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ANCIENT MONUMENTS LABORATORY

REPORT

4076

SERIES/No CONTRACTOR

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TITLE Some scientific techniques used in the study of past diet shown by remains at Worcester, Oxford and compared with other results

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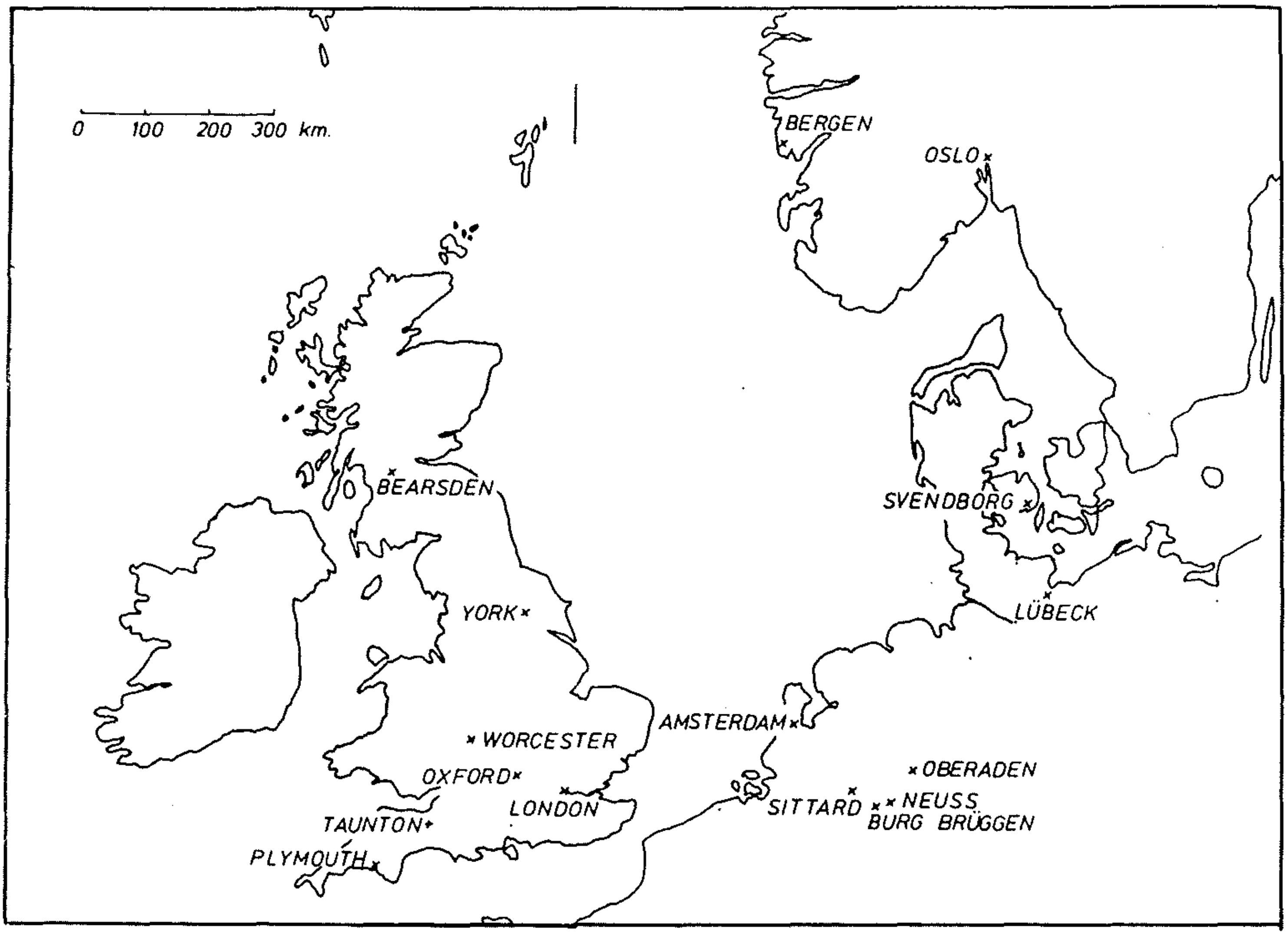
Introduction

Much interest in past diet has been shown by archaeologists, since much of the activity of early mankind was concerned with getting enough to eat. Archaeological remains are often connected with food, such as granaries, food storage and preparation pots, field systems and even remains of food plants and animals. Two books by archaeologists (Brothwell & Brothwell 1969) and Wing & Brown 1979) cover, respectively, the whole world and the Americas, and even nutritionalists have contributed to the subject (Yudkin 1969). More recently, there has been considerable progress in various archaeologically-applied sciences which show new aspects of past diets and also the prospect of further increases in information on the subject.

The main ways of studying past diet

Past diet is a complex matter, and the different types of evidence for it provide information on very different aspects of the subject which are not always easy to bring together. There is evidence from documents and pictures (including wall paintings and mosaic floors) which is often the province of historians rather than archaeologists. There is the study of skeletal pathology and human remains, often done by doctors interested in archaeology, and the study of the remains of crop plants and animal bones, mollusc shells etc. which are usually to be found scattered on archaeological sites and which can be collected systematically, and finally the rather specialist topic of faecal remains, such as single coprolites (turds) or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BURG BRÜGGEN
TAUNTON
PLYMOUTH

the larger masses of sewage whose study is the main subject of this paper.

Documentary evidence goes back to the earliest cuneiform tablets of the Assyrian civilisation (ca. 3000 B.C.E.) Ellison (1981). Egyptian hieroglyphs occasionally mention foodstuffs, or how they were obtained through agriculture, such as the opium poppy, an important oil seed in around 200 B.C.E. (Crawford 1973). Classical Greek writing (from ca. 800 B.C.E.) contains some imformation on food and medicine, and the Romans borrowed extensively from the Greek works as well as producing original writings. The dietary information is usually in the form of chance remarks, although there are some whole works that are relevant like Apicius' book on cooking (Flower & Rosenbaum 1958); how typically some of these recipes represent Roman diet is rather questionable, however. From the Middle Ages (around 1000-1500 C.E.) there are scraps of documentary information which deal with diet contained mainly in legal documents such as wills, tax (such as customs.records: Gras 1918) or trade records (Ruddock 1951). Some historians have drawn together very useful bodies of information relating to diet directly (Dyer 1983) or via another subject, such as gardening (Tyssen-Amherst 1894, McLean 1981).

