cells, also provides some interesting insights into the role of monasteries in the agricultural economy. This hagiographic source again records how monks may bring land to a monastery:

> Abba Isaac said, 'I knew a brother who wanted to eat an ear of wheat while he was harvesting in a field. He said to the foreman of the field, "Will you allow me to eat an ear of wheat?" The latter was astonished at these words and said to him, "Father, this field belongs to you, why are you asking me this?" See how conscientious the brother was.'
>
> (*Apophthegmata Patrum* - Isaac, Priest of the Cells: 4, trans. Ward 1983: 100)

These hagiographic accounts of land inheritance or gifts of land from monks provide the only source of evidence for the acquisition of land by monasteries in the fourth and fifth centuries AD (Bagnall 1993a: 291). Although it is unwise to take the hagiographic sources literally, as Rousseau (1985: 155) points out in reference to the story of Isaac where the brother requests to eat wheat from his own field, "[t]he humility of the request would be less striking if the reply were not to be taken literally." Moreover, it is because mention of owning land, donating land, or working land are often made in passing in these hagiographic sources that their verity seems likely. The earliest non-hagiographic records of land ownership by religious establishments date from the mid-fifth century AD (Wipszycka 1972: 47 in ref. to *P. Lond.* V. 1832; Bagnall 1993a: 291). The documentary papyri clearly establish that monastic institutions owned land and sold goods; however, they often do not explain how they acquired this land or organized trade relations (e.g. Bagnall 1993a: 289-293).

In some cases, it is clear that the scale of land owned by a monastery could be quite substantial. For example the sixth century records of landholding by Ammonius (Johnson and West 1967: 271-272) show that *ca.* 26.4 arouras (or 7.26 hectares) of land was rented from a monastery. Ammonius' accounts show that the monastery received an annual rent for this land of approximately 400 artabas (or 16,000 liters - using the conversion that 1 artaba = 40 choinikes and 1 choinix = 1 liter from Rowlandson 1996: 366) of grain (most likely wheat) a year over a four year period (Johnson and West 1967: 271). When one considers that in most traditional societies cereal grain accounts for 40% of caloric intake and that 1 liter of grain per day would supply the entire caloric intake for a healthy male adult (Foxhall and Forbes 1982: 66 and 86-87), it seems likely that this rent could easily supply bread and other cereal-based products for a community of 88 monks for an entire year.[8] Such calculations are unlikely to be exact, but they do demonstrate the scale of wealth monastic estates could command.

2.6.2 Self-sufficiency

There is some evidence that monks provided for their own livelihood. For example, one passage briefly alludes to the fact that monks worked in the fields, although it does not establish whether they owned the fields themselves or simply worked as hired labor:

> Abba Isaac said to the brethren, 'Our Fathers and Abba Pambo wore old garments woven from palm fronds and mended all over; now you are foppishly dressed. Go away from here; leave this place.' When they prepared to go harvesting he said to them, 'I am not giving you any more directions because you would not keep them.'
>
> (*Apophthegmata Patrum* - Isaac, Priest of the Cells: 7, trans. Ward 1983: 100)

Another passage establishes that monks, even Abbas, were expected to fund themselves:

> Abba Isaac and Abba Abraham lived together. When he came home one day, Abba Abraham found Abba Isaac in tears. He asked him, 'Why are you weeping?' The old man replied, 'Why should we not weep? For where have we to go? Our Fathers are dead. Manual work is not enough to pay for the cost of the journey by boat for us to go and visit the old men, and so henceforth we are orphans; that is why I am weeping.'
>
> (*Apophthegmata Patrum* - Isaac, Priest of the Cells: 3, trans. Ward 1983: 100)

The Life of Pachomius (Rousseau 1985: 82-85 and 155) also records organized monastic manufacture of products and their marketing. In addition, Palladius (*The Lausiac History* 32.9 -12 trans. Meyer 1965: 94-95) notes in his discussion of Pachomius and the 'Tabennesiotes' the diverse number of trades practiced by monks there and that their handiwork was sold for a surplus:

> **32.9.** There are other monasteries, too, housing from two to three hundred persons each. I visited one of these when I went to Panopolis, a place of about three hundred monks. In this monastery I saw fifteen tailors, seven workers in metal, four carpenters, twelve camel drivers, and fifteen fullers, They work at every sort of handicraft and from their surplus they provide for the monasteries of women and the prison.
>
> **32.12.** It is the same with regard to their work. One works the ground as husbandman, another works as gardener, another as smith, another as baker, another as fuller, another as weaver of large baskets, another as shoemaker, another as copyist, another as weaver of tender reeds.

Frend (1978: 433) suggests that Pachomian monasteries were "self-sufficient economic units"; however, Rousseau (1985: 155) argues that these monasteries were not self-sufficient, but instead entered into

[8] Calculations based on Foxhall and Forbers (1982) who have established one liter of grain supplies approximately 2800 calories (pp. 86-87); and that, in traditional societies, average caloric intake is approximately 2,500 calories per day (p. 66). 400 artabas = 16,000 liters of grain (based on conversions in Rowlandson 1996: 366) and 16,000 liters of grain / 365 days in a year = 43.8 liters / day which could supply approximately 88 monks, assuming that intake of cereal-based foods is at levels of around 40% - 50% of total calories consumed in a day.

complex relations of dependency with the outside world. Monks clearly do work for other people, particularly land owners (e.g. *Apophthegmata Patrum* Isaac 4 and Macarius 7, trans. Ward 1983: 100 and 128) and sell their handiwork (e.g. *The Lausiac History* 7: 5; 13: 1-2, trans. Meyer 1965: 41, and 48-49). If the sources of monastic income failed (e.g. loss of donations, crop failure, or lack of local employment opportunities) these monasteries clearly would face financial ruin (Rousseau 1985: 156). In essence, monastic institutions were dependent on the economic stability of the surrounding countryside.

Monasteries and individual monks also received gifts of food, often from the laity (e.g. *The Lausiac History* 13: 2 and 36: 2-3 trans. Meyer 1965: 49 and 103-104; Winlock and Crum 1973: 145-148). Whether monasteries were dependent on these gifts is open to debate, but clearly gifts of food or donations of land eased the financial burden of these institutions and strengthened ties with the outside world. A number of payments of cash and crops to religious institutions from the sixth century accounts of the Apion estate are known; whether these are payments in lieu of taxes as Johnson and West (1967: 253-254) suggest, or straightforward donations / rents is not clear. What is notable is the monetary value of these payments. For example a three meter papyrus accounts scroll from the Apion estate dating to AD 565 / 566 records a number of donations / payments to religious institutions (P. Oxy. 3804 - Rea 1988: 118-119):

> To the monastery of Abba Andrew according to the custom in respect of sol. [solidi] 50 less car. [carats] 200 also for the 14th indiction wheat, by cancellus, art. [artabas] 1000 and on the day of the great man art. 12. Total wheat by cancellus, art. 1012.

Aside from the cash donation / payment, this possible gift or rent in wheat alone amounts to 40,480 liters or enough to feed 220 monks for an entire year.[9] Obviously such gifts or rents (see example in §9.3.1) could be sold for cash value or traded for other goods, but the amounts of this donation / payment is quite substantial.

Although the Church attempted to exercise power over monastic communities (Rousseau 1985: 170-171), often by ordaining monks as priests, it clearly did not bear financial responsibility for monasteries. For example, in times of famine, individual monasteries were left to their own devices (Rousseau 1985: 156). The financial independence of monasteries from the Church may explain why some see these institutions as self-sufficient communities. Certainly, in terms of providing for the needs of the community, monastic institutions often generated their own income. Nevertheless, monasteries were economically dependent on the towns, markets, and agricultural as well as non-agricultural production in, at least, their immediate region and perhaps somewhat beyond, which would result in close ties with the outside world instead of isolation from it (Rousseau 1985: 156-157).

[9] Using calculations for Rowlandson 1996: 366 (see §9.3.1) and from Foxhall and Forbes (1982) see above footnote 8. Again, this calculation is made to demonstrate the value of the gift / rent, but is not intended to be an exact calculation. Egypt, like the rest of the Late Antique world suffered from inflation (see Bagnall 1993a: 330-332), so it is difficult to put a precise value on the solidi; however, to illustrate the scale of this payment, P. Oxy. 2195 dated *ca.* AD 576 shows the pronoetes (a general land agent - see Bagnall 1993a: 152) earned 2 solidi less 5 carats and 24 artabas of wheat yearly (Johnson and West 1967: 195).

2.6.3 *Egyptian monastic 'estates' and precedence*

A number of different styles of monastic life were possible in Late Antique Egypt (see §2.5.1) and it is likely that each monastery was unique in organization or character. For example, some monasteries clearly combined communal and ascetic forms of monastic life (e.g. the monastery of Epiphanius - Winlock and Crum 1973: 125). Members of these communities clearly would have had to be fed and therefore would have been dependent on either gifts of food or their own production of food. Acquisition of land (through gift or purchase) was one means of ensuring food supply or income.

Certainly 'landed monastic estates' existed in Late Antique Egypt, but was this a new development or was it part of a pre-existing tradition of donation to religious bodies? Egyptian Graeco-Roman period temples, although much reduced in influence and wealth from their Pharaonic predecessors, still owned property, ran markets, received government subsidy (a *syntaxis*), and made profits from selling religious offices (Bowman 1986: 107 and 179-180). Early accounts of Christian ecclesiastical institutions do not survive, but the period of overlap between the decline of Pagan temples and the expansion of Christian institutions (e.g. Fox 1986) may have informed Christian attitudes toward donations or endowment in Late Antiquity. Although one can argue that a precedent for monastic landholding starts in Late Antique Egypt, seen in this wider context, it is more likely that monastic landholding resulted partly from necessity (provision of food for monks) and partly from pre-existing tradition. Documentary evidence on this particular point does not exist, however, most likely as a result of the secrecy of Early Christian communities during the period of persecutions (see §2.5).

2.7 Summary

The preceding survey of some of the major transitions which took place during Late Antiquity in the Mediterranean, and in particular Egypt, underscores the need for further research in many areas. This study is designed to address some specific questions about this period. In particular, agriculture underpinned the ancient economy in Egypt (e.g. Bowman 1986: 90-91) and this thesis explores the role of monasteries in the agricultural economy of Late Antique Egypt. A consistent theme in many Mediterranean based studies is the increased power of the Church as an institution at this time. The emergence of monasteries in Late Antiquity has Egyptian origins. The growing influence of monasteries in the rural landscape is well recorded, especially in Egypt, but little studied archaeologically. Many questions regarding the nature of agricultural practice and economy of these early monasteries remain unanswered. Synthetic histories primarily based on the documentary record of these institutions, however, are likely to provide only a limited picture of monastic life. The archaeobotanical case study presented here is designed to address such questions, but from a new and different perspective.

Chapter 3. Archaeological Background

The archaeobotanical case study will primarily focus on the agricultural practice and economy of Kom el-Nana. The wider context of this settlement, however, is, of course, also of importance. The role of the site within the Hermopolite nome and consideration of what the Kom el-Nana results tell us about monasticism in Egypt as a whole also are issues for this chapter.

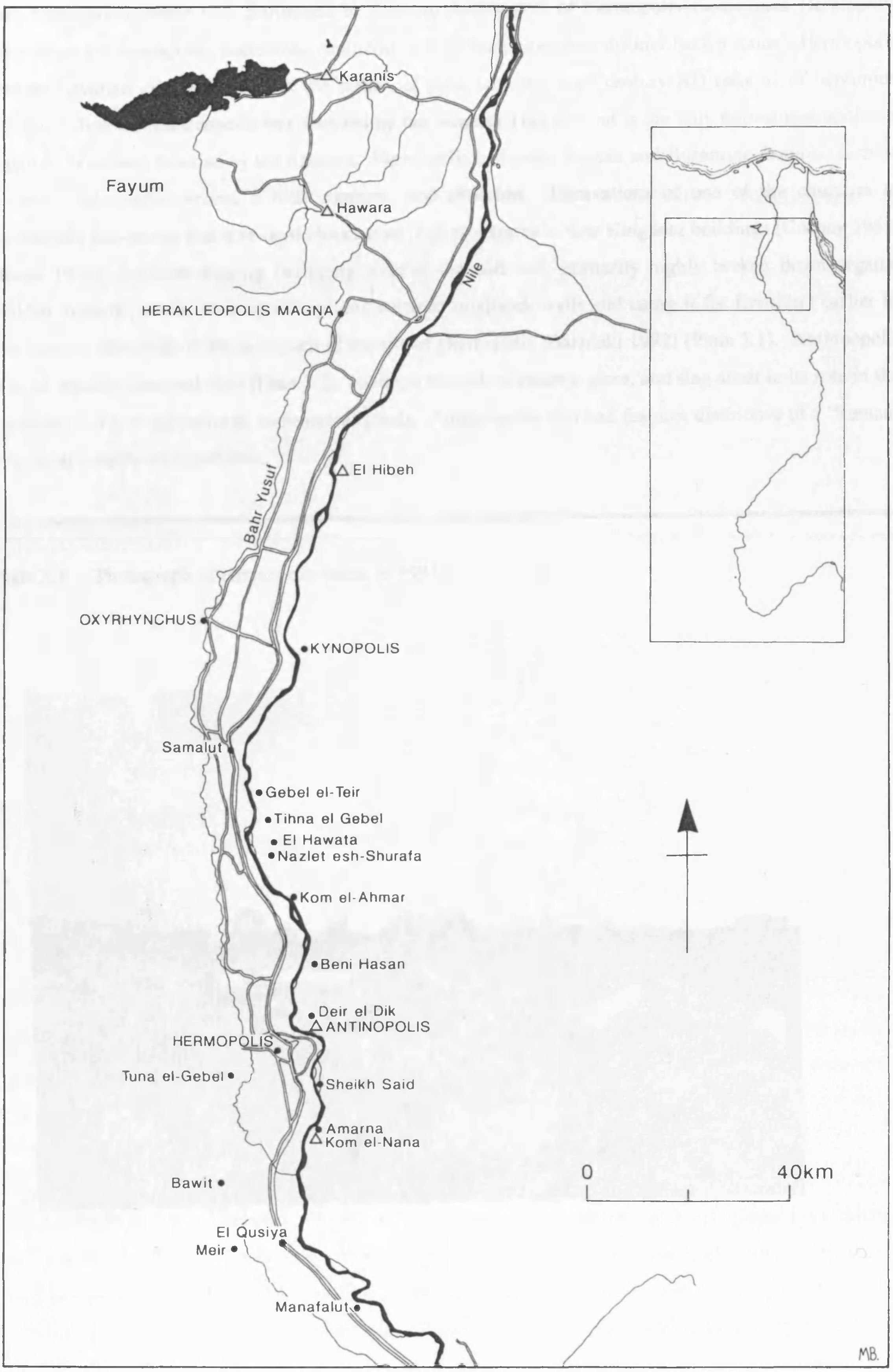
3.1 The Hermopolite Setting

Archaeological research in the ancient Hermopolite nome, a *ca.* 75 km stretch of the Nile roughly between Samâlût and Manafalût in Middle Egypt (see Figure 3.1), has generated a great deal of historical and archaeological evidence for Late Antique settlement in this region of Egypt (e.g. Drew-Bear 1979). Papyrological records of urban, rural and monastic settlement enhance our archaeological knowledge of this area.

3.1.1 The papyrological record for settlement

Archives dating to the second, fourth and fifth centuries AD attest the presence of a number of large estates in the Hermopolite nome (Bagnall 1992; Bowman 1985; Drew-Bear 1979: 2-3). Research by Bagnall (1992) and Bowman (1985) also suggests that fourth century landholding in the Hermopolite nome consisted of a number of types, ranging from substantial estates to smaller parcels of privately owned land. Bagnall (1992: 137; 1993a: 334) has recently determined that the area of the fourth century Hermopolite nome (including the Antinoite nome) was approximately 1140 km^2, of which roughly 820 km^2 (or 72%) was made up of taxable arable land. In total, there are 160 towns, villages and hamlets named in the surviving papyri of the fifth through seventh centuries AD which are clearly located in the Hermopolite nome (Drew-Bear 1979: 351-373, 380 and 383-386). It is unlikely that all of these settlements were occupied throughout the entire period, or that the area under cultivation precisely matches Bagnall's proposed figure; however, the record of so many settlements and so much agricultural land suggests that this region of the Nile valley was quite densely populated.

Figure 3.1 Boundaries of the Hermopolite nome (showing modern place names mentioned in text).



3.1.2 *The archaeological record for cities and villages*

The Hermopolite nome was dominated by the two metropoleis of Hermopolis (sometimes Hermopolis Magna) and Antinoopolis (sometimes Antinoou polis). Both cities had distinct backgrounds. Hermopolis was an Egyptian city which gained the status of polis with the third century AD reforms of Septimius Severus; whereas, Antinoopolis was founded by the emperor Hadrian and is the only known metropolis in Egypt to have been founded by the Romans. Hermopolis had many Roman and Byzantine features, such as a circus, colonnaded streets, a bath complex, and churches. Excavations of one of the churches at Hermopolis has shown that it re-used blocks from Tell el-Amarna's New Kingdom buildings (Cooney 1965; Hanke 1978). *Sebbakh* digging (stripping sites of the soft soil, primarily highly broken down organic midden material, which built up around and between mudbrick walls and using it for fertilizer) earlier in this century effectively destroyed much of the site of Hermopolis (Baranski 1992) (Plate 3.1). Antinoopolis is in an equally damaged state (Plate 3.2), but huge mounds of pottery, glass, and slag attest to its role in the production of non-agricultural, commercial goods. Antinoopolis also had features distinctive of a 'Roman' city, most notably a hippodrome.

Plate 3.1 Photograph of Hermopolis taken in 1994.

Plate 3.2 Photograph of Antinoopolis taken in 1994. For scale, the woman is approximately 1.70m tall and she is standing on a hill of pottery, slag, and glass.

In addition to the presence of two metropoleis, a number of Graeco-Roman and Late Antique remains (i.e. pottery scatters or remains of buildings), primarily on the east bank of the Nile, have been found and, in some cases, partially excavated. Drew-Bear (1979) catalogues a series of excavations / observations of Graeco-Roman and Late Antique occupation throughout the Hermopolite nome: in particular, necropoleis are identified at Samâlût (Graeco-Roman - i.e. Ptolemaic and Roman period site), Gebel el Teir or ancient Tehneh (Graeco-Roman), El Hawata (possibly Late Antique), Nazlet esh-Shurafa or esh-Sheikh Mubârik (Roman), Kom el Ahmar or ancient Alabastron polis (Graeco-Roman and Late Antique), Beni Hasan (Graeco-Roman), Balansûra (Roman), and at Tuneh el Gebel (Graeco-Roman). At Gebel el Teir or ancient Tehneh (Roman) and at Beni Hasan (Graeco-Roman) temples were carved out of the cliffs of the Eastern Desert Mountains. Villages have been identified at El Hawata (possibly Late Antique - not excavated), Nazlet esh-Shurafa or esh-Sheikh Mubârik (Roman), Tihna el Gebel or ancient Tinah (Roman), and Kom el Ahmer (Roman). At Taha El A'Mida the Napoleonic survey recorded the remains of a Late Antique church. At Beni Hasan, the area around Antinoopolis (especially Deir el Dîk) and Sheikh Saïd, some of the rock tombs are transformed into anchorite dwellings in Late Antiquity (Davies 1901, 1903, 1905; Drew-Bear 1979: 25 and 27-31).

The most famous Early Christian site within the region is the monastery of Bawit (finds from this site dominate the displays at the Coptic Museum in Cairo - the term means monastery in Coptic). Other early Christian sites have been noted in the vicinity of Tell el-Amarna, in particular the remains of anchorite dwellings in the mountains of the Eastern Desert (Petrie 1894: 2; Frankfort and Pendlebury 1933: 66-67; M.

Jones 1991; Kemp 1993, 1995b: 433). Nearby Sheikh Saïd, just to the north of Tell el-Amarna, also supported such anchorite communities (Davies 1901; M. Jones 1991). The Pharaonic period tombs in the cliffs behind Tell el-Amarna supported many anchorite churches and dwellings (Davies 1903: 2-3 and 1905: 11-13; M. Jones 1991). Recent survey work conducted by Kemp (1993; 1995b: 445) suggests that several additional Late Antique sites also were present on the east bank of the Nile, in the Amarna area. In addition, three villages or hamlets are known to have existed locally at the modern villages of Et-Tell, El-Hagg Qandil and El-Hawata (Kemp 1993: 13).

Based on the present archaeological and philological research in the Hermopolite nome, it is possible to build a rough picture of settlement in the area around the site of Kom el-Nana during Late Antiquity. Figure 3.2 incorporates all available evidence of Graeco-Roman and Late Antique finds in the Amarna area of the Hermopolite nome. No attempt was made to extend the map to cover all of the southern half of the Hermopolite nome. Between Bawit and Manafalût, there are only two sites with Late Antique remains at Meir, where anchorites re-used rock-cut tombs (Badawy 1974: 103) and at El Qusiya, where Greek and Coptic inscriptions were found (Drew-Bear 1979: 37-39). Instead of covering the entire area of the Hermopolite nome, the map was limited to the Pharaonic boundaries of Amarna. Here, there is good archaeological evidence of Ptolemaic through Late Antique period occupation in the immediate vicinity of Kom el-Nana. Evidence for the re-use of Amarna period (fourteenth century BC) stone blocks at Hermopolis does establish ties between the Kom el-Nana area and Hermopolis in Late Antiquity (Cooney 1965; Hanke 1978). As a result, the ancient boundaries were slightly extended to include the metropoleis of Hermopolis and Antinoopolis to the north, covering an area of the Nile valley just under 35km long. Figure 3.2 represents those known sites within a reasonable distance (one days journey) from Kom el-Nana.

Current evidence from Kom el-Nana (see below §3.3) suggests that this site was most likely a monastery. Certainly the period of the site and its construction is generally in keeping with other Early Christian monastic settlements in Egypt. As a result, the monastic archaeology of Egypt is also central to this study. Only a small number of monasteries based in the Nile valley have been excavated (Badawy 1978: 41), so in addition to considering archaeological evidence from monasteries based in the Hermopolite nome, monasteries based elsewhere in Egypt also will be considered.

Finally, the lack of archaeological research south of Bawit results in the limited number of Graeco-Roman through Late Antique period remains known from this region. In addition, recent fundamentalist uprisings in Middle Egypt curtail archaeological investigation of this area of Egypt. It is, however, highly likely that this more southerly area of the Hermopolite nome also supported a variety of Graeco-Roman and Late Antique sites.

Figure 3.2 Graeco-Roman and Late Antique sites in the Amarna area (southern Hermopolite nome) after Drew-Bear (1979), M. Jones (1991), Kemp (1993) and Petrie (1894).[1]

[1] Site names on the west bank of the Nile follow the English transliterations of Petrie (1894) but are noticeably quite different from those produced by Drew-Bear (1979). Petrie's Kom el Ahmar corresponds to Drew-Bear's Dairût umm Nakla, Petrie's Gildeh corresponds to Drew-Bear's Dalga and Petrie's Deshawit corresponds to Drew-Bear's Dashlût. All other place names match Drew Bear's or are from other, English publications cited above.

3.2 The Archaeological Record for Monasteries in Egypt

During Late Antiquity hundreds of monasteries were constructed in Egypt, of which only a handful have been excavated (Bagnall 1993a: 295; Badawy 1978: 41; Rousseau 1985: 2). Of these, only two monasteries based near Thebes have had any form of archaeobotanical investigation - the monasteries of Epiphanius (Winlock and Crum 1973: 61) and Phoebammon (Täckholm 1961).[2] Clearly, the paucity of monasteries excavated and sampled for environmental remains limits our understanding of these institutions.

Excavations of anchorite, laurite and coenobite settlements have demonstrated certain architectural distinctions between some of these religious communities. In the main, anchorite settlements are located well away from the cultivation strip and often re-use rock-cut tombs dating from the Pharaonic through Roman period (Badawy 1978: 33-34) Coenobitic monasteries typically include "an enclosure wall, gatehouse, houses for monks, refectory, assembly hall, kitchen, infirmary and guest house, as well as a church" (Bagnall 1993a: 296; Walters 1974). *Lauria* may also include many of these features (e.g. Bagnall 1993: 296-297; Walter 1974), but in some cases, particularly in Middle and Upper Egypt, develop around re-used rock-cut tombs (Badawy 1978: 41), and often have an earlier anchorite phase before developing into a *laura* (e.g. the monastery of Epiphanius in western Thebes - Badawy 1978: 13-14).

3.2.1 Hermopolite monastic settlements

A number of anchorite / laurite settlements existed in the Hermopolite nome. Near Antinoopolis, the *laura* at Deir el Dîk comprised fifteen rock-cut cells, two churches, also cut into the cliff, and a watch tower (Walters 1974: 10). Other anchorite settlements, similarly cut into the cliffs or re-using rock-cut tombs and of roughly similar size, are located near to Deir el Dîk at Deir Abou Fana, Deir el Nassâra, Deir Sombât and Deir Abou Hennes (Drew-Bear 1979: 28-29). In the Amarna area, a number of anchorite dwellings are known (M. Jones 1991; Kemp 1993). At Sheikh Saïd, fifth or sixth Dynasty tombs were re-used as monastic hermitages with mudbrick buildings placed immediately in front of the openings of these tombs. The 'Northern Tombs' at Amarna, originally designed for the officials of Akhenaten in the fourteenth century BC, were also re-used as hermit cells and churches in Late Antiquity. A series of "stone huts" were built in front of the tomb entrances and on the surrounding slopes (M. Jones 1991: 133). Evidence of mudbrick or fired brick buildings beneath some of the 'stone huts' suggests an earlier phase to this settlement (M. Jones 1991: 133-134). Both settlements re-decorated their rock-cut tombs with

[2] An archaeological report for the Monastery of Phoebammon exists (Charles Bachatly (editor) 1981 *Le Monastère de Phoebammon dans la Thébaïde: Tome I: L'archéologie du site*. Cairo: Société d'Archéologie Copte), but this report was, unfortunately, not available through inter-library loan in the United Kingdom. However, the archaeobotanical report (see Täckholm 1961) published twenty years earlier was available and was consulted.

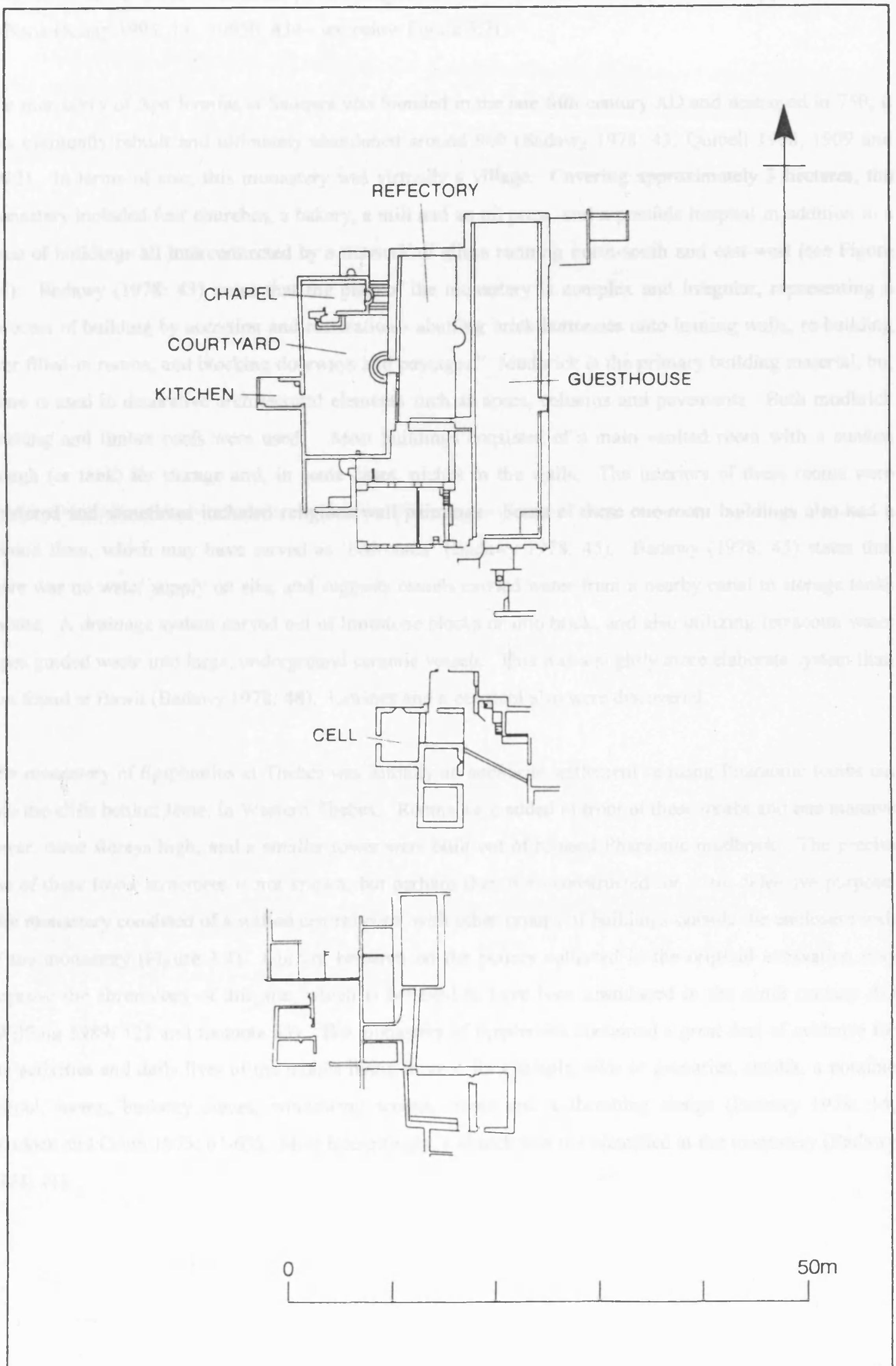
Christian wall-paintings; however, these are poorly preserved or were completely removed to reveal the Pharaonic period tomb paintings beneath them (M. Jones 1991: 130). Since a number of cells and buildings are in association at each site, it is likely that these communities were laurite in character in their later stages. M. Jones (1991: 129) suggests that these and other Upper Egyptian hermitages are of a "somewhat different character" from the hermitages at Kellia (Wadi Natrun - sometimes Cellia) or Esna in Lower Egypt. Upper Egyptian hermitages are not subterranean and it is quite likely that these monastic communities did not enjoy such close ties with Alexandria as Esna and Kellia did.

In addition to the *lauria* in the Kom el-Nana region, there is also a coenobitic monastery located just opposite Kom el-Nana at Bawit; however, publications of the excavations at the monastery of Apa Apollo at Bawit are of poor standard (Badawy 1978: 43; Walters 1974: 11) and no precise chronology is available. Nevertheless, it is worthwhile to consider the architectural organization of the site, as it is the nearest excavated monastery to the site of Kom el-Nana and the site is of broadly similar date. The buildings at Bawit were organized into isolated groups and generally followed a north-south orientation (Figure 3.3) (Badawy 1978: 43 and 109). No unified architectural plan is apparent and each building group appears to be unique in plan and completely isolated. Many of the internal walls were highly decorated with scenes from old and new testament storeys as well as depictions of saints (Clédat 1904, 1916; Maspero and Drioton 1943; Walters 1974: 120-153). Several chapels are identified in the building groups at Bawit, but separate churches also exist. The 'south church' was orientated east-west and built of limestone blocks and the floor was paved with granite slabs, most likely robbed out from a nearby Pharaonic period temple (Walters 1974: 45). The rectilinear church plan is quite simple with a nave and two aisles. The aisles are separated from the nave by two limestone colonnades. The 'sanctuary' at the east end of the church is rectilinear and stretches across the width of the building. Apparently, this is an unusual feature in ecclesiastical architecture of the period, but does correspond to church plans from Tunisia, Algeria and Syria (Walters 1974: 34). The walls are not preserved to great height, but Walters (1974: 45) predicts that the plan of the south church made "a timber roof obligatory." A second church at the north of Bawit also exists. It was constructed with fired brick and mudbrick but is not as well preserved as the south church. At least two monasteries existed at Bawit (the monastery of Apollo and a nunnery at the south end of the site) and both were surrounded by a single enclosure wall. There is no evidence for a watchtower at Bawit, but some of the mudbrick buildings do appear to have had a second storey (Walters 1974: 109).

3.2.2 Other Egyptian monastic settlements

Two other Egyptian monasteries are worth considering: Apa Jeremias at Saqqara and Epiphanius at Thebes. Other monasteries exist but are either subterranean and therefore of unique architectural plan, such as at Esna (Sauneron and Jacquet 1972); or have regular plans, such as at Kellia (Kasser 1967), than the unstructured architectural plans of the monastery at Bawit and the lauria discussed above. The monastery

Figure 3.3 Plan of the monastery of Apollo at Bawit (after Badawy 1973: 42).



of Apa Jeremias and Epiphanius both exhibit somewhat unordered architecture, aspects also observed in the plans of villages and cities in the period (Bagnall 1993: 296). This style of plan is also apparent at Kom el-Nana (Kemp 1993: 13, 1995b: 434 - see below Figure 3.7).

The monastery of Apa Jermias at Saqqara was founded in the late fifth century AD and destroyed in 750; it was eventually rebuilt and ultimately abandoned around 960 (Badawy 1978: 43; Quibell 1908, 1909 and 1912). In terms of size, this monastery was virtually a village. Covering approximately 3 hectares, the monastery included four churches, a bakery, a mill and an oil press, and a possible hospital in addition to a mass of buildings all interconnected by a network of alleys running north-south and east-west (see Figure 3.4). Badawy (1978: 43) notes that the plan of the monastery is complex and irregular, representing a "process of building by accretion and restoration - abutting brick buttresses onto leaning walls, re-building over filled-in rooms, and blocking doorways and passages." Mudbrick is the primary building material, but stone is used in decorative architectural elements such as apses, columns and pavements. Both mudbrick vaulting and timber roofs were used. Most buildings consisted of a main vaulted room with a sunken trough (or tank) for storage and, in some cases, niches in the walls. The interiors of these rooms were plastered and sometimes included religious wall paintings. Some of these one-room buildings also had a second floor, which may have served as 'bedrooms' (Badawy 1978: 45). Badawy (1978: 45) states that there was no water supply on site, and suggests camels carried water from a nearby canal to storage tanks on site. A drainage system carved out of limestone blocks or into brick, and also utilizing terracotta water pipes guided waste into large, underground ceramic vessels. This was a slightly more elaborate system than that found at Bawit (Badawy 1978: 48). Latrines and a cesspool also were discovered.

The monastery of Epiphanius at Thebes was initially an anchorite settlement re-using Pharaonic tombs cut into the cliffs behind Jême, in Western Thebes. Rooms were added in front of these tombs and one massive tower, three storeys high, and a smaller tower were built out of re-used Pharaonic mudbrick. The precise use of these tower structures is not known, but perhaps they were constructed for some defensive purpose. The monastery consisted of a walled central core with other groups of buildings outside the enclosure wall of the monastery (Figure 3.4). Current research on the pottery collected in the original excavation may improve the chronology of this site, which is believed to have been abandoned in the ninth century AD (Wilfong 1989: 122 and footnote 33). The monastery of Epiphanius contained a great deal of evidence for the activities and daily lives of the monks living there - for example, silos or granaries, stables, a possible school, looms, basketry sieves, winnowing scoops, ovens and a threshing sledge (Badawy 1978: 14; Winlock and Crum 1973: 61-63). Most interestingly, a church was not identified at the monastery (Badawy 1974: 41).

Figure 3.4 Plan of the monastery of Apa Jeremias at Saqqara (after Quibell 1912: Plate 1).

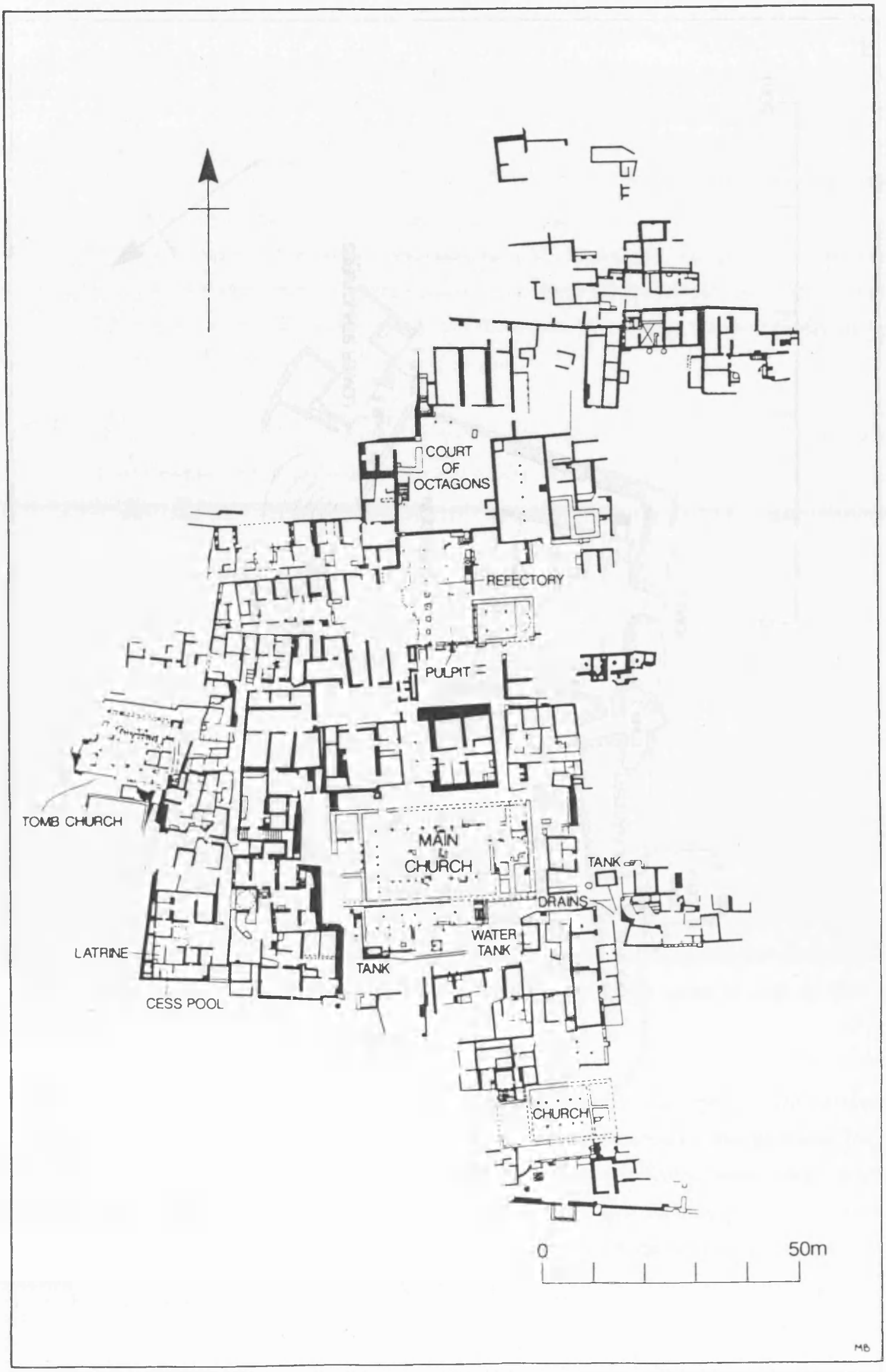
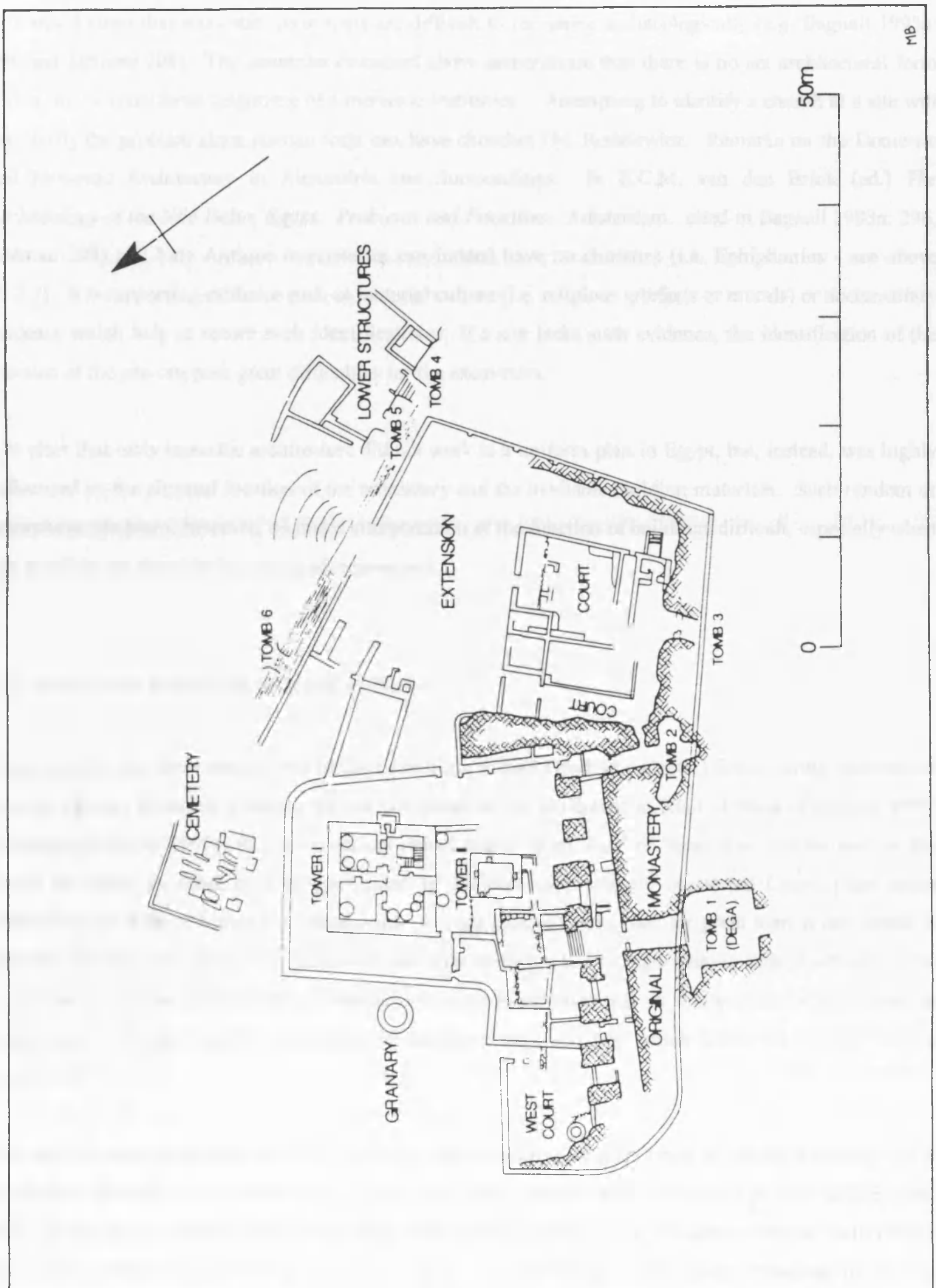


Figure 3.5 Plan of the monastery of Epiphanius in Western Thebes
(after Winlock and Crum 1973: Plate III)



3.2.3 Difficulty of recognition of monastic institutions in the archaeological record

It is well known that monastic institutions are difficult to recognize archaeologically (e.g. Bagnall 1993a: 296 and footnote 208). The examples discussed above demonstrate that there is no set architectural form which can be considered diagnostic of a monastic institution. Attempting to identify a church at a site will not clarify the problem since Roman forts can have churches (M. Rodziewicz. Remarks on the Domestic and Monastic Architecture in Alexandria and Surroundings. In E.C.M. van den Brink (ed.) *The Archaeology of the Nile Delta, Egypt: Problems and Priorities*. Amsterdam. cited in Bagnall 1993a: 296, footnote 208) and Late Antique monasteries can indeed have no churches (i.e. Ephiphanius - see above §3.2.2). It is supporting evidence such as material culture (i.e. religious artefacts or murals) or documentary evidence which help to secure such identifications. If a site lacks such evidence, the identification of the function of the site can pose great difficulties for the excavators.

It is clear that early monastic architecture did not work to a uniform plan in Egypt, but, instead, was highly influenced by the physical location of the monastery and the available building materials. Such random or amorphous site plans, however, do make interpretation of the function of buildings difficult, especially when few artefacts are found in the course of excavations.

3.3 Historical Evidence at Kom el-Nana

Coptic graffiti and three ostraca (two in Coptic and one in both Greek and Coptic) found during excavations provide primary historical evidence for the occupants of the settlement at Kom el-Nana (Clackson 1997, forthcoming; Kemp 1995a: 8). Two ostraca record that a 'great man' or 'head man' (terms used in the period for either an abbot or a village leader) of Teclooce (a previously unattested Coptic place name presumably for Kom el-Nana) has leased land. In once case the term used for great man is one which is typically used to name elders of a monastery and only rarely applied to high-ranking village officials. The identification of Kom el-Nana as a monastic settlement largely depends on this pivotal interpretation, in combination with the current archaeological evidence from the site which seems to support such a conclusion.

Two ostraca mention possible soldiers from Pejla (sometimes translated as Pesla or Pescla), a military camp of unknown location in the Hermopolite nome. One of the ostraca which mentions a possible soldier from Pejla, clearly shows that the agreement is made with an unnamed person at Teclooce. Several walls on site have Coptic graffiti painted on or scratched into the plaster facing which represent prayers to God or requests that God watch over certain individuals, adding further evidence for the religious character of this settlement.

3.4 Site Description of Kom el-Nana

Kom el-Nana is located 270km south of Cairo, at the southern edge of the site of Tell el-Amarna (Figure 3.6), on the east bank of the Nile, approximately 1km beyond the end of the modern cultivation strip and, certainly, well beyond the extent of the ancient flood plain. The 1989, 1993 and 1994 excavations were directed by Barry Kemp, Faculty of Oriental Studies, Cambridge University under the auspices of the Egypt Exploration Society. Initially the remains of a New Kingdom (14th century BC) temple complex were investigated, but as excavations moved to the northern area of the site a monastic settlement (see below §3.5 for a detailed discussion on this interpretation) dating to the Late Antique period (ca. AD 400 - 750) was discovered (Kemp 1993; 1995a; 1995b). Whilst excavations have only exposed a portion of the relevant deposits at Kom el-Nana, nonetheless they have provided a great deal of information about the settlement (see Figure 3.7).

The architecture is entirely of mudbrick, with the exception of the stone foundation course of the enclosure wall. The north / south orientation of the settlement follows that of the underlying New Kingdom temple buildings and there is also evidence for the re-use of New Kingdom mudbrick in Late Antique buildings at Kom el-Nana (Kemp 1993: 14; 1995a: 8). Features excavated on the site can be divided into three main categories: towers, smaller structures and open areas (Figure 3.7).

The settlement is dominated by three mudbrick towers, of at least two storeys and of possible defensive function, located in the north-east, north-west and south-east of the site. There also are a number of smaller structures scattered throughout the site and built adjacent to the towers. The structures around the north-east tower, which are the source of many of the archaeobotanical samples under study here, have been provisionally interpreted by Kemp as workshops and animal yards (1993: 14). How the towers were roofed is not known, but other buildings on site do preserve evidence for vaulting. Some of the rooms excavated had built-in features such as oven installations, mudbrick slots (to support storage jars), mudbrick troughs, plastered mudbrick benches and a cistern. White plaster decorated the floors and walls of several rooms, and one room had a flagged floor. Areas of open space separating buildings were used as middens, the garden / orchard and an alleyway. The site appears to have been surrounded by a wall which incorporated re-used stone blocks from the New Kingdom temple complex. During the final stage of occupation, however, the settlement seems to be without an enclosure wall (Kemp 1993:14). Artefacts found during excavations include glass, coins, basketry, cloth, twine, and pottery; but items of personal adornment such as jewellery appear to be entirely missing from the site (Kemp 1993: 14). Environmental evidence such as animal bone, insects and plant remains was also recovered. Results from the study of other archaeological evidence, especially archaeozoological and archaeo-entomological evidence, from Kom el-Nana, however, were not available for comparison, with the exception of preliminary pottery and coin dating evidence.

After approximately three and a half centuries of occupation, the site was abandoned. In the collapsed rubble of the south-east tower, a temporary encampment (termed 'squatter camp') assumed to date after ca. 700/750 AD was identified. In addition a number of graves, which post-date the abandonment of the monastery, were orientated east / west and included adult and child burials were discovered. Neither the date of these burials nor the religion of the deceased could be determined.

Figure 3.6 Map showing the relation of Kom el-Nana to the New Kingdom (ca. 1350 BC) site of Tell el-Amarna (based on Kemp 1994: 135).

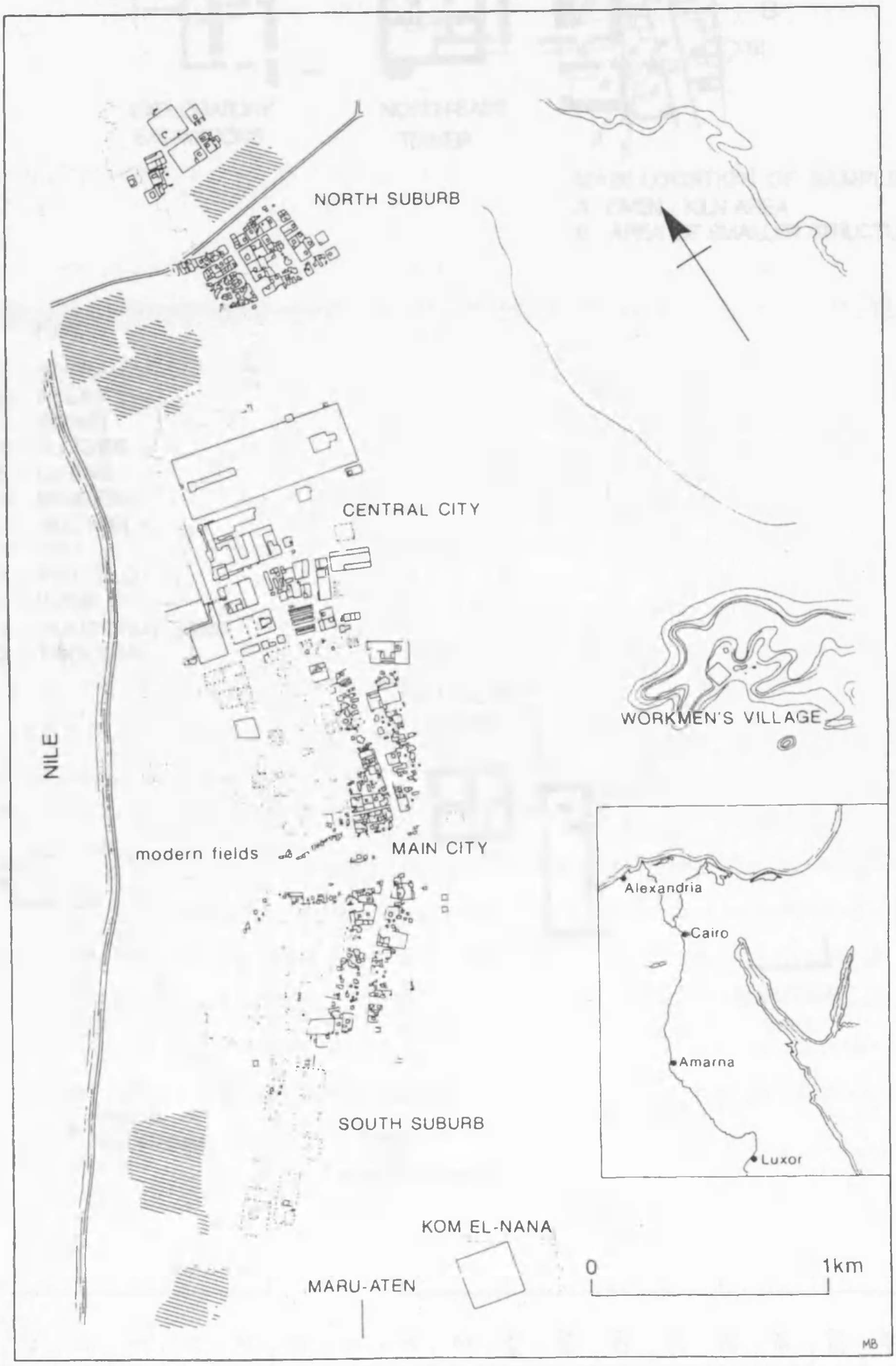
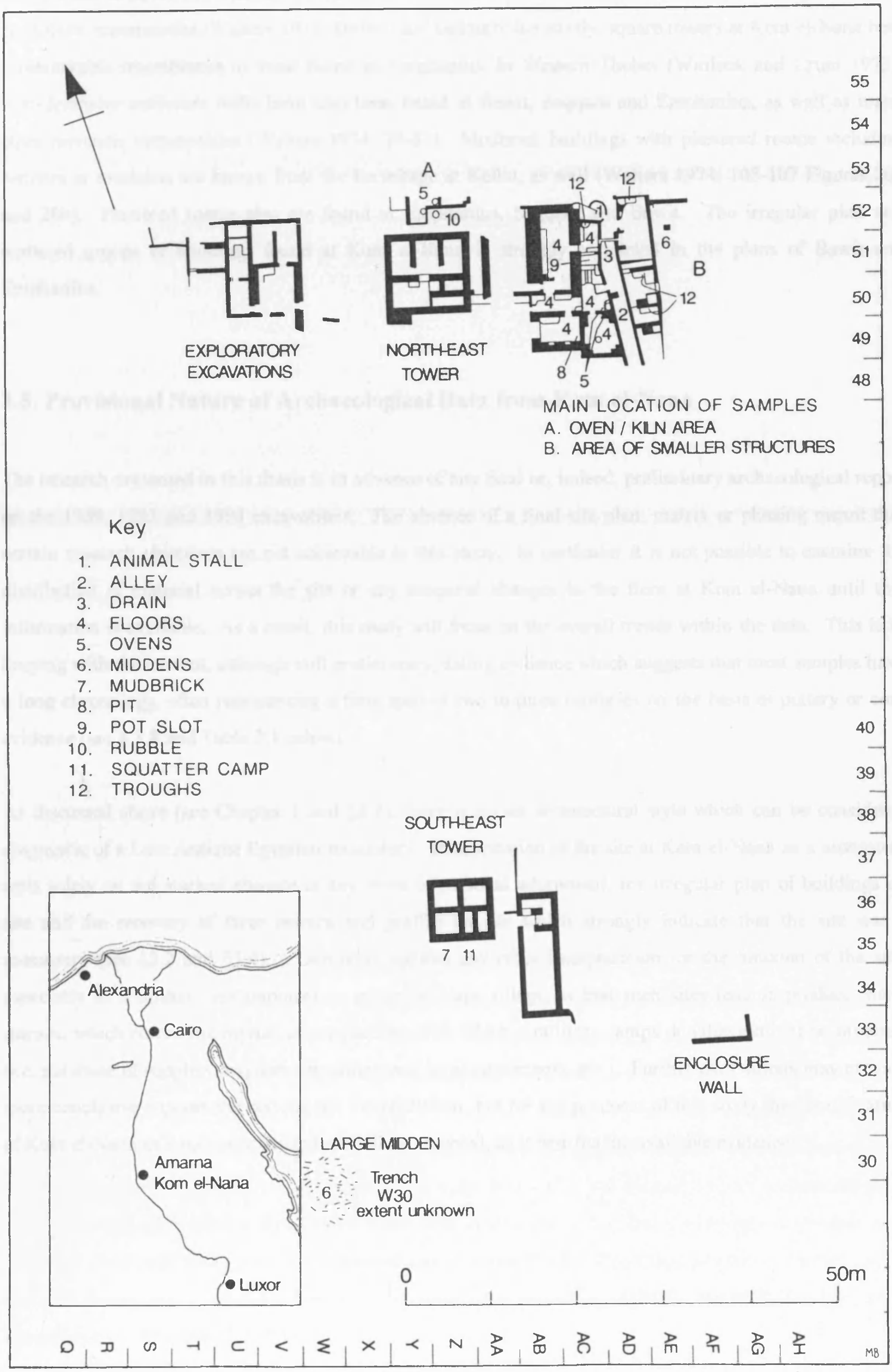


Figure 3.7 Plan of the Late Antique remains at Kom el-Nana (based on Kemp 1995a).



Many of the features of Kom el-Nana are evident at other monastic sites. The north-south orientation is also present at Bawit and Epiphanius (Badawy 1974: 42-44). Towers have been found at many lauria and coenobitic communities (Walters 1974: 86-99), and certainly the sturdy, square towers at Kom el-Nana bear a remarkable resemblance to those found at Epiphanius, in Western Thebes (Winlock and Crum 1973). Non-defensive enclosure walls have also been found at Bawit, Saqqara and Epiphanius, as well as many other monastic communities (Walters 1974: 79-81). Mudbrick buildings with plastered rooms including benches or mastabas are known from the hermitage at Kellia, as well (Walters 1974: 105-107 Figures 20a and 20b). Plastered rooms also are found at Epiphanius, Saqqara and Bawit. The irregular plan and scattered groups of buildings found at Kom el-Nana is strongly paralleled in the plans of Bawit and Epiphanius.

3.5 Provisional Nature of Archaeological Data from Kom el-Nana

The research presented in this thesis is in advance of any final or, indeed, preliminary archaeological report on the 1989, 1993 and 1994 excavations. The absence of a final site plan, matrix or phasing meant that certain research objectives are not achievable in this study. In particular it is not possible to examine the distribution of material across the site or any temporal changes in the flora at Kom el-Nana until this information is available. As a result, this study will focus on the overall trends within the data. This is in keeping with the current, although still preliminary, dating evidence which suggests that most samples have a long chronology, often representing a time span of two to three centuries on the basis of pottery or coin evidence (see § 3.8 and Table 3.1 below).

As discussed above (see Chapter 1 and §3.2), there is no set architectural style which can be considered diagnostic of a Late Antique Egyptian monastery. Interpretation of the site at Kom el-Nana as a monastery rests solely on the marked absence of any items of personal adornment, the irregular plan of buildings on site and the recovery of three ostraca and graffiti on site which strongly indicate that the site was a monastery (see §3.2 and §3.4). One point against any other interpretation for the function of the site, especially as a military encampment or as an ordinary village, is that such sites tend to produce many ostraca, which record the myriad of transactions with which a military camps or village might be involved (i.e. purchase of supplies, requests for equipment, legal agreements, etc.). Further excavations may provide more conclusive support the current site interpretation, but for the purposes of this study the identification of Kom el-Nana as a monastic institution will be accepted, as it best fits the available evidence.

3.6 Preservation

Recent expansion of agriculture in the area currently threatens Kom el-Nana. At present the site adjoins irrigated fields to its north and east. The precise effect of the raised water table on the preservation of the site cannot be quantified, but the lower levels of the site are noticeably damp. The constant wetting and drying of the site from the nearby irrigation canals will effect the mudbrick and plaster as well as more fragile desiccated artefacts such as cloth, basketry and plant remains. Rescue excavation of Kom el-Nana has allowed investigation of the site before the raised water table irretrievably damages the New Kingdom and Late Antique deposits.

3.7 Definition of Contexts Sampled

Although many types of context were encountered and sampled during the course of excavations, this section will only focus on the twelve types of context which are examined in this study. The sampling methodology will be discussed in more detail in the following chapter. This section simply presents a definition of the contexts sampled. In addition, these contexts can conveniently be divided into two categories based on the frequency with which they occur.

3.7.1 Frequently occurring contexts

Frequently occurring contexts at Kom el-Nana are floors, ovens, middens, pot slots and troughs. This category also includes the rubble and mudbrick samples. In total these contexts provided 88% of the archaeobotanical samples used in the case study. Here, each type of frequently occurring context will be described.

Any area bounded by four walls was defined as a floor by trench supervisors (Nos. 4 on Figure 3.7 - see also Plate 3.3). Floors also include areas of compacted earth and any build up of material above or between floors. Two types of areas intended for burning were identified as hearths and ovens (Nos. 5 on Figure 3.7 - see also Plate 3.4). The hearths are low to the floor and are obviously an area set aside for open fires. The ovens are much larger (approximately 1-1.5m high), with circular clay or brick structures (Plate 3.4). Deposits of dumped material (e.g. broken pottery, animal bones and plant remains) were considered to be middens (No. 6 on Figure 3.7). One midden was quite substantial and located well away from the main area of the site and in another case a small build up of waste material was found near some of the excavated buildings. A storage area comprised of mudbrick slots supporting pottery storage jars was unearthed during the 1994 excavations (Plate 3.5). The fill of the storage jars was not available for the study, but samples of the sediment within several individual

Plate 3.3 Photograph of plastered room in Trench AC 51/52.

Plate 3.4 Installation of three ovens just north of the north-east tower in Trench Y52.

Plate 3.5 Storage area in Trench AC 50 / 51. Here, pottery storage jars are clearly seen pushed down into the individual mudbrick pot slots.

pot slots (No. 9 on Figure 3.7) were included. A number of rectangular areas bounded by ca. 0.5m mudbrick walls were discovered inside and outside of buildings at Kom el-Nana. For convenience these features were called troughs (Nos. 12 on Figure 3.7), but their precise function(s) are not known. The pot slot contexts already mentioned are essentially mudbrick troughs with a specific, identified function.

In addition to these, two other context types were present in abundance: mudbrick rubble (indicated by the number 10 in Figure 3.7) and individual mudbricks (No. 7 in Figure 3.7). A mudbrick is not necessarily just made up of mud and gravel (Spencer 1994: 316-317). Organic tempers such as ash, vegetable matter and dung are often used as binding agents in mudbrick (French 1984: 194; Hillman 1984: 127; Lucas 1989: 48-50; Spencer 1979; Unger 1862 and 1866; van der Veen 1996: 138-140), as well as in other traditional building materials such as daub (Hubbard 1990: 218), plaster (Matthews *et al.* 1994: 187-188; Samuel 1994: 155; Spencer 1979: 133-134; van der Veen 1996) or mortar (Ford and Miller 1978: 184). It is also well recognized that mudbrick does disintegrate at archaeological sites (e.g. Kenyon 1979: 14; Spencer 1994). Plant remains present in the temper of the mudbricks or plaster at Kom el-Nana could have eroded out of these building materials and become sources of contamination for other sampled contexts. No samples of plaster have been collected from the excavations, but two individual mudbricks and a sample of mudbrick rubble from Kom el-Nana, as well as half of a Pharaonic period mudbrick from the main city of Tell el-Amarna, are included in the case study in order to determine what temper(s) were used in these bricks and to explore whether organic temper eroding out of mudbrick might be contaminating other samples at Kom el-Nana.

3.7.2 Infrequently occurring contexts

The remaining 12% of case study samples are derived from context types which were less common on site. A passageway or corridor running north / south between two structures was defined as an alleyway (No. 1 in Figure 3.7). An area adjacent to a building with low, curved (i.e. arcing in plan) mudbrick walls was identified as an animal stall (No. 2 in Figure 3.7) on the basis of its similarity to known animal stalls from New Kingdom sites elsewhere at Amarna (Shaw 1984: 40-59). A drain (No. 3 in Figure 3.7) emptying from a room to the outside was found during excavation and sampled. A shallow trench within a building has been provisionally labelled as a pit (No. 8 in Figure 3.7). Finally, evidence of a temporary encampment within the ruins of the south-east tower which post-dates the occupation of the monastery has been labelled a 'squatter camp' (No. 11 in Figure 3.7).

3.7.3 Identified versus understood contexts

Explanation of the function and / or activities which took place within the variety of features found at Kom el-Nana is not always possible. In some cases the nature of the deposits may be obvious (e.g. floors and ovens) but the activities which occurred in these areas are not yet clear. Other context types (e.g. the troughs and the pit) were clearly identifiable, but could only be given a convenient working label since their function was not understood during excavation. Sampling both types of contexts for their plant remains is one means of generating additional information to aid interpretation of the activities that took place at Kom el-Nana.

3.8 Dating Evidence

Two main forms of dating evidence, namely pottery and coins, are available from Kom el-Nana. No C^{14} dates were collected, especially since cross-contamination with earlier fourteenth century BC, New Kingdom deposits was considered likely. Analysis of the pottery assemblage is still underway, but those contexts with provisional dating from pottery or coin evidence are presented below in Table 3.1. These results support the conclusion that the site is predominantly a Late Antique settlement, with possible evidence for occupation in the early Islamic period. Most pottery found dates between AD 475-625, but as a whole the corpus ranges from AD 400-750 (Faiers forthcoming). The majority of pottery at Kom el-Nana is of local origin and, therefore, is unable to support the tight chronologies of better known wares such as African red slip. The coins found were in circulation throughout the eastern Mediterranean, and those dating from the fifth through sixth centuries AD are similar to finds from Carthage and Jerusalem *(pers. comm.* Richard Reece). One ostracon found in one of the troughs has been dated to the late fifth / early sixth centuries AD based on palaeographical evidence (Clackson forthcoming) and is included in the dates presented in Table 3.1.

Table 3.1 Available dating information for case study samples (ordered by sample number).

TRENCH	CONTEXT	SAMPLE No.	CONTEXT DESCRIPTION	POTTERY DATE †	COIN DATE
AE52	8192	94-002	MIDDEN	4-6TH CENT	4-6TH CENT
AE52	8203	94-008	FLOOR	AD 400 - 600	-
AC51	8208	94-012	FLOOR	N/A	4-6TH CENT
AC49	8152	94-031	RUBBLE	AD 400 - 650	-
AC49	8329	94-035	FLOOR	AD 400 - 650	-
AD49	8313	94-036 (2)	FLOOR	AD 475 - 600	-
AC50	8334	94-037	FLOOR	ca. 6TH CENT	-
AD49	8344	94-042	ALLEY	AD 400 - 650	-
AD50	8459	94-047	ALLEY	AD 475 - 625	-
AD49	8461	94-048	OVEN / HEARTH	AD 400 - 650	-
AD50	8407	94-049	FLOOR	AD 460 - ca. 550	-
AC / AD 50	8470	94-052	OVEN / HEARTH	N/A	4-6TH CENT
AD50	8411	94-053	FLOOR	AD 400 - 650	-
AE49	8703	94-056	FLOOR	AD 400 - 650	-
AC52	8410	94-175	TROUGH	Based on ostracon: 5-6TH CENT AD	-
AE50	8408	94-177	TROUGH	AD 400-650	-
AC51	8588	94-184	POT SLOT	6TH CENT AD.	-
W30	5597 #10	5597 #10	MIDDEN	AD 400 - 750	-
W30	5597 #12	5597 #12	MIDDEN	AD 400 - 750	-
W30	5696	5696	MIDDEN	AD 400 - 750	-
W30	5697	5697	MIDDEN	AD 400 - 750	-
W30	5697	5698	MIDDEN	AD 400 - 750	-
AD51	7791	7791	DRAIN FILL	N/A	5TH CENT
Y52	8509	8509	OVEN / HEARTH	AD 400 - 650	-

† AD 400 - 750 *indicates precise pottery dating, primarily based on finewares, known from regional and eastern Mediterranean chronologies.* 4TH - 6TH CENT *indicates less secure dates for pottery or coin circulation.*

3.9 Summary

Excavations at Kom el-Nana have led to the discovery of a settlement dating to the Late Antique period, which, on the basis of current evidence, is most likely a monastery. The desiccated conditions have resulted in the exceptional preservation of many features and artefacts at the site. Many of the architectural features revealed in the excavation at Kom el-Nana have parallels at other monastic settlements. Excavations at Kom el-Nana incorporated sampling for archaeobotanical remains and those samples chosen for the case study reflect the need to understand both the more common and the more unusual context types encountered during excavations.

The dating and historical evidence found on site set these plant remains in a specific historical context - namely Late Antique monastic Egypt. At one level the site will be representative of the hundreds of Nile valley monastic communities which have been lost to us. Recent work, however, suggests that the regions of Egypt are distinct and no single site or archive should be used to generalize conditions for the whole of Egypt (e.g. Bagnall 1995: 12-13 and 26-29). In order to circumvent such problems, the plant remains at Kom el-Nana will primarily be considered in their Hermopolite and monastic context, and no attempt will be made to generalize beyond this.

Chapter 4. Archaeobotanical Methodology

A number of methodological decisions were made in the field and in the laboratory during the collection, processing, and analysis of the 52 Kom el-Nana case study samples. Most recent methodological work in archaeobotany has been concerned with carbonized plant remains; in particular, their sampling, quantification and numerical analysis (i.e. G. Jones 1984, 1987 and 1991; M. K. Jones 1985 and 1991; van der Veen 1984; van der Veen and Fieller 1982). The analysis of desiccated plant remains from ancient Egypt using the methodology established in north-west Europe is a relatively new approach (e.g. Cappers 1996; van der Veen 1996 and forthcoming a). The methodology applied to the primarily desiccated assemblage from Kom el-Nana also follows the northern European tradition. This chapter sets out the archaeobotanical methodology employed in this study.

4.1 Sampling Strategy

Sampling strategy can be defined as the method of sample collection employed during excavation and sample selection for study after excavation. These two steps can occur together or separately. In the case of Kom el-Nana, sample collection during excavation and sample selection for study were two separate stages.

4.1.1 Sampling at Kom el-Nana - the development of a strategy

Archaeobotany at the various sites at Tell el-Amarna has become more sophisticated since the 1980's. Earlier work at the Workmen's Village site was based on an exceedingly small sample size of only 3 cubic centimeters (= 3 ml) (Renfrew 1985: 177). Some excavators' methods were slow to change when a policy of large samples, of at least 15 liters in volume was established. As a result, the archaeobotanical work undertaken by Delwen Samuel at Kom el-Nana in 1989 and 1993 must be seen as a transitional phase. This crucial work demonstrated that large quantities of well preserved desiccated and carbonized plant remains were present, which in turn led to an increase in the volume of soil sampled to a minimum of 15-20 liters. In addition to the increased sampling size, a strategy of total sampling also developed at Kom el-Nana (see §4.1.2). My own fieldwork, which was conducted jointly with Dr. Samuel in 1994, greatly benefited from her pioneering fieldwork during the previous two seasons of excavation at Kom el-Nana.

4.1.2 Sampling strategies

The sampling strategies available to archaeobotanists range from an unsystematic strategy to a probabilistic or random sampling strategy (e.g. M. K. Jones 1991). Four possible sampling strategies are possible:

1. **Haphazard Sampling**: sampling a few contexts, but following no definite strategy.

2. **Total Sampling**: sampling all sealed contexts at the site.

3. **Random Sampling**: with knowledge of how many contexts will be excavated, a table of random numbers is used to select contexts for sampling. Here, every context has an equal chance of being selected for sampling.

4. **Combination of Random Sampling with Judgement Sampling**: using random samples, but supplementing these samples with a collection of samples from areas which *in the judgement* of the excavator or archaeobotanist may be of importance.

In addition, it is possible to apply random sampling, once the excavation is complete, to a collection of samples from any site which utilized a total sampling strategy (e.g. van der Veen 1992a: 21).

Each method has its own drawbacks. Haphazard sampling may not produce a representative sample of plant remains from a site. This method of sampling can result in a scenario where out of the 40 house floor contexts encountered in an excavation, only two were actually sampled. Total sampling produces samples from all sealed contexts encountered during an excavation but on large sites can result in an unmanageable number of samples. Despite the time involved, total sampling does have its advantages. Once all samples are processed it is possible for an archaeobotanist to make a selection of the samples. These can be chosen by context type, the particular area of the site, their richness, or randomly. Random sampling also has its drawbacks. Most site directors will not limit excavation to a set number of contexts, and most excavators are bound to encounter contexts not included in the random sampling grid, but of obvious importance. Indeed the latter problem led to a modification in the random sampling at the site of Thorpe Thewles by van der Veen (1992a: 39) in order to include additional 'judgement' samples which were from contexts that the excavators thought were important, but were not included in the random sampling of the site. Perhaps of most concern, Hall (in Kenward and Hall 1995: 467) and M.K. Jones (1991: 55) both find that random sampling often results in poor coverage of the contexts encountered at a site, and can lead to situations where only one house floor sample represents all house floors found at a particular site.

4.2 Sampling at Kom el-Nana

The choice of sampling strategy was influenced by the three main objectives for archaeobotany at Kom el-Nana:

1. What species were present at Kom el-Nana?
2. What do the plant remains tell us about the function of a room or area on site?
3. What does the assemblage tell us about the agricultural practice and economy at Kom el-Nana?

These objectives required a strategy which would ensure representative sampling of the site and several samples from each context type. In addition, it was not possible to predict in advance of excavation whether the samples recovered would contain similar or different archaeobotanical assemblages. The use of a total sampling strategy accommodates such concerns.

4.2.1 Sample collection at Kom el-Nana

The collection of archaeobotanical samples conducted during three seasons of excavations at Kom el-Nana can be classed under two sampling strategies: haphazard sampling and total sampling. The choice of sampling was dependent on the co-operation of excavators in all three seasons. As a result parts of the Kom el-Nana excavations are considered to be totally or near-totally sampled and other areas of the excavation fall under the category of haphazard sampling. The large midden in Trench W30, the structures around the north-east tower, and excavation near the enclosure wall were sampled under a total-sampling strategy. The south-east and north-east towers were haphazardly and, therefore, poorly sampled. In addition, the excavations in the area around the south-east tower and exploratory excavations to the west of the north-east tower did not include many archaeobotanical samples.

Some samples which were from small, discrete areas, or formed the fill of pottery vessels, were collected in their entirety; but generally between 15-20 liters of soil were collected for each sample. All remaining soil from a context was dry-sieved through a 4mm mesh by workmen who were trained to pick out artefacts such as pottery, coin, bones and plant remains. Dry-sieved plant remains were given a registry number and were provisionally identified. In general, large stoned fruits such as date and peach were most often retrieved in dry-sieving. The dry-sieved plant remains are not used in this case study, but often served as a useful indicator of contexts containing large quantities of plant remains.

4.2.2 Sample selection at Kom el-Nana

In total, 152 bulk soil samples and the fill of 39 vessels were collected during the three seasons of excavation at Kom el-Nana. Initially, based on experience with carbonized material from other Mediterranean sites, it seemed possible to sort all these samples. Based on this assumption, the first samples chosen for study were intentionally selected for their richness, and only from the bulk soil samples. This ensured the presence of a large and diverse assemblage of archaeobotanical remains. Roughly one-third of the samples collected were selected on this basis. In addition, an attempt was made to select samples from most of the context types encountered and to emphasize the most commonly found archaeological contexts such as house floors, middens, and ovens / hearths. The great amount of time needed to sort, identify and quantify desiccated plant remains, however, was not taken into consideration. The first fifty-two samples studied from Kom el-Nana resulted in over 27,500 identifications, and required just over one year of laboratory research to achieve. As a result, it was not possible to include any additional samples from Kom el-Nana in this present study.

4.3 Sample Recording

Details about each sample were recorded by trench supervisors on special forms (Figure 4.1). Site supervisors provided a rough plan of the context sampled, noting down full details of the trench number, context number, date excavated and excavator's initials as well as a brief description of the context sampled and any information about the phasing (i.e. date) of the context or the samples relationship with other contexts.

During flotation, sample volume and any observations were recorded onto this form. Prior to final bagging of dry samples, any impressions made during a quick scanning of the samples were noted down to aid the selection of samples for laboratory analysis. The remaining quarter of this form was not used.

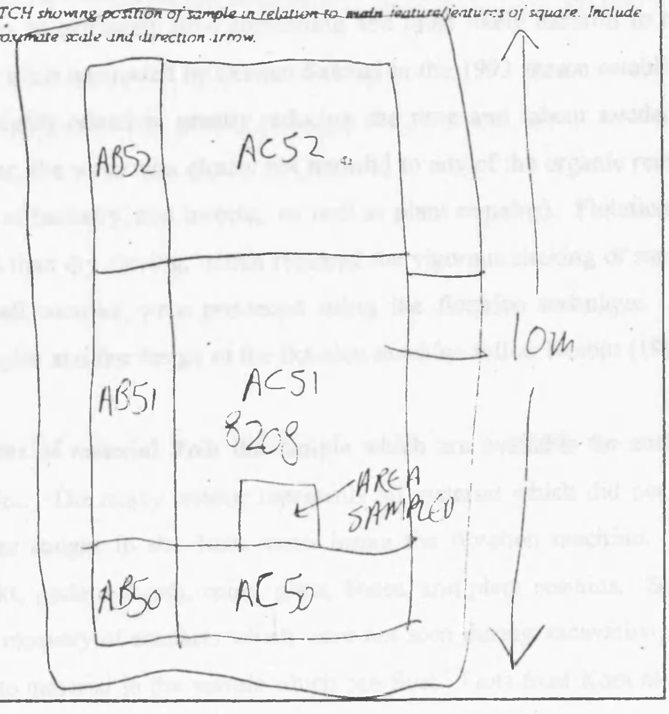
Figure 4.1 Archaeobotanical sampling sheet.

BOTANICAL SAMPLE RECORD SHEET: AMARNA 1994

Square Number:	Unit Number:	Date Excavated: 7/3/94	SAMPLE NUMBER
AC51	8208	Excavator's Initials: DS	94 012

Brief unit description (include comment on whether deposit seems sealed or mixed):

SKETCH showing position of sample in relation to ~~main~~ feature/features of square. Include approximate scale and direction arrow.



Relationship to other samples and/or contexts:
below sample 4011 (8207)
above stone floor

Provisional phasing and any other comments:
Roman

Date floated:	Soil volume:	Flotation comments:
?-3-94	15 litres	C: [illegible] [illegible] CULM NODES / INTERESTING [illegible]/BLACK STRIPED SEED — ? CUCURBITACEA F: SEVERAL SMALL ROUND SEEDS OR IN SEED HEADS? HC: SEVERAL CLOVE [illegible]

SCANNED IMPRESSION OF CONTENTS (Identifications and quantities):

1 mm sieve:	0.3 mm sieve:	Heavy residue:
Looks very good. [illegible] [illegible] [illegible] [illegible] Rumex, [illegible], safflower.		

Plan:	Sections:	Photo:

Final Phasing:

FLOT VOLUMES	1 mm flot	0.3 mm flot	Other comments
FLOT WEIGHTS	1 mm flot	0.3 mm flot	

4.4 Sample Flotation

Archaeobotanical research at Kom el-Nana depended on the successful extraction of macroscopic plant remains from soil samples. In theory, a sample could contain a vast amount of plant remains and a time saving technique was required for the extraction of small organic macro-fossils contained within each soil sample. Two methods were available: dry sieving or water flotation. Dry sieving conducted by Delwen Samuel and myself proved to be extremely time consuming and most likely harmful to more fragile plant remains. Experimental trials conducted by Delwen Samuel in the 1993 season established that flotation of this material was highly effective, greatly reducing the time and labour needed for extraction of plant remains. Moreover, the water was clearly not harmful to any of the organic remains (bone, fragments of cloth, fragments of basketry, and insects; as well as plant remains). Flotation is a much more gentle extraction method than dry sieving, which required the vigorous shaking of samples within metal sieves. In the end, all samples were processed using the flotation technique. The procedure for the flotation of the samples and the design of the flotation machine follow Nesbitt (1995).

Flotation produces two separate forms of material from the sample which are available for analysis, namely the heavy residue and the flot. The heavy residue represents all material which did not float from that particular sample and was caught in the 1mm mesh lining the flotation machine. This typically includes such items as rocks, pottery sherds, coins, glass, bones, and plant remains. Sorting heavy residues often resulted in the recovery of artefacts which were not seen during excavation. The flots, on the other hand, are limited to material in the sample which can float. Flots from Kom el-Nana generally contained small animal bones, insects, and plant remains. A 1.7 mm and a 500 μm mesh sieve were used to collect the flot at Kom el-Nana. Earlier trials with a 1mm and 300 μm mesh sieve, the sizes of mesh typically used in the Near East to collect flots (Nesbitt 1993: 21), were unsuccessful; the sieves blocked up with the flot and, in some cases, overflowed.

4.5 Sub-sampling

Sub-sampling of flots is controlled by three factors. These are the accuracy with which a sub-sample reflects the entire assemblage of seeds, the desired number of samples to be studied and the time constraints of the project. The sample size (approximately 15 to 20 liters) used in all three seasons of excavation at Kom el-Nana resulted in the recovery of large quantities of plant remains and a method of data reduction (G. Jones 1991: 67-68) was needed. The most efficient means of achieving this for the heavy residues and flots was sub-sampling. Representative sub-samples of the flots and heavy residues were made using the 'riffle-method' outlined by van der Veen and Fieller (1982). A sample's heavy residue or flot was poured through a riffle box which divided it into equal halves. Each subsequent sub-sample could be further divided until the desired size of sub-sample was attained. Generally a sub-sample of 1/8 was used on heavy residues. Like heavy residues, the flots are so rich in plant remains that completely sorting a sample would take a great deal of time, potentially resulting in the study of fewer samples from the site. The sub-samples for flots varied between 1/2 and 1/16 of a sample. The size of the sub-sample was dependent on the number of plant remains quantified.

Methodological work suggests that there is no one magic number of seeds which would be representative of any plant assemblage (van der Veen and Fieller 1982). The choice of number varies according to the level of accuracy desired (i.e. how likely the number of seeds selected will represent the complete assemblage) and the proportion of species within a population. A representative number of 250 was selected. This number would be representative of an infinite population of plant remains to an accuracy to ± 5% at 95% confidence, where 20% of that population could be made up of one species (van der Veen and Fieller 1982: 296). The choice of a minimum number of seeds to be representative of a sample was also influenced by the time required to sort sub-samples until the desired number was reached or surpassed. The choice of 250 seeds per sample is a compromise between the desire to have representative sub-samples and the need to examine as many samples as possible.

Typically, a 1/8 sub-sample of a flot was sorted completely for archaeobotanical remains. If a sample appeared to be particularly rich when riffling the flot into sub-samples, a smaller fraction was sorted. Once the sub-sample was sorted a rough estimate of the number of plant remains was made. In some cases the sub-sample contained well over 250 plant remains. If the sub-sample clearly contained less than 200 quantified plant remains, however, an additional sub-sample(s) were completely sorted until the target of 250 quantified plant remains was achieved or surpassed.

4.6 Quantification and Identification Method

Archaeobotanical research rests on the identification and quantification of reproductive parts from a plant; namely seeds, fruits and nuts and plant parts directly related to seeds (in the widest sense) such as rachis or glumes. Various approaches to quantification and identification are available (summarized in G. Jones 1991: 63-66), but because the aim of this study is to numerically analyze the data, a "fully-quantitative" approach was adopted.

Quantification depends on the accurate identification of plant remains or their fragments. Although these structures can be perceived by the naked eye, microscopic analysis of these remains is necessary for identification. Low powered microscopic analysis is the cheapest and generally most effective means of identifying such material. The plant assemblage from Kom el-Nana required microscopic analysis at magnifications between x10 and x45. Identifications were made using modern comparative material from the University of Leicester. The collection of the Herbarium, Cairo University was also consulted. Nomenclature follows Täckholm (1974) for indigenous species and Zohary and Hopf (1994) for the economic species. The traditional binomial system for the cereals has been used here, following Zohary stones, fruits of *Beta vulgaris*, wild radish capsules and split leaf / grass / palm appear at a higher frequency than the other plant remains. Safflower, grape, olive stones, date stones, and split leaf / grass / palm are present in 50% or more of the sorted heavy residues. The plants recovered are not limited to large stoned fruits and other heavier items; they do include lighter items such cereal grain, cereal rachis and other chaff elements, unidentified hila of legumes, and weed species. However, the taxa present in the heavy residues provide a much more limited range of species than in the flots. Out of the eighteen heavy residues examined, all of the species identified were also present in the fifty-two flots. However, in terms of individual samples, seventeen out of the eighteen heavy residues produced species which were not present in their respective flots. This suggests that, at the level of the individual sample, a small amount of botanical information is lost if the archaeobotanical results from the heavy residues are not integrated with the flots. Ideally, an equal fraction of the heavy residue and flot from each sample should be sorted and these results should be combined.

Table 4.2 Summary of desiccated component of sorted heavy residues

Sample Number	5597	5696	5697	7348	7782	7785	7791	94-002	94-005	94-008	94-010	94-011	94-012	94-023	94-024	94-031	94-037	94-186
Sample Volume in Liters	129.5	9	20	10	20	10	7	13.5	10	13	19	14	15	10	14	26	13	17
Fraction of Sample Sorted	1/2	100%	1/4	100%	1/4	1/4	100%	1/2	1/4	1/4	20%	1/4	1/2	1/8	1/8	1/8	1/8	1/8
Sample Preservation	DESC	DESC	DESC	DESC	DESC	DESC	DESC	DESC	DESC	DESC	DESC	DESC	DESC	DESC	DESC	DESC	DESC	DESC
Sample Type	MIDDEN	MIDDEN	MIDDEN	SQUAT	TROUGH	TROUGH	DRAIN	MIDDEN	MIDDEN	FLOOR	FLOOR	FLOOR	FLOOR	MIDDEN	MIDDEN	RUBBLE	FLOOR	POT SLOT
Triticum aestivum L. / *T. durum* Desf. - grain	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hordeum sp. (hulled) - grain	PH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triticum durum Desf. - glume	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triticum durum Desf. - palea / lemma	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triticum durum-type - rachis internode	-	-	-	-	-	-	-	-	-	-	-	-	-	PH	-	-	-	-
Triticum sp. - free threshing rachis internode	-	-	-	-	-	-	-	-	-	-	PH	-	-	A	-	-	-	-
Triticum sp. - glume	-	-	-	-	-	-	-	-	-	-	-	-	-	P=	-	-	-	-
Hordeum vulgare L. - rachis internode	-	-	-	-	-	-	-	-	-	-	-	-	-	PH	-	-	-	-
Cerealia - indeterminate culm node	-	-	-	P=	-	-	PH	-	-	-	PH	-	-	-	PH	-	-	PH
Cerealia - indet. unquant. glume/ palea/lemma	PH	P=	PH	P=	P=	-	P=	-	-	A	-	-	-	-	-	P=	-	-
Hilum - indeterminate	A	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carthamus tinctorius L.	PH	P=	P=	A	PH	P=	PH	P=	P=	-	PH	-	PL	-	-	-	-	P=
Ficus carica L.	-	-	-	PH	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ficus sycomorus L.	PH	-	-	-	PH	-	-	-	-	-	-	-	-	-	-	-	-	-
Morus sp.	-	-	-	-	A	-	-	-	-	-	-	-	-	-	-	PH	-	-
Prunus persica (L.) Batsch	PL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zizyphus spina-christi (L.) Desf.	-	-	-	-	P=	-	-	-	-	-	-	-	-	-	-	-	-	-
Cucumis sp.	PH	-	PL	-	PH	PH	PL	A	-	-	A	PH	PH	-	-	-	-	-
Punica granatum L.	-	-	-	-	-	-	-	-	-	-	-	-	A	-	-	-	-	-
Vitis vinifera L. - pip	PH	PL	PL	A	PL	PL	PL	PL	-	PH	PH	PH	PL	PH	PH	A	-	P=
Vitis vinifera L. - stalk	A	-	-	-	A	-	A	-	-	-	-	-	-	-	-	-	-	-
Olea europaea L. - stone	PL	P=	A	-	PL	A	PL	PH	PH	-	PH	PH	A	A	PL	A	A	PH
Olea europaea L. - kernel	A	-	-	-	A	-	A	-	-	-	A	-	-	A	A	-	-	-
Olea europaea L. - leaf	P=	-	A	-		-	-	PH	-	-	-	-	-	P=	-	-	-	-
Cordia myxa L.	-	-	A	-	P=	-	-	-	-	-	-	-	-	A	-	-	-	-
Phoenix dactylifera L. - stone	PL	A	PL	A	PL	PL	A	A	PH	-	-	-	PL	PL	-	-	P=	PL
Phoenix dactylifera L. - perianth	-	-	-	-	-	PL	-	-	-	-	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - female flower	-	-	-	-	-	-	-	P=	-	-	-	-	-	-	-	-	-	-
Coriandrum sativum L.	-	-	-	-	-	-	-	PH	-	-	-	-	-	-	-	-	-	-
Cuminum cyminum L.	-	-	-	-	PH	-	-	-	-	-	PH	PH	-	-	-	-	-	-
cf. *Ocimum basilicum* L.	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Allium cepa L. - tunic (= skin)	PH	-	-	-	A	-	-	-	-	-	-	-	-	-	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - seed	-	A	A	A	P=	-	-	-	-	-	-	-	-	A	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - pod	-	-	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tamarix aphylla (L.) Karst. - needle	PH	-	PH	PH	-	-	P=	-	-	-	-	-	-	-	-	-	-	-
Myrtus communis L.	P=	-	-	-	PH	-	-	A	-	-	-	-	P=	-	-	-	-	-
Rumex spp. - nut (naked)	-	-	PL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beta vulgaris L.	P=	-	A	-	P=	-	-	PH	P=	-	-	-	-	A	-	-	-	-
Chenopodium murale L.	-	-	-	-	-	PH	-	-	-	-	-	-	-	PH	-	-	-	-
Cornulaca cf. *monocantha* Del.	PH	PH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zilla spinosa (Turra) Prantl	PH	P=	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Raphanus raphanistrum L. capsule	-	-	A	A	-	P=	-	-	-	-	PH	-	A	A	-	-	-	-
Medicago sp.	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fagonia sp.	-	-	-	A	P=	-	-	-	-	-	-	-	-	-	-	-	-	-
Malva sp.	PH	-	-	-	-	-	-	-	-	-	-	-	-	P=	-	A	-	PH
Galium spp.	PH	-	PL	-	-	PH	-	PL	-	-	-	-	-	-	-	-	-	-
Echium sp.	-	-	-	A	-	PH	-	-	-	-	-	-	-	-	-	-	-	-
Sonchus sp.	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Avena sp. - grain	-	-	P=	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phalaris spp.	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Setaria spp. with palea / lemma	-	-	-	-	-	-	-	-	-	-	-	-	-	PH	-	-	-	-
Gramineae - small seeded	-	PH	PH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gramineae - large seeded	A	-	-	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
?X - a) Unidentified leaf	P=	P=	PH	P=	P=	-	-	-	-	-	A	-	-	-	-	P=	-	-
?X - b) Split leaf / grass / palm	P=	-	-	P=	P=	-	P=	-	PH	-	-	A	P=	P=	-	P=	P=	-
?A16 - a) unidentified root	-	-	-	-	-	-	-	-	PH	-	-	P=	A	A	-	-	-	-
- b) unidentified bark	-	A	A	-	-	-	-	-	P=	-	-	A	-	-	-	-	-	A
?A27 - a) unidentified small fruit	-	-	-	-	A	-	-	PH	-	-	-	-	-	-	-	-	-	-
?A29 - Small rounded seeds	PL	-	-	-	-	A	-	-	-	-	-	-	-	-	-	-	-	-
?A49 - b) Small flower head	-	-	PH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL IDENTS. FOR HEAVY RES.	75	11	32	16	72	36	33	17	4	1	36	4	25	29	9	4	1	8
PERCENTAGE OF SAMPLE	100.0%	100.0%	100.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	80.0%	100.0%	88.9%
SEEDS PER LITER	1.2	1.2	6.4	1.6	14.4	14.4	4.7	2.5	1.6	0.3	9.5	1.1	3.3	23.2	5.1	1.2	0.6	3.8
TOTAL DESC FLOT IDENTIFICATIONS	1569	299	559	247	213	666	389	749	213	183	518	481	427	218	724	649	181	308
HR AS A PERCENTAGE OF FLOT	4.8%	3.7%	5.7%	6.5%	33.8%	5.4%	8.5%	2.3%	1.9%	0.5%	6.9%	0.8%	5.9%	13.3%	1.2%	0.6%	0.6%	2.6%

A = ABSENT IN FLOT, P= = PRESENT IN SAME AMOUNT IN FLOT, PL = PRESENT IN LOWER AMOUNT IN FLOT, AND PH = PRESENT IN HIGHER AMOUNT IN THE FLOT. Shaded species represent those species which were present in over 25% of the sorted heavy residues.

Table 4.3 Summary of carbonized component of sorted heavy residues

Sample Number	**5597**	**5696**	**5697**	**7348**	**7782**	**7785**	**7791**	**94-002**	**94-005**	**94-008**	**94-010**	**94-011**	**94-012**	**94-023**	**94-024**	**94-031**	**94-037**	**94-186**
Sample Volume in Liters	129.5	9	20	10	20	10	7	13.5	10	13	19	14	15	10	14	26	13	17
Fraction of Sample Sorted	1/2	100%	1/4	100%	1/4	1/4	100%	1/2	1/4	1/4	20%	1/4	1/2	1/8	1/8	1/8	1/8	1/8
Sample Preservation	CARB	CARB	CARB	CARB	CARB	CARB	CARB	CARB	CARB	CARB	CARB	CARB	CARB	CARB	CARB	CARB	CARB	CARB
Sample Type	MIDDEN	MIDDEN	MIDDEN	SQUAT	TROUGH	TROUGH	DRAIN	MIDDEN	MIDDEN	FLOOR	FLOOR	FLOOR	FLOOR	MIDDEN	MIDDEN	RUBBLE	FLOOR	POT SLOT
Hordeum sp. (hulled) - grain	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	A
Triticum dicoccum Schübl. - glume base	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	A	-	-
Hordeum vulgare L. - rachis internode	-	-	-	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vitis vinifera L. - stalk	-	-	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Juniperus cf. *oxycedrus* L. / *phoenicea* L.	-	-	-	-	-	-	-	-	-	PH	-	-	-	-	-	-	-	-
Trifolium spp. - seed	-	-	-	PH	-	-	-	-	-	-	-	-	-	-	-	-	-	-
?X - a) Unidentified leaf	-	-	-	-	-	-	-	-	-	A	-	-	-	-	-	-	-	-
TOTAL IDENTS. FOR HEAVY RES.	0	0	1	4	0	0	0	0	0	0	0	0	0	0	0	1	0	1
PERCENTAGE OF SAMPLE	0.0%	0.0%	0.0%	20.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	80.0%	0.0%	11.1%
SEEDS PER LITER	0	0	0.2	0.4	0	0	0	0	0	0	0	0	0	0	0	0.3	0	0.5
TOTAL CARB FLOT IDENTIFICATIONS	-	-	27	0	-	-	-	-	-	-	-	-	-	-	-	109	-	3
HR AS A PERCENTAGE OF FLOT	-	-	3.7%	100.0%	-	-	-	-	-	-	-	-	-	-	-	0.9%	-	33.3%

A = ABSENT IN FLOT, P= = PRESENT IN SAME AMOUNT IN FLOT, PL = PRESENT IN LOWER AMOUNT IN FLOT, AND
PH = PRESENT IN HIGHER AMOUNT IN FLOT.

4.9 Use of Modern Analogues

Many of the conclusions on the ancient plant remains which are made in this study are contingent on the results of the study of the modern environment. In essence, the habitat requirements of a plant found in Egypt today are presumed to have been the same for that plant in the past. In addition, the uses and processing techniques for crops grown today also are used as analogue for past agricultural practice (e.g. Hillman 1984a and 1985; G. Jones 1984).

These assumptions are based on the premise that the basic characteristics of plants have not changed much over the past few millennia. However, since the beginning of the twentieth century the Nile system has been progressively altered, such that since 1965 the cultivation strip has not been inundated. Most modern studies of the flora of Egypt post-date the construction of Aswan Dam. As a result, there is no precise record of the plant communities which existed under active conditions of inundation in Egypt, only records of those plants which persist on formerly inundated lands today. Certainly, Zahran and Willis (1992: 365-375) suggest that there are many gaps in our understanding of the ancient vegetation of Egypt. In addition, recent studies in England have shown that the weeds commonly found associated with ancient crops are not necessarily in evidence today and change over time (Greig 1990; M.K. Jones 1988a); this also is likely to be the case for the archaeological weed flora encountered in the Kom el-Nana assemblage.

4.9.1 The modern physical setting as analogue

Today, Egypt is characterized primarily by desert with fertile lands located along the Nile and in the oasis depressions. Zahran and Willis (1992: 1) suggest that only 3% of the total area of Egypt is fertile land. The fertility of the cultivation strip along the banks of the Nile is dependent on the runoff waters from a basin nearly 3 million km^2 in eastern Africa (Figure 4.2) that provides the equivalent of a monsoon season's rain into a narrow fertile strip between the Red Sea Hills and the Western Desert (Beaumont 1993; Hamdan 1961; Zahran and Willis 1992: 303-307). Prior to the recent damning projects in the nineteenth and twentieth centuries, "the Nile had one of the largest discharges of any river in the world" (Beaumont 1993: 26). Egypt is reliant on the water provided by the Nile but the volume of water carried down the Nile varied from year to year (Butzer 1976: 27-36) and, in the past, overly low or high floods could result in famine.

Dry air masses from the Sahara dominate the Egyptian weather system for most of the year (Beaumont 1993). Cooler, damper air masses from the Mediterranean Sea, however, somewhat ameliorate these dry conditions in Egypt. During the summer, temperatures are uniformly high with very little precipitation. On the coast, annual winter storms provide between 120 to 150 mm of precipitation, which is just sufficient to support agriculture. Toward the middle of the Delta, winter rainfall averages 50 mm a year and drops steadily the further south one travels. The arid and hyper-arid conditions of Egypt appear to have remained unchanged since 3000 BC (Butzer 1976: 39-41; Zahran and Willis 1992: 7-8). Indeed most archaeobotanists assume, either implicitly (e.g. Cappers 1996) or explicitly (e.g. van der Veen 1996: 139), that there is little variation between the environmental conditions in Egypt during antiquity and the present day.

Egyptian plants often occur in specific geographic regions (Figure 4.3). Our present knowledge of the flora of Egypt, however, is only derived from phytosociological studies (studies of plant communities which group species into a hierarchical system) and no study of individual plant requirements (autecological studies) in Egypt is available. Since individual plant requirements are not known, and since the irrigation regime in fields and orchards has radically altered since antiquity, any analogy drawn between ancient weed assemblages and modern studies of the flora of Egypt will be quite rudimentary. Nonetheless, in this study, analogies between the ancient plant remains from Kom el-Nana and modern phytosociological studies in Egypt, and elsewhere in the region (i.e. Palestine and Iraq), have been made. These will be discussed in detail in Chapter 6 §6.3.

Figure 4.2 Map of Africa showing the full extent of the Nile watershed and the location of Egypt. (after Zahran and Willis 1993: 2).

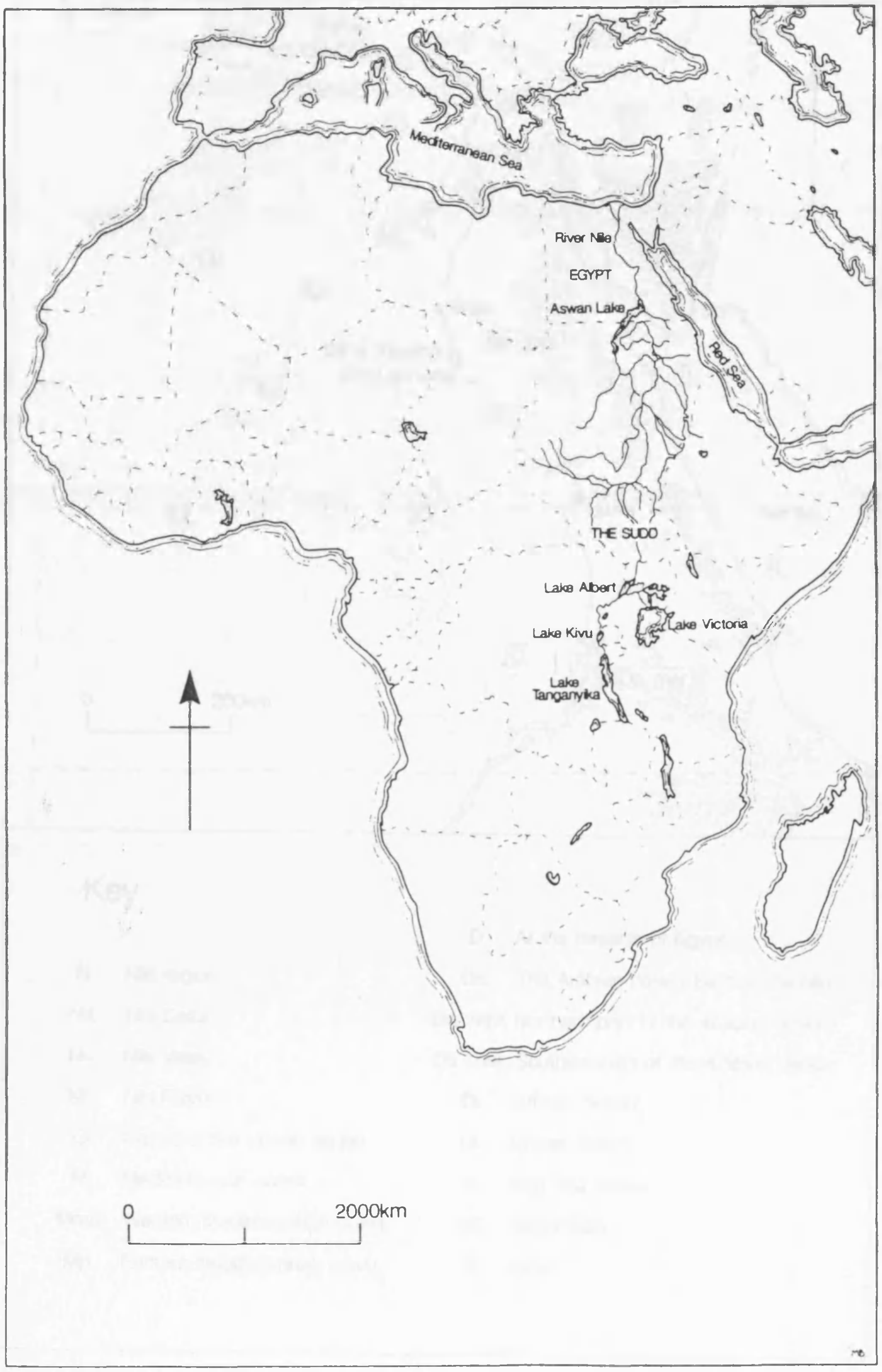
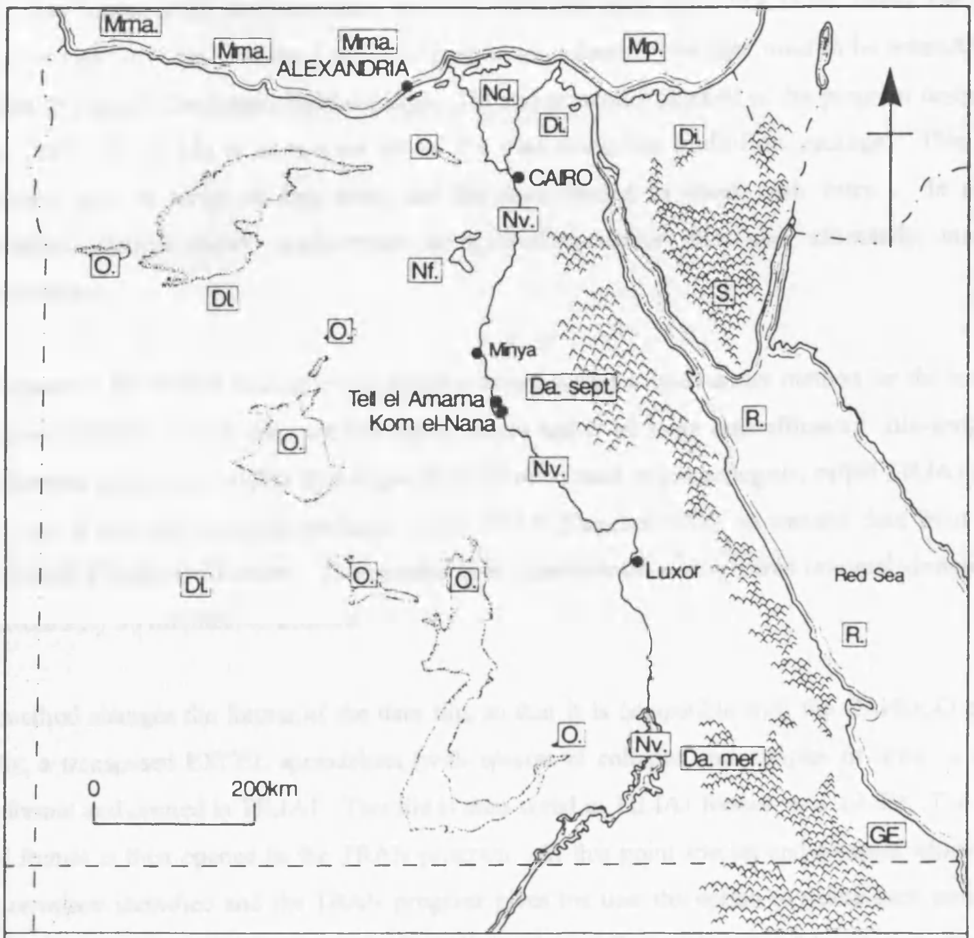


Figure 4.3 Phytogeographic zones of Egypt. (after Täckholm 1974: 19-20)



Key

		D.	All the deserts of Egypt
N.	Nile region	Da.	The Arabian desert East of the Nile
Nd.	Nile Delta	Da. sept.	Northern part of the Arabian desert
Nv.	Nile Valley	Da. mer.	Southern part of the Arabian desert
Nf.	Nile Faiyum	Di.	Isthmic desert
O.	Oases of the Libyan desert	Dl.	Libyan desert
M.	Mediterranean coast	R.	Red Sea coast
Mma.	Western Mediterranean coast	GE.	Gebel Elba
Mp.	Eastern Mediterranean coast	S.	Sinai

4.10 Data Entry

To analyze proportions of plants within a data set, an archaeobotanist must first use a spreadsheet (i.e. Hastorf and Popper 1988) and then use a statistical package, such as CANOCO (ter Braak 1987-1992), for multivariate analyses. If the CANOCO program is adopted, the data need to be entered into the program in Cornell Condensed Format (.cep). The recommended method of the program designer (ter Braak 1987-1992: 9-14) is to re-enter all of the data using the Multi-Edit package. This is time consuming both in terms of data entry and the care needed to check each entry. In addition, uncorrected 'clerical errors' could result in misleading scatter plots and, ultimately, misleading interpretations.