Documentary evidence does not give a balanced picture of past nutrition, because it tends to show what one section of the populace may have eaten, usually the better-off minority who were written about and had their pictures painted. Recipes may not show what people actually did eat, but rather interesting variations on the normal diet, and the documentary record of diet is very incomplete.

Pathological evidence can be useful for dietary information, usually from human bones because this tends to survive when other remains have long disappeared. The pathology of dietary problems which can then be studied includes rickets, dental wear and caries. Dental disease in ancient Egypt and Nubia was studied by Hillson (1979.) The rare occasions when fairly well-preserved whole bodies are found have given opportunity for more dietary information to be obtained. Disappointingly, Egyptian mummies often had internal organs removed during the embalming process. The 'bog people' found preserved in parts of northern Europe (Glob 1969) have provided some detailed information thanks to the expert work of the late Hans Helbæk (e.g. Helbæk 1958). The gut contents included wheat, barley, linseed and the seeds of a range of weeds of arable land. Hillman (1981: 156-158) has somewhat re-interpreted the original conclusion that this was the normal diet of the time by showing that the remains are very similar to those which would be found in grain processing waste. The possible tail grain, chaff and weed seeds would have been kept for animals, famine food or, in this case, for a condemned prisoner who did not deserve better ! The main problem with this kind of dietary study is the rarity of well-preserved corpses as well as the question whether someone's last meal is representative of diet as a whole.

The scattered and fragmentary remains of edible plants and animals are nowadays as carefully sought by archaeologists as the solid structures and artifacts that they have traditionally found more interesting. The remains of grain have commonly been preserved by charring (partial burning) when crop processing waste was burnt, during grain drying, or occasionally when the contents of a granary were burnt either accidentally or because the grain was infested with insects (Osborne 1977): few cereal remains survive otherwise. Likewise a large range of animal bones, some with characteristic butchery marks, are to be found on most archaeological sites unless the soil is very acidic. Mollusc shells are common in some places on the coast, and inland in the case of Roman oyster remains. Careful sieving can reveal the part that fish played in the diet. All this is indeed dietary information, but at one stage removed from actually being eaten, with consequent problems of interpretation; barley, for instance, may have been used as animal food or as a punishment diet for Roman soldiers rather than being an important part of human diet (Davies 1971), and bones may not necessarily mean a meat diet if the animals supplied products like leather rather than meat (O'Connor, in press).

Faecal remains such as turds (called 'coprolites' in the archaeological literature) can give some very detailed dietary information. Pioneer work on remains preserved in dry climates in the Americas has been done by Callen (e.g. 1969), and plant remains (mainly seeds and nuts) insects, fish scales, bone, parasite ova and animal hairs were studied from a range of American Indian sites dating from 7000 B.C.E. - 1500 C.E. In northern Europe, the conditions are not so suitable for the survival and recognition of coprolites, but prehistoric faeces from the Netherlands have been studied by Paap (1976) and in Poland by Kowalski et al. (1976), and in Britain, some dated from c. 1300 Oxford by Greig (unpublished) and Hall et al (1983) studied one of Viking age from York. Coprolites offer the great advantage that they represent food residues with no other rubbish unlike most sewage, although some of the insect remains in them can have got in after deposition. They have a corresponding disadvantage that they are rather rare, small in quantity and not always certainly human. Dogs scavenge waste food from humans now, and as they probably did so in the past they could have had a diet which included things like bread. Most of the coprolites studied seem to have had abundant signs of cereal pollen, and although this was not always realised at the time, bread does contain substantial amounts of this pollen. The Dutch coprolites were argued to be human, on anatomical grounds, while those from Poland and and Britain were thought canine, the latter because of the large amount of finely-divided bone.

Much work has been done recently on accumulations of sewage from cesspits and latrines (American: outhouse) and this paper is mainly concerned with seeking evidence of diet from these results. As plant remains are usually the most numerous and immediately obvious content of this material, most of the work has been done by botanists who may not have had diet as one of their main aims of research, but it is hoped that future work will be more directed towards dietary information.

The cesspits and latrines are often large accumulations of material up to cubic metres in volume, and buried fairly deeply in the ground so that they sometimes lie intact until modern building works expose them. Sometimes the remains are poorly preserved or mineralised, and the results from these are understandably meagre. Others are well-preserved because of waterlogging, or an impermeable soil and can contain a very large range of remains of plants, insects, molluscs, fish, birds, mammals and artifacts like pottery, glass, cloth, shoes etc.

A few Roman remains have been studied but these finds are rare because the Romans were generally excellent sanitary engineers and built such good means of waste disposal that the sewage itself has usually long gone; the Roman sewer at York contained very little that could be connected with Roman sewage (Buckland 1976).

There appears to be a gap in occurrence of sewage from around 500 - 1000 C.E. although the floor layers of York at around 800 C.E. have signs of some faecal matter, although not concentrated (Hall et al 1983). In the middle ages latrines and cesspits seem to have been common, perhaps a result of the needs of people living in towns, and the time from 1400 - 1700 C.E. seems to have been the best for these deposits (Greig 1982b).

methods

Ancient sewage is usually a brown amorphous organic mass with visible fruit seeds and often holes from insect activity. It is probably found more often than it is studied, and some of the samples analysed have been extremely small, limiting the amount of information obtained, such as a mere 40 g. (Wilson 1975). Samples for analysis are ideally as large as possible, so that the different types of remains can be dealt with suitably. Animal bone studies usually involve the sieving of many kg. of material. Insect remains are recovered from samples up to 5 kg. and are floated away from the organic mass with kerosene, but seeds are so numerous that smaller samples are needed --- 500 - 1000 gm. These methods are described in Kenward et al(1980). Smaller samples of about 1 gm. can be used for studying bran and for pollen analysis. Parasite ova can be detected in the pollen slides if a modified treatment process is used.