Researchers in the related field of bio-geography have adopted a much easier method for the transfer of data into CANOCO, which does not risk typing errors and is far more time efficient.[2] Bio-geographers are achieving such data transfers by using a program often used by palynologists, called TILIA1 (Grimm 1991), and a specially designed package, called TRAN (Juggins 1992), to transfer data from TILIA1 into Cornell Condensed Format. The process is straightforward and requires minimal computer time (approximately 30 minutes) to achieve.

The method changes the format of the data file, so that it is compatible with the CANOCO program. Briefly, a transposed EXCEL spreadsheet (with species in columns and samples in rows) is saved in .wks format and opened in TILIA1. This file is then saved in TILIA1 format, as a .til file. The new file in .til format is then opened in the TRAN program. At this point species and samples which contain only zeros are identified and the TRAN program gives the user the option to delete such samples and species or not. The file is then saved in Cornell Condensed Format (.cep) and can now be read by the CANOCO program. In this way, multivariate analysis in CANOCO can be started without any data-entry. This method is simple, ensures the accuracy of data and is time efficient; therefore, it has been adopted for this study.

[2] I would like to thank Dr. Jon Sadler, Department of Geography, University of Birmingham for showing me this method of data entry.

4.11 Summary

Methodologies developed in northwest Europe were applied to the Late Antique plant remains from Kom el-Nana. The sampling strategy developed over the three seasons of excavation. Certain areas of Kom el-Nana were poorly sampled and, as a result, this study only focuses on those areas which were sampled and, in particular, those areas where a total sampling strategy was put into effect.

Flotation of the soil samples proved an extremely effective means of extracting plant remains, causing no visible damage to them. Samples were selected for the case study based on their richness, but coverage across the site was also a priority. The riffle-method of sub-sampling was used on both the flots and heavy residues to reduce the size of data from these rich samples. A target of 250 seeds per flot was used.

In most cases the plant remains were fully quantified. Some material, however, could not be quantified. In these cases a semi-quantitative scoring system was used to indicate the quantity of such plant remains in the samples. Identifications were made using modern comparative material and low powered binocular microscopy at magnifications between x15 and x45. A single feature, such as an embryo, was used to quantify a seed or other plant part. The identification and quantification criteria used for the plant remains from Kom el-Nana are summarized in Appendix 1. The carbonized plant remains are treated separately from the desiccated plant remains in this study, although it is possible that they are related data. Ideally, plant remains found in heavy residues should be used as well; however, this was not possible at Kom el-Nana. In most cases sorting the heavy residues, in addition to the flot, did generate a few more new identifications of plants, but in terms of the overall assemblage, all species identified in the eighteen sorted heavy residues were accounted for within all of the sorted flots. Modern botanical and ethnobotanical research will be used as analogues, to aid the interpretation of the Kom el-Nana archaeobotanical assemblage.

Chapter 5. Plants of Economic Importance at Kom el-Nana

This chapter answers three basic questions about the economic plants found at Kom el-Nana:

1. what proportion of the assemblage is made up of economic plants?
2. how are these plants of economic importance?
3. how do the Kom el-Nana economic plants compare with those found at other Egyptian sites?

An 'economic plant' is any plant intentionally grown or collected for human use (i.e. food, fodder, fuel, timber, fiber, oil production, etc.). Identification of the economic plants and their possible uses can help to build a picture of daily diet and activity at this monastery. In addition, comparison of the Kom el-Nana economic plants with other archaeobotanical finds from the Ptolemaic through Islamic period can help to determine if the agricultural economy of Kom el-Nana is more restricted than other, non-monastic sites in Egypt.

5.1 The Overall Assemblage

The fifty-two sub-sampled flots yielded a rich assemblage of desiccated and carbonized plant remains. In total 27,758 identifications of 174 taxa were made.[1] Of these, 24,630 or 89% of the macrofossils identified were desiccated and the remaining 3,128 or 11% were carbonized. Desiccated plant remains were recovered at an average density of 280 seeds / liter, whereas carbonized remains were only recovered at an average density of 30 seeds / liter. The full lists of plants recovered are presented by context type in Tables 1-12 of Appendix 1.

Earlier work on carbonized assemblages developed a style of summarizing data based on the remains typically recovered; namely cereal grain, cereal chaff and weeds (e.g. M. K. Jones 1985; van der Veen 1992a). Hall (in Kenward and Hall 1995) also has recently summarized a large archaeobotanical data set from waterlogged deposits at Anglo-Scandinavian York into a wide range of categories based on plant use. Recent archaeobotanical studies from Roman / Late Antique Berenike (Cappers 1996) and Roman Mons Claudianus (van der Veen 1996) in Egypt have been summarized into a number of plant categories and this study broadly follows these classifications.

One difference in the method used here is that the unidentified component of the assemblage will also be included. Unidentified plant remains are morphologically distinct seed and / or vascular tissue which

[1] All discussion from this point forward is based entirely on the results of the 52 flots. It was not possible to incorporate the results from the heavy residues into this present study. For a discussion of the results from the 18 heavy residues which were sorted see Chapter 4 §4.7.

currently cannot be identified without more comparative material. Although, at present, there is very little that can be done with these plant remains, they do contribute to the overall character of the Kom el-Nana archaeobotanical assemblage. 6% of the desiccated component and 20% of the carbonized component are unidentified. The large proportion of unidentified taxa in the carbonized component is due to two reasons. First this material was in a poor state of preservation, typically warped and twisted through direct exposure to heat or flame. Second, given the limited amount of time available, the priority had to be the identification of desiccated plant remains, which were better preserved and formed the majority of the taxa recovered.

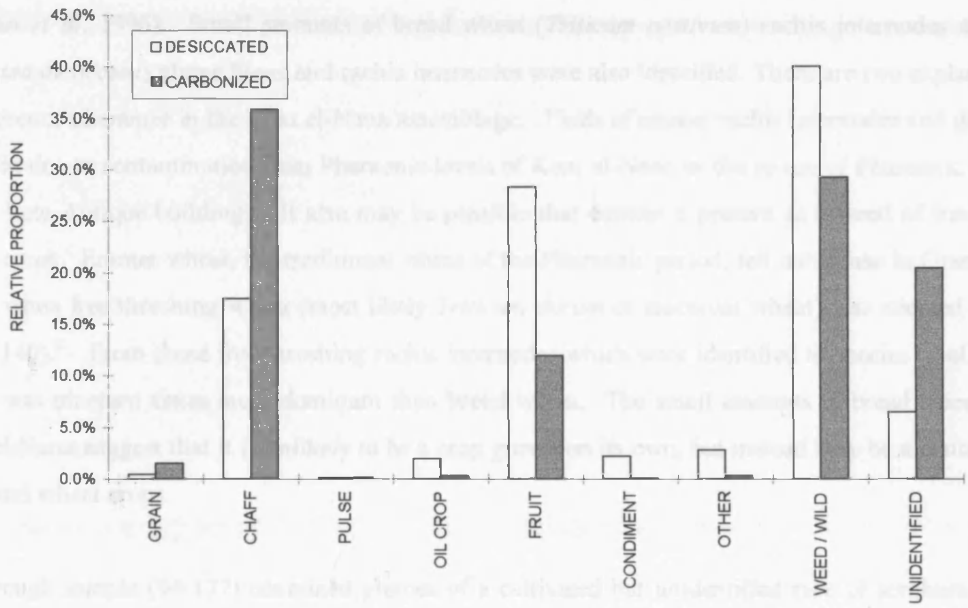
Kenward and Hall (1997: 664) have recently argued that restricting archaeobotanical or archaeoentomological identifications and, therefore analysis, to certain taxa does risk information loss and suggest that "even a rough listing of principal macroscopic constituents" can be useful. The exceptional preservation conditions at Kom el-Nana have resulted in the survival of much more desiccated and carbonized vegetative material than just the seeds and other related plant parts (i.e. rachis internodes, cereal culm nodes, or seed capsules), which commonly form the bulk of archaeobotanical assemblages. This study will focus on the identified reproductive parts (see Chapter 4 §4.6), but the unidentified taxa (whether seed, leaf, root, etc.) will also be included in order to demonstrate the full nature of the contexts encountered.

The Kom el-Nana archaeobotanical assemblage divides into three main categories: economic plants, weed / wild plants, and unidentified plants. These basic categories are made in terms of the economic use(s) of an individual species and, to a certain extent, their botanical differences. The economic plants can be defined as those plants which are recognized agricultural resources (i.e. fiber, food, oil crops, timber, etc.) and of economic significance. The economic plants can be further sub-divided into several categories: cereal grain, cereal chaff, pulses (beans), oil crops, fruits, and condiments (flavorings). Like any classification system, however, certain species are not easily categorized so the classification of 'other' has also been used to include those plants of economic importance which do not neatly fit into any of the main economic plant categories. The specific members of each category of economic plants will be described below in §5.2.

The weed / wild plants include those plants which often are found as weeds of cultivation, waste ground, or canal banks. In some cases, certain species (e.g. *Beta vulgaris*, beet, or *Portulaca oleracea,* purslane) can occur as either wild or cultivated plants in Egypt. Since it is not possible to claim that these species were cultivated, in this study such species were always classified as weed / wild plants. The final category of unidentified plant remains is described in Appendix 2, but are not discussed in detail here because their exact identifications and, therefore, significance are not known. However, this plant category will be shown in all summaries of the overall assemblage and individual samples, in order to demonstrate the portion of the sample which remains unidentified and also may include non-seed related items such as leaves, root or bark, following the methodology of Kenward and Hall (1997). In cases where taxa from the unidentified component of the Kom el-Nana assemblage are abundant, the particular plant remains will be discussed (see Chapter 7).

By assigning plants to these different categories, it is possible to summarize the data for the complete assemblage or an individual sample. Context and absolute count vary between samples so comparisons of taxa will require form of standardization of the data. Percentages are widely used in archaeobotany in order to make direct comparisons between individual taxa or groups of taxa (e.g. cereal grain, pulses, etc.) which vary in absolute count between samples (Miller 1988), and also have been adopted for this study. Figure 5.1 summarizes the Kom el-Nana assemblage into economic, weed / wild and unidentified plant categories. Clearly, cereal chaff, fruit and weed / wild plants are abundant in both components of the assemblage (excluding the unidentified component whose taxa probably belong to both the economic and weed / wild plant categories).

Figure 5.1 Summary of the Kom el-Nana archaeobotanical assemblage.
(Desiccated identifications = 24,630 and carbonized identifications = 3,128.)



5.2 Economic Plants

The economic plants (i.e. all grain, chaff, pulse, oil crop, fruit, condiment and other economic plant categories) account for 54% of the desiccated component and 50% of the carbonized component in total. Cereal chaff is one of the most abundant categories of economic plants, accounting for 18% of the desiccated component and 36% of the carbonized component. Fruit, another abundant category of economic plants, accounts for 28% of the desiccated component and 12% of the carbonized component. The desiccated component also includes cereal grain (0.4%), oil crops (2%), condiments (2.2%), and other less easily classified economic crops (2.8%). Aside from carbonized cereal grain (1.5%), the remaining categories of economic plants account from less than 2% of the carbonized assemblage. A small amount of desiccated (0.2%) and carbonized pulses or beans (0.1%) were also present.

5.2.1 Cereal grain and chaff

Macaroni wheat (*Triticum durum*) and barley (*Hordeum vulgare*) dominate the identified cereal remains from Kom el-Nana. Many parts of these cereals including grain, glume, palea, lemma, awn, rachilla, culm node and rachis internode are present. Only a few grains of free-threshing wheat and barley were found in the Kom el-Nana samples. In many cases the testa or outer seed coat of wheat grains and the hulls of barley are preserved but the endosperm was absent. Barley has a long history in Egypt and is known from Neolithic deposits onwards (Täckholm 1961: 4). A 3:1 ratio exists for the rachis internodes of free threshing wheat to barley at Kom el-Nana. Most of the free threshing wheat rachis could not be easily identified to species because the internode had broken high, near to the glume insertion point (*sensu* Hillman *et al.* 1996). Small amounts of bread wheat (*Triticum aestivum*) rachis internodes and emmer (*Triticum dicoccum*) glume bases and rachis internodes were also identified. There are two explanations for the presence of emmer in the Kom el-Nana assemblage. Finds of emmer rachis internodes and glume bases could be due to contamination from Pharaonic levels of Kom el-Nana or the re-use of Pharaonic mudbricks in the Late Antique buildings. It also may be possible that emmer is present as a weed of free threshing wheat crops. Emmer wheat, the traditional wheat of the Pharaonic period, fell out of use in Graeco-Roman times, when free threshing wheat (most likely *Triticum durum* or macaroni wheat) was adopted (Crawford 1979: 140).[2] From those free threshing rachis internodes which were identified to species level, macaroni wheat was nineteen times more dominant than bread wheat. The small amounts of bread wheat found at Kom el-Nana suggest that it is unlikely to be a crop grown on its own, but instead may be a contaminant of macaroni wheat crops.

One trough sample (94-177) contained glumes of a cultivated but unidentified race of sorghum (*Sorghum bicolor* - race unknown). In a few cases the glumes still encased the grain. At present the sorghum from Kom el-Nana has not been identified to race. The Kom el-Nana remains of sorghum show no evidence of breakage and in some cases clearly remained tightly clasped, suggesting that the sorghum grains, like the wheat and barley grains, may not survive the taphonomic conditions present at Kom el-Nana. Cappers (1996: 334-335) suggests that this kind of sorghum "trash" can be generated from both imported and locally produced sorghum and, therefore, it is not possible to determine whether sorghum was cultivated in the Kom el-Nana area during Late Antiquity. This result does add to the Berenike (Cappers 1996) and Qasr

[2] Although El-Hadidi and Amer (1996: 34-35) identify emmer wheat (***Triticum dicoccum***) at 5th - 8th century Abu Sah'ar, this identification seems unlikely and figure 3a (p. 35) which is intended to illustrate the identification is not persuasive, and certainly does not look like the classic emmer spikelet forks illustrated in El-Hadidi *et al.* (1996: 49 figure 2b), although incorrectly labelled barley spikelets. In addition no emmer grains, glume bases or rachis internodes are recorded in the catalogue of archaeological specimens from Abu Sha'ar at the Cairo University Herbarium (El-Hadidi and El-Fayoumi 1996), although hard wheat (***Triticum durum***) is.

Ibrim (Rowley-Conwy 1989; 1991) finds of sorghum prior to the Islamic invasion, and suggests Watson's (1983) premise that sorghum was an Islamic introduction to Egypt is inaccurate.

All cereals recovered have been found in Roman and Late Antique period assemblages in Egypt (Cappers 1996; El-Hadidi and Amer 1996; El Hadidi and El-Fayoumi 1996; Hepper 1981; Leighty 1933; Täckholm 1961; van der Veen 1996; Wetterstrom 1982) and are staple crops which could serve as human food and animal fodder.

5.2.2 Pulses

A small number of pulses (beans or peas) have been found at Kom el-Nana. Like cereal grain, the preservation of pulses is often poor. Detached hila (the point where a bean attaches to the pod) or fragments of testa (the seed coat) are most often found in the samples. Complete pulses are only rarely found. Lentil (*Lens culinaris*), white lupin (*Lupinus* cf. *albus*) and vetchling (*Lathyrus* sp.) have been found completely preserved. Lentils are a well known culinary pulse, but white lupin and vetchling are also of economic importance. White lupin (sometimes called '*termis*') requires soaking or boiling before eating, and is often eaten as a snack food in the eastern Mediterranean and Near East today (Zohary and Hopf 1994: 117). Vetchling is most often used as a fodder crop today, but is considered part of human diet in the past (Zohary and Hopf 1994: 114). All three legumes have been found at Roman and Late Antique period sites in Egypt (Barakat and Baum 1992; Cappers 1996; El-Hadidi and Amer 1996; van der Veen 1996; Wetterstrom 1982; Willerding and Wolf 1991).

5.2.3 Oil crops

Three plants which are potential oil crops have been recovered at Kom el-Nana, but all three have other uses. First, linseed or flax (*Linum usitatissimum*) seed and capsules were recovered. Linseed can be grown as an oil or fiber crop (Langer and Hill 1991: 293-298; Zohary and Hopf 1994: 119-126). Indeed, it may be possible to grow the plant for both commodities (e.g. Bond and Hunter 1987: 177-178). In addition, linseed or linseed cake (the by-product of linseed oil production) can be used as a fodder. Linseed oil also can be used as lighting fuel for lamps and as a cooking oil (Zohary and Hopf 1994: 119). Linseed oil, which is quick drying, also is an excellent base to paints or pigments (Langer and Hill 1991: 295) .

The second oil crop is safflower (*Carthamus tinctorius*). Safflower is similar to a thistle in appearance and is a winter crop (Knowles 1955; 1967). The seeds (achenes) of safflower are ground and pressed to produce oil. In some cases the seeds may be parched before pressing. Today, safflower is a minor crop in the Mediterranean and Near East, but where it is grown it is considered superior to other cooking oils, such as linseed oil (Knowles 1967: 156). Safflower oil, however, has a short shelf life and will spoil after a couple of months. The pressings of safflower can be used as an animal fodder, and so are also of economic importance. In addition, the petals of safflower can be used as a substitute for saffron and as a dye-stuff, producing dyes ranging in color from yellow to red (Cannon and Cannon 1994: 92-93).

Finally, olive (*Olea europaea*) stones and leaf are present in the assemblage. Olive has not been included with the oil crop plant category, but has been classified with fruits following Zohary and Hopf (1994: 137-143). They were, and are, a crop of major economic importance in the Mediterranean (e.g. Mattingly 1988 for the Roman period). Olives can be eaten as a fruit and / or used as an oil crop; producing cooking and lighting oils as well as serving as an ingredient in ointments, soaps and perfumes (Zohary and Hopf 1994 : 137). Olive oil also can be used as an insecticide (Panagiotakopulu *et al.* 1995: 706), and the pressings from olive oil production can be used as a fuel (Matson 1972: 219). Other elements of the olive also are of use. Olive leaves can be used as a fodder or a fuel (Goor 1966: 226).

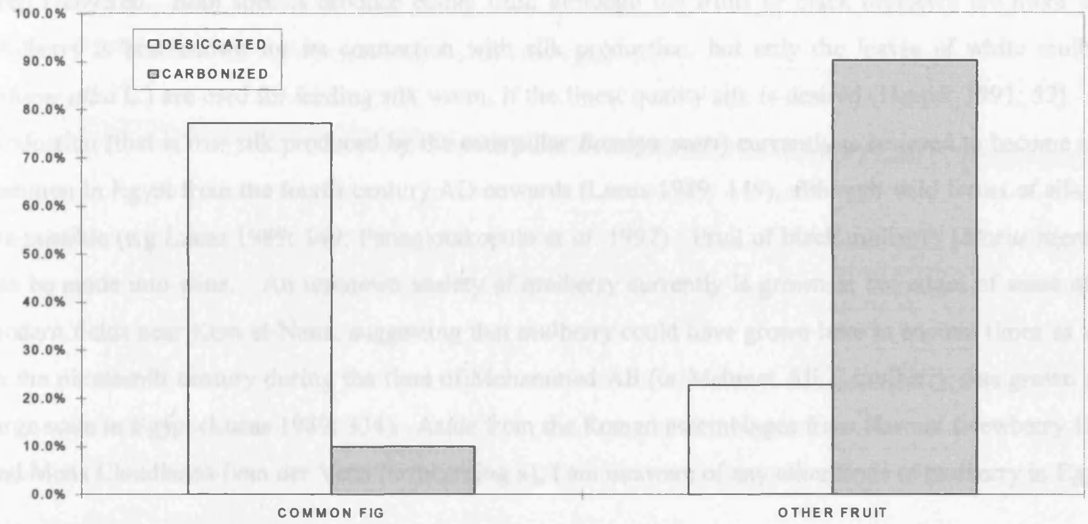
Although Strabo (*Geography* XVII: I, 35) suggests that olive orchards were restricted to the Arsinoite Nome (the Fayum) and more recent, nineteenth century authors suggest a limited distribution of olive trees in Egypt (Lucas 1989: 333-334); there is some evidence for olive trees outside of the Fayum. Both Theophrastus (*Enquiry into Plants* IV: 2, 7) and Pliny (*Natural History* XIII: 19) noted that olive trees also were grown in the Thebaid and a number of nineteenth and twentieth century commentators have noted olive trees elsewhere in Egypt, particularly in other oases (Lucas 1989: 333-334). Large quantities of olive leaf found on site suggest that olive was grown at the Kom el-Nana monastery.

All three oil crops have been found at other Graeco-Roman and Late Antique sites in Egypt (Barakat and Baum 1992; Bartlett 1933; Cappers 1996; El-Hadidi and Amer 1996; Hepper 1981; Newberry 1889; Rowley-Conwy 1989; Täckholm 1961; van der Veen 1996; Wetterstrom 1982; Willerding and Wolf 1991).

5.2.4 Fruit

A great deal of fruit has been recovered from the archaeobotanical samples, but these are overwhelmingly dominated by the seeds of common fig (*Ficus carica*). In the desiccated component, over 70% of all fruit plant identifications are common fig (Figure 5.2). With between 1000 to 2000 seeds per fruit, it is likely that this seed rich fruit may be unduly dominating many samples. In most cases, the number of fig seeds recovered from a flot is far less than 1000. Most notably, in the carbonized component common fig only account for 10% of all identifications of fruit.

Figure 5.2 Proportion of common fig (*Ficus carica* L.) and other fruits in the Kom el-Nana assemblage
(Total number of desiccated fruit identifications = 6997 and carbonized = 374)



Other fruits recovered include sycomore fig (*Ficus sycomorus*), mulberry (*Morus* sp.), peach (*Prunus persica*), Christ's thorn or '*nabq*' (*Zizyphus spina-christi*), melon or cucumber (*Cucumis* sp.), pomegranate (*Punica granatum*), grape pip and stalk (*Vitis vinifera*), olive stone and leaf (*Olea europaea*), Egyptian plum (*Cordia myxa*) and dates (*Phoenix dactylifera*), including date stones and other reproductive parts. All of these species have been found at other Graeco-Roman and Late Antique sites in Egypt (Barakat and Baum 1992, Bartlett 1933, Bonnet 1902 and 1905, Cappers 1996, El-Hadidi and Amer 1996; Hepper 1981; Newberry 1889 and 1890, Rowley-Conwy 1989, Täckholm 1961, van der Veen 1996; Wetterstrom 1981; Winlock and Crum 1973).

Fig, olive, grape, date, pomegranate and sycomore fig are believed to be some of the first fruit trees cultivated in the old world (Zohary and Hopf 1994: 135). Peach is a Ptolemaic introduction to Egypt (Crawford 1979: 140; Préaux 1947: 27) and has been found at several Graeco-Roman and Late Antique period sites in Egypt (Bartlett 1933; Cappers 1996; Täckholm 1961; Wetterstrom 1982). In addition to these introduced cultivars, some of the fruits found at Kom el-Nana are indigenous to Egypt, such as date and Christ's thorn.

Aside from serving as eating fruit, many of the fruit plants identified at Kom el-Nana have other economic uses. Fermented dates can be dry-pressed to make a liquid, sugary syrup, which is used as a sweetener (Nesbitt 1991: 32-33). Dates also can be used to make a wine (Lucas 1989: 23). Date palm wood can be used as a toothbrush (Boulos 1983: 140). Date palm frond and fiber are also used for basketry, matting and string (e.g. Lucas 1989: 128-133; Wendrich 1995).

The seeds of an unidentified species of mulberry (either black mulberry, *Morus nigra* L. or white mulberry, *Morus alba* L. - scanning electron microscopy is necessary to make the identification to species level) have been recovered. Both species produce edible fruit, although the fruits of black mulberry are more tasty. Mulberry is best known for its connection with silk production, but only the leaves of white mulberry (*Morus alba* L.) are used for feeding silk worm, if the finest quality silk is desired (Hepper 1991: 52). Silk production (that is true silk produced by the caterpillar *Bombyx mori*) currently is believed to become more common in Egypt from the fourth century AD onwards (Lucas 1989: 149), although wild forms of silk also are possible (e.g Lucas 1989: 149; Panagiotakopulu *et al.* 1997). Fruit of black mulberry (*Morus nigra* L.) can be made into wine. An unknown variety of mulberry currently is grown at the edges of some of the modern fields near Kom el-Nana, suggesting that mulberry could have grown here in ancient times as well. In the nineteenth century during the time of Mohammed Ali (or Mehmet Ali), mulberry was grown on a large scale in Egypt (Lucas 1989: 334). Aside from the Roman assemblages from Hawara (Newberry 1890) and Mons Claudianus (van der Veen forthcoming a), I am unaware of any other finds of mulberry in Egypt.

Christ's thorn (or '*nabq*' in Arabic) is believed to be indigenous to Egypt (Täckholm 1961: 25). It produces a small, cherry-sized fruit which has a sweet, apple-like taste. Christ's thorn is also an important source of timber in Egypt. Melon or cucumber (*Cucumis* sp.) is believed to have first been brought into cultivation in south-west Asia or Egypt (Zohary and Hopf 1994: 182), and has been found in a number of the Kom el-Nana samples.

Finally, a species known as 'Egyptian plum' or '*mokheit*' (*Cordia myxa*) also was recovered. Täckholm (1961: 29) believes that the tree is of Indian origin and has naturalized in the Mediterranean. When ripe, the slimy fruits can be used for bird liming - branches of a tree are covered with the pulped Egyptian plum which adheres to the feet of small birds, trapping them (Täckholm 1961: 29). Classical authors also mention Egyptian plum. Pliny (*Natural History* XIII.10) notes their use in "myxa wine," and Theophrastus (*Enquiry into Plants* IV.2.10) mentions their use for making cakes (cited in Lucas 1989: 23; see also Manniche 1993: 93; Täckholm 1961: 29)

5.2.5 Condiments

A variety of condiments or flavourings were found in many of the Kom el-Nana samples. Coriander (*Coriandrum sativum*), dill (*Anethum graveolens*), cumin (*Cuminum cyminum*), fennel (*Foeniculum vulgare*), celery (*Apium graveolens*), onion (*Allium cepa*) and possibly basil (cf. *Ocimum basilicum*) have all been identified. These condiments were primarily preserved in the desiccated component of the assemblage, with the exception of coriander which is also found in the carbonized component. Except for the possible identification of basil, all of the identified condiments have been found at other sites (Cappers 1996; El-Hadidi and Amer 1996; Hepper 1981; Newberry 1889 and 1890; van der Veen 1996; Wetterstrom 1982; Willerding and Wolf 1991). Many of these condiments are known to have been grown before classical times in the Mediterranean and Near East, but became well known in the Graeco-Roman period (Zohary and Hopf 1994: 188-189). Onion, in particular, is known archaeobotanically from Pre-Dynastic times in Egypt (Zohary and Hopf 1994: 185) and, although it should be strictly considered a vegetable, it is included with condiments here because its use in the preparation of food is for its flavour enhancing qualities. The skins of onions also are a useful dyestuff, producing dyes ranging in color from pinkish-brown, to yellow and bright orange (Cannon and Cannon 1994: 84-85). Cumin is grown primarily for its seed, but all parts of basil, celery, coriander, dill and fennel are edible as salad greens or vegetables. Coriander and dill leaf, in particularly, are used as flavourings in cooking (e.g. Norman 1991). Coriander also can act as an insecticide (Panagiotakopulu *et al.* 1995: 706).

The identification of basil must remain tentative as identification criteria are not well established and the comparative material available was limited. Basil is indigenous to India, but is now grown throughout the Mediterranean (Manniche 1993: 128). Manniche (1993: 128) makes reference to Pharaonic finds of basil, but does not cite the source.

5.2.6 Other economic plants

A number of species recovered could not be easily categorized. Carbonized and desiccated juniper berries were recovered from one of the floor samples (94-008). Juniper berries (*Juniperus* cf. *oxycedrus* or *J.* cf. *phoenicea*) have been found from Pre-Dynastic times onwards and are typically viewed as a constituent ingredient in the embalming process (Hepper 1990: 60; Täckholm 1961: 1-2). However, these berries can be used medicinally (Boulos 1983: 77-79; Manniche 1989: 110-112) and also make an excellent flavouring, especially with meat (e.g. recipes by Delia Smith 1995: 86-87).

Two opium poppy (*Papaver somniferum*) seeds have been recovered; one in midden sample 94-020 and one in pot slot sample 94-186. To my knowledge, these are the only archaeobotanical finds of opium poppy in Egypt. Although known as a drug plant, opium poppy can also be grown for its seed which produces an odourless and tasteless oil, which has no narcotic properties (Polunin and Huxley 1992: 75), that can be used as an adulterant to other, more expensive, oils. Papyrological records attest such a use of opium poppy in the Ptolemaic period (Crawford 1973). It is possible, however, that opium poppy also can be present as a weed of crop (e.g. G. Jones 1981: 107; Polunin and Huxley 1992: 75).

Almond is one of the most widely cultivated trees in the Mediterranean today, and was probably also an early cultivar (Zohary and Hopf 1994: 173). Almond also has been found at Roman period sites in Egypt (Newberry 1890; Cappers 1996; van der Veen 1996). In addition to eating raw, blanched or roasted almonds (*Amygdalus communis* L.), they also can be used for oil. Pliny (*Natural History* XIII: 2 and XV: 7) mentions the manufacture of the "Mendesian unguent" in Egypt, which contains the oil of "bitter almonds," but no other records of the production of almond oil are known in Egypt (Lucas 1989: 329).

A species of rue, most likely Aleppo or Syrian rue (*Ruta chalepensis*) has been identified. The desiccated seeds are brown and, therefore, common rue (*Ruta graveolens*) with its black seeds may be ruled out. Comparative material consulted at the Cairo Herbarium also had brown seeds with a rugose surface pattern, but because the seeds could not be directly compared this identification has had to remain tentative. Today *Ruta graveolens* is restricted to the European Mediterranean and Turkey (Polunin and Huxley 1992: 113), so it is likely that the 'rue' found at Kom el-Nana is not this species. *Ruta chalepensis*, however, is indigenous in the Mediterranean, Arabia and North Africa and can be used for a variety of medicinal and culinary purposes (Boulos 1983: 158; Jansen 1981).

Myrtle (*Myrtus communis*) is native to the Mediterranean and has been found at Graeco-Roman sites in Egypt (Barakat and Baum 1992: 63; Germer 1988: 19 - garland of Graeco-Roman mummy in Berlin Museum but exact provenance is not known, simply Fayum; Hepper 1981; Newberry 1889). The plant can be used as a condiment, in cosmetics and medicinally (Boulos 1983: 134-137; Manniche 1993: 124).

Bottle gourd (*Lagenaria siceraria*) has a variety of uses. Its seeds are edible, at an early stage in development the gourd can be eaten as a vegetable, and the dried bottle gourd can be fashioned into many useful items such as cups, bowls, ladles, and bottles (Bates *et al.* 1995: 107; Täckholm 1961: 32). One seed of carrot (*Daucus carota*) was recovered from midden sample 94-002. The size of seed compared favourably with modern cultivars of carrot and was roughly two to three times the size of reference material for weed / wild carrot. I am unaware of any other finds of carrot in Egypt.

Leaf and flower of tamarisk (*Tamarix aphylla*) have been identified. This species is indigenous to Egypt and can be found around Kom el-Nana, today. Tamarisk is an effective windbreak and is often used for hedges around fields. It can also be used to fix sand dunes (Baum 1978: 12). Many species of tamarisk secrete salt and can desalinize deeper soil layers while increasing the salinity of upper soil layers beneath the tree. *Tamarix aphylla* is also known to transpire significant amounts of water and, therefore, requires irrigation (Baum 1978: 13). Its wood is a good heating fuel and its leaves can be used as fodder (Baum 1978: 13). The leaves of *Tamarix aphylla* clearly bear salt crystals, and it may be that tamarix leaves fed to animals as fodder also serve to replace salts in livestock, of particular importance in arid regions.

Leaf, seed and pods of acacia (*Acacia nilotica*) or '*sant*' in Arabic also have been recovered. This species also is indigenous in Egypt. Acacia wood is a hard wood which has been used in building and boat making since Pharaonic times (Hepper 1990: 22-23). Acacia leaves, pods and beans also make a highly nutritious animal fodder (El-Hadidi and Boulos 1988: 32). Acacia gum, leaf and flowers are used in medicines, the bark is high in tannin and is used for preparation of leather and hides, and the pods produce a blue dye (Hepper 1990: 23; Manniche 1993: 65-67). Other species of acacia and tamarisk have also been found in Egypt (Barakat and Baum 1992; Germer 1985; Newberry 1889). Although there is no devoted report to the plant remains from the monastery at Esna, a reference to a find of *Acacia nilotica* pods within a pot in a kitchen in hermitage 5 was published in the pottery report (Sauneron and Jacquet 1972: Vol. III, 7).

5.3 Weed / Wild Plants

The weed / wild plant remains recovered from Kom el-Nana are one of the first such assemblages available for analysis in Egypt. In most cases, time constraints, sampling strategy or the preliminary nature of the research, mean that the weed / wild component of Egyptian archaeobotanical assemblages is often absent or simply unrecorded (e.g. Bartlett 1933; Cappers 1996; El-Hadidi and Amer 1996; Rowley-Conwy 1989; Täckholm 1961; van der Veen 1996). In some cases (*pers. comm.* René Cappers and Marijke van der Veen) this will be rectified in future publications, but most published research available neglects the weed / wild component of the assemblage. These species can provide useful information about the environment of a site, agricultural practice and utilization of wild resources. The weed / wild plants from Kom el-Nana account for 40% of the desiccated component and 29% of the carbonized component, respectively, and make a substantial contribution toward the characteristics of the overall assemblage.

5.3.1 Weed / wild plants of possible economic importance

Some of the weed / wild plants recovered also may be of economic importance. In particular, purslane (*Portulaca oleracea*), beet (*Beta vulgaris*) and endive or chicory (*Cichorium endivia / C. intybus*) could be viewed as weed / wild plants or economic plants. All three plants are used as 'greens' in the diet. The stems, leaves and flowers of purslane are all edible. New leaves are used as a salad green and have a sharp taste and older leaves require cooking (boiling or steaming) (Manniche 1993: 137). Purslane is a procumbant (lying close to the ground) plant with long tendrils. The growth of the plant is such that although flowers may not have bloomed at the growing tip, seed will already have developed lower down the tendril. This growing habit means that it is hard to avoid collecting seed when gathering purslane leaf (*pers. comm.* Delwen Samuel).

Beet can be grown for its leaf and swollen tap root. Ford-Lloyd (1995) suggests that prior to the sixteenth century, beets were used for their leaf, as a chard, and swollen tap roots were most likely a fodder crop. Langer and Hill (1991: 198 - no sources cited) note the presence of recipes using beetroot dating to the early Roman period. Although the taproot produces vibrant reds in combination with vinegar, beetroot will only produce "drab and dull fawn" dye colors on wool (Cannon and Cannon 1994: 21).

The leaves of either chicory or endive can be eaten raw or cooked as a vegetable. Langer and Hill (1991: 164) suggest that although chicory root can be processed as a substitute for coffee, in ancient times chicory was a salad vegetable. Pliny (*Natural History* XIX.39; XX.39; cf. also XXI.52) mentioned a wild form of chicory which grew alongside the cultivated form in Egypt (cited in Manniche 1993: 88).

Other weed / wild species, are not grown as crops but also can be collected for food. Parts of *Solanum nigrum* or black nightshade are edible. The leaves can be boiled and eaten as spinach and the berries can be eaten raw (Polunin and Huxley 1992: 165). Boulos (1966: 190) notes that the leaves of *Chenopodium murale* are eaten as a cooked green in Nubia. The leaves of a species of Pulicaria, *Pulicaria undulata* (L.) Kost., are used to make 'wild tea' (Osborn 1968: 165). Some species of *Medicago* and *Trifolium* can be cultivated as a green fodder (Boulos 1966: 204 and 206; Butler 1996). In addition, hand weeding of crops, commonly practiced in Egypt and elsewhere in the Mediterranean (e.g. Forbes forthcoming; Palmer 1994: 99), can result in the collection of many of these species as young or near-mature plants for use as animal fodder. The third century Heroninos archive does record that both vineyards and arable fields were regularly hoed, not only to prepare the soil for planting, but presumably to keep weeds under control as well (Rathbone 1991: 260-264).

5.4 Medicinal Plants

In Late Antiquity, many early monasteries in Egypt and elsewhere in the Mediterranean are associated with medicine and treatment of illnesses (Bagnall 1993a: 300; Cameron 1993: 165; Meyer 1965). There are a number of historical records for the treatment of the ill and the use of medicinal plants by monks in Egypt (i.e. Winlock and Crum 1973: 163-164). The identification of seed and other reproductive parts of a plants of possible medicinal importance does not necessarily confirm such medicinal use(s) of plants, however, the possibility should be considered. Many of the economic and weed / wild plants found in the Kom el-Nana assemblage do have medicinal uses. Table 5.1 summarizes some of the possible medicinal uses of the economic plants found in the Kom el-Nana assemblage.

In addition, many of the weed / wild species found at Kom el-Nana have medicinal uses (Boulos 1983). The entire plant of purslane (*Portulaca oleracea*) can treat dysentery, diarrhoea, and haemorrhoids; as well as expel intestinal worms. The root of *Vaccaria pyramidata* can be used to treat wounds, sores, scabies and other skin infections. In strong doses, the leaves and roots can cause paralysis. A decoction made from the leaves of *Cornulaca monocantha* is used to treat jaundice. *Zilla spinosa* is used to treat kidney stones. *Solanum nigrum* or black nightshade is toxic in large doses; the entire plant can be used as a calmative, to treat burns and other skin conditions and the berries are a narcotic and sedative, and act as an analgesic if used externally. Today, in North Africa, the seeds of black nightshade are considered an aphrodisiac. A tonic made from the leaves and root of *Cichorium intybus* can be used as a diuretic or laxative, and an infusion of the leaves aids digestion and stimulates bile secretion. A species of *Fumaria*, *Fumaria judaica* Boiss., can be used to treat jaundice, hepatic fever, scabies and dermatitis. A species of *Brassica*, *Brassica nigra* (L.) Koch, aside from having a culinary use as mustard, can be used medicinally as a laxative, a diuretic and to reduce fever. Two species of *Malva*, *Malva parviflora* L. and *Malva sylvestris* L. have medicinal uses. An infusion of *Malva parviflora* can be used as a gargle and for gastro-intestinal ailments. Leaves and flowers of *Malva sylvestris* are a mild astringent, and in large doses act as a laxative.

Table 5.1 Examples of possible medicinal uses for the economic plants found at Kom el-Nana

COMMON NAME	LATIN BINOMIAL	DIABETES	DIARRHOEA	DIURETIC	EYES	LAXATIVE	PAIN RELIEF	PARASITES	RESPIRATORY	SKIN	STIMULANT	STOMACH
White Lupin	*Lupinus albus* L.	✓						✓				
Linseed / Flax	*Linum usitatissimum* L.					✓	✓					
Common fig	*Ficus carica* L.			✓	✓	✓						
White Mulberry	*Morus alba* L.			✓								
Christ's thorn or 'nabq'	*Zizyphus spina-christi* (L.) Desf.					✓						
Melon	*Cucumis melo* L.							✓				
Bottle gourd	*Lagenaria siceraria* (Mol.) Standl.			✓								
Pomegranate	*Punica granatum* L.			✓				✓				
Olive	*Olea europaea* L.		✓									
Date	*Phoenix dactylifera L.*		✓		✓							
Coriander	*Coriandrum sativum* L.			✓	✓						✓	✓
Dill	*Anethum graveolens* L.			✓							✓	✓
Cumin	*Cuminum cyminum* L.			✓							✓	✓
Fennel	*Foeniculum vulgare* (L.) Mill			✓	✓			✓			✓	✓
Celery	*Apium graveolens* L.			✓			✓					✓
Basil	*Ocimum basilicum* L.		✓	✓						✓	✓	✓
Onion	*Allium cepa* L.			✓								
Juniper	*Juniperus oxycedrus* L.			✓				✓		✓	✓	
Juniper	*Juniperus phoenicea* L.		✓			✓				✓		
Opium poppy	*Papaver somniferum* L.		✓				✓				✓	
Acacia	*Acacia nilotica* L.	✓	✓							✓		
Aleppo rue or Syrian rue	*Ruta chalepensis* L.						✓					
Tamarisk	*Tamarix aphylla* L.							✓				
Carrot	*Daucus carota* L.			✓								
Myrtle	*Myrtus communis* L.				✓		✓		✓		✓	✓

Source: Boulos (1983)

An infusion of leaves and flowers can be used to treat coughs and diarrhoea. The dried, powdered leaves of a species of *Heliotropium*, *Heliotropium bacciferum* Forssk., are used to make a plaster to treat abscesses, boils, and sprains. A poultice made from the leaves of a species of *Asphodelus*, *Asphodelus aestivus* Brot., treats rheumatism and the fruits of the plant are used to treat earache and toothache. Two species of *Lolium*, *Lolium perenne* L. and *Lolium temelentum* L. have medicinal properties. An influsion made from *Lolium perenne* and wine is used to stop diarrhoea and hemorrhage. Mature caryopses (grass seeds) of *Lolium temulentum* are used to treat neuralgia, rheumatism, arthritis, nausea, and intestinal cramps. A species of *Avena, Avena sativa* L., is a diuretic, laxative and calmative. A poultice made from fresh flowering *Avena sativa* is used to treat arthritis, rheumatism, paralysis, liver infection and skin disease. The tubers of two species of *Cyperus, Cyperus esculentus* L. and *Cyperus rotundus* L. have medicinal properties. Aside from being edible, the tubers of *Cyperus esculentus* are an aphrodisiac, increase the secretion of milk, and soothe inflamed or irritated skin. The tubercles of *Cyperus rotundus* can be used to treat dyspepsia and diarrhoea. It also can be used as a stimulant, a condiment and an aphrodisiac.

5.5 Comparing the Kom el-Nana Economic Plants with Other Egyptian Sites

Table 5.2 presents the Kom el-Nana economic plants as well as all published archaeobotanical finds of economic plants in Egypt dating between 332 BC and AD 1000. Figure 5.3 shows the location of all of these sites and also includes the location of the Roman / Late Antique period sites of Kellis and Mons Porphyrites where current archaeobotanical work is underway (*pers. comm.* Ursula Thanheiser and Marijke van der Veen). The plants are categorized by type (i.e. cereals, legumes, oil crops, etc.) and are arranged in alphabetical order by common name within each classification. In addition, the fruits are divided into Mediterranean / Near Eastern crop complex (i.e. plants already cultivated in this region prior to 332 BC) and North African crop complex following Zohary and Hopf (1994) and van Zeist and Bakker-Heeres (1985). Many of the archaeobotanical reports used to create Table 5.2 are not quantified, and often are derived from haphazard sampling during excavation, so comparison between sites is only made on the general level of presence. In addition, no attempt has been made to revise or alter identifications published in these reports.

The most notable result from this table, is that the majority of crops known in Late Antiquity were also grown, and in a few cases imported (i.e. juniper berry), in the preceding Ptolemaic and Roman periods. Two interesting results concern Mediterranean fruits and nuts, which are found at a number of Graeco / Roman and Late Antique sites, but are not found at some Late Antique and Early Islamic sites. In the case of nuts, this may indicates a loss of trade connections with producers outside of Egypt. The absence of Mediterranean fruits from the Islamic period sites, however, may be unduly influenced by the isolated location of the two Islamic sites of Quseir al-Qadim (Wetterstrom 1982) on the Red Sea coast, and Qasr Ibrim (Rowley-Conwy 1989) in Egyptian Nubia, near Aswan. These locations would not support cultivation of such Mediterranean / Near Eastern fruits and possibly nuts and, therefore, these crops could only arrive at these sites through trade connections. So few, well sampled sites are available for the Late Antique and Early Islamic period that no definitive conclusion can be made at present; however, this question is worth considering at future excavations of Late Antique and Early Islamic sites.

In total, thirty-five economic plants have been identified in the Kom el-Nana assemblage. Four new archaeobotanical finds in Egypt have been made at Kom el-Nana; namely opium poppy, Aleppo rue, carrot and possibly basil. In terms of the range of plant types identified, the Kom el-Nana assemblage included all

Table 5.2 Archaeobotanical finds of economic plants in Egypt (332BC - AD 1000).

COMMON NAME	LATIN BINOMIAL	Kom el-Nana	PTOL	PTOL / ROMAN	ROMAN	ROMAN / LATE ANTIQUE	LATE ANTIQUE	ISLAMIC to AD 1000
CEREALS								
Barley - hulled, six-row barley	*Hordeum vulgare* L.	✓	1	5	6, 7	9, 10, 11	12, 14	6, 11
Barley - unknown variety	*Hordeum* sp.			2, 4		8	13	
Common millet / broomcorn millet	*Panicum miliaceum* L.					11		
Pearl millet	*Pennisetum typhoides* Stapf et Hubbard					11		11
Rice	*Oryza sativa* L.					9		
Sorghum	*Sorghum bicolor* (L.) Moench	✓				cf. 8, 9, 11		6, 11
Sorghum - race durra	*Sorghum bicolor* (L.) Moench race *durra*							11
Wheat - emmer wheat	*Triticum dicoccum* Schübl.		1	5		11		11
Wheat - free threshing	*Triticum aestivum* L. / *T. durum* Desf.	✓	1	2, 5	6	cf. 8, 9, 11	cf. 12, 14	6, 11
Wheat - hard wheat	*Triticum durum* L.	✓			7	10		
PULSES / LEGUMES								
Acacia	*Acacia nilotica* L.	✓	1	4, 5			13	6
Acacia	*Acacia arabica* (Lam.) Willd.			2		10		
Bersim	*Trifolium alexandrinum* L.			2				
Bitter vetch	*Vicia ervilia* (L.) Wild.		cf. 1		6	9		
Carob	*Ceratonia siliqua* L.		1	2			12, 14	
Chickpea	*Cicer arietinum* L.			2	6, 7		14	6
Clover	*Trifolium* sp.	✓						
Cow pea	*Vigna unguiculata* (L.) Walp.							11
Fava bean or broad bean	*Vicia faba* L.			2	6, 7		13, 14	6
Fenugreek	*Trigonella foenum-graecum* L.						13	6
Field pea	*Pisum arvense* L.			2				
Garden pea	*Pisum sativum* L.			2	7	11		11
Grass pea	*Lathyrus sativus* L.			2				
Lentil	*Lens culinaris* Medik.	✓		2, 5	6, 7	9, 10, 11	12	6, 11
Sesbania	*Sesbania sesban* (L.) Merrill			3		8		
Vetchling (unkown species)	*Lathyrus* sp.	✓				8	12	
White lupin or termis	*Lupinus alba* L.	✓		2	7	8, 9, 10, 11	12, 14	11

Table 5.2 continued…

COMMON NAME	LATIN BINOMIAL	Kom el-Nana	PTOL	PTOL / ROMAN	ROMAN	ROMAN / LATE ANTIQUE	LATE ANTIQUE	ISLAMIC to AD 1000
OIL CROPS								
Ben-oil tree / horseradish tree	*Moringa peregrina* Fiori			2		11		11
Castor bean	*Ricinis communis* L.		1	5		11	13	11
Linseed / flax	*Linum usitatissimum* L.	✓	1	4, 5	6, 7	8, 9, 10, 11		6, 11
Radish	*Raphanus* sp.					10	12, 14	
Safflower	*Carthamus tinctorius* L.	✓		5	6, 7	8	12	6
Sesame	*Sesamum indicum* L.		1	5		11		11
CONDIMENTS								
Basil	*Ocimum basilicum* L.	cf. ✓						
Bay tree	*Laurus nobilis* L.			2				
Black cumin or nigella	*Nigella sativa* L.				7			
Celery	*Apium graveoles* L.	✓			7			
Coconut	*Cocos nucifera* L.					9		6
Coriander	*Coriandrum sativum* L.	✓	1	2, 5	6, 7	9, 11	14	6, 11
Cumin	*Cuminum cyminum* L.	✓			7			
Dill	*Anethum graveolens* L.	✓		5	7			
Fennel	*Foeniculum vulgare* (L.) Mill	✓			7			
Garlic	*Allium sativum* L.			4	7	11	14	6, 11
Marjoram	*Majorana hortensis* Moench.			2, 3		8		
Onion	*Allium cepa* L.	✓		2	7	11	13, 14	11
Pepper	*Piper nigrum* L.					9		6
Rosemary	*Rosmarinus officinalis* L.			3		8		

Table 5.2 continued...

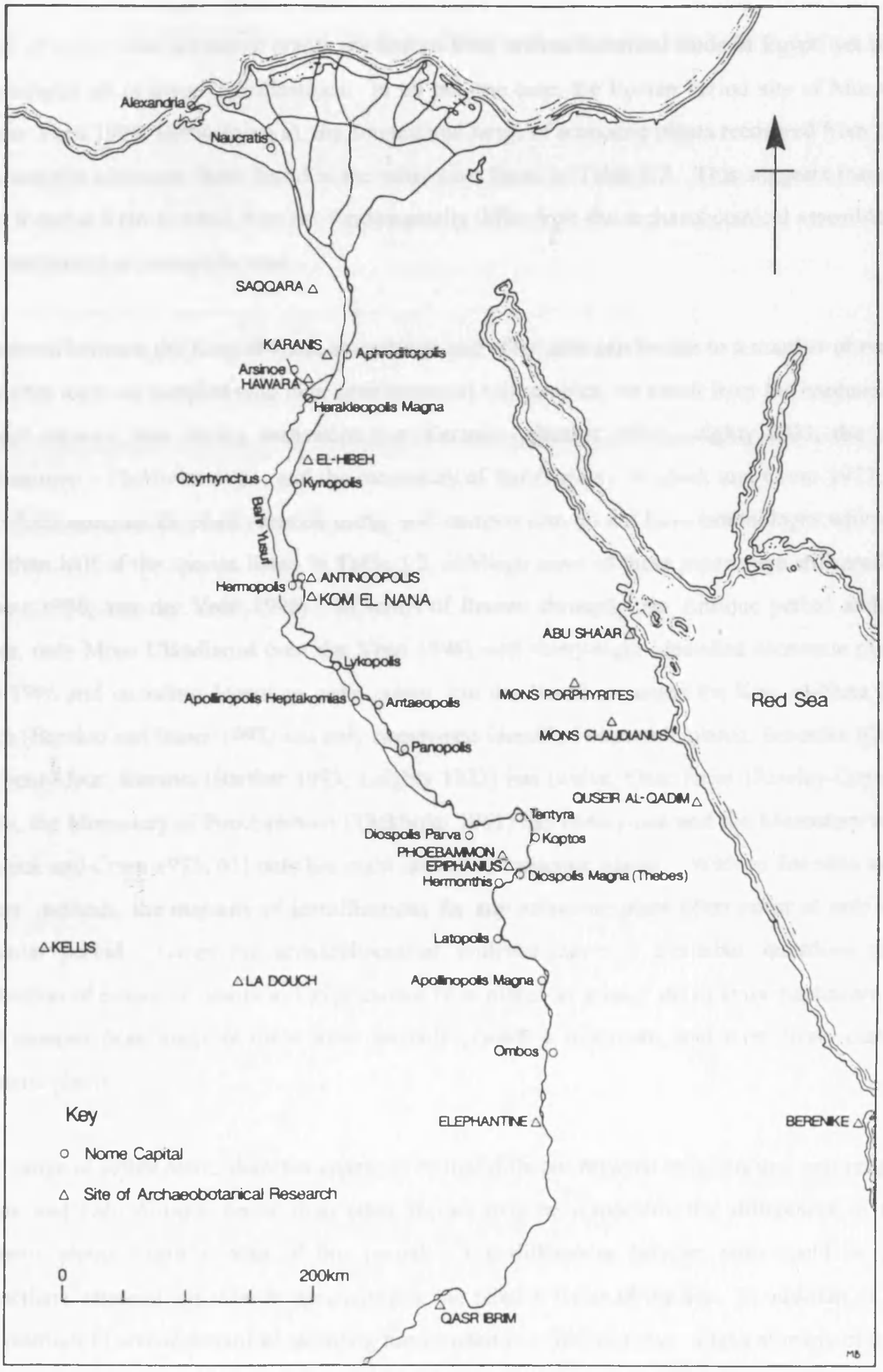
COMMON NAME	LATIN BINOMIAL	Kom el-Nana	PTOL	PTOL / ROMAN	ROMAN	ROMAN / LATE ANTIQUE	LATE ANTIQUE	ISLAMIC to AD 1000
MEDITERRANEAN / NEAR	**EASTERN FRUIT**							
Apricot	*Armeniaca vulgaris* Lam.			4				
Citron	*Citrus medica* L.			3	7		12	
Crab apple	*Malus sylvestris* (L.) Mill					8		
Fig (common fig)	*Ficus carica* L.	✓		5		10	12	
Grape	*Vitis vinifera* L.	✓		2, 3, 5	6, 7	8, 9	12, 14	6
Mulberry	*Morus* sp.	✓*		2				
Olive	*Olea europaea* L.	✓	1	2, 3, 4	6, 7	8, 9, 10	12	
Peach	*Prunus persica* (L.) Batsch	✓	1	2	6	9, 10	12	6
Pear	*Pyrus communis* L.			2				
Plum (or prune)	*Prunus domestica* L.			3				
Pomegranate	*Punica granatum* L.	✓		2, 4	7	8	14	
Quince	*Cydonia vulgaris* L.					10		
NORTH AFRICAN FRUIT								
Bitter apple (sometimes watermelon)	*Citrullus colocynthus* (L.) Schrad.			5	6, 7		12	6
Christ's thorn or '*nabq*'	*Zizyphus spina-christi* (L.) Desf.	✓	1	2	6, 7	9	12	6
Cucumber / melon	*Cucumis sativus* L. / *Cucumis melo* L.	✓		2, 5	7	8, 11		11
Date palm	*Phoenix dactylifera* L.	✓	1	2, 3, 4, 5	6, 7	8, 9, 10, 11	12, 14	6, 11
Doum palm	*Hyphaene thebaica* (L.) Mart		1	2, 4, 5	6, 7	8, 9, 11	12, 13	6, 11
Egyptian plum or sebesten	*Cordia myxa* L.	✓	1	2, 4	6, 7		12	
False balsam or sugar date	*Balanites aegyptiaca* (L.) Delile		1	2, 4		8, 9, 11	12, 13	
Persea	*Mimusops schimperi* Hochst.		1	2, 3, 4		8	12	
Sycomore fig	*Ficus sycomorus* L.	✓	1	2, 4, 5		8, cf. 11		cf. 11
Watermelon	*Citrulllus lanatus* (Thunb.) Mats. & Nakai		1	5	7	9, 11	12	11
NUTS								
Almond	*Amygdalus communis* L.	✓		2	7	9		
Hazelnut	*Coryllus avellana* L.			2, 4	6, 7	9, 10		
Pistachio	*Pistacia vera* L.					10		
Stone pine or umbrella pine	*Pinus pinea* L.		1	2	6, 7	9, 10		
Sweet chestnut	*Castanea sativa* L.			4				
Walnut	*Juglans regia* L.			2	6, 7	9, 10		

COMMON NAME	LATIN BINOMIAL	Kom el-Nana	PTOL	PTOL / ROMAN	ROMAN	ROMAN / LATE ANTIQUE	LATE ANTIQUE	ISLAMIC to AD 1000
VEGETABLES								
Beat root	*Beta vulgaris* L.	✓					12	
Bottle gourd	*Lagenaria siceraria* (Mol.) Stand.	✓		2, 5		8	12	
Cabbage	*Brassica oleracea* L.			2				
Carrot	*Daucus carota* L.	✓						
Cress	*Lepidium sativum* L.			5	7			
Globe artichoke	*Cynara scolymus* L.				cf. 7			
OTHER ECONOMIC PLANTS								
Aleppo rue or Syrian rue	*Ruta chalapensis* L.	cf. ✓						
Cork oak	*Quercus suber* L.			2				
Cotton	*Gossypium* sp.					11		11
Henna	*Lawsonia inermis* L.			2		8		
Job's tears	*Coix lacryma-jobi* L.					9		
Juniper	*Juniperus oxycedrus* L. / *J. phoenicea* L.	✓		2			12, 13	
Myrtle	*Myrtus communis* L.	✓		2, 4		8		
Opium poppy	*Papaver somniferum* L.	✓						
Papyrus	*Cyperus papyrus* L.			2, 3, 4				
Tamarisk	*Tamarix* sp.					8		
Tamarisk	*Tamarix aphylla* L.	✓						
Tamarisk	*Tamarix nilotica* L.			2				
Tiger nut	*Cyperus esculentus* L.			4				

* Mulberry has also been found at Mons Claudianus (Site 7) (*pers. comm.* Marijke van der Veen)

KEY TO SITE CODES: Ptolemaic Sites: 1. El-Hibeh (Wetterstrom 1984) **Ptolemaic / Roman Sites:** 2. Hawara (Newberry 1889 and 1890); 3. Antinoopolis (Bonnet 1902 and 1905); 4. Saqqara (Hepper 1981); and 5. Elephantine (Willerding and Wolf 1991) **Roman Sites:** 6. Quseir al-Qadim (Wetterstrom 1982) and 7. Mons Claudianus (van der Veen 1996) **Roman / Late Antique Sites:** 8. La Douch (Barakat and Baum 1991); 9. Berenike (Cappers 1996); 10. Karanis (Bartlett 1933 and Leighty 1933); and 11. Qasr Ibrim (Rowley-Conwy 1989) **Late Antique Sites:** 12. Monastery of Phoebammon (Täckholm 1961); 13. Monastery of Epiphanius (Winlock and Crum 1973: 61); and 14. Abu Sha'ar (El-Hadidi and Amer 1996 and El-Hadidi and El-Fayoumi 1996) **Islamic Sites:** 6. Quseir al-Qadim (Wetterstrom 1982) and 11. Qasr Ibrim (Rowley-Conwy 1989)

Figure 5.3 Location map of sites dating between 332 BC and AD 1000 where archaeobotanical research has taken place in Egypt. Figure also includes location of Kellis and Mons Porphyrites where forthcoming work is expected (*pers. comm*. Ursula Thanheiser and Marijke van der Veen).



plant classification groups. In addition, with the exception of the new crop identifications made in the Kom el-Nana assemblage, the vast majority of crops found at Kom el-Nana are known from sites dating to the preceding Graeco-Roman period. One notable exception is sorghum, which appears to be first introduced into Egypt in the early centuries of the first millennium AD (Cappers 1996; Rowley-Conwy 1989, 1991).

A total of eighty-nine economic plants are known from archaeobotanical finds in Egypt, yet no single site has produced all of these identifications. In all but one case, the Roman period site of Mons Claudianus (van der Veen 1996; forthcoming a), the amount and range of economic plants recovered from the Kom el-Nana samples surpasses those found at the other sites listed in Table 5.2. This suggests that the range of plants found at Kom el-Nana does not fundamentally differ from the archaeobotanical assemblages found at other settlement or necropolis sites.

Differences between the Kom el-Nana assemblage and other sites can be due to a number of reasons. First, many sites were not sampled with bulk environmental soil samples, but result from the haphazard collection of plant remains seen during excavation (i.e. Karanis - Bartlett 1933; Leighty 1933, the monastery of Phoebammon - Täckholm 1961, and the monastery of Epiphanius - Winlock and Crum 1973: 61). Those sites which sampled for plant remains using soil samples also do not have assemblages which account for more than half of the species listed in Table 5.2, although some of these reports are still preliminary (e.g. Cappers 1996; van der Veen 1996). In terms of Roman through Late Antique period archaeobotanical studies, only Mons Claudianus (van der Veen 1996) with thirty-eight identified economic plants (van der Veen 1996 and including *Morus* sp. *pers. comm.* van der Veen) surpasses the Kom el-Nana findings. La Douch (Barakat and Baum 1992) has only twenty-one identified economic plants, Berenike (Cappers 1996) has twenty-four, Karanis (Bartlett 1933; Leighty 1933) has twelve, Qasr Ibrim (Rowley-Conwy 1989) has twenty, the Monastery of Phoebammon (Täckholm 1961) has twenty-one and the Monastery of Epiphanius (Winlock and Crum 1973: 61) only has eight identified economic plants. With so few sites sampled using modern methods, the majority of identifications for any economic plant often occur at only one site in a particular period. Given the archaeobotanical evidence currently available, questions regarding the distribution of economic plants in Egypt cannot be explored in greater detail since haphazard sampling of plant remains from many of these sites can only provide a minimum, and most likely biased, range of economic plants.

If the range of edible plants does not appear to be that different between religious and non-religious sites in Roman and Late Antique times, than other factors may be responsible for differences in the range of economic plants found at sites of this period. The differences between sites could be due to trade connections, regional variation in agriculture or the relative status of the site. In addition, it is likely that poor methods of archaeobotanical sampling has resulted in a limited range of taxa at many of the sites listed in Table 5.2. Only two settlement sites, dating to the Ptolemaic period (Wetterstrom 1982; 1984) and only one necropolis dating to the Roman / Late Antique period (Barakat and Baum 1992) have been fully quantified. Other Roman and Late Antique period archaeobotanical assemblages such as Berenike (Cappers

1996) or Mons Claudianus (van der Veen 1996) are still at a preliminary stage and further economic plants may be reported. Nevertheless, this basic comparison has demonstrated that the range of economic plants at Kom el-Nana rivals or surpasses those from other, Post-Pharaonic sites in Egypt. The implications of this result for monastic diet will be explored in more detail in Chapter 9.

5.6 Conclusions

A wide range of crops and useful weed / wild plants were recovered from the Kom el-Nana samples. The overall assemblage has abundant remains of cereal chaff, fruit and weed / wild plants, although many other types of economic plants (i.e. oil crops and condiments) also were present. This study has generated four new identifications of economic plants in Egypt; namely opium poppy, Aleppo rue, carrot, and possibly basil. Many of the plants recovered have other uses aside from human food. It also is of interest that many of the plants identified have possible medicinal use(s), especially since monasteries in this period are known to have had some medical expertise. The archaeobotanical assemblage from Kom el-Nana contains a wider range of economic plants than many other archaeobotanical assemblages, particularly from other Roman and Late Antique period sites. This result may be due to the use of fairly haphazard methods of collecting plant remains at these archaeological sites; however, it strongly suggests that historical descriptions of the use of only a limited range of edible plants at monasteries may not be accurate.

Chapter 6. Evidence for Agricultural Practice at Kom el-Nana

The previous chapter established what plants were present at Kom el-Nana and how they might have been used. The archaeobotanical evidence also can provide many details about agricultural practice. This chapter explores the direct archaeobotanical evidence for agricultural practice. In particular, evidence about the agricultural setting, crop processing, and harvesting height will be considered here.

6.1 Producer or Consumer?

Many archaeobotanical studies attempt to determine whether a site operated as a producer or consumer (e.g. M. K. Jones 1985; van der Veen 1992a). In archaeobotany, this question actually is extremely limited and only considers whether a site produced cereals or consumed them. So even if a site has evidence for imported pottery or crops (i.e. crops which cannot grow in the region and could only arrive on site through trade), this has no bearing on the 'classic' archaeobotanical definition of producer or consumer sites (e.g. van der Veen 1991: 349 and 352).

Two archaeobotanical methods have been used to identify a producer or consumer site. Based on his ethnographic research in Turkey, Hillman (1981: 142) suggests the presence of cereal chaff from any stage in the crop processing sequence will indicate a producer site of free threshing wheat. Hulled wheat (such as emmer - *Triticum dicoccum* Shübl) has a slightly different processing sequence from free threshing wheats (e.g. Hillman 1981, 1984a, 1985; G. Jones 1984) and Hillman (1981: 142) suggests that whole spikelets of hulled wheats, such as emmer, can be found at consumer sites.[1] Based on this model, a producer site would have considerably more cereal chaff than grain, and consumer sites would have an abundance of grain. Van der Veen (1991: 352) suggests that the identification of producer or consumer sites using this model can be achieved by examining "the ratio of wheat grains to glumes; the quantities of cereal grain found; the ratio of barley rachis internodes to barley grains; and the presence of straw nodes."

The second method for the identification of producer and consumer sites draws on the ratio of cereal grain: cereal chaff: weeds (M. K. Jones 1985). M. K. Jones (1985) studied the plant remains from a series of Iron Age sites on the first and second terraces of the river Thames in England. The entomological evidence (Robinson 1981; 1983) from waterlogged deposits in ditches around the sites clearly established that the sites on the second terrace were surrounded by arable land and sites of the first terrace were surrounded by open pasture. Analysis of the ratio of cereal grain: cereal chaff: weeds established that cereal grains were found in the largest concentrations at sites surrounded by arable land and sites with the greatest amount of

[1]Initially Hillman (1981: 142) suggested that storage of complete spikelets of hulled wheat only occurred in wet climates. However, archaeobotanical evidence from Assiros Toumba in Greece (G. Jones *et al.* 1986) and from Egypt (Nesbitt and Samuel 1996: 51; Murray forthcoming a) strongly suggests that the hulled wheats also were stored in their spikelets in dry climates. In terms of Late Antique period Egyptian sites, free threshing wheat replaced hulled wheats (see Chapter 2 §2.4.2), so according to Hillman's model (1981) any large quantities of free threshing wheat chaff would indicate a producer site.

cereal chaff were surrounded by open pasture (M. K. Jones 1985: 118-119). As a result of this study, M. K. Jones (1985: 120) suggested that cereal producer sites would have an abundance of cereal grain, the exact opposite of what Hillman (1981) suggested.

These approaches to the identification of producer / consumer sites are recognized to have certain flaws in Iron Age Britain (van der Veen 1991; 1992a: 94-99). In particular the first model only relies on the presence of cereal straw and rachis internodes without specifying "how many of these elements are required" (van der Veen 1991: 358). In addition, van der Veen (1991: 358) has also noted that absence of cereal straw nodes is not sufficient evidence to identify a site as a consumer of cereal crops. As van der Veen (1985: 359) notes, the second model assumes that samples collected from a site are representative of the site as a whole and it also is dependent on other forms of archaeological or historical evidence about the site(s) (in this case archaeo-entomological evidence).

One point which is not discussed by van der Veen (1991) in regard to the second model, is that the sites on the first terrace of the Thames which are used by M. K. Jones (1985) in his study were involved in raising cattle and the buildings were probably constructed of wattle-and-daub walls and thatch roofing. Is it possible that these chaff rich sites were biased by the activities occurring in the vicinity (i.e. stock rearing which may use straw as livestock feed or bedding) and the building materials of the site (for the archaeological implications of the presence of straw in thatch see Letts 1996)? Given the building materials and the agricultural activities occurring at the sites on the first terrace of the Thames, it may not be surprising that cereal chaff is the most abundant remain of cereal crops at these sites. This suggests that in addition to relying on other forms of archaeological data (van der Veen 1991: 359), the possible building materials and agricultural activities (i.e. stock rearing, farming, etc...) of a site should also be taken into account when defining sites as cereal producers or consumers whether the Hillman (1981) or M.K. Jones (1985) models are employed or not.

In addition to the reasons set out by van der Veen (1991), there is a great deal of historical evidence in Egypt to suggest that such models are not applicable in this period of Egypt's history. For example, in Egyptian Late Antiquity cereal straw and chaff were saleable commodities (e.g. Bagnall 1993a: 41 and 224), and grain does not necessarily remain at the producer site, either for threshing, storage, or milling (e.g. Bagnall 1993a: 79 and 133; Rowlandson 1996: 189). Historical and literary sources from monasteries also demonstrate that monasteries could receive donations of food and crops (Johnson and West 1967: 253-254; Rea 1988: 118-119) or agricultural lands (Bagnall 1993a: 289-293; Hardy 1968: 44-46; Johnson and West 1967: 69-71; Rousseau 1985; Wipszycka 1972), and that monks also worked in fields and gardens (*Apophthegmata Patrum* - Isaac, Priest of the Cells: 3 and 7, trans. Ward 1983: 100; *Lausiac History* 32.12 trans. Meyer 1965: 94-95). These well established historical facts mean that the presence of chaff, straw, or grain at a site could be the result of either purchase or direct cultivation. As a result, use of any model to identify producer or consumer sites is not appropriate at Kom el-Nana or any other Late Antique Egyptian site. However, examination of what proportion of the assemblage is cereal chaff or grain is worthwhile, as this can provide information on the agricultural practice and / or activities of a site (see below in §6.5.3).

6.2 The Economic Plants and the Agricultural Setting

In total thirty-four economic plants were identified in the Kom el-Nana samples. Table 6.1 lists the economic plants found at Kom el-Nana and their most likely cultivation regime in Egypt. These included

Table 6.1 Economic plants found at Kom el-Nana and their cultivation method

Common Name	Latin Binomial	Cultivation method(s)		
		Arable	Orchard / Garden	Hedging
CEREALS				
Free threshing wheat	mainly *Triticum durum* Desf.	✓		
Barley	*Hordeum vulgare* L.	✓		
Sorghum	*Sorghum bicolor* (L.) Moench variety unknown	✓		
PULSES				
Lupin or 'termis'	*Lupinus* cf. *albus* L.	✓		
Lentil	*Lens culinaris* Medik.	✓		
Vetchling	*Lathyrus* sp.	✓		
OIL CROPS				
Linseed / Flax	*Linum usitatissimum* L.	✓		
Safflower	*Carthamus tinctorius* L.	✓		
FRUIT				
Common fig	*Ficus carica* L.		✓	✓
Sycomore fig	*Ficus sycomorus* L.		✓	✓
Mulberry	*Morus* sp.		✓	✓
Almond	*Amygdalus communis* L.		✓	✓
Peach	*Prunus persica* (L.) Batsch		✓	✓
Christ's thorn or '*nabq*'	*Zizyphus spina-christi* (L.) Desf.		✓	✓
Melon or cucumber	*Cucumis* sp.		✓	
Bottle gourd	*Lagenaria siceraria* (Mol.) Standl.		✓	
Pomegranate	*Punica granatum* L.		✓	✓
Grape	*Vitis vinifera* L.		✓	
Olive	*Olea europaea* L.		✓	
Egyptian plum or '*mokheit*'	*Cordia myxa* L.		✓	✓
Date	*Phoenix dactylifera* L.		✓	✓
CONDIMENTS				
Coriander	*Coriandrum sativum* L.		✓	
Celery	*Apium graveolens* L.		✓	
Cumin	*Cuminum cyminum* L.		✓	
Dill	*Anethum graveolens* L.		✓	
Fennel	*Foeniculum vulgare* (L.) Mill		✓	
? Basil	cf. *Ocimum basilicum* L.		✓	
Onion	*Allium cepa* L.	✓	✓	
OTHER ECONOMIC PLANTS				
Juniper *	*Juniperus* cf. *oxycedrus* L. / *phoenicea* L.			
Opium poppy	*Papaver somniferum* L.	✓	✓	
Acacia or '*sant*'	*Acacia nilotica* (L.) Willd. ex Del.			✓
Aleppo rue or Syrian rue	*Ruta* cf. *chalepensis* L.		✓	
Tamarisk	*Tamarix aphylla* (L.) Karst.			✓
Carrot	*Daucus carota* L.		✓	
Myrtle	*Myrtus communis* L.		✓	✓

* indicates definite import into the Nile Valley (Hepper 1990: 60; Lucas 1994: 437; Täckholm 1974: 50).

both arable and garden / orchard crops. Classification of crops as arable is based on historical evidence (Crawford 1971, 1973a, 1973b; Bagnall 1993a; Rathbone 1991; Rowlandson 1996), except for sorghum. Since other cereals in the period are cultivated in arable fields, this is likely to be the case for sorghum as well. Sorghum was found in only one deposit (Trough sample 94-177) at Kom el-Nana. Based on this current archaeobotanical evidence, it is not possible to determine if sorghum was imported to the monastery, or cultivated in the local area. Date, olive, and grape are well documented as orchard crops in historical sources, and have been classified as such. Other tree fruits are also likely to be cultivated in this way. In addition, it is possible that trees or shrubs can be grown around the edges of arable fields or garden / orchard plots. This type of hedge planting is commonly seen around field systems today in Egypt.

The term for garden and orchard was interchangeable in Roman / Late Antique Egypt (e.g. Rathbone 1991: 16; Rowlandson 1996: 24), but clearly refered to any area set aside for at least fruit trees and vines. The main technical difference between these two types of agricultural land is that orchards were subject to taxation and gardens were largely unregulated in Late Antique Egypt (Bagnall 1993a: 115-116; Rathbone 1991: 16). Orchards and gardens cannot be located on lands which are regularly inundated (e.g. Rathbone 1991: 249-251 for artificial irrigation of vineyards), and so would have been located above the flood plain, forming a separate agricultural zone from arable fields, which are located within the flood plain. The presence of both arable and garden / orchard crops at Kom el-Nana means both zones were utilized by this site.

If orchard and arable land were subject to taxation but gardens were unregulated, it seems reasonable to assume that the majority of unattested crops were grown on a small scale (i.e. in a garden or as hedging around fields) since they are absent from taxation and other documentary records. Based on this assumption, it is possible speculate how the economic plants recovered at Kom el-Nana might have been grown. The hypothetical classification of Kom el-Nana's economic plants into cultivation regimes is presented in Table 6.1.

Although arable crops do have a significant role at Kom el-Nana, the majority of crops identified are known to / or likely to occur in orchards or gardens. This reflects the importance of fruits and condiments in the diet of the occupants of this particular monastery, but these results also may be influenced by crops from the garden or orchard located immediately on site. Although the Kom el-Nana assemblage may be biased toward garden / orchard plants, archaeobotanical evidence from other Roman and Late Antique Egyptian sites (see Chapter 5, Table 5.1) does confirm that many fruits and condiments were of general importance in the Roman and Late Antique Egyptian agricultural economy and diet, despite their rare occurrence in the documentary record (Bagnall 1993a: 25-33; Rowlandson 1996: 24-25).

6.3 Weed Ecology and the Agricultural Setting

Modern studies of weed communities are often used in analogy with ancient weed assemblages (e.g. G. Jones 1992a; van der Veen 1992a). The aim is to use archaeobotanical weed floras to aid reconstruction of ancient farming practices based on environmental information derived from modern weed floras. Two methods for the study of modern weed communities are available; namely phytosociology and autecology. The phytosociological approach is the study of vegetation communities and their classification into a hierarchical system, with 'indicator species' identified for specific ecological characteristics (e.g. G. Jones 1992a: 136; van der Veen 1992a: 101-102). Autecology, on the other hand, is the study of individual species and their behaviour in specific environments (van der Veen 1992a: 103). The autecological approach also groups species in terms of certain environmental conditions such as moisture, pH, nitrogen and temperature. Van der Veen (1992a: 107-109) recently rejected analogies based on phytosociological approaches in archaeobotany for three reasons. First, phytosociological approaches assume no change in the composition of weed communities over time, even though there is every reason to think that modern weed communities have changed from those of the past (e.g. Greig 1990; M. K. Jones 1988a). Second, ancient weed assemblages, which are by their very nature incomplete floras, cannot be directly compared to modern weed assemblages. Third, these studies neglect the relationship between weed communities and human activity, and only focus on the weed community itself. As a result of these criticisms, van der Veen (1992a: 109) recommends the use of autecological studies over phytosociological studies in any attempt to draw an analogy between archaeobotanical weed assemblages and modern weed communities.

In Egypt, studies of modern weed communities which are available (e.g. El-Hadidi and Kosinová 1971; Kosinová 1974, 1975) only follow the phytosociological approach. Typically, these studies rarely note conditions affecting these plants; such as temperature, shade, moisture, pH, or human activity; but instead, present a list of taxa found during collection in a certain environment (i.e. field of winter wheat, orchard, or garden at various geographical locations). However, certain kinds of information about the archaeological weed assemblage from these studies are still of use. Modern phytosociological studies in Egypt do provide details about certain influencing factors, such as the various habitats of modern weeds and their seasonality. These can be used in analogy with the ancient weed / wild plants recovered in the Kom el-Nana samples to provide information about the agricultural setting. Indeed, in a recent reconstruction of the agricultural setting of Iron Age Britain (van der Veen 1992a: 136-137) the height range of weeds, although derived from European autecological studies, was used in analogy with ancient weed assemblages from various British sites, in order to reconstruct harvesting height.

6.3.1 Weed ecology and habitat(s)

The ancient weed / wild flora from Kom el-Nana is compared with the available information for the modern Egyptian weed flora in order to suggest the potential habitat(s) of the weed / wild plants found in this assemblage. The phytosociological information is drawn from modern conditions and therefore may not accurately reflect the weed flora of Egypt under conditions of inundation. All records of weeds in arable fields are from modern irrigated field systems which now receive perennial irrigation from the Nile (e.g. El-Hadidi and Kosinová 1971). Therefore, those weed species found in modern arable fields are considered to indicate conditions of irrigation, not necessarily inundation. This approach is supported by a recent study of the modern flora in Egypt, which has shown that the single most important determining factor for the presence of weed / wild plants in Egypt is their water requirements (Dargie and El Demerdash 1991: 6).

Table 6.2 summarizes the type of plant (e.g. annual or perennial) and its known habitat(s). As can clearly be seen, the majority of weed / wild plants recovered in the Kom el-Nana archaeobotanical samples occur today as annuals and weeds of arable fields, and along canals or banks of the Nile. *Cornulaca monocantha*, *Zilla spinosa* and many species of *Fagonia* are typical of desert habitats today (e.g. Kassas and Girgis 1965; Zahran and Willis 1992), but also can occur in cultivated fields in Middle Egypt (El Amry 1981), and so have not been excluded from consideration as possible weeds of crops. These results strongly suggest that much of the ancient weed flora from Kom el-Nana is derived from irrigated land (i.e. arable or orchard / garden). Information on weeds of garden / orchards is limited in Egypt, and so no conclusions about whether the ancient weed / wild plants from Kom el-Nana can also occur in gardens or orchards can be made at present.

Table 6.2 Summary of plant type and habitat information for the ancient weed / wild plants found at Kom el-Nana.

WEED / WILD COMPONENT	PLANT TYPE	ARABLE FIELDS	CANALS / NILE BANK	DESERT	WASTE GROUND
Rumex spp.	ANN	✓	✓	-	-
Glinus cf. *lotoides* L.	ANN	-	✓	-	-
Portulaca oleracea L.	ANN	✓	✓	-	✓
Vaccaria cf. *pyramidata* Medicus	ANN	✓	-	-	-
Silene sp. - large	ANN / PER	✓	✓	-	-
Beta vulgaris L.	ANN / BI	✓	-	-	✓
Chenopodium murale L.	ANN	✓	✓	-	✓
Cornulaca cf. *monocantha* Del.	SHRUB	✓ (rare)	-	✓	-
Fumaria spp.	ANN	✓ (TYP)	-	-	-
Brassica spp. / *Sinapis arvensis* L.	ANN	✓ (TYP)	-	-	✓ (TYP)
Zilla spinosa (Turra) Prantl	SHRUB	✓ (rare)	-	✓	✓
Raphanus raphanistrum L.	ANN	✓	-	-	-
Coronopus cf. *niloticus* (Del.) Spreng	ANN	-	✓	-	-
Reseda spp.	ANN / PER	✓	-	✓	✓
Medicago sp.	ANN / PER	✓	-	-	-
Trifolium spp.	ANN / PER	✓	✓	-	-
Scorpiurus muricatus L.	ANN	✓	-	-	✓
Fagonia sp.	ANN/ PER/ SHRUB	✓ (rare)	-	✓(TYP)	-
Euphorbia peplus L.	ANN	✓	-	-	-
Malva sp.	ANN	✓	✓	-	✓
Galium spp.	ANN / PER	✓	-	-	✓
Heliotropium spp.	ANN / SHRUB	-	✓	-	-
Echium sp.	ANN / PER / BI	✓	-	-	-
Solanum nigrum L.	ANN	✓	✓	-	✓
Pulicaria sp.	ANN / PER	✓	✓	-	-
Cichorium endivia L. / *intybus* L.	ANN	✓	-	-	✓
Picris sp.	ANN / PER	-	-	-	-
Sonchus sp.	ANN (TYP)	✓	✓	-	-
Asphodelus spp.	ANN / PER	✓	-	✓	-
Lolium spp.	ANN / PER	✓	✓	-	✓
Avena sterilis L.	ANN	✓	-	-	-
Avena spp.	ANN	✓	-	-	-
Crypsis spp.	ANN	✓	✓	-	✓
Phalaris paradoxa L.	ANN	✓	-	-	✓
Phalaris spp.	ANN / PER	✓	-	✓	-
Setaria spp.	ANN	✓	-	-	✓
Saccharum spontaneum L.	PER	-	✓ (TYP)	-	✓
Fimbristylis bis-umbellata (Forssk.) Bub.	ANN	-	✓	-	-
Scirpus cf. *praelongatus* Poir.	ANN	-	✓	-	-
Scirpus sp.	ANN / PER	-	✓	-	-
Cyperus spp.	ANN / PER	-	✓	-	-

KEY: ANN = herbaceous annual; PER = herbaceous perennial
BI = herbaceous biennial; SHRUB = shrub or shrublet
(TYP) = typically found; (rare) = rarely found
✓ = present

Information based on Boulos 1966; Boulos and El- Hadidi 1994; El-Amry 1981; Kosinová 1975; Täckholm 1974; Täckholm and Drar 1954; Townsend *et al.* 1968; and M. Zohary 1966 and 1972.

6.3.2 Weed ecology and seasonality

Many of the weed / wild plants encountered in the assemblage could not be identified securely to species level; however, some information can still be derived from those identifications which were made. Table 6.3 summarizes the season when these species are found as weeds of crops for those weed / wild plant remains which have been identified to species level. There were only fifteen species with precise information on the season(s) when they occur as weeds of crops so the information presented here is quite provisional; however, five of these weed / wild plants typically are weeds of summer crops, six typically are weeds of winter crops, and two can occur in crops grown in either season. This result suggests it is possible that crops could be grown in both the summer and winter seasons. It also is possible that this result is related to the two different agricultural zones (i.e. garden / orchard and arable fields) utilized at Kom el-Nana. The majority of weed / wild plants, however, have not been identified to species level, and any conclusions about the seasonality of the Kom el-Nana crop assemblage are extremely tentative.

Table 6.3 Summary of season(s) known for the ancient weed / wild plants from Kom el-Nana

WEED / WILD COMPONENT	SUMMER	WINTER	BOTH
Glinus cf. *lotoides* L.	✓	possible ✓	-
Portulaca oleracea L.	-	-	✓
Vaccaria cf. *pyramidata* Medicus	-	✓	-
Beta vulgaris L.	rare ✓	✓	-
Chenopodium murale L.	rare ✓	✓	-
Zilla spinosa (Turra) Prantl	✓	-	-
Raphanus raphanistrum L. - capsule & seed	✓	-	-
Coronopus cf. *niloticus* (Del.) Spreng	✓	-	-
Scorpiurus muricatus L.	-	✓	-
Euphorbia peplus L.	rare ✓	✓	-
Solanum nigrum L.	✓	rare ✓	-
Cichorium endivia L. / intybus L.	-	-	✓
Phalaris paradoxa L.	-	✓	-
Saccharum spontaneum L.	-	-	✓

KEY: ✓ = present. Information based on Boulos and El-Hadidi 1994; Kosinová 1975; Täckholm 1974; and Townsend and Guest 1980. A summer weed means it is a weed of summer crops, that is crops planted in the Spring and harvested in the Autumn. A winter weed means it is a weed of winter crops, that is crops planted in the Autumn and harvested in the Spring.

6.3.3 Weed ecology and the region(s) of crop production

The weed flora recovered at Kom el-Nana does not compare well with many of the modern weed ecology studies. This is most likely due to three reasons. First, agricultural practice in modern Egypt has changed radically since ancient times; with the introduction of fertilizers, tractors, new crops and desert reclamation (e.g. Craig 1993). Second, most systematic surveys of weed and wild flora in Egypt post-date the construction of the dam at Aswan. The absence of the inundation in the fields, canals and banks of the Nile has a marked effect on the species which currently grow in these regions. Perennial irrigation, a practice dating from at least Early Islamic times for the whole of Egypt (Watson 1983), would also alter the makeup of the weed species found in the fields and along the banks of canals and the Nile (El Hadidi and Kosinová 1971: 354-356). The assumption that the irrigation regimes will influence the composition of the weed flora has been tested elsewhere in the Mediterranean. G. Jones and others (1995) have recently explored the effect irrigation regimes have on weeds of crops in Spain, suggesting a clear variation between the weed flora of intensively and moderately irrigated fields. Water requirements also have proved a crucial determining factor in multivariate analysis of modern surveys of the flora of Egypt (Dargie and El Demerdash 1991: 6). Finally, much of the weed ecology work is based on studies in regions outside of Middle Egypt; such as Aswan (Boulos 1966; El Hadidi and Ghabour 1968) or Cairo (Hejný and Kosinová 1977). Nevertheless, studies which cover a range of sites along the entire length of the Nile Valley, including sites in Minya province, also have produced weed floras which have very few species in common with the Kom el-Nana assemblage (e.g. El Hadidi and Kosinová 1971; Kosinová 1974, 1975). Recently, however, El-Amry (1981) surveyed the weed flora of arable fields in Minya province (roughly equivalent to the ancient Hermopolite Nome) and many of the weed / wild species which are present in the ancient Kom el-Nana assemblage also were found in these modern fields. The presence of many species which are absent from other studies suggest that certain species may be indigenous to this part of the Nile valley or, perhaps more likely, that this extremely poor region of Egypt has implemented less of the modern agricultural changes, especially weed killers, than other more prosperous areas in Egypt and may provide a relict weed flora absent in other regions of Egypt.

Table 6.4 presents a direct comparison of species found in the archaeobotanical samples from Kom el-Nana and those found in the modern survey of weed / wild plants in Minya Province. Most notably, there is a great degree of similarity in the exact or type of species recovered. Those species which were absent in the modern survey are indicated by (X) and those species which are present in the modern survey are indicated by (✓). Plant remains such as *Vaccaria pyramidata*, *Phalaris paradoxa*; and species of *Silene*, *Reseda*, *Echium* and *Asphodelus* which were absent in the El-Amry Minya survey have been found in the survey of weeds of crop conducted by Kosinová (1971) for the whole of Egypt, but none were collected in Middle Egypt. It may be that the presence of such species indicates that crops grown outside of the region of Kom el-Nana were brought onto site, but without surveys of the weed flora of Middle Egypt prior to the damming projects of the nineteenth and twentieth centuries there is no way to determine if these species represent introduced or extinct weeds within the archaeological flora recovered. With the results that are available, however, it is apparent that the majority of ancient weed / wild plants recovered are still growing in the region as weeds of crops today and, therefore, it seems likely that many of the ancient weed / wild plants found at Kom el-Nana could have grown locally, in the Hermopolite Nome. This result strongly suggests that if the weed / wild plants are of local origin, than many of the economic plants found in the archaeobotanical samples also are of local origin.

Table 6.4 Comparison of ancient Kom el-Nana weed / wild plants with modern survey of Minya Province weed / wild plants.

ANCIENT WEED / WILD COMPONENT FROM KOM EL-NANA	MODERN EL-AMRY (1981) SURVEY OF WEED / WILD PLANTS IN MINYA PROVINCE, MIDDLE EGYPT
Rumex spp.	*Rumex dentatus* L.
Polygonaceae - unidentified	*Polygonum salicifolium* Brouss ex Willd., *P. senegalense* Meisn. , *P. patulum* M. B., *P. aviculare* L., and *P. plebejum* R. Br.
Glinus cf. *lotoides* L.	✓
Aizoaceae - unidentified	X
Portulaca oleracea L.	✓
Vaccaria cf. *pyramidata* Medicus	X
Silene sp. - large	*Silene villosa* Forssk. and *Silene rubella* L.
Stellaria sp. - type	X
Caryophyllaceae - unidentified	*Polycarpon tetraphyllum* (L.) L. and *Gymnocarpos decandrum* Forssk.
Beta vulgaris L.	✓
Chenopodium murale L.	✓
Cornulaca cf. *monocantha* Del.	✓
Chenopodiaceae - unidentified	*Salsola baryosma* (Roem. & Schult.) Dandy and *S. vermiculata* L. var *villosa* (Del. ex Roem. & Schult) Moq.
Fumaria spp.	*Fumaria densiflora* DC
Brassica spp. / *Sinapis arvensis* L.	*Brassica rapa* L., *B. tournefortii* Gouan, *B. nigra* (L.) Koch and *Sinapis arvensis* L.
Zilla spinosa (Turra) Prantl	✓
Raphanus raphanistrum L.	✓
Coronopus cf. *niloticus* (Del.)	✓
Reseda spp.	X
Medicago sp.	*Medicago sativa* L. (escape from cultivation)
Trifolium spp.	*Trifolium resupinatum* L. and *T. alexandrium* L. (escape from cultivation)
Scorpiurus muricatus L.	X
Leguminosae - unidentified	several species present
Fagonia sp.	*Fagonia arabica* L. and *Fagonia bruguieri* DC.
Zygophyllaceae - unidentified	*Zygophyllum simplex* L. and *Z. coccineum* L. and *Tribulus terrestris* L.
Euphorbia peplus L.	✓
Malva sp.	*Malva parviflora* L.
Umbelliferae - unidentified	*Apium leptophyllum* (Pers.) F. Muell ex Benth. and *Ammi majus* L.
Galium spp.	X
Heliotropium spp.	*Heliotropium digynum* (Forssk.) Asch ex. C.
Echium sp.	X
Verbenaceae / Labiatae	*Phyla nodiflora* (L.) Greene
Solanum nigrum L.	✓
Pulicaria sp.	*Pulicaria crispa* (Forssk) Oliver
Cichorium endivia L. / *intybus* L.	not present although *Cichorium pumilum* Jacq. is found
Picris sp.	X
Sonchus sp.	*Sonchus oleraceus* L.
Compositae - unidentified	several species present
Asphodelus spp.	X
Lolium spp.	*Lolium temulentum* L.
Avena spp.	*Avena fatua* L. and *Avena sativa* L.
Avena sterilis L. - rachilla	X
Crypsis spp.	X
Phalaris paradoxa L.	X
Phalaris spp.	X
Setaria spp.	*Setaria pumila* (Par) Roem & Schult. and *S. viridis* (L.) Beauv.
Saccharum spontaneum L.	✓
Gramineae - small seeded	variety of species present
Gramineae - large seeded	variety of species present
Fimbristylis bis-umbellata (Forssk.)	✓
Scirpus cf. *praelongatus* Poir.	X
Scirpus sp.	*Scirpus litotalis* Schrad. and *Bolboschoenus maritumus* (L.) Palla = *Scirpus tuberosus* Desf. sensu
Cyperus spp.	*Cyperus rotundatus* L., *C. dives* Del., *C. fenzelianus* Steud., *C. articulatus* L. and *C. alopecuroides* Rottb.

KEY: ✓ = species also present and X = species not present in El Amry (1981) survey.

6.4 Harvesting Height [2]

In Table 6.1 (see §6.2), eight traditionally arable crops were identified; including free threshing wheat, barley, sorghum, lupin, lentil, vetchling, linseed / flax and safflower. It also is possible that onion and opium poppy could be grown as arable crops. Since so many arable crops are present at Kom el-Nana, it is not possible to claim that the weed / wild plants found in these samples came in with any one specific crop or type of crop. It is quite likely that some of these weed / wild plants also could occur in gardens or orchards. However, it is possible to use evidence for the range of heights (Boulos and El-Hadidi 1994; Kosinová 1975; Täckholm 1974; Townsend and Guest 1980) of those weed / wild plants identified to species level to examine the harvesting height of some, perhaps all, of these arable crops found at Kom el-Nana.

Figure 6.1 shows the height range for those weed / wild plants identified to species level from the desiccated component of the Kom el-Nana samples, except for *Saccharum spontaneum* which ranges in height between 300 and 500 cm and is, therefore, considerably taller than the other weed / wild plants which have been identified to species level. Admittedly, this is only a small proportion of the weed / wild plants within the Kom el-Nana assemblage, however, most of these taxa have not been identified beyond the level of genera, and those taxa which have been identified to species level such as *Portulaca oleracea* and *Chenopodium murale* are quite abundant in the overall assemblage. Indeed, the fifteen species identified account for sixty-one percent of all desiccated weed / wild identification in the Kom el-Nana assemblage.

The weed / wild plants are arranged in ascending order of their maximum height. Forty-two of the fifty-two case study samples contain weed / wild plants which grow to heights of 35 cm or less and this suggests that harvesting height must have occurred at or below 35 cm in order for these weed / wild plants to be present. Such a low harvesting height indicates that cereal straw and other plant stalks, such as safflower hay (Knowles 1955: 294) or the stalks of flax / linseed (Bond and Hunter 1987: 178), were intentionally collected during harvest. A further six samples (drain sample 94-7791, midden sample 94-024, mudbrick samples 7348 and 7663, pot slot sample 94-186, and trough sample 94-175) contain purslane (*Portulaca oleracea*) seed, but do not contain weed / wild plants with heights under 35 cm. This suggests that the harvesting height for these six samples must be under 50 cm but above 35 cm. This harvesting height is also fairly low, and may not necessarily mean a significant difference in harvesting technique from the previous samples.

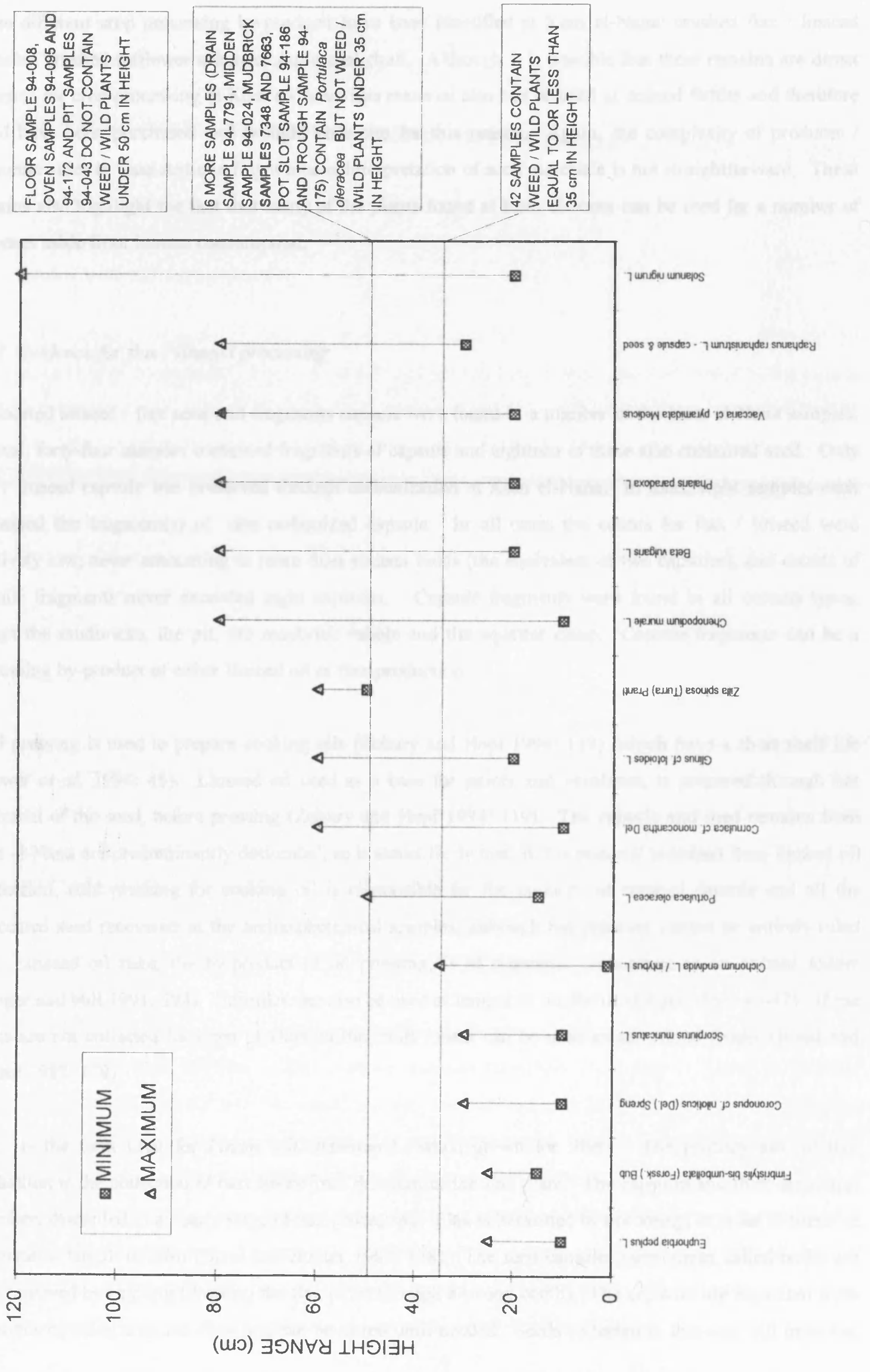
The remaining four samples (floor sample 94-008, oven samples 94-095 and 94-172, and pit sample 94-043) do not contain weed / wild plants under 50 cm in height. These samples may indicate a different harvesting height, but also could be examples of different activities. For example, both oven samples are primarily made up of rachis internodes and culm nodes in the carbonized component. Although it cannot

[2] This section only considers the results from the desiccated component of the Kom el-Nana assemblage.

yet be established whether this is cereal straw used directly for fuel or cereal straw that has come in with dung used as fuel; in this instance, it is certainly the case that nearly pure cereal straw was used at Kom el-Nana. The lack of weeds in these samples may say something about harvesting height; but because they are from ovens, it also may be possible that carbonization has resulted in the poor preservation of certain weed / wild seeds. The remaining two samples, the pit and the floor sample, are somewhat unusual in that they are almost exclusively dominated by one crop. Floor sample 94-008 is almost entirely fig seeds and pit samples 94-043 is almost entirely light cereal chaff (awn, glume and lemma). These samples are rather unusual, and therefore may reflect activities which have nothing to do with harvesting arable crops, such as the collection of fruit, or reflect only part of the harvested crop; such as the collection of light chaff, perhaps after winnowing, for a particular use.

The evidence for a low harvesting height at Kom el-Nana not only suggests that plant stalks were collected, but that they were of economic value in Late Antique Egypt. There is a great deal of ethnographic evidence for the use of plant stalks such as cereal straw, leguminous plants, linseed plants, and safflower plants for animal fodder (Bond and Hunter 1987: 178; Butler 1996; Hillman 1984a, 1984b, 1984; Forbes forthcoming; G. Jones 1984; Knowles 1955: 294). It also is possible that the collection of cereal and other plant straw can be used for a source of fuel (e.g. Hillman 1984a, 1984b, 1985; G. Jones 1984). Finally, it is likely that cereal straw has a number of other uses (i.e. basketry, matting, or temper - cf. Murray forthcoming).

Figure 6.1 The height range for those desiccated weed /wild plants identified to species level (based on Boulos and El-Hadidi 1994; Kosinová 1975; Täckholm 1974; Townsend and Guest 1980)



6.5 Crop Processing

Three different crop processing by-products have been identified at Kom el-Nana: crushed flax / linseed capsules, crushed safflower achenes, and cereal chaff. Although it is possible that these remains are direct evidence for crop processing at Kom el-Nana, this material also can be used as animal fodder and therefore could have been purchased and brought onto site for this reason. Again, the complexity of producer / consumer roles in Late Antique Egypt means interpretation of such materials is not straightforward. These remains also highlight the fact that many of the plants found at Kom el-Nana can be used for a number of purposes aside from human consumption.

6.5.1 Evidence for flax / linseed processing

Desiccated linseed / flax seed and fragments capsule were found in a number of the Kom el-Nana samples. In total, forty-four samples contained fragments of capsule and eighteen of these also contained seed. Only flax / linseed capsule was preserved through carbonization at Kom el-Nana. In total, eight samples each contained the fragment(s) of one carbonized capsule. In all cases the counts for flax / linseed were relatively low, never amounting to more than sixteen seeds (the equivalent of two capsules), and counts of capsule fragments never exceeded eight capsules. Capsule fragments were found in all context types, except the mudbricks, the pit, the mudbrick rubble and the squatter camp. Capsule fragments can be a processing by-product of either linseed oil or flax production.