The extraction, identification and counting of the different kinds of remains is a difficult and time consuming operation, usually involving the collaboration of a number of specialists if all aspects of a deposit are studied, which is what this author firmly believes should happen. Identification is normally based on close comparison with modern material of known identity, sometimes treated specially so as to simulate the state of preservation of the archaeological specimens. There are some helpful books (Winton & Moeller 1906).

Latrines would normally be expected to contain sewage and cesspits should contain sewage with some other rubbish, perhaps. So how can the scientist prove that he is dealing with sewage, or domestic rubbish, or a mixture?

Ancient sewage has a distinctive appearance, a little like ginger cake, and it may contain small fruit seeds. If seen in situ a latrine may have a distinctive 'architecture' such as a lining of stones, tile or a barrel. In the laboratory there are other clues, such as a distinctive fly fauna, a distinctive beetle fauna (Osborne 1981), the presence of bran, large amounts of pollen such as Cereals, *Borago* (borage) *Vicia faba* (broad bean) and a great abundance of ova of *Trichuris* and *Ascaris*, intestinal parasites. Dickson et al (1979) has reported biochemical tests involving coprosterols. Rubbish is indicated, on the other hand, by the presence of inedible food remains like fruit stones, animal bones, shells, and signs of the remains of hay and straw, which causes problems in the interpretation of these deposits, but at the same time it may provide additional information about the diet.

A digest of dietary information; bran

Bran is the periderm of cereals, and is very important for giving evidence of the cereal component of past diet. It lay unrecognised among the masses of finely divided plant debris examined by botanists until 1979, when it was identified by several workers at once. Dickson et al (1979) found bran as the main part of a deposit in a Roman fort's ditch at Bearsden, and first decided that this must represent the remains of flour or bread. Then came the suggestion this this was sewage, and an elegant proof from the coprosterol content. The sewage occurred in only one part of the ditch fill, and the archaeologist was able to find the sewer which led from that point to where the latrines must have been. It is possible to identify the periderm of grasses and cereals (Körber-Grohne 1967), but bran is often so fragmentary that the diagnostic cell patterns cannot be seen very clearly. It is also time-consuming to prepare fresh grains for comparison by hydrolysing the starch. Kucan (1981) identified bran from Roman Oberaden and Knörzer (1979a) identified bran from 1500 - 1700 C.E. as that of rye, but many authors have simply noted its presence for the time being (Bakels 1980, Greig 1981, Hall et al 1983).

The potential for obtaining dietary information from bran remains does not yet seem to have been fully realised. Full identification is an obvious development, even though this means growing the various types of grain that were used in the past and then preparing their grains. Quantitative studies should also be valuable, measuring the amount of bran per gram in both ancient sewage and modern, to see whether any comparison can be made.

Weed seeds may have been used for famine food (Hillman 1981) and have also been common contaminants of grain products but it is not clear whether they were actually eaten (Winton & Moeller 1906), Wilson (1975) drew attention to the toxic quality of Agrostemma githago (corn cockle), the seeds of which appeared in a pit filled in 1400 - 1500 in Chester. The presence of a large range of weed seeds and also of 46 plum stones shows that domestic rubbish was probably a large component, compared with the 4 Vaccinium (bilberry) seeds which would be more representative of sewage. On present evidence, therefore, it does not appear that medieval bread was greatly contaminated by these poisonous seeds. Bakels (1980) studied material associated with the inn 'aan de bruggen bij de markt' (by the bridge near the market) at Sittard in the Netherlands, dating to around 1500 C.E. which was rich in bran, and she suggests that the poisonous weed seeds (Agrostemma githago) were carefully sifted out from the grain and discarded in rubbish which ended up in the latrine, which seems a reasonable explanation.

pollen

Cereals produce pollen which can sometimes be identified to genus, although not all scientists do this. Grain and flour is rich in cereal pollen, and Krzywinski (1979, in press) has demonstrated the need for pollen analysis to supplement other botanical work --- he found very large amounts of barley pollen in samples from latrines in Rosenkrantzgaten in Bergen, Norway, dating from 1200 - 1300 C.E. To see whether this 56% barley pollen could have come from cereal food, he took a strong laxative and thereafter ate only barley porridge for three days, with added Lycopodium spores for a quantitative estimation. His faeces on the last day of this diet contained the equivalent of 800 000 barley pollen grains per kg., and some weed pollen and he commented that he found the diet very dull (in litt.).

The writer has started the large task of studying the pollen content of modern materials like food to assist the interpretation of archaeological remains (Greig 1982a). He has shown that while the 6-7 wheat grains in an ear may contain about 1000 pollen grains each, the chaff from the ear can have about 30 000 grains, and each 10 cm of straw may have about 5000 cereal pollen grains, and an equal number from weeds. Although these somewhat isolated results badly need to be repeated, it can be seen that cereal pollen in cesspits does not necessarily come from bran if straw or chaff are present.

Some cornfield weeds have distinctive pollen, such as Centaurea cyanus (cornflower) characteristic of medieval cornfields, and Spergula arvensis (corn spurrey), characteristic of sandy soils. In pure faecal matter these would be a sign of some contaminants in food, but in most samples the presence of the seeds of these plants also suggests that grain cleaning was a domestic matter and that these weed seeds and pollen represent household rubbish.

A surprising sign of cereals is to be found in beetle remains, but where these are pests of stored cereal products they can provide useful information. Sir Joseph Banks recorded the consumption of these insects during Captain Cook's 1769 voyage of discovery:

> "Our bread is but indifferent, occasioned by the quantity of vermin that are in it. I have often seen hundreds, nay thousands, shaken out of a single biscuit. We in the cabin have, however, an easy remedy for this, by baking it in an oven, not too hot, which makes them all walk off; but this cannot be allowed to the ship's people, who must find the taste of these animals very disagreeable,

as they everyone taste as strong as mustard, or rather spirits of hartshorn...." (ammonia) (quoted from Buckland 1981)

Osborne (in prep.) has made a practical experiment similar to to Krzywinski's and has eaten dead grain weevils and then recovered most of them from faeces (18 out of 24) in a recognisable form, thus proving that the grain pests found in sewage could have come from infested food.

The scientific evidence of Roman cereal diet comes from military establishments, so it is hardly surprising that the few conclusions that can be drawn from the evidence that now exists compare more closely with the account of military diet by Davies (1971) rather than Apicius' recipes (Flower & Rosenbaum 1958). The cereal dominated diet at Bearsden seems to have a documentary counterpart in the Panis militaris, a wholemeal bread mentioned by Pliny the Elder. Davies, however, does argue that meat was eaten at all times in the Roman army, on the grounds of documentary evidence and also that from bone finds from Roman establishments. However, It is possible that meat eating was restricted to very important occasions among the ordinary soldiers, and the hunting and feasting got an exaggerated importance in the records. After all, the Bedouin are commonly credited with eating great feasts of whole roast sheep, when in fact this is a rare honour for important visitors (Nir, this volume).

We know, mainly from charred grain finds summarised by Knörzer (1979b) that the Romans used Triticum spelta (spelt wheat) which was also identified at Bearsden Dickson et al (1979) with some Triticum compactum s.l. (club wheat) and Triticum dicoccum (emmer wheat), Secale cereale (rye) Triticum monococcum (einkorn) and even Oryza sativa (rice), this last presumably imported.

Barley was the most abundant grain at Novaesium (Knörzer 1970) but as Davies (1971) considers it was only given to Roman soldiers as a punishment, and as Roman horse dung has had barley as the main cereal remains (Wilson 1979) we can exclude barley from our consideration of important cereals in Roman diet.

The scientific evidence for diet in the middle ages and more recently reveals a large cereal component which is not surprising since the potato has only recently become our main source of bulk and carbohydrate. It would be very interesting to study the various types of medieval cereal, like manchet bread, to see how far scientific evidence might provide more detailed information on what grains were consumed: Knörzer identified rye from Burg Bruggen (1979). The numerous and obvious remains of fruit tend to obscure the signs of cereal, yet this last may have been the more important food, as quantitative studies may show.

The parallel documentary evidence from Britain (Dyer 1983) shows evidence that the diet of ordinary people, about whom the least has been recorded, was mainly cereal-based until the later middle ages (ca. 1400) when meat became more widely available. It may have occasionally been a time of rustic plenty, but probably not of variety in diet.

Vegetables

Although vegetables are regarded mainly as a side dish now, they may have been more important in general nutrition in the past especially when they provide a good source of protein that can be stored, like the pulses. The main examples relevant here are *Vicia faba* (broad bean), *Pisum sativum* (pea) and two which do not grow in northern Europe, *Lens culinaris* (lentil) and *Cicer arietinum* (chick pea). Pulses tend to be seriously under-represented in the botanical record since, unlike the cereals, heat is not much needed for threshing so they are rarely charred and the seeds tend to disintegrate into unrecognisability in waterlogged deposits. Other sources of evidence for these include pollen, which is distinctive. The pollen of these crops has not been described in the three main pollen keys, so the researcher has to rely on reference material and his judgement for making the identifications. Some insect remains are also characteristic of this plant family, like the bean weevils (such as *Bruchus rufimanus* which was found at Worcester, Osborne 1981).

There are rather few records of legumes from latrines and cesspits which is not very surprising considering the difficulties in detection but the Romans did cultivate them. Knörzer (1980) found a charred lentil at Aachen, and Willcox (1977) has found lentil and pea at London. These remains probably under-represent the true past importance of these plants, for the extremely rich remains at Neuss (Knörzer 1970) had more than 50,000 broad beans, some showing signs of insect damage, 2500 peas, 2250 lentils, 750 chick-peas and 40 fenugreek. There are documentary records referring to beans and lentils (Davies 1971) but this food certainly does not seem to have been as important as cereals.

There are similarly scattered records from medieval and later sites, which may likewise tend to give an under-estimate of the importance of legumes in the diet. The broad bean has been identified from pollen wherever this has been studied, at Bergen (Krzywinski 1979), Worcester (Greig 1981) and Oriel College Oxford (Greig 1982b). Although too few figures are yet available to compare the pollen content of cereals with those of legumes, it is clear that cereals, with about 5 000 - 50 000 pollen grains per ear will figure much more prominantly in the pollen records than legumes with pollen contents that may be around 200 per pod (Greig 1982a) Further work on pollen contents should help clarify this point. The only macroscopic pea remains found appear to be the one from Burg Brüggen (Knörzer 1979a).

The parallel documentary evidence from the middle ages supports the view that peas and beans were included in the diet (lentils and chick peas could not be grown in northern Europe, and were apparently not eaten from the end of the Roman period until recent times). McLean (1981) cites evidence that peas and beans were used for pottage which ordinary people ate, although Dyer (1983) feels that all vegetables were no more than a minor dietary supplement.

The author feels that peas and beans tend to be regarded as their present-day equivalents which are soft vegatables of the season (or freezer) now, and not as they were in the past as the starchy basis of bulk food.

Oilseeds are another important dietary element. The oil itself would be hard to detect in faecal remains, but some oil seeds like Papaver somniferum (opium poppy) and Linum usitatissimum (linseed) are eaten in or on bread (linseed bread is still sold in Germany). Both plants will grow well in northern Europe, so it is not surprising that there are records from Roman sites including sewage, like Bearsden (poppy) or London (linseed). The Romans also imported Olea europaea (olive) which has been found at Aachen (Knörzer 1980) and at Oberaden (Kučan 1981) and even at London (Willcox 1977). Juglans regia (walnut) was grown for its oil as well as for nuts, the remains of which have been found on Roman sites, although it is questionable whether the trees grew there until pollen results show Juglans pollen.

In the medieval period the same oil plants were used with the exception of olives, which do not seem to have been imported any more from their Mediterranean habitats. This is surprising as there is evidence of widespread trade in other Mediterranean commodities, unless it is just a matter of the dislike which many north Europeans have for oily Mediterranean foods. The Viking finds of walnut in north Germany are considered to represent imports Behre (1981), although in Britain there are medieval Juglans pollen records (Colledge, in Greig 1982a) showing that walnuts were probably growing locally, although they might also have been imported.