Cold pressing is used to prepare cooking oils (Zohary and Hopf 1994: 119), which have a short shelf life (Brewer *et al.* 1994: 45). Linseed oil used as a base for paints and varnishes, is prepared through hot treatment of the seed, before pressing (Zohary and Hopf 1994: 119). The capsule and seed remains from Kom el-Nana are predominantly desiccated, so it seems likely that, if this material is indeed from linseed oil production, cold pressing for cooking oil is responsible for the majority of crushed capsule and all the desiccated seed recovered in the archaeobotanical samples, although hot pressing cannot be entirely ruled out. Linseed oil cake, the by-product of oil pressing, is of economic importance as an animal fodder (Langer and Hill 1991: 294). Capsules can also be used as temper in mudbrick (Unger 1866: 46-47). If the stalks are not collected for linen production the chaff / stem can be used as an animal fodder (Bond and Hunter 1987: 178).

Flax is the term used for *Linum usitatissimum* L. when grown for fiber. The primary aim of flax production is the collection of bast fibers from the stem of the flax plant. The capsules and their seeds are, therefore, discarded in an early stage of flax processing. Flax is harvested by uprooting, in order to preserve the greatest length of stem (Bond and Hunter 1987: 178). The seed capsules (sometimes called bolls) are then removed by rippling (drawing the flax plant through a strong comb). The capsules are separated from the stems by using a coarse sieve and can be stored until needed. Seeds collected in this way will have lost some of their quality for oil production (Bond and Hunter 1987: 175), but could be used for animal fodder or sowing seed (Pals and van Dierendonck 1988: 242). There also are Greek and Roman references for making bread mixed with whole linseed / flax seed (Grieve 1992: 319 - no source cited).

No large concentrations of flax / linseed capsule or seed were found on site. Low numbers of capsule fragments, however, were found in most of the samples. The ubiquity of capsule fragments in the Kom el-Nana assemblage may be significant.

6.5.2 Evidence for safflower processing

In total 365 achenes (or seeds) of safflower were identified in the Kom el-Nana assemblage. Most of this material was highly fragmentary. Many of the achenes had lost their glossy outer seed coat, and the surface of some appeared frayed. Out of all the samples, only two complete safflower achenes were recovered in sampling. Desiccated safflower was found in thirty-eight of the fifty-two samples collected, and was recovered from all context types except the mudbricks, the pit and the squatter camp. Eight samples also contained no more than one carbonized safflower achene each. In most cases the number of safflower identifications did not exceed ten in the desiccated component, but in floor samples 94-010 (N = 137) 94-176 (N = 121) and trough sample 93-7782 (N = 29) desiccated safflower was present in larger numbers. The samples found on the floors are particularly of interest, because they may imply locations for processing activity.

Safflower oil can be produced either through hot pressing or cold pressing. Hot pressing does not require the removal of the hull of the achene (the part recovered here) and often results in charring of the hull (Knowles 1967: 158). In cold pressing, the hulls of the achene must be removed to free the oil bearing kernel, usually by cracking the seed with a stone roller (Knowles 1967: 158-159 and 162). The resulting mixture of safflower hulls and kernels is sieved and winnowed to separate the hulls from the oil bearing kernels. Both the hulls of safflower and the resulting oil pressings (primarily of safflower kernels) make an excellent fodder for livestock (Knowles 1955: 293) and, therefore, are of economic importance.

The broken and frayed fragments of safflower hulls found at Kom el-Nana do suggest processing, although not necessarily at Kom el-Nana. The safflower achenes identified are primarily preserved through desiccation, and this may indicate that a cold pressing method was used for oil production. It is possible that the substantial quantities of safflower found in two floor samples (94-010 and 94-176) and a trough sample (93-7782) are evidence of safflower oil production at Kom el-Nana, but because detached hulls of safflower achenes also are of economic importance it is not possible to determine if this is debris from a processing activity which took place on site, or simply animal fodder, possibly brought onto site, which could have been stored and used on site. The frayed appearance of some of the safflower achene fragments also may indicate that some of this material was consumed by livestock as fodder.

6.5.3 Cereal processing

Both the barley and wheat recovered in the Kom el-Nana samples are free threshing.[3] Wheat and barley crops go through a specific set of processing sequences in order to separate cereal chaff from grain (Hillman 1985; G. Jones 1984; van der Veen 1992a), and these are summarized here in Figure 6.2.

Figure 6.2 Basic crop processing sequence for cereals (based on Hillman 1981: 132-135)

HARVEST ⇨	COLLECTION OF PART OR ALL OF THE PLANT FROM THE FIELD
↓	
THRESHING ⇨	BREAKS CEREAL INTO COMPONENT PARTS (FREES GRAIN AND CHAFF FROM RACHIS INTERNODES AND STRAW)
↓	
WINNOWING ⇨	SEPARATION OF MOST LIGHT CHAFF (AWN, GLUMES AND SMALL FRAGMENTS OF RACHIS), STRAW FRAGMENTS, AND LIGHT WEED SEEDS FROM GRAIN, HEAVIER STRAW NODES, WEED HEADS, AND LARGE WEED SEEDS
↓	
COARSE SIEVING ⇨	SEPARATION OF LARGE WEED SEEDS OR CAPSULES, STRAW NODES AND RACHIS FRAGMENTS FROM GRAIN *(i.e. removes contaminants coarser than the cereal grain)*
↓	
FINE SIEVING ⇨	SEPARATION OF ALL SMALL WEED SEEDS FROM THE GRAIN *(i.e. removes contaminants finer than the grain)*
↓	
CLEAN GRAIN	

[3]The sorghum was found in only one sample (trough sample 93-7782) and, therefore, is not included in this discussion. Emmer (*Triticum dicoccum*) and bread wheat (*Triticum aestivum*) are not considered here because these are believed to be crop contaminants at Kom el-Nana (See Chapter 5 §5.2.1).

By examining the relative proportion of rachis internodes to grain it is possible to distinguish early stages from later stages in the crop processing sequence (e.g. van der Veen 1992a: 82). Cereal grains occur at a specific number per rachis internode. The ratio of cereal grain : cereal rachis for six-row barley is 3:1. The majority of free threshing wheat identified to species level, was identified as macaroni wheat (*Triticum durum*) (see Chapter 5 §5.2.1), and therefore the ratio of cereal grain : rachis for free threshing wheat will be based on that for macaroni wheat at between three to four grains per rachis internode. If these ratios are transformed into percentages, a percentage of rachis internodes considerably greater than 25% for six-row barley or macaroni wheat indicates the presence of early crop processing residues, suggesting a by-product of winnowing or coarse sieving. If the relative percentage for either barley rachis internodes or free threshing internodes falls significantly below 25%, this suggests the presence of barley or wheat grains from a later stage in the crop processing sequence.

Figure 6.3 shows the relative proportion of desiccated free threshing wheat grain and rachis internodes for those samples which contained over twenty-five identifications of free threshing wheat grain and chaff. The number twenty-five is arbitrary, but was selected as a threshold because this number would represent 10% of the target figure of 250 seeds per sub-sampled flot. All of these samples contained high proportions of rachis internodes as compared to cereal grain (indeed no sample fell below 95%) strongly suggesting that all of the free threshing wheat chaff found in these samples is derived from an early stage in the crop processing sequence.

Figure 6.3 Relative proportion of desiccated free threshing wheat grain to free threshing wheat rachis internodes

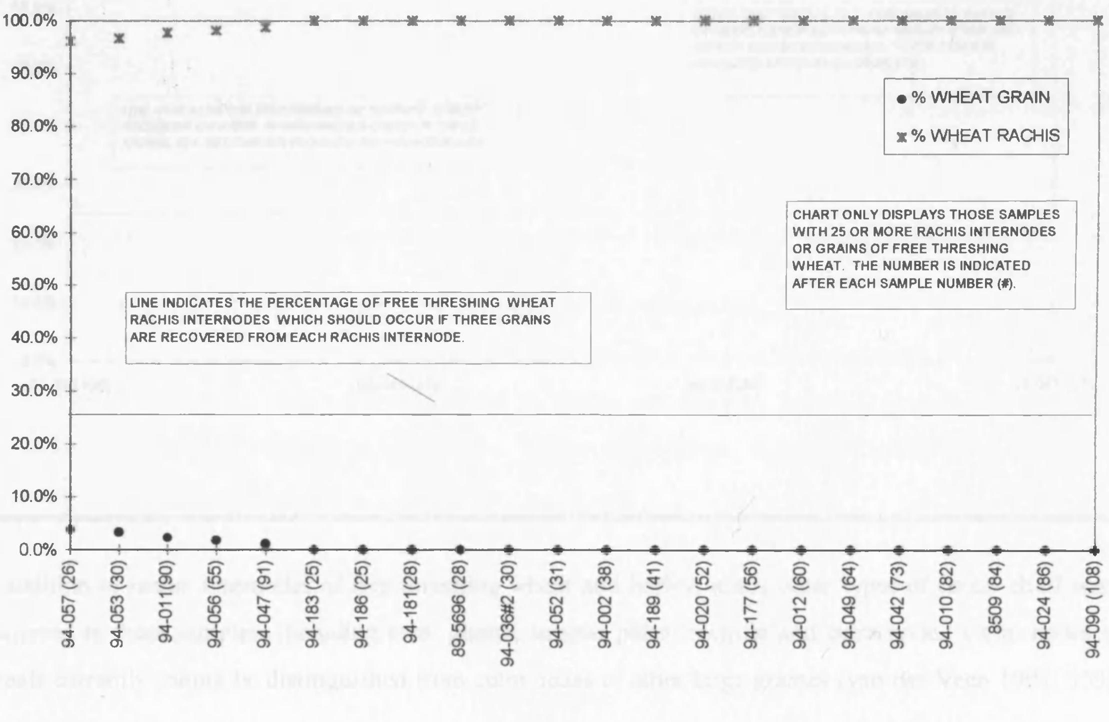
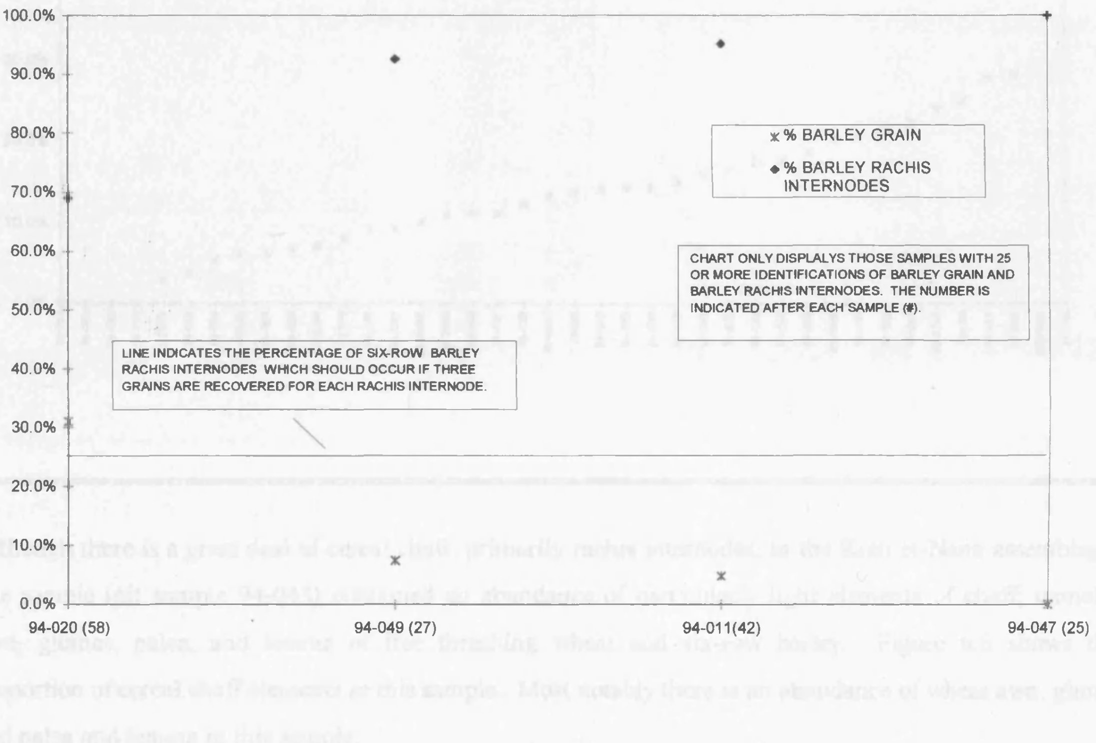


Figure 6.4 shows the relative proportion of desiccated barley grain and rachis internodes for those samples which contained twenty-five or more six-row barley grains and rachis internodes. In all cases the relative contribution of barley rachis internodes was greater than 25% and suggests that most of the remains come from an early stage(s) in the crop processing sequence. In one case, floor sample 94-020, the amount of barley grain slightly exceeded the 25% threshold; however, rachis internodes still outnumber barley grain by a ratio of 3:1 in this sample; suggesting that cereal chaff was intentionally collected. The inclusion of barley grain with barley chaff may be intentional at Kom el-Nana since eighteen of the samples (89-5698, 93-5597#10, 93-5597#12, 93-7348M, 94-002, 94-010, 94-011, 94-012, 94-020, 94-023, 94-024, 94-035, 94-042, 94-049, 94-053, 94-056, 94-057, 94-058) contain barley grain; however, most of these samples have less than twenty-five identified barley grains and rachis internodes so this suggestion is only speculative. Perhaps in certain cases, such as animal fodder, a mixture of barley chaff and grain was desired. Unlike the results for free threshing wheat, the barley results shown in Figure 6.4 suggest that both grain-free chaff and a mixture of grain with cereal chaff were in use at Kom el-Nana.

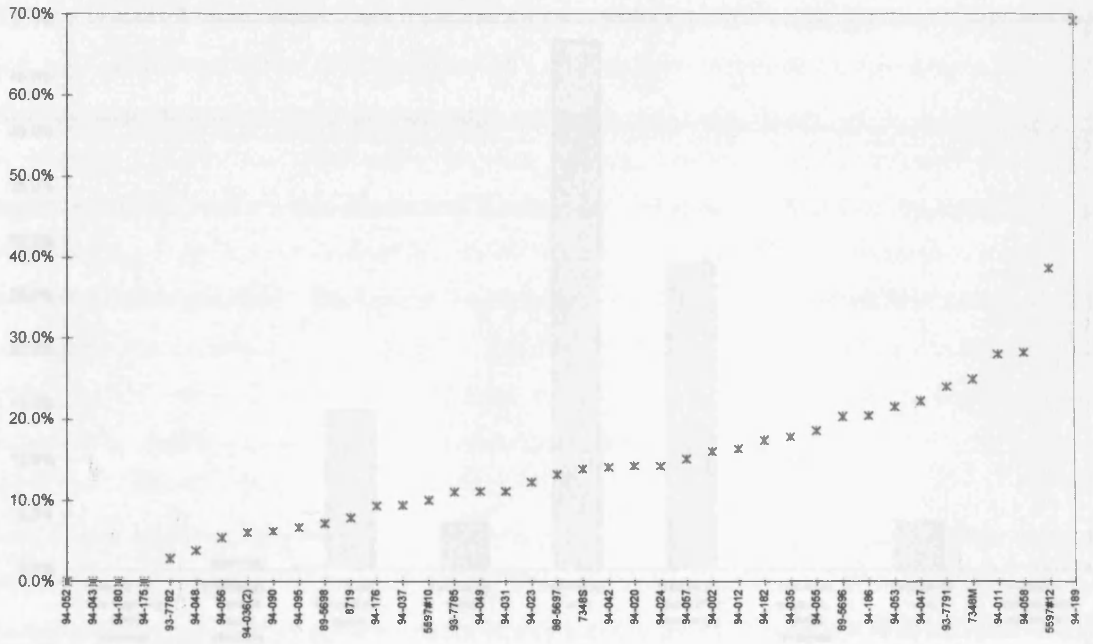
Figure 6.4 The relative proportion of desiccated barley grain to barley rachis internodes



In addition to rachis internodes of free threshing wheat and barley, many other types of cereal chaff were recovered in these samples; including awn, glume, lemma, palea, rachilla and culm node. Culm nodes of cereals currently cannot be distinguished from culm nodes of other large grasses (van der Veen 1991: 353), however, at Kom el-Nana these culm nodes are assumed to be cereal chaff (following van der Veen 1992a, 1992b; and van der Veen *et al.* 1996).

Figure 6.5 illustrates the proportion of desiccated culm nodes out of all identifications of cereal chaff in all of the Kom el-Nana samples with 25 or more identifications of cereal chaff. In the majority of samples containing cereal chaff, culm nodes account for 10% or more of all cereal chaff identifications. This result also suggests that by-products of early stages of cereal processing are used at Kom el-Nana, also confirming the results seen in the comparison of free threshing wheat grain to rachis internodes and six-row barley grain to rachis internodes.

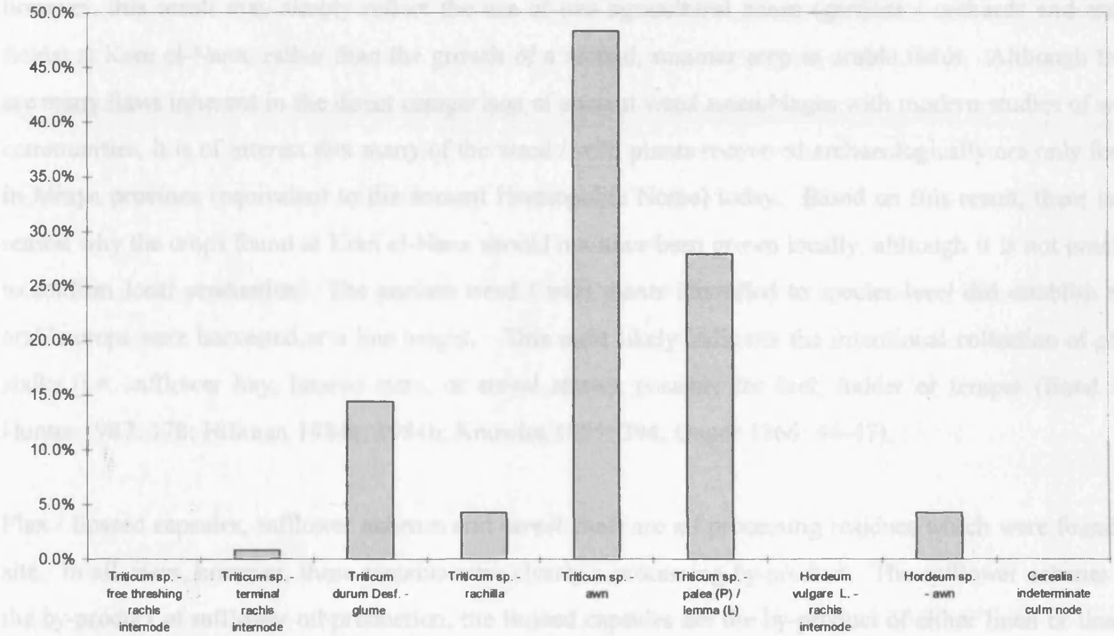
Figure 6.5 Proportion of desiccated cereal culm nodes out of all cereal chaff identifications in the Kom el-Nana samples. (Figure only includes those samples with 25 or more identifications of cereal chaff).



Although there is a great deal of cereal chaff, primarily rachis internodes, in the Kom el-Nana assemblage, one sample (pit sample 94-043) contained an abundance of particularly light elements of chaff; namely, awn, glumes, palea, and lemma of free threshing wheat and six-row barley. Figure 6.6 shows the proportion of cereal chaff elements in this sample. Most notably there is an abundance of wheat awn, glume and palea and lemma in this sample.

The lightest elements of cereal chaff (i.e. rachilla, palea, lemma and awn) most likely came in with straw waste from the first and second winnowing or coarse riddling (Hillman 1984b: 5 and 10). Hillman (1984a, 1984b and *pers. comm.*[4]) suggests that these fine and lightest elements of light chaff are sometimes intentionally collected for temper (i.e. for pottery or plaster), especially when the product needs to be quite smooth. One sample, pit sample 94-043, was almost entirely made up of these fine, light elements of chaff. A rodent nest can be ruled out as the source of this material since no faeces were found in the sample, however, the archaeological context of this find, a shallow pit within a plastered room, does not clarify the origins of this material. One possible explanation may be that this sample represents some of the stuffing of a pillow or mattress which may have filtered out through the mattress or pillow cover. In terms of the overall assemblage, this is a unique find at Kom el-Nana.

Figure 6.6 Relative proportion of desiccated cereal chaff elements in pit sample (94-043). (N = 118)



Examination of cereal chaff and grain at Kom el-Nana has shown that by-products of the early stages of cereal processing dominate the Kom el-Nana assemblage. One sample, pit sample 94-043, also demonstrated that lighter elements of cereal chaff were used on site. The ubiquitous presence of cereal chaff in almost all of the Kom el-Nana samples suggest that this agricultural by-product was an important component of the agricultural economy of the site. Certain samples, such as the ovens or the mudbricks do provide definitive evidence for the specific use of cereal chaff at Kom el-Nana. Other contexts (such as the house floors or middens), do not provide such detailed information. The relative contribution of cereal chaff to the Kom el-Nana assemblage will be discussed further in Chapter 7.

[4] I would like to thank Marijke van der Veen for discussing this particular sample with Gordon Hillman on my behalf, and Gordon Hillman for his useful comments on the possible origin of this sample.

6.6 Conclusions

This study will not pursue producer / consumer models for cereal production. In part, this is because shortcomings in this approach have already been identified (van der Veen 1991), and also due to the fact that Late Antique historical evidence clearly establishes that cereal grain and chaff were saleable commodities in Egypt. The Kom el-Nana economic plants are derived from both arable and garden / orchard cultivation. This means that the monastery at Kom el-Nana participated in a mixed agricultural landscape. Archaeological evidence for a garden at Kom el-Nana (see Chapter 3 §3.3) does suggest one potential source for the garden / orchard plants identified there.

The weed / wild flora is primarily comprised of annual weeds of irrigated arable fields. Seasonality of those weed / wild plants identified to species level suggests the growth of both summer and winter crops; however, this result may simply reflect the use of two agricultural zones (gardens / orchards and arable fields) at Kom el-Nana, rather than the growth of a second, summer crop in arable fields. Although there are many flaws inherent in the direct comparison of ancient weed assemblages with modern studies of weed communities, it is of interest that many of the weed / wild plants recovered archaeologically are only found in Minya province (equivalent to the ancient Hermopolite Nome) today. Based on this result, there is no reason why the crops found at Kom el-Nana should not have been grown locally, although it is not possible to confirm local production. The ancient weed / wild plants identified to species level did establish that arable crops were harvested at a low height. This most likely indicates the intentional collection of plant stalks (i.e. safflower hay, linseed stem, or cereal straw), possibly for fuel, fodder or temper (Bond and Hunter 1987: 178; Hillman 1984a, 1984b; Knowles 1955: 294; Unger 1866: 46-47).

Flax / linseed capsules, safflower achenes and cereal chaff are all processing residues which were found on site. In all cases, however, these remains were clearly a processing by-product. The safflower achenes are the by-product of safflower oil production, the linseed capsules are the by-product of either linen or linseed oil production, and cereal chaff is the by-product of cereal grain processing. All of these processing by-products are of economic value as fuel, fodder, or temper (e.g. Hillman 1984a, 1984b, 1985; G. Jones 1984; Langer and Hill 1991: 294; Knowles 1955: 293-294; Unger 1866: 46-47); and could be sold or traded. Whether the monastery at Kom el-Nana grew these crops, or received them as rent or gifts, it is clear that many kinds of agricultural by-products (safflower achenes, linseed / flax capsules, and cereal chaff and straw) were in use at Kom el-Nana, possibly as fuel, fodder and temper.

Chapter 7. Data Patterns, Dominance, and Cross-Contamination

This chapter explores the patterns which underlie the Kom el-Nana archaeobotanical assemblage. The relative contribution of plant categories is explored for each context type and each individual sample. Those plants which dominate the assemblage by overall count, by presence, or by overall count in individual samples are examined. Finally, multivariate statistics are used to explore patterns underlying the Kom el-Nana data set.

7.1 Relative Contribution of Plant categories by Context

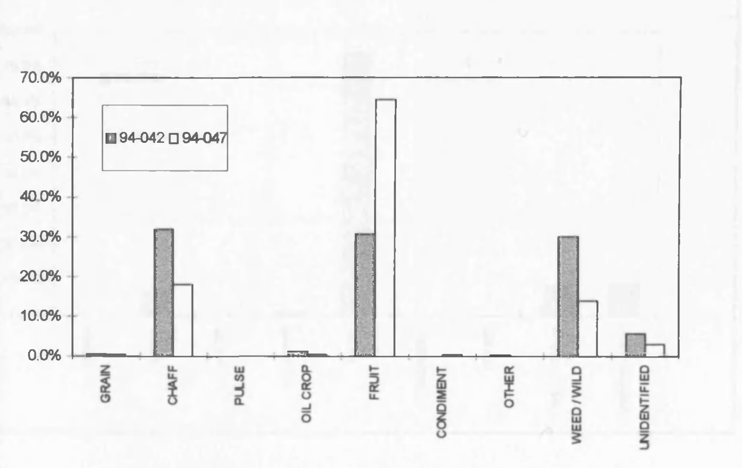
In Chapter 5 (see §5.1) cereal chaff, fruit and weed / wild plants were shown to be the most abundant plant categories found in both the carbonized and desiccated components of the overall assemblage. Here, the relative contribution of the various plant categories is examined for each individual sample by context type (see Chapter 3 §3.5), for all the desiccated samples and for those carbonized samples from floor, oven, midden and rubble contexts which contained 10% or more of the total identifications made overall in an individual sample.

This section simply presents the patterns observed in individual samples from each context type and generally puts forward no conclusions on the origins of this material, except in cases where the presence of plants in that context directly explains use (i.e. fuel in ovens, temper in mudbrick). Whether these samples represent primary or cross-contaminated contexts, however, will be explored below in §7.4.

7.1.1 The alley samples

Two samples were collected from an alleyway. In total 1251 identifications were made of which 1248 (or 99.8%) were desiccated. Figure 7.1 shows that desiccated cereal chaff, fruit and weed / wild plant remains are abundant in both alley samples. Free threshing wheat rachis internodes, barley rachis internodes and culm nodes dominate the cereal chaff remains in these samples. Common fig and

Figure 7.1 Proportion of plant categories in the desiccated component of the alley samples. (94-042 = 340 and 94-047 = 907)

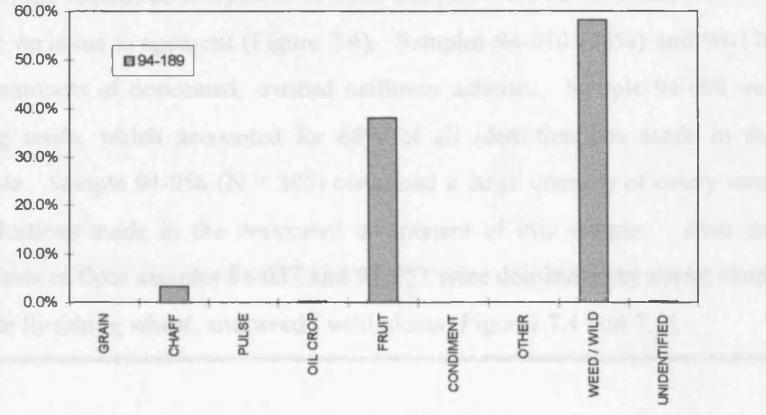


sycomore fig are the most dominant fruit remains in both samples and seeds of *Portulaca oleracea* and *Chenopodium murale* dominate the weed / wild component of the assemblage.

7.1.2 The animal stall sample

The animal stall sample is also dominated by desiccated remains which comprise 5082 of the 5084 identifications made in this sample. In Figure 7.2, fruit and weed / wild plants dominate this sample. The weed / wild plants are primarily seeds of *Chenopodium murale*. Like the alley samples, common fig and sycomore fig form the majority of identifications of fruit. In total the identifications of common fig, sycomore fig and *Chenopodium murale* account for 90% of all identifications made in this sample. A small amount of cereal chaff, primarily free threshing wheat rachis internodes, was also identified in this sample.

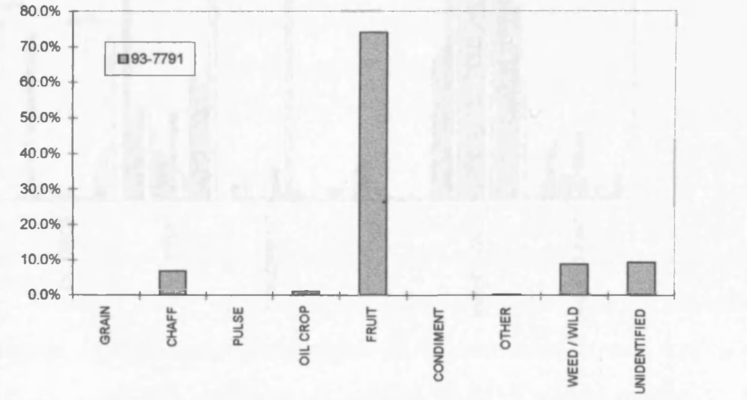
Figure 7.2 Proportion of plant categories in the desiccated component of the animal stall sample. (94-189 = 5082)



7.1.3 The drain sample

The drain sample primarily contained desiccated plant remains, accounting for 389 or 98% of the 396 identifications made from this sample. Identifications of common fig, sycomore fig and cucumber / melon account for 70% of all identifications made in this sample. Figure 7.3 shows the dominance of fruit in this sample.

Figure 7.3 Proportion of plant categories in the desiccated component of the drain sample. (93-7791 = 389)



7.1.4 The floor samples

Fourteen floor samples were studied from Kom el-Nana. All floor samples were dominated by desiccated plant remains, but carbonized plant remains did produce more than 10% of all identifications made in floor samples 94-037 (N = 47 or 20.6%) and 94-053 (N = 49 or 14.3%). Small amounts of carbonized remains were found in the other samples, but these never exceeded 10% of all identifications made in a sample. In total 5671 identifications were made in the floor samples of which 5456 were desiccated identifications, accounting for 96.2% of all identifications made in these samples.

The most abundant plant remains in the desiccated component of these samples were cereal chaff, fruit and weed / wild plants; however, some variation is apparent (Figure 7.4). Samples 94-010 (26%) and 94-176 (26%) both contained substantial amounts of desiccated, crushed safflower achenes. Sample 94-008 was clearly dominated by common fig seeds, which accounted for 68% of all identifications made in the desiccated component of this sample. Sample 94-056 (N = 305) contained a large quantity of celery seed, accounting for 42% of all identifications made in the desiccated component of this sample. Both the desiccated and carbonized components of floor samples 94-037 and 94-053 were dominated by cereal chaff, particularly rachis internodes of free threshing wheat, and weed / wild plants (Figures 7.4 and 7.5).

Figure 7.4 Proportion of plant categories in the desiccated component of the floor samples.
(desiccated identifications for 94-008 =183, 94-010 = 518, 94-011 = 481, 94-012 = 427, 94-035 = 366, 94-036(2) =409, 94-037 = 181, 94-049 = 367, 94-053 =293, 94-056 =732, 94-057 =175, 94-058 = 431, 94-090 = 431 an d94-176 = 462.)

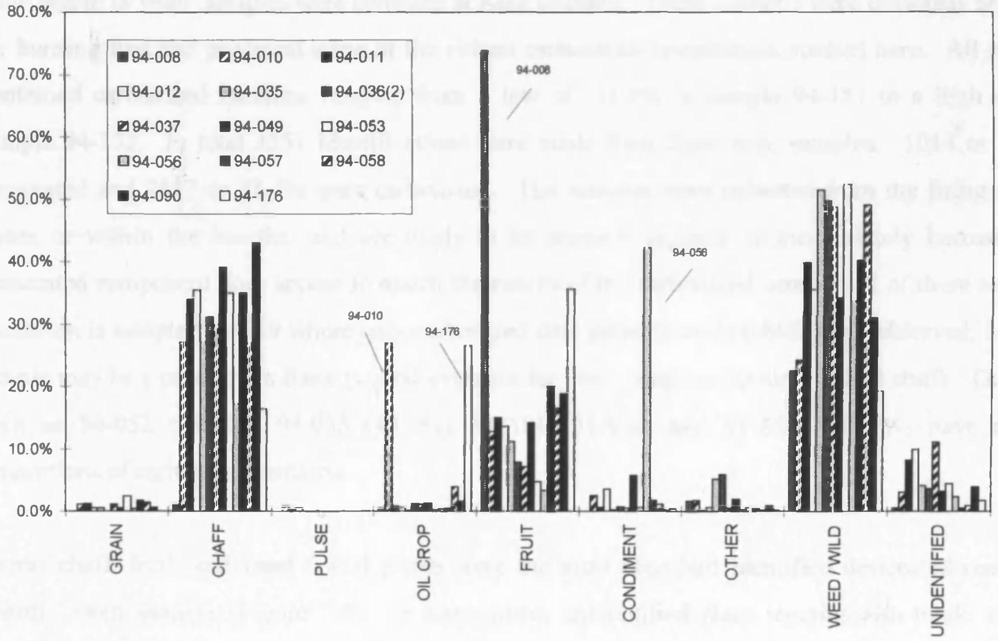
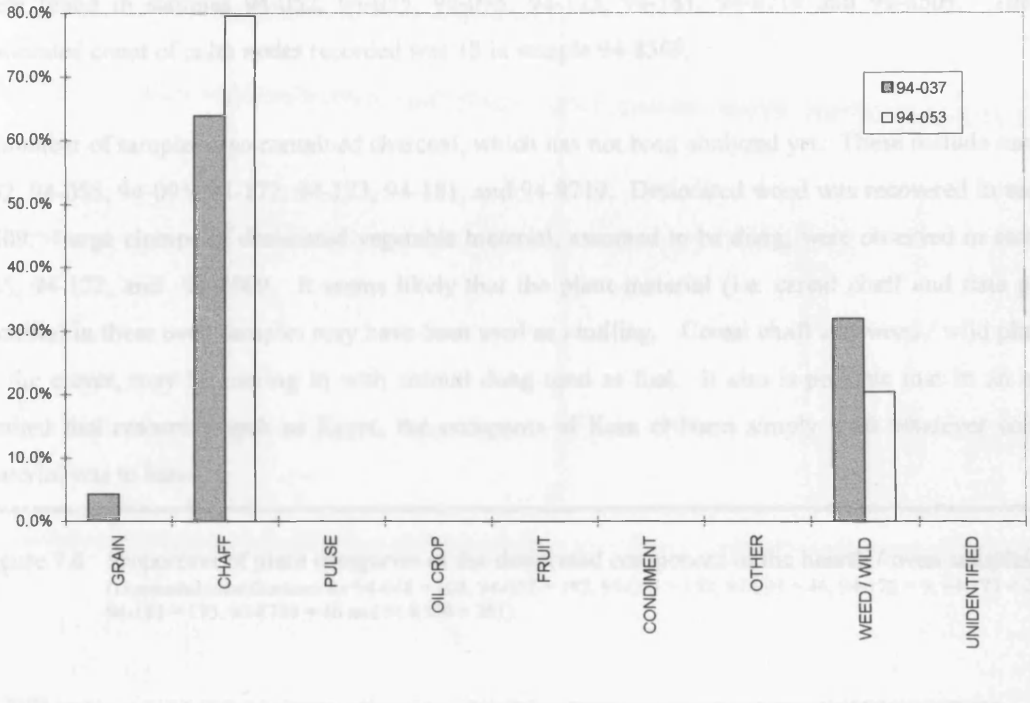


Figure 7.5 Proportion of plant categories in the carbonized component of the floor samples.
(Only two of the floor samples contained >10% carbonized identifications for the overall assemblage. Carbonized identifications for 94-037 = 47 and 94-053 = 49.)



7.1.5 *The hearth / oven samples*

Nine hearth or oven samples were collected at Kom el-Nana. These contexts were obviously areas set aside for burning fuel and produced some of the richest carbonized assemblages studied here. All nine samples contained carbonized remains, ranging from a low of 31.4% in sample 94-181 to a high of 97.8% in sample 94-172. In total 3551 identifications were made from these nine samples. 1014 or 28.6% were desiccated and 2537 or 71.4% were carbonized. The samples were collected from the firing chambers of ovens or within the hearths, and are likely to be primary deposits of incompletely burned fuel. The desiccated component does appear to match the results of the carbonized component of these samples. The exception is sample 94-8719 where only carbonized date perianth and rachilla were observed; however, this simply may be a case where there is good evidence for near complete burning of fuel stuffs. Other samples such as 94-052 (48.5%), 94-055 (43.5%), 94-181 (31.4%), and 94-8509 (32.7%) have much lower proportions of carbonized remains.

Cereal chaff, fruit, and weed / wild plants were the most abundant identified desiccated remains in the hearth / oven samples (Figure 7.6). In some cases, unidentified plant remains also made an important contribution to the desiccated assemblage. The carbonized component of the oven samples was dominated by cereal chaff and weed / wild plants, with the exception of sample 94-8719 which produced 108 carbonized date perianths and 197 date rachillae (Figure 7.7). An unidentified species of clover (*Trifolium* sp.) accounted for 44% of all carbonized identifications in sample 94-048 and 33% of all desiccated identifications in sample 94-052. Rachis internodes of free threshing wheat and barley were found in both the desiccated and carbonized components of the oven samples. Carbonized culm nodes were found in all oven samples and in high numbers in sample 94-095 (57) and sample 94-173 (41). Desiccated culm nodes were found in samples 94-052, 94-055, 94-095, 94-173, 94-181, 94-8719 and 94-8509. The highest desiccated count of culm nodes recorded was 18 in sample 94-8509.

A number of samples also contained charcoal, which has not been analyzed yet. These include samples 94-052, 94-055, 94-095, 94-172, 94-173, 94-181, and 94-8719. Desiccated wood was recovered in sample 94-8509. Large clumps of desiccated vegetable material, assumed to be dung, were observed in samples 94-055, 94-172, and 94-8509. It seems likely that the plant material (i.e. cereal chaff and date perianth / rachilla) in these oven samples may have been used as kindling. Cereal chaff and weed / wild plants, such as the clover, may be coming in with animal dung used as fuel. It also is possible that in an area with limited fuel resources such as Egypt, the occupants of Kom el-Nana simply used whatever combustible material was to hand.

Figure 7.6 Proportion of plant categories in the desiccated component of the hearth / oven samples. (Desiccated identifications for 94-048 = 108, 94-052 = 192, 94-055 = 152, 94-095 = 46, 94-172 = 9, 94-173 = 25, 94-181 = 175, 94-8719 = 46 and 94-8509 = 261)

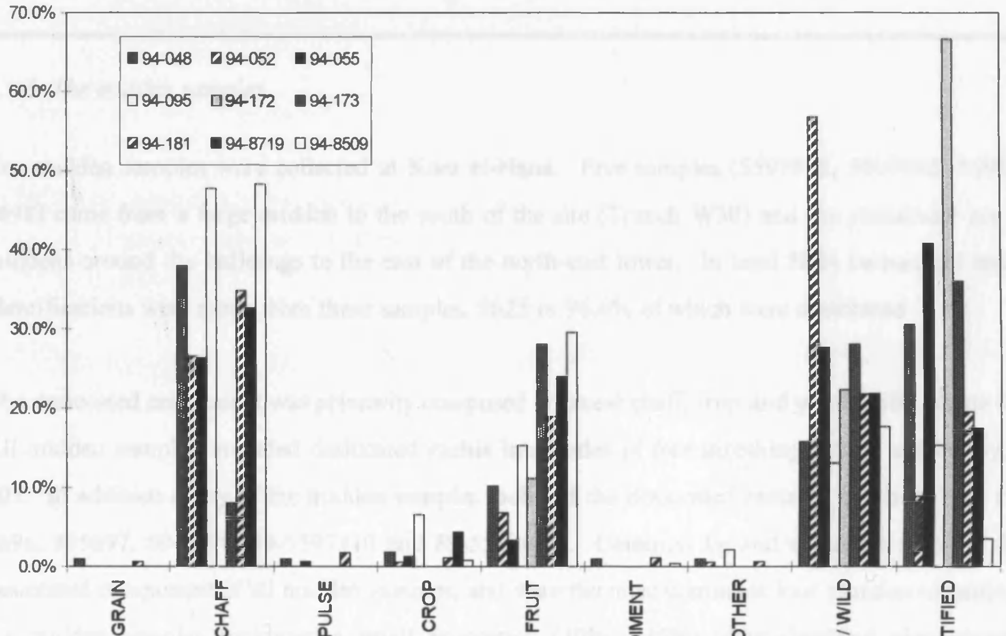
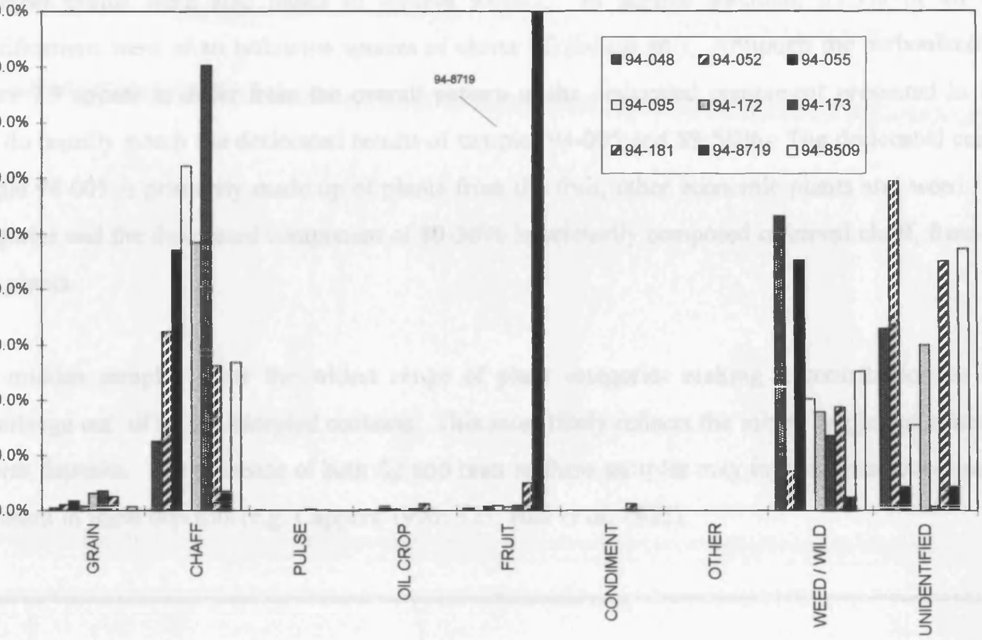


Figure 7.7 Proportion of plant categories in the carbonized component of the hearth/oven samples
(Carbonized identifications for 94-048 = 652, 94-052 = 182, 94-055 = 117, 94-095 = 410, 94-172 = 397, 94-173 = 228, 94-181 = 80, 94-8719 = 344 and 94-8509 = 127)



7.1.6 The midden samples

Ten midden samples were collected at Kom el-Nana. Five samples (5597#10, 5597#12, 5696, 5697 and 5698) come from a large midden to the south of the site (Trench W30) and the remainder are from small middens around the buildings to the east of the north-east tower. In total 5824 carbonized and desiccated identifications were made from these samples, 5625 or 96.6% of which were desiccated.

The desiccated component was primarily composed of cereal chaff, fruit and weed / wild plants (Figure 7.8). All midden samples included desiccated rachis internodes of free threshing wheat and barley, except 94-005. In addition many of the midden samples included the desiccated remains of wheat bran (94-020, 89-5696, 895697, 89-5698, 89-5597#10 and 89-5597#12). Common fig and sycomore fig were found in the desiccated component of all midden samples, and were the most dominant fruit remains identified. Many of the midden samples contained a small proportion (10% - 15%) of unidentified plant remains. The desiccated component of sample 89-5698 exhibits a somewhat different trend to the other midden samples by including significant amounts of unidentified stamen and anther, accounting for 26.6% of all desiccated identifications in this sample. Sample 94-005 is slightly unusual in that it only contained low amounts (<2%) of cereal chaff in the desiccated component.

The carbonized remains from two samples, 94-005 and 89-5696, accounted for more than 10% of the overall assemblage of each sample (Figure 7.9). Carbonized date perianth and flowers account for 32% of all carbonized identifications in sample 94-005. Both carbonized (6) and desiccated (10) detached embryos of cereal grains were also found in sample 94-005. In sample 89-5696, 57.5% of all carbonized identifications were of an unknown species of clover (*Trifolium* sp.). Although the carbonized results in Figure 7.9 appear to differ from the overall pattern of the desiccated component presented in Figure 7.8, they do broadly match the desiccated results of samples 94-005 and 89-5696. The desiccated component of sample 94-005 is primarily made up of plants from the fruit, other economic plants and weed / wild plant categories and the desiccated component of 89-5696 is primarily composed of cereal chaff, fruit and weed / wild plants.

The midden samples show the widest range of plant categories making a contribution to the overall assemblage out of all the sampled contexts. This most likely reflects the mixed origins of material in such rubbish deposits. The presence of both fig and bran in these samples may indicate that faecal material also is present in these deposits (e.g. Cappers 1996: 325; Hall *et al.* 1983).

Figure 7.8 Proportion of plant categories in the desiccated component of the midden samples.
(Desiccated identifications for 94-002 = 749, 94-005 = 213, 94-020 = 962, 94-023 = 218, 94-024 = 742, 89-5696 = 299, 89-5797 = 599, 89-5698 = 332, 89-5597#10 = 495 and 89-5597#12 = 1074.)

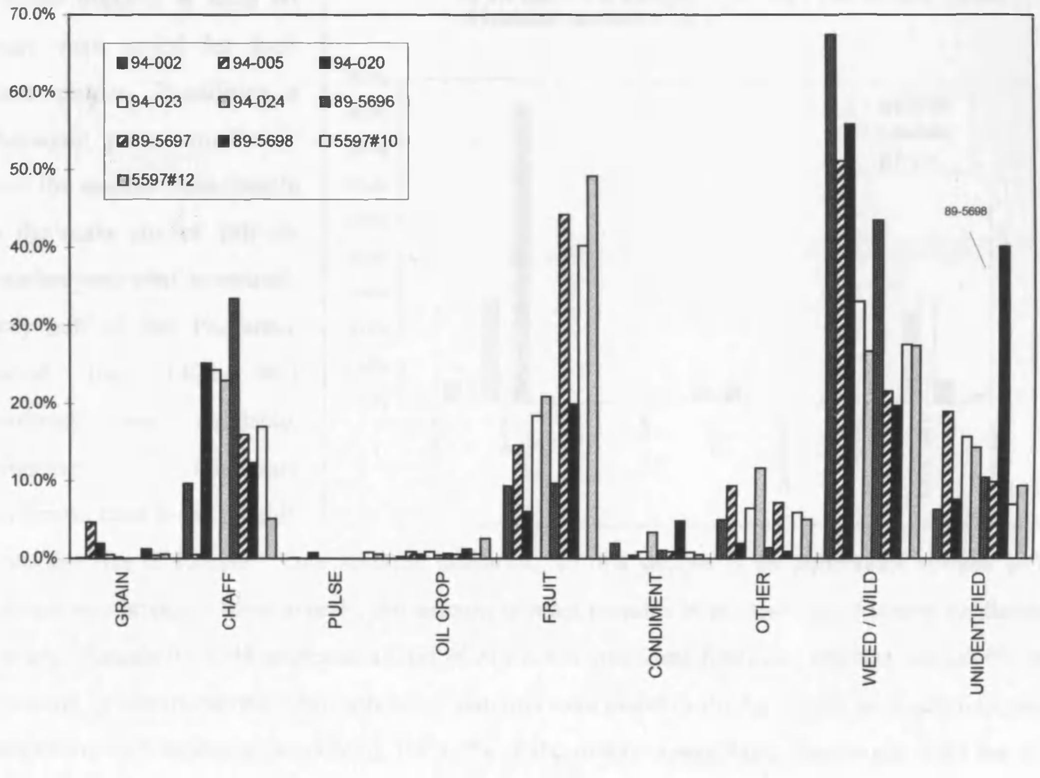
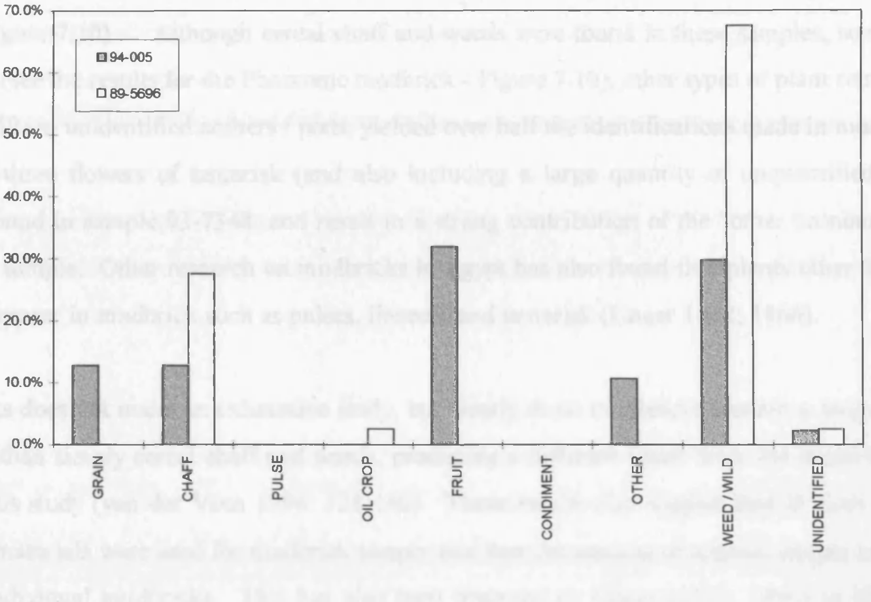
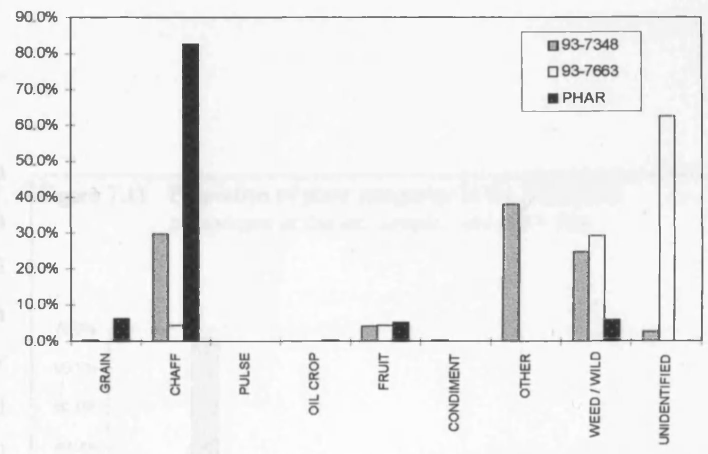


Figure 7.9 Proportion of plant categories in the carbonized component of the midden samples
(Carbonized identifications for 94-005 = 47 and 89-5696 = 40)



7.1.7 *The mudbrick samples*

Figure 7.10 Proportion of plant categories in the desiccated component of the mudbrick samples. (93-7348 = 219, 93-7663 =24 and ½ Pharaonic mudbrick = 275.)



Two mudbricks from Late Antique deposits at Kom el-Nana were sorted for their plant remains. In addition, a Pharaonic period mudbrick, from the smaller Aten temple in the main city of Tell el-Amarna was also examined. Only half of this Pharaonic period (ca. 1400 BC) mudbrick was available; however, Pharaonic mudbricks tend to be roughly twice the size of Roman / Late Antique mudbrick, so this sample is an equivalent volume to the Late Antique mudbricks. Most notably, the amount of plant remains in the two Late Antique mudbricks varied sharply. Sample 93-7348 produced a total of 219 desiccated identifications; whereas sample 93-7663 only produced 24 identifications. No carbonized remains were found in the Late Antique mudbricks; and only 9 carbonized identifications, accounting for 3.2% of the overall assemblage, were made from the Pharaonic mudbrick.

The three mudbricks examined produced different results from the unspecified number of Roman period mudbricks, studied by van der Veen (1996), which primarily contained cereal chaff and weeds. In the case of the two Kom el-Nana Late Antique mudbricks, these plant categories do not clearly dominate the assemblages (Figure 7.10). Although cereal chaff and weeds were found in these samples, sometimes in large quantities (see the results for the Pharaonic mudbrick - Figure 7.10), other types of plant remains were also present. Fifteen unidentified anthers / pods, yielded over half the identifications made in mudbrick 93-7663. Eighty-three flowers of tamarisk (and also including a large quantity of unquantified tamarisk needles) were found in sample 93-7348, and result in a strong contribution of the "other economic plants" category in this sample. Other research on mudbricks in Egypt has also found that plants other than cereal and weeds can appear in mudbrick such as pulses, linseed, and tamarisk (Unger 1862; 1866).

Three mudbricks does not make an exhaustive study, but clearly these mudbricks contain a larger range of plant materials than simply cereal chaff and weeds, producing a different result from the mudbricks in the Mons Claudianus study (van der Veen 1996: 138-140). These results also suggest that at Kom el-Nana a wider range of materials were used for mudbrick temper and that the amount of organic temper can sharply vary between individual mudbricks. This has also been observed by Unger (1862; 1866) in his study of Pharaonic mudbricks from the Dashur pyramid and Eileithyia. Finally, these results imply other plant remains in addition to cereal chaff and weeds can erode out of mudbrick and become mixed with other deposits (i.e. house floors), further complicating the already complex taphonomic processes involved in the erosion of mudbrick (van der Veen 1996 and forthcoming b) and the more general taphonomic processes already known to occur at desiccated sites in Egypt (Rowley-Conwy 1994).

7.1.8 The pit sample

A shallow pit or groove within a room was sampled for plant remains. In total 183 identifications were made from this sample, of which 176 or 96.2% were desiccated. Cereal chaff accounted for 67.6% of all desiccated identifications in the pit sample (Figure 7.11). Most notably, rachis internodes are almost entirely missing from this sample. Instead, glumes of macaroni wheat and wheat awn

Figure 7.11 Proportion of plant categories in the desiccated component of the pit sample. (94-043 = 176)

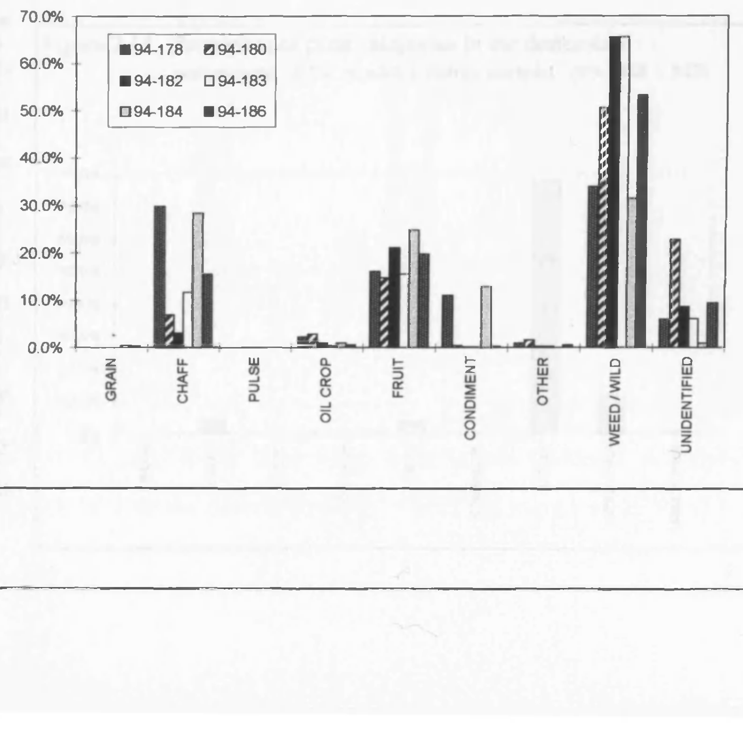
dominate these remains. Seeds identified as members of the Zygophyllaceae family, and *Setaria* spp. seeds dominate the weed / wild remains in this sample.

Two possible explanations for the presence of such light elements of cereal chaff in this shallow pit present themselves. First, after abandonment, possibly even during occupation, a rodent or small animal made a nest in this area. However, no faeces were found in the sample, as have been found elsewhere on site, and there is no evidence of gnawing or scratching in the area. Second, it could be possible that this material represents stuffing which has filtered out through the covering of a mattress or pillow, and collected in this shallow trench. At present, however, no conclusive interpretation of this sample can be put forward.

7.1.9 The pot slot samples

Six mudbrick bins or 'pot slots' which supported storage jars were sampled for plant remains. In total 2219 identifications were made from these samples, 2182 or 98% of which were desiccated. The pot slots are dominated by weed / wild plants, but other categories of plant remains such as cereal chaff and fruit were also abundant. (Figure 7.12). In addition oil and condiment crops, such as safflower achenes, linseed capsule, and condiments (especially coriander), also were found in these samples. One seed of opium poppy was found in sample 94-186. Only two opium poppy seeds have been found in the Kom el-Nana assemblage and it is not possible to determine whether these are merely weeds of crops or economic plants. Desiccated cereal chaff remains are dominated by rachis internodes of wheat and barley. With the exception of almond and pomegranate, all other fruits found in the Kom el-Nana assemblage are present in these samples. Seeds of *Portulaca oleracea* dominated the weed / wild plant remains in these samples. *Glinus lotoides* and *Chenopodium murale* also were found in all samples.

Figure 7.12 Proportion of plant categories in the desiccated component of the pot slot samples. (94-178 = 218, 94-180 = 245, 94-182 = 586, 94-183 = 631, 94-184 = 194, and 94-186 = 308)

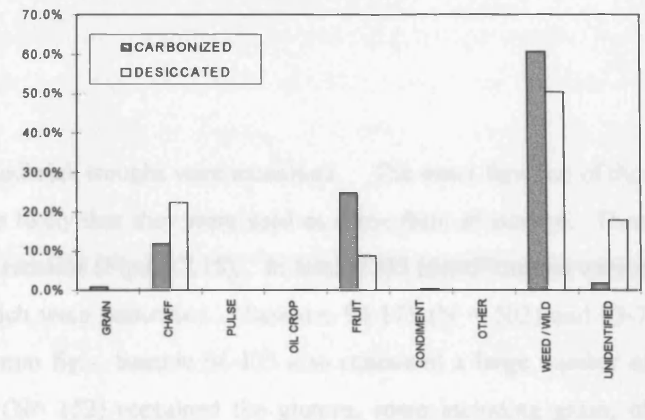


Interpretation of the contents of these samples is not straightforward. These samples are not from primary storage, but from the structure supporting storage jars. At a later phase, this storage area was abandoned. The storage jars were pushed down into each pot slot and the entire area was covered over by a plaster floor. The mixture of material seen in these samples is likely to be a reflection of the possible sources of material in this storage area. Potential sources for these samples include the mudbrick walls used to support the storage jars, dumping debris packed underneath the plaster floor when the storage area was abandoned, and the remains of stored products (not necessarily just foodstuffs).

7.1.10 The mudbrick rubble sample

One sample of mudbrick rubble was examined. In total 758 identifications were made, 649 or 85.6% were desiccated and 109 or 14.4% were carbonized. Cereal chaff, fruit and weed / wild plants are abundant in both components of the assemblage (Figure 7.13). Rachis internodes of wheat and barley, common fig, sycomore fig, mulberry and seeds of *Glinus lotoides* are the most abundant finds in this assemblage. Like mudbrick 93-7663, unidentified stamen, stigma and anthers are found in the unidentified category of the desiccated component. In addition complete flower heads and parts of an unidentified capsule were also found in the desiccated component. Like the mudbrick, the mudbrick rubble sample contains a variety of plant categories. Since the deposit was sealed, it seems likely that the source of these plant remains is from the broken and decayed mudbrick within this archaeological context.

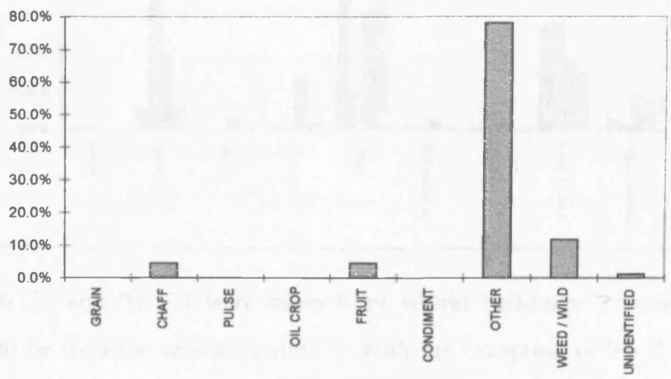
Figure 7.13 Proportion of plant categories in both components of the rubble sample. (Desiccated identifications for 94-031 = 649 and carbonized identifications for 94-031 = 109)



7.1.11 The squatter camp sample

The squatter camp sample was collected from an area believed to be a temporary encampment at Kom el-Nana, after the abandonment of the monastery. The sample is overwhelmingly dominated by the remains from the "other economic plant" category (Figure 7.14). The sample was almost entirely devoid of economic plant

Figure 7.14 Proportion of plant categories in the desiccated component of the squatter camp sample. (93-7348 = 247)



remains (23 identifications in total), except for the flowers (N= 193) and the unquantified leaves of tamarisk (*Tamarix aphylla* L. - for the economic uses see Chapter 5 §5.2.6). Only 29 further identifications were made of weed / wild and unidentified plants in the sample. A few carbonized leaves of tamarisk were identified, but no quantified carbonized remains were found.

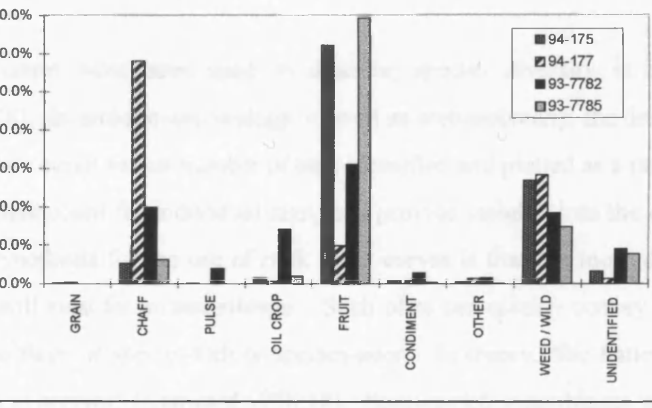
This sample is almost entirely made up of remains of tamarisk. The source of tamarisk needle and flower could be from a tree surviving in the ruins of the site, but also could come from material eroding out of mudbricks in the area. A complete mudbrick, mudbrick 7348, was collected from this context and contained an abundance of tamarisk flower and needle.

7.1.12 The trough samples

Four samples of the contents from mudbrick troughs were examined. The exact function of these troughs was not clear during excavation. It is likely that they were used as some form of storage. These samples also contained a wide variety of plant remains (Figure 7.15). In total, 2335 identifications were made from these samples, 2321 or 99.4% of which were desiccated. Samples 94-175 (N = 502) and 93-7785 (N = 447) are dominated by seeds of common fig. Sample 94-175 also contained a large number of purslane seeds (N = 115). Sample 94-177 (N= 152) contained the glumes, some including grain, of an early sorghum cultivar (*Sorghum bicolor* race unknown). This is the only find of sorghum in the assemblage. Sample 93-7782 primarily contained rachis internodes of wheat and barley, crushed safflower achenes, seeds of common fig and sycomore fig, seeds and involucres of clover (*Trifolium* sp.), and seeds of *Malva* sp.

The exact function of these troughs has not been clarified by the study of their plant assemblages. There is an abundance of fruit in these samples, and these troughs may represent storage areas of plants intended for consumption or use (i.e. as fuel or temper). Perhaps the same is true for the sorghum found in sample 94-177. Alternatively, all of these materials could be used for animal fodder; however, samples 94-175 and 94-177 were taken from within buildings in rooms with plastered floors, areas not expected to be used for animal stalling. With the exception of 94-177, these

Figure 7.15 Proportion of plant categories in the desiccated component of the trough samples.
(94-175 = 950, 94-177 = 492, 93-7782 = 213 and 93-7785 = 666)



samples do broadly follow the results of the "animal stall sample", which was dominated by fruit and weed / wild plants. It may be possible that these troughs are simply multi-functional, providing a tidy but basic area for the storage of both human and animal foodstuffs.

7.1.13 Significance of patterning by context and sample

Although chaff, fruit and weed / wild plants are some of the most frequently found plant categories in the overall archaeobotanical assemblage; the relative proportion of each category varies between samples (for example, see Figures 7.1 and 7.2). Many of these samples are dominated by one category of plant remain, which often accounts for 50% or more of the total identifications made (e.g. trough samples 94-175 and 93-7785 in Figure 7.15 above). In several cases, it is clear that individual samples are dominated by a single species (e.g. floor samples 94-010 and 94-176 in Figure 7.4 above). Generally, archaeobotanical assemblages comprised of a single species are considered primary (e.g. storage of grain, parched glume wheats, crop processing debris etc...) and archaeobotanical assemblages comprised of a mixture of unrelated species, at least in terms of agricultural practice or consumption, are considered intentionally mixed (e.g. midden, cess pit, etc...) or contaminated. The Kom el-Nana samples exhibit features of both primary and mixed deposits. Whether these are contaminated deposits (i.e. from mudbrick or post-abandonment debris) or evidence for the use of the same suite of plant remains for a number of different purposes (i.e. food, fodder, fuel and temper) at Kom el-Nana remains to be examined (see § 7.4).

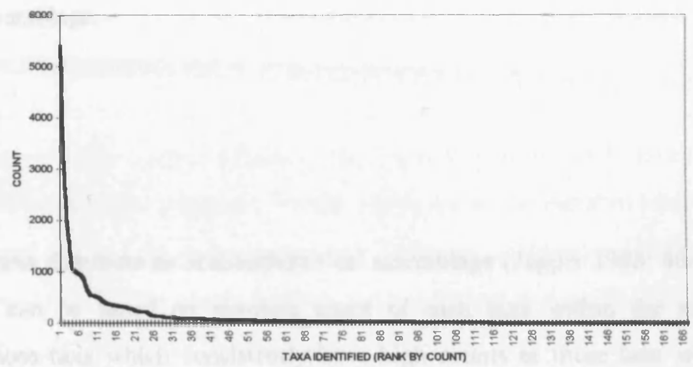
7.2 Absolute Count and Diversity

Many of the Kom el-Nana samples clearly are dominated by a single plant category. In most cases this was a result of the abundance of a small number of taxa or even a single taxon within a sample. Before discussing how individual taxa dominate the Kom el-Nana assemblage, it is worth exploring the character of dominance by absolute count in the overall assemblage.

Patterns of dominance by absolute count have been used to describe species diversity in archaeo-entomological faunas by Kenward (1978). In archaeo-entomology, as well as archaeobotany, the description of an assemblage as a function of absolute count versus number of taxa identified and plotted as a rank order curve (i.e. in descending order of absolute count for individual taxa) can provide insights into the diversity of taxa within an assemblage. The hypothesis for the use of rank order curves is that the more diverse a population, the more sources of origin will exist for an assemblage. Such plots can quickly convey whether an individual sample or an entire assemblage is species-rich or species-poor. In theory, "the flatter a rank order curve the richer is the population in species" (Kenward 1978:18). Species-rich assemblages will have a long flat curve with a majority of species occurring in low numbers and a species-poor assemblage will have a short curve with high counts for the majority of species present.

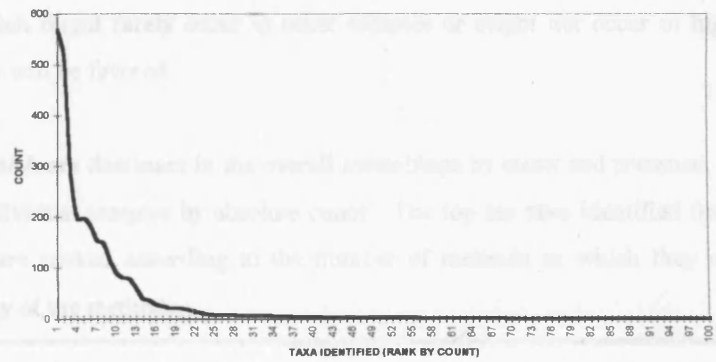
Figures 7.16 and 7.17 present the rank order curves for the desiccated and carbonized components of the Kom el-Nana archaeobotanical assemblage. A different number of taxa are preserved in the desiccated component than in the carbonized component and, therefore, the rank order curves for the carbonized and desiccated component are plotted separately. In each graph the total count for an individual taxon was ranked in descending order and plotted as a curve.

Figure 7.16 Rank order curve of desiccated taxa arranged in descending order by absolute count.



Figures 7.16 and 7.17 clearly demonstrate that both the desiccated and carbonized components of the Kom el-Nana assemblage are species-rich. The rank order curves show that in both the desiccated and carbonized component only a small group of taxa dominate the overall assemblage by absolute count. In addition, the plots strongly suggest that both the carbonized and desiccated plant remains are likely to be derived from a number of different sources.

Figure 7.17 Rank order curve of carbonized taxa arranged in descending order by absolute count.



N.B. *A smaller range of taxa were found in the carbonized component of the Kom el-Nana assemblage. In addition the rank order of taxa by count is in an entirely different order to the desiccated taxa shown in Figure 7.16.*

In the previous section many samples consistently had an abundance of cereal chaff, fruit and weed / wild plant categories. The presence of fruit and cereal chaff together implies that materials from two different agricultural zones, namely arable fields and gardens / orchards, are mixed together in these deposits. Fruits have a number of potential uses, such as food, fodder and medicinal uses. Cereal chaff also has a number of potential uses, such as temper, fodder, fuel, matting, stuffing or packing. The rank order curves show that both the carbonized and desiccated component of this assemblage are species rich, and likely to be derived from a number of potential sources. In contexts such as middens or floors, there could be a number of potential routes for the arrival of this material into the samples. In addition, one further result of the rank order curves is that only a few taxa highly dominate this assemblage by absolute count. Is it possible that a few taxa, used in a variety of different ways on site (i.e. food, fodder, fuel, etc...) explain the patterns observed in this assemblage? The following section explores the various patterns of dominance for individual taxa in the Kom el-Nana assemblage.

7.3 Dominance

There are three ways to assess which taxa dominate an archaeobotanical assemblage (Popper 1988: 60-62). First, dominance of individual taxa can be based on absolute count of each taxa within the entire assemblage. This approach favors those taxa which consistently have high counts or those taxa which perhaps do not occur in as many samples, but have very high counts when they are present. Dominance by absolute count, however, neglects those taxa which are consistently present in the samples, but occur in low numbers. A second method to determine dominance is to calculate dominance on the basis of presence (i.e. the number of samples in which a taxon is present). This method will favor those taxa which are consistently present in the samples regardless of count, but does not favor those taxa which only are present in a few samples. This method overlooks those taxa which dominate only a few samples by absolute count. A third method for calculating dominance identifies those taxa which dominate individual samples by absolute count. In this way, taxa which might rarely occur in other samples or might not occur in high numbers within the overall assemblage will be favored.

Table 7.1 lists those desiccated taxa which are dominant in the overall assemblage by count and presence, as well as those taxa which dominate individual samples by absolute count. The top ten taxa identified from each method of dominance analysis are ranked according to the number of methods in which they are dominant, although not in order for any of the methods.

Table 7.1 Ten most dominant desiccated taxa in each of the three dominance methods. (N = 52 samples)

DESICCATED TAXA	**OVERALL ASSEMBLAGE**		**INDIVIDUAL SAMPLE(S)**
	BY COUNT	**BY PRESENCE**	**BY COUNT**
Ficus carica L.	✓	✓	✓
Chenopodium murale L.	✓	✓	✓
Portulaca oleracea L.	✓	✓	✓
Triticum sp. - free threshing rachis internode	✓	✓	✓
Ficus sycomorus L.	✓	✓	✓
Cerealia - indeterminate rachis internode	✓	✓	✓
Tamarix aphylla (L.) Karst	✓	✓	✓
Cerealia - indeterminate culm node	✓	✓	
Setaria spp.	✓		✓
Glinus cf. *lotoides* L.	✓		✓
Unknown U - *Lawsonia*-like seed		✓	
Linum usitatissimum L. - capsule		✓	
Carthamus tinctorius L.			✓

Seven desiccated taxa dominate the desiccated component in all three dominance analysis methods. Cereal culm nodes are dominant by count and presence in the overall assemblage, but never dominate an individual sample. The weed / wild plants *Setaria* spp. and *Glinus* cf. *lotoides* are dominant in the overall assemblage by absolute count and do dominate individual samples, but are not ranked as the top ten taxa most often present in the overall assemblage. Although both taxa do not dominate the assemblage based on presence, *Setaria* spp, is present in 42 or 80.8% of all samples and is only just outside the top ten taxa which are dominant based on presence, and *Glinus* cf. *lotoides* is present in 34 or 65% of all samples. Two taxa, an unidentified species (Unknown U - *Lawsonia*-like seed) and linseed / flax capsule (*Linum usitatissimum*) do occur in the top ten most dominant species based on presence. In both cases, these taxa occur in relatively low numbers, but are consistently present in the Kom el-Nana samples. Safflower (*Carthamus tinctorius*) dominates two floor samples (94-010 and 94-176) based on absolute count, although this species does not dominate the overall assemblage by either absolute count or presence.

Table 7.2 summarizes those carbonized taxa which dominate the overall assemblage by count or presence, and dominate individual samples by count. Again, the top ten species identified from each method are ranked according to the number of methods in which they are dominant, although not in order for any of the methods.

Table 7.2 Ten most dominant carbonized taxa in each of the three dominance methods. †

CARBONIZED TAXA	OVERALL ASSEMBLAGE (N = 52)		INDIVIDUAL SAMPLE(S) (N = 14)
	BY COUNT	BY PRESENCE	BY COUNT
Trifolium spp. - seed	✓	✓	✓
Triticum sp. - free threshing rachis internode	✓	✓	✓
Cerealia - indeterminate rachis internode	✓	✓	✓
Gramineae - small seeded	✓	✓	✓
Cerealia - indeterminate culm node	✓	✓	
Hordeum vulgare L. - rachis internode	✓	✓	
Triticum durum Desf. - rachis internode	✓	✓	
Indeterminate	✓		✓
Phoenix dactylifera L. - rachilla	✓		✓
Phoenix dactylifera L. - perianth	✓		
Malva sp.		✓	
Triticum sp. - basal rachis internode		✓	
Tamarix aphylla (L.) Karst - needle		✓	
Ficus carica L.			✓

† *Although all 52 samples were used to calculate dominance by absolute count or presence, dominance for individual samples based on absolute count was based on those fourteen samples which had carbonized remains accounting for 10% or more of the combined desiccated and carbonized counts. The dominance results for this third method may favor the hearth / oven samples, but avoids calculating dominance in individual samples with under 30 carbonized identifications.*

The top ten dominant species in the carbonized component differ from the desiccated component. Most notably the weed / wild taxa which are dominant in the carbonized and desiccated components are completely different. The carbonized component also is dominated by many more cereal taxa than the desiccated component. In addition, common fig (*Ficus carica*), which is the most dominant species in all three dominance analysis methods in the desiccated component, only dominates one sample by count in the carbonized component and clearly plays a much more minor role in the carbonized component of the Kom el-Nana assemblage.

In addition to these variations in the dominant taxa, the type of dominance also is different in the carbonized component. In the desiccated assemblage, seven taxa were dominant in all three methods of dominance analysis; whereas, in the carbonized assemblage, only four carbonized taxa are dominant in this way. A further three taxa (culm nodes, barley rachis internodes and hard wheat rachis internodes) are dominant in the overall carbonized assemblage by both absolute count and presence. Indeterminate taxa (included here because four of the individual carbonized samples are dominated by indeterminate carbonized plant remains) dominate the overall assemblage by absolute count, as well as four individual samples. Carbonized date rachilla (*Phoenix dactylifera*) also dominate the overall assemblage and a single sample by absolute count. The remaining taxa only are dominant according to one of the three dominance methods.

7.4 Ordination of the Kom el-Nana Data Set

Although a small group of taxa dominate these samples and many samples appear to have similar contents, no clear explanation for this pattern is apparent. It may be that the Kom el-Nana samples have become contaminated, perhaps through the decay of mudbrick (e.g. van der Veen 1996: 138-140; forthcoming b), or through the general mixing of materials in the process of abandonment and re-use of buildings (e.g. Rowley-Conwy 1994). It also is possible that although the plant remains within individual samples are similar, they actually are used in different ways depending on the context. In order to explore this issue further, ordination on the Kom el-Nana samples was carried out.

7.4.1 Pattern searching and ordination

Ordination is commonly used for pattern searching of data sets by community ecologists (e.g. Gauch 1984 and ter Braak 1987) and archaeobotanists (e.g. Jones 1991 and van der Veen 1992a). In this multivariate statistical technique, samples are plotted by x and y co-ordinates, such that samples with similar contents are plotted close together and samples with different contents are plotted far apart on the xy ordination diagram. Ordination analysis was conducted on the Kom el-Nana assemblage using the statistical packages CANOCO (ter Braak 1987-1992) and CANODRAW (Smilauer 1992). The two methods of ordination analysis used in this study are correspondence analysis (CA) or reciprocal averaging which assumes that ecological data has a normal distribution (i.e. when plotted it forms a bell shaped curve), and detrended correspondence analysis (DCA) which is also a form of reciprocal averaging but is specifically designed to mathematically correct for faults in the CA statistical package (Ter Braak 1987).

In modern ecology the interpretation of the resulting ordination diagrams often is dependent on known environmental variables. Factors affecting agricultural crops might include the rotation regime, the previous year's crop, tillage methods, sowing rate, sowing date, manuring, and weeding (e.g. Palmer 1994: 114-148). In addition, the irrigation regime also may be a determining factor (e.g. G. Jones *et al.* 1995). Such environmental data are not available for Kom el-Nana; however, the archaeological context of all of these samples is known. Ordination can be used to consider the effect context type has on the archaeobotanical assemblage.

Correspondence analysis (and detrended correspondence analysis) of the Kom el-Nana data will generate an ordination diagram which places samples with similar contents close together and samples with different contents further apart. If all of the Kom el-Nana samples plot out closely together, it will suggest that many of the Kom el-Nana samples are cross-contaminated; however, if the samples plot out into distinct groupings (i.e. midden samples are separated from pot slot storage samples), it will suggest that although the archaeobotanical contents of these samples initially appear quite similar, there clearly are distinct differences between context types.

7.4.2 Data preparation for multivariate statistical analysis

As discussed in Chapter 4 §4.7, the desiccated and carbonized components of an archaeobotanical assemblage are treated separately in the statistical analysis of this assemblage. Four manipulations of the data were performed on both the desiccated and carbonized Kom el-Nana archaeobotanical data sets prior to correspondence and detrended correspondence analyses.

First, all provisional scores (indicated with cf. before the number in Appendix 1) for a particular taxon were not included. For example, if a sample contained 32 / cf. 8 identifications of fig, only 32 identifications will be used in the multivariate analysis. Second, all taxa were given a seven or eight letter code, and those taxa which were identified to various levels (e.g. *Triticum durum* glume and *Triticum* sp. glume) but which most likely were the same taxa (i.e. free threshing wheat) and / or represented similar ecological conditions were combined. Table 7.3 lists those taxa which were combined under one code and Table 7.5 lists all coded taxa used in the multivariate analyses. Third, any samples with total counts (i.e. combined counts of all identified taxa) under the threshold of 100 were not included in the analysis. Generally, samples with counts under 100 are not considered valid for statistical analysis in archaeobotany (e.g. van der Veen 1992a: 25). In the carbonized component only seven samples had over 100 identifications, resulting in a data matrix that is too small for multivariate analysis (e.g. Gauch 1984: 6). Therefore, only the desiccated Kom el-Nana data was used in the multivariate analysis. Table 7.4 lists those samples which were used in the multivariate analysis.

In correspondence analysis (CA), "species that are both rare and occur in samples with low total abundances are treated as being extremely distinctive" (Gauch 1984: 152). To avoid separation of samples based on taxa which rarely occur in the assemblage, all taxa which occur in only a few samples were removed from the analysis. Various CA trials of coded desiccated data were run, and the threshold for the percentage of occurrences for the taxa in all 52 samples was manipulated. The highest eigenvalues, defined as "the importance measure of the ordination ax[es]" (ter Braak 1987-1992: 4) and expressed as a percentage of the data such that an eigenvalue of 0.540 means that 54% of the ordination diagram of the data is explained by that particular axis, were achieved with reduction of the data to those taxa which occur in 25% (13 samples) or more samples and with at least 100 identifications per sample. A 25% occurrence threshold may seem extreme, but in "ecological studies species are typically defined as rare if they occur in ... fewer than about 5 to 20 of the samples" (van der Veen 1992a: 25). The reduced list of taxa, including combined taxa, is presented in Table 7.5.

Table 7.3 Combined taxa.

TAXA	CODE
Triticum durum rachis internodes *Triticum durum*-type rachis internodes *Triticum aestivum* rachis internodes *Triticum aestivum*-type rachis internodes *Triticum* sp. free threshing rachis internodes *Triticum* sp. terminal rachis internode *Triticum* sp. basal rachis internode	TRITRACH
Triticum dicoccum glume base *Triticum dicoccum* type glume base	TRDITGB
Triticum durum glume *Triticum* sp. glume	TRITGLUM
Triticum durum palea / lemma † *Triticum* sp. palea / lemma	TRITPAL
Hordeum vulgare rachis internode *Hordeum vulgare* pedicelled rachis internode	HORRACH
Rumex sp. - with turbucle(s) *Rumex* sp. - naked	RMXSPNA
Setaria spp. - with palea / lemma *Setaria* spp. - naked	SETARIA

† A lemma was still attached to a rachis internode of *Triticum durum*, and therefore securely identified to *Triticum durum*.

Table 7.4 Desiccated Kom el-Nana samples used in multivariate analyses

SAMPLE	CONTEXT	FULL	REDUCED	SAMPLE	CONTEXT	FULL	REDUCED
94-042	ALLEY	340	306	94-002	MIDDEN	749	647
94-047	ALLEY	907	865	94-005	MIDDEN	213	154
94-189	ANIMAL STALL	5082	4931	94-020	MIDDEN	962	768
93-7791	DRAIN	389	362	94-023	MIDDEN	218	167
94-008	FLOOR	183	108	94-024	MIDDEN	724	550
94-010	FLOOR	518	460	89-5696	MIDDEN	299	210
94-011	FLOOR	481	392	89-5697	MIDDEN	559	456
94-012	FLOOR	427	319	89-5698	MIDDEN	332	185
94-035	FLOOR	366	290	89-5597#10	MIDDEN	495	423
94-036#2	FLOOR	409	306	89-5597#12	MIDDEN	1074	937
94-037	FLOOR	181	126	93-7348	MUDBRICK	219	176
94-049	FLOOR	367	281	94-042	PIT	175	111
94-053	FLOOR	293	251	94-178	POT SLOT	218	177
94-056	FLOOR	732	673	94-180	POT SLOT	245	199
94-057	FLOOR	175	156	94-182	POT SLOT	586	524
94-058	FLOOR	431	357	94-183	POT SLOT	631	531
94-090	FLOOR	431	358	94-184	POT SLOT	194	171
94-176	FLOOR	462	421	94-186	POT SLOT	308	250
94-048*	OVEN	108	64	94-031	MUDBRICK RUBBLE	649	458
94-052	OVEN	192	148	93-7348	SQUATTER CAMP	247	233
94-055*	OVEN	152	96	94-175	TROUGH	950	904
94-181	OVEN	175	119	94-177	TROUGH	492	298
94-8509	OVEN	261	225	93-7782	TROUGH	213	176
				93-7785	TROUGH	666	573

* Oven samples 94-048 and 94-055 had low counts after reducing taxa to those present in 25% or more of the assemblage, but removing these samples from the data did not change eigenvalues in the CA, so they were included.

These manipulations result in a much reduced data set (47 samples by 51 taxa) from the original desiccated raw data (52 samples by 174 taxa), but these changes do allow exploration of the most commonly occurring taxa within those samples which maintain 100 identifications or more. In total, these manipulations reduced the data by only 15%, from a total of 24,630 desiccated taxa to 20,892. Increasing the threshold of taxa occurrence or the number of identifications within a sample beyond this point did not produce higher eigenvalues and, on an intuitive level, became an over extreme reduction of the raw data.

Table 7.5 Individual taxa or taxa groupings used in multivariate analyses.

CEREAL GRAIN	**CODE**
Hordeum sp. (hulled)	HORSPGR
CEREAL CHAFF	
combined *Triticum dicoccum* - glume base	TRDITGB
combined free threshing wheat rachis internodes	TRITRACH
Triticum sp. - rachilla	TRSPRAC
Triticum sp. - awn	TRSPAWN
combined wheat glume	TRSPGLU
combined *Hordeum vulgare* rachis internodes	HORDRACH
Hordeum sp. - awn	HVULAWN
Cerealia - indeterminate culm node	CINDCUL
OIL CROPS	
Linum usitatissimum L. - seed	LINMSED
Linum usitatissimum L. - capsule	LINMCAP
Carthamus tinctorius L.	CARTINC
FRUITS	
Ficus carica L.	FICSCAR
Ficus sycomorus L.	FICSSYC
Morus sp.	MORUSSP
Cucumis sp.	CUCUMSP
Lagenaria siceraria (Mol.) Standl.	LAGESIC
Punica granatum L.	PUNGRAN
Vitis vinifera L. - pip	VITVINP
Vitis vinifera L. - stalk	VITVINS
Olea europaea L. - stone	OLEASTN
Phoenix dactylifera L. - stone	PHOESTN
Phoenix dactylifera L. - perianth	PHOEPER
CONDIMENTS	
Coriandrum sativum L.	CORISAT
Cuminum cyminum L.	CUMICYM
Apium graveolens L.	APIUMGR

OTHER ECONOMIC PLANTS	**CODE**
Tamarix aphylla (L.) Karst. - flower / calyx	TMAPHFL
Myrtus communis L.	MYRTCOM
WEED / WILD COMPONENT	
combined *Rumex* spp.	RMXSPNA
Glinus cf. *lotoides* L.	GLINLOT
Portulaca oleracea L.	POROLER
Vaccaria cf. *pyramidata* Medicus	VACPYRA
Caryophyllaceae - unidentified	CARYOSP
Beta vulgaris L.	BETAVUL
Chenopodium murale L.	CHENMUR
Cornulaca cf. *monocantha* Del.	CORNMON
Chenopodiaceae - unidentified	CHENIND
Coronopus cf. *niloticus* (Del.) Spreng	CORONIL
Trifolium spp. - seed	TRIFSED
Zygophyllaceae - unidentified	ZYGOIND
Malva sp.	MALVASP
Heliotropium spp.	HELIOSP
Verbenaceae / Labiatae	VERBLAB
Cichorium endivia L. / *intybus* L.	CICENIN
Asphodelus spp.	ASPHOSP
Avena spp. - rachilla	AVSPRAC
Crypsis spp.	CRYPSPP
Phalaris paradoxa L.	PHALPAR
combined *Setaria* spp.	SETARIA
Saccharum spontaneum L. *	CYMBOSP
Gramineae - small seeded	GRAMSSD
Cyperus spp.	CYPERSP
UNIDENTIFIED	
?U - *Lawsonia*-like seed	UNKNWNU

* The identification of *Saccharum spontaneum* L. was made after statistical analyses were completed, but was first recorded as *Cymbopogon* sp. The coding was not changed since it has no bearing on the statistical results.

7.4.3 Manipulation of data during multivariate analyses

During multivariate analysis using CANOCO two further manipulations of the data occurred. Both the correspondence analysis (CA) and the detrended correspondence analysis (DCA) in CANOCO were carried out using all default options. Some archaeobotanists (e.g. Kooistra 1996: 76) and community ecologists (Ter Braak 1987: 103) transform their data in order to ensure that the data set is standardized, such that species with exceptionally high or low counts do not unduly influence the ordination of the data. This was attempted here, but both square root and logged square root transformations radically reduced the eigenvalues suggesting that such alterations were not 'pulling in' the upper tail of the data, while leaving the majority of the data unchanged (Shennan 1988: 11 cited in van der Veen 1992a: 26). As a result, both the CA and DCA were run without transformation of the data set.

Several CA runs were made which produced ordination diagrams with one or a few samples plotted well away from the main data cloud. Such samples are termed outliers. In total ten of these outliers were identified in the Kom el-Nana assemblage. All of these clearly contained large quantities of a group of taxa or an individual taxon, which is likely to explain their separation from other samples in the ordination diagram. Table 7.6 presents those outliers removed from the multivariate analysis on this basis. The changes in eigenvalues in the CA after the removal of these outliers is recorded in Table 7.7. The removal of the tenth outlier, animal stall sample 94-189, did result in a considerable reduction in eigenvalues for the first axis, but the resulting ordination diagram produced no further outliers.

Table 7.6 Outliers removed from the correspondence analysis (listed in order of removal from analysis)

OUTLIER SAMPLE	MOST LIKELY EXPLANATION
94-043 (PIT)	Contained large quantities of light chaff (e.g. *Triticum* sp. awn and glume)
94-056 (FLOOR)	Contained large quantities of celery seed
93-7348 (MUDBRICK)	Contained large quantities of tamarisk flower
93-7348 (SQUATTER)	Contained large quantities of tamarisk flower
94-002 (MIDDEN)	Contained large quantities of weed / wild plants, as opposed to economic crops
94-020 (MIDDEN)	Contained large quantities of weed / wild plants, as opposed to economic crops
94-010 (FLOOR)	Contained large quantities of safflower achenes
94-176 (FLOOR)	Contained large quantities of safflower achenes
93-7782 (TROUGH)	Contained an equal proportion of oil crops to cereal chaff
94-189 (ANIMAL STALL)	Contained large quantities of common fig and *Chenopodium murale*.

Table 7.7 Change in eigenvalues for the Kom el-Nana data after outliers were removed in the Correspondence Analysis.

CA Run	OUTLIERS REMOVED FROM CORRESPONDENCE ANALYSIS	Eigenvalues			
		Axis 1	Axis 2	Axis 3	Axis 4
1	None	0.540	0.406	0.381	0.329
2	1 - 94-043	0.537	0.389	0.329	0.254
3	4 - Run 2 + 94-056, 93-7348 (M) and 93-7348 (S)	0.518	0.269	0.217	0.191
4	9 - Run 3 + 94-002, 94-020, 94-010, 94-176 and 93-7782	0.508	0.217	0.178	0.153
5	10 - Run 4 + 94-189	0.314	0.192	0.180	0.133

7.4.4 Correspondence analysis (CA) versus detrended correspondence analysis (DCA)

The results of the CA with all ten outliers removed showed a strong arching effect in the ordination diagram (see Figure 7.18). Hill and Gauch (1980: 47-50) have argued that correspondence analysis does not reliably "extract the correct configuration of data" and often results in an 'arch effect' with distorted relative distances between samples. Although archaeobotanists tend to use CA (e.g. Buurman 1996, G. Jones 1991, and Kooistra 1996), community ecologists (e.g. Hill and Gauch 1980, Gauch 1984) and archaeoentomologists (e.g. Sadler 1991 and D.N. Smith 1991) have adopted detrended correspondence analysis (DCA) to avoid such distortions of the data.

Ter Braak (1987: 107) suggests comparing three aspects of the CA results and DCA results in order to determine if the CA ordination is valid. These are the eigenvalues, the rank order of species on the first axis, and the overall pattern of the ordination diagram. If the CA ordination is valid, these three aspects of the DCA analysis should be precisely or nearly identical. The following tables and figures demonstrate these comparisons for the Kom el-Nana data set.

Table 7.8 Eigenvalues for CA and DCA of the Kom el-Nana data, with all outliers removed.

Statistical Analysis	**Eigenvalues**			
	Axis 1	**Axis 2**	**Axis 3**	**Axis 4**
CA	0.314	0.192	0.188	0.133
DCA	0.314	0.134	0.909	0.053

The eigenvalues for both the CA and DCA with all outliers removed are similar (Table 7.8); however, the rank order of species on the first axis of the CA is the complete reverse of that in the first axis of the DCA (Table 7.9). Only one species grouping, *Triticum* sp. rachis internodes, was ranked in the same order in both the CA and DCA. Ter Braak's (1987: 107) guidelines on this point state that the order of species scores must be identical or near-identical (i.e. only one or two species can be in a different order) between the CA and DCA, and therefore the Kom el-Nana data does not meet this criterion. As a result of the different order of species scores in the CA and DCA, the overall pattern of the CA and DCA ordination diagrams are different. For example, the position of trough samples 94-175 and 7785, drain sample 7791, midden samples 5697, 5597#10 and 5597#12, and alley sample 94-047 are at the left (Quadrant III) in the CA ordination diagram, but are at the far right in the DCA ordination diagram. Although ter Braak (1987: 107) does accept slight variation between the layout (i.e. the precise position of samples in the diagram, without reference to the axis scores) of CA and DCA ordination diagrams, the complete difference in the overall shape and position of samples in the ordination diagrams from the Kom el-Nana CA and DCA suggests that the CA ordination of the Kom el-Nana data is suffering from the 'arch effect' and, therefore, DCA should be adopted. Since two of ter Braak's (1987: 107) criteria clearly have not been met, and since the ordination diagram for the DCA analysis also provides a clearer separation of samples from different context, DCA has been adopted for this study.

Table 7.9 Species scores for the first axis of the CA and DCA of the Kom el-Nana data
(All outliers are removed. † indicates those taxa in the same order in both the CA and DCA)

CA SPECIES CODE	AXIS 1 SCORE	DCA SPECIES CODE	AXIS 1 SCORE
CHENIND	132	FICSCAR	247
CORONIL	132	VITVINP	210
ZYGOIND	125	CUCUMSP	208
CYPERSP	123	FICSSYC	176
TRSPRAC	93	LINMSED	174
GLINLOT	82	CHENMUR	171
CARYOSP	82	POROLER	160
AVSPRAC	82	MALVASP	153
CICENIN	75	PHOESTN	151
GRAMSSD	74	CARTINC	148
CYMBOSP	73	BETAVUL	143
VACPYRA	73	LINMCAP	137
MORUSSP	67	HVULAWN	134
HORSPGR	62	VITVINS	133
TRDITGB	60	TMAPHFL	108
HELIOSP	59	ASPHOSP	107
TRIFSED	55	UNKNWNU	105
CRYPSPP	55	CINDCUL	95
VERBLAB	54	MYRTCOM	90
RMXSPNA	51	PHOEPER	86
APIUMGR	50	CORISAT	85
TRSPGLU	48	TRSPAWN	73
HORDRACH	43	PHALPAR	72
CORNMON	42	OLEASTN	69
SETARIA	40	CUMICYM	61
TRITRACH†	33	TRITRACH†	57
CUMICYM	32	SETARIA	42
OLEASTN	28	CORNMON	37
PHALPAR	27	HORDRACH	34
TRSPAWN	26	TRSPGLU	25
CORISAT	22	APIUMGR	21
PHOEPER	21	RMXSPNA	18
MYRTCOM	20	VERBLAB	14
CINDCUL	18	TRIFSED	12
UNKNWNU	14	CRYPSPP	12
TMAPHFL	13	HELIOSP	4
ASPHOSP	13	TRDITGB	3
HVULAWN	3	HORSPGR	-3
VITVINS	3	MORUSSP	-11
LINMCAP	1	VACPYRA	-23
BETAVUL	-1	CYMBOSP	-24
CARTINC	-3	CICENIN	-26
PHOESTN	-5	GRAMSSD	-26
MALVASP	-5	GLINLOT	-40
POROLER	-8	AVSPRAC	-40
CHENMUR	-14	CARYOSP	-41
LINMSED	-15	TRSPRAC	-61
FICSSYC	-17	CYPERSP	-120
CUCUMSP	-39	ZYGOIND	-125
VITVINP	-41	CORONIL	-136
FICSCAR	-74	CHENIND	-137

Figure 7.18 CA ordination diagram of the Kom el-Nana data, with all outliers removed.

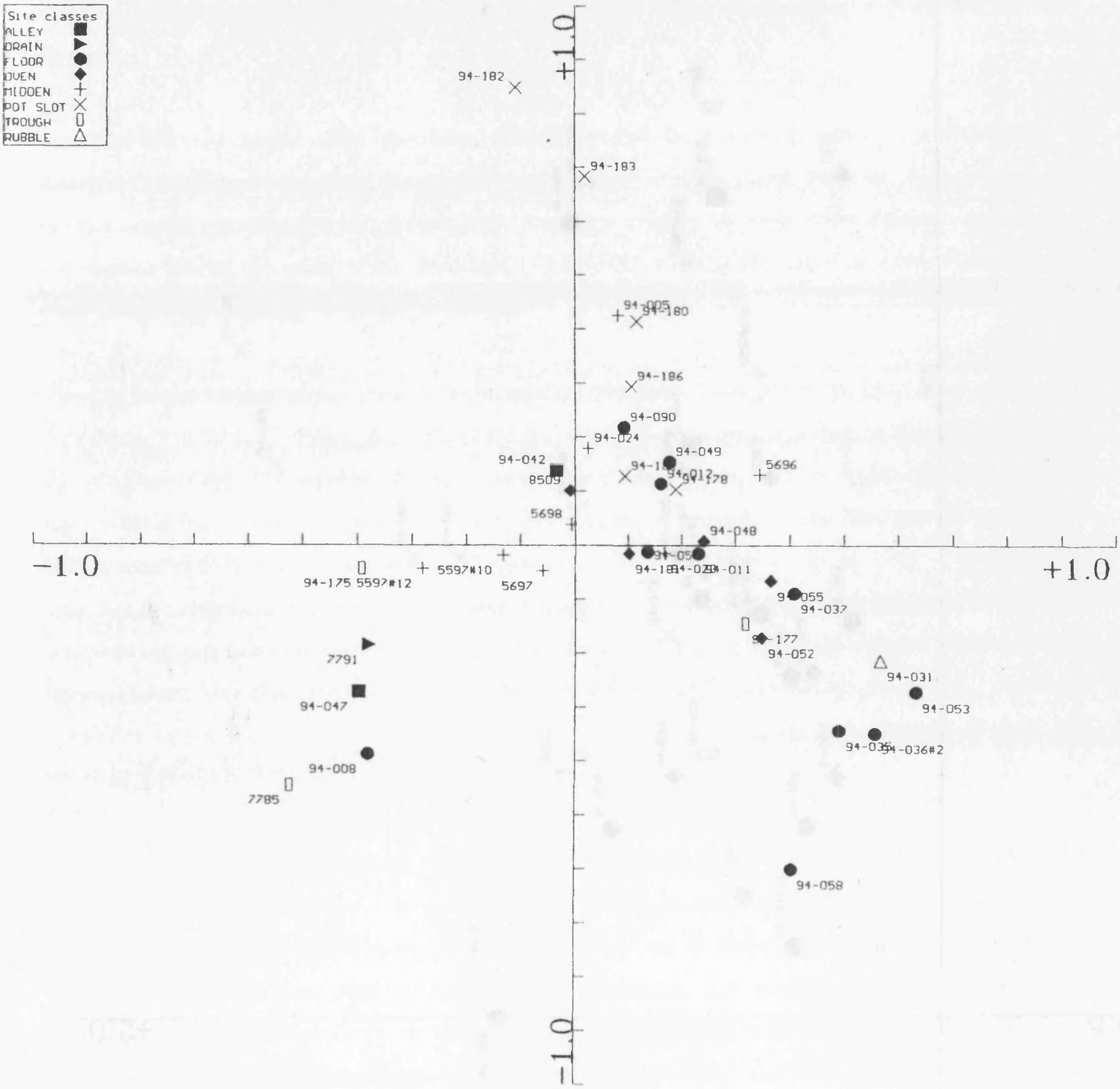
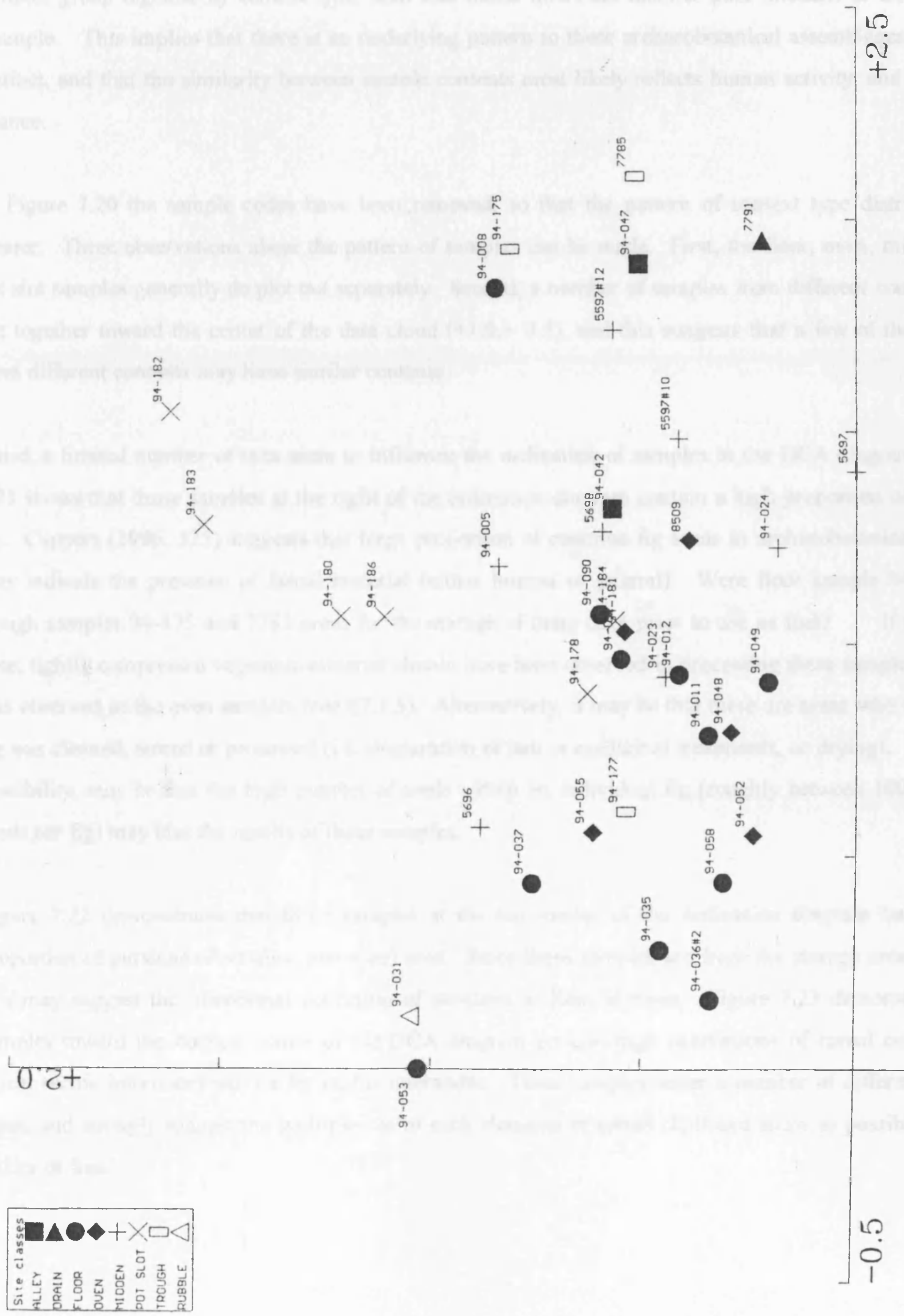


Figure 7.19 DCA ordination diagram on the Kom el-Nana data, with all outliers removed.