Many vegetables consist of fairly soft parts like leaves (cabbages, spinach, leeks, onions) or roots (beet, turnips, parsnips, celeriac, carrots) which are rather unlikely to survive in identifiable form in sewage. The Romans liked to grind their food in mortaria, while the main medieval method of cooking seems to have been stewing for 24 hours (McLean 1981), a stern test for the survival powers of any plant matter. Even if there is not faecal evidence for the consumption of these vegetables there are finds from associated rubbish such as the seeds of the cabbages, turnips, and beet. However, onions, leeks and garlic, which have a long documentary record of popularity seem to have disappeared without archaeological trace apart from the charred Roman garlic bulb from Neuss (Knörzer 1970), an unusual find indeed. Our archaeological view of diet will not be falsified as long as we realise that there are some foods which have disappeared almost without trace. The documentary evidence points to the wide use of the alliaceae, such as the import of boatloads to medieval Britain (Gras 1918) and John the Gardener's poem written about 1450 (Tyssen Amherst 1894):

'....How he schall his sedys sowe
Of euery moneth he most knowe
Both of wortys and of leke
Ownyns and of garleke ....'

herbs and spices

Spices, compared with vegetables, tend to be found very often because many of them are seeds like the umbellifers : coriander, celery seed, caraway, fennel and dill, which survive well. Some of them have been popular from Roman times until now, although dill does not seem to have arrived back in Britain, although it was popular in Europe in the middle Ages. Parsley and caraway seem to be post-medieval introductions or perhaps the parsley seed is a chance find from dried herbs containing the seed; Satureia hortensis (summer savory), found at Taunton (1600 - 1700) (Greig unpubl) and Neuss (Knörzer 1968) may also be the result of seed-containing herbs. Apicius recommends a far longer list of spices, some imported from the tropics like long pepper (Rosengarten 1973), but so far these have not been detected. In the medieval period, herbs and spices seem to have been very popular, as shown by the amounts of fennel found, for example, which the documents suggest to have been used as a breath sweetener and as an anti-flatulent (Greig 1981). Brassica nigra (mustard) seeds can also be common, and John the Gardener recommends a long list of other herbs

'....Wurtys we most haue
Both to mayster and to knaue
Ye schul haue mynde here
To have wurtys yong' al tyme of þe yere'...

The emphasis seems to have been on strong-flavoured food additives, which the pottages probably needed to liven them up. Recently Piper nigrum (black pepper) has been found in latrines from 1700-1800, a tropical import at last (Robinson, Greig, in Greig 1982 b). Many other spices seem to have been imported but their remains have not yet been found.

Fruit with seeds under about 4 mm.

Small seeds tend to be consumed with fruit, as in many jams eaten today. In ancient sewage the woody seeds may be the only sign that survives in an unfavourable environment, and when preservation is good, many thousands can occur in a small sample of 250 - 500 g. sewage. Roman deposits have had moderate or small numbers of seeds of Rubus fruticosus (bramble), R. idaeus (raspberry), Fragaria vesca (strawberry), Pyrus malus (pear), Malus domestica (apple) and Vaccinium sp. (bilberry), all of which could have grown wild or semi-domesticated. Ficus carica (fig), however, can hardly grow in northern Europe, and seems to have been imported very widely, even reaching Bearsden in Scotland (Dickson et al 1979). Vitis vinifera (grape) is another likely Roman import.

Grapes were imported to Hedeby in the early middle ages (800 - 1000 C.E.)(Behre 1981) and are found in most latrine fills thereafter. Figs evidently followed soon after, and their seeds occur in Norway (Griffin 1979, 1981), Germany, the Netherlands and Britain, but apparently not in Denmark (Jørgensen 1980). Fig seeds are found almost universally in medieval latrine remains in Britain, showing that figs were widely eaten by fairly ordinary people. Remains from Taunton from ca. 1700 - 18th contained the remains of some 6 figs per kg deposit, based upon seed counts and comparison with modern figs. Historical records show that they were not cheap, a kilogram costing about twice the daily wage of a skilled labourer in around 1300 CE AD, these being among the cheapest of imported fruit. The reasons for this wide fig and raisin consumption may have been availability, occasioned by the trade routes from Spain and Portugal, and also the natural craving for sweet food which today causes such a disastrous over-use of refined sugar. It is true that grapes can be grown in northern Europe quite well, but these seem to have been mainly used for making the vinegar-like 'verjuice' which was popular at the time (McLean 1981). Morus (mulberry) occurred in Roman London, and although it has been found in Medieval deposits on the Continent, it does not appear to have become popular in Britain again. Ribes (currants and gooseberries) are less common, with records from Worcester (Greig 1981), pollen from Oxford (Greig 1982b) and records from Amsterdam (Paap, in press).

Larger fruit-stones like those of plums and cherries would not have been eaten, and seem to be part of the domestic rubbish which appears in concentrations in some sewage, and more scattered in the organic deposits which characterise medieval towns. Particularly common in the medieval deposits are the stones of Prunus spinosa (sloe) which is much too sour to be eaten, although it may have provided verjuice. Behre (1978) has made the interesting observation that early medieval Prunus finds show a great variation in fruit-stones, which is suggests as the result of self-sown trees. After about 1200 CE distinct varieties of plum-stones can be recognised, which he equates with the re-introduction of grafting techniques by Christians. Paap (in press) has demonstrated from a large number of latrines at Amsterdam of various dates that there is a pattern of continual introduction of new kinds of fruit and other food from ca. 1200 - 1900.

Bakels (1980) and Jørgensen (1980) have commented that the fruit remains could represent the consumption of preserved fruit rather than just a seasonal glut in late summer.

wine, beer etc.