7.4.5 Patterns in the DCA ordination diagram of the Kom el-Nana archaeobotanical assemblage

The aim of the ordination of the Kom el-Nana archaeobotanical data is to ascertain whether the plant remains are derived from mixed or contaminated deposits, or represent distinct agricultural activities. If samples from a variety of different context types all plot closely together, it is likely that the deposits are mixed, perhaps from dumped rubbish, or contaminated, possibly from eroded mudbrick. However, if samples group together by context type, such that house floors are distinct from middens or troughs, for example. This implies that there is an underlying pattern to these archaeobotanical assemblages which is distinct, and that the similarity between sample contents most likely reflects human activity, and not mere chance.

In Figure 7.20 the sample codes have been removed, so that the pattern of context type distribution is clearer. Three observations about the pattern of samples can be made. First, the floor, oven, midden and pot slot samples generally do plot out separately. Second, a number of samples from different contexts plot out together toward the center of the data cloud (+1.0,+ 0.5), and this suggests that a few of the samples from different contexts may have similar contents.

Third, a limited number of taxa seem to influence the ordination of samples in the DCA diagram. Figure 7.21 shows that those samples at the right of the ordination diagram contain a high proportion of common fig. Cappers (1996: 325) suggests that large proportion of common fig seeds in archaeobotanical samples may indicate the presence of faecal material (either human or animal). Were floor sample 94-008 and trough samples 94-175 and 7785 areas for the storage of dung cake prior to use as fuel? If this is the case; tightly compressed vegetable material should have been observed in processing these samples, such as was observed in the oven samples (see §7.1.5). Alternatively, it may be that these are areas where common fig was cleaned, stored or processed (i.e. preparation of jam or medicinal treatments, or drying). One other possibility, may be that the high number of seeds within an individual fig (roughly between 1000 to 2000 seeds per fig) may bias the results of these samples.

Figure 7.22 demonstrates that those samples at the top, center of the ordination diagram have a high proportion of purslane (*Portulaca oleracea*) seed. Since these samples are from the storage area pot slots, this may suggest the intentional collection of purslane at Kom el-Nana. Figure 7.23 demonstrates that samples toward the bottom, center of the DCA diagram contain high proportions of cereal culm nodes, wheat rachis internodes and barley rachis internodes. These samples cover a number of different context types, and strongly suggest the multiple use of such elements of cereal chaff and straw as possible temper, fodder or fuel.

Figure 7.20 DCA ordination diagram, with all outliers removed and without sample labels.

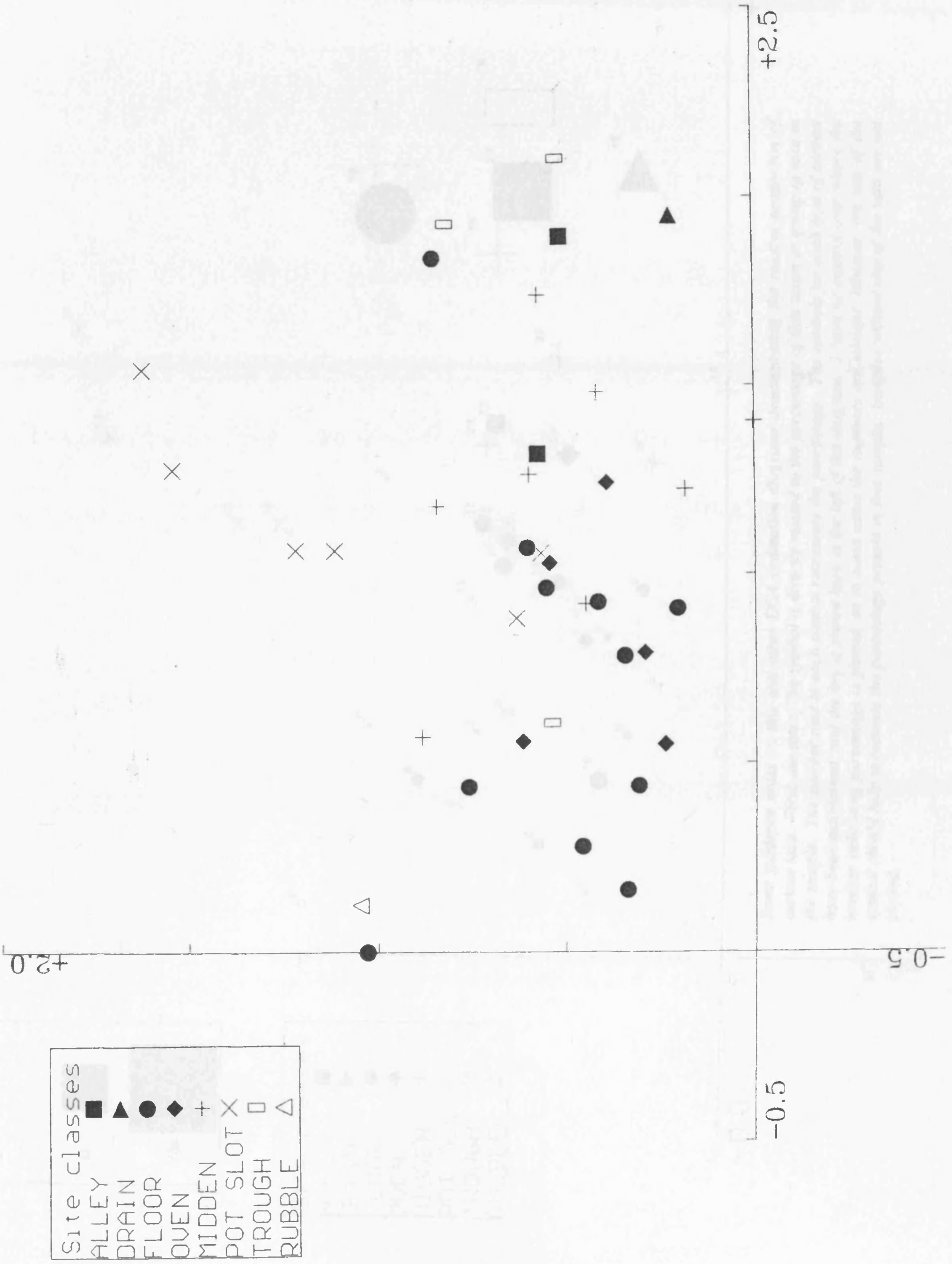
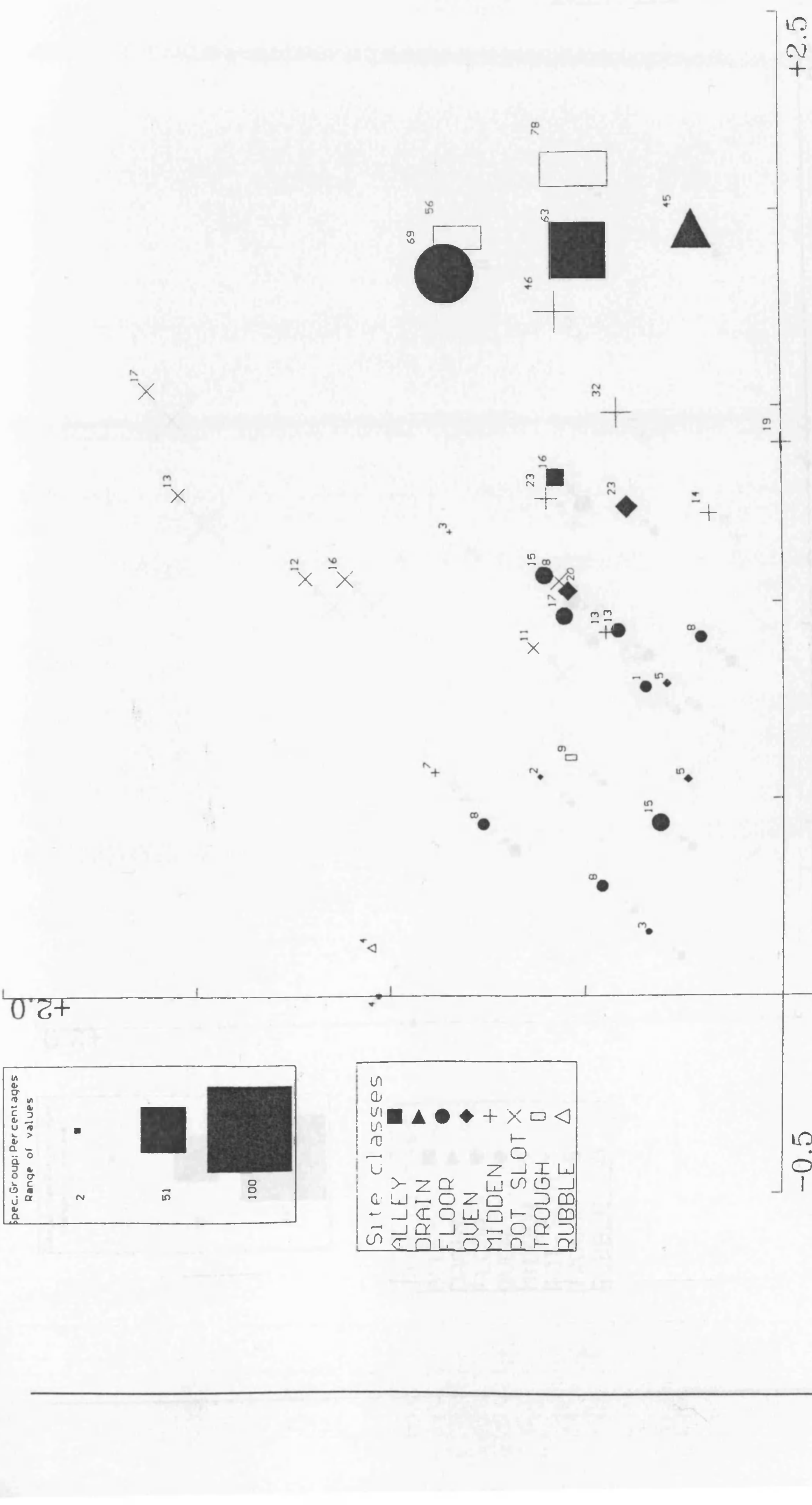


Figure 7.21 DCA ordination diagram showing relative proportion of common fig (*Ficus carica* L.).



Some guidance notes on this and other DCA ordination diagrams demonstrating the relative proportion of certain taxa. First, the size of the symbol is directly related to the percentage of that taxon or group of taxa in the sample. The number next to each symbol represents the percentage. The symbols for each type of context have been maintained, and the key is shown here at the left of the diagram. I have no control over where the number indicating percentage is placed, so in some cases the numbers are unclear, however, the size of the symbol should help to indicate the percentage present in that sample. Samples without any of the taxa are not plotted.

Figure 7.22 DCA ordination diagram showing relative proportion of purslane (*Portulaca oleracea* L.).

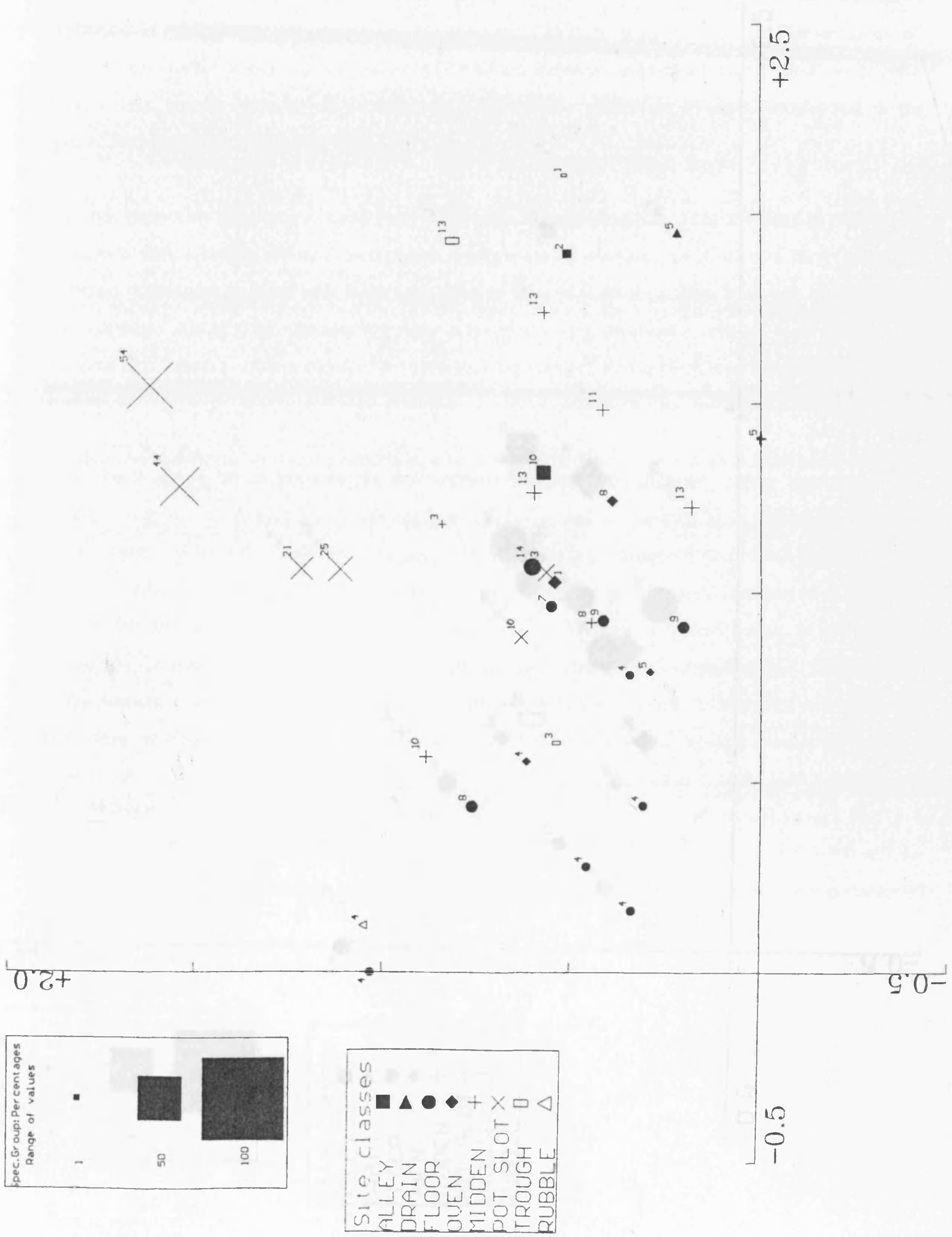
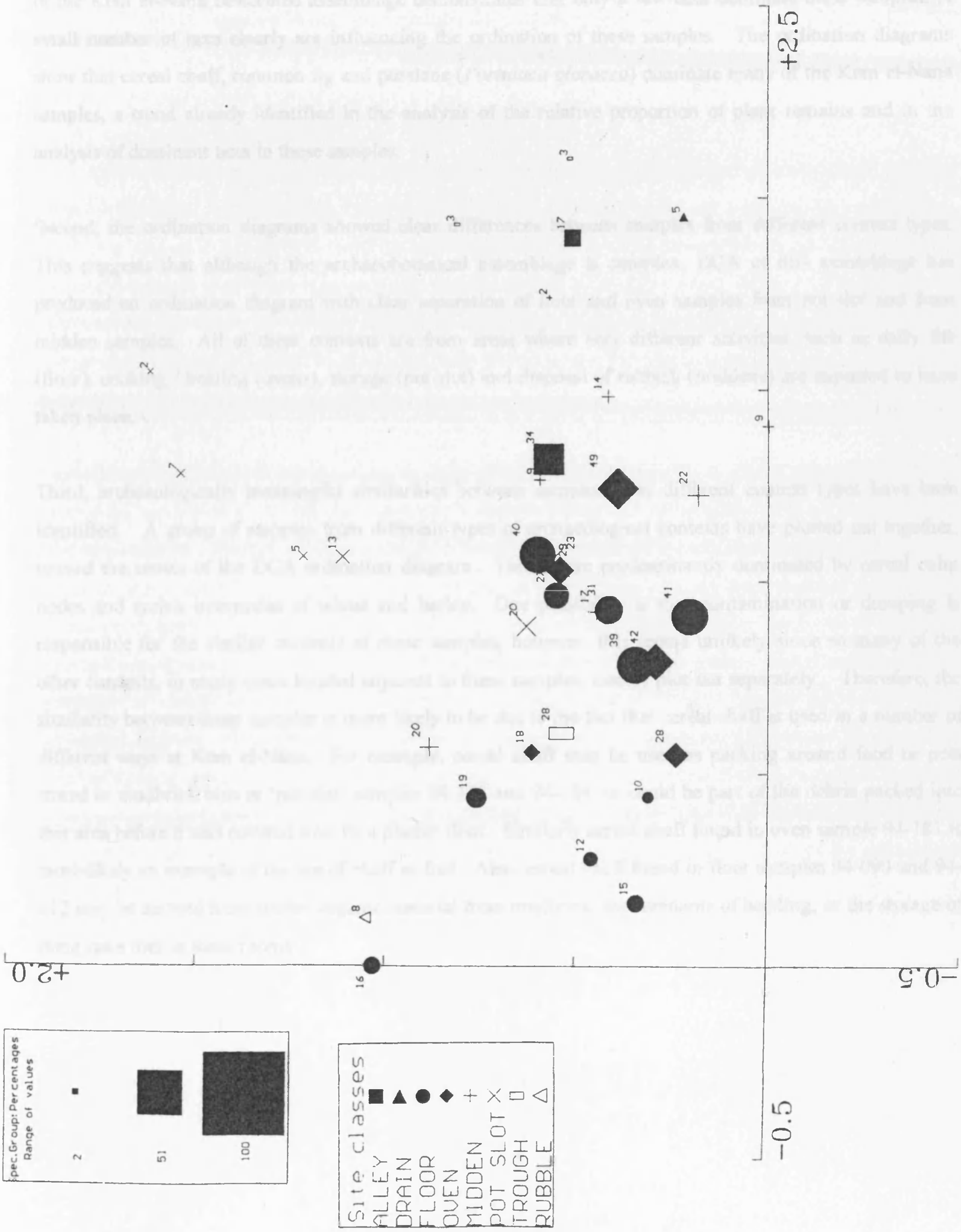


Figure 7.23 DCA ordination diagram showing relative proportion of cereal culm nodes and wheat and barley rachis internodes.



7.4.6 Summary of the results of the detrended correspondence analysis

Detrended correspondence analysis (DCA) has been applied successfully to the desiccated archaeobotanical assemblage from Kom el-Nana. Three conclusions can be made as a result of this analysis. First, the DCA of the Kom el-Nana desiccated assemblage demonstrates that only a few taxa dominate these samples. A small number of taxa clearly are influencing the ordination of these samples. The ordination diagrams show that cereal chaff, common fig and purslane (*Portulaca oleracea*) dominate many of the Kom el-Nana samples, a trend already identified in the analysis of the relative proportion of plant remains and in the analysis of dominant taxa in these samples.

Second, the ordination diagrams showed clear differences between samples from different context types. This suggests that although the archaeobotanical assemblage is complex, DCA of this assemblage has produced an ordination diagram with clear separation of floor and oven samples from pot slot and from midden samples. All of these contexts are from areas where very different activities, such as daily life (floor), cooking / heating (ovens), storage (pot slot) and disposal of rubbish (middens) are expected to have taken place.

Third, archaeologically meaningful similarities between samples from different context types have been identified. A group of samples from different types of archaeological contexts have plotted out together, toward the center of the DCA ordination diagram. These were predominantly dominated by cereal culm nodes and rachis internodes of wheat and barley. One possibility is that contamination or dumping is responsible for the similar contents of these samples, however, this seems unlikely since so many of the other contexts, in many cases located adjacent to these samples, clearly plot out separately. Therefore, the similarity between these samples is more likely to be due to the fact that cereal chaff is used in a number of different ways at Kom el-Nana. For example, cereal chaff may be used as packing around food or pots stored in mudbrick bins or 'pot slot' samples 94-178 and 94-184, or could be part of the debris packed into this area before it was covered over by a plaster floor. Similarly cereal chaff found in oven sample 94-181 is most-likely an example of the use of chaff as fuel. Also, cereal chaff found in floor samples 94-090 and 94-012 may be derived from eroded organic material from mudbrick, the remnants of bedding, or the storage of dung cake fuel in these rooms.

7.5 Conclusions

The Kom el-Nana plant remains are not dominated by primary deposits of stored crops or crop processing debris. The absence of such deposits also has been observed by Rowley-Conwy (1994) at Qasr Ibrim (or ancient Primis), in Egyptian Nubia. Full quantification of the economic and weed / wild plants at Kom el-Nana, however, has allowed exploration of patterns underlying the data and generated some interesting results.

First, the overall assemblage and many individual samples contain an abundance of cereal chaff, fruit and weed / wild plants. In many cases a few taxa or an individual taxon dominate a sample. The assemblage, itself, is quite complex because it clearly is species-rich and likely to be derived from a number of different sources. However, only a few taxa dominate the assemblage by absolute count, although a large range of taxa were identified overall. Indeed, the detrended correspondence analysis (DCA) ordination of the Kom el-Nana samples was influenced by only a few taxa (*Ficus carica*, *Portulaca oleracea*, Cerealia culm node, *Triticum* sp. rachis internodes, and *Hordeum* sp. rachis internodes.)

The repeated appearance of the same taxa in many of these samples could imply mixed deposits or different uses of the same plants. It was not possible to ascertain which case is occurring at Kom el-Nana using relative proportions of plant remains or dominance analyses, but the DCA ordination does suggest that both scenarios are possible. The rubble sample was plotted near to many of the floor samples in the DCA ordination diagram, suggesting that some of the floor samples may contain temper from eroded mudbrick. Alternatively, a group of samples from different types of archaeological context which contained large quantities of cereal culm and rachis internodes all plotted closely together toward the center of the ordination diagram. Although it is not possible to identify the precise reason for the presence of cereal chaff in all of these samples, it is clear that cereal chaff was an important resource at Kom el-Nana and was likely to be used as fodder, fuel and temper. This also confirms other evidence from Kom el-Nana (see Chapter 6 §6.5) which suggests that the by-products of crop processing were an important part of the agricultural economy and practice at this site.

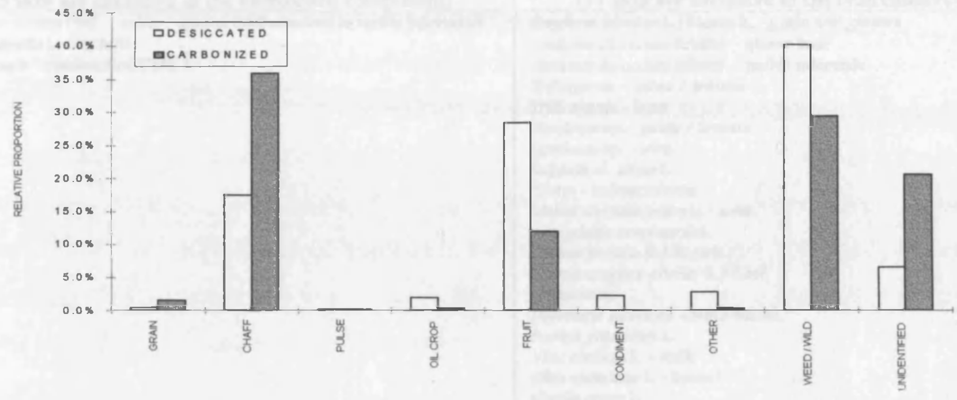
Chapter 8. Observations on Differential Preservation

Carbonization is the most common mode of preservation for plant remains at archaeological sites, unless the particular environmental and taphonomic conditions of a site allow for waterlogging, desiccation or mineralization. For some time, archaeobotanists have recognized that the composition of a carbonized assemblage "is no indication of its composition before carbonization" (Wilson 1984: 205). It also has been observed that carbonized assemblages generally contain crop processing remains of cereals and many studies are devoted to identification of the particular stage(s) of processing based on proportions of carbonized cereal remains (Hillman 1973, 1981, 1984a and 1985; Dennell 1974, 1976 and 1978; G. Jones 1984 and 1987; M.K. Jones 1985; van der Veen 1992a). Dennell (1976: 232) recognized the theoretical "possibility that much of our archaeo-botanical evidence [from carbonized assemblages] might provide a more accurate identification of what was thrown away than of what was actually eaten." Green (1982: 41) argued that woody seeds potentially have a greater chance of surviving changing soil conditions, such as a raised water table. In addition, experiments have shown that carbonization as a form of preservation is biased against certain types of plant remains such as straw and free threshing cereal rachis (Boardman and Jones 1990) or seeds with high oil or moisture content (Wilson 1984). The Kom el-Nana archaeobotanical assemblage contains both desiccated and carbonized plant remains, and provides an opportunity to investigate the differences and similarities between desiccated and carbonized plant remains from an archaeological site.

8.1 Comparison of the Relative Proportion of Plant Remain Categories

In this section, the relative proportions of the carbonized and desiccated components are directly compared in order to assess how accurately the carbonized component reflects the desiccated component of the Kom el-Nana archaeobotanical assemblage. In Figure 8.1, comparison of the relative proportions of plant categories show that, generally, the carbonized component does follow the pattern observed in the desiccated component, with cereal chaff, fruit and weed / wild plants most abundant (excluding the unidentified plant category which can be either economic or weed /wild plants). However, the relative proportion of plant remains in the desiccated component is always different from that of the carbonized component.

Figure 8.1 Relative proportion of plant remain categories in the carbonized and desiccated component of the Kom el-Nana assemblage. (Desiccated = 24,630 and Carbonized = 3,128).



8.2 Comparison of Individual Carbonized and Desiccated Taxa

In order to ascertain if the carbonized archaeobotanical assemblage accurately reflects the composition of the desiccated assemblage, three comparisons of the taxa are made. First, those taxa which are preserved either by carbonization or desiccation, but not both, can be identified. This comparison will indicate which preservation component generates the widest range of taxa. Second, the relative proportion of carbonized and desiccated items for each individual taxon can be made. This will establish whether the majority of identifications of an individual taxon are made in the desiccated or carbonized component. Finally, the number of desiccated and carbonized samples a taxon occurs in can be compared. This will identify those carbonized or desiccated taxa which are consistently present, as well as those carbonized or desiccated taxa which are rarely present in the Kom el-Nana samples. These analyses can be used to assess whether the Kom el-Nana charred remains provide the same information as the desiccated remains.

Table 8.1 lists those species which only are present either in the carbonized component or desiccated component of the Kom el-Nana assemblage. Although a few taxa are found exclusively in the carbonized component of the assemblage, the vast majority only occur in the desiccated component. At Kom el-Nana seventy-seven of the desiccated taxa recovered are not represented in the carbonized component; whereas, only three carbonized plant remains are not preserved through desiccation at Kom el-Nana. In addition, all three of the taxa which exclusively occur in the carbonized component each appear in only one of the samples. Many fruit, condiment, and weed / wild plants are not preserved in the carbonized component at all. It may be that those taxa found exclusively in the desiccated component will not survive charring. Experimental work by Wilson (1984) strongly suggests that seeds of Umbelliferae as well as *Portulaca oleracea* often do not survive charring. Other factors, such as human activity, may contribute to this result. For example, the majority of carbonized plant remains at Kom el-Nana are derived from the oven samples

Table 8.1 Taxa exclusively present in either the carbonized or desiccated component of the Kom el-Nana assemblage. (In total 174 taxa were identified in the assemblage)

TAXA ONLY PRESERVED IN THE CARBONIZED COMPONENT (3 taxa are exclusive to the carbonized component)	TAXA ONLY PRESERVED IN THE DESICCATED COMPONENT (77 taxa are exclusive to the desiccated component)
Triticum durum Desf. - palea / lemma (still attached to rachis internode)	*Sorghum bicolor* (L.) Moench. - grain and glumes
Avena sterilis L. - rachilla	*Triticum dicoccum* Schübl. - glume base
Cyperaceae - unidentified TYPE 1	*Triticum dicoccum* Schübl. - rachis internode
	Triticum sp. - palea / lemma
	Triticum sp. - bran
	Hordeum sp. - palea / lemma
	Hordeum sp. - awn
	Lupinus cf. *albus* L.
	Hilum - indeterminate
	Linum usitatissimum L. - seed
	Amygdalus communis L.
	Prunus persica (L.) Batsch
	Zizyphus spina-christi (L.) Desf.
	Cucumis sp.
	Lagenaria siceraria (Mol.) Standl.
	Punica granatum L.
	Vitis vinifera L. - stalk
	Olea europaea L. - kernel
	Cordia myxa L.
	Phoenix dactylifera L. - stone
	Phoenix dactylifera L. - male flower
	Phoenix dactylifera L. - embryo
	Anethum graveolens L.
	Cuminum cyminum L.
	Foeniculum vulgare (L.) Mill
	Apium graveolens L.
	cf. *Ocimum basilicum* L.
	Allium cepa L. - tunic (= skin)
	Papaver somniferum L.
	Acacia nilotica (L.) Willd. ex Del. - seed
	Acacia nilotica (L.) Willd. ex Del. - pod
	Acacia nilotica (L.) Willd. ex Del. - leaf
	Ruta cf. *chalepensis* L.
	Daucus carota L.
	Myrtus communis L.
	Glinus cf. *lotoides* L.
	Aizoaceae - unidentified
	Vaccaria cf. *pyramidata* Medicus
	Silene sp. - large
	Stellaria sp. - type
	Cornulaca cf. *monocantha* Del.
	Brassica spp. / *Sinapis arvensis* L.
	Zilla spinosa (Turra) Prantl
	Raphanus raphanistrum L. seed
	Reseda sp. TYPE 2 - tubercled
	Medicago sp.
	Trifolium spp. - involucre
	Scorpiurus muricatus L.
	Fagonia sp.
	Euphorbia peplus L.
	Echium sp.
	Verbenaceae / Labiatae
	Labiatae - Ocimum type
	Labiatae - Thymus type
	Picris sp.
	Lolium spp.
	Avena sp.
	Saccharum spontaneum L.
	?H - leafy involucre
	?U - *Lawsonia*-like seed
	?X - c) Small leaf / petal ?
	?A4 - c) anther Large
	?A4 - d) anther / pod
	?A10 - Shiny compressed seed - striated
	?A22 - flower head / calyx
	?A28 - Crescent part of stalk
	?A35 - scaly interior of seed ?
	?A37 - ??*Plantago*
	?A38 - Internal structure ?
	?A42 - pod / seed capsule
	?A47 - Unidentified seed coat (fragments)
	?A48 - ?Flower petals
	?A49 - a) Large flower head
	?A50 - extremely small fig-like seed
	?A53 - ? seed pod - grooved b) complete pod
	?A56 - Small pitted seed

(see §8.3), and this most likely limits the charred plants identified to those selected intentionally for use as traditional fuels on site, or those used as animal fodder which then arrive on site in dung cake used as fuel.

Figure 8.2 presents the proportion of desiccated and carbonized identifications for each individual taxon with 25 (approximately 10% of the identifications made in any sample) or more desiccated or carbonized identifications. The use of 10% as a minimum cut-off point is commonly applied in archaeobotanical or ecological studies (e.g. van der Veen 1992: 25). The total identifications made for individual taxa are noted in parentheses after the Latin binomial (i.e. *Triticum aestivum* L / *T. durum* Desf. - grain (27) = 27 carbonized and / or desiccated identifications of free threshing wheat grains were made in total). The bar indicates the relative proportion of carbonized (indicated by shading) and desiccated identifications made for each taxon in the archaeobotanical assemblage.

Several conclusions can be made about the relative proportion of carbonized and desiccated taxa. First, cereals are generally well represented in the carbonized component. However, in most cases desiccation has preserved more cereals and pulses. In terms of oil crops, fruit, condiments, other economic plants, weed / wild plants and the unidentified taxa, the desiccated component contained a much wider range of taxa than the carbonized assemblage. In addition, in those cases where an individual taxon was preserved in both the desiccated and carbonized component, the desiccated component generally had the largest proportion of identifications. Notably, the carbonized component favored the remains of free threshing wheat grain and large seeded weed / wild grasses. In addition, the vast majority of indeterminate taxa were recovered in the carbonized component (see Chapter 5 §5.1).

Most of the taxa recovered in the Kom el-Nana assemblage occur primarily in the desiccated component. There are particularly low proportions of charred common fig (*Ficus carica*), purslane (*Portulaca oleracea*), *Chenopodium murale*, sycomore fig (*Ficus sycomorus*), tamarisk (*Tamarix aphylla*), *Setaria* spp., *Glinus* cf. *lotoides*, Unknown U - *Lawsonia*-like seed, linseed capsule (*Linum usitatissimum*) and safflower (*Carthamus tinctorius*), although these dominate the desiccated assemblage (see Chapter 7 §7.3). Within specific plant categories, carbonization appears to selectively favor certain taxa (i.e. in the weed / wild component large sized seeds of Gramineae dominate the carbonized component). Although part of the difference between preservation components may be attributed to human activity, charring experiments (e.g. Boardman and Jones 1990; Wilson 1984) have shown that certain taxa often do not survive charring. It is possible that the process of charring does not favor the preservation of those taxa which have been recovered exclusively in the desiccated component.

Figure 8.2 Summary of the proportion of carbonized and desiccated identifications made for each taxa with 25 or more identifications. (N) = number of total identifications for each taxa. Shaded bar = proportion of carbonized identifications and unshaded bar = proportion of desiccated identifications.

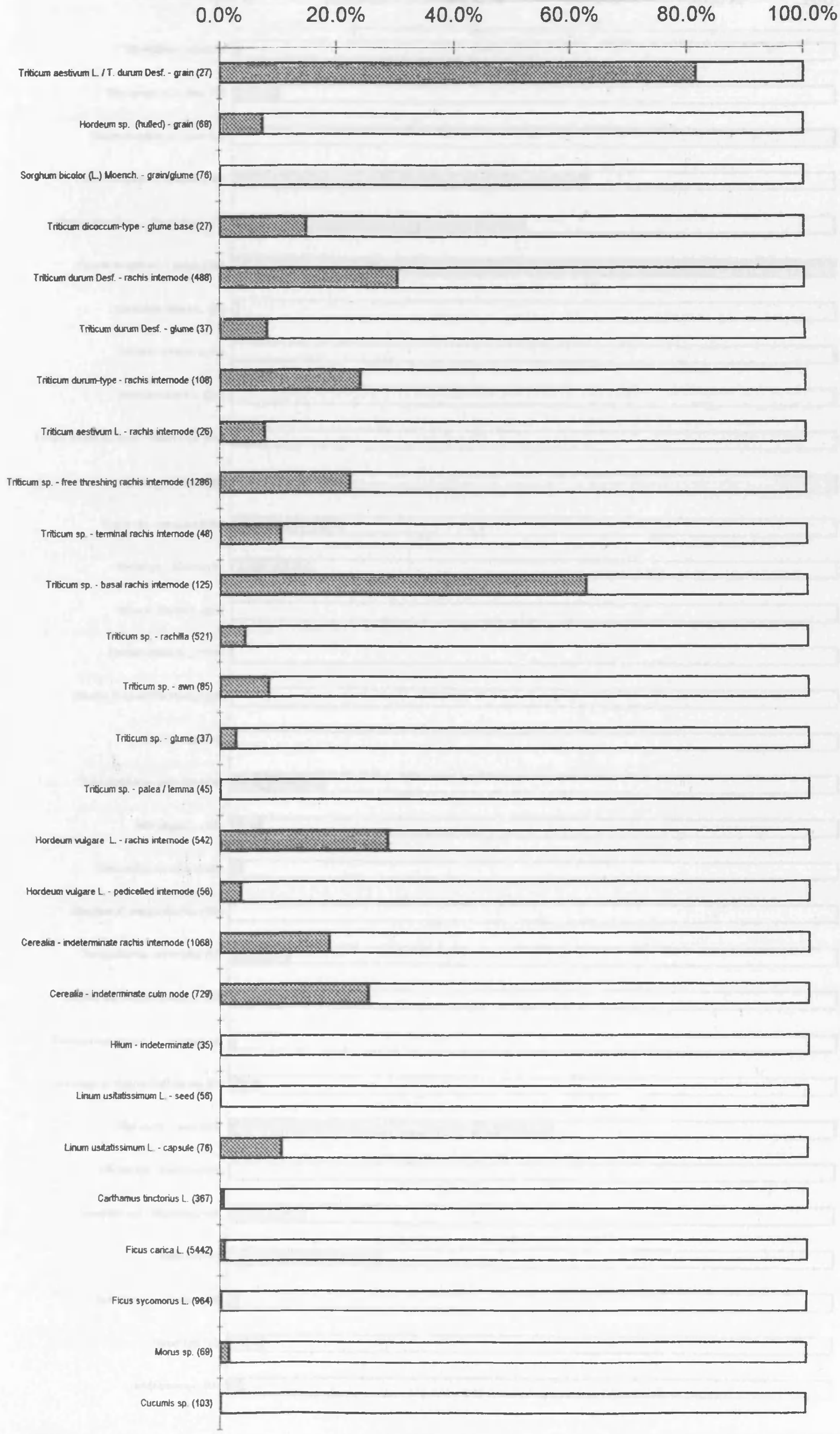


Figure 8.2 continued

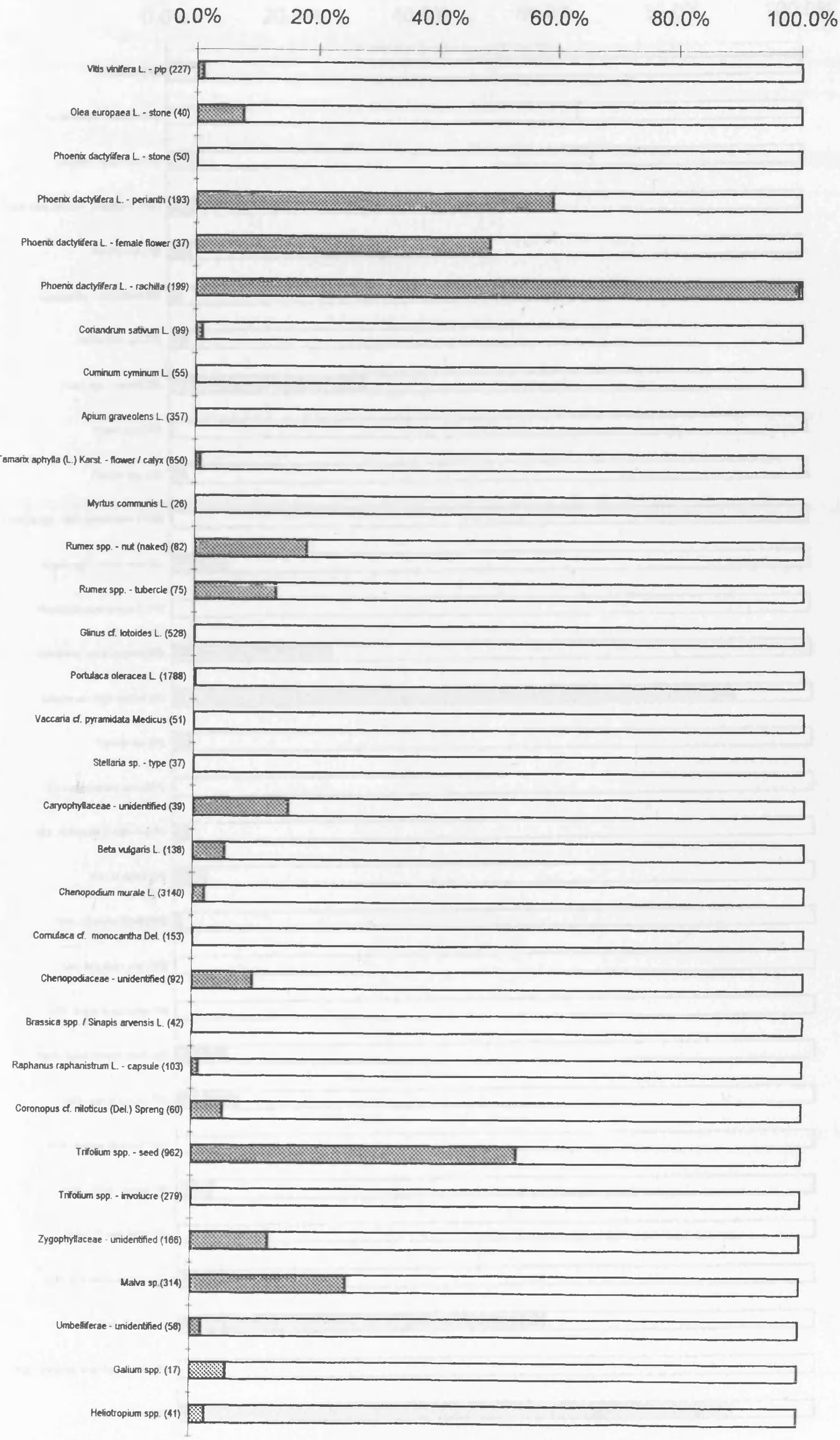


Figure 8.2 continued

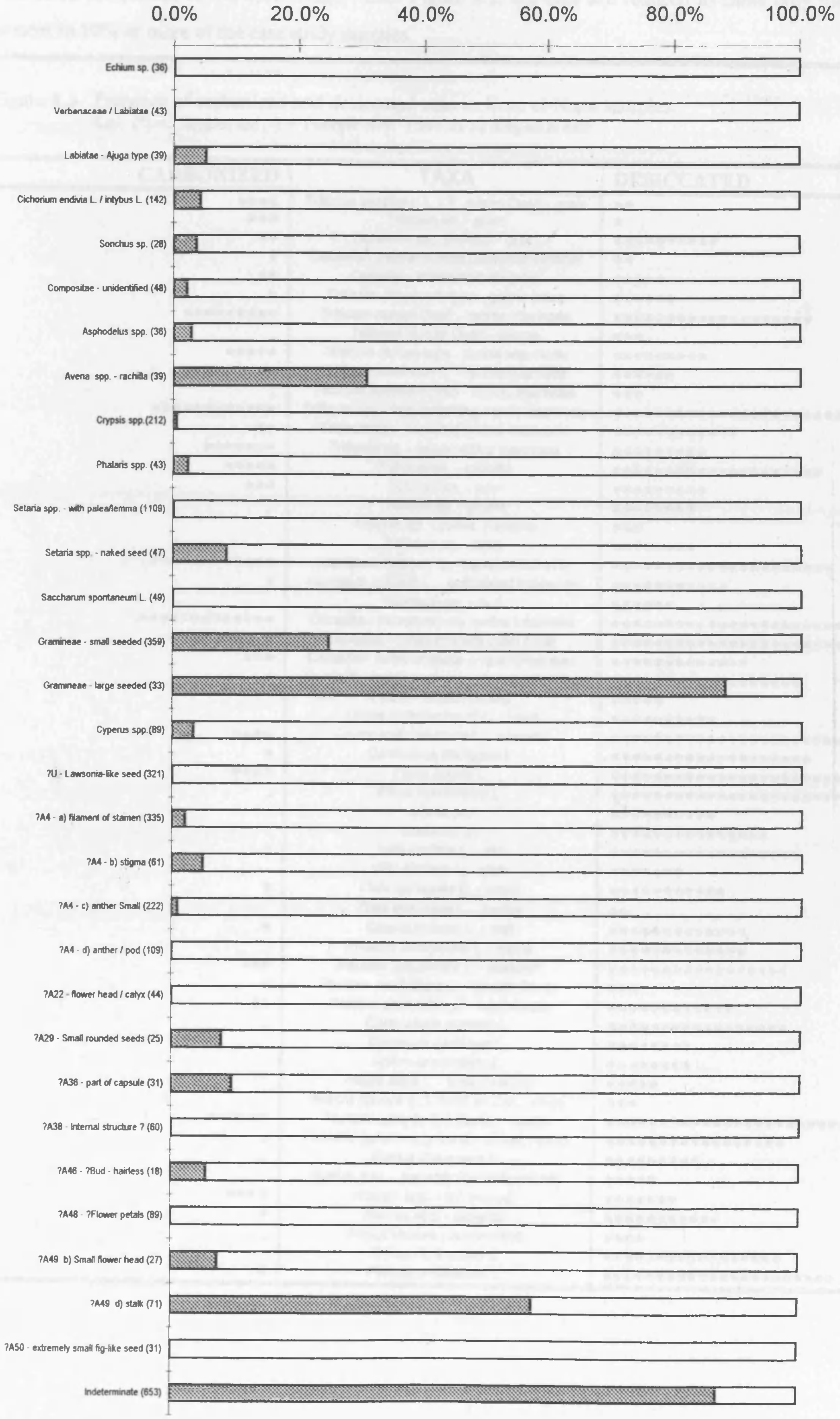


Figure 8.3 presents the number of samples in which each taxon was present for both the carbonized and desiccated component of the assemblage. Like Figure 8.2, the data are reduced to show only those taxa present in 10% or more of the case study samples.

Figure 8.3 Presence of carbonized and desiccated taxa in Kom el-Nana samples.
Key: (*) = 2 samples and (-) = 1 sample only. There are 52 samples in total.

CARBONIZED	TAXA	DESICCATED
****	*Triticum aestivum* L. / *T. durum* Desf. - grain	**
***	*Triticum* sp. - grain	*
**	*Hordeum* sp. (hulled) - grain	**********
*	Cerealia - Indeterminate detached embryo	**
**	Cerealia - Indeterminate grain	*****
*	*Triticum dicoccum*-type - glume base	******
*********	*Triticum durum* Desf. - rachis internode	*******************
-	*Triticum durum* Desf. - glume	***
*****	*Triticum durum*-type - rachis internode	*********
*	*Triticum aestivum* L. - rachis internode	******
-	*Triticum aestivum*-type - rachis internode	***
************	*Triticum* sp. - free threshing rachis internode	**********************
**	*Triticum* sp. - terminal rachis internode	************
*******	*Triticum* sp. - basal rachis internode	*********
*****	*Triticum* sp. - rachilla	********************
***	*Triticum* sp. - awn	*********
-	*Triticum* sp. - glume	********
	Triticum sp. - palea / lemma	***
	Triticum sp. - bran	********
************	*Hordeum vulgare* L. - rachis internode	*********************
*	*Hordeum vulgare* L. - pedicelled internode	***********
	Hordeum sp. - awn	******
*************	Cerealia - indeterminate rachis internode	************************
**********	Cerealia - indeterminate culm node	**********************
***	Cerealia - indeterminate unquantified awn	*************
*	Cerealia - indet. unquant. glum/pal/lemma	******************
	Hilum - indeterminate	*****
	Linum usitatissimum L. - seed	**********
****	*Linum usitatissimum* L. - capsule	**********************
*	*Carthamus tinctorius* L.	*******************
****	*Ficus carica* L.	*************************
-	*Ficus sycomorus* L.	**********************
-	*Morus* sp.	**********
	Cucumis sp.	***************
*	*Vitis vinifera* L. - pip	******************
	Vitis vinifera L. - stalk	*******
*	*Olea europaea* L. - stone	***********
	Olea europaea L. - kernel	**
*	*Olea europaea* L. - leaf	*************
	Phoenix dactylifera L. - stone	*************
***	*Phoenix dactylifera* L. - perianth	*****************
*	*Phoenix dactylifera* L. - female flower	***
**	*Phoenix dactylifera* L. - leaf sheath	************
-	*Coriandrum sativum* L.	*****************
	Cuminum cyminum L.	********
	Apium graveolens L.	********
	Allium cepa L. - tunic (= skin)	*****
	Acacia nilotica (L.) Willd. ex Del. - seed	***
******	*Tamarix aphylla* (L.) Karst. - needle	***********************
-	*Tamarix aphylla* (L.) Karst. - flower / calyx	*****************
	Myrtus communis L.	*********
-	*Rumex* spp. - perianth (nut with valves)	*****
****	*Rumex* spp. - nut (naked)	*******
*	*Rumex* spp. - tubercle	***********
-	Polygonaceae - unidentified	****
	Glinus cf. *lotoides* L.	*****************
*	*Portulaca oleracea* L.	**********************

Figure 8.3 continued

CARBONIZED	TAXA	DESICCATED
	Vaccaria cf. *pyramidata* Medicus	******
	Stellaria sp. - type	***
*	Caryophyllaceae - unidentified	********
*	*Beta vulgaris* L.	**************
***	*Chenopodium murale* L.	**********************
	Cornulaca cf. *monocantha* Del.	**************
*	Chenopodiaceae - unidentified	******
**	Chenopodiaceae - needle	*******
-	Chenopodiaceae - floret	********
	Brassica spp. / *Sinapis arvensis* L.	******
	Zilla spinosa (Turra) Prantl	***
-	*Raphanus raphanistrum* L. capsule	*****
*	*Coronopus* cf. *niloticus* (Del.) Spreng	********
-	*Reseda* sp. TYPE 1 - smooth	***
************	*Trifolium* spp. - seed	********************
*	*Trifolium* spp. - calyx	*******
	Trifolium spp. - involucre	******************
-	Leguminosae - pod	****
	Fagonia sp.	****
*	Zygophyllaceae - unidentified	*************
	Euphorbia peplus L.	*****
*******	*Malva* sp.	********************
-	Umbelliferae - unidentified	***********
-	*Galium* spp.	****
-	*Heliotropium* spp.	*********
	Echium sp.	****
	Verbenaceae / Labiatae	********
	Labiatae - *Thymus* type	****
-	Labiatae - *Ajuga* type	***
**	*Cichorium endivia* L. / *intybus* L.	***************
	Picris sp.	***
-	*Sonchus* sp.	*****
-	Compositae - unidentified	********
-	*Asphodelus* spp.	********
	Avena sp.	****
**	*Avena* spp. - rachilla	*******
-	*Crypsis* spp.	****************
-	*Phalaris paradoxa* L.	********
-	*Phalaris* spp.	***
-	*Setaria* spp. - with palea/lemma	*********************
*	*Setaria* spp. - naked seed	**
	Saccharum spontaneum L.	*******
********	Gramineae - small seeded	*********************
*	Gramineae - wild grass rachis	**
*	*Fimbristylis bis-umbellata* (Forssk.) Bub.	********
*	*Cyperus* spp.	***********
	?U - Lawsonia-like seed	**********************
****	?X - a) Unidentified leaf	*****************
******	?X - b) Split leaf / grass / palm	********************
-	?A4 - a) filament of stamen	*********************
-	?A4 - b) stigma	***********
-	?A4 - c) anther Small	****************
	?A4 - d) anther / pod	*************
-	?A15 - shrivelled veined fruit	***
***	?A16 - a) unidentified root	***********
	?A22 - flower head / calyx	***
-	?A24 - interior of fruit w/ seed	**
*	?A27 - a) unidentified small fruit	******
	?A28 - Crescent part of stalk	*****
*	?A29 - Small rounded seeds	****
	?A35 - scaly interior of seed ?	****
-	?A36 - part of capsule?	****
	?A38 - Internal structure ?	********
-	?A46 - ?Bud - hairless	****
	?A47 - Unidentified seed coat (fragments)	************
-	b) Small flower head	***
*	c) flower stalk	***
**	d) stalk	******
*****	Indeterminate	*****

This figure demonstrates that the desiccated component includes a wider range of taxa which are present in far more of the case study samples than the carbonized component. Carbonized cereal grain and chaff appear in many samples and although present in fewer samples than desiccated cereals, they do occur in a higher proportion of samples than most other carbonized taxa. Notably, pulses, fruit, condiments, other economic crops, weed / wild plants and unidentified taxa are present in far fewer carbonized samples than desiccated. *Trifolium* sp., *Malva* sp. and small seeds of Gramineae, however, do appear in more samples than other carbonized weed / wild taxa. Whether these are more likely to survive charring conditions than other taxa, or whether human agency (i.e. the intentional selection of certain plants as oven fuel) is somehow responsible is not clear.

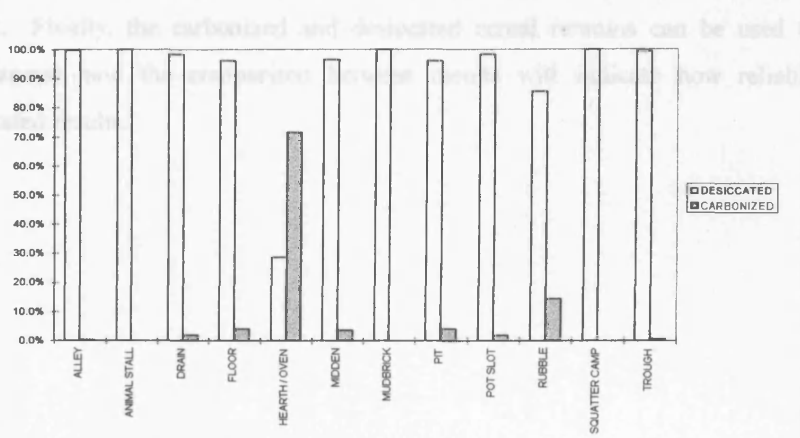
These results, however, should be taken in context. Sampling size was greatly reduced at Kom el-Nana, because plant remains were primarily preserved through desiccation. The small sampling size means that the recovery of carbonized remains on site was quite low in most cases. Increasing the sample size such that a target of 250 carbonized seeds are recovered from each sample could alter the patterns described here.

8.3 Context and the Carbonized Assemblage

In the previous section it was shown that carbonized taxa are much more limited than desiccated taxa in terms of the range identified, their absolute count and their presence in samples. This pattern could result from the fact that carbonization as a form of preservation is biased against the survival certain taxa. It also is possible that carbonization at Kom el-Nana reflects human activity, in particular, the selection of certain plants for use as traditional fuel. Here, the relative proportion of desiccated and carbonized identifications by context is examined in order to determine if charred material is limited to a specific set of contexts at Kom el-Nana.

Figure 8.4 shows the relative proportion of desiccated and carbonized remains for each context type. This figure illustrates that ovens and hearths clearly are the primary source of carbonized taxa at Kom el-Nana. Indeed, 81% of all carbonized identifications are derived from the nine oven and hearth samples.

Figure 8.4 Relative proportion of carbonized and desiccated remains recovered in each sample.



This strongly suggests that human activity (i.e. the selection of traditional fuels) is directly influencing the composition of the carbonized assemblage at Kom el-Nana.

Smaller amounts of carbonized remains appear in some of the other contexts, but in much lower proportions. A detailed plan of the site showing the relation of all sampled contexts is not yet available for the site, but it seems likely that many of the contexts with low amounts of charred remains may be from areas adjacent to ovens. For example, the rubble sample was collected from near the oven installations to the north of the north-east tower and the pot slot samples with charred remains were from an area where charring, possibly accidental, had occurred in this part of the site.

Based on these results, carbonized remains appear to be localized at Kom el-Nana; only occurring in high concentrations in areas of intentional burning or areas where spent fuel might be used (i.e. carbonized material used as temper in mudbrick), intentionally discarded (i.e. carbonized material dumped in a midden), or accidentally included, most likely due to the close proximity of ovens or hearths (i.e. carbonized material spilled from an oven onto a house floor).

8.4 Carbonized vs. Desiccated: The Oven Samples

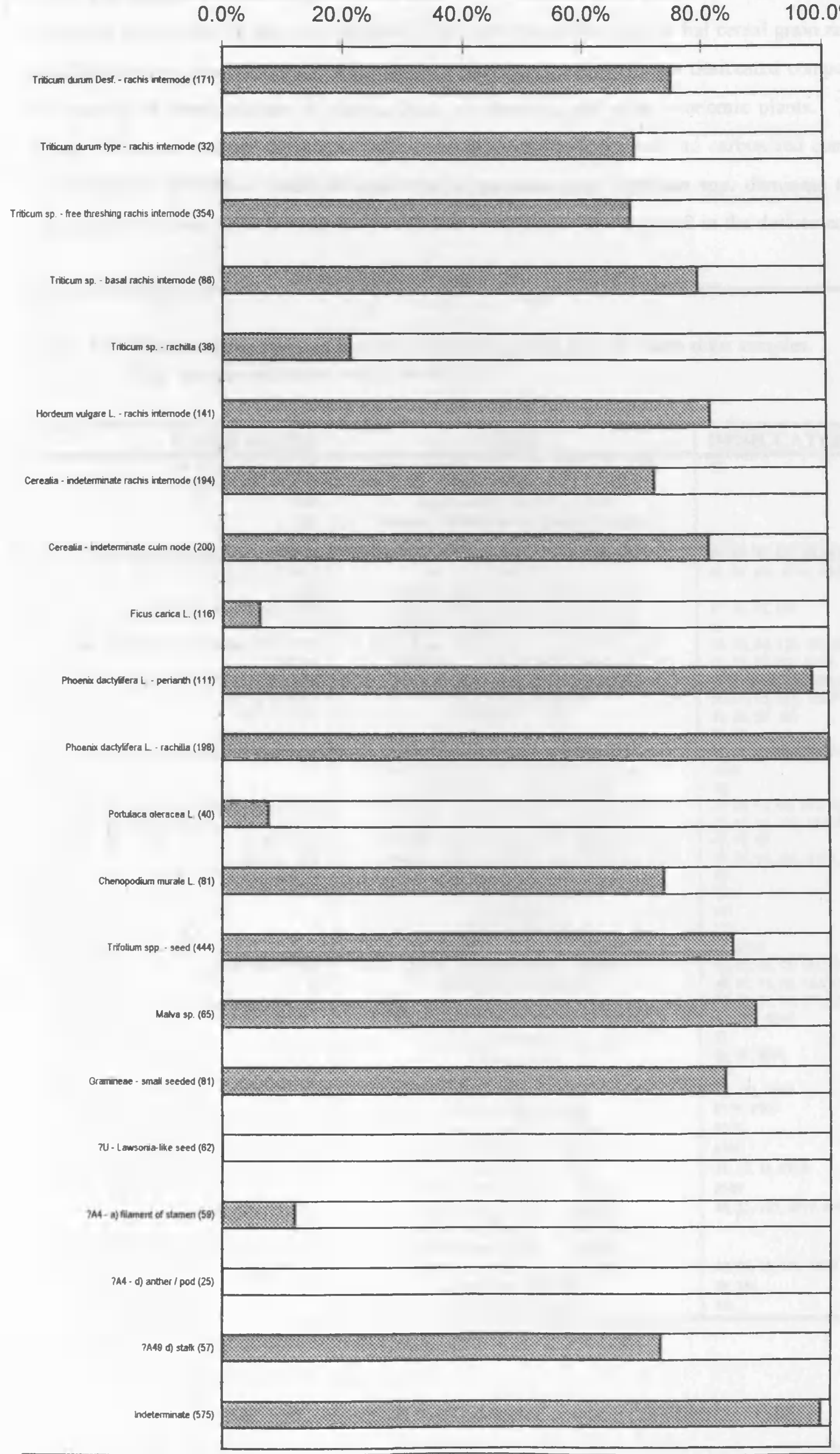
The oven samples provide the largest assemblage of carbonized remains at Kom el-Nana (see Figure 8.4). The desiccated and carbonized components are likely to differentially preserve the same source of plant remains, namely fuel in primary deposits. In this section, comparisons of the desiccated and carbonized components are made in order to ascertain if the carbonized component differs from or matches the desiccated component in the oven samples. First, the relative proportion of carbonized and desiccated identifications made for each individual taxon in the oven samples will be examined. In this way, differences or similarities in the carbonized and desiccated preservation of plant remains can be determined. Second, the presence of individual taxa in the carbonized and desiccated component will be compared. Here, the pattern of presence in both preservation components of the Kom el-Nana assemblage can be examined, regardless of count. Finally, the carbonized and desiccated cereal remains can be used to determine crop processing stage(s), and the comparison between results will indicate how reliably carbonized results reflect desiccated results.

8.4.1 Relative proportion of carbonized and desiccated plant remains

Figure 8.5 demonstrates the relative proportion of carbonized and desiccated identifications made for each individual taxon accounting for 25 or more of the identifications made in the oven samples. This comparison was made in order to determine which individual taxa, or groups of taxa, dominate the carbonized and desiccated component respectively. The carbonized component of the oven samples is strongly dominated by cereal grain and chaff remains, by the perianth and rachilla (i.e. the chaff) of date palm, and by weed / wild seeds of Chenopodiaceae, Gramineae, Cyperaceae, *Trifolium* sp. and *Malva* sp. The carbonized component also contains the majority of indeterminate plant remains, since carbonization often had warped and twisted seeds and other plant parts beyond recognition. The desiccated component has very small amounts of cereal grain, and many more fruits, condiments and weed / wild plants. In total (i.e. including those taxa not listed in Figure 8.5) only thirteen economic taxa were identified in the carbonized component, whereas thirty-seven were identified in the desiccated component. The interpretation of this assemblage will be discussed in detail in Chapter 9.

In terms of assessing what economic and weed / wild plants were present at Kom el-Nana, based on these oven samples, the carbonized component provides a much more limited range of taxa than the desiccated component. The carbonized component also shows a strong bias toward the preservation of cereal remains and, perhaps, other woody plant remains such as date palm perianth and rachilla. Many of the carbonized taxa identified in the oven samples, however, are not included in the desiccated component; in particular, the use of date palm perianth and rachilla as fuel.

Figure 8.5 Summary of the proportion of carbonized and desiccated identifications for each taxa found in the oven samples with 25 or more identifications. (N) = number of total identifications for each taxa. Shaded bar = proportion of carbonized identifications and unshaded bar = proportion of desiccated identifications.



8.4.2 Comparison of the presence of individual taxa in the carbonized and desiccated component

Figure 8.6 presents a direct comparison of the presence of individual plant remains in the carbonized and desiccated components of the oven samples. The most noticeable result is that cereal grain and cereal chaff identifications are more common in the carbonized component, while the desiccated component provides the majority of identifications of pulses, fruits, condiments, and other economic plants. There also are strong differences between the weed / wild component of the desiccated and carbonized component of the oven samples. Primarily, seeds of Gramineae, Cyperaceae and *Trifolium* spp. dominate the carbonized component; whereas, a much wider range of weed / wild plants are recovered in the desiccated component.

Figure 8.6 Presence of carbonized and desiccated taxa in the Kom el-Nana oven samples.
(Key: Sample codes reduced such that 94-048 = 48.)

CARBONIZED	TAXA	DESICCATED
48, 55, 95, 172, 173, 181	*Triticum aestivum* L. / *T. durum* Desf. - grain	48
52, 95, 172, 173, 181	*Triticum* sp. - grain	
8509	*Hordeum* sp. (hulled) - grain	
172	Cerealia - Indeterminate detached embryo	
95, 172, 173	Cerealia - Indeterminate grain	181
48, 52, 55, 95, 172, 173, 8719, 8509	*Triticum durum* Desf. - rachis internode	48, 52, 55, 181, 8719, 8509
95, 172, 173, 8719, 8509	*Triticum durum* Desf. - glume	48, 95, 181, 8719, 8509
8509	*Triticum durum* Desf. - palea / lemma	
48, 52, 55, 95, 172, 181, 8719	*Triticum durum*-type - rachis internode	52, 55, 95, 181
	Triticum aestivum L. - rachis internode	48
48, 52, 55, 95, 172, 173, 181, 8719, 8509	*Triticum* sp. - free threshing rachis internode	48, 52, 95, 172, 181, 8719, 8509
95, 181	*Triticum* sp. - terminal rachis internode	52, 55, 95, 181, 8509
48, 52, 55, 95, 172, 173, 181, 8509	*Triticum* sp. - basal rachis internode	48, 55, 172, 173, 181, 8509
48, 52, 95, 8509	*Triticum* sp. - rachilla	48, 55, 95, 181, 8509
48, 52, 55, 95	*Triticum* sp. - awn	48, 52, 55, 181
	Triticum sp. - bran	55, 95
48, 52, 55, 95, 172, 173, 181, 8719, 8509	*Hordeum vulgare* L. - rachis internode	48, 52, 55, 95, 181, 8509
	Hordeum vulgare L. - pedicelled internode	8509
	Hordeum sp. - palea / lemma	181
48, 52, 55, 95, 172, 173, 181, 8719, 8509	Cerealia - indeterminate rachis internode	48, 52, 55, 95, 181, 8719, 8509
48, 52, 55, 95, 172, 173, 181, 8719, 8509	Cerealia - indeterminate culm node	52, 55, 95, 173, 181, 8719, 8509
48, 52, 55, 95	Cerealia - indeterminate unquantified awn	48, 55, 95
95, 173, 8509	Cerealia - indet. unquant. glum/pal/lemma	52, 55, 95, 181, 8719, 8509
48, 173	*Lupinus* cf. *albus* L.	55
	Lens culinaris Medik.	181
	Lathyrus sp.	181
	Hilum - indeterminate	173
	Linum usitatissimum L. - seed	95, 8719
48, 55, 173, 181	*Linum usitatissimum* L. - capsule	48, 52, 55, 95, 181, 8719
95	*Carthamus tinctorius* L.	48, 52, 55, 95, 181, 8509
48, 95, 172, 173, 181	*Ficus carica* L.	48, 52, 55, 95, 172, 173, 181, 8719, 8509
	Ficus sycomorus L.	52, 181, 8509
	Morus sp.	52
	Cucumis sp.	48, 55, 8509
	Punica granatum L.	181
55, 95	*Vitis vinifera* L. - pip	52, 181, 8509
	Vitis vinifera L. - stalk	8719, 8509
48, 95, 181	*Olea europaea* L. - stone	8509
	Olea europaea L. - kernel	8509
55, 95	*Olea europaea* L. - leaf	48, 52, 55, 8719
	Phoenix dactylifera L. - stone	8509
48, 95, 172, 173, 8719	*Phoenix dactylifera* L. - perianth	48, 55, 173, 8719, 8509
8719	*Phoenix dactylifera* L. - female flower	
95, 8719	*Phoenix dactylifera* L. - rachilla	
52, 55, 95, 172	*Phoenix dactylifera* L. - leaf sheath	52, 55, 95, 181, 8509
181	*Coriandrum sativum* L.	48, 181
	Anethum graveolens L.	181

Figure 8.6 continued

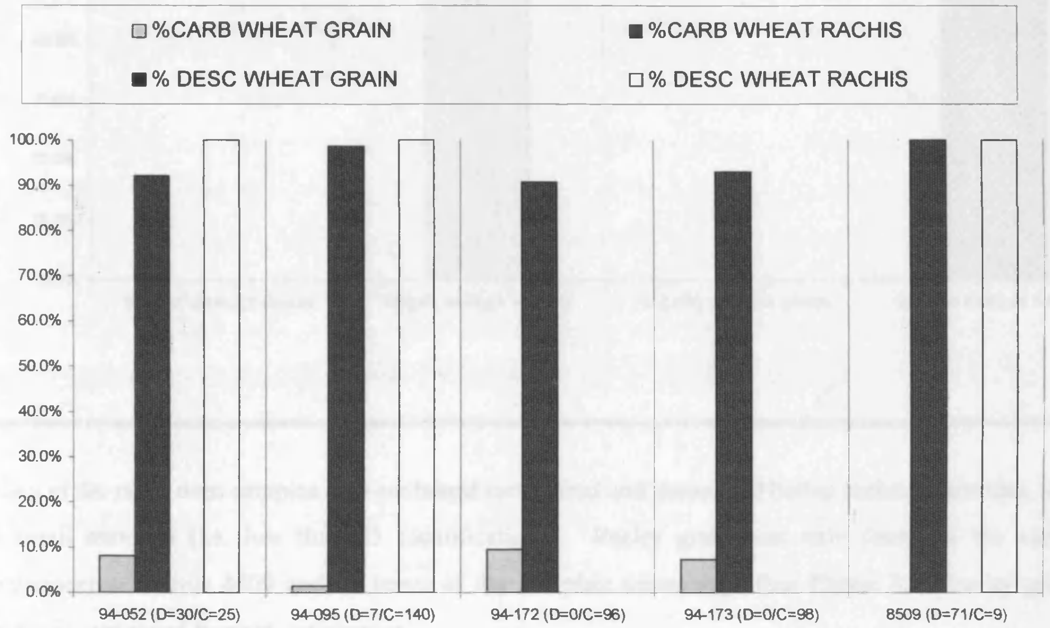
CARBONIZED	TAXA	DESICCATED
48, 52, 55, 95, 172, 173, 181	*Tamarix aphylla* (L.) Karst. - needle	48, 52, 55, 95, 181, 8509
	Tamarix aphylla (L.) Karst. - flower / calyx	48, 95, 181
	Myrtus communis L.	52
48, 95, 173	*Rumex* spp. - nut (naked)	52, 55
95	*Rumex* spp. - tubercle	52, 55, 173
48	Polygonaceae - unidentified	55
	Glinus cf. *lotoides* L.	181
52, 55	*Portulaca oleracea* L.	48, 55, 181, 8509
	Vaccaria cf. *pyramidata* Medicus	55, 8509
48, 172, 173	*Beta vulgaris* L.	52, 8509
48, 55, 95, 172, 181, 8719	*Chenopodium murale* L.	48, 52, 55, 8719, 8509
	Cornulaca cf. *monocantha* Del.	52, 55, 95, 8509
48, 95	Chenopodiaceae - unidentified	
95	Chenopodiaceae - needle	
55	Chenopodiaceae - floret	52, 55, 8719
	Zilla spinosa (Turra) Prantl	181
	Coronopus cf. *niloticus* (Del.) Spreng	181
48, 55, 95, 172, 173, 181, 8719, 8509	*Trifolium* spp. - seed	48, 52, 55, 181
52	*Trifolium* spp. - calyx	181
	Trifolium spp. - involucre	48, 52, 55, 95, 181, 8719, 8509
	Scorpiurus muricatus L.	48
	Leguminosae - large seeded	8509
55	Zygophyllaceae - unidentified	48, 52, 55, 181
48, 52, 55, 95, 172, 173, 181	*Malva* sp.	48, 52, 55, 95, 181, 8719, 8509
	Heliotropium spp.	181
	Echium sp.	172
	Verbenaceae / Labiatae	52
	Labiatae - *Ajuga* type	52, 55
55, 95, 172, 173	*Cichorium endivia* L. / *intybus* L.	48, 52, 55, 173, 8719
172	*Sonchus* sp.	95
52	Compositae - unidentified	181, 8509
95	*Asphodelus* spp.	8509
55	*Avena sterilis* L. - rachilla	
55, 95	*Avena* spp. - rachilla	55, 181, 8719
	Crypsis spp.	52, 55, 181, 8509
8509	*Phalaris paradoxa* L.	
	Setaria spp. - with palea/lemma	48, 52, 55, 173, 181, 8719, 8509
48, 55, 95, 173, 181, 8719, 8509	Gramineae - small seeded	48, 55, 95, 181
48, 172	Gramineae - large seeded	52
48, 8719	Gramineae - wild grass rachis	48
172	*Scirpus* cf. *praelongatus* Poir.	181
95	*Cyperus* spp.	
48	Cyperaceae - unidentified TYPE 1	
48, 52, 55	Cyperaceae - unidentified TYPE 2	48
	?U - *Lawsonia*-like seed	48, 55, 95, 172, 173, 181, 8719, 8509
52, 55, 181, 8509	?X - a) Unidentified leaf	48, 52, 55181, 8509
48, 52, 55, 95, 172, 173, 181, 8719, 8509	?X - b) Split leaf / grass / palm	48, 52, 55, 95, 181, 8719, 8509
172	?A4 - a) filament of stamen	48, 52, 55, 95, 173, 181, 8719, 8509
55	?A4 - b) stigma	
172	?A4 - c) anther Small	48, 52, 55, 181
	?A4 - d) anther / pod	48, 55, 95, 181, 8509
48, 55, 95, 172, 8719	?A16 - a) unidentified root	52, 55, 95, 8509
	?A35 - scaly interior of seed ?	181
	?A36 - part of capsule?	55
	?A38 - Internal structure ?	48, 55, 181, 8509
	?A47 - Unidentified seed coat (fragments)	48, 55
95	? A49 b) Small flower head	55
48, 95	?A49 c) flower stalk	48
48, 55, 95, 172	?A49 d) stalk	48, 55, 95, 181, 8509
172	?A53 - ? seed pod - grooved a) fragment	
48	?A55 - Bud (hairy)	
48, 52, 55, 95, 172, 173, 181, 8719, 8509	Indeterminate	48, 55, 181

8.4.3 Reconstruction of cereal processing based on the carbonized and desiccated remains

The ratio of free threshing wheat rachis internodes to grain and free threshing barley internodes to grain in the desiccated component (see Chapter 6 §6.5.3) suggested that all of the Kom el-Nana samples contained cereal remains from an early stage(s) in the crop processing sequence (see Chapter 6 §6.5.3 for further discussion of the crop processing sequence), most likely winnowing or coarse sieving. Do the carbonized remains of free threshing wheat and barley also exhibit these results? Here, the processing of free threshing wheat and barley will be considered based on the ratios of grain to rachis internodes for both the desiccated and carbonized components of the oven samples.

Figure 8.7 shows the proportions of carbonized and desiccated free threshing wheat grain and rachis internodes in the five oven samples with 25 or more identified elements from these taxa. This figure demonstrates that although the relative proportion of carbonized free threshing wheat remains does vary from the desiccated, the carbonized free threshing wheat remains also are from an early stage(s) in crop processing.

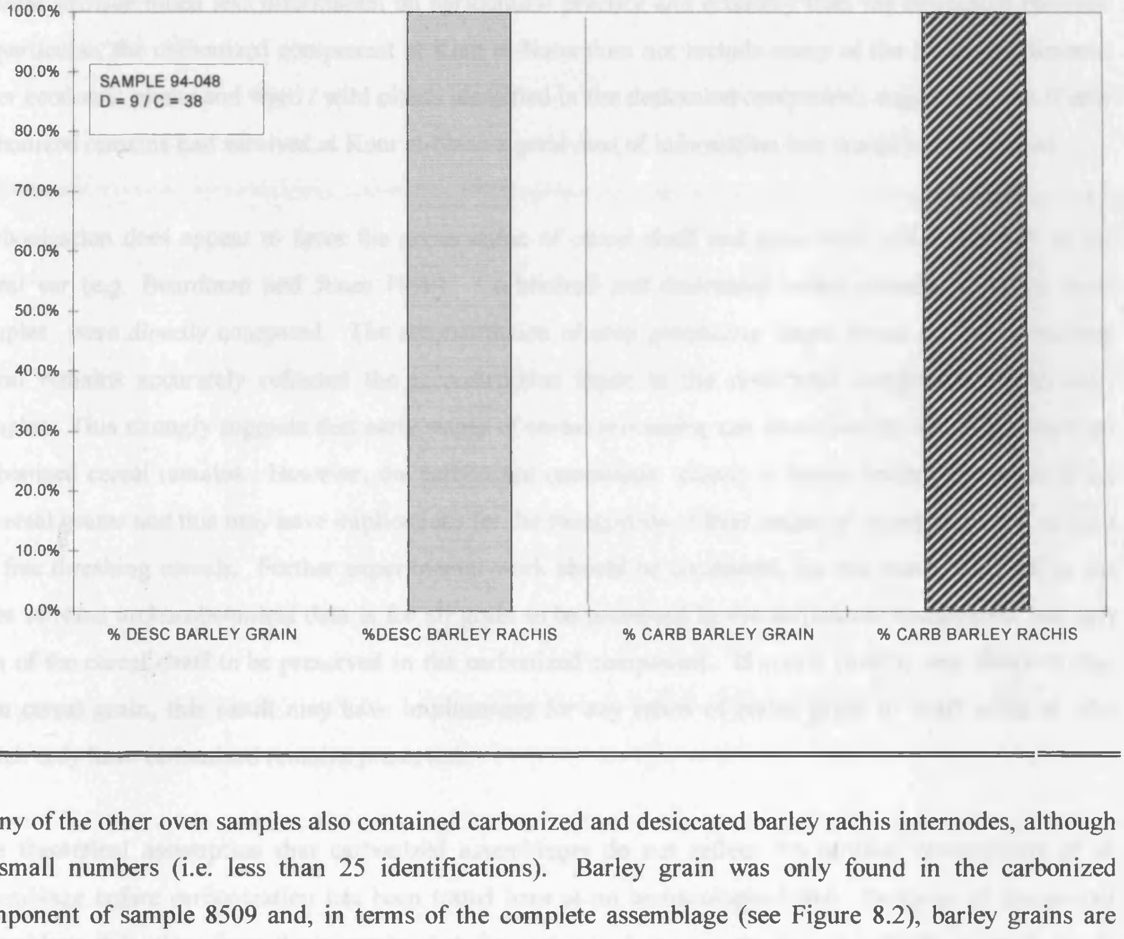
Figure 8.7 A comparison of carbonized and desiccated remains of free threshing wheat in the Kom el-Nana oven samples. (D = total desiccated identifications of wheat grain and rachis internodes and C = total carbonized identifications of wheat grain and rachis internodes. The figure only shows those samples with 25 or more identifications made in one or both of the preservation components.)



It is worth noting that the proportions of carbonized free threshing wheat rachis internodes, when desiccated rachis internodes are preserved (samples 94-052, 94-095 and 8509) are quite similar. In all cases, grain was only preserved in the carbonized component. This may suggest that carbonization favors the preservation of cereal grain over rachis internodes. Charring experiments by Boardman and Jones (1990: 6) also found that cereal grain is more likely to survive charring than cereal rachis internodes.

Figure 8.8 compares the proportion of barley grain and rachis internodes in the carbonized and desiccated components of oven samples 94-048, the only sample which contained over 25 identifications of these elements. The relative proportion of either carbonized or desiccated barley rachis to grains in this sample suggests that these remains are derived from an early stage(s) in the crop processing sequence.

Figure 8.8 A direct comparison of carbonized and desiccated remains of barley in the Kom el-Nana oven sample 94-048. (D = total desiccated identifications of wheat grain and rachis internodes and C = total carbonized identifications of wheat grain and rachis internodes. The figure only shows those samples with 25 or more identifications made in one or both of the preservation components.)



Many of the other oven samples also contained carbonized and desiccated barley rachis internodes, although in small numbers (i.e. less than 25 identifications). Barley grain was only found in the carbonized component of sample 8509 and, in terms of the complete assemblage (see Figure 8.2), barley grains are primarily preserved through desiccation.

In terms of the recognition of early stages in the crop processing sequence, the carbonized remains of free threshing wheat and barley from the Kom el-Nana oven samples produce similar results to the desiccated components of these samples. Notably, the Kom el-Nana free threshing wheat grains and barley grains only arrive in these samples as charred remains. These archaeological results suggest that cereal grain may be over-represented in a charred assemblage. Certainly, experiments conducted by Boardman and Jones (1990) did establish that cereal grain best survived charring conditions. Although cereal chaff may not survive as well as grain in charring conditions (Boardman and Jones 1990: 3), in those cases where barley and wheat rachis internodes were preserved in an oven sample, the proportion of cereal rachis in each separate preservation component of the assemblage were similar. This suggests that carbonized cereal rachis internodes may reliably reflect the original composition of a deposit.

8.5 Conclusions

Although the carbonized assemblage generally matches the desiccated assemblage at Kom el-Nana, it produces a much more limited range of taxa. As a result, the Kom el-Nana carbonized archaeobotanical remains provide much less information on agricultural practice and economy than the desiccated remains. In particular, the carbonized component at Kom el-Nana does not include many of the fruits, condiments, other economic plants and weed / wild plants identified in the desiccated component, suggesting that if only carbonized remains had survived at Kom el-Nana a great deal of information loss would have occurred.

Carbonization does appear to favor the preservation of cereal chaff and grain over other elements of the cereal ear (e.g. Boardman and Jones 1990). Carbonized and desiccated cereal remains from the oven samples were directly compared. The reconstruction of crop processing stages based on the carbonized cereal remains accurately reflected the reconstruction made in the desiccated component of the oven samples. This strongly suggests that early stages of cereal processing can be accurately identified based on carbonized cereal remains. However, the carbonized component clearly is biased toward the preservation of cereal grains and this may have implications for the recognition of later stages of crop processing, at least for free threshing cereals. Further experimental work should be conducted, but the trend exhibited in the Kom el-Nana archaeobotanical data is for all grain to be preserved in the carbonized component, but only part of the cereal chaff to be preserved in the carbonized component. If cereal chaff is less likely to char than cereal grain, this result may have implications for any ratios of cereal grain to chaff made at sites which only have carbonized remains preserved.

The theoretical assumption that carbonized assemblages do not reflect the original composition of an assemblage before carbonization has been tested here at an archaeological site. In terms of the overall assemblage it is clear from these results that the carbonized component do not provide as much, or as precise, information on agriculture as the desiccated component of the Kom el-Nana assemblage. The samples from ovens, contexts where fuel is differentially preserved as desiccated and carbonized plant remains, also showed that the carbonized remains will preserve different individual taxa than the desiccated remains. As a result, any study of the carbonized component will emphasize different taxa than the desiccated assemblage. Although this analysis is based on a small carbonized data set, this trend may have implications for carbonized sites elsewhere. Clearly the common pattern of carbonized sites dominated by cereal grain, cereal chaff and weeds may be an artefact of preservation, rather than a true reflection of the range of crops, wild plants, and weeds used on a particular site. Circumstances for charring vary at each site, but at Kom el-Nana, the charred remains do not preserve many elements which provide information about agricultural practice at this site. However, the analysis of those oven samples with both carbonized and desiccated remains of barley and free threshing wheat rachis internodes does demonstrate that, in this specific case, the carbonized data accurately matched the desiccated data.

The differences between the carbonized and desiccated components of the Kom el-Nana assemblage rest on a limited amount of carbonized data. This is entirely an artefact of sampling methodology, which was based on a small sample size because archaeobotanical remains at this site were primarily preserved by desiccation. The conclusions presented here, therefore, are tentative. In order to produce reliable results from the comparison of the carbonized and desiccated components at Kom el-Nana, the counts of carbonized plant remains would need to be at levels of around 250 seeds per sample, matching those of the desiccated component.

Chapter 9. Integrating Historical and Archaeobotanical Data

The history of agriculture in Egypt is one of the most ancient in the Mediterranean world. Near Eastern 'founder crops' (e.g. emmer wheat and barley) were introduced into Egypt by the late sixth millennium - early fifth millennium BC (Zohary and Hopf 1994: 209-210, 230-234). By the second millennium BC, in New Kingdom Pharaonic Egypt, agriculture had moved well beyond a subsistence economy and had developed into a complex system of production with its accompanying bureaucracy (Kemp 1994: 133). As Kemp (1994: 133) points out in reference to the Pharaonic period evidence:

> Although most ancient Egyptians must have been peasants, they lived in a society permeated with an administration dedicated to moving commodities about and recording them with complex systems of enumeration, and also turning a proportion into luxuries for the elite. One is not dealing with a subsistence economy.

The Ptolemaic bureaucracy, whose "*raison d'être* was the enrichment of the monarchy through a highly organized and tightly controlled economy", became one of the most efficient in the ancient world (Bowman 1986: 56). By Late Antiquity, therefore, the bureaucratic control of agricultural production was well established and its complexity meant that small scale settlements were highly integrated into wider political and economic systems (e.g. Bagnall 1993a: 138-142).

To date, consideration of the role monasteries played in the agricultural economy of Late Antique Egypt has been largely a historical debate (e.g. Bagnall 1993a: 289-293; Wipszycka 1972). Excavations at the monastery at Kom el-Nana have generated a new and independent body of evidence, namely archaeobotanical data. The analysis of the Kom el-Nana archaeobotanical data set provides the opportunity to examine the issue of Late Antique or monastic agricultural practice in Egypt from a different perspective. This study re-examines aspects of the historical record for monastic institutions, particularly in terms of issues of daily life (e.g. diet) or agricultural practice (e.g. use of crops) in light of this new archaeobotanical evidence.

9.1 Integrating Environmental, Archaeological and Historical Data

Some environmental archaeologists working in Egypt, the Near East and elsewhere in the Mediterranean have successfully integrated environmental evidence with the historical and archaeological record. This process has brought environmental evidence, derived from a number of different disciplines (e.g. archaeozoology, archaeobotany, archaeoentomology, etc...), directly to bear on issues within the historical and archaeological record for agricultural practice and economy. This approach is particularly suited to studies of ancient agriculture, where contrasting different forms of evidence can highlight areas for future research, and can move understanding of agricultural practice forward (e.g. Postgate and Powell 1987: v).

Samuel (1994: 153-154; see also Samuel 1993b) has recently assigned the term "thematic" integration to the process of integrating "different data sets...over different scales of distribution."

9.1.1 The need for integration

Archaeology is an eclectic discipline which houses a wide range of specialists. In many cases the speciality can be an independent field of study (i.e. archaeobotany, linguistics or pottery analysis). The number of specialists which might be associated with an archaeological project can be quite large and does require organisation and strong ties of communication between them if they are to fully integrate their research with each other. In the past, specialist studies were normally placed at the end of archaeological reports, often in an appendix and the synthesis of results was left to the site director (Bell 1992: 21). However, most recognize that a number of different perspectives on the same problem can lead to better understanding or, in cases where independent data clearly are in conflict, identification of areas for further research (e.g. Kenward and Hall 1997: 665).

There have been a growing number of calls for the integration of research results produced by different specialists. For example, Bagnall (1988: 201) has recently made a plea for the further integration of the historical and archaeological record in Egypt. Environmental archaeologists, such as Luff and Rowley-Conwy (1994), also have strongly argued for further integration of archaeological and environmental evidence and, preferably, from the initial stages of project design. Moreover, Bell (1992: 25) has recently suggested that environmental archaeology "can provide an independent perspective on problems more usually examined by studies of artefact typology, art history, settlement patterns, place-names, etc." (also see Bell 1989). As Kemp (1994: 133) suggests, the "way ahead" is to recognize that environmental, historical and other archaeological evidence (e.g. wall paintings, archaeological features, artefacts, etc...) are, in fact, complementary forms of evidence on any ancient society. The differences or similarities found in comparing these independent forms of evidence can only enhance our understanding of the past.

9.1.2. Examples of previous work

How one might achieve integration of different forms of evidence (e.g. environmental, archaeological or historical), however, depends on a variety of factors, such as strong communication between specialists, project design, and project aims; but also may be vulnerable to constraints of time or funding (Bell 1992). Many aspects of ancient agricultural practice or the ancient economy elude us today. Basic questions about agriculture and economy, such as how one might bake bread in ancient Egypt or if wild silk was used for textile manufacture in Bronze Age Greece (see below), abound. Research on such questions benefits from considering more than one form of archaeological evidence and, in turn, leads to better understanding of the ancient economy and ancient societies.

Attempts to integrate different forms of archaeological data, in particular the integration of different forms of archaeological evidence on ancient agriculture, have occurred in many areas of the Mediterranean and Near East. Three main methods for integration are possible:

1. Independent publication. Here specialists separately report results, generally on the same theme, but without integrating their research with each other.

2. Individual integration. Here a specialist, usually an environmental archaeologist, integrates his/her evidence with existing archaeological (including environmental) and historical evidence.

3. Joint publication. Here fully integrated archaeological, historical and environmental evidence are presented in synthesis by more than one author.

An example of the first approach is best exhibited by the Sumerian Agricultural Group. This group regularly holds meetings which bring together a number of different specialists (i.e. archaeologists, linguists, archaeozoologists, archaeobotanists, etc...) to discuss different forms of archaeological and historical evidence on certain agricultural themes (i.e. cultivation of cereals, oil crops, or fruit). The papers presented at these meetings are published in *Bulletin on Sumerian Agriculture* (Volumes I (1984), II (1985) and III (1987) are especially devoted to agricultural crops), which successfully brings together independent approaches to Sumerian agricultural research (especially linguistic studies and archaeobotany). This approach is also evident in a recent joint paper on food in Pharaonic Egypt (Kemp *et al.* 1994), where each author approached the study of food from the basis of their own archaeological speciality but also attempted to integrate other, independent forms of evidence into their studies.

Individual integration of environmental evidence with the wider archaeological and historical record has become a more common approach in Mediterranean and Near Eastern archaeology. In particular, work by Halstead (e.g. 1992a, 1992b, and 1995) has successfully integrated environmental, archaeological and historical evidence on both agricultural practice and economy in Bronze Age Greece. These studies clearly establish that archaeozoological and archaeobotanical remains can address 'gaps' in the historical evidence, providing insight into both recorded and unrecorded transactions of the palatial economy in Bronze Age Greece. For example, Halstead (1995: 229) shows that the archaeobotanical record for Late Bronze Age Greece "contrasts strongly" with the available historical evidence. He establishes that the ancient terms of certain crops do not appear to be as refined as our present-day taxonomic classifications, and this may imply that crops considered distinctly different today (i.e. different varieties of wheat) were actually considered the same thing in ancient times.

Aside from historical questions, art-historical interpretations, which have often informed our understanding of agricultural practice (e.g. Samuel 1993a: 276-278 and 1996: 3), can be re-assessed in light of other forms of evidence. For example, Samuel's (1989, 1993a, 1993b and 1996) investigations into Egyptian bread and beer making also contrasts the art-historical, archaeological and historical records from the Pharaonic period with experimental and archaeobotanical research (in this case the specialized analysis of food residues using scanning electron microscopy). Samuel's (1989) bread baking experiments indicate that although the art-historical record appears quite detailed, the precise method of baking bread in ceramic moulds in Pharaonic period Egypt remains uncertain. In a separate study on ancient brewing techniques, Samuel (1996) has resolved a long standing debate on the precise meaning of certain 'cereal-related' words, by establishing that there is strong archaeological evidence (both archaeobotanical and food residue analysis) for the use of malt in Pharaonic Egyptian beer.

In addition to these examples of individual integration of disparate sources of archaeological data, there are some examples of joint integration. For example, the discovery of a lepidopterous cocoon in excavations at Bronze Age Thera, Greece has lead to the conclusion that silk production may have occurred in Greece as early as the Bronze Age and also has generated a complete re-interpretation of artistic depictions of moths / butterflies and, more particularly, the West House wall paintings also found at Thera (Panagiotakopulu *et al.* 1997). The strength of such individual or joint studies which integrate different forms of evidence lies in the fact that can add detailed, expert knowledge on many different aspects of the archaeological record in order to produce a piece of research which not only integrates disparate data but actually achieves synthesis.

9.2 Monastic Diet

The fourth through seventh century documentary records for monasteries suggest that monks survived on a meagre diet, comprised of a limited range of foodstuffs. Walters (1974: 205) goes so far as to suggest that the monastic diet was "at all times frugal." Specific mention of food crops in the documentary and literary evidence for monasteries include barley, cabbage, cumin, dates, figs, grapes / raisins, herbs (sometimes green herbs, sometimes dried or preserved), leeks, lentils, lupin, olives, pomegranates, wheat and various vegetable oils (Bagnall 1993a: 300; Walters 1974: 206; Winlock and Crum 1973: 146-147). Bread and wine also are mentioned (Winlock and Crum 1973: 145-146 and 161-162; Clackson 1996: 42).

Archaeobotanical finds from the monastery of Phoebammon (Täckholm 1961), the monastery of Epiphanius (Winlock and Crum 1973: 61) and, now, Kom el-Nana confirm many of these attested food crops, but greatly extend the number of foodstuffs known from monasteries. Table 9.1 lists the archaeobotanical finds from these three monasteries and indicates which crops are known from the historical record. Although it is not possible to claim that all the monks (or nuns) at these monasteries ate all of the foodstuffs recovered, the archaeobotanical evidence from these monasteries does illustrate that the monastic diet was much more varied than the historical records would suggest.

9.2.1 Comparison of historical and archaeobotanical evidence for agricultural crops at monasteries

The historical evidence for crops is dominated by records of arable crops (i.e. barley and wheat), and to a somewhat lesser extent by orchard crops (i.e. date, fig, grape, and olive). Other crops are only rarely mentioned. Earlier (Chapter 6 §6.2) in the thesis, it was suggested that those crops which are rarely attested in the documentary record most likely are grown in gardens. It also may be that tree fruits, such as Christ's thorn or pomegranate, were grown as orchard crops rather than as individual garden trees. Records of greens or herbs are almost impossible to attribute to a specific plant although some of the species identified in the Kom el-Nana archaeobotanical assemblage could be used as 'greens' or 'herbs' (see Chapter 5 §5.2.5 and §5.3.1).

Table 9.1 lists all crops which also are known from the historical or archaeobotanical record of monasteries in Egypt. In total, forty-seven crops are listed. Of these, fourteen are attested in the historical record and forty-five are known from the archaeobotanical evidence recovered from the monasteries of Epiphanius (EPIPH) and Phoebammon (PHOEB) in western Thebes and from Kom el-Nana.

Leek and cabbage, although attested in the documentary record, have not been found in archaeobotanical sampling from any of these monasteries. Leek (or possibly kurrat - the two are closely related) has been identified archaeobotanically in Egypt to date (Murray forthcoming b), but I am unaware of any post-Pharaonic period finds. To my knowledge, only one find of cabbage leaf and seed has been made from the Graeco-Roman cemetery at Hawara (Newberry 1890; and see Zohary and Hopf 1994: 186 for paucity of archaeological identifications of cabbage). Distinguishing between species of *Brassica* with seeds in the size range of cabbage (*Brassica oleracea* L.) often is not attempted (e.g. Moffett and Smith 1996: 160), and this may explain its under-representation in the archaeobotanical record. Leek is generally consumed before it flowers, so archaeobotanical finds of leek would most likely be limited to its leaves, and such vascular tissue is less likely to survive, even in the conditions of near perfect, desiccated preservation which occur at some Egyptian sites (Murray forthcoming b). This may be the case for cabbage leaf as well.

Table 9.1 Comparison of the historical and archaeobotanical record for food crops at monasteries.

COMMON NAME	LATIN BINOMIAL	HISTORICAL RECORD	ARCHAEOBOTANICAL FINDS FROM		
			EPIPH	PHOEB	KOM EL-NANA
ARABLE CROPS					
Barley	*Hordeum vulgare* L.	✓	✓	✓	✓
Flax / Linseed ‡	*Linum usitatissimum* L.	-	-	-	✓
Safflower	*Carthamus tinctorius* L.	-	-	✓	✓
Sorghum ††	*Sorghum bicolor* (L.) Moench.	-	-	-	✓
Wheat	*Triticum aestivum* L. / *T. durum* Desf.	✓	-	✓	✓
? ARABLE CROPS	**/ ? GARDEN CROPS**				
Broad bean	*Vicia faba* L.	-	✓	-	-
Fenugreek	*Trigonella foenum graecum* L.	-	✓	-	-
Leek	*Allium porrum* L.	✓	-	-	-
Lentil	*Lens culinaris* Medik.	✓	-	✓	✓
Lupin	*Lupinus* cf. *albus* L.	✓	-	✓	✓
Onion	*Allium cepa* L.	✓	✓	-	✓
ORCHARD CROPS					
Date	*Phoenix dactylifera* L.	✓	-	✓	✓
Grape / Raisin	*Vitis vinifera* L.	✓	-	✓	✓
Olive	*Olea europaea* L.	✓	-	✓	✓
GARDEN CROPS *					
Almond	*Amygdalus communis* L.	-	-	-	✓
Aleppo rue	*Ruta* cf. *chalepensis* L.	-	-	-	✓
Basil	*Ocimum basilicum* L.	-	-	-	?✓
Beet	*Beta vulgaris* L.	✓	-	✓	✓
Bottle gourd	*Lagenaria siceraria* (Mol.) Standl.	-	-	✓	✓
Cabbage	*Brassica oleracea* L.	✓	-	-	-
Carob	*Ceratonia siliqua* L.	-	-	✓	-
Carrot	*Daucus carota* L.	-	-	-	✓
Castor	*Ricinus communis L.*	-	✓	-	-
Celery	*Apium graveolens* L.	-	-	-	✓
Christ's thorn	*Zizyphus spina-christi* (L.) Desf.	-	-	✓	✓
Citron	*Citrus medica* Risso.	-	-	✓	-
Coriander	*Coriandrum sativum* L.	-	-	-	✓
Cucumber / Melon	*Cucumis* sp.	-	-	-	✓
Cumin	*Cuminum cyminum* L.	✓	-	-	✓
Dill	*Anethum graveolens* L.	-	-	-	✓
Dom palm	*Hyphaene thebaica* (L.) Mart.	-	✓	✓	-
Egyptian balsam	*Balanites aegyptiaca* (L.) Del.	-	✓	✓	-
Egyptian plum	*Cordia myxa* L.	-	-	✓	✓
Fan palm	*Medemia argun* Württemb ex Mart.	-	✓	-	-
Fennel	*Foeniculum vulgare* (L.) Mill	-	-	-	✓
Fig	*Ficus carica* L.	✓	-	✓	✓
Mulberry	*Morus* sp.	-	-	-	✓
Peach	*Prunus persica* (L.) Batsch.	-	-	✓	✓
Persea	*Mimusops schimperi* Hochst.	-	-	✓	-
Pomegranate	*Punica granatum* L.	✓	-	-	✓
Purslane	*Portulaca oleracea* L.	-	-	-	✓
Radish	*Raphanus sativus* L.	-	-	✓	-
Sycomore fig	*Ficus sycomorus* L.	-	-	-	✓
WILD					
Bitter apple	*Citrullus colocynthis* (L.) Schrad.	-	-	✓	-
IMPORT					
Juniper berry †	*Juniperus* cf. *oxycedrus* L. / *phoenicea* L.	-	✓	✓	✓

Key: ✓ = present in the historical record or as an archaeobotanical find and - = not present. Historical data after Bagnall 1993a: 300; Gould 1993: 142; Meyer 1965; Walters 1974: 206; Winlock and Crum 1973: 145-148 and 161-162), EPIPH = the monastery of Epiphanius (Winlock and Crum 1973: 61) and PHOEB = the monastery of Phoebammon (Täckholm 1961).

* = the garden crops could also be grown as arable or orchard crops in theory, but I am unaware of any records for this. It may be that the orchard crops are grown in gardens as well. In addition, it also is possible that some of the fruit trees could be planted as hedges around fields. (See Chapter 2 §2.4.1 and 6 §6.2).

‡ = there are no records for the use of linseed oil; however, flax for weaving is attested (Winlock and Crum 1973: 156-157)

† = indicates definite import into the Nile Valley (Hepper 1990: 60; Lucas 1994: 437; Täckholm 1974: 50).

†† = At present, there is no definitive evidence for the cultivation of sorghum in this region of Egypt, however, finds of sorghum at Qasr Ibrim (Rowley-Conwy 1991) in Egyptian Nubia may suggested that in some regions of Egypt, sorghum was cultivated.

9.2.2 Conclusions on archaeobotanical and historical evidence for agricultural crops at monasteries

Aside from leek and cabbage, which have yet to be identified at any monastic settlements, all other historically attested crops have been recovered from one or more of the three Late Antique monasteries which have been sampled (see Table 9.1). With the possible exception of safflower, flax / linseed, and possibly sorghum (see note on sorghum at bottom of Table 9.1), which most likely were cultivated as arable crops, the remainder of crops found in archaeobotanical sampling at these monasteries were probably grown as garden plants. Of course, it is possible that some of these plants were grown in orchards or as hedging around the edges of fields (see Chapter 6 §6.2.), but it is striking that the archaeobotanical finds, which first and foremost greatly expand our knowledge of crops plants at these monastic institutions, support the conclusion that monasteries were also relying on garden crops, perhaps grown in gardens located immediately on site, to supplement their diet.

Evidence for monastic gardens is present in the hagiographic texts. For example, Saint Antony is known to have kept a garden (*Vita Antoni* 50 cited in Brakke 1995: 226 and 232-233). There also are some references to monastic gardens in the Lausiac History (7.4 and 32.12 trans. Meyer 1965: 41 and 95). Archaeological evidence for a garden at Kom el-Nana is quite compelling. Evidence for plow marks (Plate 9.1), roots (Plate 9.2), and large quantities of leaves have all been found. Garden crops clearly are used by monasteries although most garden crops are rarely documented or completely unattested. This result may confirm Bagnall's (1993a: 115-116) suggestion that gardens and, therefore, garden crops rarely enter the historical record, because gardens are small-scale and not subject to taxation in Late Antiquity (see Chapter 2 §2.4.1).

Table 9.1 also demonstrates that more systematic methods of archaeobotanical sampling (see Chapter 4 §4.1) generate better results. The archaeobotanical evidence from both the monastery of Epiphanius and the monastery of Phoebammon are from haphazard collections of plant remains seen during excavation and are not derived from soil samples (see also Chapter 2 §2.4.2). Täckholm (1961: 3) notes that the excavators at the monastery of Phoebammon took great care to collect "even the smallest seeds and leaf fragments." The Phoebammon results do offer a much more extensive list of taxa than those from Epiphanius; however, even with the greatest of care, many plant remains are not easily visible to the naked eye and will go unnoticed during excavation. Kom el-Nana has produced slightly more edible plants than the monastery of Phoebammon, but also has yielded a wide range of non-edible economic plants and weed species, many of which are under 2mm in diameter (e.g. *Portulaca oleracea* or *Glinus* cf. *lotoides*). In addition, the Epiphanius and Phoebammon reports provide only the sketchiest information on the archaeological context(s) of these finds; whereas, all of the plant remains found at Kom el-Nana have known archaeological contexts. Although it is possible to discuss the range of edible plants found at these monasteries, only archaeobotanical samples from known archaeological contexts, with no bias against small sized plant remains, can support research into precisely how these plants were used at monasteries.

Plate 9.1 Plow marks in open area to the east of the north-east tower and smaller structures

Plate 9.2 Large fragment of root (currently unidentified) hand-picked from site during excavations

9.3 The Absence of Cereal Grain and Pulses at Kom el-Nana

The plant remains recovered from Kom el-Nana form a somewhat unusual assemblage. Although large, pure deposits of food crops are rare (e.g. the first century AD Vesuvian sites of Herculaneum, Pompeii, and the villa at Torre Annuziata - F. Meyer 1980), most archaeological sites tend to produce an abundance of cereal grain (M. K. Jones 1988b: 44). At Kom el-Nana, however, only 98 desiccated cereal grains and 48 carbonized cereal grains were found in an assemblage of over 27,500 identifications.[1] In addition, complete pulses are scarce and detached hila (the point where beans or peas attach to the pod) are the most common remain of larger, most likely edible, pulses in this assemblage.[2] Why are cereal grain and pulses rarely found in the Kom el-Nana assemblage?