Alcoholic drinks do not ever seem to have gone out of fashion in northern Europe, although the availability of different kinds may have varied. When water was liable to be contaminated there were good health reasons (even if they were not know at the time) why ale, beer, wine, mead etc would have been a better choice. Like many foodstuffs, these drinks would have differed from their modern counterparts in some ways; ales were made with a range of flavouring herbs such as Myrica (sweet gale) (found at Bergen, Svendborg and Brüggen) before Humulus (hop) became the main bitter agent (Corran 1975). Hops were found at Hedeby, Svendborg, Sittard and Neuss, all probably from domestic rubbish, so brewing is not proven, but possible. Grape products like wine and verjuice were also popular. Faecal residues of ale, beer, wine and mead can be expected in the form of pollen of the gale, hop, grape or honey. Modern drinks are filtered and so do not appear to contain pollen, and more crudely prepared wine and beer is being sought for testing. Some wine from around 1750 has been tested, but only objects that resembled degraded Vitis pollen were seen, although this was from a dried residue in which pollen might not necessarily survive (Greig, unpubl.). The privy of the Provost of Oriel College Oxford has shown appreciable amounts of Vitis pollen and Cannabaceae (a group including Humulus). If the macrofossils do not show presence of these plants, remains of wine and beer may well be indicated.

honey and its products

The archaeological remains of honey have been detected by pollen analysis by Dickson (1978) on pot residues from around 500 B.C.E. in Scotland, and by Jacob (1981) in Germany. Honeys do have distinctive pollen spectra because the bees are unsuccessful in trying to collect nectar only, and the few pollen grains included show which plants they visited, or spores can indicate (Crane) honeydew. Food residues, even if not mixed with domestic waste contain pollen spectra from a range of sources which are difficult to interpret, and this makes honey difficult to detect here. The Provost of Oriel College Oxford has provided an exceptionally varied pollen flora, and it is possible that like Borago (borage), otherwise a salad that could partly come from honey, although the work is only just starting on this site. The potential for the detection of honey is yet more reason why the pollen content of these deposits should always be examined.

parasite ova

The ova of Trichuris and Ascaris are usually very abundant in sewage, as can be easily noted by keeping part of the pollen preparation for the acetolysis process, and another which is not acetolysed for examination of the ova. It would seem that infection by these damaging worms was very widespread, and that of course would have affected the nutrition of the population by absorbing foodstuff, and perhaps more so by interfering with normal digestion and absorbtion of nutriment. Diphyllobothrium latum the fish tapeworm seems to be harder to detect, but it might be evidence of fish in the diet. Taenia spp. tapeworms from meat likewise seem hard to detect in ancient faeces.

medicines

There are plenty of documentary sources which deal with past medical practice. Medicine was first written about by Greeks, and copied by Romans, and then by medieval doctors. Many of the remedies involved plants, but these plants can be hard to recognise in the Greek descriptions and harder still when this information appears later and in a different part of Europe, so herbals like the Saxon ones are very strange indeed and offer cures for many ailments which cannot easily be recognised, like 'elf-shot'. It also appears that nearly the whole flora could be put to some use or other, and archaeobotanists have sometimes been ready to link their plant finds with possible use which can easily be found in the herbals. A very cautious approach is probably wiser, and leaves us with far fewer possible medicines, but better authenticated. The very mixed nature of the cesspit deposits increase the confusion, but there seem to be two possible drug plants, Atropa bella-donna (deadly nightshade) and Hyoscyamus niger (henbane). Both are members of the Solanaceae, a family well-known for some members' content of narcotic alkaloids like hyoscyamine. The bella-donna gets its name from the dilation of the eye pupils caused by the alkaloids, thought to make ladies more attractive. Both plants do occur as weeds, although infrequently in Britain now, yet their seeds turn up in medieval sewage fairly regularly and they are known from Roman sites. Either they were far more common in the past, or they may have been used . Hopefully further work will provide better evidence. There is even documentary evidence that laxatives were imported to Britain (Ruddock 1951) which would hardly appear to have been necessary in view of the wide consumption of fruit such as figs.

meat, fish, eggs and dairy produce

Although the writer admits to a botanical bias, he is aware of the problem. The amount of animal products consumed is as interesting as the plant-derived foods, but may be harder to detect. It is possible that meat fibres might survive, and both these and bone fragments were found in the Grauballe man (Helbæk 1958). Animal hairs can be identified and where meat was crudely prepared these might be useful; they certainly appear in some sewage. Small bones like those of fish can easily be eaten, and tiny fragments of eggshell also. Sometime a deposit of sewage contains a selection of domestic refuse that could well be the inedible waste of the same group of people whose faeces are there. The Worcester barrel latrine contained pieces of eggshell, chicken bones and those of eel, herring and ?dace. The herring would have come from deep sea, probably having been salted or smoked. Dairy products seem to be elusive at present, but there may be some test relating to calcium, perhaps, which might provide clues, or the biochemical residues.

The main conclusions of these preliminary results are that the Romans seem to have either introduced or imported much food which was hitherto unknown in northern Europe, although the soldiers may have had a monotonous mainly vegetarian diet based on spelt wheat. There is practically no evidence for the immediate post-Roman period, but it would appear that the imports ceased and that many of the cultivated plants died out. In the medieval period the number of foods gradually increased with new introductions and imports, a process which continues to the

BIBLIOGRAPHY

Bakels, C.C. (1980): Een Sittardse beerput en mestvalt. Archeologie in Limburg 9, 2-3.

Behre, K-E. (1978): Formenkreise von Prunus domestica L. von der Wikingerzeit bis in die frühe Neuzeit nach Fruchtsteinen aus Haithabu und Alt Schleswig . Berichte der Deutschen Botanischen Gesellschaft 91, 161-179.

Behre, K-E. (1981): Zur Nahrungswirtschaft der Wikingerzeit im nördlichen Europa. Zeitschrift für Archäologie 15, 25-40.

Brothwell, D. & P. (1969): Food in Antiquity (Ancient People & Places 66), London: Thames & Hudson.

Buckland, P.C. (1981): The early dispersal of insect pests of stored products as indicated by archaeological records. Journal of Stored Products Research 17, 1-12.

Callen, E.O. (1969): Diet as revealed by coprolites. In Science and Archaeology, 2nd edn. ed. D. Brothwell & E. Higgs, pp. 235-243. London: Thames & Hudson.

O'Connor, T. (in press): Feeding Lincoln in the 11th Century --- a speculation. In Integrating the Subsistance Economy ed. M.U. Jones & J. Turner. Oxford: British Archaeological Reports (International Series).

Corran, H.S. (1975): A History of Brewing Newton Abbott: David & Charles.

Crane, E.

Crawford, D.J. (1973): The opium poppy --- a study of Ptolemaic agriculture. In Problèmes de la terre en Grèce ancienne sous la direction de M.I. Finley ed. M.I. Finley. Paris: Mouton.