It may be that the areas of the site which have been excavated simply are places where cereal grain was not in storage, used or processed. For example, Kemp (1993: 14) suggests that the buildings to the east of the north-east tower are workshops and animal stalls (see also Chapter 3 §3.3) and, therefore, may not be contexts where cereal grains, especially free threshing wheat grains, or pulses used primarily for human consumption might be found. One other possibility for the absence of cereal grain and pulses could be that some taphonomic reason (i.e. insect predation, wetting and drying of site, etc.) at the site of Kom el-Nana is affecting the preservation of cereal grains and pulses. This hypothesis has already been suggested for the Libyan Valley Archaeological Survey (van der Veen *et al.* 1996: 233-240), where cereal grain and pulses also were scarce. This explanation may partially explain the lack of grain and pulses, but in light of the fact that archaeobotanical remains of fragile vascular tissue (in particular desiccated leaves, flower petals and onion skins) do survive at Kom el-Nana, taphonomy may not be the only reason why cereal grain and pulses are scarce at this monastery. Although taphonomy is likely to play a role, the presence of fragile archaeobotanical remains at Kom el-Nana does suggest that some other factor(s) may be contributing to the absence of cereal grain and pulses.

In addition to looking for taphonomic or archaeological explanations for the absence of cereal grains and pulses at Kom el-Nana, the historical record can be consulted in order to explore why cereal grain and pulses might be absent from this site. Both the historical and archaeological record provide detailed information about food processing in Late Antique Egypt. Food processing installations, such as threshing floors, oil presses and bakeries have been found at several monasteries (e.g. Badawy 1978: 41; Walters 1974: 206-209 and 217; Winlock and Crum 1973: 61-63), demonstrating that some crop processing was done at monastic settlements. The documentary evidence from monasteries also suggests that bread was commonly sent as a gift to monks, or indeed requested by them (Winlock and Crum 1973: 146), indicating

[1] Identifications of cereal grains include barley, free threshing wheat, unidentified wheat, unidentified cereals and detached cereal embryos. Grains were quantified based on the presence of the embryo. Desiccated cereal grain account for 0.4% of the overall desiccated assemblage and carbonized cereal grains account for 1.5% of the overall carbonized assemblage at Kom el-Nana.

that in some cases fully processed and cooked cereal grain, not whole grain, arrived at monasteries. Processing of leguminous food crops is possible as well. In particular, there is historical evidence for several forms of processed lentils, such as gifts of pressed lentil at the monastery of Epiphanius (Winlock and Crum 1973: 146).

9.3.1 Regulation of cereals in Late Antiquity

One possible explanation for the scarcity of whole cereal grain in the archaeobotanical record may result from the importance of cereal crops in the economy of Late Antique Egypt. The pre-eminence of cereals, in particular wheat, in Late Antique Egyptian taxation meant that this crop was highly regulated. Rents and taxes often were paid in cereal grain, and large quantities were shipped in the yearly *annona* (tax shipment of grain) to feed Constantinople (Bagnall 1993: 23-25 and 156). Land taxes and wages were paid completely or partially in cereal grain in Late Antiquity (e.g. Bagnall 1993a: 23).

Diocletian's reforms resulted in a taxation system whereby the imperial government would set the amount of taxes to be raised from each province, and then provincial officers would assign quotas for each nome. These nome quotas would be collected by officials from each nome-capital, as well as cities and villages within each nome (Bagnall 1993a: 156). Since the Roman period, imperial revenue was raised primarily through land-based taxation (Bowman 1986: 76). Although there is the impression that Late Antique taxation was a burden on the Egyptian population (e.g. Brown 1991: 36), in reality, the tax-burden of Late Antique Egypt was considerably lower than in the preceding Roman period. For example, at the well-documented village of Karanis, fourth century land tax was as much as 70% less than second century tax rates; nevertheless, paying these lower rates of tax was considered a burden by the fourth century Karanis villagers (Bagnall 1985: 297). At Karanis, and elsewhere, the flat rate of land tax could result in a higher tax rate (in real terms) on less productive land, simply because poor quality land will yield less grain than more fertile land (Bagnall 1985: 306).

A flat-rate of tax was charged on public (imperial) and private land (see Chapter 2 §2.3.2 and §2.4.1 for a discussion of land tenure in Late Antique Egypt) whereby public (or imperial) land was taxed at around 3 artabas of wheat / aurora of land (Bagnall 1985: 300-301; Rowlandson 1996: 71-72) and private land was taxed at around 1 artaba of wheat / aurora of land (Bagnall 1985: 300-301; Rowlandson 1996: 37). These basic tax rates serve as a 'rule of thumb' since the actual rate of taxation was variable in Late Antiquity, surcharges often were added, and the overall rate also could increase when imperial government needed additional funds, such as in times of war (e.g. Bagnall 1985: 300 and 305; Bagnall and Worp 1980b: 264; Rowlandson 1996: 35-37, 71-72 and 292). Taxation applied to all landowners and, therefore, any monastic

[2] In total, 5 desiccated and 3 carbonized complete pulses were recovered and 35 desiccated detached hila were also identified. No carbonized detached hila were recovered. Desiccated pulses, including detached hila, account for 1.6% of the overall desiccated assemblage and carbonized pulses account for 0.1% of the overall carbonized assemblage.

institutions which owned land were also subject to taxation in the period (Bagnall 1993a: 290).

Harvested cereal crops were taken directly to the state-controlled threshing floor where taxes and rent were collected in kind (Rowlandson 1996: 20), and in some places taxes also were collected on the cereal chaff (Bagnall 1985: 302 and 1993a: 156 footnote 37). Processing of cereals could take place in the village as well as the city, but milling of grain into flour "was certainly (if not uniquely) an urban occupation" (Bagnall 1993a: 79). Although it is possible that future excavations at Kom el-Nana may provide evidence for grain storage or milling on site, the absence of cereal grain currently observed in the Late Antique archaeobotanical data may perhaps be explained by this system of tight regulation on cereal crops for tax purposes.

It is possible that cereal grain was sometimes stored on a large scale in Late Antique Egypt, but such activity may have been restricted to urban mills, resulting in an absence of large volume grain storage at rural settlements (i.e. villas, small settlements, perhaps even small villages). Historical evidence for Late Roman Oxyrhynchus establishes that "landowners customarily held grain 'accounts' at village granaries, from which payments and transfers could be made in the manner of a currency, thus obviating the use of coins" (Rathbone 1991: 310-311; Rowlandson 1996: 189, see also 108-109, 112, 116-118, 138 and 266). Given the spectacular preservation conditions at many Late Antique sites (e.g. Karanis - where whole loaves of bread were preserved - see Bowman 1986: 108 figure 62) silos or containers full of cereal grain would be easily identifiable, yet in all excavations of Roman and Late Antique sites such deposits are entirely absent, although granaries have been identified (e.g. Hussleman 1952; Winlock and Crum 1973). In Late Antiquity, granaries at the village of Karanis appear to fall out of use (Hussleman 1952: 58). Admittedly, Karanis was experiencing a sharp decline in productivity at this period (e.g. Bagnall 1985, Hussleman 1952: 56), but this may indicate a wider trend of urban control of granaries in Late Antiquity.

The persistent lack of deposits of pure grain at individual sites in the Egyptian *chora* suggests that grain was centrally stored (most likely in urban granaries, but possibly mills as well) and that most Egyptians in this period might have stored flour in their homes or simply purchased bread outright. If government control of cereal crops was as restrictive as the documentary records suggest, then it is highly likely that small-scale, rural producers and consumers of cereals, including the monastery at Kom el-Nana, would be drawn into larger political and economic systems in Egypt through the taxation, rent payment and purchase of cereal grain.

9.3.2 Ethnographic and archaeobotanical evidence for processing of pulses prior to consumption

The scarcity of whole pulses is marked at Kom el-Nana. Like cereal grain, the partial or complete processing of pulses may be responsible for the low numbers of complete pulses. A wide variety of pulses have been found at other Late Antique Egyptian sites (see Chapter 5 §5.5), but lack of quantification and systematic sampling means that it is not possible to ascertain if these quantities of edible pulses are also low at these sites.

Ethnographic evidence for the processing of pulses (i.e. the removal of the outer seed coat, splitting the two halves of the bean or pea, or pounding) prior to consumption is well known (e.g. G. Jones 1992b; 1993; Murray forthcoming b). In some cases processing of pulses, such as the fava bean (*Vicia faba* L.) results in shorter cooking time, as well as aiding digestion of the beans (G. Jones 1993: 103). There are historical records of lentil which demonstrate that this pulse was traded or exchanged in several different states of processing; such as 'closed', 'pressed', and 'pounded' (Winlock and Crum 1973: 146).

9.3.3 Historical and archaeobotanical evidence for processed cereals

There are many records of delivery or payment of 'corn' from the monastery of Epiphanius (Winlock and Crum 1973: 232-239 - see also Chapter 3 §3.2.2 for a description of the monastery). However, the state of the cereal grain (i.e. processed or unprocessed) does not seem to be specified. It may be that generally clean, whole grain is delivered and then immediately ground into flour. One seventh century document from Hermopolis clearly specifies the state of the grain:

> ...the annual rent...total, 5 artabas of wheat and 5 ½ artabas barley in the receiving measure of Jusuts the farmer; which rent I shall duly pay to you new, clean, unadulterated, and sifted in the month Epeiph each year without delay, and I shall deliver the same to your house in Hermopolis by my own private beasts and men and at my own expense.
>
> Rees 1964: 69-73

Although Bagnall (1993a: 79) suggests that grain was generally milled in urban centers, there is some evidence to suggest that small scale, hand-milling did occur at monasteries. One letter from Koletjew, the mother of Epiphanius, to her son suggests that she will come up to help him grind grain into flour:

> If thou art grinding (corn), send unto me and I will fetch his (grind-)stone and come up.
>
> Winlock and Crum 1973: 242 - ostraca Epiphanius 336 (MMA 14.1.91)

Alternatively, there is evidence for the delivery of processed cereal grain to monasteries. For example, there is a request for 'fine flour' from a sick monk:

> Be so good, if little Ezekiel come in to thee, admonish him well that he tell no man, save his parents only; and they likewise, that they tell no man. And that he tell them to grind a maje of corn and to pound it to fine flour; and that he bring it in unto thee and that thou bring it and set it by the door. For I am sick; for days I have not been able to eat. Be so good, tell not the young brethren at all that I am sick and so disturb their mind; for (otherwise) I shall at last be grieved with thee, even unto death. Neither tell any other man.
>
> Winlock and Crum 1973: 232 - Ostracon - Epiphanius 297 (Cairo 44674.167)

There also are several documents from the monastery of Epiphanius for the delivery of loaves of bread:

> From Shebêw to John. The writer is sending a small present by (?) Jeremias, consisting of (...), butter (?), loaves and (....).
>
> Winlock and Crum 1973: 217 - Ostracon - Epiphanius 246 (M.M.A. 12.180.118 + 119)

> From John to Elisaius. Lo, here are the loaves; I have sent them, smeared and sealed, by Philemon, and have left them until (...) come, that no man may see them.
>
> Winlock and Crum 1973: 219 - Papyrus - Epiphanius 253 (M.M.A. 14.1.483)

The consistent absence of cereal grains, even when granaries and mill emplacements are found (e.g. Hussleman 1952, Winlock and Crum 1973), strongly suggests that this absence is significant. It may be that taphonomy, perhaps insect predation, may, in part provide an explanation for the small quantities of cereal grains which have been found to date. In addition, it must also be remembered that cereal grain, the desired main product of processing, and would have been carefully collected and not subjected to much wastage at the stage of primary processing (threshing, winnowing, sieving) or secondary processing (the grinding or milling of grain to make flour or the pounding, pressing, or rolling of pulses).

Archaeobotanical evidence from other sites at Amarna (of which Kom el-Nana is only one) can be used to test whether the trend for absence is actually limited to Late Antiquity. An archaeobotanical study of cereal processing from the New Kingdom Period Workmen's Village site at Tell el-Amarna has shown that a sample of desiccated plant remains from around a mortar emplacement did not contain large quantities of loose cereal grain (Samuel 1989; 1994). Ethnographic studies on the primary processing of cereal or leguminous crops (i.e. the separation of the grain or pulse from the whole plant) have also established that at the early stages of processing (e.g. threshing and winnowing), very little loose cereal grain or pulses are included in the by-product and that the crop processing sequence is designed to retrieve as many grains or pulses as possible (Hillman 1984a, 1985; G. Jones 1984, 1995: 104-109; 1996). So unless pure or near-pure deposits of grain are found, most likely in storage contexts or perhaps around cooking areas, grain and pulses would otherwise only occur in very small amounts.

9.3.4 A significant absence?

Why are large deposits of cereal grain or pulses not found in Late Roman / Late Antique Egypt? Given the spectacular preservation of many Egyptian sites, large deposits of cereal grain or pulses should survive. Certainly it is possible for such material to survive in Egypt, for example storage containers (jars or baskets) of desiccated barley, emmer wheat, and fenugreek were found in Tutankhamun's tomb (de Varatavan 1990: 476). Proposed taphonomic explanations for the absence of cereal grains and pulses (e.g. van der Veen *et al.* 1996: 233-240) may partially explain the paucity of finds, but do not sufficiently explain their absence when fragile remains such as the Karanis bread (Bowman 1986: 108 figure 62) or vascular plant tissue, such as leaves, flowers and roots at Kom el-Nana, do survive. The historical sources clearly establish that processed cereals and pulses were available and regularly delivered to monasteries. Perhaps the underlying reason why large deposits of whole cereal grain and pulses aren't found at rural Late Roman and Late Antique sites is simply because these sites were regularly using processed or semi-processed grain and pulses.

Foods based on cereals and pulses generally process whole grain or pulses prior to cooking (e.g. bread is made from flour). In addition, the very act of cooking can break down whole grains or pulses making them difficult to recognize using standard archaeobotanical methodology. It seems likely that identification of cereals and pulses may increase with the recognition and recovery of food residues adhering to pottery (e.g. Samuel 1996: 5). Although it is possible that new excavations may reveal large scale grain storage at Kom el-Nana or other Late Antique sites, the absence of cereal grains and pulses from those sites already excavated appears to be significant. It seems unlikely that large, pure deposits of cereal grain or pulses would go unobserved, even at those excavations which did not employ more modern methods of archaeobotanical sampling. This may suggest that large scale storage of cereal grain was not commonly practiced at most Late Antique rural communities.

9.4 Evidence for the Use of Traditional Fuels at Kom el-Nana

Egypt is not without wood resources (Zahran and Willis 1992); however, these resources are scarce. Research in the Near East has suggested that when wood is limited alternative fuels (often termed traditional fuels), such as animal dung, are used (Anderson and Ertug-Yaras forthcoming; Bottema 1984; Miller 1984a and 1984b; Miller and Smart 1984). Ethnographic research also has shown that crop processing by-products, such as cereal chaff (Hillman 1984, 1985; Jones 1984) can be used as fuel. Moreover, in reviewing the historical evidence for fuel, Bagnall (1993a: 41) notes that aside from records for the use of cereal chaff as fuel in baths, there is a paucity of references for the use of wood and other traditional fuels in Late Antique Egypt.

9.4.1 The Kom el-Nana oven samples

Excavations at Kom el-Nana have revealed a number of oven installations at the site which provide the opportunity to explore what fuels were used. Although charcoal has been found in some of these ovens, the vast majority of sampled ovens have shown that fuels other than wood were in use at Kom el-Nana (i.e. there are a few samples primarily containing charcoal, which have not yet been studied). In addition to containing carbonized remains, many of these ovens also include desiccated plant remains. Ethnographic work on traditional fuels also has shown that in a 'true fire' situation, fuel does not always burn completely (e.g. Miller and Smart 1984: 19). The oven samples were collected from well sealed contexts and directly from the firing chamber of each oven. As a result, I have interpreted the desiccated remains found in these samples to be incompletely burned fuel, rather than contamination. In total, nine ovens, located to the north of the north-east tower and in the buildings at the east of this tower were studied.

9.4.2 Contents of the Kom el-Nana oven samples

The entire contents from the firing chamber of each oven were collected. Preservation of material within these oven samples varied. Three oven samples (94-052, 94-181 and 94-8509) contained a large proportion of unidentifiable charred seeds, which had been badly warped and twisted. Five of the oven samples contained substantially more carbonized than desiccated plant remains, but four oven samples (94-052, 94-055, 94-181 and 94-8509) contained more desiccated than carbonized plant remains.

The oven samples are dominated by four plant groupings: cereal chaff, date perianth and rachilla, clover and weed / wild plants. Cereals were an important crop in Late Antique Egypt (see §9.3). The cereal chaff is primarily comprised of rachis internodes of free threshing wheat (primarily *Triticum durum* Desf.) and barley (*Hordeum vulgare* L.), and cereal culm nodes; but also includes barley awns and awns, glume and rachilla of wheat. Cereal chaff and straw can be used as fuel after crop processing (Hillman 1984, 1985; Jones 1984) or added as a temper in dung cake fuel (Moens and Wetterstrom 1988: 166). Cereal chaff and straw also can be used as an animal fodder (Hillman 1984, 1985; Jones 1984) and, therefore, may enter dung cake fuel this way as well.

Species of *Trifolium* or clover can be cultivated as green fodder (Boulos 1966: 204 and 206). Moens and Wetterstrom (1988) found large quantities (ca. 20% of the total assemblage) of carbonized *Trifolium* sp. seed at the Pharaonic (Old Kingdom) site of Kom el-Hisn. They (1988: 169) suggest that although clover is cultivated as a green fodder crop, the plants will not develop in synchrony so any harvest of this crop would include plants in a variety of stages of development. Today in Egypt, Egyptian clover or '*bersim*' (*Trifolium alexandrinum* L.) is the most important livestock feed (Barker 1993). The terminology for leguminous fodder crops in ancient Egypt, however, is complex (e.g. Crawford 1971: 112; Rowlandson 1996: 20-21) and, as a result, there is no direct historical evidence for the cultivation of clover as fodder in Egyptian Late

Antiquity. Cultivation of unspecified leguminous fodder crops, however, is documented and was an important component of agriculture in ancient Egypt (Rowlandson 1996: 21).

Date stones have been found at many Roman and Late Antique period sites in Egypt (Barakat and Baum 1992; Bartlett 1933; Cappers 1996; Rowley-Conwy 1989; Täckholm 1961; van der Veen 1996). Date palm rachilla (or the structure on which the dates grow) and perianth (the persistent calyx of the female date flower) have not been reported in Late Antique archaeobotanical assemblages, but both desiccated and carbonized date perianth and rachilla also have been found at a few Libyan sites, dating between 900 BC - AD 800 (van der Veen 1992b: 28 and 30; van der Veen *et al.* 1996: 236-238). Traditionally in Egypt, date palm (*Phoenix dactylifera* L.) are used as string when fresh, or when dried in bundles to make brooms.[3]

The weed / wild plants found in the oven samples could have come into these deposits with either the cereal chaff or clover. In addition, the identification of immature *Avena sterilis* L. (wild oat) rachis within one of these oven samples (94-055) also may suggest that weeds were collected, perhaps through hand weeding of crops, and used for animal fodder.

All of these plants occur in different proportions in the desiccated and carbonized components of the nine oven samples (see Figures 9.1 and 9.2). In the carbonized component (Figure 9.1) all of the oven samples contained cereal chaff and weed / wild plants. All but one sample (sample 94-052) contained carbonized seeds of clover (*Trifolium* sp.) and one sample (94-8719) contained large quantities of carbonized date (*Phoenix dactylifera* L.) perianth and rachilla. Two observations can be made about the desiccated component of these oven samples (Figure 9.2). First, cereal chaff and weed / wild plants dominate the desiccated component of all of these samples and one oven sample (94-052) also contains a large quantity of desiccated clover seeds. Second, the carbonized and desiccated components of these oven samples do not always 'tell the same story'. For example, oven sample 94-8719 is highly dominated by date perianth and rachilla in the carbonized component, yet no identifications of date perianth or rachilla were made in the desiccated component of this

[3] I would like to thank Dr. Salima Ikram for showing me date rachillae brooms on a visit to Cairo in October 1995.

Chapter 10. Conclusions

This thesis brought archaeobotanical data to bear on the predominantly historically-based discussion of agricultural economy and practice in Late Antique Egypt, especially in terms of monasteries. The plant remains used from previous archaeobotanical studies at monasteries, and now from Kom el-Nana, all come from Middle and Upper Egyptian sites and may not necessarily reflect agricultural conditions elsewhere in Egypt. The archaeobotanical study at Kom el-Nana was termed a case study because only one-third of all the samples from a limited area of the site have currently been examined. As a result, many of the conclusions proposed here should be seen as tentative and will need testing in future archaeobotanical study of the site. In addition, wider interpretations or conclusions about agriculture at monasteries or more generally in Late Antique Egypt should be seen as hypotheses generated from our current archaeobotanical, archaeological and historical knowledge, which should be tested against the results of future research.

This study was designed to address basic questions such as what was monastic diet? or were monasteries actively participating in the agricultural economy? which have previously only been addressed through the historical sources. This historically-based approach to monastic agricultural economy and practice has left many aspects of daily life poorly understood. The examination of literary sources as well as documentary papyri (such as rent agreements, taxation documents or personal letters) presented here has shown that monasteries were not isolated communities but were highly integrated into wider economic and political systems. The existing documentary evidence for monastic diet, however, only provides a restricted range of food crops. The incorporation of plant remains from the monastery at Kom el-Nana, and from earlier archaeobotanical research at the monasteries of Epiphanius and Phoebammon in western Thebes, has established that the range of food plants available to these monasteries was considerably more varied than the historical record would suggest. Although fasting may still play a role in the diet of monks or nuns, these results strongly suggest that their daily diet was not as meagre as some literary sources would have us believe.

The documentary papyri demonstrate that monasteries could be major landowners. Indeed, the ostraca found at Kom el-Nana also suggest that this particular monastery controlled agricultural land in the region, if it did not own that land outright. The economic plants found at Kom el-Nana confirm that a number of agricultural zones were used to produce food and other agricultural products for the occupants of Kom el-Nana. Evidence for arable crops and garden / orchard crops is quite strong. It is also possible that many tree species (e.g. Christ's thorn, Egyptian plum, mulberry, or pomegranate) were grown around the edges of arable fields. In addition, at Kom el-Nana there is strong archaeological evidence for a garden on site, and it is likely that many of the 'garden crops' identified in the assemblage could have been grown immediately on site.

The integration of new archaeobotanical evidence from Kom el-Nana with the historical evidence also has allowed exploration of wider agricultural issues which may apply to the whole of Egypt in the period. The absence of cereal grain and pulses at many Post-Pharaonic sites and at Late Antique Kom el-Nana was not satisfactorily explained by taphonomic or archaeological factors. The historical record presented here attests that in this period both cereal grain and pulses were processed. Although this consumer pattern may only partially contribute to the obvious absence of whole cereal grains and pulses from many Late Antique Egyptian sites, it does provide an additional explanation for this observed trend.

In Late Antiquity fuel is rarely recorded in the historical sources and, although most assume that traditional fuels such as crop processing waste or animal dung were used, no definitive evidence exists in the historical record. The study of nine ovens from the monastery at Kom el-Nana suggests that both crop processing remains (i.e. cereal chaff and straw, and date perianths and rachillae) and animal dung were used for fuel.

In the documentary papyri, mentions of agricultural by-products are limited to cereal chaff (i.e. its taxation, purchase, and use as fuel) in Late Antique Egypt. The archaeobotanical evidence from Kom el-Nana not only confirms the importance of cereal chaff at the site but also suggests that other crop processing by-products were used and, therefore, were of economic importance. Finds of crushed safflower achenes and linseed capsules, as well as date perianths and rachillae, all suggest that waste material from crop processing was of use, possibly for fodder or fuel. Finally, an analysis of the growing heights of those weeds identified to species level in the desiccated component of the Kom el-Nana assemblage has suggested that harvesting height of arable crops (cereals, but also linseed / flax, safflower, possibly sorghum, and perhaps some of the pulses) was quite low and, therefore, cereal straw and other plant stalks were intentionally collected, suggesting that agricultural by-products were of economic value in an area of limited grassland and fuel resources.

The Kom el-Nana archaeobotanical data set also was analyzed in this study. Most interestingly a small range of taxa dominated the assemblage. Examination of the frequency of count versus the number of taxa identified established that both the desiccated and carbonized component of the Kom el-Nana assemblage were 'species-rich' and likely to be derived from a number of different sources. Multivariate analysis of the data set was used to explore whether the Kom el-Nana samples were contaminated or not. Individual samples plotted out into discrete groupings such that house floors were distinct from middens or storage area. Even if some cross-contamination was occurring in individual samples, the ordination diagram of the data still maintained archaeologically meaningful differences between samples and, therefore, the assemblage is unlikely to be affected by cross-contamination. The multivariate analysis also demonstrated that a small number of taxa dominate the overall assemblage. This suggests that crops may be used for a number of different purposes at Kom el-Nana (e.g. food, fodder, fuel, temper, etc...).

Two technical results also were achieved in this study (presented in Appendix 3). First, identification criteria were established to distinguish galls of sycamore fig (*Ficus sycomorus* L.) from seed of common fig (*Ficus carica* L.) and to distinguish the internal membrane of linseed / flax (*Linum usitatissimum* L.) capsules from membrane in capsules of the noxious weed *Raphanus raphanistrum* L., even in this most fragmentary of material. This methodological work now allows the secure identification of two major economic crops, sycomore fig and linseed / flax, in Egypt and elsewhere.

Detrended correspondence analysis (DCA) was adopted over correspondence analysis (CA) for the multivariate analysis of the Kom el-Nana archaeobotanical data. This approach, to my knowledge, has not been adopted in archaeobotany previously, but this study has shown that CA results should be tested against DCA results in order to establish that an accurate ordination diagram of the data has been produced. This is an important methodological point, because archaeobotanical interpretation of data relies on the correct placement of samples or species in an ordination diagram. Checking CA results against DCA results is not time consuming, and since the DCA package is also available on the CANOCO program currently used by most archaeobotanists for CA, it seems worthwhile incorporating this cross-check when carrying out multivariate analyses of archaeobotanical data.

This research has established that study of archaeobotanical evidence from Late Antique Egyptian sites is worthwhile. In particular, recovery of plant remains at Kom el-Nana has increased our knowledge of agricultural economy and practice at a Late Antique monasteries. In addition, this study demonstrated that, under the same archaeological conditions during deposition and post-deposition, desiccated archaeobotanical assemblages produce a much wider range of taxa than carbonized. These results clearly demonstrate that studies which are limited to only carbonized macrofossils and exclude other differentially preserved material (i.e. waterlogged or desiccated material) available at a site are simply not justified. Far too many sites in Egypt have not incorporated sampling for plant remains, but as this project has shown the historical record alone is not sufficient to describe many aspects of agriculture and daily life in Egypt. If anything, this study should demonstrate that it is no longer acceptable to avoid incorporating archaeobotanical and other environmental evidence into archaeological and historical research on Late Antique Egypt.

Finally, the integration of historical evidence with archaeobotanical evidence has been attempted primarily through the utilization of synthetic historical research on Egypt in this period. Clearly it is risky for archaeobotanists studying Late Antique plant remains to ignore the historical evidence from this period, but it is too much to expect them also to master all the historical sources available. Archaeobotany and papyrology are specialist disciplines which require expertise to truly appreciate the complexity of the data. Collaboration between papyrologists and archaeobotanists is, in my opinion, the best way forward for study of ancient agriculture in Late Antique Egypt.

10.1 Future Research

This thesis has highlighted several areas for future archaeobotanical research in Egypt. The type of site and location may influence the archaeobotanical assemblage at Kom el-Nana. Future archaeobotanical study from non-monastic sites and other monasteries will set this archaeobotanical assemblage into its wider context.

It is certain that in the past weeds grew in orchards and gardens in Egypt. The limited study of the modern weed flora in orchards or gardens means that we may not recognize those species which grow in such conditions. Further study of the modern flora in such habitats may help us to better recognize this method of cultivation in ancient Egypt. The modern weed flora of Minya province seems to compare well with the ancient weed / wild flora found at Kom el-Nana. This strongly suggests that study of weeds of crops in those areas of Egypt which continue to use more traditional methods of cultivation and do not use weed killers may provide a useful analogy to weeds of crops in ancient Egypt. Finally the striking differences between modern weeds of crops from elsewhere in Egypt and the modern study of Minya province suggests that there may be regionalism in the weed flora along the Nile Valley. Therefore, study of the weed flora in areas other than around the Cairo and Aswan regions is worth pursuing.

Many of the interpretations presented in this thesis are speculative. For example, the use of animal dung for fuel and possibly in temper is primarily based on ethnographic observations of the practice and that this explanation best fits the assemblage. All of the Kom el-Nana oven samples lacked remains clearly identifiable as dung cake fuel, although three ovens did produce desiccated and carbonized compacted vegetable material. These interpretations, however, can be tested through further archaeobotanical study and experiments with modern dung cake fuel. The compacted vegetable material found in three of the oven samples can be broken down and studied for plant remains. If these clumps, which seem likely to be the remnants of dung cake fuel, contain similar plant remains to those already identified in the samples, it would strengthen the interpretation. Today, in the villages around the site of Kom el-Nana dung cake fuel is still used. Charring experiments on modern dung cake fuel can be used to test the archaeological results. Experiments on modern dung cake fuel can determine how much this type of material breaks down in a true fire situation (i.e. does dung cake fuel, possibly from certain animals, regularly break down into unrecognizable clumps of vegetable material). This can be achieved by measuring the volume of ash, compacted vegetable material, and desiccated or carbonized seeds from a specified volume of dung cake fuel.

In many cases the origin(s) of archaeobotanical deposits and their potential uses could only be hypothesized. The results of the detrended correspondence analysis of the Kom el-Nana data set suggest that although many of the samples contain similar contents (primarily cereal chaff, fruits and weed /wild plants), they are unlikely to result from cross-contamination or mixing of deposits. Almost all of the archaeobotanical samples studied here also contained remains of insects, primarily beetles (Coleoptera). Beetles live in specific habitats and their strict ecological preferences can be used to identify the origin of material such as manure (Kenward and Hall 1997). The future study of the insect remains in these samples may help to clarify the origin(s) of many of the deposits studied here.

Only one portion of the diet, namely the fruit and vegetable foods, at the Kom el-Nana monastery has been studied here. In order to fully understand the monastic diet practiced at this site, the analysis of the animal bone remains (currently under study by Dr. Rosie Luff, Cambridge University) will need to be integrated with these archaeobotanical results.

This study is only a first step in the analysis of the archaeobotanical assemblage at this site. In particular, the distribution of plant remains across contexts and phases at Kom el-Nana remains to be studied, once final phasing and plans for the site are available. Further excavation is planned at Kom el-Nana and this provides the opportunity to determine if the assemblage studied here is unique to this area of the site. In addition, remains of bark, root, charred and desiccated wood, leaves and flowers also need study. Criteria for their identification as well as those plant remains still unidentified in this assemblage need to be established. Finally, limited excavations of certain open areas (i.e. areas without Late Antique buildings) of the site have revealed evidence of a garden or orchard. Plow marks, deposits of leaves and several root balls have been excavated. These remains provide the opportunity to study the layout of a Late Antique monastic garden (or orchard), and to identify the plants grown there.

Appendix 1. List of Taxa in the Kom el-Nana Samples

The following tables list all taxa recovered in the Kom el-Nana case study samples by context type. Nomenclature follows Täckholm (1974) for indigenous species and Zohary and Hopf (1994) for the economic species. The traditional binomial system for the cereals has been used here, following Zohary and Hopf (1994: Table 3 p. 24 and Table 5 p. 58). In addition, some synonyms for economic plants have been used, because they are still commonly found in current archaeobotanical reports from Egypt. For example, *Prunus persica* L. is used here for peach instead of *Persica vulgaris* Miller (Zohary and Hopf 1994: 172). This means that the Kom el-Nana species list agrees with the usage seen in the recent Berenike archaeobotanical report (Cappers 1996). Some economic species are not included in Zohary and Hopf (1994) and in these cases the Latin binomial used in Germer (1985) was adopted.

The abbreviation 'im' is used to indicated immature seeds, such as immature grape pips. Any score preceded by 'cf.' indicates a provisional identifications. Such scores are not included in the total counts or in any statistical analysis of the assemblage. Two of the currently unidentified taxa (A5 and A57) are likely to be zooarchaeological remains. There scores have been shown in the tables but within parentheses to indicate that these scores are not added to total counts or used in any analyses of the data. Shading is used on columns of carbonized plant remains from a sample to emphasise the distinction between the carbonized and desiccated components of each sample.

Table 1: List of Plant Remains from the Alley Samples

Sample Number **Sample Volume in Liters** **Fraction of Sample Sorted** **Sample Preservation**	**94-042** **20** **1/8** **CARB**	94-042 DESC	**94-047** **21** **1/8** **CARB**	94-047 DESC
CEREAL GRAIN				
Triticum aestivum L. / T. *durum* Desf.	-	-	-	-
Triticum sp.	-	-	-	1
Hordeum sp. (hulled)	-	1	-	-
Cerealia - detached embryo	-	1	-	2 /cf. 1
Cerealia - Indeterminate	-	-	-	-
CEREAL CHAFF				
Triticum dicoccum Schübl. - glume base	-	-	-	-
Triticum dicoccum-type - glume base	-	-	-	-
Triticum dicoccum Schübl. - rachis internode	-	-	-	-
Triticum durum Desf. - rachis internode	-	6	-	13
Triticum durum Desf. - glume	-	-	-	-
Triticum durum Desf. - palea (P) / lemma (L)	-	-	-	-
Triticum durum-type - rachis internode	-	2	-	2
Triticum aestivum L. - rachis internode	-	-	-	-
Triticum aestivum-type - rachis internode	-	-	-	-
Triticum sp. - free threshing rachis internode	-	64	-	75
Triticum sp. - terminal rachis internode	-	1	-	-
Triticum sp. - basal rachis internode	-	-	-	-
Triticum sp. - rachilla	-	1	-	-
Triticum sp. - awn	-	-	-	-
Triticum sp. - glume	-	-	-	-
Triticum sp. - palea (P) / lemma (L)	-	-	-	-
Triticum sp. - bran	-	-	-	-
Hordeum vulgare L. - rachis internode	-	7	1	23
Hordeum vulgare L. - pedicelled internode	-	4	-	2
Hordeum sp. - palea / lemma	-	-	-	-
Hordeum sp. - awn	-	-	-	-
Sorghum bicolor (L.) Moench. - glume	-	-	-	-
Cerealia - indeterminate rachis internode	-	9	-	14
Cerealia - indeterminate culm node	-	14	-	33
Cerealia - indeterminate unquantified awn	-	-	-	-
Cerealia - indet. unquant. glume/ palea / lemma	-	+	-	+
PULSES				
Lupinus cf. *albus* L.	-	-	-	-
Lens culinaris Medik.	-	-	-	-
Lathyrus sp.	-	-	-	-
Hilum - indeterminate	-	-	-	-
OIL CROPS				
Linum usitatissimum L. - seed	-	2	-	-
Linum usitatissimum L. - capsule	-	1	-	1
Carthamus tinctorius L.	-	1	-	2
FRUIT				
Ficus carica L.	-	67	-	549
Ficus sycomorus L.	-	27	-	17
Morus sp.	-	-	-	-
Prunus persica (L.) Batsch	-	-	-	-
Zizyphus spina-christi (L.) Desf.	-	-	-	-
Cucumis sp.	-	1	-	6
Punica granatum L.	-	-	-	cf. 1
Vitis vinifera L. - pip	-	3	-	9
Vitis vinifera L. - stalk	-	1	-	1
Olea europaea L. - stone	-	-	-	1
Olea europaea L. - kernel	-	-	-	-
Olea europaea L. - leaf	-	-	-	-
Cordia myxa L.	-	-	-	-
Phoenix dactylifera L. - stone	-	1	-	cf. 1
Phoenix dactylifera L. - perianth	-	4	-	1
Phoenix dactylifera L. - female flower	-	-	-	-
Phoenix dactylifera L. - male flower	-	-	-	-
Phoenix dactylifera L. - rachilla	-	-	-	-
Phoenix dactylifera L. - embryo	-	-	-	-
Phoenix dactylifera L. - leaf sheath	-	+	-	+

Table 1: Alley Samples continued...

Sample Number Sample Preservation	94-042 CARB	94-042 DESC	94-047 CARB	94-047 DESC
CONDIMENTS				
Coriandrum sativum L.	-	cf. 2	-	2
Anethum graveolens L.	-	-	-	-
Cuminum cyminum L.	-	-	-	1
Foeniculum vulgare (L.) Mill	-	-	-	-
Apium graveolens L.	-	-	-	-
cf. *Ocimum basilicum* L.	-	-	-	-
Allium cepa L. - tunic (= skin)	-	-	-	-
OTHER ECONOMIC PLANTS				
Juniperus cf. *oxycedrus* L. / *phoenicea* L.	-	-	-	-
Papaver somniferum L.	-	-	-	-
Amygdalus communis L.	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - seed	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - pod	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - leaf	-	-	-	-
Ruta cf. *chalepensis* L.	-	-	-	-
Tamarix aphylla (L.) Karst. - needle	-	+	-	+
Tamarix aphylla (L.) Karst. - flower / calyx	-	-	-	-
Myrtus communis L.	-	1	-	-
Lagenaria siceraria (Mol.) Standl.	-	-	-	-
Daucus carota L.	-	-	-	-
WEED / WILD PLANTS				
Rumex spp. - perianth (nut with valves)	-	-	-	-
Rumex spp. - nut (naked)	-	1	-	-
Rumex spp. - tubercle	-	1	-	1
Polygonaceae - unidentified	-	-	-	-
Glinus cf. *lotoides* L.	-	7	-	25
Aizoaceae - unidentified	-	-	-	-
Portulaca oleracea L.	-	43	-	21
Vaccaria cf. *pyramidata* Medicus	-	-	-	-
Silene sp. - large	-	-	-	-
Stellaria sp. - type	-	-	-	-
Caryophyllaceae - unidentified	-	-	-	-
Beta vulgaris L.	-	2/cf. 1	-	1
Chenopodium murale L.	-	13	-	34
Cornulaca cf. *monocantha* Del.	-	-	-	-
Chenopodiaceae - unidentified	-	-	-	-
Chenopodiaceae - needle	-	+	-	-
Chenopodiaceae - floret	-	-	-	-
Fumaria spp.	-	-	-	-
Brassica spp. / *Sinapis arvensis* L.	-	1/cf. 1	-	-
Zilla spinosa (Turra) Prantl	-	-	-	-
Raphanus raphanistrum L. capsule	-	2	-	2
Raphanus raphanistrum L. seed	-	-	-	1/cf. 1
Coronopus cf. *niloticus* (Del.) Spreng	-	cf. 2	-	1
Reseda sp. TYPE 1 - smooth	-	-	-	-
Reseda sp. TYPE 2 - tubercled	-	-	-	-
Medicago sp.	-	-	-	-
Trifolium spp. - seed	-	4	1	12/cf. 1
Trifolium spp. - calyx	-	2	-	1
Trifolium spp. - involucre	-	-	-	-
Scorpiurus muricatus L.	-	-	-	-
Leguminosae - large seeded	-	-	-	-
Leguminosae - pod	-	-	-	-
Fagonia sp.	-	-	-	-
Zygophyllaceae - unidentified	-	-	-	-
Euphorbia peplus L.	-	-	-	-
Malva sp.	-	9	-	19
Umbelliferae - unidentified	-	-	-	2
Galium spp.	-	-	-	-
Heliotropium spp.	-	-	-	-
Echium sp.	-	-	-	-
Verbenaceae / Labiatae	-	-	-	-
Labiatae - *Ocimum* type	-	-	-	-
Labiatae - *Thymus* type	-	-	-	-
Labiatae - *Ajuga* type	-	-	-	-
Solanum nigrum L.	-	-	-	-
Pulicaria sp.	-	-	-	-
Cichorium endivia L. / *intybus* L.	-	3	-	-

Table 1: Alley Samples continued...

Sample Number / **Sample Preservation**	**94-042 CARB**	**94-042 DESC**	**94-047 CARB**	**94-047 DESC**
WEED / WILD PLANTS cont...				
Picris sp.	-	-	-	-
Sonchus sp.	-	-	-	-
Compositae - unidentified	-	-	-	-
Asphodelus spp.	-	cf. 1	-	-
Lolium spp.	-	-	-	-
Avena sp. - grain	-	-	-	-
Avena sterilis L. - rachilla	-	-	-	-
Avena spp. - rachilla	1	-	-	-
Crypsis spp.	-	1	-	-
Phalaris paradoxa L.	-	-	-	-
Phalaris spp.	-	-	-	-
Setaria spp. - with palea/lemma	-	11	-	-
Setaria spp. - naked seed	-	-	-	-
Saccharum spontaneum L.	-	-	-	-
Gramineae - small seeded	-	2	-	3
Gramineae - large seeded	-	-	-	-
Gramineae - wild grass rachis	-	-	-	-
Fimbristylis bis-umbellata (Forssk.) Bub.	-	-	-	-
Scirpus cf. *praelongatus* Poir.	-	-	-	-
Scirpus spp.	-	-	-	-
Cyperus spp.	-	-	-	2
Cyperaceae - unidentified TYPE 1	-	-	-	-
Cyperaceae - unidentified TYPE 2	-	-	-	-
UNIDENTIFIED				
?H - leafy involucre	-	-	-	-
?U - *Lawsonia*-like seed	-	1	-	9
?X - a) Unidentified leaf	-	+	-	+
?X - b) Split leaf / grass / palm	-	++	-	++
?X - c) Small leaf / petal ?	-	-	-	-
?A4 - a) filament of stamen	-	1	-	6
?A4 - b) stigma	-	-	-	-
?A4 - c) anther Small	-	-	-	2
anther Large	-	-	-	-
?A4 - d) anther / pod	-	-	-	1
?A5† - Thin walled, red - zooarchaeological?	-	(14)	-	(16)
?A10 - Shiny compressed seed - striated	-	-	-	-
?A15 - shrivelled veined fruit	-	-	-	-
?A16 - a) unidentified root	-	-	-	+
- b) unidentified bark	-	-	-	-
?A22 - flower head / calyx	-	-	-	-
?A24 - interior of fruit w/ seed	-	-	-	-
?A27 - a) unidentified small fruit	-	-	-	1
- b) unidentified fruit stem	-	-	-	-
?A28 - Crescent part of stalk	-	1	-	3
?A29 - Small rounded seeds	-	-	-	-
?A35 - scaly interior of seed?	-	-	-	-
?A36 - part of capsule?	-	-	-	-
?A37 - ??Plantago	-	-	-	-
?A38 - Internal structure ?	-	15	-	-
?A42 - pod / seed capsule	-	-	-	-
?A46 - ?Bud - hairless	-	-	-	-
?A47 - Unidentified seed coat (frags)	-	-	-	-
?A48 - ?Flower petals	-	-	-	-
?A49 - a) Large flower head	-	-	-	-
b) Small flower head	-	-	-	-
c) flower stalk	-	-	-	-
d) stalk	-	1	-	1
?A50 - extremely small fig-like seed	-	-	-	1
?A53 - ? seed pod - grooved a) fragment	-	-	-	-
b) complete pod	-	-	-	-
?A55 - Bud (hairy)	-	-	-	-
?A56 - Small pitted seed	-	-	-	-
?A57† - Pink and round - zooarchaeological ?	-	-	-	-
Indeterminate:	-	-	-	3
TOTAL NUMBER OF IDENTIFICATIONS:	1	340	2	907
PERCENTAGE OF SAMPLE:	0.3%	99.7%	0.2%	99.8%
SEEDS / LITER:	0.4	136.0	0.8	362.8

† - A5 and A57, which are provisionally considered insect remains, will not be included in counts for samples or statistical analysis.

Table 2: List of Plant Remains from the Animal Stall Sample

Sample Number	94-189	94-189
Sample Volume in Liters	16	
Fraction of Sample Sorted	1/8	
Sample Preservation	CARB	DESC
CEREAL GRAIN		
Triticum aestivum L. / T. *durum* Desf.	-	-
Triticum sp.	-	-
Hordeum sp. (hulled)	-	1/cf. 1
Cerealia - detached embryo	-	-
Cerealia - Indeterminate	-	-
CEREAL CHAFF		
Triticum dicoccum Schübl. - glume base	-	-
Triticum dicoccum-type - glume base	-	-
Triticum dicoccum Schübl. - rachis internode	-	-
Triticum durum Desf. - rachis internode	-	3
Triticum durum Desf. - glume	-	-
Triticum durum Desf. - palea (P) / lemma (L)	-	-
Triticum durum-type - rachis internode	-	-
Triticum aestivum L. - rachis internode	-	-
Triticum aestivum-type - rachis internode	-	-
Triticum sp. - free threshing rachis internode	-	32
Triticum sp. - terminal rachis internode	-	4
Triticum sp. - basal rachis internode	-	2
Triticum sp. - rachilla	-	4
Triticum sp. - awn	-	1
Triticum sp. - glume	-	-
Triticum sp. - palea (P) / lemma (L)	-	-
Triticum sp. - bran	-	-
Hordeum vulgare L. - rachis internode	-	3
Hordeum vulgare L. - pedicelled internode	-	1
Hordeum sp. - palea / lemma	-	-
Hordeum sp. - awn	-	-
Sorghum bicolor (L.) Moench. - glume	-	-
Cerealia - indeterminate rachis internode	1	6
Cerealia - indeterminate culm node	-	112
Cerealia - indeterminate unquantified awn	-	+
Cerealia - indet. unquant. glume / palea / lemma	-	+
PULSES		
Lupinus cf. *albus* L.	-	-
Lens culinaris Medik.	-	-
Lathyrus sp.	-	-
Hilum - indeterminate	-	-
OIL CROPS		
Linum usitatissimum L. - seed	-	7
Linum usitatissimum L. - capsule	-	4
Carthamus tinctorius L.	-	4
FRUIT		
Ficus carica L.	-	1743
Ficus sycomorus L.	-	166
Morus sp.	-	-
Prunus persica (L.) Batsch.	-	-
Zizyphus spina-christi (L.) Desf.	-	-
Cucumis sp.	-	8
Punica granatum L.	-	-
Vitis vinifera L. - pip	-	5 /2im
Vitis vinifera L. - stalk	-	-
Olea europaea L. - stone	-	1
Olea europaea L. - kernel	-	-
Olea europaea L. - leaf	-	-
Cordia myxa L.	-	2
Phoenix dactylifera L. - stone	-	-
Phoenix dactylifera L. - perianth	-	4
Phoenix dactylifera L. - female flower	-	-
Phoenix dactylifera L. - male flower	-	-
Phoenix dactylifera L. - rachilla	-	-
Phoenix dactylifera L. - embryo	-	-
Phoenix dactylifera L. - leaf sheath	-	+

Table 2: Animal Stall Sample continued...

Sample Number Sample Preservation	94-189 CARB	94-189 DESC
CONDIMENTS		
Coriandrum sativum L.	-	1
Anethum graveolens L.	-	-
Cuminum cyminum L.	-	-
Foeniculum vulgare (L.) Mill	-	-
Apium graveolens L.	-	-
cf. *Ocimum basilicum* L.	-	-
Allium cepa L. - tunic (=skin)	-	-
OTHER ECONOMIC PLANTS		
Juniperus cf. *oxycedrus* L. / *phoenicea* L.	-	-
Papaver somniferum L.	-	-
Amygdalus communis L.	-	-
Acacia nilotica (L.) Willd. ex Del. - seed	-	-
Acacia nilotica (L.) Willd. ex Del. - pod	-	-
Acacia nilotica (L.) Willd. ex Del. - leaf	-	-
Ruta cf. *chalepensis* L.	-	-
Tamarix aphylla (L.) Karst. - needle	+	+
Tamarix aphylla (L.) Karst. - flower / calyx	-	-
Myrtus communis L.	-	-
Lagenaria siceraria (Mol.) Standl.	-	-
Daucus carota L.	-	-
WEED / WILD PLANTS		
Rumex spp. - perianth (nut with valves)	-	3
Rumex spp. - nut (naked)	-	19
Rumex spp. - tubercle	-	13
Polygonaceae - unidentified	-	-
Glinus cf. *lotoides* L.	-	-
Aizoaceae - unidentified	-	-
Portulaca oleracea L.	-	57
Vaccaria cf. *pyramidata* Medicus	-	-
Silene sp. - large	-	4
Stellaria sp. - type	-	-
Caryophyllaceae - unidentified	-	-
Beta vulgaris L.	-	18
Chenopodium murale L.	-	2600
Cornulaca cf. *monocantha* Del.	-	cf. 1
Chenopodiaceae - unidentified	-	1
Chenopodiaceae - needle	-	+
Chenopodiaceae - floret	-	-
Fumaria spp.	-	-
Brassica spp. / *Sinapis arvensis* L.	-	-
Zilla spinosa (Turra) Prantl	-	-
Raphanus raphanistrum L. - capsule	-	82
Raphanus raphanistrum L. - seed	-	-
Coronopus cf. *niloticus* (Del.) Spreng	-	-
Reseda sp. TYPE 1 - smooth	-	-
Reseda sp. TYPE 2 - tubercled	-	-
Medicago sp.	-	1
Trifolium spp. - seed	-	62
Trifolium spp. - calyx	-	1
Trifolium spp. - involucre	-	-
Scorpiurus muricatus L.	-	-
Leguminosae - large seeded	-	-
Leguminosae - pod	-	-
Fagonia sp.	-	-
Zygophyllaceae - unidentified	-	-
Euphorbia peplus L.	-	2
Malva sp.	-	49
Umbelliferae - unidentified	-	-
Galium spp.	-	-
Heliotropium spp.	-	-
Echium sp.	-	25
Verbenaceae / Labiatae	-	2
Labiatae - *Ocimum* type	-	-
Labiatae - *Thymus* type	-	-
Labiatae - *Ajuga* type	-	-
Solanum nigrum L.	-	-
Pulicaria sp.	-	1
Cichorium endivia L. / *intybus* L.	-	6

Table 2: Animal Stall Sample continued...

Sample Number Sample Preservation	94-189 CARB	94-189 DESC
WEED / WILD PLANTS continued...		
Picris sp.	-	-
Sonchus sp.	-	-
Compositae - unidentified	-	-
Asphodelus spp.	-	1
Lolium spp.	-	-
Avena sp. - grain	-	-
Avena sterilis L. - rachilla	-	-
Avena spp. - rachilla	-	-
Crypsis spp.	-	1
Phalaris paradoxa L.	-	-
Phalaris spp.	-	2
Setaria spp. - with palea/lemma	-	1
Setaria spp. - naked seed	-	-
Saccharum spontaneum L.	-	-
Gramineae - small seeded	1	-
Gramineae - large seeded	-	-
Gramineae - wild grass rachis	-	-
Fimbristylis bis-umbellata (Forssk.) Bub.	-	-
Scirpus cf. *praelongatus* Poir.	-	-
Scirpus spp.	-	-
Cyperus spp.	-	5
Cyperaceae - unidentified TYPE 1	-	-
Cyperaceae - unidentified TYPE 2	-	-
UNIDENTIFIED		
?H - leafy involucre	-	-
?U - *Lawsonia*-like seed	-	1
?X - a) Unidentified leaf	-	-
?X - b) Split leaf / grass / palm	-	-
?X - c) Small leaf / petal ?	-	-
?A4 - a) filament of stamen	-	2
?A4 - b) stigma	-	-
?A4 - c) anther Small	-	-
anther Large	-	-
?A4 - d) anther / pod	-	-
?A5† - Thin walled, red - zooarchaeological ?	-	(2)
?A10 - Shiny compressed seed - striated	-	-
?A15 - shrivelled veined fruit	-	1
?A16 - a) unidentified root	-	-
- b) unidentified bark	-	-
?A22 - flower head / calyx	-	-
?A24 - interior of fruit w/ seed	-	-
?A27 - a) unidentified small fruit	-	-
- b) unidentified fruit stem	-	-
?A28 - Crescent part of stalk	-	-
?A29 - Small rounded seeds	-	-
?A35 - scaly interior of seed ?	-	-
?A36 - part of capsule ?	-	-
?A37 - ??Plantago	-	-
?A38 - Internal structure ?	-	-
?A42 - pod / seed capsule	-	-
?A46 - ?Bud - hairless	-	-
?A47 - Unidentified seed coat (frags)	-	-
?A48 - ?Flower petals	-	-
?A49 - a) Large flower head	-	-
b) Small flower head	-	-
c) flower stalk	-	-
d) stalk	-	-
?A50 - extremely small fig-like seed	-	6
?A53 - ? seed pod - grooved a) fragment	-	-
b) complete pod	-	-
?A55 - Bud (hairy)	-	-
?A56 - Small pitted seed	-	-
?A57† - Pink and round - zooarchaeological ?	-	-
Indeterminate:	-	-
TOTAL NUMBER OF IDENTIFICATIONS:	2	5082
PERCENTAGE OF SAMPLE:	0%	100%
SEEDS / LITER:	1	2541.0

† - A5 and A57, which are provisionally considered insect remains, will not be included in counts for samples or statistical analysis.

Table 3: List of Plant Remains from the Drain Sample

Sample Number	**93-7791**	
Sample Volume in Liters	**7**	
Fraction of Sample Sorted	**1/8**	
Sample Preservation	**CARB**	**DESC**
CEREAL GRAIN		
Triticum aestivum L. / T. *durum* Desf.	-	-
Triticum sp.	-	-
Hordeum sp. (hulled)	-	-
Cerealia - detached embryo	-	-
Cerealia - Indeterminate	-	-
CEREAL CHAFF		
Triticum dicoccum Schübl. - glume base	-	-
Triticum dicoccum-type - glume base	-	-
Triticum dicoccum Schübl. - rachis internode	-	-
Triticum durum Desf. - rachis internode	-	-
Triticum durum Desf. - glume	-	-
Triticum durum Desf. - palea (P) / lemma (L)	-	-
Triticum durum-type - rachis internode	-	-
Triticum aestivum L. - rachis internode	-	1
Triticum aestivum-type - rachis internode	-	-
Triticum sp. - free threshing rachis internode	-	7
Triticum sp. - terminal rachis internode	-	-
Triticum sp. - basal rachis internode	-	-
Triticum sp. - rachilla	1	5
Triticum sp. - awn	-	1
Triticum sp. - glume	-	-
Triticum sp. - palea (P) / lemma (L)	-	-
Triticum sp. - bran	-	+
Hordeum vulgare L. - rachis internode	1	1
Hordeum vulgare L. - pedicelled internode	-	3
Hordeum sp. - palea / lemma	-	-
Hordeum sp. - awn	-	1
Sorghum bicolor (L.) Moench. - glume	-	-
Cerealia - indeterminate rachis internode	-	1
Cerealia - indeterminate culm node	-	6
Cerealia - indeterminate unquantified awn	-	+
Cerealia - indet. unquant. glume / palea / lemma	-	+
PULSES		
Lupinus cf. *albus* L.	-	-
Lens culinaris Medik.	-	-
Lathyrus sp.	-	-
Hilum - indeterminate	-	-
OIL CROPS		
Linum usitatissimum L. - seed	-	1
Linum usitatissimum L. - capsule	-	1
Carthamus tinctorius L.	-	2
FRUIT		
Ficus carica L.	-	164
Ficus sycomorus L.	-	85
Morus sp.	-	1
Prunus persica (L.) Batsch.	-	-
Zizyphus spina-christi (L.) Desf.	-	cf. 1
Cucumis sp.	-	33
Punica granatum L.	-	-
Vitis vinifera L. - pip	-	2 / 1 im
Vitis vinifera L. - stalk	-	-
Olea europaea L. - stone	-	1
Olea europaea L. - kernel	-	-
Olea europaea L. - leaf	-	-
Cordia myxa L.	-	-
Phoenix dactylifera L. - stone	-	-
Phoenix dactylifera L. - perianth	-	1
Phoenix dactylifera L. - female flower	-	-
Phoenix dactylifera L. - male flower	-	-
Phoenix dactylifera L. - rachilla	-	-
Phoenix dactylifera L. - embryo	-	-
Phoenix dactylifera L. - leaf sheath	-	-

Table 3: Drain Sample continued...

Sample Number	93-7791	
Sample Preservation	CARB	DESC
CONDIMENTS		
Coriandrum sativum L.	-	-
Anethum graveolens L.	-	-
Cuminum cyminum L.	-	-
Foeniculum vulgare (L.) Mill	-	-
Apium graveolens L.	-	-
cf. *Ocimum basilicum* L.	-	-
Allium cepa L. - tunic (=skin)	-	-
OTHER ECONOMIC PLANTS		
Juniperus cf. *oxycedrus* L. / *phoenicea* L.	-	-
Papaver somniferum L.	-	-
Amygdalus communis L.	-	-
Acacia nilotica (L.) Willd. ex Del. - seed	-	-
Acacia nilotica (L.) Willd. ex Del. - pod	-	-
Acacia nilotica (L.) Willd. ex Del. - leaf	-	-
Ruta cf. *chalepensis* L.	-	-
Tamarix aphylla (L.) Karst - needle	+	+
Tamarix aphylla (L.) Karst. - flower / calyx	-	-
Myrtus communis L.	-	1
Lagenaria siceraria (Mol.) Standl.	-	-
Daucus carota L.	-	-
WEED / WILD PLANTS		
Rumex spp. - perianth (nut with valves)	-	-
Rumex spp. - nut (naked)	-	-
Rumex spp. - tubercle	-	-
Polygonaceae - unidentified	-	-
Glinus cf. *lotoides* L.	-	-
Aizoaceae - unidentified	-	-
Portulaca oleracea L.	-	18
Vaccaria cf. *pyramidata* Medicus	-	-
Silene sp. - large	-	-
Stellaria sp. - type	-	-
Caryophyllaceae - unidentified	-	-
Beta vulgaris L.	-	1
Chenopodium murale L.	-	5
Cornulaca cf. *monocantha* Del.	-	-
Chenopodiaceae - unidentified	-	-
Chenopodiaceae - needle	-	-
Chenopodiaceae - floret	-	-
Fumaria spp.	-	-
Brassica spp. / *Sinapis arvensis* L.	-	-
Zilla spinosa (Turra) Prantl	-	-
Raphanus raphanistrum L. - capsule	-	-
Raphanus raphanistrum L. - seed	-	-
Coronopus cf. *niloticus* (Del.) Spreng	-	-
Reseda sp. TYPE 1 - smooth	-	-
Reseda sp. TYPE 2 - tubercled	-	-
Medicago sp.	-	-
Trifolium spp. - seed	2	2
Trifolium spp. - calyx	-	2
Trifolium spp. - involucre	-	-
Scorpiurus muricatus L.	-	-
Leguminosae - large seeded	-	-
Leguminosae - pod	-	-
Fagonia sp.	-	-
Zygophyllaceae - unidentified	-	-
Euphorbia peplus L.	-	-
Malva sp.	-	2
Umbelliferae - unidentified	-	-
Galium spp.	-	-
Heliotropium spp.	-	-
Echium sp.	-	-
Verbenaceae / Labiatae	-	-
Labiatae - *Ocimum* type	-	-
Labiatae - *Thymus* type	-	-
Labiatae - *Ajuga* type	-	-
Solanum nigrum L.	-	-
Pulicaria sp.	-	-
Cichorium endivia L. / *intybus* L.	-	-

Table 3: Drain Sample continued...

Sample Number Sample Preservation	93-7791 CARB	DESC
WEED / WILD PLANTS		
Picris sp.	-	-
Sonchus sp.	-	-
Compositae - unidentified	-	-
Asphodelus spp.	-	-
Lolium spp.	-	-
Avena sp. - grain	-	-
Avena sterilis L. - rachilla	-	-
Avena spp. - rachilla	-	-
Crypsis spp.	-	-
Phalaris paradoxa L.	-	-
Phalaris spp	-	-
Setaria spp. - with palea/lemma	-	4
Setaria spp. - naked seed	-	-
Saccharum spontaneum L.	-	-
Gramineae - small seeded	-	-
Gramineae - large seeded	-	-
Gramineae - wild grass rachis	-	-
Fimbristylis bis-umbellata (Forssk.) Bub.	-	-
Scirpus cf. *praelongatus* Poir.	-	-
Scirpus spp.	-	-
Cyperus spp.	-	-
Cyperaceae - unidentified TYPE 1	-	-
Cyperaceae - unidentified TYPE 2	-	-
UNIDENTIFIED		
?H - leafy involucre	-	-
?U - *Lawsonia*-like seed	-	12
?X - a) Unidentified leaf	+	+
?X - b) Split leaf / grass / palm	+	+
?X - c) Small leaf / petal ?	-	-
?A4 - a) filament of stamen	-	12
?A4 - b) stigma	-	-
?A4 - c) anther Small	-	3
anther Large	-	-
?A4 - d) anther / pod	-	-
?A5† - Thin walled, red - zooarchaeological ?	-	(6)
?A10 - Shiny compressed seed - striated	-	-
?A15 - shrivelled veined fruit	-	-
?A16 - a) unidentified root	-	+
- b) unidentified bark	-	-
?A22 - flower head / calyx	-	-
?A24 - interior of fruit w/ seed	-	-
?A27 - a) unidentified small fruit	-	-
- b) unidentified fruit stem	-	-
?A28 - Crescent part of stalk	-	-
?A29 - Small rounded seeds	-	-
?A35 - scaly interior of seed ?	-	-
?A36 - part of capsule ?	-	-
?A37 - ??Plantago	-	-
?A38 - Internal structure ?	-	1
?A42 - pod / seed capsule	-	-
?A46 - ?Bud - hairless	-	-
?A47 - Unidentified seed coat (frags)	-	+
?A48 - ?Flower petals	-	-
?A49 - a) Large flower head	-	-
b) Small flower head	-	-
c) flower stalk	-	-
d) stalk	-	-
?A50 - extremely small fig-like seed	-	-
?A53 - ? seed pod - grooved a) fragment	-	3
b) complete pod	-	-
?A55 - Bud (hairy)	-	-
?A56 - Small pitted seed	-	-
?A57† - Pink and round - zooarchaeological ?	-	(1)
Indeterminate:	3	5
TOTAL NUMBER OF IDENTIFICATIONS:	7	389
PERCENTAGE OF SAMPLE:	1.8%	98.2%
SEEDS / LITER:	8	444.6

†A5 and A57, which are provisionally considered insect remains, will not be included in counts for samples or statistical analysis.

Table 4a: List of Plant Remains from the Floor Samples

Sample Number	**94-008**	94-008	**94-010**	94-010	**94-011**	94-011	**94-012**	94-012	**94-035**	94-035
Sample Volume in Liters	**13**		**19**		**14**		**15**		**18**	
Fraction of Sample Sorted	**1/2**		**1/4**		**1/4**		**1/4**		**1/8**	
Sample Preservation	**CARB**	**DESC**	**CARB**	**DESC**	**CARB**	**DESC**	**CARB**	**DESC**	**CARB**	**DESC**
CEREAL GRAIN										
Triticum aestivum L. / T. *durum* Desf.	-	-	-	-	1	2	-	-	1	-
Triticum sp.	-	-	-	-	-	-	-	-	-	-
Hordeum sp. (hulled)	-	-	1	4	-	2	-	2	-	2
Cerealia - detached embryo	-	-	-	2	-	-	-	-	-	-
Cerealia - Indeterminate	-	-	-	-	-	2	-	-	-	-
CEREAL CHAFF										
Triticum dicoccum Schübl. - glume base	-	-	-	-	-	2	-	-	-	1
Triticum dicoccum type - glume base	-	-	-	-	-	8	-	2	-	-
Triticum dicoccum Schübl. - rachis internode	-	-	-	-	-	-	-	-	-	-
Triticum durum Desf. - rachis internode	-	-	1	23	-	46	-	5	1	2
Triticum durum Desf. - glume	-	-	-	-	-	-	-	-	-	-
Triticum durum Desf. - palea (P) / lemma (L)	-	-	-	-	-	-	-	-	-	-
Triticum durum-type - rachis internode	-	-	-	13	-	9	-	-	-	5
Triticum aestivum L. - rachis internode	-	-	-	7	-	1	-	3	-	1
Triticum aestivum-type - rachis internode	-	-	-	8	-	-	-	-	-	-
Triticum sp. - free threshing rachis internode	-	-	-	30	-	22	-	51/cf.2	6	7
Triticum sp. - terminal rachis internode	-	-	-	-	-	3	-	1	-	1
Triticum sp. - basal rachis internode	-	-	-	1	-	7	-	-	-	-
Triticum sp. - rachilla	-	1	-	2	-	-	-	1	-	28
Triticum sp. - awn	-	1	-	-	-	-	-	-	-	-
Triticum sp. - glume	-	-	-	-	-	-	-	-	1	1
Triticum sp. - palea (P) / lemma (L)	-	-	-	-	-	-	-	-	-	2L
Triticum sp. - bran	-	-	-	+	-	+	-	+	-	cf. +
Hordeum vulgare L. - rachis internode	-	-	-	6	-	37	-	22	-	14
Hordeum vulgare L. - pedicelled internode	-	-	-	5	-	3	-	-	-	1
Hordeum sp. - palea / lemma	-	-	-	-	-	-	-	-	-	-
Hordeum sp. - awn	-	-	-	-	-	-	-	-	-	-
Sorghum bicolor (L.) Moench. - glume	-	-	-	-	-	-	-	-	-	-
Cerealia - indeterminate rachis internode	-	-	1	8	-	-	-	48	2	32
Cerealia - indeterminate culm node	1	-	-	37	-	25	-	18	5	4
Cerealia - indeterminate unquantified awn	-	-	-	-	-	-	-	-	+	+++
Cerealia - indet. unquant. glume/palea/lemma	-	-	-	-	-	-	-	-	-	++
PULSES										
Lupinus cf. *albus* L.	-	-	-	-	-	-	-	-	-	-
Lens culinaris Medik.	-	-	-	-	-	-	-	-	-	-
Lathyrus sp.	-	-	-	-	-	-	-	-	-	-
Hilum - indeterminate	-	-	-	4	-	2	-	2	-	-
OIL CROPS										
Linum usitatissimum L. - seed	-	-	-	1	-	-	-	-	-	-
Linum usitatissimum L. - capsule	-	1	-	1	-	3	-	2	-	1
Carthamus tinctorius L.	-	-	-	137	-	1	-	1	-	-
FRUIT										
Ficus carica L.	-	124	-	29	-	39	-	40	-	24
Ficus sycomorus L.	-	-	-	8	-	9	-	10	-	14
Morus sp.	-	-	-	6	-	3	-	-	-	2
Prunus persica (L.) Batsch.	-	1	-	-	-	-	-	-	-	-
Zizyphus spina-christi (L.) Desf.	-	-	-	1	-	1	-	-	-	-
Cucumis sp.	-	-	-	1	-	2	-	2	-	-
Punica granatum L.	-	-	-	-	-	-	-	-	-	-
Vitis vinifera L. - pip	-	11	-	8	-	4	-	2/2im	-	-
Vitis vinifera L. - stalk	-	-	-	4	-	1	-	-	-	-
Olea europaea L. - stone	-	-	-	6	-	2	-	-	-	cf. 1
Olea europaea L. - kernel	-	-	-	-	-	1	-	-	-	-
Olea europaea L. - leaf	-	+	-	-	-	-	-	+	-	+
Cordia myxa L.	-	-	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - stone	-	-	-	2	-	6	-	1	-	-
Phoenix dactylifera L. - perianth	-	-	-	-	-	4	-	1	-	-
Phoenix dactylifera L. - female flower	-	-	-	1	-	-	-	-	-	-
Phoenix dactylifera L. - male flower	-	-	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - rachilla	-	-	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - embryo	-	-	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - leaf sheath	-	-	-	-	-	-	-	+	-	-

Table 4a: Floor Samples continued...

Sample Number **Sample Preservation**	**94-008** **CARB**	**94-008** **DESC**	**94-010** **CARB**	**94-010** **DESC**	**94-011** **CARB**	**94-011** **DESC**	**94-012** **CARB**	**94-012** **DESC**	**94-035** **CARB**	**94-035** **DESC**
CONDIMENTS										
Coriandrum sativum L.	-	-	-	2	-	3	-	2	-	-
Anethum graveolens L.	-	-	-	-	-	-	-	-	-	-
Cuminum cyminum L.	-	-	-	10/cf. 6	-	cf. 2	-	13	-	-
Foeniculum vulgare (L.) Mill	-	-	-	1	-	-	-	cf. 1	-	-
Apium graveolens L.	-	-	-	-	-	-	-	-	-	1
cf. *Ocimum basilicum* L.	-	-	-	-	-	-	-	-	-	-
Allium cepa L. - tunic (=skin)	-	-	-	-	-	-	-	-	-	-
OTHER ECONOMIC PLANTS										
Juniperus cf. *oxycedrus* L. / *phoenicea* L.	3	1	-	-	-	-	-	-	-	-
Papaver somniferum L.	-	-	-	-	-	-	-	-	-	-
Amygdalus communis L.	-	-	-	-	-	-	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - seed	-	-	-	1	-	-	-	1	-	-
Acacia nilotica (L.) Willd. ex Del. - pod	-	-	-	1	-	-	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - leaf	-	-	-	-	-	-	-	-	-	-
Ruta cf. *chalepensis* L.	-	-	-	-	-	-	-	-	-	-
Tamarix aphylla (L.) Karst. - needle	+	++	-	-	-	++	-	+	-	++
Tamarix aphylla (L.) Karst. - flower / calyx	-	1	-	-	-	1	-	1	-	19
Myrtus communis L.	-	-	-	7	-	-	-	1	-	-
Lagenaria siceraria (Mol.) Standl..	-	-	-	-	-	-	-	-	-	-
Daucus carota L.	-	-	-	-	-	-	-	-	-	-
WEED / WILD PLANTS										
Rumex spp. - perianth (nut with valves)	-	-	-	-	-	3	-	1	-	-
Rumex spp. - nut (naked)	-	-	-	1	-	11	-	1	-	-
Rumex sp. - tubercle	-	-	-	4	-	5	-	6	-	3
Polygonaceae - unidentified	-	-	-	-	-	-	-	3	-	3
Glinus cf. *lotoides* L.	-	34	-	10	-	9	-	-	-	38
Aizoaceae - unidentified	-	-	-	2	-	-	-	-	-	-
Portulaca oleracea L.	-	-	-	22	-	15	-	30	-	12
Vaccaria cf. *pyramidata* Medicus	-	-	-	-	-	19	-	12/cf. 2	-	2
Silene sp. - large	-	-	-	-	-	-	-	-	-	-
Stellaria sp. - type	-	-	-	-	-	-	-	-	-	-
Caryophyllaceae - unidentified	-	-	-	1	-	1	-	-	-	-
Beta vulgaris L.	-	-	-	-	-	2	-	-	-	1
Chenopodium murale L.	-	7	-	14	-	11	-	9	-	6
Cornulaca cf. *monocantha* Del.	-	-	-	1	-	1	-	-	-	5
Chenopodiaceae - unidentified	-	-	-	1	-	2	-	1	-	10
Chenopodiaceae - needle	-	-	-	-	-	-	-	-	-	-
Chenopodiaceae - floret	-	-	-	-	-	-	-	+	-	-
Fumaria spp.	-	-	-	-	3	-	-	-	-	-
Brassica spp. / *Sinapis arvensis* L.	-	-	-	-	-	24	-	-	-	-
Zilla spinosa (Turra) Prantl	-	-	-	-	-	-	-	-	-	-
Raphanus raphanistrum L. - capsule	-	-	-	6	-	-	-	-	-	-
Raphanus raphanistrum L. - seed	-	-	-	-	-	-	-	-	-	-
Coronopus cf. *niloticus* (Del.) Spreng	-	-	-	-	-	-	-	1	-	13
Reseda sp. - TYPE 1 - smooth	-	-	-	-	-	-	-	-	-	-
Reseda sp. - TYPE 2 - tubercled	-	-	-	-	-	-	-	-	-	-
Medicago sp.	-	-	-	-	-	-	-	-	-	-
Trifolium spp. - seed	-	-	1	10	-	18/cf. 1	-	21/cf. 4	1	8
Trifolium spp. - calyx	-	-	-	-	-	-	-	-	-	-
Trifolium spp. - involucre	-	-	-	-	-	4	-	1	-	9
Scorpiurus muricatus L.	-	-	-	-	-	-	-	-	-	-
Leguminosae - large seeded	-	-	-	-	-	-	-	-	-	-
Leguminosae - pod	-	-	-	1	-	2	-	-	-	-
Fagonia sp.	-	-	-	-	-	-	-	-	-	3
Zygophyllaceae - unidentified	-	-	1	7	-	-	-	-	-	-
Euphorbia peplus L.	-	-	-	-	-	-	-	-	-	2
Malva sp.	3	-	-	4	-	13	-	5	-	2
Umbelliferae - unidentified	-	-	-	5/cf. 1	-	cf. 1	-	9	-	2
Galium spp.	-	-	-	-	-	1	-	-	-	-
Heliotropium spp.	-	-	-	-	-	1	-	1	-	-
Echium sp.	-	-	-	-	-	1	-	1	-	cf. 1
Verbenaceae / Labiatae	-	-	-	2	-	4	-	1	-	2
Labiatae - *Ocimum* type	-	-	-	-	-	-	-	-	-	-
Labiatae - *Thymus* type	-	-	-	-	-	1	-	1	-	2
Labiatae - *Ajuga* type	-	-	-	1	-	3	-	-	-	-
Solanum nigrum L.	-	-	-	-	2	-	-	-	-	-
Pulicaria sp.	-	-	-	1	-	-	-	-	-	-
Cichorium endivia L. / *intybus* L.	-	-	-	2/cf. 1	-	1	-	cf. 1	-	5

Table 4a: Floor Samples continued...

Sample Number / **Sample Preservation**	**94-008 CARB**	**94-008 DESC**	**94-010 CARB**	**94-010 DESC**	**94-011 CARB**	**94-011 DESC**	**94-012 CARB**	**94-012 DESC**	**94-035 CARB**	**94-035 DESC**
WEED / WILD PLANTS continued...										
Picris sp.	-	-	-	1	-	1	-	-	-	2
Sonchus sp.	-	-	-	1	-	-	-	1	-	-
Compositae - unidentified	-	-	-	-	-	2	-	1	-	-
Asphodelus spp.	-	-	-	-	-	-	-	6/cf. 1	-	-
Lolium spp.	-	-	-	-	-	-	-	-	-	-
Avena sp. - grain	-	-	-	-	-	-	-	1	-	1
Avena sterilis L. - rachilla	-	-	-	-	-	-	-	-	-	-
Avena spp. - rachilla	-	-	-	-	-	-	-	1	-	3
Crypsis spp.	-	-	1	20	-	21	-	29	-	9/cf. 2
Phalaris paradoxa L.	-	-	-	-	-	1	-	1	-	-
Phalaris spp.	-	-	-	-	-	-	-	-	-	-
Setaria spp. - with palea/lemma	-	-	-	3	-	5	-	4	-	13
Setaria spp. - naked seed	-	-	-	2	-	-	-	-	-	-
Saccharum spontaneum L.	-	-	-	-	-	-	-	-	-	6
Gramineae - small seeded	-	-	-	1	1	7	-	3	1	9
Gramineae - large seeded	-	-	-	-	-	-	-	-	-	-
Gramineae - wild grass rachis	-	-	-	1	-	-	-	-	-	-
Fimbristylis bis-umbellata (Forssk.) Bub.	-	-	-	1	-	-	-	-	-	1
Scirpus cf. *praelongatus* Poir.	-	-	-	-	-	1	-	-	-	-
Scirpus spp.	-	-	-	-	-	-	-	-	-	-
Cyperus spp.	-	-	-	-	-	1	-	-	-	16
Cyperaceae - unidentified TYPE 1	-	-	-	-	-	-	-	-	-	-
Cyperaceae - unidentified TYPE 2	-	-	-	-	-	-	-	-	-	-
UNIDENTIFIED										
?H - leafy involucre	-	-	-	-	-	-	-	-	-	1
?U - *Lawsonia*-like seed	-	-	-	1	-	8	-	10	-	2
?X - a) Unidentified leaf	-	-	-	-	-	-	-	-	-	+
?X - b) Split leaf / grass / palm	-	-	-	-	-	-	-	-	-	+
?X - c) Small leaf / petal ?	-	-	-	-	-	-	-	-	-	-
?A4 - a) filament of stamen	-	-	-	3	-	-	-	-	-	1
?A4 - b) stigma	-	-	-	-	-	3	-	1	-	-
?A4 - c) anther Small	-	-	-	5	-	5/cf. 1	-	10	-	10
anther Large	-	-	-	-	-	-	-	-	-	-
?A4 - d) anther / pod	-	-	-	6	-	3	-	2	-	-
?A5† - Thin walled, red - zooarchaeological ?	-	-	-	(1)	-	-	-	(6)	-	-
?A10 - Shiny compressed seed - striated	-	-	-	-	-	-	-	-	-	-
?A15 - shrivelled veined fruit	-	-	-	1	-	1	-	-	-	-
?A16 - a) unidentified root	-	-	-	+	-	+	-	-	-	-
- b) unidentified bark	-	-	-	-	-	-	-	-	-	-
?A22 - flower head / calyx	-	-	-	-	-	1	-	-	-	-
?A24 - interior of fruit w/ seed	3	1	-	-	-	-	-	1	-	1
?A27 - a) unidentified small fruit	-	-	-	-	-	1	2	-	-	-
- b) unidentified fruit stem	-	-	-	-	-	-	-	-	-	-
?A28 - Crescent part of stalk	-	-	-	-	-	2	-	2	-	-
?A29 - Small rounded seeds	-	-	-	-	-	-	-	-	-	-
?A35 - scaly interior of seed ?	-	-	-	-	-	-	-	-	-	-
?A36 - part of capsule ?	-	-	-	-	-	-	-	-	-	-
?A37 - ?? Plantago	-	-	-	-	-	-	-	-	-	-
?A38 - Internal structure ?	-	-	-	-	-	4	-	8	-	-
?A42 - pod / seed capsule	-	-	-	-	-	-	-	-	-	-
?A46 - ?Bud - hairless	-	-	-	-	-	-	-	-	-	-
?A47 - Unidentified seed coat (frags)	-	-	-	-	-	+	-	+	-	-
?A48 - ?Flower petals	-	-	-	-	-	-	-	-	-	-
?A49 - a) Large flower head	-	-	-	-	-	-	-	-	-	-
b) Small flower head	-	-	-	-	-	-	-	-	-	-
c) flower stalk	-	-	-	-	-	-	-	-	-	-
d) stalk	-	-	-	-	-	3	-	4	-	-
?A50 - extremely small fig-like seed	-	-	-	-	-	-	-	-	-	-
?A53 - ?seed pod - grooved a) fragment	-	-	-	-	-	-	-	-	-	-
b) complete pod	-	-	-	-	-	-	-	-	-	-
?A55 - Bud - (hairy)	-	-	-	-	-	-	-	-	-	-
?A56 - Small pitted seed	-	-	-	-	-	-	-	-	-	-
?A57† - Pink, round - zooarchaeological ?	-	-	-	-	-	-	-	-	-	-
Indeterminate:	-	-	-	-	-	8	-	4	-	-
TOTAL NUMBER OF	10	183	6	518	7	481	2	427	18	366
PERCENTAGE OF SAMPLE:	5.2%	94.8%	1.4%	98.9%	1.4%	98.6%	0.5%	99.5%	4.7%	95.3%
SEEDS / LITER:	1.5	28.2	2.0	109.1	2.0	137.4	0.5	113.9	8.0	162.7

† - A5 and A57, which are provisionally considered insect remains, will not be included in counts for samples or statistical analysis.

Table 4b: List of Plant Remains from the Floor Samples

Sample Number	**94-036(2)**	94-036(2)	**94-037**	94-037	**94-049**	94-049	**94-053**	94-053	**94-056**	94-056
Sample Volume in Liters	**20**		**13**		**16**		**14**		**6**	
Fraction of Sample Sorted	**1/8**		**1/8**		**1/8**		**1/8**		**1/4**	
Sample Preservation	**CARB**	**DESC**	**CARB**	**DESC**	**CARB**	**DESC**	**CARB**	**DESC**	**CARB**	**DESC**
CEREAL GRAIN										
Triticum aestivum L. / T. *durum* Desf.	-	-	-	-	-	-	-	-	-	1
Triticum sp.	-	-	1	-	-	-	-	1	-	-
Hordeum sp. (hulled)	-	-	cf. 1	2	-	2/cf. 1	-	5	-	2
Triticum sp. detached embryo	-	-	-	-	-	-	-	-	-	-
Cerealia - Indeterminate	-	-	1	-	-	-	-	1	-	-
CEREAL CHAFF										
Triticum dicoccum Schübl. - glume base	-	-	-	-	-	-	-	-	-	-
Triticum dicoccum-type - glume base	-	-	1	1	-	-	-	1	-	-
Triticum dicoccum Schübl. - rachis internode	-	-	-	-	-	-	-	2	-	2
Triticum durum Desf. - rachis internode	-	-	1	4	-	5	2	2	-	18
Triticum durum Desf. - glume	-	3	-	-	-	-	-	-	-	-
Triticum durum Desf. - palea (P) / lemma (L)	-	-	-	-	-	-	-	-	-	-
Triticum durum-type - rachis internode	-	-	-	-	-	4	-	4	-	-
Triticum aestivum L. - rachis internode	-	2	1	-	-	-	-	-	-	1
Triticum aestivum-type - rachis internode	-	-	-	-	-	1	-	1	-	-
Triticum sp. - free threshing rachis internode	1	23	6	10	-	54	12	22	-	35
Triticum sp. - terminal rachis internode	-	2	-	-	-	-	-	-	-	-
Triticum sp. - basal rachis internode	-	3	-	-	-	-	-	-	-	-
Triticum sp. - rachilla	1	14	-	2	-	1	-	32	8	1
Triticum sp. - awn	-	cf. 1	-	1	-	-	-	cf. 1	-	-
Triticum sp. - glume	-	1	-	-	-	1	-	1	-	-
Triticum sp. - palea (P) / lemma (L)	-	-	-	-	-	-	-	-	-	-
Triticum sp. - bran	-	-	-	-	-	cf. +	-	-	-	-
Hordeum vulgare L. - rachis internode	1	8	4	7	3	19	3	7	-	17
Hordeum vulgare L. - pedicelled internode	-	2	-	-	1	6	-	1	-	1
Hordeum sp. - palea / lemma	-	-	-	-	-	-	-	-	-	-
Hordeum sp. - awn	-	cf. 1	-	cf. 1	-	-	-	-	-	-
Sorghum bicolor (L.) Moench. - glume	-	-	-	-	-	-	-	-	-	-
Cerealia - indeterminate rachis internode	2	63	13	26	3	27	20	25	1	38
Cerealia - indeterminate culm node	-	6	4	3	-	25	2	4	-	13
Cerealia - indeterminate unquantified awn	-	-	+	++	-	-	-	-	-	-
Cerealia - indet. unquant. glume/palea/lemma	-	++	-	++	-	++	-	+++	-	+
PULSES										
Lupinus cf. *albus* L.	-	-	-	-	-	-	-	-	-	-
Lens culinaris Medik..	-	-	-	-	-	-	-	-	-	-
Lathyrus sp.	-	-	-	-	-	-	-	-	-	-
Hilum - indeterminate	-	-	-	-	-	-	-	-	-	-
OIL CROPS										
Linum usitatissimum L. - seed	-	1	-	-	-	cf. 1	-	-	-	1
Linum usitatissimum L. - capsule	-	1	-	2	-	1/cf. 1	-	1	-	1
Carthamus tinctorius L.	-	3	-	-	-	4	-	-	-	1
FRUIT										
Ficus carica L.	-	10	-	10	-	23	-	9	-	13
Ficus sycomorus L.	-	14	-	1	-	18	-	1	-	5
Morus sp.	1	2	-	-	-	-	-	-	-	-
Prunus persica (L.) Batsch.	-	-	-	-	-	-	-	-	-	-
Zizyphus spina-christi (L.) Desf.	-	-	-	-	-	-	-	-	-	-
Cucumis sp.	-	2	-	-	-	5	-	1	-	1
Punica granatum L.	-	-	-	-	-	-	-	-	-	-
Vitis vinifera L. - pip	-	1	-	-	-	3	-	2	-	2
Vitis vinifera L. - stalk	-	-	-	-	-	-	-	-	-	1
Olea europaea L. - stone	-	1	-	-	-	1	-	1	-	-
Olea europaea L. - kernel	-	-	-	-	-	-	-	-	-	-
Olea europaea L. - leaf	-	+	-	+	-	-	-	-	-	+
Cordia myxa L.	-	-	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - stone	-	-	-	1	-	1	-	-	-	-
Phoenix dactylifera L. - perianth	-	2/cf. 3	-	1	-	1	-	-	-	3
Phoenix dactylifera L. - female flower	-	-	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - male flower	-	-	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - rachilla	-	-	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - embryo	-	-	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - leaf sheath	-	-	-	-	-	-	-	-	-	-

Table 4b: Floor Samples continued...

Sample Number Sample Preservation	94-036(2) CARB	94-036(2) DESC	94-037 CARB	94-037 DESC	94-049 CARB	94-049 DESC	94-053 CARB	94-053 DESC	94-056 CARB	94-056 DESC
CONDIMENTS										
Coriandrum sativum L.	-	1	-	1	-	15	-	-	-	1
Anethum graveolens L.	-	-	-	-	-	-	-	-	-	-
Cuminum cyminum L.	-	-	-	-	-	4	-	-	-	-
Foeniculum vulgare (L.) Mill	-	-	-	-	-	1	-	cf. 1	-	-
Apium graveolens L.	-	2	-	-	-	-	-	2	-	305
cf. *Ocimum basilicum* L.	-	-	-	-	-	-	-	-	-	-
Allium cepa L. - tunic (= skin)	-	-	-	-	-	1	-	-	-	2
OTHER ECONOMIC PLANTS										
Juniperus cf. *oxycedrus* L. / *phoenicea* L.	-	-	-	-	-	-	-	-	-	-
Papaver somniferum L.	-	-	-	-	-	-	-	-	-	-
Amygdalus communis L.	-	-	-	-	-	-	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - seed	-	-	-	-	-	-	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - pod	-	-	-	-	-	-	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - leaf	-	-	-	+	-	-	-	-	-	-
Ruta cf. *chalepensis* L.	-	-	-	-	-	-	-	-	-	-
Tamarix aphylla (L.) Karst. - needle	-	+++	+	++	-	+	-	+	-	++
Tamarix aphylla (L.) Karst. - flower / calyx	-	24	-	1	-	6	-	-	-	4
Myrtus communis L.	-	-	-	-	-	1	-	1	-	1
Lagenaria siceraria (Mol.) Standl.	-	-	-	-	-	-	-	-	-	-
Daucus carota L.	-	-	-	-	-	-	-	-	-	-
WEED / WILD PLANTS										
Rumex spp. - perianth (nut with valves)	-	-	-	-	-	-	-	-	-	-
Rumex spp. - nut (naked)	-	2	-	-	2	1	-	-	-	-
Rumex spp. - tubercle	-	3	1	-	-	1	-	-	-	1
Polygonaceae - unidentified	-	2/cf. 1	-	-	-	-	-	1	-	1
Glinus cf. *lotoides* L.	-	44	-	18	-	-	-	44	-	6
Aizoaceae - unidentified	-	-	-	-	-	-	-	-	-	-
Portulaca oleracea L.	-	12/cf. 1	-	10	-	25	-	9	-	112
Vaccaria cf. *pyramidata* Medicus	-	2	-	-	-	-	-	-	-	-
Silene sp. - large	-	-	-	-	-	-	-	-	-	-
Stellaria sp. - type	-	-	-	1	-	30	-	-	-	-
Caryophyllaceae - unidentified	-	3	-	1	-	3	-	-	-	-
Beta vulgaris L.	-	1	-	-	-	1	-	-	-	2
Chenopodium murale L.	-	-	-	1	-	1	-	8	-	5
Cornulaca cf. *monocantha* Del.	-	5	-	2	-	-	-	-	-	-
Chenopodiaceae - unidentified	-	25	cf. 1	-	-	-	-	-	-	-
Chenopodiaceae - needle	-	-	-	+	-	-	-	-	-	-
Chenopodiaceae - floret	-	-	-	+	-	-	-	-	-	-
Fumaria spp.	-	-	-	-	-	-	-	-	-	-
Brassica spp. / *Sinapis arvensis* L.	-	-	-	-	-	-	-	-	-	-
Zilla spinosa (Turra) Prantl	-	-	-	-	-	-	-	-	-	-
Raphanus raphanistrum L. - capsule	-	-	-	-	-	-	-	-	-	-
Raphanus raphanistrum L. - seed	-	-	-	-	-	-	-	-	-	-
Coronopus cf. *niloticus* (Del.) Spreng	-	13	1	-	-	1	1	2	-	-
Reseda sp. TYPE 1 - smooth	-	-	-	1	-	-	-	-	-	-
Reseda sp. TYPE 2 - tubercled	-	-	-	-	-	-	-	-	-	-
Medicago sp.	-	-	-	-	-	-	-	-	-	-
Trifolium spp. - seed	1	8	11/cf. 2	14/cf. 1	2	-	7	6	-	28
Trifolium spp. - calyx	-	-	-	1	-	-	-	-	-	-
Trifolium spp. - involucre	-	9	-	3	-	13	-	-	-	-
Scorpiurus muricatus L.	-	-	-	-	-	-	-	-	-	-
Leguminosae - large seeded	-	-	-	-	-	-	-	-	-	-
Leguminosae - pod	-	-	-	-	-	-	-	-	-	-
Fagonia sp.	-	3	-	1	-	-	-	1	-	-
Zygophyllaceae - unidentified	-	-	-	8	-	2	-	45	-	-
Euphorbia peplus L.	-	2	-	-	-	2	-	-	-	-
Malva sp.	10	2	1/cf. 3	2	-	1	-	1	-	4
Umbelliferae - unidentified	-	2	1	-	-	1	-	3	-	-
Galium spp.	-	-	-	-	-	-	-	-	-	-
Heliotropium spp.	-	1	-	-	-	-	-	-	-	-
Echium sp.	-	cf. 1	-	-	-	cf. 1	-	-	-	-
Verbenaceae / Labiatae	-	-	-	-	-	-	-	-	-	1
Labiatae - *Ocimum* type	-	-	-	-	-	-	-	-	-	-
Labiatae - *Thymus* type	-	-	-	-	-	-	-	-	-	-
Labiatae - *Ajuga* type	-	-	-	-	-	-	-	-	-	-
Solanum nigrum L.	-	-	-	-	-	-	-	-	-	-
Pulicaria sp.	-	-	-	-	-	-	-	-	-	-
Cichorium endivia L. / *intybus* L.	-	5	-	1	-	2	-	-	-	8

Table 4b: Floor Samples continued...

Sample Number / **Sample Preservation**	94-036(2) CARB	94-036(2) DESC	94-037 CARB	94-037 DESC	94-049 CARB	94-049 DESC	94-053 CARB	94-053 DESC	94-056 CARB	94-056 DESC
WEED / WILD PLANTS continued...										
Picris sp.	-	2	-	-	-	-	-	-	-	-
Sonchus sp.	-	-	-	-	-	-	-	-	-	7
Compositae - unidentified	-	-	-	4/cf. 1	-	-	-	-	-	-
Asphodelus spp.	-	-	-	-	-	-	-	-	-	-
Lolium spp.	-	-	-	-	-	-	-	-	-	-
Avena sp. - grain	-	-	-	-	-	-	-	1	-	-
Avena sterilis L. - rachilla	-	-	-	-	-	-	-	-	-	-
Avena spp. - rachilla	-	3	-	1	-	-	-	-	-	-
Crypsis spp.	-	9/cf. 2	-	6	-	35	-	-	-	-
Phalaris paradoxa L.	-	-	-	1	-	-	-	-	-	-
Phalaris spp.	-	-	-	-	-	-	-	-	-	-
Setaria spp. - with palea/lemma	-	13	-	4	-	3	-	16	-	62
Setaria spp. - naked seed	-	-	-	-	-	-	-	-	-	-
Saccharum spontaneum L.	-	6	-	-	-	-	-	1	-	-
Gramineae - small seeded	1	9	-	4	-	1	1	15	-	1
Gramineae - large seeded	-	-	-	-	-	-	-	-	-	-
Gramineae - wild grass rachis	-	-	-	-	-	-	-	-	-	-
Fimbristylis bis-umbellata (Forssk.) Bub.	-	1	-	-	-	2	-	-	-	-
Scirpus cf. *praelongatus* Poir.	-	-	-	1	-	-	-	-	-	-
Scirpus spp.	-	-	-	1	-	-	1	-	-	-
Cyperus spp.	-	16	-	2	-	-	-	-	-	7
Cyperaceae - unidentified TYPE 1	-	-	-	-	-	-	-	-	-	-
Cyperaceae - unidentified TYPE 2	-	-	-	-	-	-	-	-	-	-
UNIDENTIFIED										
?H - leafy involucre	-	1	-	-	-	-	-	-	-	-
?U - *Lawsonia*-like seed	-	2	-	4	-	4	-	6	-	10
?X - a) Unidentified leaf	+	+	+	+	-	-	-	-	-	-
?X - b) Split leaf / grass / palm	-	+	-	+	-	++	-	+	-	++
?X - c) Small leaf / petal ?	-	-	-	-	-	-	-	-	-	-
?A4 - a) filament of stamen	-	1	-	1	-	3	-	7	-	7
?A4 - b) stigma	-	-	-	3	-	-	-	-	-	-
?A4 - c) anther Small	-	10	-	5	-	-	-	-	-	-
anther Large	-	-	-	-	-	-	-	-	-	-
?A4 - d) anther / pod	-	-	-	1	-	-	-	-	-	-
?A5† - Thin walled, red - zooarchaeological ?	-	-	-	-	-	-	-	-	-	-
?A10 - Shiny compressed seed - striated	-	-	-	-	-	-	-	-	-	-
?A15 - shrivelled veined fruit	-	-	-	-	-	-	-	-	-	-
?A16 - a) unidentified root	-	-	+	-	-	+	-	-	-	-
- b) unidentified bark	-	-	-	-	-	-	-	-	-	-
?A22 - flower head / calyx	-	-	-	1	-	-	-	-	-	-
?A24 - interior of fruit w/ seed	-	1	-	-	-	-	-	-	-	-
?A27 - a) unidentified small fruit	-	-	-	-	-	1	-	-	-	-
- b) unidentified fruit stem	-	-	-	-	-	-	-	-	-	-
?A28 - Crescent part of stalk	-	-	-	-	-	1	-	-	-	-
?A29 - Small rounded seeds	-	-	-	-	-	2	-	-	-	-
?A35 - scaly interior of seed ?	-	-	-	-	-	-	-	-	-	-
?A36 - part of capsule ?	-	-	-	1	-	-	-	-	-	-
?A37 - ??Plantago	-	-	-	-	-	-	-	-	-	-
?A38 - Internal structure ?	-	-	-	3	-	1	-	-	-	-
?A42 - pod / seed capsule	-	-	-	-	-	-	-	-	-	-
?A46 - ?Bud - (hairy)	-	-	-	1	-	-	-	-	-	-
?A47 - Unidentified seed coat (frags)	-	-	-	+	-	-	-	+	-	+
?A48 - ?Flower petals	-	-	-	-	-	-	-	-	-	-
?A49 - a) Large flower head	-	-	-	-	-	-	-	-	-	-
b) Small flower head	-	-	-	-	-	-	-	-	-	-
c) flower stalk	-	-	-	-	-	-	-	-	-	-
d) stalk	-	-	-	-	-	-	-	-	-	-
?A50 - extremely small fig-like seed	-	-	-	-	-	-	-	-	-	-
?A53 - ? seed pod - grooved a) fragment	-	-	-	-	-	-	-	-	-	-
b) complete pod	-	-	-	-	-	-	-	-	-	-
?A55 - Bud (hairy)	-	-	-	-	-	-	-	-	-	-
?A56 - Small pitted seed	-	-	-	-	-	-	-	-	-	-
?A57† - Pink, round - zooarchaeological ?	-	-	-	-	-	-	-	-	-	-
Indeterminate:	-	-	-	-	-	-	-	-	-	-
TOTAL NUMBER OF	18	409	47	181	11	367	49	293	9	732
PERCENTAGE OF SAMPLE	4.2%	95.8%	20.6%	79.4%	2.9%	97.1%	14.3%	85.7%	1.2%	98.8%
SEEDS / LITER:	7.2	163.6	28.9	111.4	5.5	183.5	28.0	167.4	6.0	488.0

† - A5 and A57, which are provisionally considered insect remains, will not be included in counts for samples or statistical analysis.

Table 4c: List of Plant Remains from the Floor Samples

Sample Number Sample Volume in Liters Fraction of Sample Sorted Sample Preservation	94-057 6 1/4 CARB	94-057 DESC	94-058 14 1/8 CARB	94-058 DESC	94-090 20 1/8 CARB	94-090 DESC	94-176 18 1/8 CARB	94-176 DESC
CEREAL GRAIN								
Triticum aestivum L. / T. *durum* Desf.	-	1	-	-	-	-	-	-
Triticum sp.	-	-	-	-	-	-	-	-
Hordeum sp. (hulled)	-	1	-	6	1	-	-	-
Cerealia - detached embryo	-	-	-	-	-	-	-	-
Cerealia - Indeterminate	-	1	-	-	-	3	-	-
CEREAL CHAFF								
Triticum dicoccum Schübl. - glume base	-	-	-	-	-	-	-	-
Triticum dicoccum-type - glume base	-	-	-	3	-	-	-	-
Triticum dicoccum Schübl. - rachis internode	-	-	-	-	-	-	-	-
Triticum durum Desf. - rachis internode	cf. 1	9	-	10	-	31	-	2
Triticum durum Desf. - glume	-	-	-	-	-	-	-	-
Triticum durum Desf. - palea (P) / lemma (L)	-	-	-	-	-	-	-	-
Triticum durum-type - rachis internode	-	-	-	-	-	-	-	1
Triticum aestivum L. - rachis internode	-	-	-	-	-	-	-	-
Triticum aestivum-type - rachis internode	-	-	-	-	1	1	-	-
Triticum sp. - free threshing rachis internode	1	16	-	12	-	72	-	11
Triticum sp. - terminal rachis internode	-	-	-	1	-	2	-	-
Triticum sp. - basal rachis internode	-	-	-	-	-	2	-	-
Triticum sp. - rachilla	1	-	-	71	-	4	-	24
Triticum sp. - awn	-	2	-	-	-	-	-	cf. 1
Triticum sp. - glume	-	2	-	5	-	1	-	4
Triticum sp. - palea (P) / lemma (L)	-	-	-	1P	-	-	-	-
Triticum sp. - bran	-	-	-	++	-	+	-	-
Hordeum sp. - rachis internode	4	3	-	3	1	19	-	3/cf. 1
Hordeum sp. - pedicelled rachis internode	-	1	-	3	-	3	-	5
Hordeum sp. - palea / lemma	-	-	-	-	-	-	-	-
Hordeum sp. - awn	-	cf. 1	-	-	-	1	-	-
Sorghum bicolor (L.) Moench. - glume	-	-	-	-	-	-	-	-
Cerealia - indeterminate rachis internode	2	15	-	-	-	35	-	23
Cerealia - indeterminate culm node	2	13	-	7	1	14	-	2
Cerealia - indeterminate unquantified awn	-	-	-	+	-	-	-	+
Cerealia - indet. unquant. glume / palea / lemma	-	-	-	+++	-	+	-	++
PULSES								
Lupinus cf. *albus* L.	-	-	-	-	-	-	-	-
Lens culinaris Medik.	-	-	-	-	-	-	-	-
Lathyrus sp.	1	-	-	-	-	-	-	-
Hilum - indeterminate	-	-	-	-	-	-	-	-
OIL CROPS								
Linum usitatissimum L. - seed	-	-	-	12	-	-	-	-
Linum usitatissimum L. - capsule	1	1	1	4	-	2	-	1
Carthamus tinctorius L.	-	-	-	1	-	5	-	121
FRUIT								
Ficus carica L.	-	27	-	53	-	54	-	101
Ficus sycomorus L.	-	2	-	10	-	8	-	6
Morus sp.	-	-	-	2	-	8	-	2/cf. 2
Prunus persica (L.) Batsch.	-	-	-	-	-	-	-	-
Zizyphus spina-christi (L.) Desf.	-	-	-	-	-	-	-	-
Cucumis sp.	-	-	-	1	-	5	-	-
Punica granatum L.	-	-	-	-	-	-	-	-
Vitis vinifera L. - pip	-	3	-	2	-	1	-	42/7im
Vitis vinifera L. - stalk	-	-	-	1	-	1	-	-
Olea europaea L. - stone	-	2	-	-	-	1	-	1
Olea europaea L. - kernel	-	-	-	-	-	-	-	-
Olea europaea L. - leaf	-	+	-	+	-	+	-	-
Cordia myxa L.	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - stone	-	-	-	1	-	1	-	5
Phoenix dactylifera L. - perianth	-	1	-	1	-	2	-	-
Phoenix dactylifera L. - female flower	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - male flower	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - rachilla	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - embryo	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - leaf sheath	-	-	-	-	-	+	-	-

Table 4c: Floor Samples continued...

Sample Number **Sample Preservation**	**94-057** **CARB**	**94-057** **DESC**	**94-058** **CARB**	**94-058** **DESC**	**94-090** **CARB**	**94-090** **DESC**	**94-176** **CARB**	**94-176** **DESC**
CONDIMENTS								
Coriandrum sativum L.	-	1	-	5	-	1	-	1
Anethum graveolens L.	-	-	-	-	-	-	-	-
Cuminum cyminum L.	-	1	-	-	-	-	-	-
Foeniculum vulgare (L.) Mill	-	-	-	-	-	-	-	-
Apium graveolens L.	-	1	-	-	-	-	-	1
cf. *Ocimum basilicum* L.	-	-	-	-	-	-	-	-
Allium cepa L. - tunic (=skin)	-	-	-	-	-	-	-	-
OTHER ECONOMIC PLANTS								
Juniperus cf. *oxycedrus / phoenicea* L.	-	-	-	-	-	-	-	-
Papaver somniferum L.	-	-	-	-	-	-	-	-
Amygdalus communis L.	-	-	-	-	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - seed	-	-	-	1	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - pod	-	-	-	-	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - leaf	-	-	-	-	-	-	-	-
Ruta cf. *chalepensis* L.	-	-	-	-	-	-	-	-
Tamarix aphylla (L.) Karst. - needle	-	+	-	+	-	+	+	+
Tamarix aphylla (L.) Karst. - flower / calyx	-	1	-	-	-	2	-	-
Myrtus communis L.	-	-	-	-	-	1	-	-
Lagenaria siceraria (Mol.) Standl.	-	-	-	-	-	1	-	1
Daucus carota L.	-	-	-	-	-	-	-	-
WEED / WILD PLANTS								
Rumex spp. - perianth (nut with valves)	-	-	-	-	-	1	-	-
Rumex spp. - nut (naked)	4	3	-	-	-	-	-	-
Rumex spp. - tubercle	-	-	-	-	-	1	-	-
Polygonaceae - unidentified	-	-	-	-	-	1	-	-
Glinus cf. *lotoides* L.	-	-	-	10	-	-	-	4
Aizoaceae - unidentified	-	-	-	-	-	-	-	-
Portulaca oleracea L.	-	11	-	15	-	50	-	32
Vaccaria cf. *pyramidata* Medicus	-	-	-	5	-	1	-	1
Silene sp. - large	-	-	-	-	-	-	-	-
Stellaria sp. - type	-	-	-	1	-	-	-	-
Caryophyllaceae - unidentified	-	-	-	-	3	2	-	1
Beta vulgaris L.	-	1	-	1	-	5	-	1
Chenopodium murale L.	-	8	-	-	-	17	-	-
Cornulaca cf. *monocantha* Del.	-	2	-	-	-	-	-	1
Chenopodiaceae - unidentified	-	-	-	33	-	-	-	-
Chenopodiaceae - needle	-	-	-	-	-	+	-	+
Chenopodiaceae - floret	-	-	-	-	-	-	-	-
Fumaria spp.	-	-	-	-	-	-	-	-
Brassica spp. / *Sinapis arvensis* L.	-	-	-	2	-	-	-	-
Zilla spinosa (Turra) Prantl	-	-	-	-	-	-	-	-
Raphanus raphanistrum L. - capsule	-	-	-	-	-	-	-	-
Raphanus raphanistrum L. - seed	-	-	-	-	-	-	-	-
Coronopus cf. *niloticus* (Del.) Spreng	-	2	-	9	-	-	-	1
Reseda sp. - TYPE 1 - smooth	-	-	-	-	-	-	-	-
Reseda sp. - TYPE 2 - tubercled	-	-	-	-	-	-	-	-
Medicago sp.	-	-	-	-	-	-	-	-
Trifolium spp. - seed	-	8	-	26	13	5	-	3
Trifolium spp. - calyx	-	-	-	1	-	1	-	-
Trifolium spp. - involucre	-	2	-	58	-	7	-	8
Scorpiurus muricatus L.	-	-	-	-	-	-	-	-
Leguminosae - large seeded	-	-	-	-	-	-	-	-
Leguminosae - pod	-	-	-	-	-	-	-	1
Fagonia sp.	-	-	-	-	-	-	-	-
Zygophyllaceae - unidentified	-	-	-	1	-	4	-	2
Euphorbia peplus L.	-	-	-	cf. 1	-	2	-	-
Malva sp.	-	4	-	14	-	-	-	-
Umbelliferae - unidentified	-	-	-	1	-	1	-	-
Galium spp.	-	-	-	3	-	-	-	-
Heliotropium spp.	-	-	-	2	-	3	-	-
Echium sp.	-	-	-	-	-	-	-	-
Verbenaceae / Labiatae	-	-	-	2	-	1	-	-
Labiatae - *Ocimum* type	-	-	-	-	-	-	-	-
Labiatae - *Thymus* type	-	-	-	-	-	-	-	-
Labiatae - *Ajuga* type	-	-	-	-	-	-	-	-
Solanum nigrum L.	-	-	-	-	-	-	-	-
Pulicaria sp.	-	-	-	-	-	6	-	-
Cichorium endivia L. / *intybus* L.	-	-	-	4	-	1/cf. 3	-	2

Table 4c: Floor Samples continued...

Sample Number **Sample Preservation**	**94-057** **CARB**	**94-057** **DESC**	**94-058** **CARB**	**94-058** **DESC**	**94-090** **CARB**	**94-090** **DESC**	**94-176** **CARB**	**94-176** **DESC**
WEED / WILD COMPONENT continued...								
Picris sp.	-	-	-	-	-	1	-	-
Sonchus sp.	-	-	-	-	-	1	-	-
Compositae - unidentified	-	-	-	-	-	-	-	-
Asphodelus spp.	-	1/cf. 1	-	1/cf. 1	-	3	-	2
Lolium spp.	-	-	-	-	-	-	-	-
Avena sp. - grain	-	-	cf. 1	3	-	-	-	-
Avena sterilis L. - rachilla	-	-	-	-	-	-	-	-
Avena spp. - rachilla	-	-	-	-	-	-	-	-
Crypsis spp.	-	-	-	5	-	9	-	-
Phalaris paradoxa L.	-	-	-	3	-	-	-	-
Phalaris spp.	-	-	-	-	-	-	-	-
Setaria spp. - with palea/lemma	-	9	-	cf. 1	-	7	-	26
Setaria spp. - naked seed	-	-	-	-	-	-	-	-
Saccharum spontaneum L.	-	-	-	1	-	2	-	-
Gramineae - small seeded	-	17	-	9	-	1	-	2
Gramineae - large seeded	-	-	-	-	-	-	-	-
Gramineae - wild grass rachis	-	-	-	-	-	-	-	-
Fimbristylis bis-umbellata (Forssk.) Bub.	-	-	-	-	-	-	-	-
Scirpus cf. *praelongatus* Poir.	-	-	-	-	-	-	-	-
Scirpus spp.	-	-	-	-	-	-	1	-
Cyperus spp.	-	2	-	1/cf. 2	-	-	-	2
Cyperaceae - unidentified TYPE 1	-	-	-	-	-	-	-	-
Cyperaceae - unidentified TYPE 2	-	-	-	-	-	-	-	-
UNIDENTIFIED								
?H - leafy involucre	-	-	-	-	-	-	-	-
?U - *Lawsonia*-like seed	-	1	-	1	-	5	-	-
?X - a) Unidentified leaf	+	-	-	-	-	+	-	-
?X - b) Split leaf / grass / palm	-	++	-	+	-	+	-	+
?X - c) Small leaf / petal ?	-	-	-	-	-	-	-	-
?A4 - a) filament of stamen	-	-	-	1	-	2	-	5
?A4 - b) stigma	-	-	-	-	-	-	-	-
?A4 - c) anther Small	-	-	-	-	-	3	-	-
anther Large	-	-	-	-	-	-	-	-
?A4 - d) anther / pod	-	-	-	-	-	3	-	-
?A5† - Thin walled, red - zooarchaeological ?	-	-	-	(5)	-	(3)	-	-
?A10 - Shiny compressed seed - striated	-	-	-	1	-	-	-	-
?A15 - shrivelled veined fruit	-	-	-	1	-	-	-	-
?A16 - a) unidentified root	-	-	-	-	-	+	-	+
- b) unidentified bark	-	-	-	-	-	-	-	-
?A22 - flower head / calyx	-	-	-	-	-	-	-	-
?A24 - interior of fruit w/ seed	-	-	-	-	-	-	-	-
?A27 - a) unidentified small fruit	-	-	-	-	-	-	-	-
- b) unidentified fruit stem	-	-	-	-	-	-	-	-
?A28 - Crescent part of stalk	-	-	-	-	-	-	-	-
?A29 - Small rounded seeds	-	-	-	-	-	-	-	-
?A35 - scaly interior of seed ?	-	-	-	-	-	-	-	-
?A36 - part of capsule ?	-	-	-	-	-	1	-	-
?A37 - ??Plantago	-	-	-	-	-	-	-	-
?A38 - Internal structure ?	-	-	-	-	-	-	-	-
?A42 - pod / seed capsule	-	-	-	-	-	-	-	-
?A46 - ?Bud - hairless	-	-	-	-	-	-	-	-
?A47 - Unidentified seed coat (frags)	-	-	-	-	-	-	-	-
?A48 - ?Flower petals	-	-	-	-	-	-	-	-
?A49 - a) Large flower head	-	-	-	-	-	-	-	-
b) Small flower head	-	-	-	-	-	-	-	-
c) flower stalk	-	-	-	-	-	-	-	-
d) stalk	-	-	-	-	-	-	-	-
?A50 - extremely small fig-like seed	-	-	-	-	-	-	-	-
?A53 - ? seed pod - grooved a) fragment	-	-	-	-	-	-	-	-
b) complete pod	-	-	-	-	-	-	-	-
?A55 - Bud - (hairy)	-	-	-	-	-	-	-	-
?A56 - Small pitted seed	-	-	-	-	-	-	-	-
?A57† - Pink, round - zooar chaeological ?	-	-	-	-	-	-	-	-
Indeterminate:	-	-	-	-	-	3	-	3
TOTAL NUMBER OF IDENTIFICATIONS:	16	175	1	431	20	431	1	462
PERCENTAGE OF SAMPLE:	8.4%	91.6%	0.2%	99.8%	4.4%	95.6%	0.2%	99.8%
SEEDS / LITER:	10.7	116.7	0.6	246.3	8.0	172.4	0.4	205.3

† A5 and A57, which are provisionally considered insect remains, will not be included in counts for samples or statistical analysis.

Table 5a : List of Plant Remains from the Hearth And Oven Samples

Sample Number **Sample Volume in Liters** **Fraction of Sample Sorted** **Sample Preservation**	**94-048** **20** **1/4** **CARB**	**94-048** **DESC**	**94-052** **15** **1/8** **CARB**	**94-052** **DESC**	**94-055** **8** **1/4** **CARB**	**94-055** **DESC**	**94-095** **5.75** **1/8** **CARB**	**94-095** **DESC**	**94-172** **22** **1/4** **CARB**	**94-172** **DESC**
CEREAL GRAIN										
Triticum aestivum L. / T. *durum* Desf.	3	1	-	-	2	-	1	-	7	-
Triticum sp.	-	-	2	-	-	cf. 1	1	-	1	-
Hordeum sp. (hulled)	-	-	-	-	cf. 1	-	-	-	cf. 1	-
Cerealia - detached embryo	cf. 1	cf. 1	-	-	-	-	-	-	1	-
Cerealia - Indeterminate	cf. 4	-	-	-	-	-	1	-	3	-
CEREAL CHAFF										
Triticum dicoccum Schübl. - glume base	-	-	-	-	-	-	-	-	-	-
Triticum dicoccum-type - glume base	-	-	-	-	-	-	-	-	-	-
Triticum dicoccum Schübl. - rachis internode	-	-	cf. 1	-	-	-	-	-	-	-
Triticum durum Desf. - rachis internode	2	8	14	3	9	3	59	-	19	-
Triticum durum Desf. - glume	-	2	-	-	-	-	3	1	-	-
Triticum durum Desf. - palea (P) / lemma (L)	-	-	-	-	-	-	-	-	-	-
Triticum durum-type - rachis internode	1	-	2	2	4	4	12/cf. 2	2	1	-
Triticum aestivum L. - rachis internode	-	1	-	-	-	-	-	-	-	-
Triticum aestivum-type - rachis internode	-	-	-	-	-	-	-	-	-	-
Triticum sp. - free threshing rachis internode	6/cf. 1	8	7	25	4	-	67	5	67	-
Triticum sp. - terminal rachis internode	-	-	-	1	-	1	2	1	-	-
Triticum sp. - basal rachis internode	7	1	2	-	4	2	22/cf. 6	-	17	-
Triticum sp. - rachilla	1	3	1	-	-	12	4	3	-	-
Triticum sp. - awn	1	2	1	1	1	1	1	-	-	-
Triticum sp. - glume	-	-	-	-	-	-	-	-	-	-
Triticum sp. - palea (P) / lemma (L)	-	-	-	-	-	-	-	-	-	-
Triticum sp. - bran	-	-	-	-	-	+	-	+	-	-
Hordeum vulgare L. - rachis internode	38/cf. 4	9 / cf. 1	17/cf. 1	3/cf. 2	17/cf. 1	5	2/cf. 3	1	20/cf. 5	-
Hordeum vulgare L. - pedicelled internode	-	-	-	-	-	-	-	-	-	-
Hordeum sp. - palea / lemma	-	-	-	-	-	-	-	-	-	-
Hordeum sp. - awn	-	-	-	-	-	-	-	-	-	-
Sorghum bicolor (L.) Moench. - glume	-	-	-	-	-	-	-	-	-	-
Cerealia - indeterminate rachis internode	24	7	13	8/cf. 1	10	10	26/cf. 2	5	22	-
Cerealia - indeterminate culm node	2	-	2	8	6	2	57	4	46	
Cerealia - indeterminate unquantified awn	+	+	+	-	++	++	+	+	-	-
Cerealia - indet. unquant. glume / palea / lemma	-	-	-	+	-	++	+	+	-	-
PULSES										
Lupinus cf. *albus* L.	-	-	-	-	-	1	-	-	-	-
Lens culinaris Medik.	1	-	-	-	-	-	-	-	-	-
Lathyrus sp.	-	-	-	-	-	-	-	-	-	-
Hilum - indeterminate	-	1	-	-	-	-	-	-	-	-
OIL CROPS										
Linum usitatissimum L. - seed	-	-	-	-	-	-	-	1	-	-
Linum usitatissimum L. - capsule	1	1	-	1	1	1	-	1	-	-
Carthamus tinctorius L.	-	1	-	cf. 1	-	1	1	1	-	-
FRUITS										
Ficus carica L.	1	3	-	7	-	2	1	7	1	1
Ficus sycomorus L.	1/cf. 1	5/cf. 1	-	4	-	1	-	-	-	-
Morus sp.	-	-	-	1	-	-	-	-	-	-
Prunus persica (L.) Batsch.	-	-	-	-	-	-	-	-	-	-
Zizyphus spina-christi (L.) Desf.	-	-	-	-	-	-	-	-	-	-
Cucumis sp.	-	1	-	-	-	1	-	-	-	-
Punica granatum L.	-	-	-	-	-	-	-	-	-	-
Vitis vinifera L. - pip	-	-	-	1/cf. 1	1	-	1	-	-	-
Vitis vinifera L. - stalk	-	-	-	-	-	-	-	-	cf. 1	-
Olea europaea L. - stone	1	-	-	-	-	-	-	-	1	-
Olea europaea L. - kernel	-	-	-	-	-	-	-	-	-	-
Olea europaea L. - leaf	-	+	-	+	+	+	+	-	-	-
Cordia myxa L.	-	-	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - stone	-	-	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - perianth	1	1	-	-	-	1	1	-	1	-
Phoenix dactylifera L. - female flower	-	1	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - male flower	-	-	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - rachilla	-	-	-	-	-	-	1	-	-	-
Phoenix dactylifera L. - embryo	-	-	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - leaf sheath	-	-	+	+	+	+	++	+	+	-

Table 5a : Hearth And Oven Samples continued...

Sample Number **Sample Preservation**	94-048 CARB	94-048 DESC	94-052 CARB	94-052 DESC	94-055 CARB	94-055 DESC	94-095 CARB	94-095 DESC	94-172 CARB	94-172 DESC
CONDIMENTS										
Coriandrum sativum L.	-	1	-	-	-	-	-	-	-	-
Anethum graveolens L.	-	-	-	-	-	-	-	-	-	-
Cuminum cyminum L.	-	-	-	-	-	-	-	-	-	-
Foeniculum vulgare (L.) Mill	-	-	-	-	-	-	-	-	-	-
Apium graveolens L.	-	-	-	-	-	-	-	-	-	-
cf. *Ocimum basilicum* L.	-	-	-	-	-	-	-	-	-	-
Allium cepa L. - tunic (=skin)	-	-	-	-	-	-	-	-	-	-
OTHER ECONOMIC PLANTS										
Juniperus cf. *oxycedrus* L. / *phoenicea* L.	-	-	-	-	-	-	-	-	-	-
Papaver somniferum L.	-	-	-	-	-	-	-	-	-	-
Amygdalus communis L.	-	-	-	-	-	-	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - seed	-	-	-	-	-	-	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - pod	-	-	-	-	-	-	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - leaf	-	-	-	-	cf. +	-	-	-	-	-
Ruta cf. *chalepensis* L.	-	-	-	-	-	-	-	-	-	-
Tamarix aphylla L. - needle	+	+	+	++	++	+	+	+	+	-
Tamarix aphylla L. - flower / calyx	-	1	-	-	-	-	-	1	-	-
Myrtus communis L.	-	-	-	1	-	-	-	-	-	-
Lagenaria siceraria (Mol.) Standl.	-	-	-	-	-	-	-	-	-	-
Daucus carota L.	-	-	-	-	-	-	-	-	-	-
WEED / WILD PLANTS										
Rumex spp. - perianth (nut with valves)	-	-	-	-	-	-	-	-	-	-
Rumex sp. - nut (naked)	2	-	-	1	-	1	1	-	cf. 7	-
Rumex sp. - tubercle	-	-	-	1	-	1	3	-	-	-
Polygonaceae - unidentified	1	-	-	-	-	1	cf. 1	-	-	-
Glinus cf. *lotoides* L.	-	-	-	-	-	-	-	-	-	-
Aizoaceae - unidentified	-	-	-	-	-	-	-	-	-	-
Portulaca oleracea L.	-	3	2 /cf. 1	-	1	4	-	-	-	-
Vaccaria cf. *pyramidata* Medicus	-	-	-	-	-	1	-	-	-	-
Silene sp. - large	-	-	-	-	-	-	-	-	-	-
Stellaria sp. - type	-	-	-	-	-	-	-	-	-	-
Caryophyllaceae - unidentified	-	-	-	-	-	-	-	-	-	-
Beta vulgaris L.	2	-	-	1	-	-	-	-	3	-
Chenopodium murale L.	9	1	-	4	2	2	37	-	3	-
Cornulaca cf. *monocantha* Del.	-	-	-	1	-	1	-	1	-	-
Chenopodiaceae - unidentified	1	-	-	-	-	-	7/cf. 1	-	-	-
Chenopodiaceae - needle	-	-	-	-	-	-	+	-	-	-
Chenopodiaceae - floret	-	-	-	+	+	+	-	-	-	-
Fumaria spp.	-	-	-	-	-	-	-	-	-	-
Brassica spp. / *Sinapis arvensis* L.	-	-	-	-	-	-	-	-	-	-
Zilla spinosa (Turra) Prantl	-	-	-	-	-	-	-	-	-	-
Raphanus raphanistrum L. - capsule	-	-	-	-	-	-	cf. 1	-	-	-
Raphanus raphanistrum L. - seed	-	-	-	-	-	-	-	-	-	-
Coronopus cf. *niloticus* (Del.) Spreng	-	-	-	-	-	-	-	-	-	-
Reseda sp. TYPE 1 - smooth	-	-	-	-	-	-	-	-	-	-
Reseda sp. TYPE 2 - tubercled	-	-	-	-	-	-	-	-	-	-
Medicago sp.	-	-	-	-	-	-	-	-	-	-
Trifolium spp. - seed	284	1	-	64	14	5	11	-	21	-
Trifolium spp. - calyx	-	-	2	-	-	-	-	-	-	-
Trifolium spp. - involucre	-	1	-	1	-	2	-	1	-	-
Scorpiurus muricatus L.	-	1	-	-	-	-	-	-	-	-
Leguminosae - Large seeded	-	-	-	-	-	-	-	-	-	-
Leguminosae - pod	-	-	-	-	-	-	-	-	-	-
Fagonia sp.	-	-	-	-	-	-	-	-	-	-
Zygophyllaceae - unidentified	-	1	-	1	2	1	-	-	-	-
Euphorbia peplus L.	-	-	-	-	-	-	-	-	-	-
Malva sp.	7	2	7	1	4	3	14	2	16	-
Umbelliferae - unidentified	-	-	-	-	-	-	-	-	-	-
Galium spp.	-	-	-	-	-	-	-	-	-	-
Heliotropium spp.	-	-	-	-	-	-	-	-	-	-
Echium sp.	-	-	-	-	-	-	-	-	-	2
Verbenaceae / Labiatae	-	-	-	3	-	-	-	-	-	-
Labiatae - *Ocimum* type	-	-	-	-	-	-	-	-	-	-
Labiatae - *Thymus* type	-	-	-	-	-	-	-	-	-	-
Labiatae - *Ajuga* type	-	-	-	20	-	4	-	-	-	-
Solanum nigrum L.	-	-	-	-	-	-	-	-	-	-
Pulicaria sp.	-	-	-	-	-	-	-	-	-	-
Cichorium endivia L. / *intybus* L.	-	1	-	2	1	2	1	-	1	-

Table 5a: Hearth and Oven Samples continued...

Sample Number **Sample Preservation**	94-048 CARB	94-048 DESC	94-052 CARB	94-052 DESC	94-055 CARB	94-055 DESC	94-095 CARB	94-095 DESC	94-172 CARB	94-172 DESC
WEED / WILD PLANTS cont...										
Picris sp.	-	-	-	-	-	-	-	-	-	-
Sonchus sp.	-	-	-	-	-	-	-	1	1	-
Compositae - unidentified	-	-	1	-	-	-	-	-	-	-
Asphodelus spp.	-	-	-	-	-	-	1	-	-	-
Lolium spp.	-	-	-	-	-	-	-	-	-	-
Avena sp. - grain	-	-	-	-	-	cf. 1	-	-	-	-
Avena sterilis L. - rachilla	-	-	-	-	1	-	-	-	-	-
Avena spp. - rachilla	-	-	-	-	9	1	1	-	-	-
Crypsis sp.	-	-	-	1	-	4	-	-	-	-
Phalaris paradoxa L.	-	-	-	-	-	-	-	-	-	-
Phalaris spp.	-	-	-	-	-	-	-	-	-	-
Setaria spp. - with palea/lemma	-	2	-	4	-	1	-	-	-	-
Setaria spp. - naked seed	-	-	-	-	-	-	-	-	-	-
Saccharum spontaneum L.	-	-	-	-	-	-	-	-	-	-
Gramineae - small seeded	27	2	cf. 1	-	18	8	5	1	-	-
Gramineae - large seeded	4	-	-	4	-	-	-	-	24	cf. 1
Gramineae - wild grass rachis	1	1	-	-	cf. 1	-	-	cf. 1	-	-
Fimbristylis bis-umbellata (Forssk.) Bub.	-	-	-	-	-	-	-	-	-	-
Scirpus cf. *praelongatus* Poir.	-	-	-	-	-	-	-	-	2	-
Scirpus spp.	-	-	-	-	-	-	-	-	-	-
Cyperus spp.	-	-	-	cf. 1	-	-	2	-	-	-
Cyperaceae - unidentified TYPE 1	3/cf. 2	-	-	-	-	-	-	-	-	-
Cyperaceae - unidentified TYPE 2	5	1	1	-	1	-	-	-	-	-
UNIDENTIFIED										
?H - leafy involucre	-	-	-	-	-	-	-	-	-	-
?U - *Lawsonia*-like seed	-	5	-	7	-	25	-	-	-	6
?X - a) Unidentified leaf	-	+	+	+	++	++	-	-	-	-
?X - b) Split leaf / grass / palm	+	+	++	+	++	+	+++	+	+	-
?X - c) Small leaf / petal ?	-	-	-	-	-	-	-	-	-	-
?A4 - a) filament of stamen	-	3	-	7	-	20	-	3	7	-
?A4 - b) stigma	-	-	-	-	3	-	-	-	-	-
?A4 - c) anther Small	-	1	-	3	-	2	-	-	2	-
anther Large	-	-	-	-	-	-	-	-	-	-
?A4 - d) anther / pod	-	16	-	-	-	1	-	2-	-	-
?A5† - Thin walled, red - zooarchaeological ?	-	(3)	-	-	(1)	(4)	-	(1)	-	-
?A10 - Shiny compressed seed - striated	-	-	-	-	-	-	-	-	-	-
?A15 - shrivelled veined fruit	-	-	-	-	-	-	-	-	-	-
?A16 - a) unidentified root	+	-	-	+	+	+	+	++	+	-
- b) unidentified bark	-	-	-	-	-	-	-	-	-	-
?A22 - flower head / calyx	-	-	-	-	-	-	-	-	-	-
?A24 - interior of fruit w/ seed	-	-	-	-	-	-	-	-	-	-
?A27 - a) unidentified small fruit	-	-	-	-	-	-	-	-	-	-
- b) unidentified fruit stem	-	-	-	-	-	-	-	-	-	-
?A28 - Crescent part of stalk	-	-	-	-	-	-	-	-	-	-
?A29 - Small rounded seeds	-	-	-	-	-	-	-	-	-	-
?A35 - scaly interior of seed ?	-	-	-	-	-	-	-	-	-	-
?A36 - part of capsule ?	-	-	-	-	-	1	-	-	cf. 1	-
?A37 - ??Plantago	-	-	-	-	-	-	-	-	-	-
?A38 - Internal structure ?	cf. 2	2	-	-	-	1	-	-	-	-
?A42 - pod / seed capsule	-	-	-	-	-	-	-	-	-	-
?A46 - ?Bud - hairless	-	-	-	-	-	-	-	-	-	-
?A47 - Unidentified seed coat (frags)	-	+	-	-	-	+	-	-	-	-
?A48 - ?Flower petals	-	-	-	-	-	-	-	-	-	-
?A49 - a) Large flower head	-	-	-	-	-	-	-	-	-	-
b) Small flower head	-	-	-	-	-	1	2	-	-	-
c) flower stalk	1/ cf. 1	1	-	-	-	-	1	-	-	-
d) stalk	4	2	-	-	1	9	31	2	5	-
?A50 - extremely small fig-like seed	-	-	-	cf. 1	-	-	-	-	-	-
?A53 - ? seed pod - grooved a) fragment	-	-	-	-	-	-	-	-	1	-
b) complete pod	-	-	-	-	-	-	-	-	-	-
?A55 - Bud (hairy)	1	-	-	-	-	-	-	-	-	-
?A56 - Small pitted seed	-	-	-	-	-	-	-	-	-	-
?A57† - Pink and round - zooarchaeological ?	-	-	-	(1)	-	-	-	-	-	-
Fungal Bodies (Not included in count)	(14)	-	-	-	-	-	-	-	-	-
Indeterminate:	209	3	108	-	1	2	30	-	104	-
TOTAL NUMBER OF IDENTIFICATIONS:	652	108	182	192	117	152	410	46	397	9
PERCENTAGE OF SAMPLE:	85.8%	14.2%	48.5%	51.3	43.5%	56.5%	89.9%	10.1%	97.8%	2.2%
SEEDS / LITER:	130.4	21.6	97.1	102.4	58.5	76.0	570.4	64.0	72.2	1.6

† A5 and A57, which are provisionally considered insect remains, will not be included in counts for samples or statistical analysis.

Table 5b: List of Plant Remains from the Hearth And Oven Samples

Sample Number	**94-173**	**94-173**	**94-181**	**94-181**	**8719**	**8719**	**8509**	**8509**
Sample Volume in Liters	**10**		**25**		**20**		**20**	
Fraction of Sample Sorted	**1/4**		**1/8**		**1/8**		**1/8**	
Sample Preservation	**CARB**	**DESC**	**CARB**	**DESC**	**CARB**	**DESC**	**CARB**	**DESC**
CEREAL GRAIN								
Triticum aestivum L. / T. *durum* Desf.	6	-	1	-	-	-	-	-
Triticum sp.	1	-	1	-	-	-	-	-
Hordeum sp. (hulled)	-	-	-	-	-	-	1	-
Cerealia - detached embryo	-	-	-	-	-	-	-	-
Cerealia - Indeterminate	1	-	-	1	-	-	-	-
CEREAL CHAFF								
Triticum dicoccum Schübl. - glume base	-	-	-	-	-	-	-	-
Triticum dicoccum-type - glume base	-	-	-	-	-	-	-	-
Triticum dicoccum Schübl. - rachis internode	-	-	-	-	-	-	-	-
Triticum durum Desf. - rachis internode	15	-	-	6	6	7	4	16
Triticum durum Desf. - glume	-	-	-	4	-	-	-	1
Triticum durum Desf. - palea (P) / lemma (L)	-	-	-	-	-	-	1	-
Triticum durum-type - rachis internode	-	-	1	2	1	-	-	-
Triticum aestivum L. - rachis internode	-	-	-	-	-	-	-	-
Triticum aestivum-type - rachis internode	-	-	-	-	-	-	-	-
Triticum sp. - free threshing rachis internode	76	-	8	15	1	5	5	55
Triticum sp. - terminal rachis internode	-	-	1	2	-	-	1	2
Triticum sp. - basal rachis internode	10	1	3	3	-	-	3	11
Triticum sp. - rachilla	-	-	-	11	-	-	2	1
Triticum sp. - awn	-	-	-	1	-	-	-	-
Triticum sp. - glume	-	-	-	-	-	-	-	-
Triticum sp. - palea (P) / lemma (L)	-	-	-	-	-	-	-	-
Triticum sp. - bran	-	-	-	-	-	-	-	-
Hordeum vulgare L. - rachis internode	11/cf. 3	-	3	2	1	-	5	7
Hordeum vulgare L. - pedicelled internode	-	-	-	-	-	-	-	1
Hordeum sp. - palea / lemma	-	-	-	1	-	-	-	-
Hordeum sp. - awn	-	-	-	cf. 1	-	-	-	-
Sorghum bicolor (L.) Moench. - glume	-	-	-	-	-	-	-	-
Cerealia - indeterminate rachis internode	30	-	2	10	1	1	11	14
Cerealia - indeterminate culm node	41	1	3	4	2	2	2	18
Cerealia - indeterminate unquantified awn	-	-	-	-	-	-	-	-
Cerealia - indet. unquant. glume / palea / lemma	+	-	-	++	-	+	+	+
PULSES								
Lupinus cf. *albus* L.	-	-	-	-	-	-	-	-
Lens culinaris Medik.	1	-	-	2	-	-	-	-
Lathyrus sp.	-	-	-	1	-	-	-	-
Hilum - indeterminate	-	-	-	-	-	-	-	-
OIL CROPS								
Linum usitatissimum L. - seed	-	-	-	-	-	1	-	-
Linum usitatissimum L. - capsule	1	-	1	1	-	1	-	-
Carthamus tinctorius L.	-	-	-	1	-	-	-	2
FRUITS								
Ficus carica L.	1	6	3	24	-	8	-	51
Ficus sycomorus L.	-	-	-	4	-	-	-	9
Morus sp.	-	-	-	-	-	-	-	-
Prunus persica (L.) Batsch.	-	-	-	-	-	-	-	-
Zizyphus spina-christi (L.) Desf.	-	-	-	-	-	-	-	-
Cucumis sp.	-	-	-	-	-	-	-	4
Punica granatum L.	-	-	-	2	-	-	-	-
Vitis vinifera L. - pip	-	-	-	1	-	-	-	2
Vitis vinifera L. - stalk	-	-	-	-	-	1	-	2
Olea europaea L. - stone	-	-	1	-	-	-	-	1
Olea europaea L. - kernel	-	-	-	-	-	-	-	1
Olea europaea L. - leaf	-	-	-	-	-	+	-	-
Cordia myxa L.	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - stone	-	-	-	cf. 1	-	cf. 1	-	1
Phoenix dactylifera L. - perianth	1	1	-	-	104/cf. 7	1/ cf. 1	-	7
Phoenix dactylifera L. - female flower	-	-	-	-	8	-	-	-
Phoenix dactylifera L. - male flower	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - rachilla	-	-	-	-	197	-	-	-
Phoenix dactylifera L. - embryo	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - leaf sheath	-	-	-	+	-	-	-	++

Table 5b: Hearth and Oven Samples continued...

Sample Number / Sample Preservation	94-173 CARB	94-173 DESC	94-181 CARB	94-181 DESC	8719 CARB	8719 DESC	8509 CARB	8509 DESC
CONDIMENTS								
Coriandrum sativum L.	-	-	1 / cf. 2	1	-	-	-	1
Anethum graveolens L.	-	-	-	1	-	-	-	-
Cuminum cyminum L.	-	-	-	-	-	-	-	-
Foeniculum vulgare (L.) Mill	-	-	-	-	-	-	-	-
Apium graveolens L.	-	-	-	-	-	-	-	-
cf. *Ocimum basilicum* L.	-	-	-	-	-	-	-	-
Allium cepa L. - tunic (=skin)	-	-	-	-	-	-	-	-
OTHER ECONOMIC PLANTS								
Juniperus cf. *oxycedrus* L. / *phoenicea* L.	-	-	-	-	-	-	-	-
Papaver somniferum L.	-	-	-	-	-	-	-	-
Amygdalus communis L.	-	-	-	-	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - seed	-	-	-	-	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - pod	-	-	-	-	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - leaf	-	-	-	-	-	-	-	-
Ruta cf. *chalepensis* L.	-	-	-	-	-	-	-	-
Tamarix sp. - needle	+	-	+	+	-	-	-	+
Tamarix sp. - flower / calyx	-	-	-	1	-	-	-	-
Myrtus communis L.	-	-	-	-	-	-	-	-
Lagenaria siceraria (Mol.) Standl.	-	-	-	-	-	-	-	-
Daucus carota L.	-	-	-	-	-	-	-	-
WEED / WILD PLANTS								
Rumex spp. - perianth (nut with valves)	-	-	-	-	-	-	-	-
Rumex spp. - nut (naked)	1	-	-	-	-	-	-	-
Rumex spp. - tubercle	-	1	-	-	-	-	-	-
Polygonaceae - unidentified	-	-	-	-	-	-	-	-
Glinus cf. *lotoides* L.	-	-	-	1	-	-	-	1
Aizoaceae - unidentified	-	-	-	-	-	-	-	-
Portulaca oleracea L.	-	-	-	12	-	-	-	18
Vaccaria cf. *pyramidata* Medicus	-	-	-	-	-	-	-	1
Silene sp. - large	-	-	-	-	-	-	-	-
Stellaria sp. - type	-	-	-	-	-	-	-	-
Caryophyllaceae - unidentified	-	-	-	-	-	-	-	-
Beta vulgaris L.	2	-	-	-	-	-	-	1
Chenopodium murale L.	cf. 2	-	6	-	2	4	-	11
Cornulaca cf. *monocantha* Del.	-	-	-	-	-	-	-	1
Chenopodiaceae - unidentified	-	-	-	-	-	-	-	-
Chenopodiaceae - needle	-	-	-	-	-	-	-	-
Chenopodiaceae - floret	-	-	-	-	-	+	-	-
Fumaria spp.	-	-	-	-	-	-	-	-
Brassica spp. / *Sinapis arvensis* L.	-	-	-	-	-	-	-	-
Zilla spinosa (Turra) Prantl	-	-	-	1	-	-	-	-
Raphanus raphanistrum L. - capsule	-	-	-	-	-	-	-	-
Raphanus raphanistrum L. - seed	-	-	-	-	-	-	-	-
Coronopus cf. *niloticus* (Del.) Spreng	-	-	-	1	-	-	-	-
Reseda sp. TYPE 1 - smooth	-	-	-	-	-	-	-	-
Reseda sp. TYPE 2 - tubercled	-	-	-	-	-	-	-	-
Medicago sp.	-	-	-	-	-	-	-	-
Trifolium spp. - seed	7	-	7	1	3	-	26	-
Trifolium spp. - calyx	-	-	-	1	-	-	-	-
Trifolium spp. - involucre	-	-	-	1	-	1	-	1
Scorpiurus muricatus L.	-	-	-	-	-	-	-	-
Leguminosae - large seeded	-	-	-	-	-	-	-	1
Leguminosae - pod	-	-	-	-	-	-	-	-
Fagonia sp.	-	-	-	-	-	-	-	-
Zygophyllaceae - unidentified	-	-	-	2	-	-	-	-
Euphorbia peplus L.	-	-	-	-	-	-	-	-
Malva sp.	8	-	1	1	-	2	cf. 1	1
Umbelliferae - unidentified	-	-	-	-	-	-	-	-
Galium spp.	-	-	-	-	-	-	-	-
Heliotropium spp.	-	-	-	2	-	-	-	-
Echium sp.	-	-	-	-	-	-	-	-
Verbenaceae / Labiatae	-	-	-	-	-	-	-	-
Labiatae - *Ocimum* type	-	-	-	-	-	-	-	-
Labiatae - *Thymus* type	-	-	-	-	-	-	-	-
Labiatae - *Ajuga* type	-	-	-	-	-	-	-	-
Solanum nigrum L.	-	-	-	-	-	-	-	-
Pulicaria sp.	-	-	-	-	-	-	-	-
Cichorium endivia L. / *intybus* L.	3	1	-	1/cf.1	-	1	-	-

Table 5b: Hearth and Oven Samples continued...

Sample Number **Sample Preservation**	**94-173** **CARB**	**94-173** **DESC**	**94-181** **CARB**	**94-181** **DESC**	**8719** **CARB**	**8719** **DESC**	**8509** **CARB**	**8509** **DESC**
WEED / WILD PLANTS continued...								
Picris sp.	-	-	-	-	-	-	-	-
Sonchus sp.	-	-	-	-	-	-	-	-
Compositae - indeterminate	-	-	-	1	-	-	-	2
Asphodelus spp.	-	-	cf. 1	-	-	-	-	1
Lolium spp.	-	-	-	-	-	-	-	-
Avena sp. - grain	-	-	-	cf. 1	-	-	-	-
Avena sterilis L. - rachilla	-	-	-	-	-	-	-	-
Avena spp. - rachilla	-	-	-	1	-	1	-	-
Crypsis spp.	-	-	-	4	-	-	-	2
Phalaris paradoxa L.	-	-	-	-	-	-	1	-
Phalaris spp.	-	-	-	-	-	-	-	-
Setaria spp. - with palea/lemma	-	5	-	4	-	1	-	5
Setaria spp. - naked seed	-	-	-	-	-	-	-	-
Saccharum spontaneum L.	-	-	-	-	-	-	-	-
Gramineae - small seeded	10	-	1	3	1	-	5	-
Gramineae - large seeded	-	-	-	-	-	-	-	-
Gramineae - wild grass rachis	-	-	-	-	2	-	-	-
Fimbristylis bis-umbellata (Forssk.) Bub.	-	-	-	-	-	-	-	-
Scirpus cf. *praelongatus* Poir.	-	-	-	1	-	-	-	-
Scirpus spp.	-	-	-	-	-	-	-	-
Cyperus spp.	-	-	-	-	-	-	-	-
Cyperaceae - unidentified TYPE 1	-	-	-	-	-	-	-	-
Cyperaceae - unidentified TYPE 2	-	-	-	-	-	-	-	-
UNIDENTIFIED								
?H - leafy involucre	-	-	-	-	-	-	-	-
?U - *Lawsonia*-like seed	-	6	-	11	-	1	-	1
?X - a) Unidentified leaf	-	-	+	+	-	-	+	+
?X - b) Split leaf / grass / palm	+	-	+	+	+	+	+	+++
?X - c) Small leaf / petal ?	-	-	-	-	-	-	-	-
?A4 - a) filament of stamen	-	3	-	4	-	7	-	5
?A4 - b) stigma	-	-	-	-	-	-	-	-
?A4 - c) anther Small	-	-	-	4	-	cf. 1	-	-
anther Large	-	-	-	-	-	-	-	-
?A4 - d) anther / pod	-	-	-	5	-	-	-	1
?A5† - Thin walled, red - zooarchaeological ?	-	-	-	(6)	(cf. 1)	(1)	-	(4)
?A10 - Shiny compressed seed - striated	-	-	-	-	-	-	-	-
?A15 - shrivelled veined fruit	-	-	-	-	-	-	-	-
?A16 - a) unidentified root	-	-	-	-	+	-	-	+
- b) unidentified bark	-	-	-	-	-	-	-	-
?A22 - flower head / calyx	-	-	-	-	-	-	-	-
?A24 - interior of fruit w/ seed	-	-	-	-	-	-	-	-
?A27 - a) unidentified small fruit	-	-	-	-	-	-	-	-
- b) unidentified fruit stem	-	-	-	-	-	-	-	-
?A28 - Crescent part of stalk	-	-	-	-	-	-	-	-
?A29 - Small rounded seeds	-	-	-	-	-	-	-	-
?A35 - scaly interior of seed ?	-	-	-	1	-	-	-	-
?A36 - part of capsule ?	-	-	-	-	-	-	-	-
?A37 - ??Plantago	-	-	-	-	-	-	-	-
?A38 - Internal structure ?	-	-	-	2	-	-	-	1
?A42 - pod / seed capsule	-	-	-	-	-	-	-	-
?A46 - ?Bud - hairless	-	-	-	-	-	-	-	-
?A47 - Unidentified seed coat (frags)	-	-	-	-	-	-	-	-
?A48 - ?Flower petals	-	-	-	-	-	-	-	-
?A49 - a) Large flower head	-	-	-	-	-	-	-	-
b) Small flower head	-	-	-	-	-	-	-	-
c) flower stalk	-	-	-	-	-	-	-	-
d) stalk	-	-	-	2	-	-	-	1
?A50 - extremely small fig-like seed	-	-	-	-	-	-	-	-
?A53 - ? seed pod - grooved a) fragment	-	-	-	-	-	-	-	-
b) complete pod	-	-	-	-	-	-	-	-
?A55 - Bud (hairy)	-	-	-	-	-	-	-	-
?A56 - Small pitted seed	-	-	-	-	-	-	-	-
?A57† - Pink and round - zooarchaeological ?	-	-	-	(1)	-	-	-	-
Indeterminate:	2	-	36	5	15	-	60	-
TOTAL NUMBER OF IDENTIFICATIONS:	228	25	80	175	344	46	127	261
PERCENTAGE OF SAMPLE:	90.1%	9.9%	31.4%	68.6%	88.0%	11.8%	32.7%	67.3%
SEEDS / LITER:	91.2	10.0	25.6	56.0	137.6	18.4	50.8	104.4

† A5 and A57, which are provisionally considered insect remains, will not be included in counts for samples or statistical analysis.

Table 6a: List of Plant Remains from the Midden Samples

Sample Number	**94-002**	**94-002**	**94-005**	**94-005**	**94-020**	**94-020**	**94-023**	**94-023**	**94-024**	**94-024**
Sample Volume in Liters	**13.5**		**10**		**10**		**10**		**14**	
Fraction of Sample Sorted	**1/8**		**1/2**		**1/8**		**1/16**		**1/8**	
Sample Preservation	**CARB**	**DESC**	**CARB**	**DESC**	**CARB**	**DESC**	**CARB**	**DESC**	**CARB**	**DESC**
CEREAL GRAIN										
Triticum aestivum L. / T. *durum* Desf.	-	-	-	-	-	-	-	-	-	-
Triticum sp.	-	-	-	-	-	-	-	-	-	-
Hordeum sp. (hulled)	-	1	-	-	-	18/cf. 4	-	1/cf. 1	-	1
Cerealia - detached embryo	-	-	6	10	-	-	-	-	-	-
Cerealia - Indeterminate	-	-	-	-	-	-	-	-	-	-
CEREAL CHAFF										
Triticum dicoccum Schübl. - glume base	-	-	-	-	-	-	-	-	-	2
Triticum dicoccum-type - glume base	-	-	-	-	-	1	-	-	-	1
Triticum dicoccum Schübl. - rachis internode	-	-	-	-	-	-	-	-	-	-
Triticum durum Desf. - rachis internode	-	6	1	-	-	26	-	-	-	7
Triticum durum Desf. - glume	-	-	-	-	-	-	-	-	-	-
Triticum durum Desf. - palea (P) / lemma (L)	-	-	-	-	-	-	-	-	-	-
Triticum durum-type - rachis internode	-	-	1	-	-	8	1	15	-	-
Triticum aestivum L. - rachis internode	-	1	-	-	-	-	1	-	-	-
Triticum aestivum-type - rachis internode	-	-	-	-	-	-	-	2	-	-
Triticum sp. - free threshing rachis internode	-	29	1	-	1	15	-	-	-	79
Triticum sp. - terminal rachis internode	-	-	-	-	-	2	-	1	-	-
Triticum sp. - basal rachis internode	-	2	-	-	-	1	-	1	-	-
Triticum sp. - rachilla	-	5	2	-	-	59	-	11/cf. 1	-	3
Triticum sp. - awn	-	-	-	-	-	-	-	-	-	-
Triticum sp. - glume	-	1	-	-	-	5	-	2	-	-
Triticum sp. - palea (P) / lemma (L)	-	1L	-	-	-	1L	-	-	-	-
Triticum sp. - bran	-	-	-	-	-	+++	-	-	-	-
Hordeum vulgare L. - rachis internode	-	2	-	-	-	37	-	4	-	6
Hordeum vulgare L. - pedicelled internode	-	1	-	-	-	3/cf. 2	-	cf. 2	-	3
Hordeum sp. - palea / lemma	-	-	-	-	-	-	-	-	-	-
Hordeum sp. - awn	-	-	-	-	-	-	-	-	-	-
Sorghum bicolor (L.) Moench - glume	-	-	-	-	-	-	-	-	-	-
Cerealia - indeterminate rachis internode	1	16	1	1	-	62	-	11	-	40/cf. 1
Cerealia - indeterminate culm node	-	8	-	-	-	22	-	6	-	25
Cerealia - indeterminate unquantified awn	-	-	-	-	-	+	-	+	-	-
Cerealia - indet. unquant. glume / palea /	-	++	-	+	-	+++	-	++	-	++
PULSES										
Lupinus cf. *albus* L.	-	-	-	-	-	-	-	-	-	-
Lens culinaris Medik.	-	-	-	-	-	-	-	-	-	-
Lathyrus sp.	-	-	-	-	-	-	-	-	-	-
Hilum - indeterminate	-	1	-	-	-	7	-	-	-	-
OIL CROPS										
Linum usitatissimum L. - seed	-	-	-	-	-	1/cf. 1	-	-	-	-
Linum usitatissimum L. - capsule	-	1	-	1	-	1	-	1	-	1
Carthamus tinctorius L.	-	1	-	1	-	3	-	1	-	2
FRUIT										
Ficus carica L.	-	48	-	5	-	50	-	22	-	79
Ficus sycomorus L.	-	13	-	2	-	4	-	11	-	44
Morus sp.	-	2	-	-	-	-	-	-	-	3
Prunus persica (L.) Batsch.	-	-	-	-	-	-	-	-	-	-
Zizyphus spina-christi (L.) Desf.	-	-	-	-	-	-	-	-	-	1
Cucumis sp.	-	-	-	-	-	1	-	1/cf. 1	-	-
Punica granatum L.	-	-	-	-	-	-	-	-	-	-
Vitis vinifera L. - pip	-	2	-	-	-	-	-	2/2 im	-	15
Vitis vinifera L. - stalk	-	-	-	-	-	-	-	-	-	-
Olea europaea L. - stone	-	2/cf. 1	-	2	-	-	-	-	-	1
Olea europaea L. - kernel	-	-	-	-	-	-	-	-	-	-
Olea europaea L. - leaf	-	++	-	++	-	+++	-	+	-	+
Cordia myxa L.	-	-	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - stone	-	-	-	2	-	1	-	1	-	2
Phoenix dactylifera L. - perianth	-	3	5	10	1	2	-	1	-	6
Phoenix dactylifera L. - female flower	-	cf. 1	10	8	-	-	-	-	-	cf. 1
Phoenix dactylifera L. - male flower	-	-	-	1	-	-	-	-	-	-
Phoenix dactylifera L. - rachilla	-	-	-	1	-	-	-	-	-	-
Phoenix dactylifera L. - embryo	-	-	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - leaf sheath	-	-	-	-	-	-	-	-	-	-

Table 6a : Midden Samples continued…

Sample Number **Sample Preservation**	**94-002 CARB**	**94-002 DESC**	**94-005 CARB**	**94-005 DESC**	**94-020 CARB**	**94-020 DESC**	**94-023 CARB**	**94-023 DESC**	**94-024 CARB**	**94-024 DESC**
CONDIMENTS										
Coriandrum sativum L.	-	4/cf. 1	-	-	-	1	-	1	-	23
Anethum graveolens L.	-	-	-	-	-	-	-	-	-	-
Cuminum cyminum L.	-	-	-	-	-	-	-	1	-	1
Foeniculum vulgare (L.) Mill	-	-	-	-	-	-	-	-	-	-
Apium graveolens L.	-	7	-	-	-	1	-	-	-	-
cf. *Ocimum basilicum* L.	-	3	-	-	-	1	-	-	-	-
Allium cepa L. - tunic (=skin)	-	-	-	-	-	1	-	-	-	-
OTHER ECONOMIC PLANTS										
Juniperus cf. *oxycedrus* L. / *phoenicea* L.	-	-	-	-	-	-	-	-	-	-
Papaver somniferum L.	-	-	-	-	-	1	-	-	-	-
Amygdalus communis L.	-	-	-	-	-	-	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - seed	-	-	-	-	-	-	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - pod	-	-	-	-	-	-	-	-	-	1
Acacia nilotica (L.) Willd. ex Del. - leaf	+	-	-	-	-	-	-	-	-	+
Ruta cf. *chalepensis* L.	-	-	-	-	-	-	-	-	-	-
Tamarix aphylla L. - needle	-	+++	++	++	-	++	-	+	-	+++
Tamarix aphylla L. - flower / calyx	-	36	5	20	-	16	-	14	-	83
Myrtus communis L.	-	-	-	-	-	1	-	-	-	-
Lagenaria siceraria (Mol.) Standl.	-	-	-	-	-	-	-	-	-	-
Daucus carota L.	-	1	-	-	-	-	-	-	-	-
WEED / WILD PLANTS										
Rumex spp. - perianth (nut with valves)	-	1	-	-	-	-	-	-	-	1
Rumex spp. - nut (naked)	-	-	1	-	-	1	-	-	-	1
Rumex spp. - tubercle	-	1	-	-	-	4	-	-	-	5
Polygonaceae - unidentified	-	-	-	-	-	-	-	-	-	-
Glinus cf. *lotoides* L.	-	2	-	-	-	1	-	4	-	8
Aizoaceae - unidentified	-	1	-	-	-	-	-	-	-	-
Portulaca oleracea L.	-	85	-	5	-	14/cf. 1	-	14	-	74
Vaccaria cf. *pyramidata* Medicus	-	-	-	-	-	1	-	1/cf. 2	-	-
Silene sp. - large	-	-	-	-	-	-	-	-	-	-
Stellaria sp. - type	-	1	-	-	-	-	-	-	-	-
Caryophyllaceae - unidentified	-	-	-	2	-	-	-	-	-	-
Beta vulgaris L.	-	7/cf. 1	-	1	-	66	-	-	-	2
Chenopodium murale L.	-	19	-	62	-	9	-	5	-	4
Cornulaca cf. *monocantha* Del.	-	4	-	-	-	2	-	3	-	3
Chenopodiaceae - unidentified	-	3	-	3	-	cf. 1	-	-	-	-
Chenopodiaceae - needle	-	+	+	+	+	++	-	+	-	-
Chenopodiaceae - floret	-	+	-	+	-	+	-	-	-	-
Fumaria spp.	-	-	-	-	-	-	-	1	-	-
Brassica spp. / *Sinapis arvensis* L.	-	-	-	-	-	-	-	-	-	1
Zilla spinosa (Turra) Prantl	-	-	-	1	-	-	-	-	-	-
Raphanus raphanistrum L. - capsule	-	1	-	-	-	-	-	-	-	2
Raphanus raphanistrum L. - seed	-	-	-	-	-	-	-	-	-	-
Coronopus cf. *niloticus* (Del.) Spreng	-	4	-	-	-	1	-	1	-	-
Reseda sp. TYPE 1 - smooth	1	-	-	1	-	-	-	-	-	-
Reseda sp. TYPE 2 - tubercled	-	-	-	-	-	-	-	-	-	-
Medicago sp.	-	-	-	-	-	-	-	1	-	1
Trifolium spp. - seed	-	1	-	2	-	3/cf. 1	-	4/cf. 1	-	17
Trifolium spp. - calyx	-	-	-	-	-	3	-	-	-	1
Trifolium spp. - involucre	-	2	-	1	-	56	-	3	-	1
Scorpiurus muricatus L.	-	-	-	-	-	-	-	-	-	-
Leguminosae - large seeded	-	-	1	-	-	-	-	-	-	-
Leguminosae - pod	-	1	-	-	-	-	-	-	-	1
Fagonia sp.	-	-	-	-	-	-	-	-	-	-
Zygophyllaceae - unidentified	-	2	-	-	-	2	-	-	-	1
Euphorbia peplus L.	-	-	-	-	-	-	-	-	-	-
Malva sp.	-	3	-	1	-	5	-	1	-	11
Umbelliferae - unidentified	-	7	-	-	-	-	-	1	-	-
Galium spp.	-	1	-	-	-	-	-	-	-	-
Heliotropium spp.	-	2	-	-	-	1	-	1	-	-
Echium sp.	-	1	-	-	-	2	-	-	-	-
Verbenaceae / Labiatae	-	-	-	-	-	-	-	2	-	2
Labiatae - *Ocimum* type	-	1	-	-	-	-	-	-	-	-
Labiatae - *Thymus* type	-	-	-	-	-	-	-	1	-	-
Labiatae - *Ajuga* type	-	5	-	-	2/cf. 2	-	-	-	-	-
Solanum nigrum L.	-	-	-	-	-	-	-	-	-	-
Pulicaria sp.	-	-	-	-	-	1/ cf. 1	-	-	-	-
Cichorium endivia L. / *intybus* L.	-	-	-	1	-	16	-	-	-	cf. 1

Table 6a: Midden Samples continued...

Sample Number **Sample Preservation**	**94-002** **CARB**	**94-002** **DESC**	**94-005** **CARB**	**94-005** **DESC**	**94-020** **CARB**	**94-020** **DESC**	**94-023** **CARB**	**94-023** **DESC**	**94-024** **CARB**	**94-024** **DESC**
WEED / WILD PLANTS cont...										
Picris sp.	-	-	-	-	-	-	-	-	-	-
Sonchus sp.	-	7	-	cf. 1	-	-	-	-	-	-
Compositae - unidentified	-	6	-	-	-	-	-	-	-	5
Asphodelus spp.	-	-	-	-	-	-	-	-	-	-
Lolium spp.	-	-	-	-	-	-	-	-	-	2
Avena sp. - grain	-	2	-	-	-	-	-	-	-	1
Avena sterilis L. - rachilla	-	-	-	-	-	-	-	-	-	-
Avena spp. - rachilla	-	1	-	-	-	5	-	-	-	2
Crypsis spp.	-	6	-	-	-	5	-	-	-	1
Phalaris paradoxa L.	-	1	-	-	-	4	-	-	-	2
Phalaris spp.	1	-	-	-	-	-	-	-	-	27
Setaria spp. - with palea/lemma	-	280/cf. 1	cf. 2	27/cf. 2	-	291	-	21	-	-
Setaria spp. - naked seed	-	10	-	-	3	8	-	-	-	15
Saccharum spontaneum L.	-	8	-	-	-	5	-	1	-	-
Gramineae - small seeded	-	29	12	2	-	29/cf. 2	-	4/cf. 1	-	-
Gramineae - large seeded	-	-	-	-	-	-	-	-	-	-
Gramineae - wild grass rachis	-	-	-	-	-	-	-	-	-	-
Fimbristylis bis-umbellata (Forssk.) Bub.	-	-	-	-	-	-	-	-	-	-
Scirpus cf. *praelongatus* Poir.	-	-	-	-	-	-	-	-	-	-
Scirpus spp.	-	-	-	-	-	-	-	-	-	-
Cyperus spp.	-	-	-	-	-	2	-	3	-	-
Cyperaceae - unidentified TYPE 1	-	-	-	-	-	-	-	-	-	-
Cyperaceae - unidentified TYPE 2	-	-	-	-	-	-	-	-	-	-
UNIDENTIFIED										
?H - leafy involucre	-	-	-	-	-	-	-	-	-	-
?U - *Lawsonia*-like seed	-	5	-	5	-	18	-	1	-	21
?X - a) Unidentified leaf	-	+	+	+	-	++	-	+	-	+++
?X - b) Split leaf / grass / palm	-	-	+	++	-	++	-	+	-	++
?X - c) Small leaf / petal ?	-	-	-	-	-	-	-	-	-	-
?A4 - a) filament of stamen	-	4	-	22	-	13	-	2	-	-
?A4 - b) stigma	-	4	-	3	-	-	-	-	-	-
?A4 - c) anther Small	-	12	-	7	-	8	-	-	-	7
anther Large	-	-	-	-	-	-	-	-	-	2/cf. 1
?A4 - d) anther / pod	-	5	-	-	-	1	-	1	-	2
?A5† - Thin walled, red - zooarchaeological ?	-	71	1	17	-	-	-	4	-	10
?A10 - Shiny compressed seed - striated	-	-	-	-	-	-	-	-	-	-
?A15 - shrivelled veined fruit	-	-	-	-	-	-	-	-	-	-
?A16 - a) unidentified root	-	-	++	++	-	-	-	-	-	+
- b) unidentified bark	-	-	++	+	-	-	-	-	-	-
?A22 - flower head / calyx	-	-	-	-	-	13	-	-	-	-
?A24 - interior of fruit w/ seed	-	-	-	-	-	-	-	-	-	-
?A27 - a) unidentified small fruit	-	2/cf. 1	-	-	1	1	-	2	-	1/cf. 1
- b) unidentified fruit stem	-	-	-	3	-	-	-	5	-	-
?A28 - Crescent part of stalk	-	-	-	-	-	-	-	-	-	6
?A29 - Small rounded seeds	-	2	1	-	-	-	-	-	-	-
?A35 - scaly interior of seed ?	-	-	-	-	-	-	-	-	-	1
?A36 - part of capsule ?	-	-	-	-	3/cf. 1	-	-	-	-	-
?A37 - ??Plantago	-	-	-	-	-	-	-	-	-	-
?A38 - Internal structure ?	-	1	-	-	-	-	-	1	-	4
?A42 - pod / seed capsule	-	-	-	-	-	-	-	-	-	-
?A46 - ?Bud - hairless	-	7	-	-	-	-	-	-	-	3
?A47 - Unidentified seed coat (frags)	-	+	-	-	-	+++	-	+	-	+
?A48 - ?Flower petals	-	-	-	-	-	18	-	21	-	50
?A49 - a) Large flower head	-	-	-	-	-	-	-	-	-	-
b) Small flower head	-	-	-	-	-	-	-	-	-	-
c) flower stalk	-	-	-	-	-	-	-	-	-	-
d) stalk	-	-	-	-	-	-	-	-	-	-
?A50 - extremely small fig-like seed	-	-	-	-	-	-	-	-	-	-
?A53 - ? seed pod - grooved a) fragment	-	-	-	-	-	-	-	-	-	-
b) complete pod	-	-	-	-	-	-	-	-	-	-
?A55 - Bud (hairy)	-	-	-	-	-	-	-	-	-	-
?A56 - Small pitted seed	-	-	-	-	-	1	-	-	-	-
?A57† - Pink and round - zooarchaeolgical ?	-	-	-	1	-	-	-	-	-	-
Indeterminate:	-	5	-	-	-	-	-	-	-	4
TOTAL NUMBER OF	3	749	47	213	11	962	2	218	0	724
PERCENTAGE OF SAMPLE:	0.4%	99.6%	18.1%	81.9%	1.1%	98.9%	0.9%	99.1%	0.0%	100%
SEEDS / LITER:	1.8	443.9	9.4	42.6	8.8	769.6	3.2	348.8	0	413.7

†A5 and A57, which are provisionally considered insect remains, will not be included in counts for samples or statistical analysis.

Table 6b: List of Plant Remains from the Midden Samples

Sample Number	89-5696	89-5696	89-5697	89-5697	89-5698	89-5698	5597#10	5597#10	5597#12	5597#12
Sample Volume in Liters	**9**		**20**		**10**		**7.5**		**8**	
Fraction of Sample Sorted	**1/4**		**1/16**		**1/16**		**1/4**		**1/4**	
Sample Preservation	**CARB**	**DESC**	**CARB**	**DESC**	**CARB**	**DESC**	**CARB**	**DESC**	**CARB**	**DESC**
CEREAL GRAIN										
Triticum aestivum L. / T. *durum* Desf.	-	-	-	-	-	-	-	-	-	-
Triticum sp.	-	-	-	-	-	-	-	-	-	-
Hordeum sp. (hulled)	-	-	-	-	-	4	-	2	-	5
Cerealia - detached embryo	-	-	-	-	-	-	1	-	-	-
Cerealia - Indeterminate	-	-	-	-	-	-	-	-	-	1
CEREAL CHAFF										
Triticum dicoccum Schübl. - glume base	-	-	-	-	-	-	-	-	-	-
Triticum dicoccum-type - glume base	-	-	-	-	-	1	-	1	-	-
Triticum dicoccum Schübl. - rachis internode	-	-	-	-	-	-	-	-	-	-
Triticum durum Desf. - rachis internode	4	7	2	9	-	4	-	3	1	7
Triticum durum Desf. - glume	-	-	-	-	-	-	-	-	-	-
Triticum durum Desf. - palea (P) / lemma (L)	-	-	-	-	-	-	-	-	-	-
Triticum durum-type - rachis internode	-	-	-	-	-	1	-	-	1	-
Triticum aestivum L. - rachis internode	-	1	-	-	-	-	-	3	-	1
Triticum aestivum-type - rachis internode	-	-	-	-	-	-	-	1	cf. 1	cf. 1
Triticum sp. - free threshing rachis internode	2	15	5	12	1	5	1	4	2	6
Triticum sp. - terminal rachis internode	-	1	-	-	-	2/ cf. 1	-	3	-	-
Triticum sp. - basal rachis internode	2	4	2	-	1	-	-	-	-	-
Triticum sp. - rachilla	-	7	-	13	-	9	-	4	-	2
Triticum sp. - awn	-	1	-	1	1	1	-	2	1	-
Triticum sp. - glume	-	1	-	2	-	3	-	3	-	2
Triticum sp. - palea (P) / lemma (L)	-	-	-	-	-	-	-	6L	-	1L
Triticum sp. - bran	-	+	-	++	-	++	-	++	-	+
Hordeum vulgare L. - rachis internode	1	8/cf. 6	-	13	1	1	4	16	-	2
Hordeum vulgare L. - pedicelled internode	-	-	-	1	-	-	-	-	1	-
Hordeum sp. - palea / lemma	-	-	-	-	-	-	-	-	-	-
Hordeum sp. - awn	-	1	-	1	-	1	-	1	-	-
Sorghum bicolor (L.) Moench. - glume	-	-	-	-	-	-	-	-	-	-
Cerealia - indeterminate rachis internode	1	47	3	33	2	10	-	8	3	27
Cerealia - indeterminate culm node	1	7	1	4	2	3	-	29	1	7
Cerealia - indeterminate unquantified awn	-	+	+	+	-	+	-	++	-	++
Cerealia - indet. unquant. glume / palea /	-	+	-	++	-	+	-	++	-	+++
PULSES										
Lupinus cf. *albus* L.	-	-	-	-	-	-	-	-	-	-
Lens culinaris Medik.	-	-	-	-	-	-	-	cf. 1	-	1
Lathyrus sp.	-	-	-	-	-	-	-	-	-	-
Hilum - indeterminate	-	-	-	-	-	-	-	4	-	5
OIL CROPS										
Linum usitatissimum L. - seed	-	-	-	1/cf. 1	-	2	-	1	-	16
Linum usitatissimum L. - capsule	1	1	1	1	-	1	-	2	-	6
Carthamus tinctorius L.	-	1	-	1	-	1	-	-	1	5
FRUIT										
Ficus carica L.	-	15	1	87	-	42	-	137	-	435
Ficus sycomorus L.	-	5	-	155	-	17	-	30	-	75
Morus sp.	-	1	-	-	-	1	-	11	-	-
Prunus persica (L.) Batsch.	-	-	-	-	-	-	-	-	-	-
Zizyphus spina-christi (L.) Desf.	-	-	-	-	-	-	-	-	-	-
Cucumis sp.	-	2	-	1/cf. 1	-	3	-	4	-	-
Punica granatum L.	-	-	-	-	-	-	-	-	-	-
Vitis vinifera L. - pip	-	1	-	3	-	1	-	8/2 im	-	9
Vitis vinifera L. - stalk	-	-	-	-	-	-	-	-	-	-
Olea europaea L. - stone	-	1	-	-	-	-	-	-	-	2
Olea europaea L. - kernel	-	-	-	-	-	-	-	-	-	-
Olea europaea L. - leaf	-	+	-	-	-	++	-	+	-	+
Cordia myxa L.	-	-	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - stone	-	-	-	1	-	1	-	5	-	5
Phoenix dactylifera L. - perianth	-	2/cf. 1	-	-	-	-	-	2	-	2
Phoenix dactylifera L. - female flower	-	-	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - male flower	-	2	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - rachilla	-	-	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - embryo	-	-	-	-	-	1	-	-	-	-
Phoenix dactylifera L. - leaf sheath	-	+	-	+	-	-	-	+	-	+

Table 6b: Midden Samples continued…

Sample Number **Sample Preservation**	89-5696 CARB	89-5696 DESC	89-5697 CARB	89-5697 DESC	89-5698 CARB	89-5698 DESC	5597#10 CARB	5597#10 DESC	5597#12 CARB	5597#12 DESC
CONDIMENTS										
Coriandrum sativum L.	-	1	-	1	-	3	-	1	-	3
Anethum graveolens L.	-	-	-	-	-	-	-	1/cf. 1	-	-
Cuminum cyminum L.	-	cf. 1	-	-	-	3	-	-	-	-
Foeniculum vulgare (L.) Mill	-	-	-	-	-	-	-	-	-	-
Apium graveolens L.	-	-	-	3/cf. 1	-	7	-	1/cf. 1	-	-
cf. *Ocimum basilicum* L.	-	1	-	-	-	2	-	-	-	-
Allium cepa L. - tunic (=skin)	-	-	-	1	-	1	-	1	-	1
OTHER ECONOMIC PLANTS										
Juniperus cf. *oxycedrus* L. / *phoenicea* L.	-	-	-	-	-	-	-	-	-	-
Papaver somniferum L.	-	-	-	-	-	-	-	-	-	-
Amygdalus communis L.	-	-	-	-	-	-	-	cf. 1	-	-
Acacia nilotica (L.) Willd. ex Del. - seed	-	-	-	-	-	-	-	1	-	-
Acacia nilotica (L.) Willd. ex Del. - pod	-	1	-	-	-	-	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - leaf	-	-	-	-	-	-	-	+	-	-
Ruta cf. *chalepensis* L.	-	1	-	-	-	-	-	-	-	-
Tamarix sp. - needle	+	++	+	++	+	++	-	+++	-	+++
Tamarix sp. - flower / calyx	-	2	-	40	-	2	-	28	-	53
Myrtus communis L.	-	-	-	-	-	1	-	-	-	1 .
Lagenaria siceraria (Mol.) Standl.	-	-	-	-	-	-	-	-	-	cf. 1
Daucus carota L.	-	-	-	-	-	-	-	-	-	-
WEED / WILD PLANTS										
Rumex spp. - perianth (nut with valves)	-	1	-	-	-	-	-	-	-	1
Rumex sp. - nut (naked)	-	-	-	1	-	-	1	-	-	-
Rumex sp. - tubercle	-	-	-	1	-	-	-	1	-	-
Polygonaceae - unidentified	-	-	-	-	-	-	-	-	-	-
Glinus cf. *lotoides* L.	-	5	-	6	-	4	-	3	-	6
Aizoaceae - unidentified	-	-	-	-	-	-	-	-	-	-
Portulaca oleracea L.	-	21	-	24/cf. 1	-	24	-	46/cf. 1	-	119
Vaccaria cf. *pyramidata* Medicus	-	-	-	-	-	-	-	cf. 1	-	-
Silene sp. - large	-	-	-	-	-	-	-	-	-	-
Stellaria sp. - type	-	-	-	-	-	-	-	-	-	3
Caryophyllaceae - unidentified	-	1	-	1	-	-	-	-	-	2
Beta vulgaris L.	-	1	-	-	-	2	-	cf. 1	-	-
Chenopodium murale L.	-	1	-	10	-	7	-	9	-	26
Cornulaca cf. *monocantha* Del.	-	51/cf. 2	-	15	-	3	-	12	-	20
Chenopodiaceae - unidentified	-	-	-	-	-	-	-	-	-	2
Chenopodiaceae - needle	-	+/cf. ++	-	+/cf.+++	-	-	-	+	-	+
Chenopodiaceae - floret	-	-	-	++	-	+	-	++	-	+
Fumaria spp.	-	-	-	-	-	-	-	-	-	-
Brassica spp. / *Sinapis arvensis* L.	-	-	-	2	-	4/cf. 3	-	2/cf. 1	-	1
Zilla spinosa (Turra) Prantl	-	2	-	1	-	-	-	1	-	1
Raphanus raphanistrum L. - capsule	-	-	-	-	-	-	-	-	-	-
Raphanus raphanistrum L. - seed	-	-	-	-	-	-	-	-	-	-
Coronopus cf. *niloticus* (Del.) Spreng	-	2	-	-	-	-	-	-	-	1
Reseda sp. TYPE 1 - smooth	-	1	-	1	-	1	-	-	-	1
Reseda sp. TYPE 2 - tubercled	-	-	-	-	-	-	-	-	-	-
Medicago sp.	-	-	-	-	-	-	-	-	-	-
Trifolium spp. - seed	23	cf. 3	10	5	2	1	12	8/cf. 1	21	12
Trifolium spp. - calyx	-	-	-	-	-	-	-	-	-	-
Trifolium spp. - involucre	-	2	-	3/cf. 1	-	1	-	8	-	2
Scorpiurus muricatus L.	-	-	-	-	-	1	-	-	-	-
Leguminosae - large seeded	-	-	-	-	-	-	-	1	-	1
Leguminosae - pod	-	-	-	4	-	-	-	3	-	-
Fagonia sp.	-	-	-	-	-	-	-	-	-	1
Zygophyllaceae - unidentified	-	17	-	2	-	1	-	1	-	6
Euphorbia peplus L.	-	-	-	-	-	-	-	-	-	-
Malva sp.	1	2	-	7	-	3	1	15	1	6
Umbelliferae - unidentified	-	-	-	-	-	1	-	1	-	9/cf. 2
Galium spp.	-	-	-	1	-	-	-	1	-	4
Heliotropium spp.	-	3	-	2	-	-	-	1	1	2
Echium sp.	-	-	-	-	-	-	-	-	-	-
Verbenaceae / Labiatae	-	-	-	1	-	-	-	-	-	-
Labiatae - *Ocimum* type	-	-	-	-	-	-	-	-	-	-
Labiatae - *Thymus* type	-	-	-	-	-	-	-	-	-	-
Labiatae - *Ajuga* type	-	-	-	-	-	-	-	-	-	-
Solanum nigrum L.	-	-	-	1	-	-	-	-	-	-
Pulicaria sp.	-	-	-	1	-	-	-	-	-	-
Cichorium endivia L. / *intybus* L.	-	4	-	-	-	-	-	-	-	-

Table 6b: Midden Samples continued…

Sample Number Sample Preservation	89-5696 CARB	89-5696 DESC	89-5697 CARB	89-5697 DESC	89-5698 CARB	89-5698 DESC	5597#10 CARB	5597#10 DESC	5597#12 CARB	5597#12 DESC
WEED / WILD PLANTS continued…										
Picris sp.	-	-	-	-	-	-	-	-	-	-
Sonchus sp.	-	-	-	-	-	-	-	-	-	-
Compositae - indeterminate	-	2	-	1	-	1	-	1	-	1/cf. 1
Asphodelus spp.	-	-	-	1	-	-	-	-	-	-
Lolium spp.	-	-	-	2	-	1	-	-	-	1
Avena sp. - grain	-	-	-	1	-	-	-	-	-	-
Avena sterilis L. - rachilla	-	-	-	-	-	-	-	-	-	-
Avena spp. - rachilla	-	-	-	3	1	-	-	1	-	-
Crypsis spp.	-	-	-	-	-	2	-	1	-	13
Phalaris paradoxa L.	-	-	-	1	-	1	-	-	-	-
Phalaris spp.	-	-	-	-	-	-	-	-	-	-
Setaria spp. - with palea/lemma	-	7	1	9	-	3	-	8/cf. 1	-	31
Setaria spp. - naked seed	1	-	-	-	-	-	-	-	-	-
Saccharum spontaneum L.	-	-	-	1	-	-	-	2	-	7
Gramineae - small seeded	1	5	-	9	-	4	1	8/cf. 2	-	14
Gramineae - large seeded	1	-	-	-	-	-	-	-	-	-
Gramineae - wild grass rachis	-	-	-	1	-	-	-	1	-	-
Fimbristylis bis-umbellata (Forssk.) Bub.	-	1	1	2	1	-	-	1	1	-
Scirpus cf. *praelongatus* Poir.	-	-	-	-	-	-	-	-	-	-
Scirpus spp.	-	-	-	-	-	-	-	-	-	-
Cyperus spp.	-	1	-	-	-	-	-	-	-	-
Cyperaceae - unidentified TYPE 1	-	-	-	-	-	-	-	-	-	-
Cyperaceae - unidentified TYPE 2	-	-	-	-	-	-	-	-	-	-
UNIDENTIFIED										
?H - leafy involucre	-	-	-	-	-	-	-	-	-	-
?U - *Lawsonia*-like seed	-	3	-	8	-	10	-	4	-	25
?X - a) Unidentified leaf	-	+	-	++	-	++	-	+	-	+
?X - b) Split leaf / grass / palm	+	+	-	+	+	+	-	+	-	+
?X - c) Small leaf / petal ?	-	-	-	-	-	-	-	-	-	-
?A4 - a) filament of stamen	-	-	-	8	-	50	-	-	-	13
?A4 - b) stigma	-	3	-	1	-	2	-	8	-	15
?A4 - c) anther Small	-	6	-	6/cf. 1	-	33	-	2	-	21
anther Large	-	-	-	-	-	5	-	1	-	-
?A4 - d) anther / pod	-	5	-	1	-	3	-	2	-	3
?A5† - Thin walled, red - zooarchaeological ?	-	3	-	-	-	10	-	1	-	1
?A10 - Shiny compressed seed - striated	-	-	-	-	-	-	-	-	-	-
?A15 - shrivelled veined fruit	-	-	-	2	-	-	1	1	-	-
?A16 - a) unidentified root	-	-	-	-	-	-	-	+	+	+
- b) unidentified bark	-	-	-	-	-	-	-	-	-	-
?A22 - flower head / calyx	-	1	-	-	-	-	-	-	-	-
?A24 - interior of fruit w/ seed	-	-	-	-	-	-	-	-	-	-
?A27 - a) unidentified small fruit	-	-	-	1	-	-	-	1	-	2/cf. 1
- b) unidentified fruit stem	1	5	-	-	-	-	-	-	-	-
?A28 - Crescent part of stalk	-	-	-	-	-	1	-	-	-	2
?A29 - Small rounded seeds	-	-	-	3	-	-	-	1	-	-
?A35 - scaly interior of seed ?	-	-	-	-	-	-	-	-	-	-
?A36 - part of capsule ?	-	-	-	1	-	-	-	-	-	1
?A37 - ??Plantago	-	-	-	-	-	-	-	1	-	-
?A38 - Internal structure ?	-	1	-	4	-	4	-	-	-	7
?A42 - pod / seed capsule	-	-	-	-	-	-	-	-	-	-
?A46 - ?Bud - hairless	-	1	-	1	-	2	-	1	-	1
?A47 - Unidentified seed coat (frags)	-	-	-	++	-	+	-	++	-	++
?A48 - ?Flower petals	-	-	-	-	-	-	-	-	-	-
?A49 - a) Large flower head	-	-	-	-	-	-	-	2	-	-
b) Small flower head	-	5	-	12/cf. 2	-	-	-	2	-	4
c) flower stalk	-	-	-	1	-	1	-	-	-	-
d) stalk	-	1	-	2	-	-	-	-	-	-
?A50 - extremely small fig-like seed	-	-	-	-	-	-	-	4	-	-
?A53 - ? seed pod - grooved a) fragment	-	-	-	3	-	7	-	-	-	-
b) complete pod	-	-	-	-	-	4	-	-	-	-
?A55 - Bud (hairy)	-	-	-	-	-	3	-	-	-	-
?A56 - Small pitted seed	-	-	-	-	-	-	-	-	-	-
?A57† - Pink and round - zooarchaeological ?	-	-	-	-	-	-	-	-	-	-
Indeterminate:	-	-	-	1	-	8	-	4	-	6
TOTAL NUMBER OF	40	299	27	559	12	332	22	495	35	1074
PERCENTAGE OF SAMPLE:	11.8%	88.2%	4.6%	95.4%	3.5%	96.5%	4.3%	95.7%	3.2%	96.8%
SEEDS / LITER:	17.8	132.9	21.6	447.2	19.2	531.2	11.7	264.0	17.5	537.0

†A5 and A57, which are provisionally considered insect remains, will not be included in counts for samples or statistical analysis.

Table 7: List of Plant Remains from the Mudbrick Samples

Sample Number	**7348**	7348	**7663**	7663	**PHAR**	PHAR
Sample Volume in Liters	**1.2**		**0.6**		**n/a***	
Fraction of Sample Sorted	**100%**		**100%**		**100%**	
Sample Preservation	CARB	DESC	CARB	DESC	CARB	DESC
CEREAL GRAIN						
Triticum aestivum L. / T. *durum* Desf.	-	-	-	-	-	-
Triticum sp.	-	-	-	-	-	-
Hordeum sp. (hulled)	-	1	-	-	-	17
Cerealia - detached embryo	-	-	-	-	-	-
Cerealia - Indeterminate	-	-	-	-	-	-
CEREAL CHAFF						
Triticum dicoccum Schübl. - glume base	-	-	-	-	6	12
Triticum dicoccum-type - glume base	-	-	-	-	-	-
Triticum dicoccum Schübl. - rachis internode	-	-	-	-	3	5
Triticum durum Desf. - rachis internode	-	6	-	-	-	-
Triticum durum Desf. - glume	-	6	-	-	-	-
Triticum durum Desf. - palea (P) / lemma (L)	-	-	-	-	-	-
Triticum durum-type - rachis internode	-	-	-	-	-	-
Triticum aestivum L. - rachis internode	-	-	-	-	-	-
Triticum aestivum-type - rachis internode	-	-	-	-	-	-
Triticum sp. - free threshing rachis internode	-	5	-	-	-	-
Triticum sp. - terminal rachis internode	-	3	-	-	-	2
Triticum sp. - basal rachis internode	-	1*	-	-	-	-
Triticum sp. - rachilla	-	27	-	-	-	26
Triticum sp. - awn	-	2	-	-	-	1
Triticum sp. - glume	-	-	-	-	-	-
Triticum sp. - palea (P) / lemma (L)	-	-	-	-	-	2
Triticum sp. - bran	-	+	-	-	-	-
Hordeum vulgare L. - rachis internode	-	1	-	cf. 2	-	20
Hordeum vulgare L. - pedicelled internode	-	-	-	-	-	97
Hordeum sp. - palea / lemma	-	2	-	-	-	-
Hordeum sp. - awn	-	2	-	-	-	50
Sorghum bicolor (L.) Moench. - glume	-	-	-	-	-	-
Cerealia - indeterminate rachis internode	-	10	-	-	-	5
Cerealia - indeterminate culm node	-	-	-	1	-	7
Cerealia - indeterminate unquantified awn	-	-	-	-	-	-
Cerealia - indet. unquant. glume / palea / lemma	-	-	-	-	-	-
PULSES						
Lupinus cf. *albus* L.	-	-	-	-	-	-
Lens culinaris Medik.	-	-	-	-	-	-
Lathyrus sp.	-	-	-	-	-	-
Hilum - indeterminate	-	-	-	-	-	-
OIL CROPS						
Linum usitatissimum L. - seed	-	-	-	-	-	-
Linum usitatissimum L. - capsule	-	-	-	-	-	1
Carthamus tinctorius L.	-	-	-	-	-	-
FRUIT						
Ficus carica L.	-	7	-	-	-	-
Ficus sycomorus L.	-	2	-	-	-	-
Morus sp.	-	-	-	-	-	14
Prunus persica (L.) Batsch.	-	-	-	-	-	-
Zizyphus spina-christi (L.) Desf.	-	-	-	-	-	-
Cucumis sp.	-	-	-	-	-	-
Punica granatum L.	-	-	-	-	-	-
Vitis vinifera L. - pip	-	-	-	1	-	-
Vitis vinifera L. - stalk	-	-	-	-	-	-
Olea europaea L. - stone	-	-	-	-	-	-
Olea europaea L. - kernel	-	-	-	-	-	-
Olea europaea L. - leaf	-	+	-	-	-	-
Cordia myxa L.	-	-	-	-	-	-
Phoenix dactylifera L. - stone	-	-	-	-	-	-
Phoenix dactylifera L. - perianth	-	-	-	-	-	-
Phoenix dactylifera L. - female flower	-	-	-	-	-	-
Phoenix dactylifera L. - male flower	-	-	-	-	-	-
Phoenix dactylifera L. - rachilla	-	-	-	-	-	-
Phoenix dactylifera L. - embryo	-	-	-	-	-	-
Phoenix dactylifera L. - leaf sheath	-	-	-	-	-	-

Weight of 1/2 Pharaonic mudbrick not available. * 7348 - *Triticum* sp. basal rachis is *T. durum* (internodes higher up ear preserved)

Table 7: Mudbrick Samples continued...

Sample Number **Sample Preservation**	**7348** **CARB**	**7348** **DESC**	**7663** **CARB**	**7663** **DESC**	**PHAR** **CARB**	**PHAR** **DESC**
CONDIMENTS						
Coriandrum sativum L.	-	-	-	-	-	-
Anethum graveolens L.	-	-	-	-	-	-
Cuminum cyminum L.	-	-	-	-	-	-
Foeniculum vulgare (L.) Mill	-	-	-	-	-	-
Apium graveolens L.	-	-	-	-	-	-
cf. *Ocimum basilicum* L.	-	-	-	-	-	-
Allium cepa L. - tunic (=skin)	-	1	-	-	-	-
OTHER ECONOMIC PLANTS						
Juniperus cf. *oxycedrus* L. / *phoenicea* L.	-	-	-	-	-	-
Papaver somniferum L.	-	-	-	-	-	-
Amygdalus communis L.	-	-	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - seed	-	-	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - pod	-	-	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - leaf	-	-	-	-	-	-
Ruta cf. *chalepensis* L.	-	-	-	-	-	-
Tamarix aphylla (L.) Karst. - needle	-	++	-	+	-	+
Tamarix aphylla (L.) Karst. - flower / calyx	-	83	-	-	-	-
Myrtus communis L.	-	-	-	-	-	-
Lagenaria siceraria (Mol.) Standl.	-	-	-	-	-	-
Daucus carota L.	-	-	-	-	-	-
WEED / WILD PLANTS						
Rumex spp. - perianth (nut with valves)	-	-	-	-	-	-
Rumex spp. - nut (naked)	-	-	-	-	-	-
Rumex spp. - tubercle	-	-	-	-	-	-
Polygonaceae - unidentified	-	-	-	-	-	-
Glinus cf. *lotoides* L.	-	-	-	-	-	-
Aizoaceae - unidentified	-	-	-	-	-	-
Portulaca oleracea L.	-	7	-	4	-	-
Vaccaria cf. *pyramidata* Medicus	-	-	-	-	-	-
Silene sp. - large	-	-	-	-	-	-
Stellaria sp. - type	-	-	-	-	-	-
Caryophyllaceae - unidentified	-	-	-	-	-	-
Beta vulgaris L.	-	1	-	-	-	-
Chenopodium murale L.	-	2	-	-	-	4
Cornulaca cf. *monocantha* Del.	-	2	-	-	-	-
Chenopodiaceae - unidentified	-	-	-	-	-	-
Chenopodiaceae - needle	-	-	-	-	-	-
Chenopodiaceae - floret	-	-	-	-	-	-
Brassica spp. / *Sinapis arvensis* L.	-	-	-	-	-	-
Zilla spinosa (Turra) Prantl	-	-	-	-	-	-
Raphanus raphanistrum L. - capsule	-	1	-	cf. 1	-	2
Raphanus raphanistrum L. - seed	-	-	-	-	-	-
Coronopus cf. *niloticus* (Del.) Spreng	-	-	-	-	-	-
Reseda sp. TYPE 1 - smooth	-	-	-	-	-	-
Reseda sp. TYPE 2 - tubercled	-	1	-	-	-	-
Medicago sp.	-	-	-	-	-	-
Trifolium spp. - seed	-	14	-	-	-	-
Trifolium spp. - calyx	-	-	-	-	-	-
Trifolium spp. - involucre	-	14	-	1	-	-
Scorpiurus muricatus L.	-	-	-	-	-	-
Leguminosae - large seeded	-	-	-	-	-	-
Leguminosae - pod	-	-	-	-	-	-
Fagonia sp.	-	1	-	-	-	-
Zygophyllaceae - unidentified	-	1	-	-	-	-
Euphorbia peplus L.	-	-	-	-	-	-
Malva sp.	-	1	-	-	-	-
Umbelliferae - unidentified	-	-	-	-	-	-
Galium spp.	-	-	-	-	-	-
Heliotropium spp.	-	1	-	-	-	-
Echium sp.	-	-	-	-	-	-
Verbenaceae / Labiatae	-	-	-	-	-	-
Labiatae - *Ocimum* type	-	-	-	-	-	-
Labiatae - *Thymus* type	-	-	-	-	-	-
Labiatae - *Ajuga* type	-	-	-	-	-	-
Solanum nigrum L.	-	-	-	-	-	-
Pulicaria sp.	-	-	-	-	-	-
Cichorium endivia L. / *intybus* L.	-	-	-	-	-	-

Table 7: Mudbrick Samples continued...

Sample Number **Sample Preservation**	**7348** **CARB**	**7348** **DESC**	**7663** **CARB**	**7663** **DESC**	**PHAR** **CARB**	**PHAR** **DESC**
WEED / WILD PLANTS cont....						
Picris sp.	-	-	-	-	-	-
Sonchus sp.	-	1	-	-	-	-
Compositae - unidentified	-	-	-	-	-	1
Asphodelus spp.	-	2	-	-	-	-
Lolium spp.	-	-	-	-	-	-
Avena sp. - grain	-	-	-	-	-	-
Avena sterilis L. - rachilla	-	-	-	-	-	-
Avena spp. - rachilla	-	2	-	-	-	-
Crypsis spp.	-	2	-	2	-	-
Phalaris paradoxa L.	-	-	-	-	-	-
Phalaris spp.	-	-	-	-	-	-
Setaria spp. - with palea/lemma	-	-	-	-	-	3
Setaria spp. - naked seed	-	-	-	-	-	-
Saccharum spontaneum L.	-	-	-	-	-	4
Gramineae - small seeded	-	1	-	-	-	2
Gramineae - large seeded	-	-	-	-	-	-
Gramineae - wild grass rachis	-	-	-	-	-	-
Fimbristylis bis-umbellata (Forssk.) Bub.	-	-	-	-	-	-
Scirpus cf. *praelongatus* Poir.	-	-	-	-	-	-
Scirpus spp.	-	-	-	-	-	-
Cyperus spp.	-	-	-	-	-	-
Cyperaceae - unidentified TYPE 1	-	-	-	-	-	-
Cyperaceae - unidentified TYPE 2	-	-	-	-	-	-
UNIDENTIFIED						
?H - leafy involucre	-	-	-	-	-	-
?U - *Lawsonia*-like seed	-	-	-	-	-	-
?X - a) Unidentified leaf	-	-	-	-	-	-
?X - b) Split leaf / grass / palm	-	-	-	++	-	-
?X - c) Small leaf / petal ?	-	-	-	-	-	-
?A4 - a) filament of stamen	-	5	-	-	-	-
?A4 - b) stigma	-	-	-	-	-	-
?A4 - c) anther Small	-	-	-	-	-	-
anther Large	-	-	-	-	-	-
?A4 - d) anther / pod	-	-	-	15	-	-
?A5† - Thin walled, red - zooarchaeological ?	-	-	-	-	-	-
?A10 - Shiny compressed seed - striated	-	1	-	-	-	-
?A15 - shrivelled veined fruit	-	-	-	-	-	-
?A16 - a) unidentified root	-	-	-	-	-	-
- b) unidentified bark	-	++	-	-	-	-
?A22 - flower head / calyx	-	-	-	-	-	-
?A24 - interior of fruit w/ seed	-	-	-	-	-	-
?A27 - a) unidentified small fruit	-	-	-	-	-	-
- b) unidentified fruit stem	-	-	-	-	-	-
?A28 - Crescent part of stalk	-	-	-	-	-	-
?A29 - Small rounded seeds	-	-	-	-	-	-
?A35 - scaly interior of seed ?	-	-	-	-	-	-
?A36 - part of capsule ?	-	-	-	-	-	-
?A37 - ??Plantago	-	-	-	-	-	-
?A38 - Internal structure ?	-	-	-	-	-	-
?A42 - pod / seed capsule	-	-	-	-	-	-
?A46 - ?Bud - hairless	-	-	-	-	-	-
?A47 - Unidentified seed coat (frags)	-	-	-	-	-	-
?A48 - ?Flower petals	-	-	-	-	-	-
?A49 - a) Large flower head	-	-	-	-	-	-
b) Small flower head	-	-	-	-	-	-
c) flower stalk	-	-	-	-	-	-
d) stalk	-	-	-	-	-	-
?A50 - extremely small fig-like seed	-	-	-	-	-	-
?A53 - ?seed pod - grooved a) fragment	-	-	-	-	-	-
b) complete pod	-	-	-	-	-	-
?A55 - Bud (hairy)	-	-	-	-	-	-
?A56 - Small pitted seed	-	-	-	-	-	-
?A57† - Pink and round - zooarchaeological ?	-	-	-	-	-	-
Indeterminate:	-	-	-	-	-	-
TOTAL NUMBER OF IDENTIFICATIONS:	0	219	0	24	9	275
PERCENTAGE OF SAMPLE:	0%	100%	0%	100%	3.2%	96.8%
SEEDS / LITER:	0	182.5	0	40	–	–

Pharaonic Mudbrick Sample not included in statistical analysis.

†A5 and A57, which are provisionally considered insect remains, will not be included in counts for samples or statistical analysis.

Table 8: List of Plant Remains from the Pit Sample

Sample Number	**94-043**	**94-043**
Sample Volume in Liters	**1.5**	
Fraction of Sample Sorted	**1/8**	
Sample Preservation	**CARB**	**DESC**
CEREAL GRAIN		
Triticum aestivum L. / T. *durum* Desf.	-	-
Triticum sp.	-	-
Hordeum sp. (hulled)	1	-
Cerealia - detached embryo	-	-
Cerealia - Indeterminate	cf. 1	-
CEREAL CHAFF		
Triticum dicoccum Schübl. - glume base	-	-
Triticum dicoccum-type - glume base	-	-
Triticum dicoccum Schübl. - rachis internode	-	-
Triticum durum Desf. - rachis internode	-	-
Triticum durum Desf. - glume	-	17
Triticum durum Desf. - palea (P) / lemma (L)	-	-
Triticum durum-type - rachis internode	-	-
Triticum aestivum L. - rachis internode	-	-
Triticum aestivum-type - rachis internode	-	-
Triticum sp. - free threshing rachis internode	-	-
Triticum sp. - terminal rachis internode	1	1
Triticum sp. - basal rachis internode	-	-
Triticum sp. - rachilla	-	5
Triticum sp. - awn	-	57
Triticum sp. - glume	-	-
Triticum sp. - palea (P) / lemma (L)	-	16P /17L
Triticum sp. - bran	-	-
Hordeum vulgare L. - rachis internode	2	-
Hordeum vulgare L. - pedicelled internode	-	-
Hordeum sp. - palea / lemma	-	-
Hordeum sp. - awn	-	5
Sorghum bicolor (L.) Moench. - glume	-	-
Cerealia - indeterminate rachis internode	-	1
Cerealia - indeterminate culm node	3	-
Cerealia - indeterminate unquantified awn	-	+++
Cerealia - indet. unquant. glume / palea / lemma	-	+++
PULSES		
Lupinus cf. *albus* L.	-	-
Lens culinaris Medik.	-	-
Lathyrus sp.	-	-
Hilum - indeterminate	-	-
OIL CROPS		
Linum usitatissimum L. - seed	-	-
Linum usitatissimum L. - capsule	-	-
Carthamus tinctorius L.	-	-
FRUIT		
Ficus carica L.	-	-
Ficus sycomorus L.	-	-
Morus sp.	-	-
Prunus persica (L.) Batsch.	-	-
Zizyphus spina-christi (L.) Desf.	-	-
Cucumis sp.	-	-
Punica granatum L.	-	-
Vitis vinifera L. - pip	-	-
Vitis vinifera L. - stalk	-	-
Olea europaea L. - stone	-	-
Olea europaea L. - kernel	-	-
Olea europaea L. - leaf	-	1
Cordia myxa L.	-	-
Phoenix dactylifera L. - stone	-	-
Phoenix dactylifera L. - perianth	-	-
Phoenix dactylifera L. - female flower	-	-
Phoenix dactylifera L. - male flower	-	-
Phoenix dactylifera L. - rachilla	-	-
Phoenix dactylifera L. - embryo	-	-
Phoenix dactylifera L. - leaf sheath	-	-

Table 8: Pit Sample continued...

Sample Number Sample Preservation	94-043 CARB	94-043 DESC
CONDIMENTS		
Coriandrum sativum L.	-	-
Anethum graveolens L.	-	-
Cuminum cyminum L.	-	-
Foeniculum vulgare (L.) Mill	-	-
Apium graveolens L.	-	-
cf. *Ocimum basilicum* L.	-	-
Allium cepa L. - tunic (=skin)	-	-
OTHER ECONOMIC PLANTS		
Juniperus cf. *oxycedrus* L. / *phoenicea* L.	-	-
Papaver somniferum L.	-	-
Amygdalus communis L.	-	1
Acacia nilotica (L.) Willd. ex Del. - seed	-	-
Acacia nilotica (L.) Willd. ex Del. - pod	-	-
Acacia nilotica (L.)Willd. ex. Del. - leaf	-	-
Ruta cf. *chalepensis L.*	-	-
Tamarix aphylla (L.) Karst. - needle	+	+
Tamarix aphylla (L.) Karst. - flower / calyx	-	-
Myrtus communis L.	-	-
Lagenaria siceraria (Mol.) Standl.	-	-
Daucus carota L.	-	-
WEED / WILD PLANTS		
Rumex spp. - perianth (nut with valves)	-	-
Rumex spp. - nut (naked)	-	-
Rumex spp. - tubercle	-	-
Polygonaceae - unidentified	-	1
Glinus cf. *lotoides* L.	-	-
Aizoaceae - unidentified	-	-
Portulaca oleracea L.	-	-
Vaccaria cf. *pyramidata* Medicus	-	-
Silene sp. - large	-	-
Stellaria sp. - type	-	-
Caryophyllaceae - unidentified	-	-
Beta vulgaris L.	-	-
Chenopodium murale L.	-	4
Cornulaca cf. *monocantha* Del.	-	-
Chenopodiaceae - unidentified	-	-
Chenopodiaceae - needle	-	-
Chenopodiaceae - floret	-	-
Fumaria spp.	-	-
Brassica spp. / *Sinapis arvensis* L.	-	-
Zilla spinosa (Turra) Prantl	-	-
Raphanus raphanistrum L. - capsule	-	-
Raphanus raphanistrum L. - seed	-	-
Coronopus cf. *niloticus* (Del.) Spreng	-	-
Reseda sp. TYPE 1 - smooth	-	-
Reseda sp. TYPE 2 - tubercled	-	-
Medicago sp.	-	-
Trifolium spp. - seed	-	-
Trifolium spp. - calyx	-	-
Trifolium spp.- involucre	-	-
Scorpiurus muricatus L.	-	-
Leguminosae - large seeded	-	-
Leguminosae - pod	-	-
Fagonia sp.	-	-
Zygophyllaceae - unidentified	-	10
Euphorbia peplus L.	-	-
Malva sp.	-	1
Umbelliferae - unidentified	-	-
Galium spp.	-	-
Heliotropium spp.	-	-
Echium sp.	-	-
Verbenaceae / Labiatae	-	-
Labiatae - *Ocimum* type	-	-
Labiatae - *Thymus* type	-	-
Labiatae - *Ajuga* type	-	-
Solanum nigrum L.	-	-
Pulicaria sp.	-	-
Cichorium endivia L. / *intybus* L.	-	-

Table 8: Pit Samples continued...

Sample Number Sample Preservation	94-043 CARB	94-043 DESC
WEED / WILD PLANTS continued...		
Picris sp.	-	-
Sonchus sp.	-	-
Compositae - unidentified	-	-
Asphodelus spp.	-	-
Lolium spp.	-	-
Avena sp. - grain	-	-
Avena sterilis L. - rachilla	-	-
Avena spp. - rachilla	-	-
Crypsis spp.	-	-
Phalaris paradoxa L.	-	-
Phalaris spp.	-	-
Setaria spp. - with palea/lemma	-	20
Setaria spp. - naked seed	-	-
Saccharum spontaneum L.	-	-
Gramineae - small seeded	-	2
Gramineae - large seeded	-	-
Gramineae - wild grass rachis	-	-
Fimbristylis bis-umbellata (Forssk.) Bub.	-	-
Scirpus cf. *praelongatus* Poir.	-	-
Scirpus spp.	-	-
Cyperus spp.	-	5
Cyperaceae - unidentified TYPE 1	-	-
Cyperaceae - unidentified TYPE 2	-	-
UNIDENTIFIED		
?H - leafy involucre	-	-
?U - *Lawsonia*-like seed	-	1
?X - a) Unidentified leaf	-	+
?X - b) Split leaf / grass / palm	-	-
?X - c) Small leaf / petal ?	-	-
?A4 - a) filament of stamen	-	8
?A4 - b) stigma	-	-
?A4 - c) anther Small	-	2
anther Large	-	-
?A4 - d) anther / pod	-	-
?A5† - Thin walled, red - zooarchaeological ?	-	-
?A10 - Shiny compressed seed - striated	-	-
?A15 - shrivelled veined fruit	-	-
?A16 - a) unidentified root	-	-
- b) unidentified bark	-	-
?A22 - flower head / calyx	-	1
?A24 - interior of fruit w/ seed	-	-
?A27 - a) unidentified small fruit	-	-
- b) unidentified fruit stem	-	-
?A28 - Crescent part of stalk	-	-
?A29 - Small rounded seeds	-	-
?A35 - scaly interior of seed ?	-	-
?A36 - part of capsule ?	-	-
?A37 - ??Plantago	-	-
?A38 - Internal structure ?	-	-
?A42 - pod / seed capsule	-	-
?A46 - ?Bud - hairless	-	-
?A47 - Unidentified seed coat (frags)	-	-
?A48 - ?Flower petals	-	-
?A49 - a) Large flower head	-	-
b) Small flower head	-	-
c) flower stalk	-	-
d) stalk	-	-
?A50 - extremely small fig-like seed	-	-
?A53 - ? seed pod - grooved a) fragment	-	-
b) complete pod	-	-
?A55 - Bud (hairy)	-	-
?A56 - Small pitted seed	-	-
?A57† - Pink and round - zooarchaeological ?	-	-
Indeterminate:	-	-
TOTAL NUMBER OF IDENTIFICATIONS:	7	176
PERCENTAGE OF SAMPLE:	3.8%	96.2%
SEEDS / LITER:	37.3	938.7

†A5 and A57, which are provisionally considered insect remains, will not be included in counts for samples or statistical analysis.

Table 9a: List of Plant Remains from the Pot-Slot Samples

Sample Number	**94-178**	94-178	**94-180**	94-180	**94-182**	94-182	**94-183**	94-183	**94-184**	94-184
Sample Volume in Liters	**3**		**8**		**16**		**16**		**18**	
Fraction of Sample Sorted	**1/2**		**1/4**		**1/4**		**1/4**		**1/8**	
Sample Preservation	**CARB**	DESC	**CARB**	DESC	**CARB**	DESC	**CARB**	DESC	**CARB**	DESC
CEREAL GRAIN										
Triticum aestivum L. / T. *durum* Desf.	-	-	-	-	-	-	-	-	-	-
Triticum sp.	-	-	-	-	-	-	-	-	-	-
Hordeum sp. (hulled)	-	-	-	-	-	-	-	-	-	-
Cerealia - detached embryo	-	-	-	-	-	-	-	-	-	-
Cerealia - Indeterminate	-	-	-	-	-	-	-	-	-	1
CEREAL CHAFF										
Triticum dicoccum Schübl. - glume base	-	-	-	-	-	-	-	-	-	2
Triticum dicoccum-type - glume base	-	-	-	-	-	-	-	-	-	-
Triticum dicoccum Schübl. - rachis internode	-	-	-	-	-	-	-	-	-	1
Triticum durum Desf. - rachis internode	-	4	-	-	-	-	-	4	3	4/cf. 3
Triticum durum Desf. - glume	-	-	-	-	-	-	-	-	-	-
Triticum durum Desf. - palea (P) / lemma (L)	-	-	-	-	-	-	-	-	-	-
Triticum durum-type - rachis internode	-	1	-	-	-	-	-	-	-	-
Triticum aestivum L. - rachis internode	-	1	-	-	-	-	-	-	-	-
Triticum aestivum-type - rachis internode	-	-	-	-	-	-	-	-	-	-
Triticum sp. - free threshing rachis internode	-	15	-	7	-	8	1	20	2/cf. 1	17/cf. 2
Triticum sp. - terminal rachis internode	-	-	-	-	-	-	-	-	-	1
Triticum sp. - basal rachis internode	-	-	-	-	1	1	2	1	-	-
Triticum sp. - rachilla	-	10	-	cf. 1	1	-	-	5	-	5
Triticum sp. - awn	-	-	-	-	-	-	-	-	-	-
Triticum sp. - glume	-	-	-	-	-	-	-	-	-	-
Triticum sp. - palea (P) / lemma (L)	-	-	-	-	-	-	-	-	-	-
Triticum sp. - bran	-	-	-	-	-	-	-	-	-	-
Hordeum vulgare L. - rachis internode	-	6	-	-	-	-	-	2/cf. 2	6	11
Hordeum vulgare L. - pedicelled internode	-	1	-	-	-	-	-	2	-	1
Hordeum sp. - palea / lemma	-	-	-	-	-	-	-	-	-	-
Hordeum sp. - awn	-	-	-	1	-	1	-	1	-	1
Sorghum bicolor (L.) Moench. - glume	-	-	-	-	-	-	-	-	-	-
Cerealia - indeterminate rachis internode	-	19	1	7	-	5	1	30	1	7
Cerealia - indeterminate culm node	-	8	-	2	-	3	1	9	-	5
Cerealia - indeterminate unquantified awn	-	-	-	+	-	+	-	+	-	+
Cerealia - indet. unquant. glume/palea/lemma	-	+	-	+	-	+	-	+	-	+
PULSES										
Lupinus cf. *albus*	-	-	-	-	-	-	-	-	-	-
Lens culinaris Medik.	-	-	-	-	-	-	-	-	-	-
Lathyrus sp.	-	-	-	-	-	-	-	-	-	-
Hilum - indeterminate	-	-	-	-	-	-	-	-	-	-
OIL CROPS										
Linum usitatissimum L. - seed	-	1	-	-	-	-	-	-	-	-
Linum usitatissimum L. - capsule	-	1	-	1	-	1	-	1	-	1
Carthamus tinctorius L.	-	3	-	6	-	5	-	2	-	1
FRUIT										
Ficus carica L.	-	19	-	23	-	90	1	67	1	30
Ficus sycomorus L.	-	5	-	8/cf. 2	-	18	-	11	-	6
Morus sp.	-	-	-	2	-	1	-	1	-	-
Prunus persica (L.) Batsch.	-	-	-	-	-	1	-	1	-	-
Zizyphus spina-christi (L.) Desf.	-	-	-	-	-	-	-	-	-	-
Cucumis sp.	-	-	-	1	-	-	-	2	-	5/cf. 1
Punica granatum L.	-	-	-	-	-	-	-	-	-	-
Vitis vinifera L. - pip	-	6	-	-	-	4	-	11/1im	-	1
Vitis vinifera L. - stalk	-	1	-	-	-	-	-	-	-	-
Olea europaea L. - stone	-	-	-	-	-	1/cf. 3	-	cf. 1	-	1
Olea europaea L. - kernel	-	-	-	-	-	1	-	-	-	-
Olea europaea L. - leaf	-	+	-	-	-	-	-	-	-	-
Cordia myxa L.	-	-	-	-	-	2	-	-	-	-
Phoenix dactylifera L. - stone	-	-	-	1	-	1	-	1	-	2
Phoenix dactylifera L. - perianth	-	4	-	1	-	5	-	3	-	3
Phoenix dactylifera L. - female flower	-	-	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - male flower	-	-	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - rachilla	-	-	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - embryo	-	-	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - leaf sheath	-	-	-	+	-	-	-	+	-	-

Table 9a: Pot-Slot Samples continued...