Davies, R.W. (1971): The Roman military diet. Britannia 2, 122-142.

Dennell, R.W. (1970): Seeds from a medieval sewer in Woolster Street, Plymouth. Economic Botany 24, 151 - 154.

Dickson, J. (1978): Bronze Age mead. Antiquity 52, 108-112.

Dickson, J.H., Dickson, C.A. & Breeze, D.J. (1979): Flour or bread in a Roman military ditch at Bearsden, Scotland. Antiquity 53, 47-51.

Dyer, C.C. (1983): English diet in the later Middle Ages. in Social Relations and Ideas: Essays in Honour of R.H. Hilton ed. Aston et al. London: Past & Present Society.

Ellison, R. (1981): Diet in Mesopotamia. The evidence of the barley ration texts ca. 3000- 1400 BC. Iraq 43(1), 35-46.

Flower, B. & Rosenbaum, E. (1958): Apicius: the Roman cookery book, a critical translation of 'The Art of Cooking' by Apicius. London,

Glob, P.V. (1969): The Bog People. London, Faber.

Gras, N.S.B. (1918): The Early English Customs Harvard University Press.

Greig, J.R.A. (1981): The investigation of a medieval barrel-latrine from Worcester. Journal of Archaeological Science 8, 265 - 282.

Greig, J.R.A. (1982a): The interpretation of pollen spectra from urban archaeological deposits. In Environmental Archaeology in the Urban Context ed. A.R. Hall and H.K. Kenward, pp. 47-65, Council for British Archaeology Research Report 43, London.

Greig, J.R.A. (1982b): Garderobes, sewers, cesspits and latrines. Current Archaeology 85, 49-52.

Griffin, K. (1979): Fossil records of fig, grape and walnut in Norway from medieval time. Archaeo-Physica 8, 57-67.

Griffin, K. (1981): Plant remains from archaeological sites in Norway: a review. Zeitschrift für Archäologie 15, 163 - 176.

Hall, A.R., Kenward, H.K., Williams, D. and Greig, J.R.A. (1983) Environment and living conditions at two Anglo-Scandinavian sites. The Archaeology of York ed. P.V. Addyman 14/4.

Helbæk, H. (1958): Grauballemandens sidste måltid. KUML (Årbog fra Jysk Arkeologisk Selskab, Århus) 1958, 83 - 116

Hillman, G. (1981): Reconstructing crop husbandry practices from charred remains of crops. In Farming Practice in British Prehistory ed. R. Mercer pp. 123 - 162, Edinburgh, University Press.

Hillson, S.W. (1979): Diet and dental disease World Archaeology 2, 147 - 161.

Jacob, H. (1981): Kulturpflanzennachweise aus Honigresten. Zeitschrift für Archäologie 15, 209 - 212.

Jørgensen, G. (1980): Om kostvaner i det middelalderlige Svendborg Naturens Verden 1980, 203 - 209.

Ellison, R. (1981): Diet in Mesopotamia. The evidence of the barley ration texts ca. 3000- 1400 BC. Iraq 43(1), 35-46.

Flower, B. & Rosenbaum, E. (1958): Apicius: the Roman cookery book, a critical translation of 'The Art of Cooking' by Apicius. London,

Glob, P.V. (1969): The Bog People. London, Faber.

Gras, N.S.B. (1918): The Early English Customs Harvard University Press.

Greig, J.R.A. (1981): The investigation of a medieval barrel-latrine from Worcester. Journal of Archaeological Science 8, 265 - 282.

Greig, J.R.A. (1982a): The interpretation of pollen spectra from urban archaeological deposits. In Environmental Archaeology in the Urban Context ed. A.R. Hall and H.K. Kenward,pp. 47-65, Council for British Archaeology Research Report 43, London.

Greig, J.R.A. (1982b): Garderobes, sewers, cesspits and latrines. Current Archaeology 85, 49-52.

Griffin, K. (1979): Fossil records of fig, grape and walnut in Norway from medieval time. Archaeo-Physica 8, 57-67.

Griffin, K. (1981): Plant remains from archaeological sites in Norway: a review. Zeitschrift für Archäologie 15, 163 - 176.

Hall, A.R., Kenward, H.K., Williams, D. and Greig, J.R.A. (1983) Environment and living conditions at two Anglo-Scandinavian sites. The Archaeology of York ed. P.V. Addyman 14/4.

Helbæk,H. (1958): Grauballemandens sidste måltid. KUML (Årbog fra Jysk Arkeologisk Selskab, Århus) 1958, 83 - 116

Hillman, G. (1981):Reconstructing crop husbandry practices from charred remains of crops. In Farming Practice in British Prehistory ed. R. Mercer pp. 123 - 162, Edinburgh, University Press.

Hillson, S.W. (1979):Diet and dental disease World Archaeology 2, 147 - 161.

Jacob, H. (1981): Kulturpflanzennachweise aus Honigresten. Zeitschrift für Archäologie 15, 209 - 212.

Jørgensen, G. (1980): Om kostvaner i det middelalderlige Svendborg Naturens Verden 1980, 203 - 209.

Kenward, H.K., Hall, A.R. & Jones, A.K. (1980): A tested set of techniques for the extraction of plant and animal macrofossils from waterlogged archaeological deposits. Science and Archaeology 22, 3 - 15.

Knörzer, K-H. (1970): Römerzeitliche Pflanzenfunde aus Neuss Limesforschungen 10 (Novaesium 4).

Knörzer, K-H (1979a): Spätmittelalterliche Pflanzenreste aus der Burg Brüggen, Kr. Viersen. Bonner Jahrbucher 179, 595-611.

Knörzer, K-H. (1979b): Uber den Wandel der angebauten Körnerfruchte und ihrer Unkrautvegetatuin auf einer niederrheinischen Lößfläche seit dem Früneolithicum. Archaeo-Physica 8, 147-163

Knörzer, K-H. (1980): Römerzeitliche Pflanzenfunde aus Aachen-Burtscheid. Archaeo-Physica 7, 35-60.