Sample Number **Sample Preservation**	**94-178** **CARB**	**94-178** **DESC**	**94-180** **CARB**	**94-180** **DESC**	**94-182** **CARB**	**94-182** **DESC**	**94-183** **CARB**	**94-183** **DESC**	**94-184** **CARB**	**94-184** **DESC**
CONDIMENTS										
Coriandrum sativum L.	-	3/cf. 1	-	1	-	1	-	1	-	7
Anethum graveolens L.	-	1	-	-	-	-	-	-	-	-
Cuminum cyminum L.	-	4	-	-	-	-	-	-	-	10
Foeniculum vulgare (L.) Mill	-	-	-	-	-	-	-	-	-	-
Apium graveolens L.	-	16/cf. 2	-	-	-	-	-	-	-	8
cf. *Ocimum basilicum* L.	-	-	-	-	-	-	-	-	-	-
Allium cepa L. - tunic (=skin)	-	-	-	-	-	-	-	-	-	-
OTHER ECONOMIC PLANTS										
Juniperus cf. *oxycedrus* L. / *phoenicea* L.	-	-	-	-	-	-	-	-	-	-
Papaver somniferum L.	-	-	-	-	-	-	-	-	-	-
Amygdalus communis L.	-	-	-	-	-	-	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - seed	-	-	-	-	-	-	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - pod	-	-	-	-	-	-	-	-	-	-
Acacia nilotica (L.) leaf	-	-	-	-	-	-	-	+/cf. +	-	-
Ruta cf. *chalepensis* L.	-	-	-	-	-	-	-	-	-	-
Tamarix aphylla (L.) Karst. - needle	-	+	-	+	+	-	-	+	-	+
Tamarix aphylla (L.) Karst. - flower / calyx	-	1	-	2	-	2	-	1	-	-
Myrtus communis L.	-	1/cf. 1	-	2/cf. 1	-	-	-	1	-	-
Lagenaria siceraria (Mol.) Standl.	-	-	-	-	-	-	-	cf. 1	-	-
Daucus carota L.	-	-	-	-	-	-	-	-	-	-
WEED / WILD PLANTS										
Rumex spp. - perianth (nut with valves)	-	-	-	-	-	-	-	-	-	-
Rumex spp. - nut (naked)	-	1	-	2	1	3	-	1	-	-
Rumex spp. - tubercle	-	-	-	1	-	-	-	1	-	-
Polygonaceae - unidentified	-	-	-	-	-	-	-	cf. 2	-	-
Glinus cf. *lotoides* L.	-	1	-	12	-	10	-	48	-	5
Aizoaceae - unidentified	-	-	-	-	-	-	-	1	-	-
Portulaca oleracea L.	-	17	-	42	-	283	-	234	-	23
Vaccaria cf. *pyramidata* Medicus	-	4	-	-	-	-	-	-	-	-
Silene sp. - large	-	-	-	-	-	-	-	-	-	-
Stellaria sp. - type	-	-	-	-	-	1	-	-	-	-
Caryophyllaceae - unidentified	-	-	-	1	-	-	-	3	-	2
Beta vulgaris L.	-	-	-	-	-	2	-	2	-	-
Chenopodium murale L.	-	9	-	15	-	30	-	34	-	1
Cornulaca cf. *monocantha* Del.	-	1	-	-	-	1	-	8	-	1
Chenopodiaceae - unidentified	-	-	-	1	-	-	1	1	-	-
Chenopodiaceae - needle	-	+	-	+	-	-	-	-	-	-
Chenopodiaceae - floret	-	+	-	-	-	-	-	-	-	-
Fumaria spp.	-	-	-	-	-	2	-	1	-	-
Brassica spp. / *Sinapis arvensis* L.	-	cf. 1	-	-	-	3	-	-	-	-
Zilla spinosa (Turra) Prantl	-	-	-	-	-	-	-	-	-	-
Raphanus raphanistrum L. - capsule	-	-	-	-	-	-	-	-	-	-
Raphanus raphanistrum L. - seed	-	-	-	-	-	-	-	-	-	-
Coronopus cf. *niloticus* (Del.) Spreng	-	1	-	-	-	-	-	-	-	1
Reseda sp. - TYPE 1 - smooth	-	-	-	-	-	-	-	-	-	-
Reseda sp. - TYPE 2 - tubercled	-	-	-	-	-	-	-	-	-	-
Medicago sp.	-	-	-	-	-	-	-	-	-	-
Trifolium spp. - seed	1	7/cf. 4	-	2	-	2/cf. 2	-	2	9	2
Trifolium spp. - calyx	-	2	-	-	-	-	-	-	-	-
Trifolium spp. - involucre	-	2	-	1	-	1	-	3	-	6
Scorpiurus muricatus L.	-	-	-	-	-	-	-	-	-	-
Leguminosae - large seeded	-	-	-	-	-	-	-	-	-	-
Leguminosae - pod	-	-	-	-	-	-	1	6	-	-
Fagonia sp.	-	-	-	-	-	-	-	-	-	-
Zygophyllaceae - unidentified	-	-	-	4	-	2	-	2	-	-
Euphorbia peplus L.	-	-	-	-	-	-	-	1	-	-
Malva sp.	-	3	-	1	-	3	1	1	-	4
Umbelliferae - unidentified	-	-	-	-	-	-	-	1	-	4
Galium spp.	-	-	-	-	-	-	-	-	-	-
Heliotropium spp.	-	2	-	-	-	2	-	2	-	-
Echium sp.	-	-	-	-	-	-	-	1	-	cf. 1
Verbenaceae / Labiatae	-	-	-	3	-	2	-	11	-	-
Labiatae - *Ocimum* type	-	-	-	-	-	-	-	3	-	-
Labiatae - *Thymus* type	-	-	-	1	-	-	-	1/cf. 1	-	-
Labiatae - *Ajuga* type	-	-	-	-	-	3	-	-	-	-
Solanum nigrum L.	-	-	-	-	-	-	-	-	-	-
Pulicaria sp.	-	-	-	-	-	-	-	-	-	-
Cichorium endivia L. / *intybus* L.	-	4	-	12	-	13	-	1	-	3

Table 9a: Pot-Slot Samples continued...

Sample Number Sample Preservation	94-178 CARB	94-178 DESC	94-180 CARB	94-180 DESC	94-182 CARB	94-182 DESC	94-183 CARB	94-183 DESC	94-184 CARB	94-184 DESC
WEED / WILD PLANTS continued...										
Picris sp.	-	-	-	-	-	-	-	-	-	-
Sonchus sp.	-	1	-	-	-	1	-	2	-	-
Compositae - indeterminate	-	4	-	-	-	-	-	11	-	-
Asphodelus spp.	-	1	-	3	-	5	-	2	-	-
Lolium spp.	-	-	-	-	-	-	-	-	-	-
Avena sp. - grain	-	-	-	-	-	-	-	1	-	-
Avena sterilis L. - rachilla	-	-	-	-	-	-	-	-	-	-
Avena spp. - rachilla	-	1	-	-	-	-	-	-	-	-
Crypsis spp.	-	2	-	4	-	3	-	3	-	-
Phalaris paradoxa L.	-	1	-	1	-	-	-	1	-	-
Phalaris spp.	-	-	-	4	-	-	-	5	-	-
Setaria spp. - with palea/lemma	-	-	-	11	-	7	-	11	-	4
Setaria spp. - naked seed	-	8	-	-	-	-	-	-	-	-
Saccharum spontaneum L.	-	-	-	2	-	-	-	1	-	-
Gramineae - small seeded	-	1	-	1	1	3	-	7	-	5
Gramineae - large seeded	-	-	-	-	-	-	-	-	-	-
Gramineae - wild grass rachis	-	-	-	-	-	-	-	-	-	-
Fimbristylis bis-umbellata (Forssk.) Bub.	-	-	-	-	-	-	-	-	-	-
Scirpus cf. *praelongatus* Poir.	-	-	-	-	-	-	-	-	-	-
Scirpus sp. - naked seed	-	-	-	-	-	-	-	-	-	-
Cyperus spp.	-	1	-	-	-	2	-	1/cf. 1	-	-
Cyperaceae - unidentified TYPE 1	-	-	-	-	-	-	-	-	-	-
Cyperaceae - unidentified TYPE 2	-	-	-	-	-	-	-	-	-	-
UNIDENTIFIED										
?H - leafy involucre	-	-	-	-	-	-	-	-	-	-
?U - Lawsonia-like seed	-	1	-	24	-	9	-	8	-	-
?X - a) Unidentified leaf	-	+	-	+	-	+	-	+	-	+
?X - b) Split leaf / grass / palm	-	+	-	-	-	-	-	+	-	++
?X - c) Small leaf / petal ?	-	-	-	-	-	-	-	-	-	-
?A4 - a) filament of stamen	-	1	-	16	-	10	-	8	-	1
?A4 - b) stigma	-	1	-	-	-	-	-	-	-	-
?A4 - c) anther Small	-	-	-	2	-	10	-	8	-	-
anther Large	-	-	-	-	-	-	-	-	-	-
?A4 - d) anther / pod	-	-	-	5	-	-	-	1	-	-
?A5† - Thin walled, red - zooarchaeological	-	(70)	-	-	-	-	-	(4)	-	(4)
?A10 - Shiny compressed seed - striated	-	-	-	-	-	-	-	-	-	-
?A15 - shrivelled veined fruit	-	-	-	-	-	-	-	-	-	-
?A16 - a) unidentified root	-	-	-	+	-	+	-	+	-	-
- b) unidentified bark	-	-	-	-	-	-	-	-	-	-
?A22 - flower head / calyx	-	-	-	-	-	-	-	-	-	-
?A24 - interior of fruit w/ seed	-	-	-	-	-	-	-	-	-	-
?A27 - a) unidentified small fruit	-	cf. 2	-	-	-	-	-	1	-	1
- b) unidentified fruit stem	-	-	-	-	-	-	-	-	-	-
?A28 - Crescent part of stalk	-	-	-	1	-	-	-	-	-	-
?A29 - Small rounded seeds	-	1	-	3	-	7	-	-	-	-
?A35 - scaly interior of seed ?	-	1	-	1	-	-	-	1	-	-
?A36 - part of capsule ?	-	-	-	-	-	-	-	-	-	-
?A37 - ??Plantago	-	-	-	-	-	-	-	-	-	-
?A38 - Internal structure ?	-	-	-	-	-	-	-	-	-	-
?A42 - pod / seed capsule	-	1	-	-	-	-	-	-	-	-
?A46 - ?Bud - hairless	-	-	1	-	-	-	-	-	-	-
?A47 - Unidentified seed coat (frags)	-	+	-	+	-	+	-	+	-	+
?A48 - ?Flower petals	-	-	-	-	-	-	-	-	-	-
?A49 - a) Large flower head	-	-	-	-	-	-	-	-	-	-
b) Small flower head	-	1	-	-	-	-	-	-	-	-
c) flower stalk	-	2	-	-	-	1	-	-	-	-
d) stalk	-	-	-	-	-	1	-	1	-	-
?A50 - extremely small fig-like seed	-	-	-	-	-	-	-	10	-	-
?A53 - ?grooved pod a) fragment	-	-	-	-	-	-	-	-	-	-
b) complete pod	-	-	-	-	-	-	-	-	-	-
?A55 - Bud (hairy)	-	3	-	-	-	-	-	-	-	-
?A56 - Small pitted seed	-	1	-	1	-	1	-	-	-	-
?A57† - Pink and round - zooarchaoelogical	-	-	-	(4)	-	(5)	-	(2)	-	-
Fungal bodies (Not included in final count)	-	-	-	-	-	(81)	-	(c. 100)	-	-
Indeterminate:	-	-	-	3	-	12	-	1	-	-
TOTAL NUMBER OF	1	218	1	245	4	586	7	631	21	194
PERCENTAGE OF SAMPLE:	0.5%	99.5%	0.4%	99.6%	0.7%	99.3%	1.1%	98.9%	9.8%	90.2%
SEEDS / LITER:	0.7	145.3	0.5	122.5	1.0	146.5	1.8	157.8	9.3	86.2

†A5 and A57, which are provisionally considered insect remains, will not be included in counts for samples or statistical analysis.

Table 9b: List of Plant Remains from the Pot-Slot Samples

Sample Number	**94-186**	**94-186**
Sample Volume in Liters	**17**	
Fraction of Sample Sorted	**1/8**	
Sample Preservation	**CARB**	**DESC**
CEREAL GRAIN		
Triticum aestivum L. / T. *durum* Desf.	-	-
Triticum sp.	-	-
Hordeum sp. (hulled)	-	-
Cerealia - detached embryo	-	-
Cerealia - Indeterminate	-	1
CEREAL CHAFF		
Triticum dicoccum Schübl. - glume base	-	-
Triticum dicoccum-type - glume base	-	-
Triticum dicoccum Schübl. - rachis internode	-	-
Triticum durum Desf. - rachis internode	-	-
Triticum durum Desf. - glume	-	-
Triticum durum Desf. - palea (P) / lemma (L)	-	-
Triticum durum-type - rachis internode	-	-
Triticum aestivum L. - rachis internode	-	-
Triticum aestivum-type - rachis internode	-	-
Triticum sp. - free threshing rachis internode	-	23
Triticum sp. - terminal rachis internode	-	1
Triticum sp. - basal rachis internode	-	1
Triticum sp. - rachilla	-	2
Triticum sp. - awn	1	1
Triticum sp. - glume	-	-
Triticum sp. - palea (P) / lemma (L)	-	-
Triticum sp. - bran	-	-
Hordeum vulgare L. - rachis internode	-	2/cf. 1
Hordeum vulgare L. - pedicelled internode	-	-
Hordeum sp. - palea / lemma	-	-
Hordeum sp. - awn	-	1
Sorghum bicolor (L.) Moench. - glume	-	-
Cerealia - indeterminate rachis internode	1	12/cf. 1
Cerealia - indeterminate culm node	-	5
Cerealia - indeterminate unquantified awn	+	+
Cerealia - indet. unquant. glume / palea / lemma	-	+
PULSES		
Lupinus cf. *albus* L.	-	-
Lens culinaris Medik.	-	-
Lathyrus sp.	-	-
Hilum - indeterminate	-	-
OIL CROPS		
Linum usitatissimum L. - seed	-	-
Linum usitatissimum L. - capsule	-	1
Carthamus tinctorius L.	-	1
FRUIT		
Ficus carica L.	-	39
Ficus sycomorus L.	-	12
Morus sp.	-	1
Prunus persica (L.) Batsch.	-	-
Zizyphus spina-christi (L.) Desf.	-	-
Cucumis sp.	-	1
Punica granatum L.	-	-
Vitis vinifera L. - pip	-	1
Vitis vinifera L. - stalk	-	2
Olea europaea L. - stone	-	2/cf. 1
Olea europaea L. - kernel	-	1
Olea europaea L. - leaf	-	-
Cordia myxa L.	-	-
Phoenix dactylifera L. - stone	-	1
Phoenix dactylifera L. - perianth	-	1
Phoenix dactylifera L. - female flower	-	-
Phoenix dactylifera L. - male flower	-	-
Phoenix dactylifera L. - rachilla	-	-
Phoenix dactylifera L. - embryo	-	-
Phoenix dactylifera L. - leaf sheath	-	-

Table 9b: Pot-Slot Samples continued...

Sample Number	**94-186**	**94-186**
Sample Preservation	**CARB**	**DESC**
CONDIMENTS		
Coriandrum sativum L.	-	-
Anethum graveolens L.	-	-
Cuminum cyminum L.	-	-
Foeniculum vulgare (L.) Mill	-	-
Apium graveolens L.	-	1
cf. *Ocimum basilicum* L.	-	-
Allium cepa L. - tunic (=skin)	-	-
OTHER ECONOMIC PLANTS		
Juniperus cf. *oxycedrus* L. / *phoenicea* L.	-	-
Papaver somniferum L.	-	1
Amygdalus communis L.	-	-
Acacia nilotica (L.) Willd. ex Del. - seed	-	-
Acacia nilotica (L.) Willd. ex Del. - pod	-	-
Acacia nilotica (L.) leaf	-	-
Ruta cf. *chalepensis* L.	-	-
Tamarix aphylla (L.) Karst. - needle	+	+
Tamarix aphylla (L.) Karst. - flower / calyx	-	1
Myrtus communis L.	-	-
Lagenaria siceraria (Mol.) Standl.	-	-
Daucus carota L.	-	-
WEED / WILD PLANTS		
Rumex spp. - perianth (nut with valves)	1	5
Rumex spp. - nut (naked)	-	-
Rumex spp. - tubercle	-	2
Polygonaceae - unidentified	-	-
Glinus cf. *lotoides* L.	-	35
Aizoaceae - unidentified	-	-
Portulaca oleracea L.	-	62
Vaccaria cf. *pyramidata* Medicus	-	-
Silene sp. - large	-	-
Stellaria sp. - type	-	-
Caryophyllaceae - unidentified	-	-
Beta vulgaris L.	-	1
Chenopodium murale L.	-	10
Cornulaca cf. *monocantha* Del.	-	2
Chenopodiaceae - unidentified	-	-
Chenopodiaceae - needle	-	-
Chenopodiaceae - floret	-	-
Fumaria spp.	-	-
Brassica spp. / *Sinapis arvensis* L.	-	-
Zilla spinosa (Turra) Prantl	-	-
Raphanus raphanistrum L. - capsule	-	-
Raphanus raphanistrum L. - seed	-	-
Coronopus cf. *niloticus* (Del.) Spreng	-	-
Reseda sp. - TYPE 1 - smooth	-	-
Reseda sp. - TYPE 2 - tubercled	-	-
Medicago sp.	-	-
Trifolium spp. - seed	-	11
Trifolium spp. - calyx	-	-
Trifolium spp. - involucre	-	4
Scorpiurus muricatus L.	-	-
Leguminosae - large seeded	-	-
Leguminosae - pod	-	1
Fagonia sp.	-	-
Zygophyllaceae - unidentified	-	2
Euphorbia peplus L.	-	-
Malva sp.	-	3
Umbelliferae -unidentified	-	-
Galium spp.	-	-
Heliotropium spp.	-	5
Echium sp.	-	-
Verbenaceae / Labiatae	-	1
Labiatae - *Ocimum* type	-	-
Labiatae - *Thymus* type	-	1
Labiatae - *Ajuga* type	-	-
Solanum nigrum L.	-	-
Pulicaria sp.	-	-
Cichorium cf. *endivia* L. / *intybus* L.	-	-

Table 9b: Pot-Slot Samples continued...

Sample Number **Sample Preservation**	**94-186** **CARB**	**94-186** **DESC**
WEED / WILD PLANTS continued...		
Picris sp.	-	2
Sonchus sp.	-	-
Compositae - unidentified	-	3
Asphodelus spp.	-	2
Lolium spp.	-	-
Avena sp. - grain	-	-
Avena sterilis L. - rachilla	-	-
Avena spp. - rachilla	-	-
Crypsis spp.	-	2
Phalaris paradoxa L.	-	-
Phalaris spp.	-	-
Setaria spp. - with palea/lemma	-	4
Setaria spp. - naked seed	cf. 1	-
Saccharum spontaneum L.	-	-
Gramineae - small seeded	-	4
Gramineae - large seeded	-	-
Gramineae - wild grass rachis	-	-
Fimbristylis bis-umbellata (Forssk.) Bub.	-	-
Scirpus praelongatus Poir.	-	-
Scirpus sp. - naked seed	-	-
Cyperus sp.	-	2
Cyperaceae - unidentified TYPE 1	-	-
Cyperaceae - unidentified TYPE 2	-	-
UNIDENTIFIED		
?H - leafy involucre	-	-
?U - *Lawsonia*-like seed	-	4
?X - a) Unidentified leaf	cf. +	+
?X - b) Split leaf / grass / palm	+	+
?X - c) Small leaf / petal ?	-	-
?A4 - a) filament of stamen	-	3
?A4 - b) stigma	-	2
?A4 - c) anther Small	-	3
anther Large	-	-
?A4 - d) anther / pod	-	3
?A5† - Thin walled, red - zooarchaeological ?	-	(9)
?A10 - Shiny compressed seed - striated	-	-
?A15 - shrivelled veined fruit	-	-
?A16 - a) unidentified root	-	+
- b) unidentified bark	-	-
?A22 - flower head / calyx	-	-
?A24 - interior of fruit w/ seed	-	-
?A27 - a) unidentified small fruit	-	cf. 1
- b) unidentified fruit stem	-	-
?A28 - Crescent part of stalk	-	1
?A29 - Small rounded seeds	-	-
?A35 - scaly interior of seed ?	-	2
?A36 - part of capsule ?	-	-
?A37 - ??Plantago	-	-
?A38 - Internal structure ?	-	-
?A42 - pod / seed capsule	-	-
?A46 - ?Bud - hairless	-	-
?A47 - Unidentified seed coat (frags)	-	+
?A48 - ?Flower petals	-	-
?A49 - a) Large flower head	-	1
b) Small flower head	-	-
c) flower stalk	-	-
d) stalk	-	-
?A50 - extremely small fig-like seed	-	10
?A53 - ?seed pod - grooved a) fragment	-	-
b) complete pod	-	-
?A55 - Bud (hairy)	-	-
?A56 - Small pitted seed	-	-
?A57† - Pink and round - zooarchaeological ?	-	(1)
Fungal Bodies (Not included in count)	-	(63)
Indeterminate:	-	-
TOTAL NUMBER OF IDENTIFICATIONS:	3	308
PERCENTAGE OF SAMPLE:	1.0%	99.0%
SEEDS / LITER:	1.4	144.9

†A5 and A57, which are provisionally considered insect remains, will not be included in counts for samples or statistical analysis.

Table 10: List of Plant Remains from the Rubble Sample

Sample Number	**94-031**	**94-031**
Volume of Sample in Liters	**26**	
Fraction of Sample Sorted	**1/8**	
Sample Preservation	**CARB**	**DESC**
CEREAL GRAIN		
Triticum aestivum L. / T. *durum* Desf.	-	-
Triticum sp.	-	-
Hordeum sp. (hulled)	1	-
Cerealia - detached embryo	-	-
Cerealia - Indeterminate	-	-
CEREAL CHAFF		
Triticum dicoccum Schübl. - glume base	-	-
Triticum dicoccum-type - glume base	-	1
Triticum dicoccum Schübl. - rachis internode	-	-
Triticum durum Desf. - rachis internode	3	4
Triticum durum Desf. - glume	-	-
Triticum durum Desf. - palea (P) / lemma (L)	-	-
Triticum durum-type - rachis internode	-	-
Triticum aestivum L. - rachis internode	-	-
Triticum aestivum-type - rachis internode	-	-
Triticum sp. - free threshing rachis internode	2	16
Triticum sp. - terminal rachis internode	-	-
Triticum sp. - basal rachis internode	1	1
Triticum sp. - rachilla	-	46
Triticum sp. - awn	-	-
Triticum sp. - glume	-	-
Triticum sp. - palea (P) / lemma (L)	-	-
Triticum sp. - bran	-	-
Hordeum vulgare L. - rachis internode	5	17
Hordeum vulgare L. - pedicelled internode	-	-
Hordeum sp. - palea / lemma	-	-
Hordeum sp. - awn	-	-
Sorghum bicolor (L.) Moench. - glume	-	-
Cerealia - indeterminate rachis internode	2	60
Cerealia - indeterminate culm node	-	-
Cerealia - indeterminate unquantified awn	-	+
Cerealia - indet. unquant. glume / palea / lemma	-	+
PULSES		
Lupinus cf. *albus* L.	-	-
Lens culinaris Medik.	-	-
Lathyrus sp.	-	-
Hilum - indeterminate	-	-
OIL CROPS		
Linum usitatissimum L. - seed	-	-
Linum usitatissimum L. - capsule	-	-
Carthamus tinctorius L.	-	1
FRUIT		
Ficus carica L.	27	18
Ficus sycomorus L.	cf. 1	23
Morus sp.	-	15
Prunus persica (L.) Batsch.	-	-
Zizyphus spina-christi (L.) Desf.	-	-
Cucumis sp.	-	-
Punica granatum L.	-	-
Vitis vinifera L. - pip	-	-
Vitis vinifera L. - stalk	-	-
Olea europaea L. - stone	-	-
Olea europaea L. - kernel	-	-
Olea europaea L. - leaf	+	+
Cordia myxa L.	-	-
Phoenix dactylifera L. - stone	-	-
Phoenix dactylifera L. - perianth	-	1
Phoenix dactylifera L. - female flower	-	-
Phoenix dactylifera L. - male flower	-	-
Phoenix dactylifera L. - rachilla	-	-
Phoenix dactylifera L. - embryo	-	-
Phoenix dactylifera L. - leaf sheath	-	+

Table 10: Rubble Sample continued...

Sample Number **Sample Preservation**	**94-031** **CARB**	**94-031** **DESC**
CONDIMENTS		
Coriandrum sativum L.	-	-
Anethum graveolens L.	-	-
Cuminum cyminum L.	-	-
Foeniculum vulgare (L.) Mill	-	-
Apium graveolens L.	-	-
cf. *Ocimum basilicum* L.	-	3
Allium cepa L. - tunic (=skin)	-	-
OTHER ECONOMIC PLANTS		
Juniperus cf. *oxycedrus* L. / *phoenicea* L.	-	-
Papaver somniferum L.	-	-
Amygdalus communis L.	-	-
Acacia nilotica (L.) Willd. ex Del. - seed	-	-
Acacia nilotica (L.) Willd. ex Del. - pod	-	-
Acacia nilotica (L.) Willd. ex. Del.- leaf	-	-
Ruta cf. *chalepensis* L.	-	-
Tamarix aphylla (L.) Karst. - needle	-	+
Tamarix aphylla (L.) Karst. - flower / calyx	-	-
Myrtus communis L.	-	-
Lagenaria siceraria (Mol.) Standl.	-	-
Daucus carota L.	-	-
WEED / WILD PLANTS		
Rumex spp. - perianth (nut with valves)	-	-
Rumex spp. - nut (naked)	2	6
Rumex spp. - tubercle	6	-
Polygonaceae - unidentified	-	-
Glinus cf. *lotoides* L.	-	113
Aizoaceae - unidentified	-	1
Portulaca oleracea L.	-	17/cf. 1
Vaccaria cf. *pyramidata* Medicus	-	-
Silene sp. - large	-	-
Stellaria sp. - type	-	-
Caryophyllaceae - unidentified	3	8
Beta vulgaris L.	-	-
Chenopodium murale L.	-	6
Cornulaca cf. *monocantha* Del.	-	1
Chenopodiaceae - unidentified	-	-
Chenopodiaceae - needle	-	-
Chenopodiaceae - floret	-	-
Fumaria spp.	-	-
Brassica spp. / *Sinapis arvensis* L.	-	-
Zilla spinosa (Turra) Prantl	-	-
Raphanus raphanistrum L. - capsule	-	-
Raphanus raphanistrum L. - seed	-	-
Coronopus cf. *niloticus* (Del.) Spreng	1	3
Reseda sp. TYPE 1 - smooth	-	-
Reseda sp. TYPE 2 - tubercled	-	-
Medicago sp.	-	-
Trifolium spp. - seed	26	9
Trifolium spp. - calyx	1	1
Trifolium spp. - involucre	-	12
Scorpiurus muricatus L.	-	-
Leguminosae - large seeded	-	-
Leguminosae - pod	-	-
Fagonia sp.	-	-
Zygophyllaceae - unidentified	18	13
Euphorbia peplus L.	-	3
Malva sp.	5	-
Umbelliferae -unidentified	-	2
Galium spp.	1	-
Heliotropium spp.	-	7
Echium sp.	-	-
Verbenaceae / Labiatae	-	3
Labiatae - Ocimum type	-	1
Labiatae - Thymus type	-	1
Labiatae - Ajuga type	-	-
Solanum nigrum L.	-	-
Pulicaria sp.	-	-
Cichorium endivia L. / *intybus* L.	-	14

Table 10: Rubble Sample continued...

Sample Number **Sample Preservation**	**94-031** **CARB**	**94-031** **DESC**
WEED / WILD PLANTS continued...		
Picris sp.	-	-
Sonchus sp.	-	-
Compositae - unidentified	-	-
Asphodelus spp.	-	-
Lolium spp.	-	-
Avena sp. - grain	-	-
Avena sterilis L. - rachilla	-	-
Avena spp. - rachilla	-	1
Crypsis spp.	-	4
Phalaris paradoxa L.	-	1
Phalaris spp.	-	cf. 1
Setaria spp. - with palea/lemma	-	53
Setaria spp. - naked seed	-	-
Saccharum spontaneum L.	-	4
Gramineae - small seeded	2	31
Gramineae - large seeded	-	-
Gramineae - wild grass rachis	-	-
Fimbristylis bis-umbellata (Forssk.) Bub.	-	2
Scirpus cf. *praelongatus* Poir.	-	-
Scirpus spp.	-	-
Cyperus spp.	1	10
Cyperaceae - unidentified TYPE 1	-	-
Cyperaceae - unidentified TYPE 2	-	-
UNIDENTIFIED		
?H - leafy involucre	-	-
?U - *Lawsonia*-like seed	-	11
?X - a) Unidentified leaf	-	+
?X - b) Split leaf / grass / palm	-	+
?X - c) Small leaf / petal ?	-	+
?A4 - a) filament of stamen	-	11
?A4 - b) stigma	-	12
?A4 - c) anther Small	-	7
anther Large	-	-
?A4 - d) anther / pod	-	17
?A5† - Thin walled, red - zooarchaeological ?	-	-
?A10 - Shiny compressed seed - striated	-	-
?A15 - shrivelled veined fruit	-	-
?A16 - a) unidentified root	+	+
- b) unidentified bark	-	-
?A22 - flower head / calyx	-	27
?A24 - interior of fruit w/ seed	-	-
?A27 - a) unidentified small fruit	-	-
- b) unidentified fruit stem	-	-
?A28 - Crescent part of stalk	-	-
?A29 - Small rounded seeds	1	3
?A35 - scaly interior of seed ?	-	5
?A36 - part of capsule ?	-	20
?A37 - ??Plantago	-	-
?A38 - Internal structure ?	-	-
?A42 - pod / seed capsule	-	-
?A46 - ?Bud - hairless	-	-
?A47 - Unidentified seed coat (frags)	-	+
?A48 - ?Flower petals	-	-
?A49 - a) Large flower head	-	-
b) Small flower head	-	-
c) flower stalk	-	-
d) stalk	-	-
?A50 - extremely small fig-like seed	-	-
?A53 - ?seed pod - grooved a) fragment	-	-
b) complete pod	-	-
?A55 - Bud (hairy)	-	-
?A56 - Small pitted seed	-	-
?A57† - Pink and round - zooarchaeological ?	-	-
Indeterminate:	1	3
TOTAL NUMBER OF IDENTIFICATIONS:	109	649
PERCENTAGE OF SAMPLE:	14.4%	85.6%
SEEDS / LITER:	33.5	199.7

†A5 and A57, which are provisionally considered insect remains, will not be included in counts for samples or statistical analysis.

Table 11: Plant Remains from the Squatter Camp Sample

Sample Number	**93-7348**	**93-7348**
Sample Volume in Liters	**10**	
Fraction of Sample Sorted	**1/16**	
Sample Preservation	**CARB**	**DESC**
CEREAL GRAIN		
Triticum aestivum L. / T. *durum* Desf.	-	-
Triticum sp.	-	-
Hordeum sp. (hulled)	-	-
Cerealia - detached embryo	-	-
Cerealia - Indeterminate	-	-
CEREAL CHAFF		
Triticum dicoccum Schübl. - glume base	-	-
Triticum dicoccum-type - glume base	-	-
Triticum dicoccum Schübl. - rachis internode	-	-
Triticum durum Desf. - rachis internode	-	1
Triticum durum Desf. - glume	-	-
Triticum durum Desf. - palea (P) / lemma (L)	-	-
Triticum durum- type - rachis internode	-	-
Triticum aestivum L. - rachis internode	-	-
Triticum aestivum- type - rachis internode	-	-
Triticum sp. - free threshing rachis internode	-	1
Triticum sp. - terminal rachis internode	-	-
Triticum sp. - basal rachis internode	-	-
Triticum sp. - rachilla	-	3
Triticum sp. - awn	-	1
Triticum sp. - glume	-	1
Triticum sp. - palea (P) / lemma (L)	-	-
Triticum sp. - bran	-	-
Hordeum vulgare L. - rachis internode	-	-
Hordeum vulgare L. - pedicelled internode	-	cf. 1
Hordeum sp. - palea / lemma	-	-
Hordeum sp. - awn	-	-
Sorghum bicolor (L.) Moench. - glume	-	-
Cerealia - indeterminate rachis internode	-	3
Cerealia - indeterminate culm node	-	1
Cerealia - indeterminate unquantified awn	-	+
Cerealia - indet. unquant. glume/ palea / lemma	-	+
PULSES		
Lupinus cf. *albus* L.	-	-
Lens culinaris Medik.	-	-
Lathyrus sp.	-	-
Hilum - indeterminate	-	-
OIL CROPS		
Linum usitatissimum L. - seed	-	-
Linum usitatissimum L. - capsule	-	-
Carthamus tinctorius L.	-	-
FRUIT		
Ficus carica L.	-	7
Ficus sycomorus L.	-	4
Morus sp.	-	-
Prunus persica (L.) Batsch.	-	-
Zizyphus spina-christi (L.) Desf.	-	-
Cucumis sp.	-	-
Punica granatum L.	-	-
Vitis vinifera L. - pip	-	-
Vitis vinifera L. - stalk	-	-
Olea europaea L. - stone	-	-
Olea europaea L. - kernel	-	-
Olea europaea L. - leaf	-	-
Cordia myxa L.	-	-
Phoenix dactylifera L. - stone	-	-
Phoenix dactylifera L. - perianth	-	-
Phoenix dactylifera L. - female flower	-	-
Phoenix dactylifera L. - male flower	-	-
Phoenix dactylifera L. - rachilla	-	-
Phoenix dactylifera L. - embryo	-	-
Phoenix dactylifera L. - leaf sheath	-	-

Table 11: Squatter Camp Sample continued...

Sample Number Sample Preservation	93-7348 CARB	93-7348 DESC
CONDIMENTS		
Coriandrum sativum L.	-	-
Anethum graveolens L.	-	-
Cuminum cyminum L.	-	-
Foeniculum vulgare (L.) Mill	-	-
Apium graveolens L.	-	-
cf. *Ocimum basilicum* L.	-	-
Allium cepa L. - tunic (=skin)	-	-
OTHER ECONOMIC PLANTS		
Juniperus cf. *oxycedrus* L. / *phoenicea* L.	-	-
Papaver somniferum L.	-	-
Amygdalus communis L.	-	-
Acacia nilotica (L.) Willd. ex Del. - seed	-	-
Acacia nilotica (L.) Willd. ex Del. - pod	-	-
Acacia nilotica (L.) Willd. ex Del. - leaf	-	-
Ruta cf. *chalepensis* L.	-	-
Tamarix aphylla (L.) Karst. - needle	+	+++
Tamarix aphylla (L.) Karst. - flower / calyx	-	193
Myrtus communis L.	-	-
Lagenaria siceraria (Mol) Standl.	-	-
Daucus carota L.	-	-
WEED / WILD PLANTS		
Rumex spp. - perianth (nut with valves)	-	-
Rumex spp. - nut (naked)	-	-
Rumex sp. - tubercle	-	-
Polygonaceae - unidentified	-	-
Glinus cf. *lotoides* L.	-	-
Aizoaceae - unidentified	-	-
Portulaca oleracea L.	-	3/cf. 1
Vaccaria cf. *pyramidata* Medicus	-	-
Silene sp. - large	-	-
Stellaria sp. - type	-	-
Caryophyllaceae - unidentified	-	-
Beta vulgaris L.	-	-
Chenopodium murale L.	-	3
Cornulaca cf. *monocantha* Del.	-	2
Chenopodiaceae - unidentified	-	-
Chenopodiaceae - needle	-	-
Chenopodiaceae - floret	-	+
Fumaria spp.	-	-
Brassica spp. / *Sinapis arvensis* L.	-	-
Zilla cf. *spinosa* (Turra) Prantl	-	-
Raphanus raphanistrum L. - capsule	-	-
Raphanus raphanistrum L. - seed	-	-
Coronopus cf. *niloticus* (Del.) Spreng	-	-
Reseda sp. TYPE 1 - smooth	-	-
Reseda sp. TYPE 2 - tubercled	-	-
Medicago sp.	-	-
Trifolium spp. - seed	-	5
Trifolium spp. - calyx	-	1
Trifolium spp. - involucre	-	4
Scorpiurus muricatus L.	-	-
Leguminosae - large seeded	-	-
Leguminosae - pod	-	-
Fagonia sp.	-	-
Zygophyllaceae - unidentified	-	4
Euphorbia peplus L.	-	-
Malva sp.	-	2
Umbelliferae - unidentified	-	-
Galium spp.	-	-
Heliotropium spp.	-	-
Echium sp.	-	-
Verbenaceae / Labiatae	-	-
Labiatae - *Ocimum* type	-	-
Labiatae - *Thymus* type	-	-
Labiatae - *Ajuga* type	-	-
Solanum nigrum L.	-	-

Table 11: Squatter Camp Sample continued...

Sample Number Sample Preservation	93-7348 CARB	93-7348 DESC
WEED / WILD PLANTS cont...		
Pulicaria sp.	-	-
Cichorium endivia L. / *intybus* L.	-	-
Picris sp.	-	-
Sonchus sp.	-	-
Compositae - unidentified	-	-
Asphodelus spp.	-	cf. 1
Lolium spp.	-	-
Avena sp. - grain	-	-
Avena sterilis L. - rachilla	-	-
Avena spp. - rachilla	-	-
Crypsis spp.	-	-
Phalaris paradoxa L.	-	-
Phalaris spp.	-	2
Setaria spp. - with palea/lemma	-	1
Setaria spp. - naked seed	-	-
Saccharum spontaneum L.	-	-
Gramineae - small seeded	-	-
Gramineae - large seeded	-	-
Gramineae - wild grass rachis	-	-
Fimbristylis bis-umbellata L.	-	1
Scirpus cf. *praelongatus* Poir.	-	-
Scirpus spp.	-	-
Cyperus spp.	-	1
Cyperaceae - unidentified TYPE 1	-	-
Cyperaceae - unidentified TYPE 2	-	-
UNIDENTIFIED		
?H - leafy involucre	-	-
?U - *Lawsonia*-like seed	-	-
?X - a) Unidentified leaf	-	+
?X - b) Split leaf / grass / palm	-	+
?X - c) Small leaf / petal ?	-	-
?A4 - a) filament of stamen	-	2
?A4 - b) stigma	-	-
?A4 - c) anther Small	-	1
anther Large	-	-
?A4 - d) anther / pod	-	-
?A5† - Thin walled, red - zooarchaeological ?	-	(1)
?A10 - Shiny compressed seed - striated	-	-
?A15 - shrivelled veined fruit	-	-
?A16 - a) unidentified root	-	-
- b) unidentified bark	-	-
?A22 - flower head / calyx	-	-
?A24 - interior of fruit w/ seed	-	-
?A27 - a) unidentified small fruit	-	-
- b) unidentified fruit stem	-	-
?A28 - Crescent part of stalk	-	-
?A29 - Small rounded seeds	-	-
?A35 - scaly interior of seed ?	-	-
?A36 - part of capsule ?	-	-
?A37 - ??Plantago	-	-
?A38 - Internal structure ?	-	-
?A42 - pod / seed capsule	-	-
?A46 - ?Bud - hairless	-	-
?A47 - Unidentified seed coat (frags)	-	-
?A48 - ?Flower petals	-	-
?A49 - a) Large flower head	-	-
b) Small flower head	-	-
c) flower stalk	-	-
d) stalk	-	-
?A50 - extremely small fig-like seed	-	-
?A53 - ? seed pod - grooved a) fragment	-	-
b) complete pod	-	-
?A55 - Bud (hairy)	-	-
?A56 - Small pitted seed	-	-
?A57† - Pink and round - zooarchaeological ?	-	(1)
Indeterminate:	-	-
TOTAL NUMBER OF IDENTIFICATIONS:	0	247
PERCENTAGE OF SAMPLE:	0%	100%
SEEDS / LITER:	0	395.2

†A5 and A57, which are provisionally considered insect remains, will not be included in counts for samples or statistical analysis.

Table 12: List of Plant Remains from the Trough Samples

Sample Number	**94-175**	94-175	**94-177**	94-177	**93-7782**	93-7782	**93-7785**	93-7785
Sample Volume in Liters	**12**		**20**		**20**		**10**	
Fraction of Sample Sorted	**1/8**		**1/16**		**1/16**		**1/8**	
Sample Preservation	**CARB**	DESC	**CARB**	DESC	**CARB**	DESC	**CARB**	DESC
CEREAL GRAIN								
Triticum aestivum L. / T. *durum* Desf.	-	-	-	-	-	-	-	-
Triticum sp.	-	-	-	-	-	-	-	-
Hordeum sp. (hulled)	-	-	-	-	-	-	-	-
Cerealia - detached embryo	-	-	-	-	-	-	-	-
Cerealia - Indeterminate	-	1	-	1	-	-	-	-
CEREAL CHAFF								
Triticum dicoccum Schübl. - glume base	-	-	-	-	-	-	-	-
Triticum dicoccum-type - glume base	3	-	-	1	-	-	-	2
Triticum dicoccum Schübl. - rachis internode	-	-	-	-	-	-	-	-
Triticum durum Desf. - rachis internode	-	2	1	17	-	3	-	4
Triticum durum Desf. - glume	-	-	-	-	-	-	-	-
Triticum durum Desf. - palea (P) / lemma (L)	-	-	-	-	-	-	-	-
Triticum durum- type - rachis internode	1	4	-	-	-	-	-	3
Triticum aestivum L. - rachis internode	-	-	-	-	-	-	-	-
Triticum aestivum- type - rachis internode	-	-	-	-	-	-	-	-
Triticum sp. - free threshing rachis internode	-	8	-	35	-	20	1	4
Triticum sp. - terminal rachis internode	-	2	-	4	-	-	-	-
Triticum sp. - basal rachis internode	1	-	-	-	-	-	-	1
Triticum sp. - rachilla	-	9/cf. 1	-	34	-	4	-	15
Triticum sp. - awn	-	-	-	-	-	-	-	-
Triticum sp. - glume	-	-	-	-	-	-	-	-
Triticum sp. - palea (P) / lemma (L)	-	-	-	-	-	-	-	-
Triticum sp. - bran	-	-	-	-	-	-	-	+
Hordeum vulgare L. - rachis internode	1	9	2	15	-	6	-	4/cf. 1
Hordeum vulgare L. - pedicelled internode	-	-	-	-	-	-	-	-
Hordeum sp. - palea / lemma	-	-	-	-	-	-	-	-
Hordeum sp. - awn	-	-	-	-	-	-	-	-
Sorghum bicolor (L.) Moench. - glume	-	-	-	152	-	-	-	-
Cerealia - indeterminate rachis internode	-	15	1	14	-	1	-	5
Cerealia - indeterminate culm node	-	1	-	13	-	8	-	3
Cerealia - indeterminate unquantified awn	-	+	-	+	-	-	-	++
Cerealia - indet. unquant. glume/ palea / lemma	-	+	-	+++	-	+	-	++
PULSES								
Lupinus cf. *albus* L.	-	-	-	-	-	-	-	-
Lens culinaris Medik.	-	-	-	-	-	-	-	-
Lathyrus sp.	-	-	-	-	-	-	-	-
Hilum - indeterminate	-	1	-	-	-	8	-	-
OIL CROPS								
Linum usitatissimum L. - seed	-	2	-	1	-	-	-	4
Linum usitatissimum L. - capsule	-	1	-	1	-	1	-	6 / 2 im
Carthamus tinctorius L.	-	10	-	1	-	29	-	1
FRUIT								
Ficus carica L.	-	502	-	28	-	20	-	447
Ficus sycomorus L.	-	41	-	11	-	39	-	3
Morus sp.	-	1	-	2	-	-	-	-
Prunus persica (L.) Batsch.	-	-	-	-	-	-	-	-
Zizyphus spina-christi (L.) Desf.	-	-	-	-	-	cf 1	-	-
Cucumis sp.	-	2	-	1	-	2	-	3
Punica granatum L.	-	-	-	-	-	-	-	-
Vitis vinifera L. - pip	-	26/7im	-	1	-	1	-	4/1 im
Vitis vinifera L. - stalk	-	4	-	3	-	-	-	-
Olea europaea L. - stone	-	-	-	-	-	3	-	-
Olea europaea L. - kernel	-	-	-	-	-	-	-	-
Olea europaea L. - leaf	-	-	-	+	-	-	-	-
Cordia myxa L.	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - stone	-	4/cf. 1	-	1	-	1	-	1
Phoenix dactylifera L. - perianth	-	2	-	1	-	cf. 1	-	1
Phoenix dactylifera L. - female flower	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - male flower	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - rachilla	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - embryo	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - leaf sheath	-	-	-	+	-	+	-	+

Table 12: Trough Samples continued...

Sample Number	94-175	94-175	94-177	94-177	93-7782	93-7782	93-7785	93-7785
Sample Preservation	CARB	DESC	CARB	DESC	CARB	DESC	CARB	DESC
CONDIMENTS								
Coriandrum sativum L.	-	4	-	1	-	2	-	1
Anethum graveolens L.	-	1	-	1	-	-	-	-
Cuminum cyminum L.	-	1	-	-	-	4	-	-
Foeniculum vulgare (L.) Mill	-	-	-	-	-	-	-	-
Apium graveolens L.	-	-	-	1	-	-	-	-
cf. *Ocimum basilicum* L.	-	-	-	-	-	-	-	-
Allium cepa L. - tunic (=skin)	-	1	-	1	-	-	-	1
OTHER ECONOMIC PLANTS								
Juniperus cf. *oxycedrus* L. / *phoenicea* L.	-	-	-	-	-	-	-	-
Papaver somniferum L.	-	-	-	-	-	-	-	-
Amygdalus communis L.	-	-	-	-	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - seed	-	2	-	-	-	1	-	-
Acacia nilotica (L.) Willd. ex Del. - pod	-	-	-	-	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - leaf	-	-	-	-	-	-	-	-
Ruta cf. *chalepensis* L.	-	2	-	-	-	-	-	-
Tamarix aphylla L. - needle	+	+	+	+	-	+	-	+
Tamarix aphylla L. - flower / calyx	-	-	-	5	-	-	-	-
Myrtus communis L.	-	-	-	1	-	2	-	1
Lagenaria siceraria (Mol) Standl.	-	-	-	-	-	-	-	-
Daucus carota L.	-	-	-	-	-	-	-	-
WEED / WILD PLANTS								
Rumex spp. - perianth (nut with valves)	-	-	-	1	-	-	-	-
Rumex spp. - nut (naked)	-	2	-	3	-	2	-	3
Rumex spp. - tubercle	-	2	-	4	-	1	-	-
Polygonaceae - unidentified	-	-	-	-	-	-	-	-
Glinus cf. *lotoides* L.	-	5	-	4	-	4	-	1
Aizoaceae - unidentified	-	-	-	-	-	-	-	-
Portulaca oleracea L.	-	115	-	10	-	8	-	3
Vaccaria cf. *pyramidata* Medicus	-	-	-	-	-	-	-	1
Silene sp. - large	-	-	-	-	-	-	-	-
Stellaria sp. - type	-	-	-	-	-	-	-	-
Caryophyllaceae - unidentified	-	-	-	-	-	1	-	-
Beta vulgaris L.	-	1	-	1	-	cf. 1	-	5
Chenopodium murale L.	-	47	-	1	-	2	-	4
Cornulaca cf. *monocantha* Del.	-	-	-	1	-	-	-	-
Chenopodiaceae - unidentified	-	-	-	-	-	-	-	-
Chenopodiaceae - needle	-	-	-	+	-	-	+	-
Chenopodiaceae - floret	-	+	-	-	-	-	-	+
Fumaria spp.	-	-	-	-	-	-	-	-
Brassica spp. / *Sinapis arvensis* L.	-	-	-	-	-	-	-	1
Zilla spinosa (Turra) Prantl	-	-	-	2	-	-	-	-
Raphanus raphanistrum L. - capsule	-	-	-	3	-	2	1	1
Raphanus raphanistrum L. - seed	-	-	-	-	-	-	-	-
Coronopus cf. *niloticus* (Del.) Spreng	-	-	-	-	-	-	-	-
Reseda sp. TYPE 1 - smooth	-	-	-	1	-	-	-	-
Reseda sp. TYPE 2 - tubercled	-	-	-	-	-	-	-	-
Medicago sp.	-	1	-	-	-	-	-	-
Trifolium spp. - seed	-	11	-	13	-	-	-	9
Trifolium spp. - calyx	-	-	-	-	-	-	-	-
Trifolium spp. - involucre	-	1	-	-	-	2	-	30
Scorpiurus muricatus L.	-	-	-	-	-	-	-	-
Leguminosae - large seeded	-	-	-	-	-	-	-	-
Leguminosae - pod	-	-	-	-	-	cf. 1	-	-
Fagonia sp.	-	-	-	-	-	2	-	1
Zygophyllaceae - unidentified	-	-	-	3	-	-	-	-
Euphorbia peplus L.	-	-	-	1	-	-	-	-
Malva sp.	-	2	-	4	-	-	-	16
Umbelliferae - unidentified	-	1	-	2	-	2	-	-
Galium spp.	-	-	-	-	-	-	-	3
Heliotropium spp.	-	1	-	-	-	-	-	-
Echium sp.	-	-	-	-	-	-	-	3
Verbenaceae / Labiatae	-	-	-	-	-	-	-	-
Labiatae - *Ocimum* type	-	-	-	-	-	-	-	-
Labiatae - *Thymus* type	-	-	-	-	-	-	-	-
Labiatae - *Ajuga* type	-	-	-	-	-	-	-	1
Solanum nigrum L.	-	-	-	-	-	-	-	1
Pulicaria sp.	-	-	-	-	-	-	-	-
Cichorium endivia L. / *intybus* L.	-	-	-	14	-	3	-	3

Table 12: Trough Samples continued...

Sample Number Sample Preservation	94-175 CARB	94-175 DESC	94-177 CARB	94-177 DESC	93-7782 CARB	93-7782 DESC	93-7785 CARB	93-7785 DESC
WEED / WILD PLANTS cont...								
Picris sp.	-	-	-	-	-	-	-	-
Sonchus sp.	-	cf. 1	-	4	-	-	-	-
Compositae - unidentified	-	2	-	-	-	-	-	-
Asphodelus spp.	-	2	-	-	-	2	-	-
Lolium spp.	-	-	-	-	-	-	-	-
Avena sp. - grain	-	-	-	-	-	-	-	-
Avena sterilis L. - rachilla	-	-	-	-	-	-	-	-
Avena spp. - rachilla	-	-	-	-	-	-	-	-
Crypsis spp.	-	1	-	1	-	-	-	3
Phalaris paradoxa L.	-	1	-	-	-	1	-	2
Phalaris spp.	-	-	-	-	-	-	-	2
Setaria spp. - with palea/lemma	-	58	-	57	-	-	-	2
Setaria spp. - naked seed	-	-	-	-	-	-	-	-
Saccharum spontaneum L.	-	-	-	-	-	2	-	-
Gramineae - small seeded	-	1	-	6	-	3	-	2
Gramineae - large seeded	-	-	-	-	-	-	-	-
Gramineae - wild grass rachis	-	-	-	2	-	-	-	-
Fimbristylis bis-umbellata (Forssk.) Bub.	-	-	-	-	-	-	-	-
Scirpus cf. *praelongatus* Poir.	-	-	-	-	-	-	-	-
Scirpus spp.	-	-	-	-	-	-	-	-
Cyperus spp.	-	-	-	1	-	2	-	1
Cyperaceae - unidentified TYPE 1	-	-	-	-	-	-	-	-
Cyperaceae - unidentified TYPE 2	-	-	-	-	-	-	-	-
UNIDENTIFIED								
?H - leafy involucre	-	-	-	-	-	-	-	-
?U - *Lawsonia*-like seed	-	15	-	1	-	1	-	7
?X - a) Unidentified leaf	-	+	-	+	-	+	-	+
?X - b) Split leaf / grass / palm	-	+	-	++	-	+	-	+
?X - c) Small leaf / petal ?	-	-	-	-	-	-	-	-
?A4 - a) filament of stamen	-	11	-	-	-	11	-	25
?A4 - b) stigma	-	-	-	-	-	-	-	-
?A4 - c) anther Small	-	3	-	-	-	7	-	12
anther Large	-	-	-	-	-	-	-	1
?A4 - d) anther / pod	-	-	-	-	-	-	-	4
?A5† - Thin walled, red - zooarchaeological ?	-	-	-	(2)	-	(1)	-	(6)
?A10 - Shiny compressed seed - striated	-	-	-	-	-	-	-	-
?A15 - shrivelled veined fruit	-	-	-	-	-	-	-	-
?A16 - a) unidentified root	-	-	-	+	-	+	-	-
- b) unidentified bark	-	-	-	-	-	-	-	-
?A22 - flower head / calyx	-	-	-	-	-	-	-	-
?A24 - interior of fruit w/ seed	-	-	-	-	-	-	-	-
?A27 - a) unidentified small fruit	-	1	-	-	-	-	-	-
- b) unidentified fruit stem	-	-	-	-	-	-	-	-
?A28 - Crescent part of stalk	-	-	-	-	-	-	-	-
?A29 - Small rounded seeds	-	1	-	-	-	-	-	-
?A35 - scaly interior of seed ?	-	-	-	2	-	-	-	-
?A36 - part of capsule ?	-	-	-	-	-	-	-	-
?A37 - ??Plantago	-	-	-	-	-	-	-	-
?A38 - Internal structure ?	-	-	-	-	-	-	-	-
?A42 - pod / seed capsule	-	-	-	-	-	-	-	1
?A46 - ?Bud - hairless	-	-	-	-	-	-	-	-
?A47 - Unidentified seed coat (frags)	-	-	-	++	-	-	+	+
?A48 - ?Flower petals	-	-	-	-	-	-	-	-
?A49 - a) Large flower head	-	-	-	-	-	-	-	-
b) Small flower head	-	-	-	cf. 1	-	-	-	-
c) flower stalk	-	-	-	2	-	-	-	-
d) stalk	-	-	-	-	-	-	-	-
?A50 - extremely small fig-like seed	-	-	-	-	-	-	-	-
?A53 - ? seed pod - grooved a) fragment	-	-	-	-	-	-	-	-
b) complete pod	-	-	-	-	-	-	-	-
?A55 - Bud (hairy)	-	-	-	-	-	-	-	-
?A56 - Small pitted seed	-	-	-	1	-	-	-	-
?A57† - Pink and round - zooarchaeological ?	-	-	-	-	-	-	-	-
Indeterminate	-	-	-	-	-	-	-	1
TOTAL NUMBER OF IDENTIFICATIONS:	6	950	4	492	0	213	3	666
PERCENTAGE OF SAMPLE:	0.6%	99.4%	0.8%	99.2%	0%	100%	0.4%	99.4%
SEEDS / LITER:	4	633.3	3.2	393.6	0	170.4	2.4	532.8

†A5 and A57, which are provisionally considered insect remains, will not be included in counts for samples or statistical analysis.

Table 13: Desiccated Plant Remains from the Sorted Heavy Residues (arranged in order of context type)

Sample Number	7791	94-008	94-010	94-011	94-012	94-037	94-002	94-005	94-023
Sample Volume in Liters	**7**	**13**	**19**	**14**	**15**	**13**	**13.5**	**10**	**10**
Fraction of Sample Sorted	**100%**	**1/4**	**20%**	**1/4**	**1/2**	**1/8**	**1/2**	**1/4**	**1/8**
Sample Preservation	**DESC**	**DESC**	**DESC**	**DESC**	**DESC**	**DESC**	**DESC**	**DESC**	**DESC**
Sample Type	**DRAIN**	**FLOOR**	**FLOOR**	**FLOOR**	**FLOOR**	**FLOOR**	**MIDDEN**	**MIDDEN**	**MIDDEN**
Triticum aestivum L. / *T. durum* Desf. - grain	-	-	-	-	-	-	-	-	-
Hordeum sp. (hulled) - grain	-	-	-	-	-	-	-	-	-
Triticum durum Desf. - glume	-	-	-	-	-	-	-	-	-
Triticum durum Desf. - palea (P) / lemma (L)	-	-	-	-	-	-	-	-	-
Triticum durum-type - rachis internode	-	-	-	-	-	-	-	-	1
Triticum sp. - free threshing rachis internode	-	3	-	-	2	-	-	-	-
Triticum sp. - glume	-	-	-	-	-	-	-	-	2
Hordeum vulgare L. - rachis internode	-	-	-	-	-	-	-	-	3
Cerealia - indeterminate culm node	1	-	1	-	-	-	-	-	-
Cerealia - indet. unquant. glume/ P / L	+	+	-	-	-	-	-	-	-
Hilum - indeterminate	-	-	-	-	-	-	-	-	-
Carthamus tinctorius L.	1	-	23	-	5	-	1	1	-
Ficus carica L.	-	-	-	-	-	-	-	-	-
Ficus sycomorus L.	-	-	-	-	-	-	-	-	-
Morus sp.	-	-	-	-	-	-	-	-	-
Prunus persica (L.) Batsch	-	-	-	-	-	-	-	-	-
Zizyphus spina-christi (L.) Desf.	-	-	-	-	-	-	-	-	-
Cucumis sp.	11	-	1	1	1	-	1	-	-
Punica granatum L.	-	-	-	-	cf. 1	-	-	-	-
Vitis vinifera L. - pip	14	1	2	1	6	-	3	-	2
Vitis vinifera L. - stalk	1	-	-	-	-	-	-	-	-
Olea europaea L. - stone	3	-	2	1	8	cf. 1	1	1	3
Olea europaea L. - kernel	1	-	2	-	-	-	-	-	2
Olea europaea L. - leaf	-	-	-	-	-	-	+	-	+
Cordia myxa L.	-	-	-	-	-	-	-	-	1
Phoenix dactylifera L. - stone	1	-	-	-	2	1	2	1	6
Phoenix dactylifera L. - perianth	-	-	-	-	-	-	-	-	-
Phoenix dactylifera L. - female flower	-	-	-	-	-	-	1	-	-
Coriandrum sativum L.	-	-	-	-	-	-	1	-	-
Cuminum cyminum L.	-	-	1	1	-	-	-	-	-
cf. *Ocimum basilicum* L.	-	-	-	-	-	-	-	-	-
Allium cepa L. - tunic (= skin)	-	-	-	-	-	-	-	-	-
Acacia nilotica (L.) Willd. ex Del. - seed	-	-	-	-	-	-	-	-	2
Acacia nilotica (L.) Willd. ex Del. - pod	-	-	-	-	-	-	-	-	-
Tamarix aphylla (L.) Karst. - needle	+	-	-	-	-	-	-	-	-
Myrtus communis L.	-	-	-	-	1	-	1	-	-
Rumex spp. - nut (naked)	-	-	-	-	-	-	-	-	-
Beta vulgaris L.	-	-	-	-	-	-	1	1	1
Chenopodium murale L.	-	-	-	-	-	-	-	-	1
Cornulaca cf. *monocantha* Del.	-	-	-	-	-	-	-	-	-
Zilla spinosa (Turra) Prantl	-	-	-	-	-	-	-	-	-
Raphanus raphanistrum L. capsule	-	-	1	-	2	-	-	-	1
Medicago sp.	-	-	-	-	-	-	-	-	-
Fagonia sp.	-	-	-	-	-	-	-	-	-
Malva sp.	-	-	-	-	-	-	-	-	1
Galium spp.	-	-	-	-	-	-	4	-	-
Echium sp.	-	-	-	-	-	-	-	-	-
Sonchus sp.	-	-	-	-	-	-	-	-	-
Avena sp. - grain	-	-	-	-	-	-	-	-	-
Phalaris spp.	-	-	-	-	-	-	-	-	-
Setaria spp. with palea / lemma	-	-	-	-	-	-	-	-	1
Gramineae - small seeded	-	-	-	-	-	-	-	-	-
Gramineae - large seeded	-	-	-	-	-	-	-	-	-
?X - a) Unidentified leaf	-	-	+	-	-	-	-	-	-
?X - b) Split leaf / grass / palm	+	-	-	+	+	+	-	+	+
?A16 - a) unidentified root	-	-	-	+	+	-	-	+	+
- b) unidentified bark	-	-	-	+	-	-	-	+	-
?A27 - a) unidentified small fruit	-	-	-	-	-	-	1	-	-
?A29 - Small rounded seeds	-	-	-	-	-	-	-	-	-
?A49 - b) Small flower head	-	-	-	-	-	-	-	-	-
Indeterminate (not quantified):	-	-	-	yes	yes	yes	yes	-	-
TOTAL IDENTIFICATIONS FOR H.R.	33	1	36	4	25	1	17	4	29
PERCENTAGE OF SAMPLE	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
SEEDS PER LITER	4.7	0.3	9.5	1.1	3.3	0.6	2.5	1.6	23.2
TOTAL DESC FLOT IDENTIFICATIONS	389	183	518	481	427	181	749	213	218
HR AS A PERCENTAGE OF FLOT	8.5%	0.5%	6.9%	0.8%	5.9%	0.6%	2.3%	1.9%	13.3%

Table 13: Desiccated Plant Remains from the Sorted Heavy Residues continued...

Sample Number	**94-024**	**5597**	**5696**	**5697**	**94-186**	**94-031**	**7348**	**7782**	**7785**
Sample Volume in Liters	**14**	**129.5**	**9**	**20**	**17**	**26**	**10**	**20**	**10**
Fraction of Sample Sorted	**1/8**	**1/2**	**100%**	**1/4**	**1/8**	**1/8**	**100%**	**1/4**	**1/4**
Sample Preservation	**DESC**	**DESC**	**DESC**	**DESC**	**DESC**	**DESC**	**DESC**	**DESC**	**DESC**
Sample Type	**MIDDEN**	**MIDDEN**	**MIDDEN**	**MIDDEN**	**POT SLOT**	**RUBBLE**	**SQUAT**	**TROUGH**	**TROUGH**
Triticum aestivum L. / *T. durum* Desf. - grain	-	5	-	-	-	-	-	-	-
Hordeum sp. (hulled) - grain	-	2	-	-	-	-	-	-	-
Triticum durum Desf. - glume	-	4	-	-	-	-	-	-	-
Triticum durum Desf. - palea (P) / lemma (L)	-	1	-	-	-	-	-	-	-
Triticum durum-type - rachis internode	-	-	-	-	-	-	-	-	-
Triticum sp. - free threshing rachis internode	-	-	-	-	-	-	-	-	-
Triticum sp. - glume	-	-	-	-	-	-	-	-	-
Hordeum vulgare L. - rachis internode	-	-	-	-	-	-	-	-	-
Cerealia - indeterminate culm node	1	-	-	-	1	-	1	-	-
Cerealia - indet. unquant. glume/ P / L	-	+	+	+	-	+	+	+	-
Hilum - indeterminate	-	-	1	-	-	-	-	-	-
Carthamus tinctorius L.	-	3	1	1	1	-	1	16	1
Ficus carica L.	-	-	-	-	-	-	1	-	-
Ficus sycomorus L.	-	1	-	-	-	-	-	1	-
Morus sp.	-	-	-	-	-	1	-	1	-
Prunus persica (L.) Batsch	-	2	-	-	-	-	-	-	-
Zizyphus spina-christi (L.) Desf.	-	-	-	-	-	-	-	1	-
Cucumis sp.	-	1	-	2	-	-	-	1	2
Punica granatum L.	-	-	-	-	-	-	-	-	-
Vitis vinifera L. - pip	1	12	2	7	1	1	6	20	21
Vitis vinifera L. - stalk	-	1	-	-	-	-	-	1	-
Olea europaea L. - stone	4	4	1	4	1	1	-	16	2
Olea europaea L. - kernel	3	1	-	-	-	-	-	3	-
Olea europaea L. - leaf	-	+	-	+	-	-	-	-	-
Cordia myxa L.	-	-	-	cf. 2	-	-	-	1	-
Phoenix dactylifera L. - stone	-	16	1	4	3	-	2	3	3
Phoenix dactylifera L. - perianth	-	-	-	-	-	-	-	-	1
Phoenix dactylifera L. - female flower	-	-	-	-	-	-	-	-	-
Coriandrum sativum L.	-	-	-	-	-	-	-	-	-
Cuminum cyminum L.	-	-	-	-	-	-	-	1	-
cf. *Ocimum basilicum* L.	-	1	-	-	-	-	-	-	-
Allium cepa L. - tunic (= skin)	-	1	-	-	-	-	-	1	-
Acacia nilotica (L.) Willd. ex Del. - seed	-	-	1	1	-	-	1	1	-
Acacia nilotica (L.) Willd. ex Del. - pod	-	-	-	2	-	-	-	-	-
Tamarix aphylla (L.) Karst. - needle	-	+	-	+	-	-	++	-	-
Myrtus communis L.	-	1	-	-	-	-	-	1	-
Rumex spp. - nut (naked)	-	-	-	2	-	-	-	-	-
Beta vulgaris L.	-	1	-	1	-	-	-	1	-
Chenopodium murale L.	-	-	-	-	-	-	-	-	1
Cornulaca cf. *monocantha* Del.	-	4	1	-	-	-	-	-	-
Zilla spinosa (Turra) Prantl	-	1	2	-	-	-	-	-	-
Raphanus raphanistrum L. capsule	-	-	-	1	-	-	1	-	1
Medicago sp.	-	cf. 1	-	-	-	-	-	-	-
Fagonia sp.	-	-	-	-	-	-	1	2	-
Malva sp.	-	1	-	-	1	1	-	-	-
Galium spp.	-	4	-	3	-	-	-	-	1
Echium sp.	-	-	-	-	-	-	1	-	2
Sonchus sp.	-	1	-	-	-	-	-	-	-
Avena sp. - grain	-	-	-	1	-	-	-	-	-
Phalaris spp.	-	1	-	-	-	-	-	-	-
Setaria spp. with palea / lemma	-	-	-	-	-	-	-	-	-
Gramineae - small seeded	-	-	1	1	-	-	-	-	-
Gramineae - large seeded	-	2	-	-	-	-	1	-	-
?X - a) Unidentified leaf	-	+	+	+	-	+	+	+	-
?X - b) Split leaf / grass / palm	-	+	-	-	-	+	+	+	-
?A16 - a) unidentified root	-	-	-	-	-	-	-	-	-
- b) unidentified bark	-	-	+	+	+	-	-	-	-
?A27 - a) unidentified small fruit	-	-	-	-	-	-	-	1	-
?A29 - Small rounded seeds	-	4	-	-	-	-	-	-	1
?A49 - b) Small flower head	-	-	-	2	-	-	-	-	-
Indeterminate (not quantified):	-	yes	-	yes	yes	yes	-	-	-
TOTAL IDENTIFICATIONS FOR H.R.	9	75	11	32	8	4	16	72	36
PERCENTAGE OF SAMPLE	100.0	100.0	100.0	100.0	88.9%	80.0%	80.0%	100.0	100.0
SEEDS PER LITER	5.1	1.2	1.2	6.4	3.8	1.2	1.6	14.4	14.4
TOTAL DESC FLOT IDENTIFICATIONS	724	1569	299	559	308	649	247	213	666
HR AS A PERCENTAGE OF FLOT	1.2%	4.8%	3.7%	5.7%	2.6%	0.6%	6.5%	33.8%	5.4%

Table 14: Carbonized Plant Remains from the Sorted Heavy Residues (arranged in order of context type)

Sample Number	**7791**	**94-008**	**94-010**	**94-011**	**94-012**	**94-037**	**94-002**	**94-005**	**94-023**
Sample Volume in Liters	**7**	**13**	**19**	**14**	**15**	**13**	**13.5**	**10**	**10**
Fraction of Sample Sorted	**100%**	**1/4**	**20%**	**1/4**	**1/2**	**1/8**	**1/2**	**1/4**	**1/8**
Sample Preservation	**CARB**	**CARB**	**CARB**	**CARB**	**CARB**	**CARB**	**CARB**	**CARB**	**CARB**
Sample Type	**DRAIN**	**FLOOR**	**FLOOR**	**FLOOR**	**FLOOR**	**FLOOR**	**MIDDEN**	**MIDDEN**	**MIDDEN**
Hordeum sp. (hulled) - grain	-	-	-	-	-	-	-	-	-
Triticum dicoccum Schübl. - glume base	-	-	-	-	-	-	-	-	-
Hordeum vulgare L. - rachis internode	-	-	-	-	-	-	-	-	-
Vitis vinifera L. - stalk	-	-	-	-	-	-	-	-	-
Juniperus cf. *oxycedrus* L. / *phoenicea* L.	-	cf. 1	-	-	-	-	-	-	
Trifolium spp. - seed	-	-	-	-	-	-	-	-	-
?X - a) Unidentified leaf	-	+	-	-	-	-	-	-	-
TOTAL IDENTIFICATIONS FOR HR	0	0	0	0	0	0	0	0	0
PERCENTAGE OF SAMPLE	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
SEEDS PER LITER	0	0	0	0	0	0	0	0	0
TOTAL CARB FLOT IDENTIFICATIONS	-	-	-	-	-	-	-	-	-
HR AS A PERCENTAGE OF FLOT	-	-	-	-	-	-	-	-	-

Table 14: Carbonized Plant Remains from the Sorted Heavy Residues continued...

Sample Number	**94-024**	**5597**	**5696**	**5697**	**94-186**	**94-031**	**7348**	**7782**	**7785**
Sample Volume in Liters	**14**	**129.5**	**9**	**20**	**17**	**26**	**10**	**20**	**10**
Fraction of Sample Sorted	**1/8**	**1/2**	**100%**	**1/4**	**1/8**	**1/8**	**100%**	**1/4**	**1/4**
Sample Preservation	**CARB**	**CARB**	**CARB**	**CARB**	**CARB**	**CARB**	**CARB**	**CARB**	**CARB**
Sample Type	**MIDDEN**	**MIDDEN**	**MIDDEN**	**MIDDEN**	**POT SLOT**	**RUBBLE**	**SQUAT**	**TROUGH**	**TROUGH**
Hordeum sp. (hulled) - grain	-	-	-	-	1	-	-	-	-
Triticum dicoccum Schübl. - glume base	-	-	-	-	-	1	-	-	-
Hordeum vulgare L. - rachis internode	-	-	-	-	-	-	1	-	-
Vitis vinifera L. - stalk	-	-	-	1	-	-	-	-	-
Juniperus cf. *oxycedrus* L. / *phoenicea* L.	-	-	-	-	-	-	-	-	-
Trifolium spp. - seed	-	-	-	-	-	-	3	-	-
?X - a) Unidentified leaf	-	-	-	-	-	-	-	-	-
TOTAL IDENTIFICATIONS FOR HR	0	0	0	1	1	1	4	0	0
PERCENTAGE OF SAMPLE	0.0%	0.0%	0.0%	0.0%	11.1%	20.0%	20.0%	0.0%	0.0%
SEEDS PER LITER	0	0	0	0.2	0.5	0.3	0.4	0	0
TOTAL CARB FLOT IDENTIFICATIONS	-	-	-	27	3	109	0	-	-
HR AS A PERCENTAGE OF FLOT	-	-	-	3.7%	33.3%	0.9%	100.0%	-	-

Appendix 2. Photographic Record of Identifications

The following plates form a photographic record of identifications made in the Kom el-Nana assemblage. In cases where a scale is shown, the unlabelled scales are in millimeters the labelled scales are in centimeters. Both cases will be indicated in the caption. In cases where a scale is not shown the magnification (i.e. x 14) will be included in the caption for that plate.

Some of the taxa found at Kom el-Nana have not been photographed successfully or, as in the case of *Acacia nilotica*, the best preserved examples are in storage in Egypt. These taxa will be photographed to add to this archive of identifications in the forthcoming 1998 excavation season at Kom el-Nana.

2.1 Cereal Grain

The embryo (located at right of Plate 2.1) was the feature used for quantification of all cereal grains.

Plate 2.1 Free threshing wheat grain (*Triticum* sp.). Dorsal view at x 13.

Plate 2.2 Hulled barley grain (*Hordeum* sp.). Dorsal view at x 13. (No naked barley grains were found in the Kom el-Nana flots, only in the heavy residues.)

Plate 2.3 Hulled barley grain (*Hordeum* sp.). Ventral view at x 13.

Plate 2.4 Hulled barley (*Hordeum* sp.) grain at x 9. Only the palea and lemma are preserved - this was always counted as a grain and quantification was made on the depression at the lemma base.

Plate 2.5 Detached cereal embryo (Cerealia sp.) at x 19.

2.2 Cereal Chaff

Plate 2.6 Emmer (*Triticum diccocum*) spikelet fork at x 16. Quantification of this spikelet fork is 2 glume bases and 1 rachis internode.

Plate 2.7 Emmer-type (*Triticum dicoccum*-type) glume base at x 20. This would be quantified as 2 emmer-type glume bases.

Plate 2.8 Hard wheat (*Triticum durum*) rachis internode at x 13.

Plate 2.9 Hard wheat (*Triticum durum*) glumes at x 13. Upper glume shows strong keel at the top of the photograph. Only glumes with preserved bases were quantified.

Plate 2.10 Hard wheat-type (*Triticum durum*-type) rachis internode at x 13.

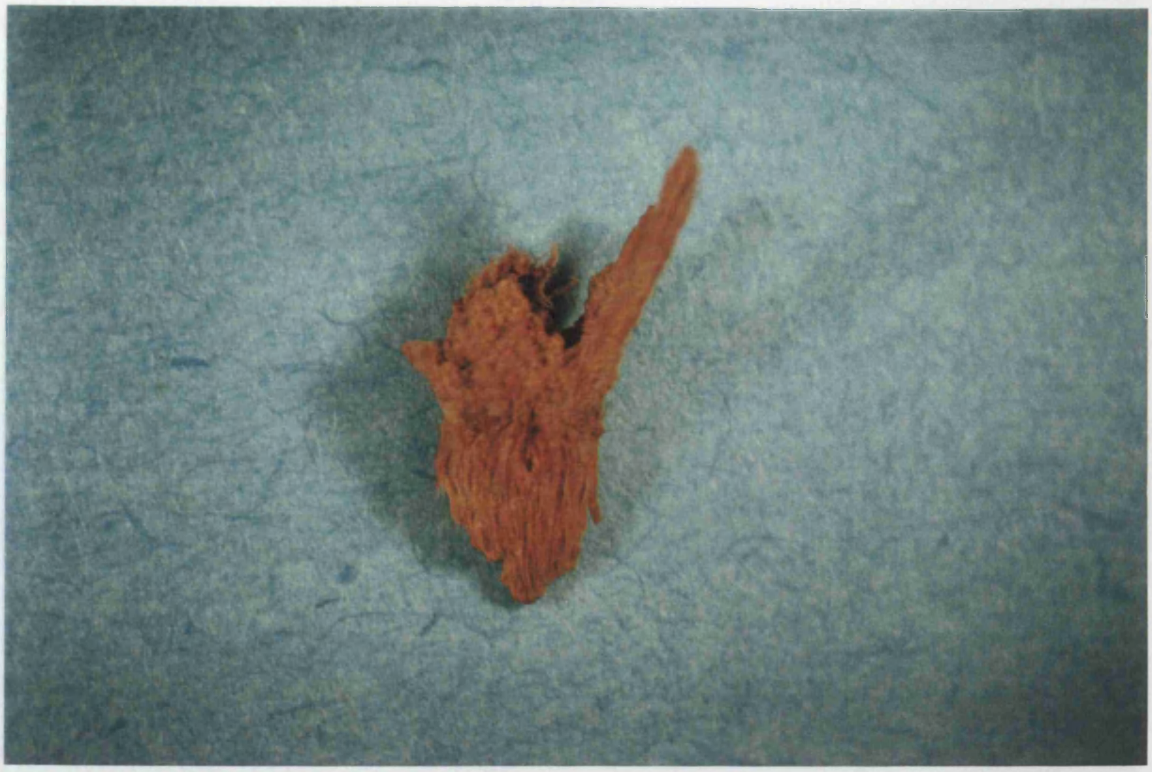


Plate 2.11 Wheat (*Triticum* sp.) rachilla at x 13.

Plate 2.12 Wheat (*Triticum* sp.) awn at x 11. Only those awn which also preserve the lemma tip were quantified.

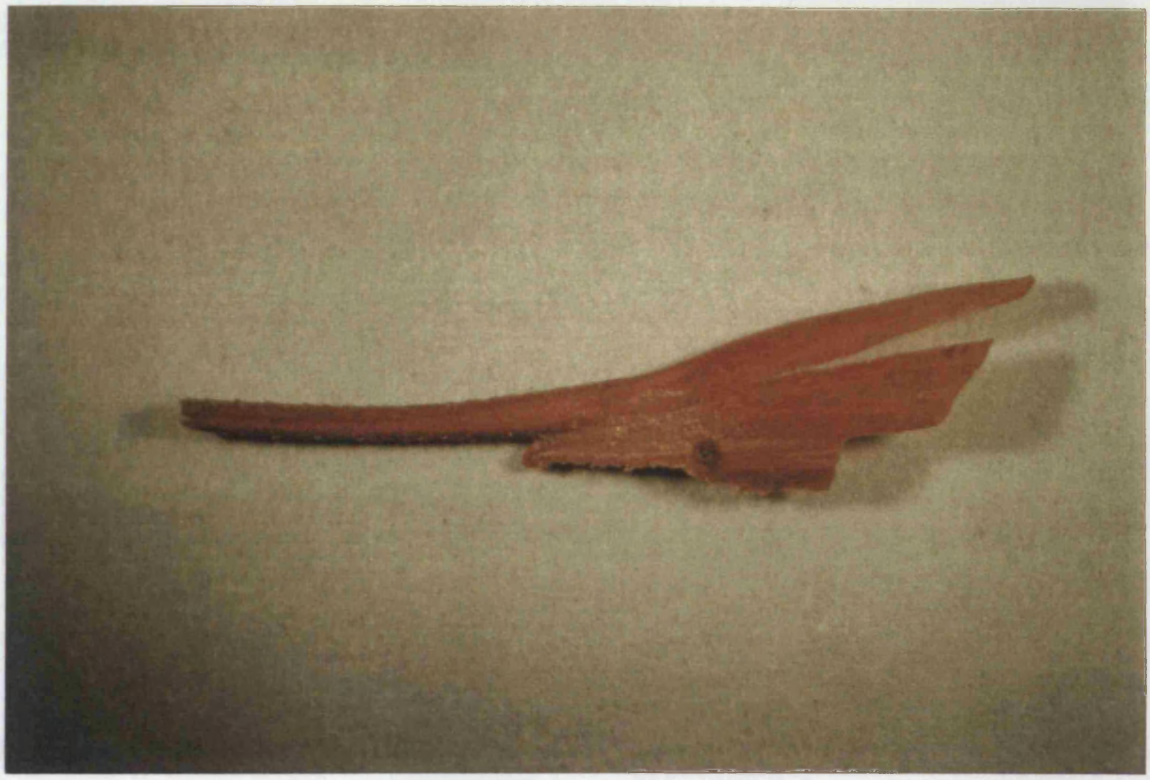


Plate 2.13 Barley (*Hordeum vulgare*) rachis internode at x 13. Two internodes shown.

Plate 2.14 Pedicelled barley (*Hordeum vulgare*) rachis internodes at x 13.

Plate 2.15 Barley (*Hordeum* sp.) awn at x 14. Only those awns which clearly show the characteristic widening (see left of bottom awn) at the top of the lemma are quantified. In this plate, only the awn at the bottom is quantified.

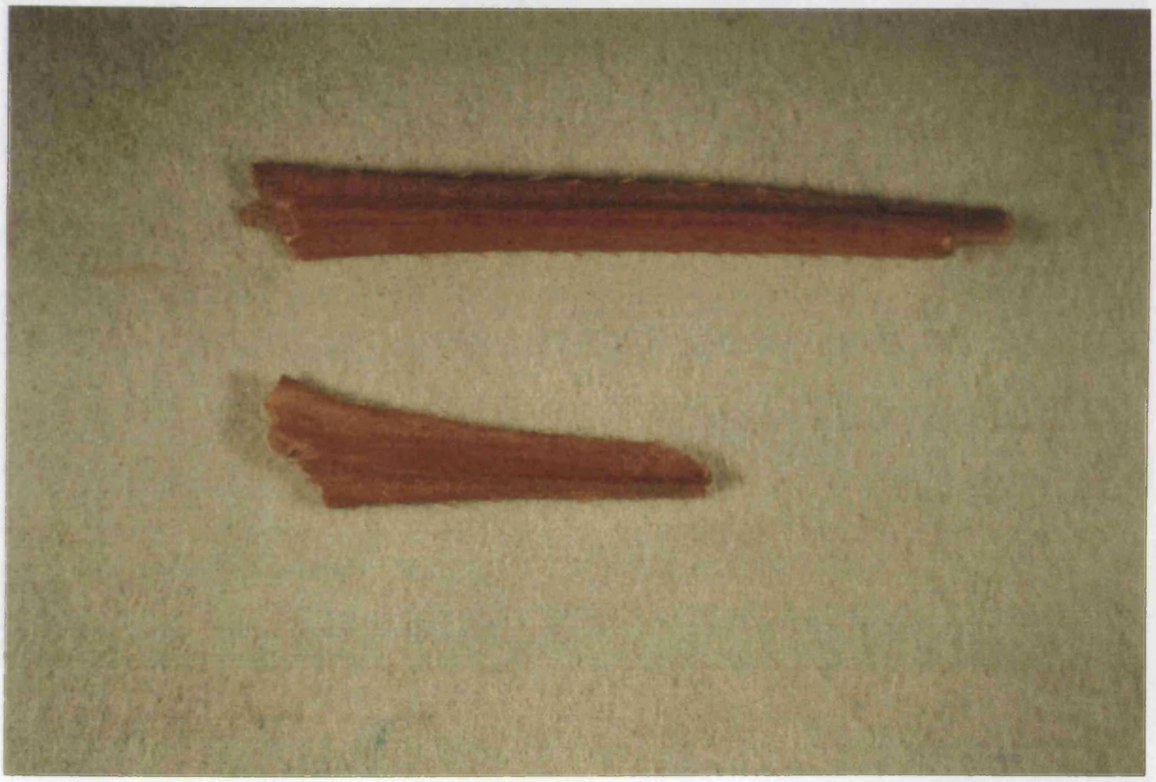


Plate 2.16 Sorghum (*Sorghum* sp.) glumes at x 13. Dorsal side shown.

Plate 2.17 Sorghum (*Sorghum* sp.) glumes at x 13. Ventral side shown.

Plate 2.18 Cereal (Cerealia indet.) culm nodes at x 9.

2.3 Pulses

Plate 2.19 Lupin (*Lupinus* cf. *albus*) at x 9.

Plate 2.20 Lentil (*Lens culinaris*) at x 20.

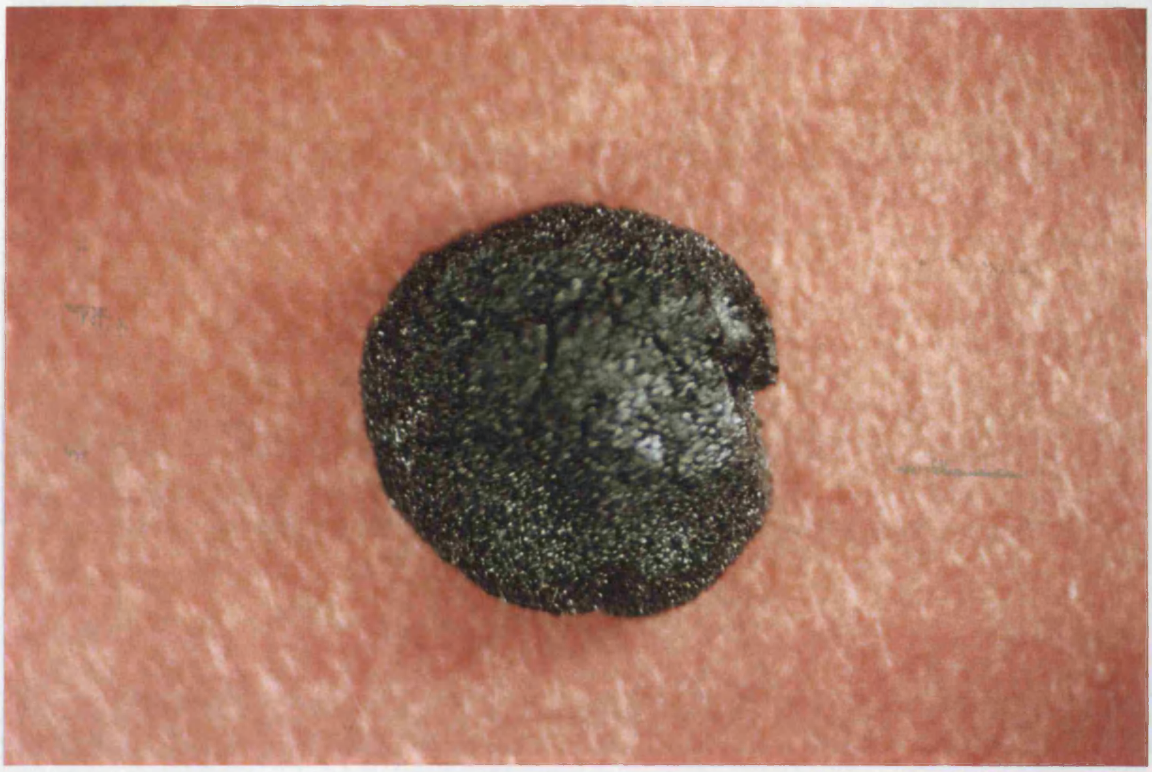


Plate 2.21 Vetchling (*Lathyrus* sp.) at x 9.

Plate 2.22 Detached hilum (the point where the pea or bean attaches to the pod) at x 20.

2.4 Oil Crops

Plate 2.23 Linseed or flax seed (*Linum usitatissimum*) at x 26.

Plate 2.24 Flax / linseed (*Linum usitatissimum*) capsule segment (10 segments = 1 capsule) at x 19.

Plate 2.25 Safflower (*Carthamus tinctorius*) achene fragments at x 9.

Plate 2.26 Close-up of distinctive cell wall of a safflower (*Carthamus tinctorius*) achene at x 33. Bands of black and tan (see right of photograph) are clearly seen in even the most fragmentary material.

2.5 Fruits

Plate 2.27 Common fig (*Ficus carica*) seeds at x 22.

Plate 2.28 Close-up of embryo of common fig (*Ficus carica*) at x 26. The embryo is the feature used for quantification of all fig seeds.

Plate 2.29 Galls of sycomore fig (*Ficus sycomorus*) at x 26. (For a detailed discussion of identification criteria see Appendix 3).

Plate 2.30 Mulberry (*Morus* sp.) seed at x 16.

Plate 2.31 Peach (*Prunus persica*) stones. (Scale shown in cm)

Plate 2.32 Christ's thorn (*Zizyphus spina-christi*) seed. (Scale shown in cm)

Plate 2.33 Cucumber / melon (*Cucumis* sp.) seed at x 16.

Plate 2.34 Bottle gourd (*Lagenaria siceraria*) seed at x 9.

Plate 2.35 Pomegranate (*Punica granatum*) seed at x 13.

Plate 2.36 Fragment of grape (*Vitis vinifera*) pip at x 26. Distinctive 'gill' pattern of cell wall clearly seen at left of photograph.

Plate 2.37 Grape (*Vitis vinifera*) stalk at x 13.

Plate 2.38 Olive (*Olea europaea*) stone at x 9.

Plate 2.39 Olive (*Olea europaea*) kernel at x 9.

Plate 2.40 Olive (*Olea europaea*) leaves. (Scale shown in cm).

Plate 2.41 Egyptian plum (*Cordia myxa*) seed. (Scale shown in mm.)

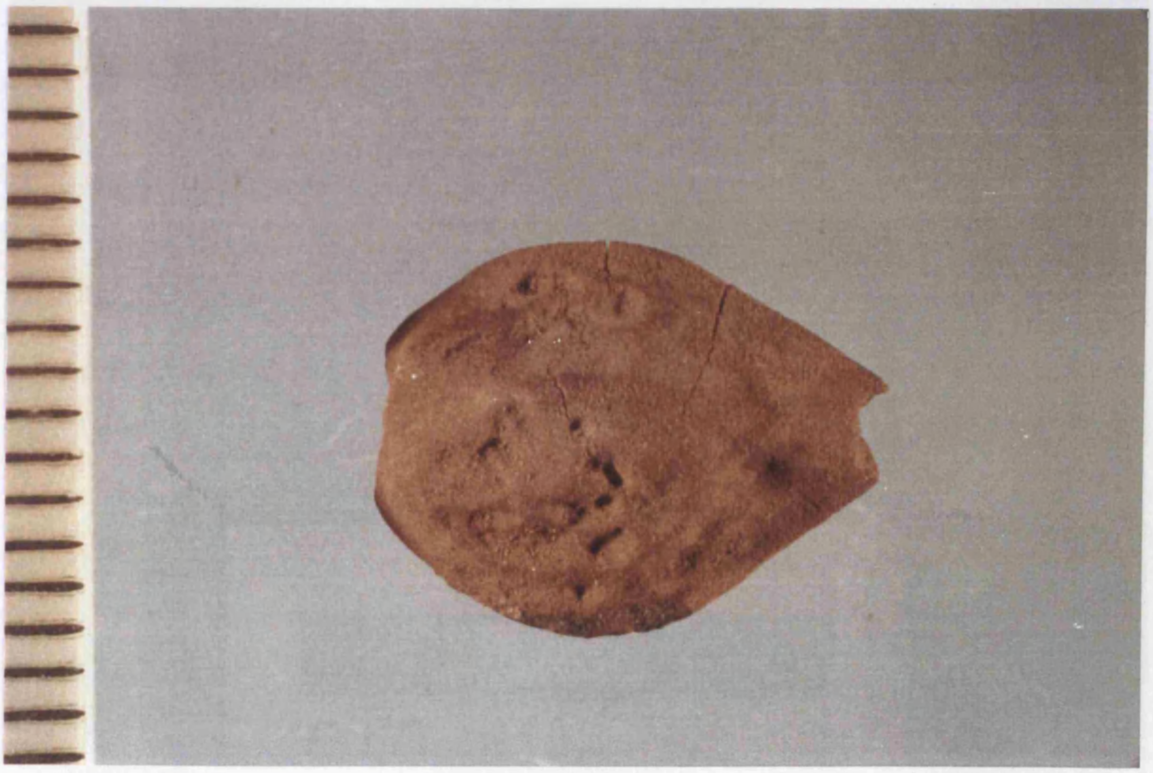


Plate 2.42 Date (*Phoenix dactylifera*) stone in various states of preservation. (Scale shown in cm).

Plate 2.43 Date (*Phoenix dactylifera*) perianth (woody calyx at top of photograph) and rachilla at x 9.

Plate 2.44 Fragment of date (*Phoenix dactylifera*) leaf sheath at x 9.

2.6 Condiments

Plate 2.45 Coriander (*Coriandrum sativum*) mericarp at x 16.

Plate 2.46 Dill (*Anethum graveolens*) mericarp at x 20.

Plate 2.47 Cumin (*Cuminum cyminum*) mericarp at x 20.

Plate 2.48 Fennel (*Foeniculum vulgare*) mericarp at x 10.

Plate 2.49 Celery (*Apium graveolens*) mericarp at x 20.

Plate 2.50 Possible basil (cf. *Ocimum basilicum*) seed at x 26.

Plate 2.51 Onion (*Allium cepa*) tunic (= skin). (Scale shown in cm).

2.7 Other Economic Plants

Plate 2.52 Juniper (*Juniperus* cf. *oxycedrus* / *Juniperus* cf. *phoenicea*) berry at x 9. Photograph of internal structure. All juniper berries found at Kom el-Nana were broken.

Plate 2.53 Opium poppy (*Papaver somniferum*) seed at x 39.

Plate 2.54 Aleppo rue / Syrian rue (*Ruta* cf. *chalepensis*) seed at x 26.

Plate 2.55 Tamarisk (*Tamarix aphylla*) needle (scale-like leaf) at x 26.

Plate 2.56 Tamarisk (*Tamarix aphylla*) flowers at x 18.

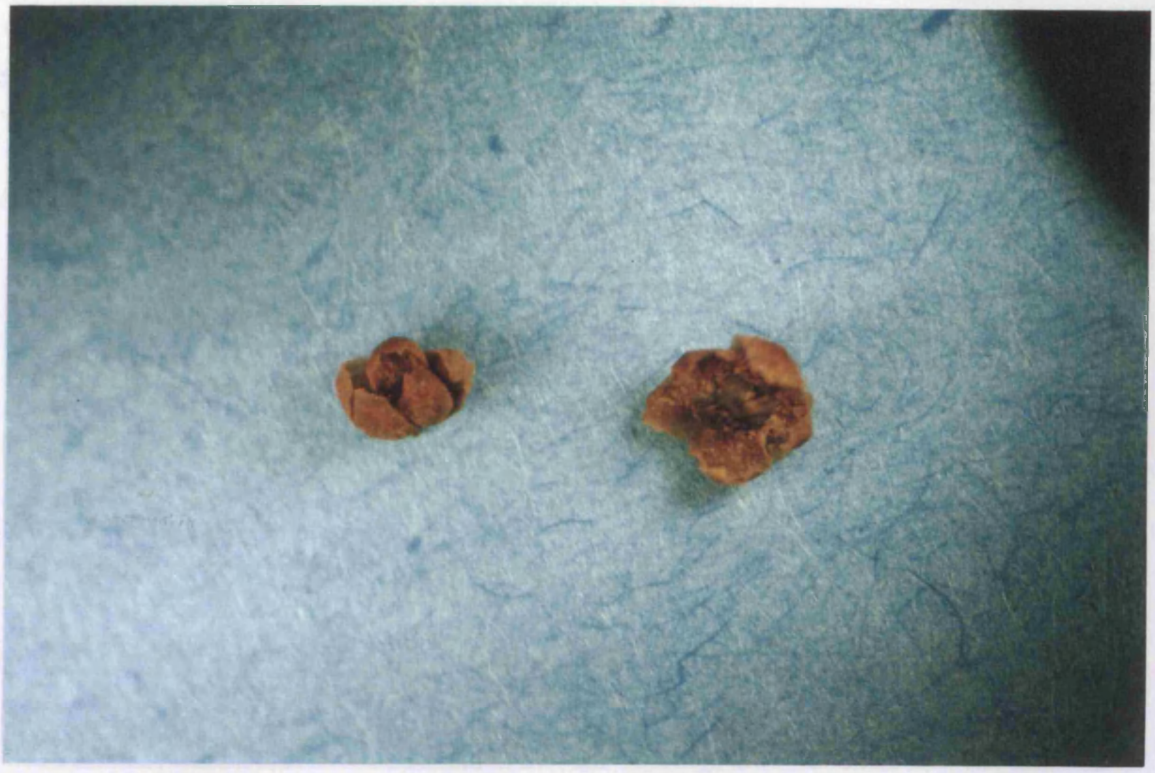


Plate 2.57 Carrot (*Daucus carota*) mericarp at x 9.

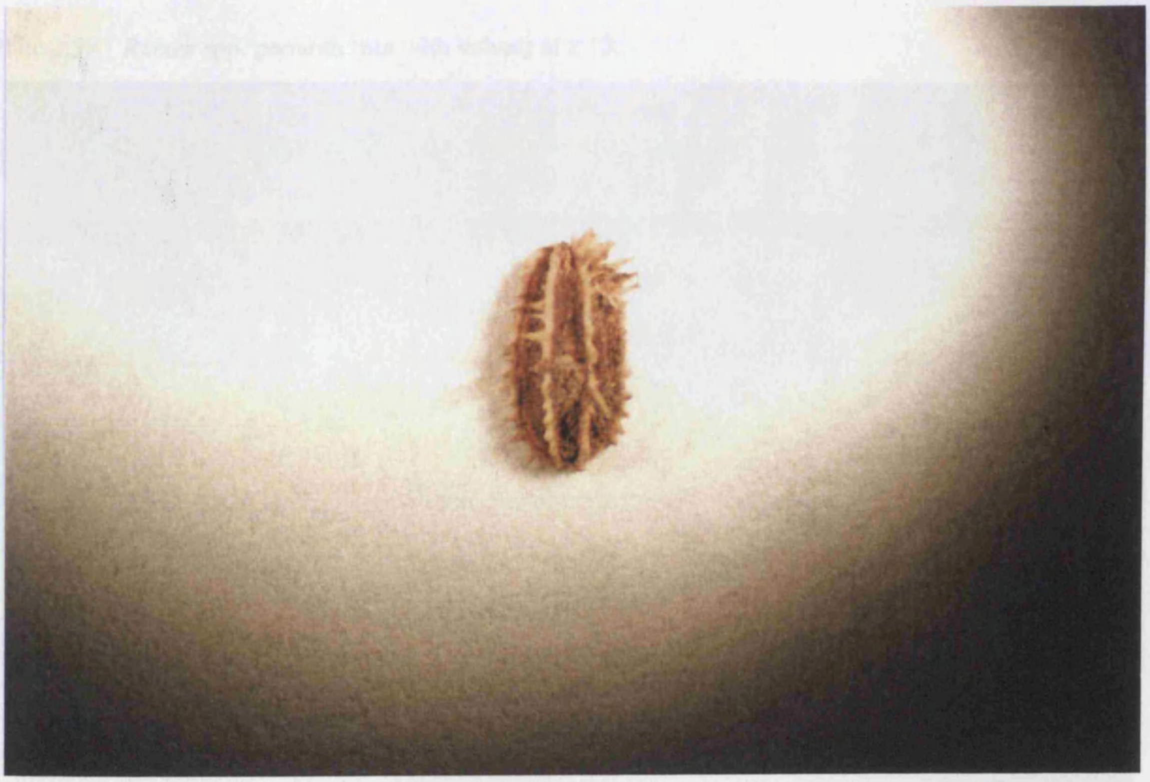
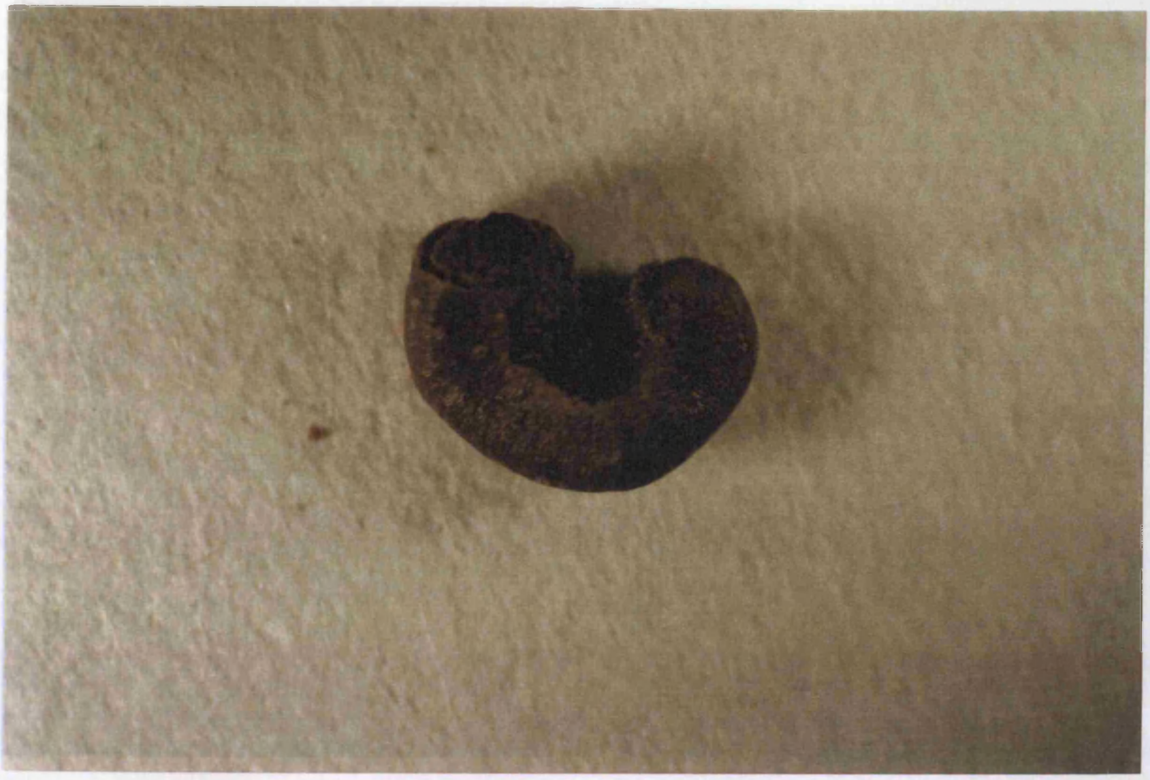


Plate 2.58 Myrtle (*Myrtus communis*) seed at x 20.



2.8 Weed / Wild Plants

Plate 2.59 *Rumex* spp. perianth (nut with valves) at x 13.

Plate 2.60 *Rumex* spp. turbucle at x 10.

Plate 2.61 *Rumex* spp. naked nuts at x 14.

Plate 2.62 Polygonaceae - unidentified seed at x 14.

Plate 2.63 *Glinus* cf. *lotoides* seeds at x 59.

Plate 2.64 Aizoaceae - unidentified seed at x 32.

Plate 2.65 Purslane (*Portulaca oleracea*) seeds at x 27.

Plate 2.64 Aizoaceae - unidentified seed at x 32.

Plate 2.65 Purslane (*Portulaca oleracea*) seeds at x 27.

Plate 2.66 *Vaccarira* cf. *pyramidata* seed at x 20.

Plate 2.67 Large *Silene* sp. seed at x 20.

Plate 2.68 *Stellaria* sp. -type seed at x 59.

Plate 2.69 Unidentified Caryophyllaceae seed. (Scale shown in mm).

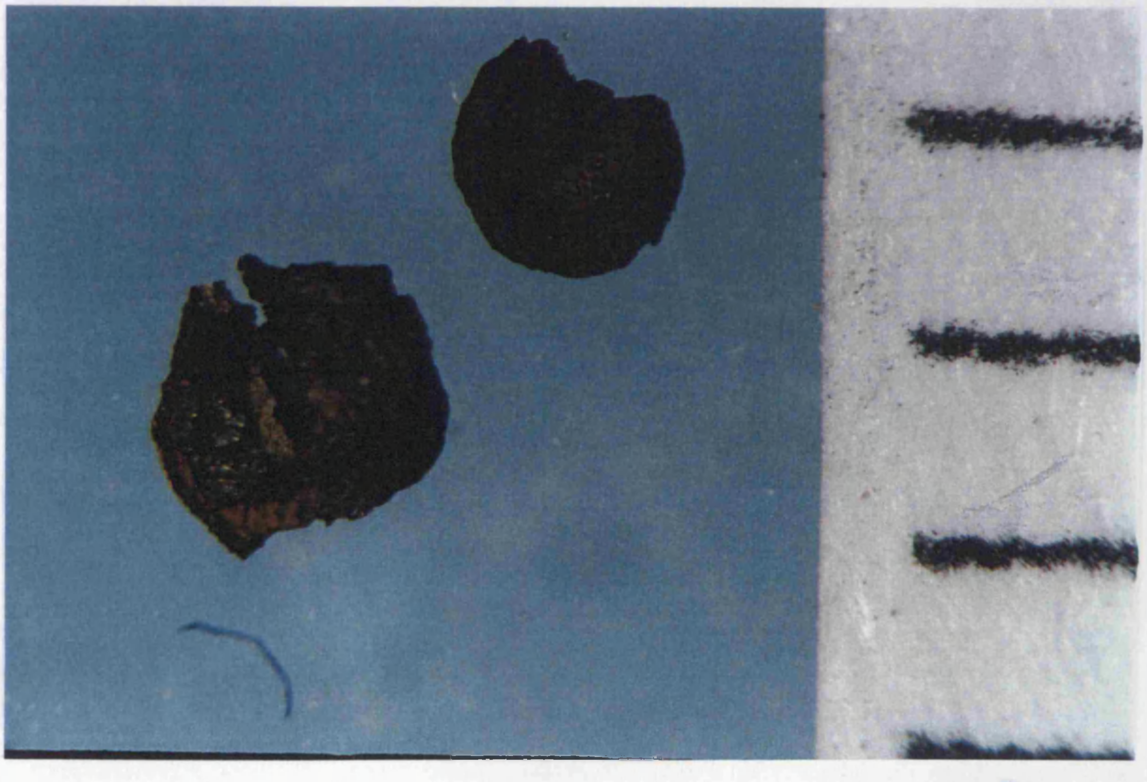


Plate 2.70 Beetroot (*Beta vulgaris*) fruits at x 20.

Plate 2.71 *Chenopodium murale* seed at x 26.

Plate 2.72 *Cornulaca* cf. *monocantha* seed at x 20.

Plate 2.73 Chenopodiaceae - unidentified seed at x 20.

Plate 2.74 Chenopodiaceae - unidentified needles (modified scale-like leaves) at x 20.

Plate 2.75 Chenopodiaceae - unidentified floret at x 32.

Plate 2.76 *Fumaria* spp. seed at x 20.

Plate 2.77 *Brassica* spp. / *Sinapis arvensis* seed. (Scale shown in mm).

Plate 2.78 *Zilla spinosa* fruit at x 13.

Plate 2.79 *Raphanus raphanistrum* capsules at x 20.

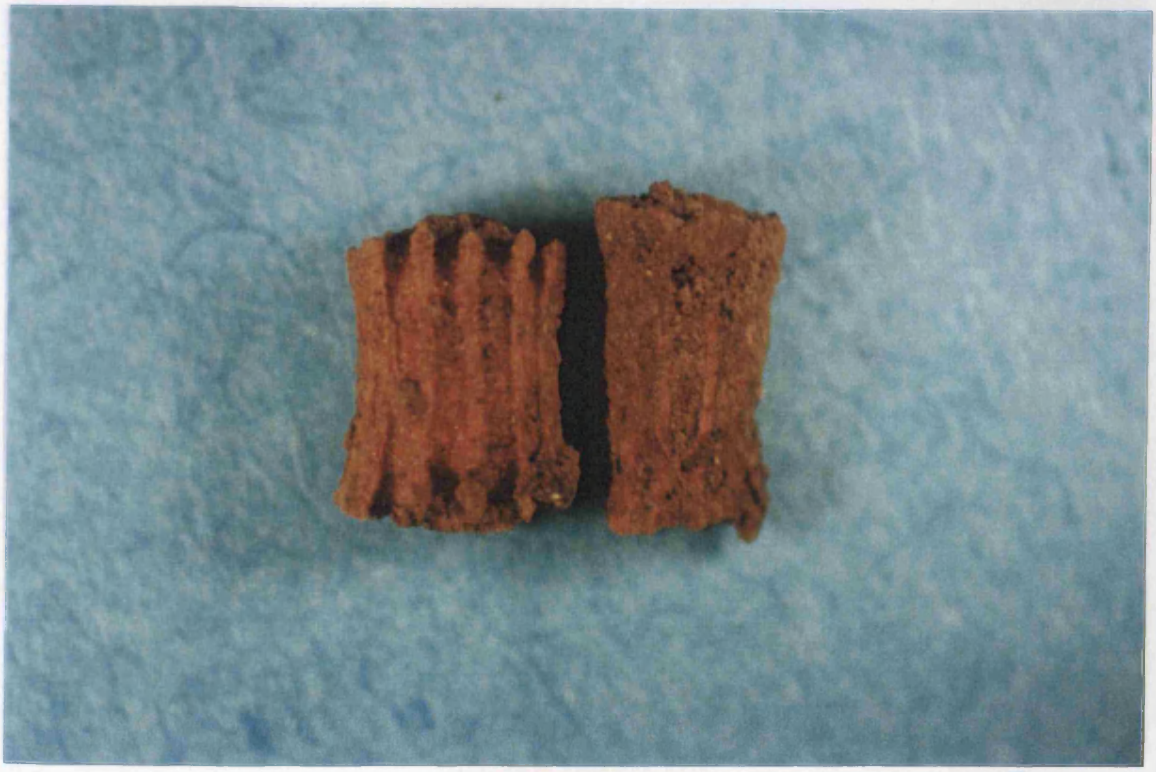


Plate 2.80 *Raphanus raphanistrum* seed at x 21.

Plate 2.81 *Coronopus* cf. *niloticus* seed at x 32.

Plate 2.82 *Reseda* sp. - TYPE 1 smooth - seeds. (Scale shown in mm).

Plate 2.83 *Trifolium* sp. seeds at x 20.

Plate 2.84 *Trifolium* sp. calyx at x 20. Seed with calyx at left of photograph is a modern comparative specimen.

Plate 2.85 *Trifolium* sp. involucre at x 20.

Plate 2.86 *Scorpiurus muricatus* seed at x 16.

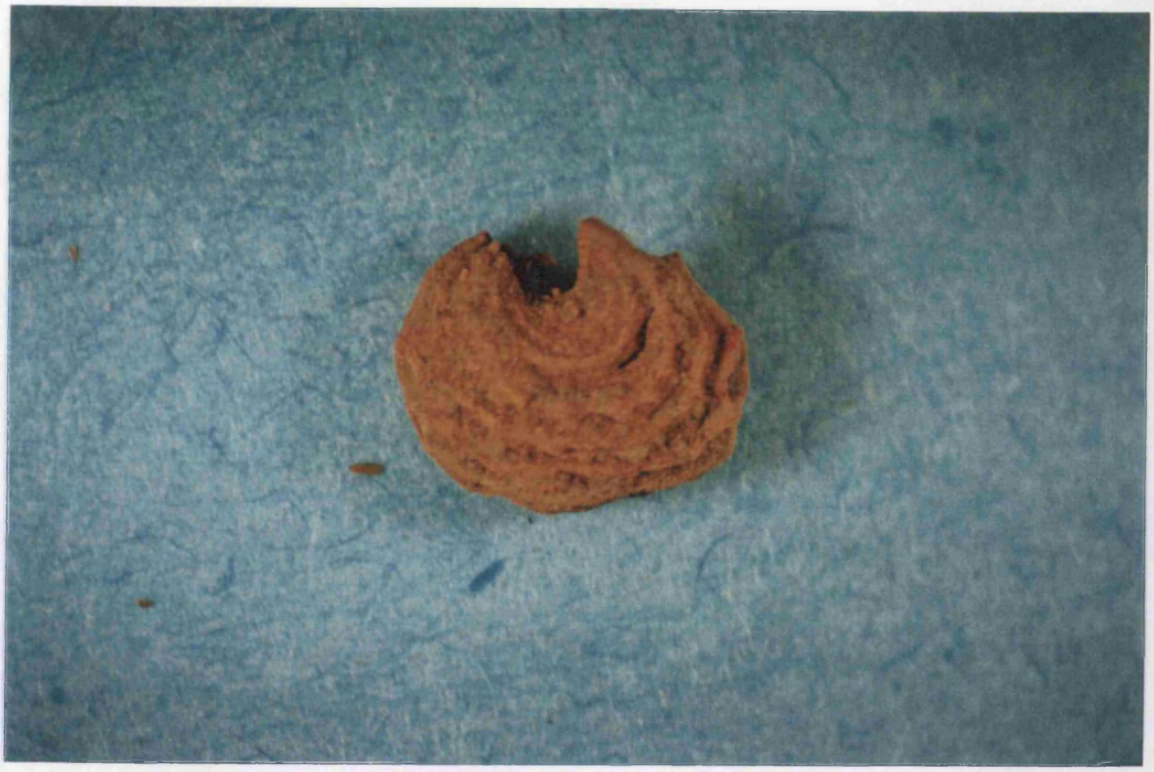


Plate 2.87 Leguminosae - large seed - unidentified. (Scale shown in mm).

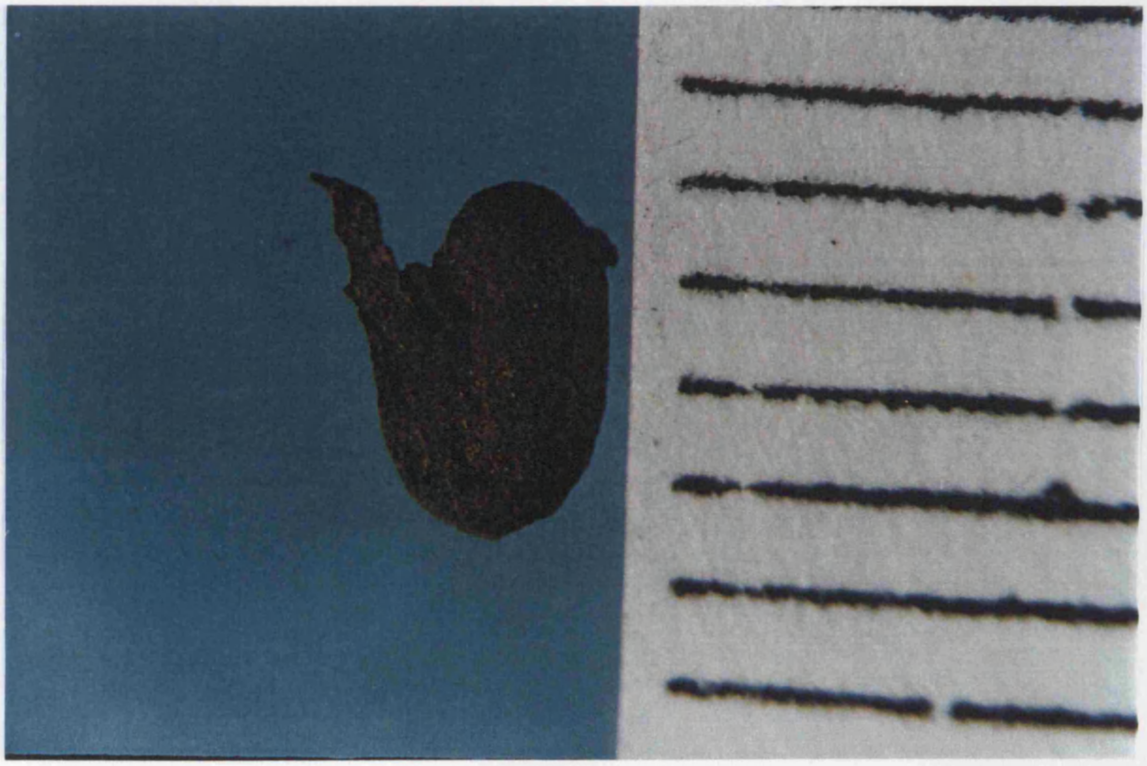


Plate 2.88 Leguminosae - pod - unidentified at x 9.

Plate 2.89 *Fagonia* sp. seed at x 39.

Plate 2.90 Zygophyllaceae - unidentified seeds. (Scale shown in mm).

Plate 2.91 *Euphorbia peplus* seed. (Scale shown in mm).

Plate 2.92 *Malva* sp. seeds. (Scale shown in mm).

Plate 2.93 *Galium* spp. seeds at x 20.

Plate 2.94 *Heliotropium* spp. seed at x 32.

Plate 2.95 *Echium* sp. seeds. (Scale shown in mm).

Plate 2.96 Verbenaceae / Labiatae unidentified seed. (Scale shown in mm).

Plate 2.97 Labiatae - *Ocimum* type - seed. (Scale shown in mm).

Plate 2.98 Labiatae - *Thymus* type seed. (Scale shown in mm).

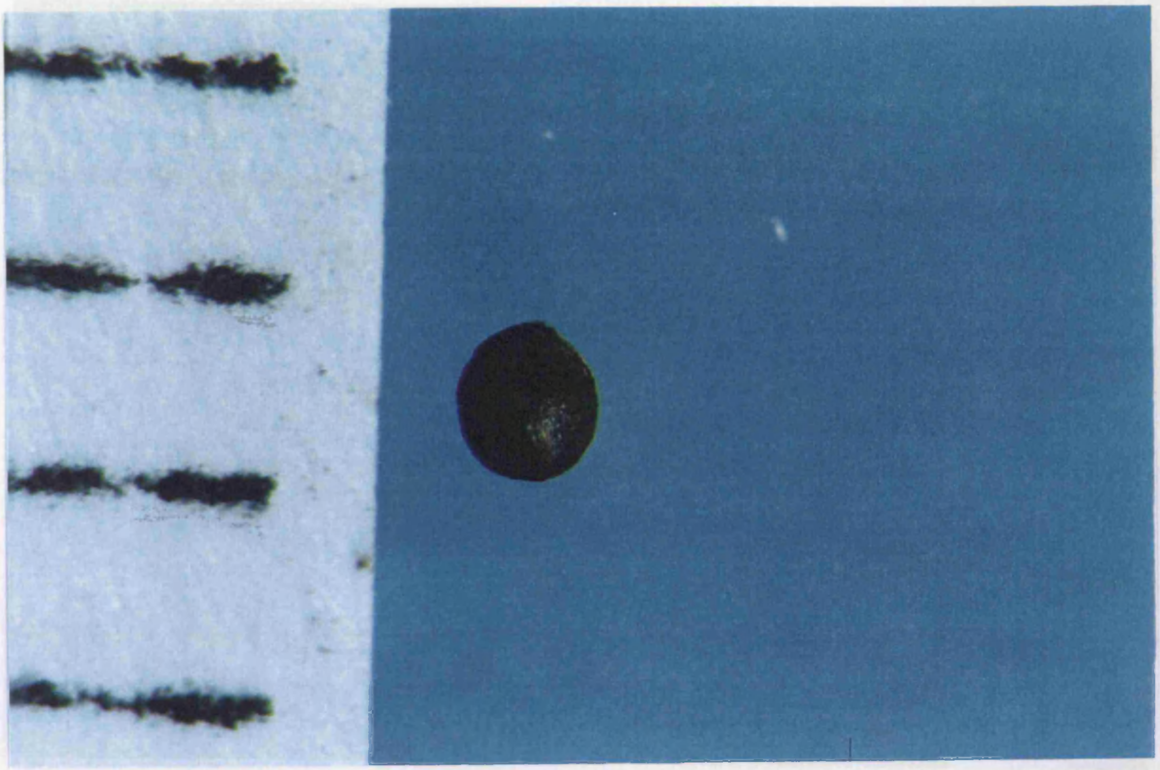


Plate 2.99 Labiatae - *Ajuga* type seed. (Scale shown in mm).

Plate 2.100 *Solanum nigrum* seed. (Scale shown in mm).

Plate 2.101 *Pulicaria* sp. seeds. (Scale shown in mm).

Plate 2.102 *Cichorium endivia* / *Cichorium intybus* seed. (Scale shown in mm).

Plate 2.103 *Picris* sp. seed. (Scale shown in mm).

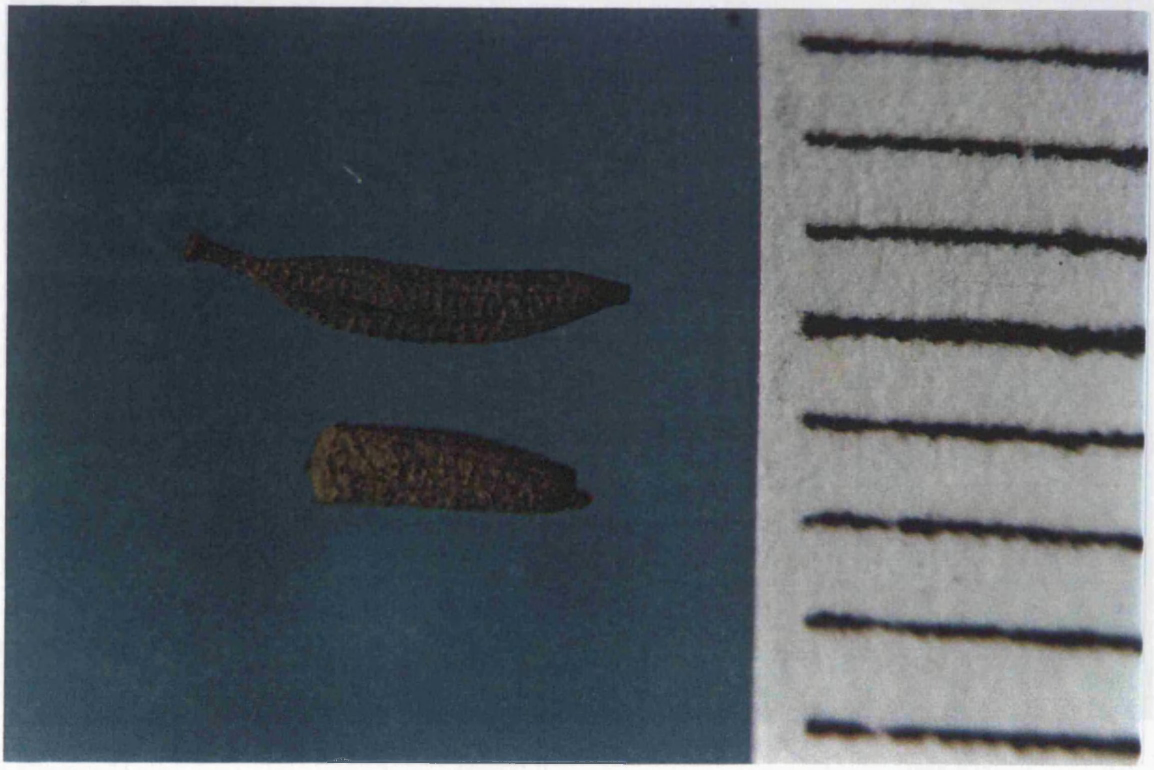


Plate 2.104 *Sonchus* sp. seed. (Scale shown in mm).

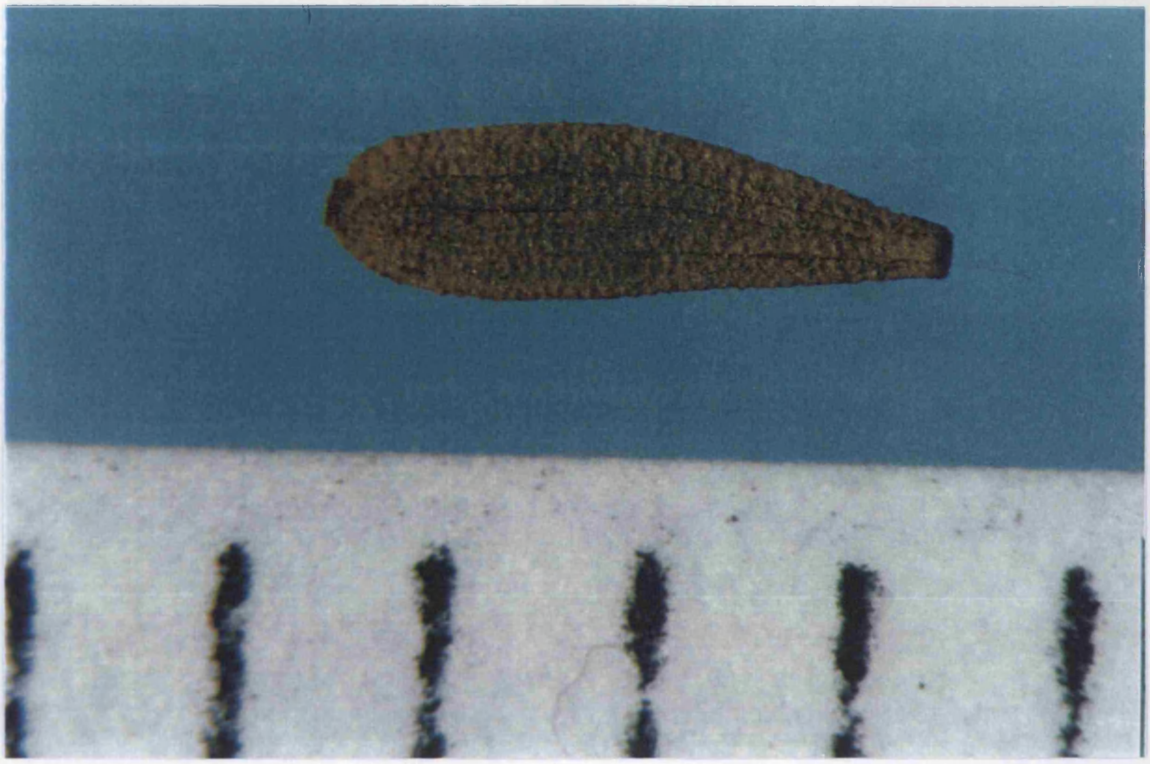


Plate 2.105 Compositae - unidentified at x 20.

Plate 2.106 *Asphodelus* spp. seed at x 11.

Plate 2.107 *Lolium* spp. caryopses at x 23.

Plate 2.108 *Avena* sp. caryopsis at x 12.

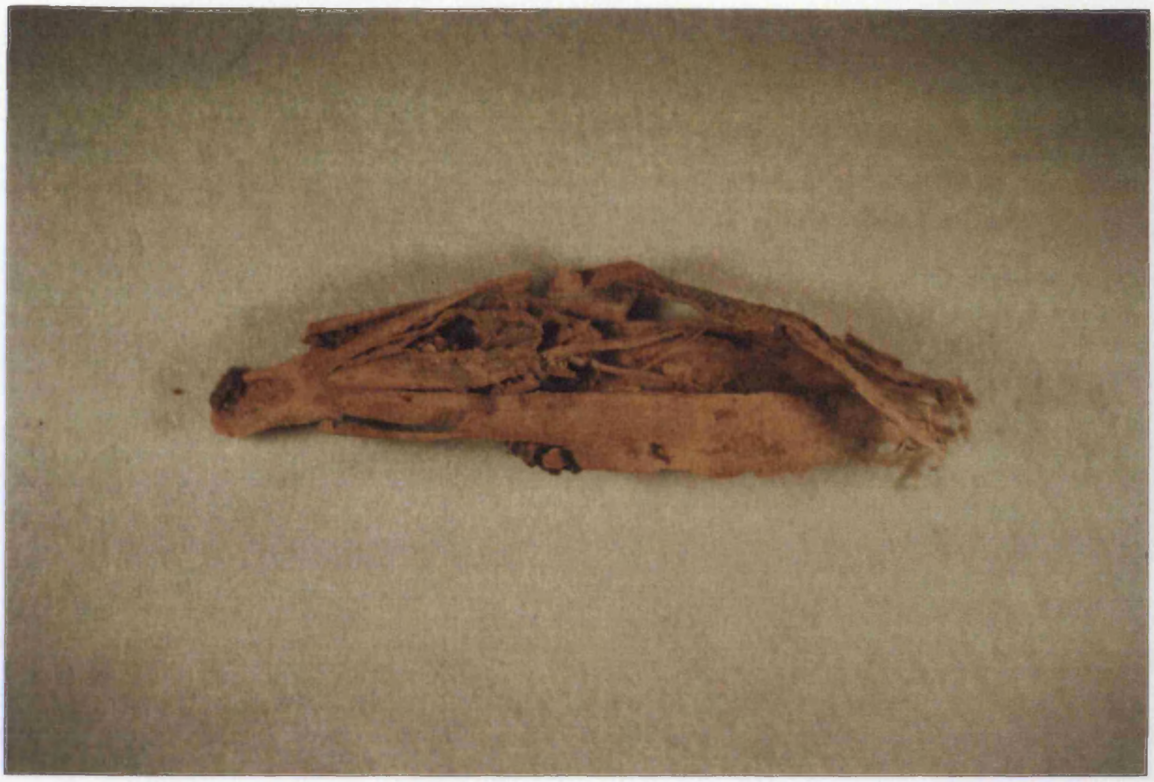


Plate 2.109 *Avena sterilis* rachillae. (Scale shown in mm).

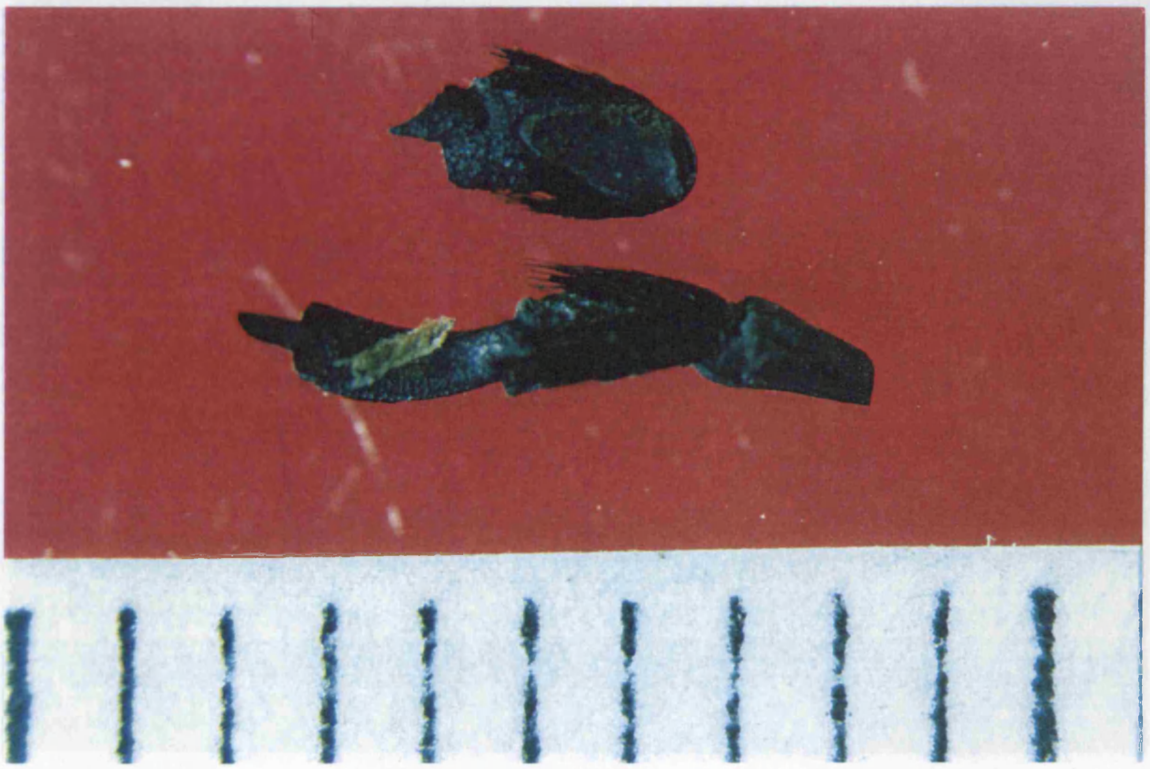


Plate 2.110 *Avena* spp. rachillae at x 14.

Plate 2.111 *Crypsis* spp. caryopses at x 25. (Embryo of central caryopsis runs entire length of left side).

Plate 2.112 *Phalaris paradoxa* spikelets at x 25.

Plate 2.113 *Phalaris* spp. caryopses at x 25.

Plate 2.114 *Setaria* spp. caryopses with palea and lemma preserved at x 26.

Plate 2.115 *Setaria* spp. caryopses - naked - at x 26.

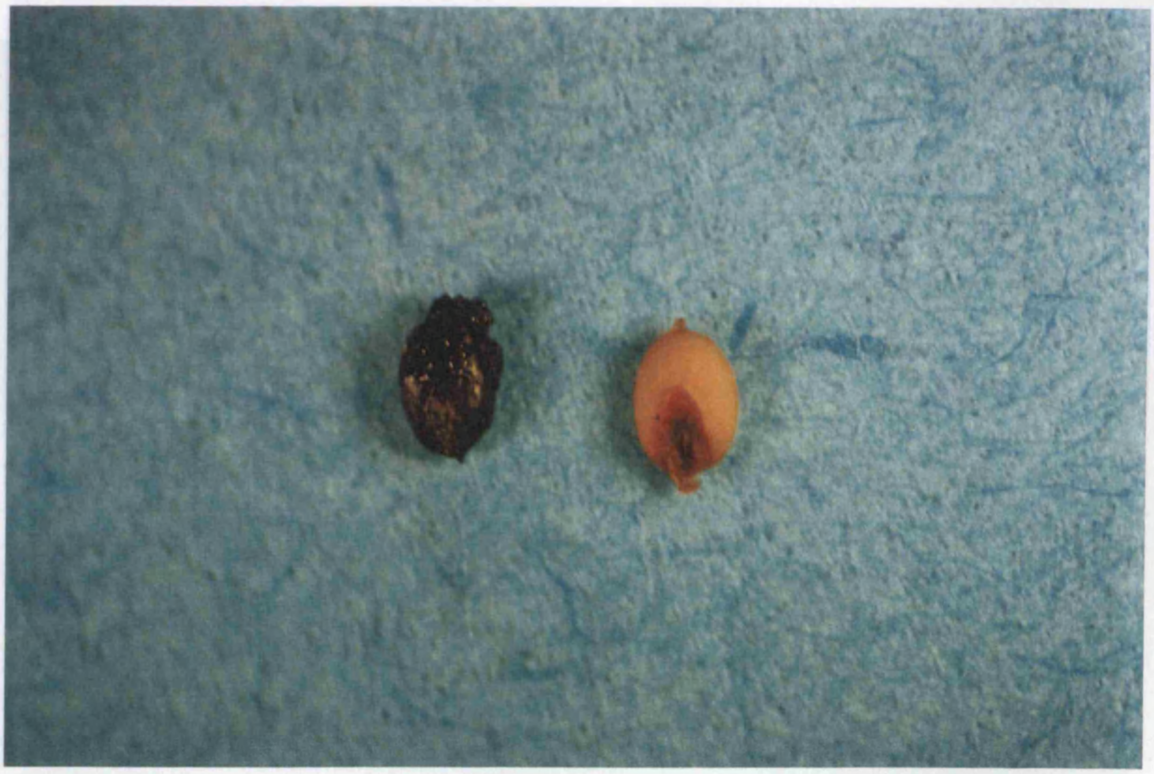


Plate 2.116 *Saccharum spontaneum* caryopses and rachis. (Scale shown in mm).

Plate 2.117 Gramineae - small caryopses at x 25

Plate 2.118 *Fimbristylis bis-umbellata* seed at x 59.

Plate 2.119 *Scirpus* cf. *praelongatus* seeds at x 52.

Plate 2.120 *Scirpus* spp. seeds. (Scale shown in mm).

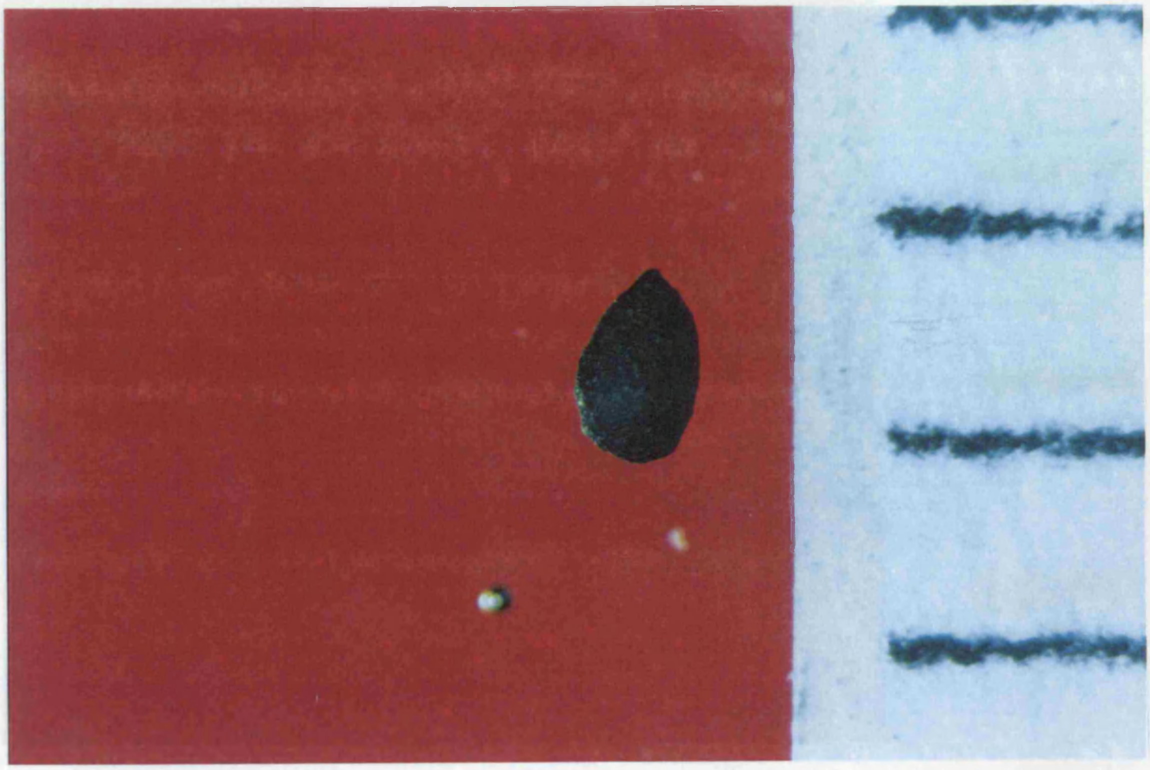


Plate 2.121 *Cyperus* spp. seed at x 26.

Plate 2.122 Cyperaceae - unidentified TYPE 1 seeds. (Scale shown in mm).

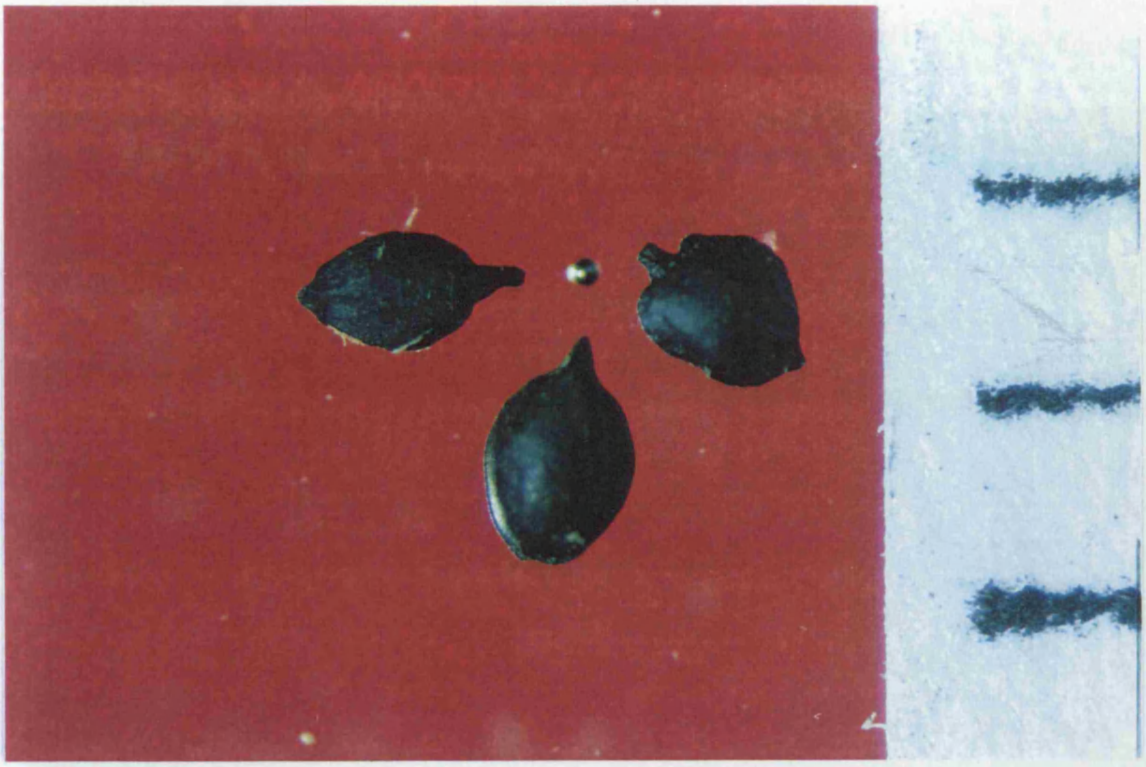


Plate 2.123 Cyperaceae - unidentified TYPE 2 seeds. (Scale shown in mm).

2.9 Unidentified

Plate 2.124 Unidentified H - leafy involucre at x 14.

Plate 2.125 Unidentified U - *Lawsonia*-like seed fragments at x 32.

Plate 2.126 Unidentified X - a) unidentified leaf at x 9.

Plate 2.127 Unidentified X - b) Split leaf / grass / palm at x 9.

Plate 2.128 Unidentified X c) small leaf / petal at x 20.

Plate 2.129 Unidentified A4 - a) filament of stamen at x 20.

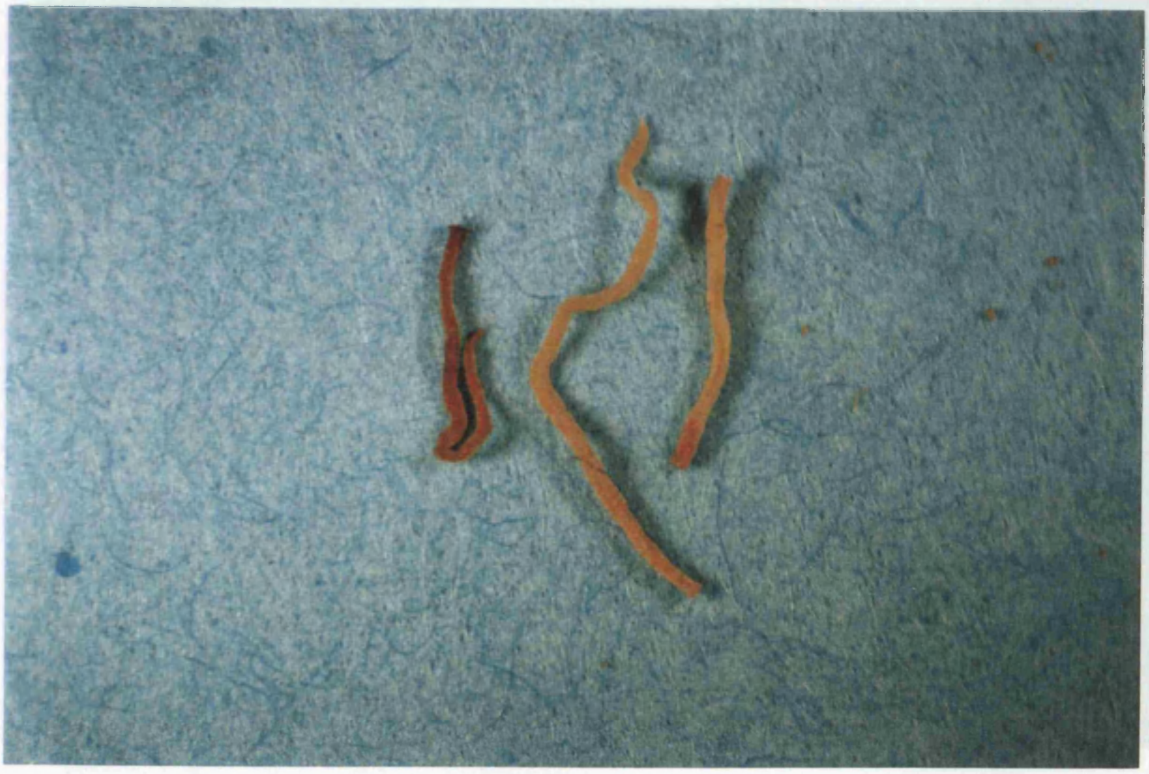


Plate 2.130 Unidentified A4 - b) stigma at x 20.

Plate 2.131 Unidentified A4 - c) anthers large and small at x 20.

Plate 2.132 Unidentified A4 - d) anthers or pods at x 26.

Plate 2.133 Unidentified A5 - Thin walled, red - zooarchaeological ? at x 29.

Plate 2.134 Unidentified A10 - shiny compressed seed - striated. (Scale shown in mm).

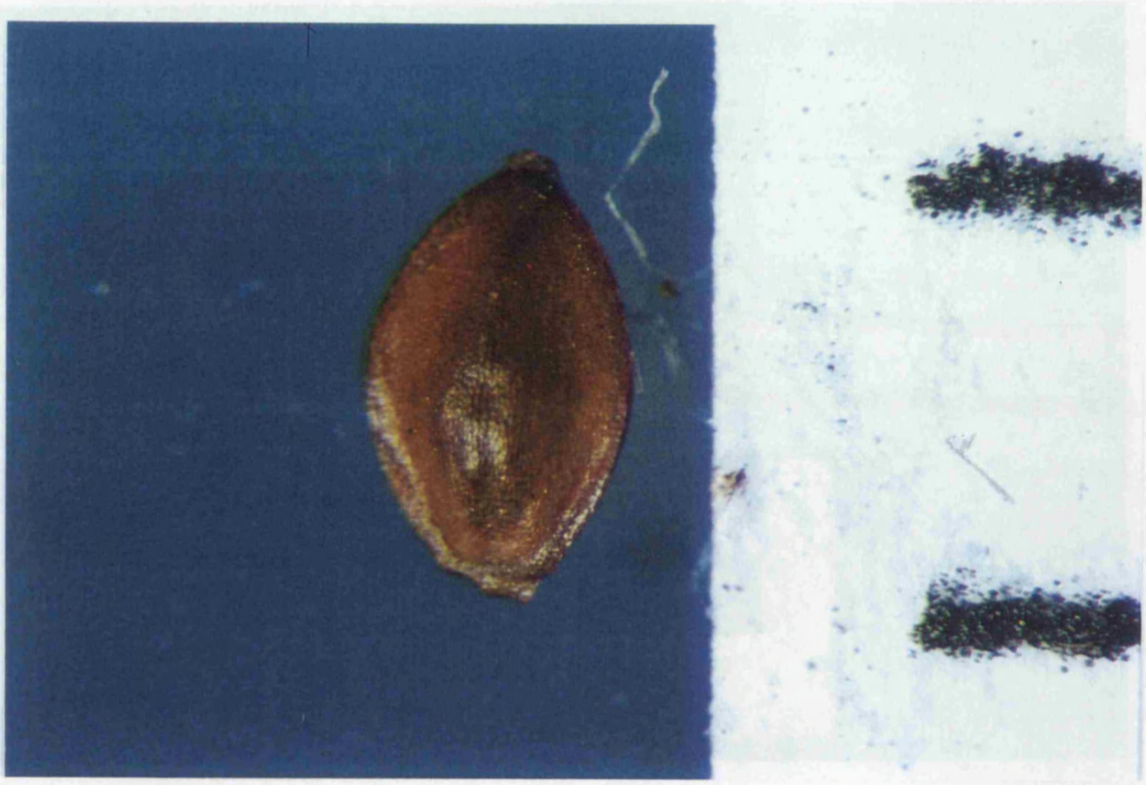


Plate 2.135 Unidentified A15 - shrivelled veined fruit at x 16.

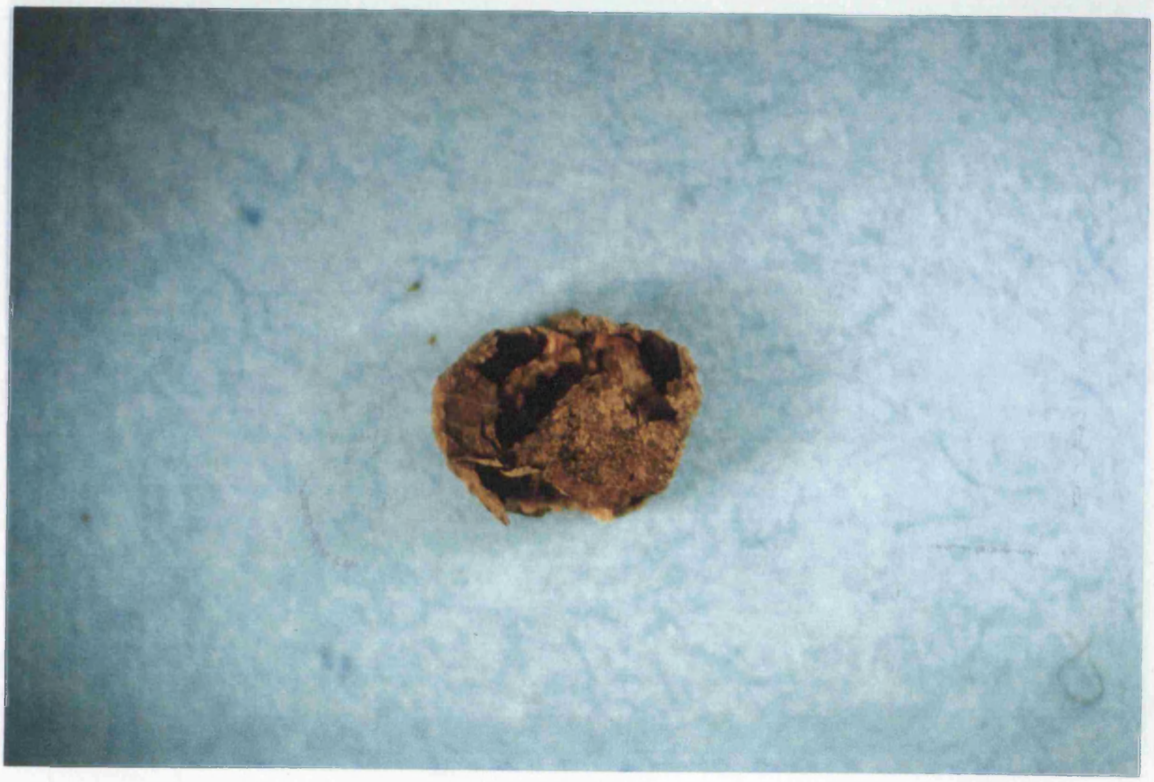


Plate 2.136 Unidentified A16 - unidentified root. (Scale shown in cm).

Plate 2.137 Unidentified A16 - b) unidentified bark. (Scale shown in cm).

Plate 2.138 Unidentified A22 - flower head / calyx at x 16.

Plate 2.139 Unidentified A24 - interior of fruit with seed at x 20.

Plate 2.140 Unidentified A27 - a) unidentified small fruit at x 13.

Plate 2.141 Unidentified A27 - b) unidentified fruit stem at x 13.

Plate 2.142 Unidentified A28 - Crescent part of stalk at x 13.

Plate 2.143 Unidentified A29 - small rounded seed at x 52.

Plate 2.144 Unidentified A35 - scale interior of seed ? at x 20.

Plate 2.145 Unidentified A36 - part of capsule? at x 20.

Plate 2.146 Unidentified A37 - ?? *Plantago*. (Scale shown in mm).

Plate 2.147 Unidentified A38 - internal structure ? (Scale shown in mm).

Plate 2.148 Unidentified A46 - ? Bud - hairless at x 13.

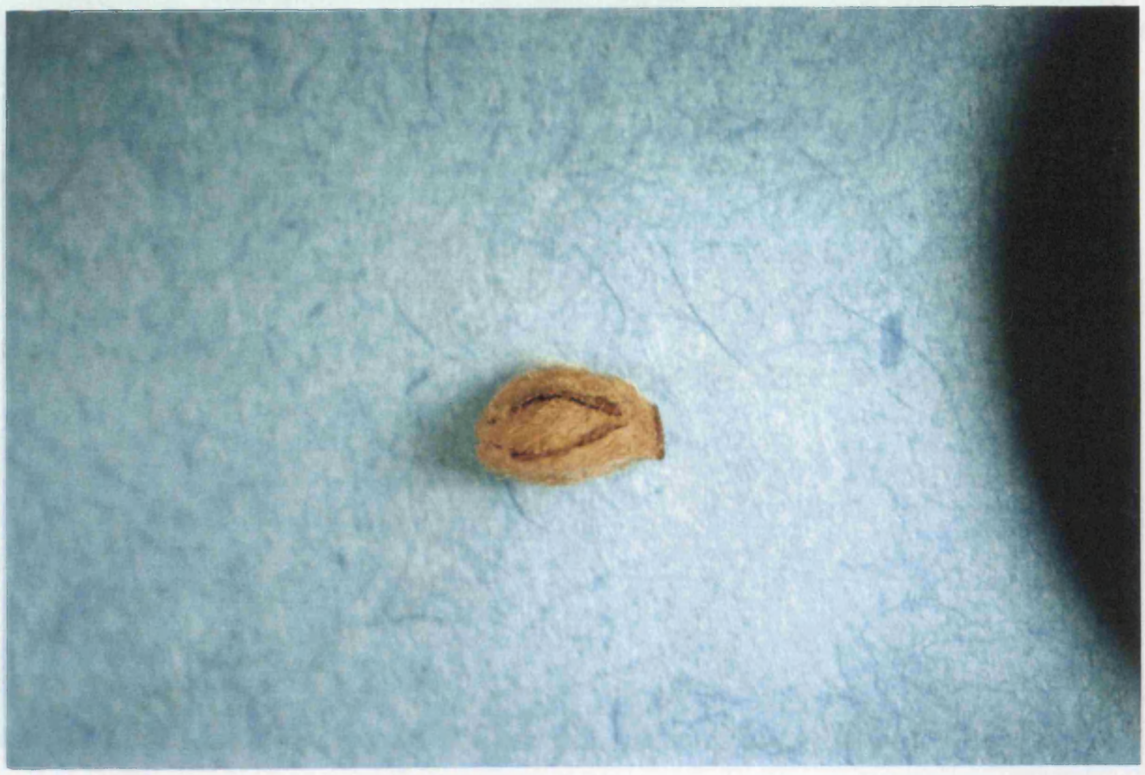


Plate 2.149 Unidentified A47 - unidentified seed coat fragments at x 20.

Plate 2.150 Unidentified A48 - ? Flower petals at x 16.

Plate 2.151 Unidentified A49 - a) large flower head at x 9.

Plate 2.152 Unidentified A49 - b) small flower head at x 22.

Plate 2.153 Unidentified A49 - d) stalk at x 13.

Plate 2.154 Unidentified A40 - extremely small fig-like seed at x 26.

Plate 2.155 Unidentified A53 - b) complete seed pod at x 26.

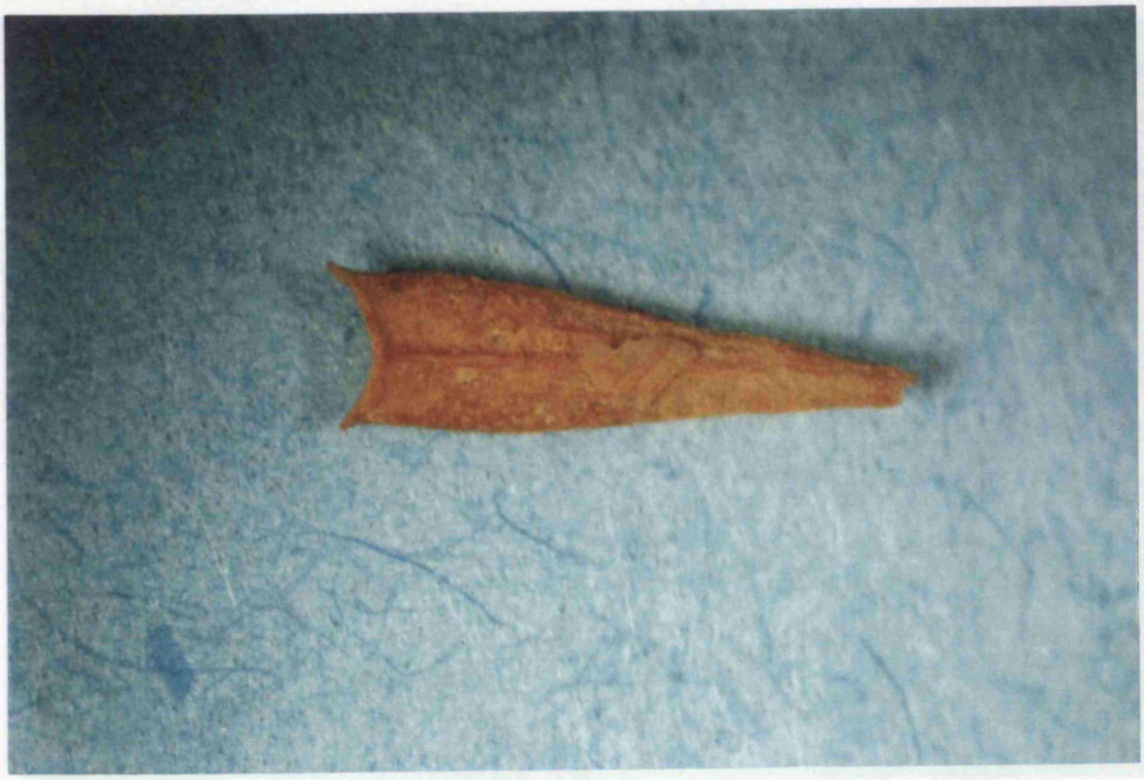


Plate 2.156 Unidentified A55 - bud (hairy) at x 13.

Plate 2.157 Unidentified A56 - small pitted seed at x 39.

Plate 2.158 Unidentified A57 - pink and round - zooarchaeological ? at x 16.

Appendix 3. New Identification Criteria

This appendix presents identification criteria for two plants of economic importance in Egypt: flax and sycomore fig.[1] Flax is a major fiber and oil crop which is known through artistic representations dating to the Pharaonic period (Brewer *et al.* 1994: 34-38, Hepper 1990; and Germer 1985: 100-102), as well as archaeobotanical finds starting from the fifth millennium BC in Egypt (Zohary and Hopf 1994: 123). Sycomore fig steadily produces fruits throughout the year and is related to the common fig, *Ficus carica* L. (Zohary and Hopf 1994: 156). Fruits of sycomore fig can be used for human consumption or as an animal fodder. The earliest archaeobotanical finds of sycomore fig date to the third millennium BC (Galil 1968) and artistic representations are known from the Pharaonic period (Germer 1985: 25-7).

The fragmentary remains of linseed / flax and sycomore fig discussed in this appendix were first labelled as miscellaneous, unidentified plants. It is not unusual to relegate fragmentary or poorly preserved plant remains to a tube labelled 'unidentified.' Most archaeobotanists quietly curate collections of unidentified plant remains from the various samples they have analyzed. Generally, due to constraints of time or money, this material is often left unidentified. However, the identification of these more fragmentary plant remains is worth pursuing and as will be shown here can provide information on well known economic plants as well as lesser known species.

The criteria discussed for flax and sycomore fig identifications are derived from elements which are not seeds, but are related to reproductive parts of these plants. In all cases modern comparative material was used to 'iron out' and illustrate the methodology for identification. In the case of flax, identification criteria were established on the desiccated material but have also been observed in the carbonized state. Sycomore fig was only preserved through desiccation at Kom el-Nana, and criteria presented here can only apply to this form of preservation at present. Scanning electron microscope (SEM) micrographs of modern material have been used here for presentation of the identification criteria as this best illustrates the characteristics used and circumvents depth of field problems inherent with photography using a low power binocular microscope. However, the characteristics chosen for the identification of flax / linseed capsule or sycomore fig are intentionally designed for archaeobotanists using a standard low power binocular microscope.

[1] In this appendix plates are not integrated with the text but are placed in order at the end.

3.1 Identification Criteria for the Internal Membrane of Flax / Linseed Capsules

3.1.1 The use and structure of Linum usitatissimum L.

Linum usitatissimum L. is a plant capable of producing two major economic products: fiber and oil. When grown for fiber, the plant is called flax and when grown for oil it is called linseed. Although today flax and linseed are distinctly separate cultivars, in the past the same plant could produce both crops but to a slightly lower standard than growing them individually (Bond and Hunter: 1987: 177-178). In general flax plants are thin, wiry and erect growing to approximately 1.2 m in height and requiring cool or temperate climates. Linseed is a shorter and much branched plant which is quicker to mature than flax and thrives in warmer climates (Langer and Hill, 1991: 293-294). Flax / linseed is an annual crop which is typically sown in the autumn and harvested in the spring in the Mediterranean and Near East (Charles 1985: 48). Linseed oil is produced by extracting the seeds from the capsules (possibly by pounding or grinding); crushing the seeds by pounding, milling or grinding and then pressing and filtering the resulting linseed meal. The by-products of this first pressing, the linseed cake and the chaff / stems of the plant, can be immediately used as a fodder or, possibly, as a fuel. Alternatively, the linseed cake can be processed again by another cold pressing or, more efficiently, by a hot pressing. In hot pressing, the linseed cake is first heated and then pounded, milled or ground to produce a lower quality oil than in the initial first pressing. The linseed cake from this second processing can be used as a livestock feed or as a fertilizer (Charles 1985: 51).

Flax is produced by four main processes (Brewer *et al.* 1994: 35-36 and Bond and Hunter 1987: 178-179). Bundles of flax are stripped of their leaves and capsules and then are submerged in slow moving water for between one to two weeks. This process breaks down the pectin which binds the bast fibers in the stem of the flax plant. The plants are then dried in the sun and, once dry, the outer bark is removed by pounding or passing the flax through a toothed instrument or brake. The fibers are then removed from the stem by bending the broken stems over a surface and beating with a flat blade (most likely wooden). Finally, the fiber is extracted by drawing the broken stems through a comb (most likely attached to a board) which removes the remains of the core and bark of the stem of the plant and leaves the flax fibers ready for spinning. The processing by-products of capsules and chaff / stem can be used as fodder for livestock or, possibly, as fuel. Fodder produced from crushed capsules of flax or linseed oil cake is high in protein but does require treatment with hot water to remove harmful toxins before feeding to livestock (Langer and Hill, 1991: 294). Flax or linseed capsule fodder is used today as a "concentrate stock food, especially for young animals and those intended for show (Langer and Hill, 1991: 294)." The term flax will be used hereafter, but either crop could be plausible at Kom el-Nana and elsewhere in Egypt.

3.1.2 Identification criteria for Linum usitatissimum L.

Capsules of flax appear to be 10 chambered, but in fact begin development with five chambers. As the plant matures each chamber is eventually divided by a false septum. Each of the 10 chambers of a mature capsule bears one seed. As the capsule ripens, the segments start to separate creating points at the tip of each capsule segment. Thus, quantification of a capsule from its fragments can be achieved by counting what could be termed as 'capsule tips,' where 10 tips are equivalent to one capsule and one capsule is equivalent to 10 seeds.

Although the overall shape and exocarp of the capsule are morphological elements available for the identification of flax capsule, the archaeobotanical recovery of complete flax capsules is unlikely. Indeed, no whole capsules were found at Kom el-Nana. Those fragments of flax capsules recovered varied in size from 5 mm^2 to less than 0.5 mm^2, none of which would be visible to even the most careful of excavators. Crushed flax capsules, the by-product of oil or linen production, are likely to be found archaeobotanically and identification criteria need to be established in order to ensure that such fragmentary material is recognized.

Careful examination of archaeological and modern material has led to the development of some useful identification criteria. Fragments of linseed capsule can be easily recognized by the clear pattern, similar to a fingerprint, found on the internal membrane of the capsules. In Figure 3.1 a ribbed pattern running transversely across the internal membrane of each capsule segment is just visible. At magnifications of roughly 30 to 45 (Figure 3.2) the ribbed patterning clearly comes into view using a low power binocular microscope. Taking advantage of the high magnification and resolution the SEM affords, at a magnification of 167 (Figure 3.3) it is clear that the individual cells which form the ribbed pattern vary in shape but are consistent in direction. Generally, the cells tend to be longer than wide but exceptions to this are present within the capsule membrane. Finally, this pattern consistently runs transversely across the capsule's internal wall.

3.1.3 The identification criteria to distinguish Linum usitatissimum L. *from Raphanus raphanistrum* L.

As might be expected, there is a complication. The internal capsule membrane of wild radish, *Raphanus raphanistrum* L. (which will be called *Raphanus* hereafter) also exhibits a similar 'fingerprint pattern' (Figure 3.4). Because *Raphanus* is a noxious weed, it is essential that criteria are established to distinguish *Raphanus* capsule fragments from those of flax.

Raphanus raphanistrum capsules (Figure 3.5) are constricted between each segment and longitudinally ridged (van Zeist *et al.* 1987: 394-397). Each capsule segment remain persistently closed upon maturity and contains one seed. The individual capsules can vary in length from 5 to 7 mm and in width from 3 to

5 mm and typically form chains of segments between 30 - 90 mm in length which often break at the points of constriction. As a result, quantification is most effectively carried out by counting each individual capsule segment as one, where one capsule segment equals one seed. The Ministry of Agriculture, Fisheries and Food bulletin on poisonous plants (Forsyth 1979: 43) notes that although there are no recent records of poisoning by wild radish, it is believed to be harmful if eaten in large quantities. The case cited for poisoning was based on French evidence for a herd of sheep which died from grazing "in a field covered with wild radish in an advanced stage of florescence (Forsyth 1979: 43)." Unfortunately, no specific information on which element or elements of the plant are poisonous was provided.

Fragments of detached membrane from capsules of *Raphanus* in either a desiccated or carbonized state can be easily confused with detached fragments of the internal membrane of flax capsule. The archaeological material from Kom el-Nana was often reduced to between 0.5 mm^2 and $1mm^2$, opaque pieces of membrane, typically with only partial preservation of the mesophyll cells from between the internal and external capsule walls. The only feature available for the identification of such fragmentary material, is the cell patterning. The 'finger print' pattern is a reliable feature to aid recognition of membrane from capsules of *Raphanus* or flax. In addition, there are a few elements in the surface pattern of *Raphanus* which allow some, but perhaps not all, membrane fragments to be distinguished from flax.

If part or all of the external capsule wall is preserved, identification of ancient *Raphanus* is straightforward. The longitudinal ridging of the external capsule wall shown in Figure 3.5 is exclusive to *Raphanus* capsules, and is a useful characteristic for identification. Generally, *Raphanus* capsule segments are twice the widest width of flax capsule segments and do not taper as strongly (Figure 3.6). There are two features at the edges of the capsule which are specific to the structure of the internal membrane of *Raphanus* capsules. First, the surface patterning of *Raphanus* varies along the length of the capsule segment where each half joins and, second, at each point of constriction between the capsule segments there is also a change in the surface patterning on the membrane. Along the edges of the capsule at magnifications between 30 to 45 bundles of cells closely packed together, and thicker than the main membrane run longitudinally up the edges of the capsule and are clearly distinct from the main pattern (Figure 3.7). At both points of constriction in a capsule segment there is a 90° change in direction of the cell pattern of the membrane (Figure 3.8). Also, the membrane at the points of constriction appears to be lying over that of the main body of the capsule. At times, the membrane at the point of constriction can appear torn. All changes in the direction of cell pattern on a capsule's internal membrane clearly distinguish *Raphanus* from flax. Fragments of membrane which do not have a change in cell pattern cannot be identified with safety to either species using low power microscopy.

3.2 Identification Criteria for the Galls of Sycomore Fig

3.2.1 The use and structure of Ficus sycomorus L.

Sycomore fig is and was a major economic plant in Egypt which produces fruit for human consumption, leaves and fruits for fodder, and timber. In Egypt, identification of *Ficus sycomorus* L., or the sycomore fig, has only been made from completely preserved fruit. This is not surprising, since sycomore fig does not produce seed in Egypt at present, and has not done so for at least the last two millennia. The rarity of finds of complete fruits of sycomore fig, even with Egypt's wonderful desiccated preservation, does mean that sycomore fig is highly under-represented in the archaeobotanical record.

Two species of edible fig are available in Egypt: *Ficus carica* L. (the true fig) and *Ficus sycomorus* L. (the sycomore fig). In either case the fig is a false fruit which is actually a fleshy swelling of the stem where it houses the tree's flowers. A small orifice or ostiole allows for insect pollination of either species of fig. Originally both species of fig relied on a symbiotic relationship with female wasps for reproduction, but cultivated *Ficus carica* produces clones without pollination which do produce seed (Zohary and Hopf 1994:151). Sycomore figs can be forced to ripen by making incisions in immature figs which cause them to swell, producing edible but seedless figs in less than a week after the incisions are made. *Ficus sycomorus* is capable of producing up to six crops a year in this way.

The sycomore fig has a complex reproductive cycle. In its native habitat on savannah lands of eastern Central Africa, the sycomore fig relies on a symbiotic relationship with the wasp *Ceratosolen arabicus* Mayr. A sycomore fig contains both long and short styled female flowers and the gall of the sycomore fig where the wasp eggs develop is actually formed from the ovaries of its flowers. When the wasp attempts to deposit its egg in the ovary of a sycomore fig's flower it is only successful with the shorter styled flowers. The long styled flowers escape infestation, are pollinated and reach maturity, producing seed (Galil 1968; Galil and Eisikowitch 1968). In this way both the sycomore fig and the wasp reproduce, as well as producing an edible fig.

Today the habitat of *C. arabicus* does not extend as far north as Egypt, but there are two other species of wasp which exist in the eastern Mediterranean that are known to invade the sycomore fig. These wasps have a parasitic relationship with the fig because their ovipositor (the tube which places the wasp's eggs into the ovary of the fig's flower) is long enough to lay eggs in the ovaries of the long styled female flowers as well as the short styled female flowers which results in a fig full of galls and not seed, and ultimately produces a fruit which can only be consumed by animals. The galls which are formed from the ovaries of the sycomore flowers in many ways mimic the development of the seeds. As the wasp develops within the ovary of the flower, the gall swells out at exactly the place where the seed would have developed and, in essence, creates a phantom of the fig seed.

One of the issues concerning identification of fig seeds in Egypt has been the possibility that seeds of *Ficus sycomorus* could not be distinguished from those of *Ficus carica* (van Zeist and de Roller 1993: 8), but at some point in Egypt's history sycomore fig stopped producing seed and so could not be confused with the true fig. Certainly Theophrastus (Book IV. Vol. 2. 1-3), who lived between 372-287 BC, states that the sycomore did not produce seeds in Egypt. Research by Galil (1968) and Galil and Eisikowitch (1968) confirms that without the original pollinators, the sycomore fig was unable to produce seed. The adoption of the gashing technique may, in fact, be another means of determining a *terminus ante quem* for the disappearance of sycomore fig seed. If a symbiotic relationship existed, edible fruit would be produced and there would be no reason to force fruit to ripen early; so it must follow that the adoption of this technique coincides with the loss of edible figs either through extinction of the symbiotic wasp or through the presence of parasitic wasps. The earliest finds of complete figs with such cuts or gashes date to the twelfth Dynasty or *ca.* twentieth century BC (Galil 1968: 178 (incorrectly dated) and Germer 1985:26), and does at least indicate the loss of sycomore seed at a considerably earlier date than that of the Kom el-Nana material.

3.2.2 The identification of Ficus sycomorus L. *gall.*

From the first few Kom el-Nana samples examined, a categorization of 'not fig' was made for plant remains which were similar to fig seeds in shape and size, but always had a dark, papery outer seed coat. Examination of modern seeds of *Ficus carica* L. and modern galls of *Ficus sycomorus* L. resulted in the recognition of the true origin of the 'not fig' material. Galls of modern sycomore figs were found to be nearly identical to the ancient 'not fig' material present at Kom el-Nana.

Modern *Ficus carica* L. seeds are clearly beaked and have an embryo (Figure 3.9). In addition, the surface pattern of common fig is strongly reticulated (Figure 3.10). Sycomore fig galls are quite distinct from common fig seeds. A modern *Ficus sycomorus* L. gall is stalked, does not have an embryo, but does have a hole at its top where the wasp escapes the gall (Figure 3.11). The gall casing of modern *Ficus sycomorus* varies in colour from tan to red-black, but is always smooth (Figure 3.12).

Figures 3.13 and 3.14 are examples of ancient 'not fig' material from Kom el-Nana. The specimen shown in Figure 3.13 clearly exhibits a round whole at one end which is remarkably similar to the exit holes observed in modern *Ficus sycomorus* L. galls. The ancient gall casing shown in Figure 3.14 exhibits the same smooth outer surface as the modern comparative material shown in Figure 3.12. Both specimens are clearly stalked and have no embryo. Finally, the stalks were adopted as the criterion for quantification and those fragments of sycomore fig gall without a stalk were not quantified.

3.3 Conclusion

The fragments of flax and sycomore fig discussed here were not immediately identifiable. However, their presence in many of the Kom el-Nana samples suggested that they may be of some significance. Careful examination of modern comparative material resulted in the identification of these plant remains as flax or *Raphanus* capsule and as sycomore fig galls. Flax and sycomore fig were of considerable economic importance in ancient Egypt and their identification means that we can better understand how these crops were grown and used at Kom el-Nana and elsewhere in Egypt. There is good evidence for the heavy production of linseed oil and for the production of linen garments, most likely as a luxury item, in Late Antique Egypt (Bagnall 1993: 29 and 33). There are, however, few records of either common fig or sycomore fig in the period (Bagnall 1993: 31). The establishment of identification criteria for these crops means that another independent form of evidence for the cultivation and use of flax or linseed and sycomore fig is available. Archaeobotanical identifications of these crops can establish where and when they were grown and, to some extent, may be used to identify centers of intense cultivation. Such archaeobotanical evidence for economic crops is a useful form of primary evidence for agricultural production which operates independently from the historical sources but can be used in combination with these records to extend our understanding of agricultural practice in Egyptian Late Antiquity or, indeed, other historical periods.

Plate 3.1 SEM micrograph of two segments of modern flax / linseed capsule.

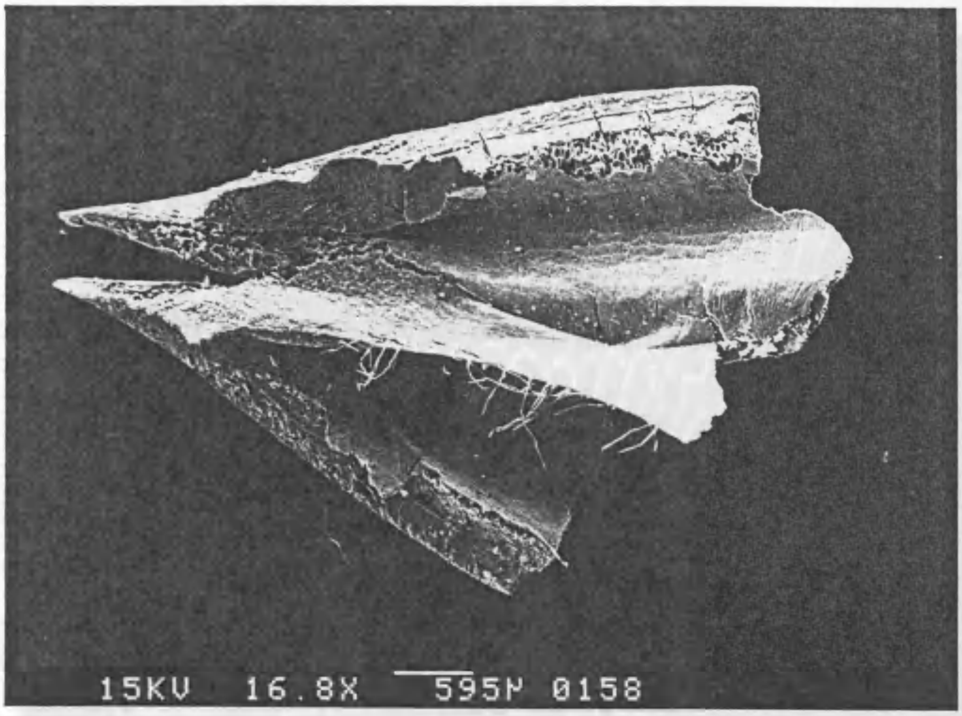


Plate 3.2 SEM micrograph detailing the ribbed pattern of the internal membrane of a modern flax / linseed capsule.

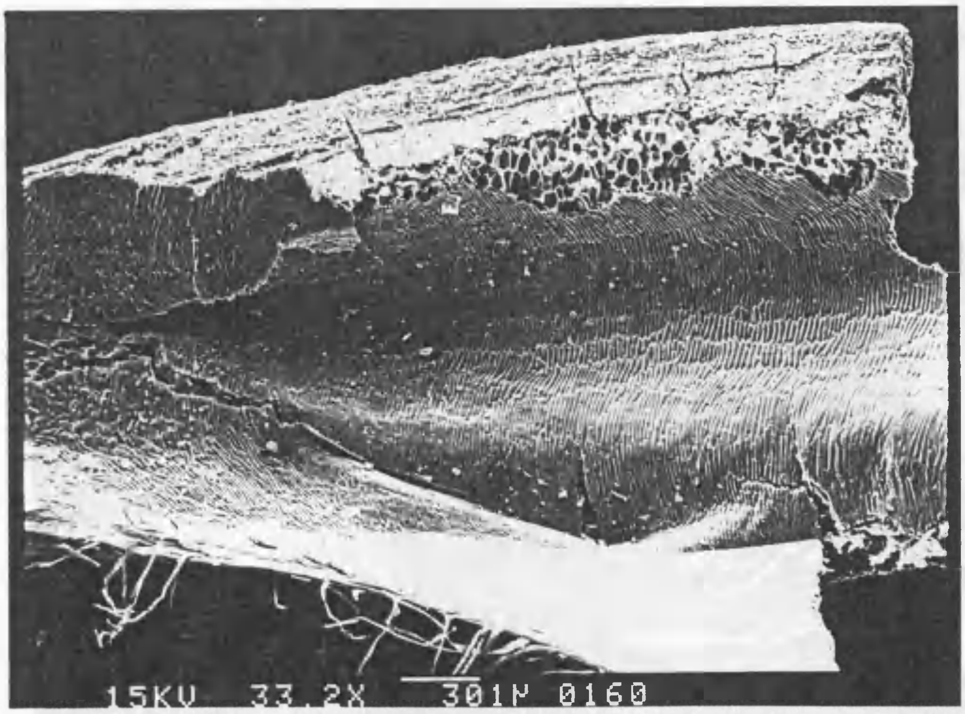


Plate 3.3 SEM micograph detailing the ribbed pattern on the internal membrane of a modern flax / linseed capsule at the level of individual cells of modern.

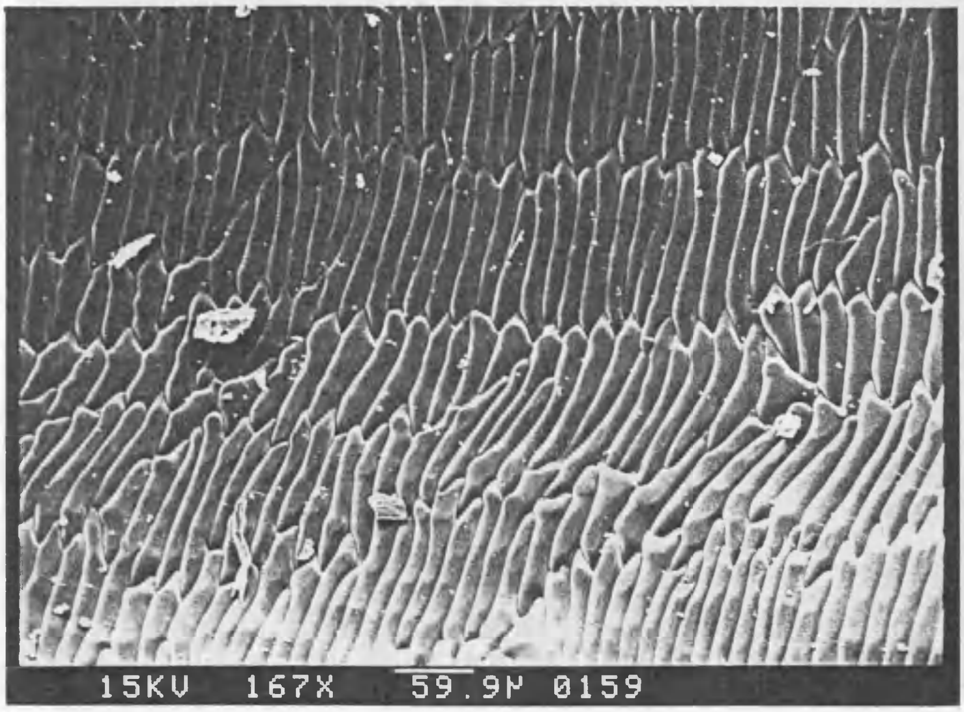


Plate 3.4 SEM micrograph detailing the ribbed pattern on the internal membrane of a modern *Raphanus raphanistrum* at the level of the individual cell.

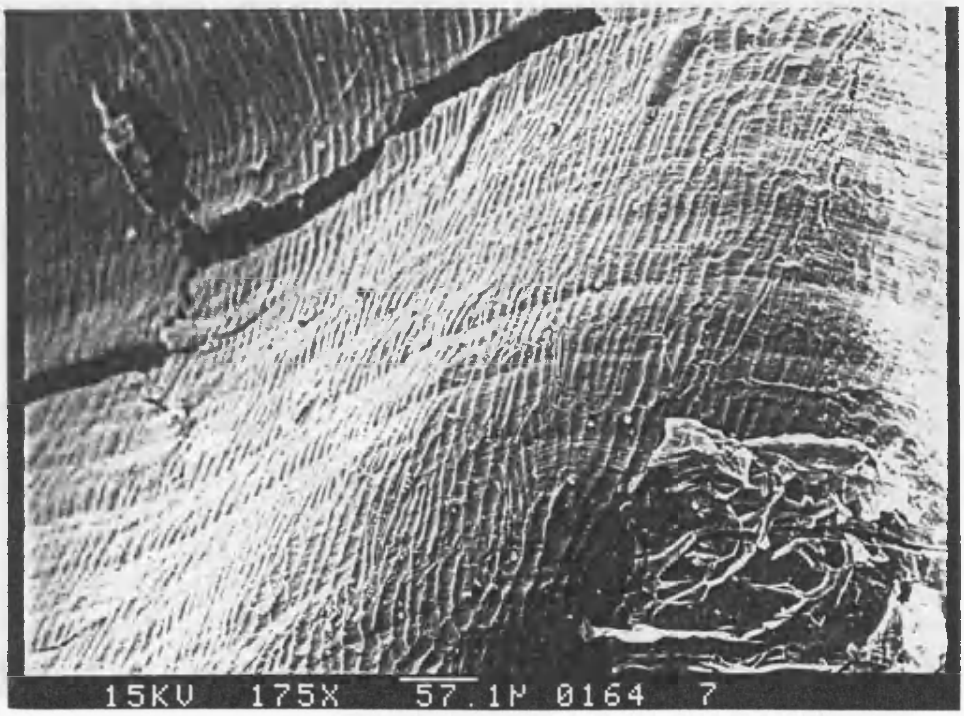


Plate 3.5 SEM micrograph of the external wall of a modern capsule of *Raphanus raphanistrum*.

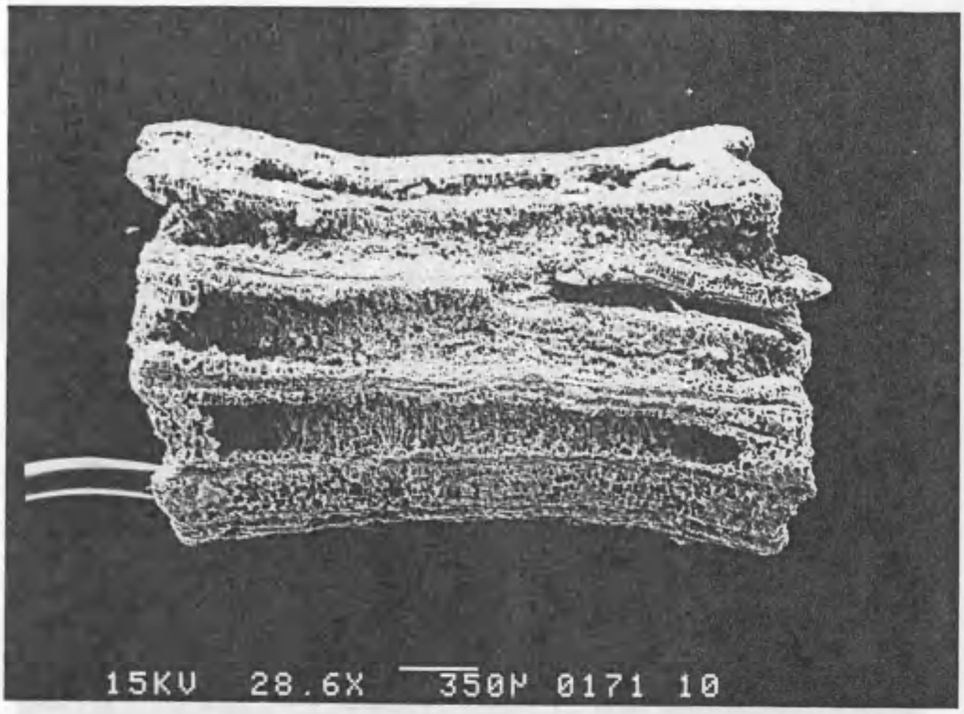


Plate 3.6 SEM micrograph of the internal membrane of a modern capsule of *Raphanus raphanistrum*.

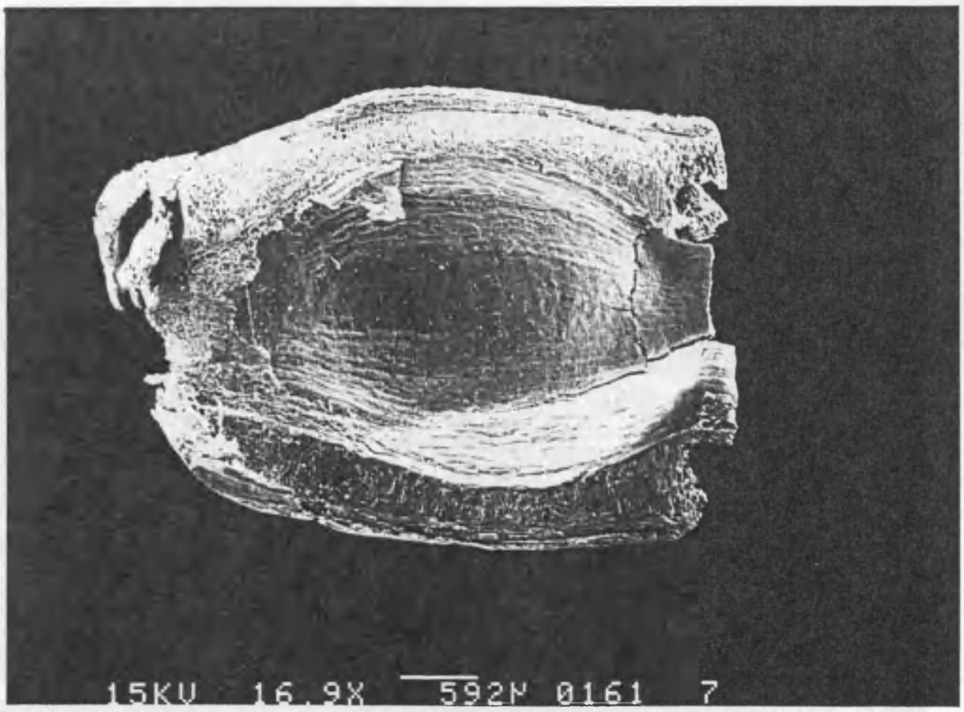


Plate 3.7 SEM micrograph detailing the change in direction of the cell pattern of the internal membrane along the length of the capsule (see bottom left of micrograph).

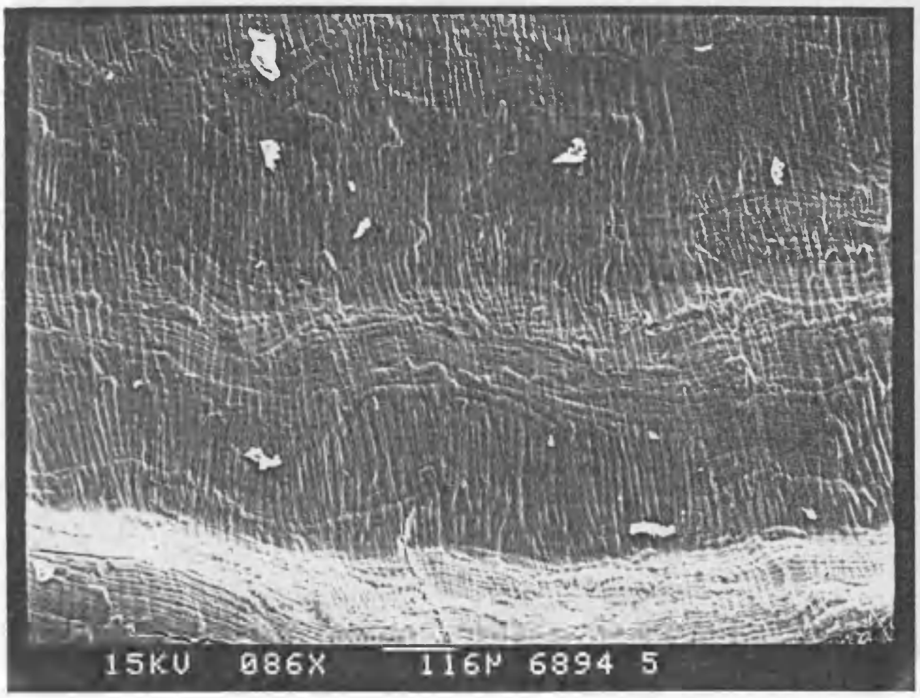


Plate 3.8 SEM micrograph detailing the change in direction of the cell pattern of the internal membrane at the point of constriction between individual capsule segments.

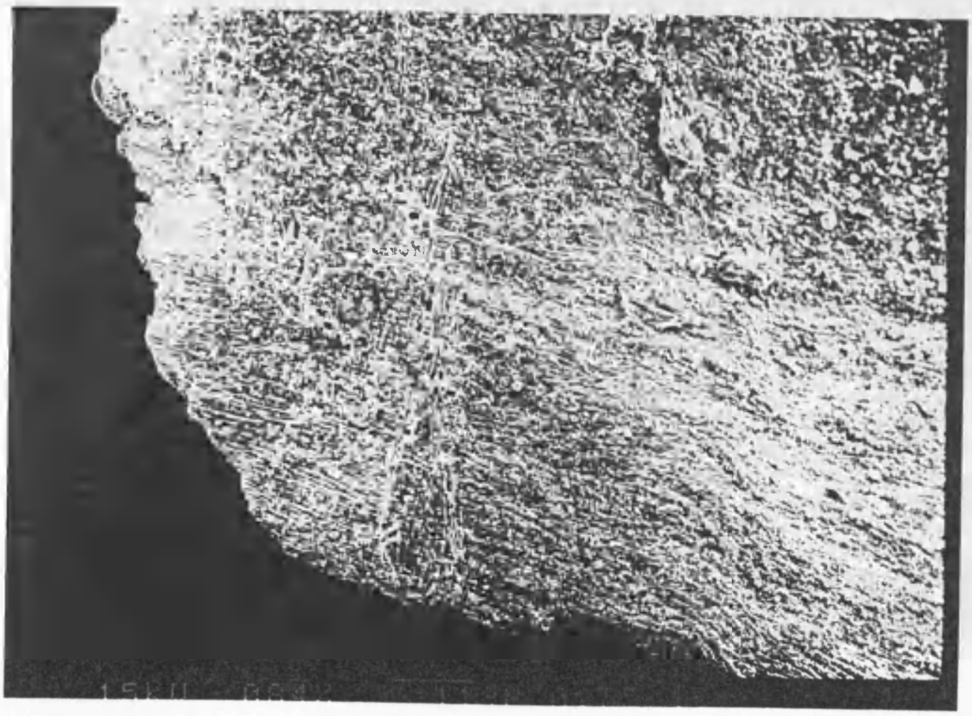


Plate 3.9 SEM micrograph of a modern *Ficus carica* L. seed.

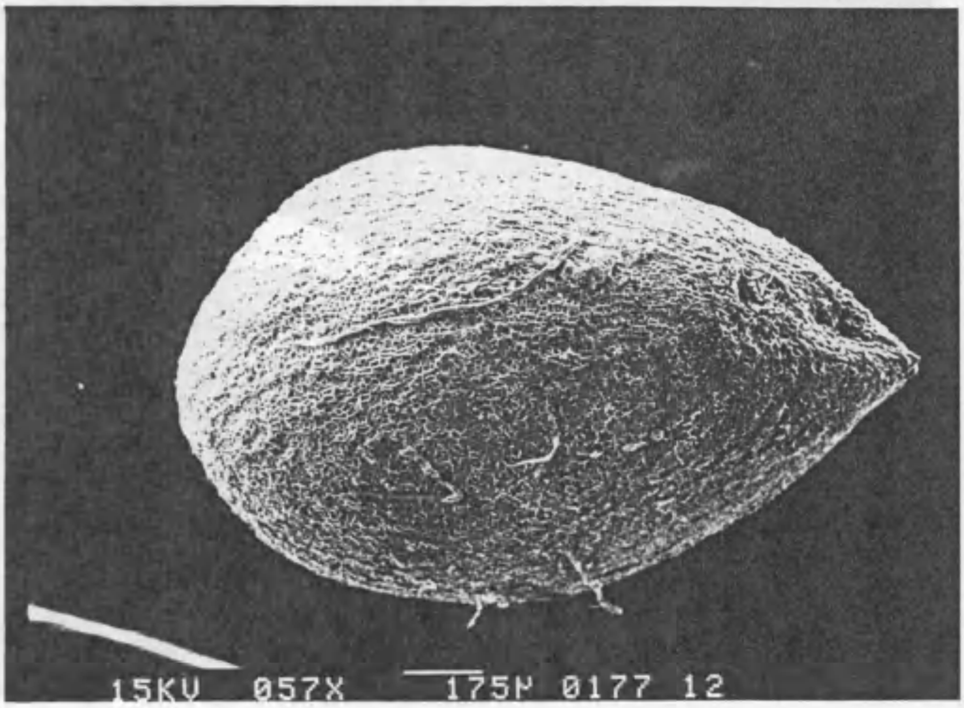


Plate 3.10 SEM micrograph detailing the reticulated surface pattern on a modern *Ficus carica* L. seed.

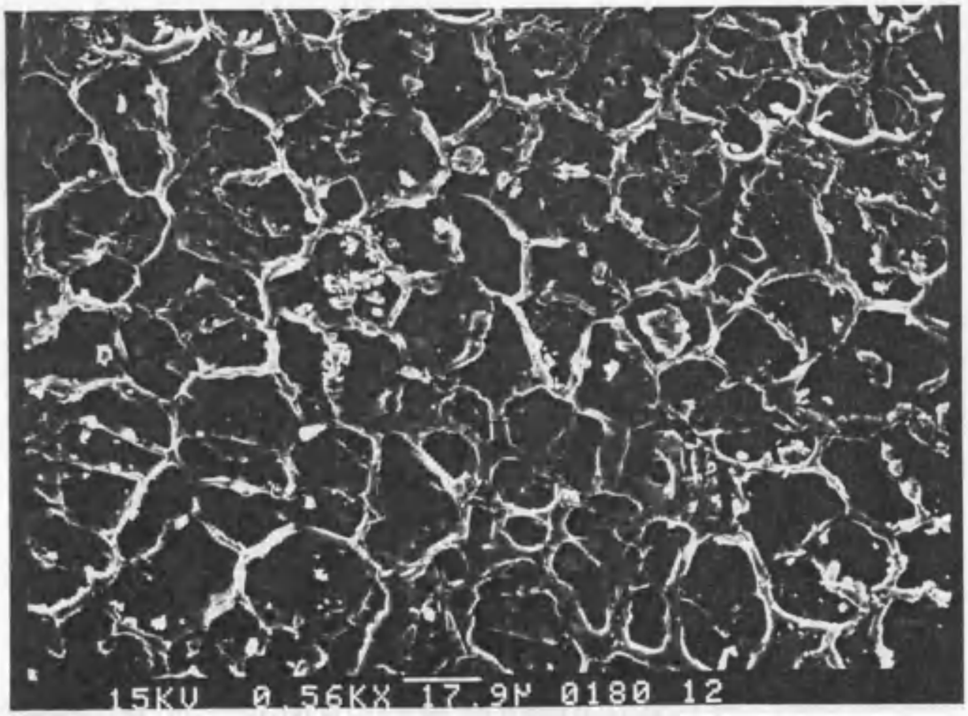


Plate 3.11 SEM micrograph of a modern Ficus sycomorus L. gall.

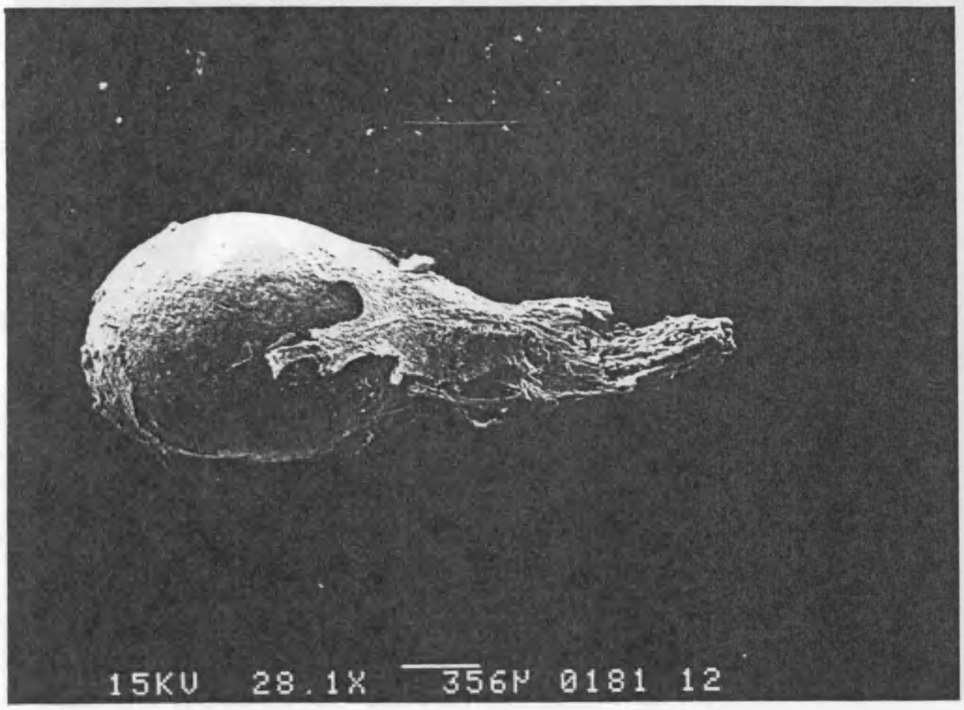


Plate 3.12 SEM micrograph detailing the smooth surface of the gall casing of a modern *Ficus sycomorus* L. gall.

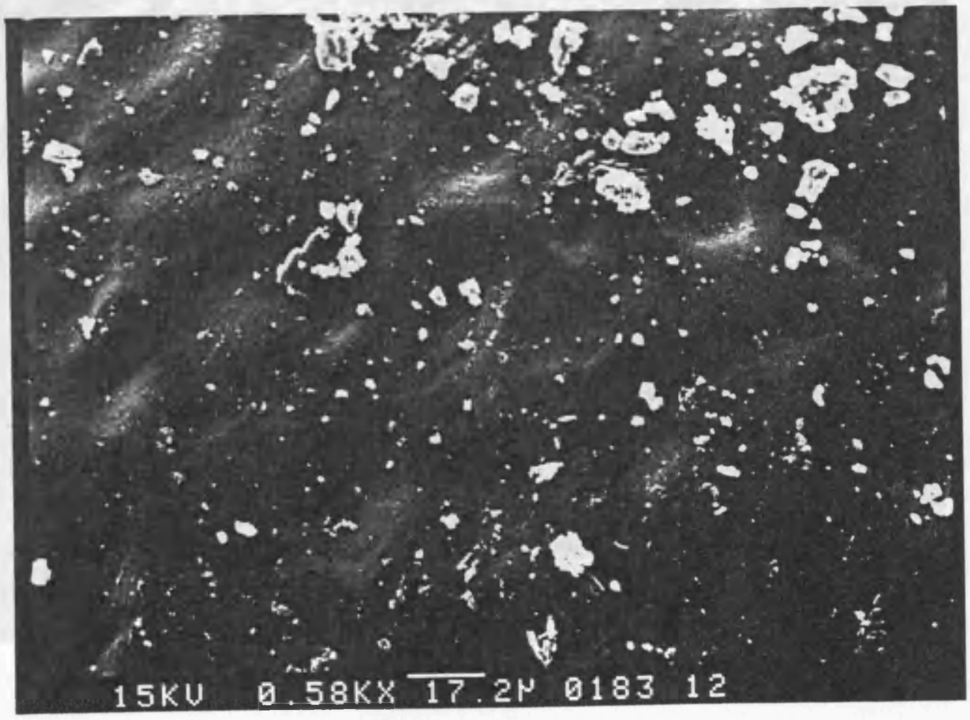


Plate 3.13 SEM micrograph of an ancient *Ficus sycomorus* L. gall from Kom el-Nana.

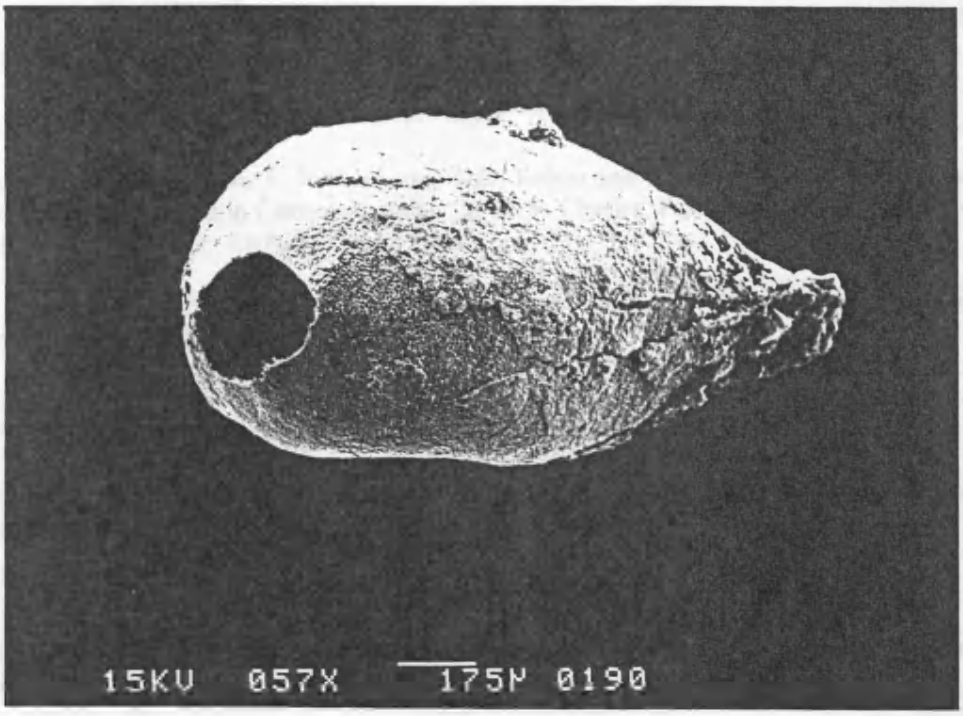
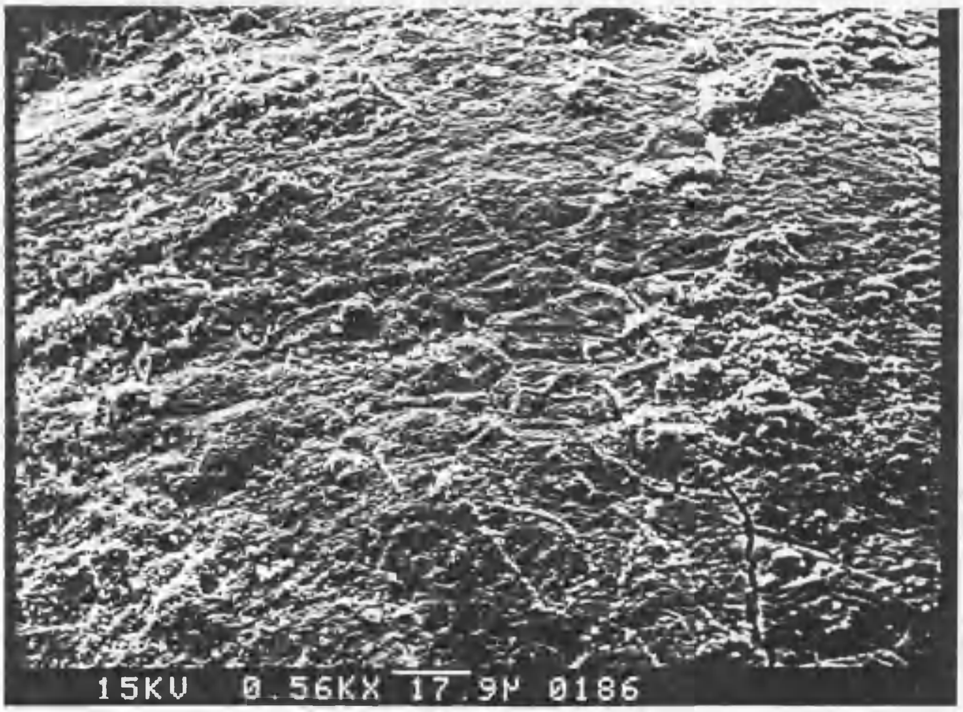


Plate 3.14 SEM micrograph of an ancient *Ficus sycomorus* L. gall casing from Kom el-Nana.



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