Knörzer, K-H. & Müller, G. (1968): Mittelalterliche Fäkalien-Fassgrube mit Pflanzenreste aus Neuß. Rheinische Ausgrabungen 1, 131 - 169.

Körber-Grohne, U. (1964) Bestimmungsschlüssel für subfossile Juncus-Samen und Gramineen-Fruchte. Hildesheim, Lax.

Kowalski, K., Malinowski, T. & Wasilikowa, K. (1976) Coprolites from a castrum of Lusatian culture in Komorowo, Poznan district. Folia Quaternaria 48, 1 - 13.

Kroll, H. (in press): Pflanzliche Großreste aus menschlichen Fäkalien in einem Holztrog der römischen Ansiedlung Auerberg.

Krzywinski, K. (1979): Peliminærundersøkelse av planterester i latrine. Arkeo (Bergen) 1/1979, 31-33.

Kučan, D. (1981): Pflanzenreste aus dem Römerlager Oberaden. Zeitschrift für Archäologie 15, 149 - 162.

McLean, T. (1981): Medieval English Gardens London, Collins.

Osborne, P.J. (1977): Stored products beetles from a Roman site at Droitwich, England. Journal of Stored Products Research 13, 203-204.

Osborne, P.J. (1981) Coleopterous fauna from Layer 1, in Greig (1981) pp. 268 - 271.

Kenward, H.K., Hall, A.R. & Jones, A.K. (1980): A tested set of techniques for the extraction of plant and animal macrofossils from waterlogged archaeological deposits. Science and Archaeology 22, 3 - 15.

Knörzer, K-H. (1970): Römerzeitliche Pflanzenfunde aus Neuss Limesforschungen 10 (Novaesium 4).

Knörzer, K-H (1979a): Spätmittelalterliche Pflanzenreste aus der Burg Brüggen, Kr. Viersen. Bonner Jahrbucher 179, 595-611.

Knörzer, K-H. (1979b): Uber den Wandel der angebauten Körnerfruchte und ihrer Unkrautvegetatuin auf einer niederrheinischen Lößfläche seit dem Frühneolithicum. Archaeo-Physica 8, 147-163

Knörzer, K-H. (1980): Römerzeitliche Pflanzenfunde aus Aachen-Burtscheid. Archaeo-Physica 7, 35-60.

Knörzer, K-H. & Müller, G. (1968): Mittelalterliche Fäkalien-Fassgrube mit Pflanzenreste aus Neuß. Rheinische Ausgrabungen 1, 131 - 169.

Körber-Grohne, U. (1964) Bestimmungsschlüssel für subfossile Juncus-Samen und Gramineen-Fruchte. Hildesheim, Lax.

Kowalski, K., Malinowski, T. & Wasilikowa, K. (1976) Coprolites from a castrum of Lusatian culture in Komorowo, Poznan district. Folia Quaternaria 48, 1 - 13.

Kroll, H. (in press): Pflanzliche Großreste aus menschlichen Fäkalien in einem Holztrog der römischen Ansiedlung Auerberg.

Krzywinski, K. (1979): Peliminærundersøkelse av planterester i latrine. Arkeo (Bergen) 1/1979, 31-33.

Kučan, D. (1981): Pflanzenreste aus dem Römerlager Oberaden. Zeitschrift für Archäologie 15, 149 - 162.

McLean, T. (1981): Medieval English Gardens London, Collins.

Osborne, P.J. (1977): Stored products beetles from a Roman site at Droitwich, England. Journal of Stored Products Research 13, 203-204.

Osborne, P.J. (1981) Coleopterous fauna from Layer 1, in Greig (1981) pp. 268 - 271.

Osborne, P.J. (in prep.): An insect fauna from a modern cesspit. Comparison with probable cesspit assembalges from archaeological sites.

Paap, N. (1976):Coprolites: preliminary results of the investigation of prehistoric faeces from Westfriesland (Province of Noord Holland). Rijksdienst voor het Oudheidkundig Bodemonderzoek 26, 127 - 132.

Paap, N.A. (in press) Environmental Studies at Amsterdam. in Integrating the Subsistance Economy ed. M.U. Jones & J. Turner Oxford: British Archaeological Reports (International Series).

Rosengarten, F. (1973) The Book of Spices New York: Pyramid.

Ruddock,

Tyssen-Amherst, A.M. (1894): On a fifteenth century treatise on gardening by 'Mayster John Gardener'. Archaeologia 54, 157-172

Willcox, G.H. (1977): Exotic plants from Roman waterlogged sites in London. Journal of Archaeological Science 4, 269-282.

Wilson, D.G. (1975): Plant foods and poisons from medieval Chester. Journal of the Chester Archaeological Society 58 (for 1972-3), 55-67.

Wilson, D.G. (1979): Horse dung from Roman Lancaster: a botanical report. Archaeo-Physica 8, 331-349.

Wing, E.S. & Brown, A.B. (1979) Paleonutrition: method and theory. London: Academic Press

Yudkin, J. (1969) Archaeology and the nutritionalist. in The Domestication and Exploitation of Plants and Animals ed. P.J. Ucko & G.W. Dimbleby, pp. 547-552, London: Duckworth.

Winton, A.L. and Moeller, J. (1906) The Microscopy of Vegetable Foods New York: Wiley.

Osborne, P.J. (in prep.): An insect fauna from a modern cesspit. Comparison with probable cesspit assembalges from archaeological sites.

Paap, N. (1976):Coprolites: preliminary results of the investigation of prehistoric faeces from Westfriesland (Province of Noord Holland). Rijksdienst voor het Oudheidkundig Bodemonderzoek 26, 127 - 132.

Paap, N.A. (in press) Environmental Studies at Amsterdam. in Integrating the Subsistance Economy ed. M.U. Jones & J. Turner Oxford: British Archaeological Reports (International Series).

Rosengarten, F. (1973) The Book of Spices New York: Pyramid.

Ruddock,

Tyssen-Amherst, A.M. (1894): On a fifteenth century treatise on gardening by 'Mayster John Gardener'. Archaeologia 54, 157-172

Willcox, G.H. (1977): Exotic plants from Roman waterlogged sites in London. Journal of Archaeological Science 4, 269-282.

Wilson, D.G. (1975): Plant foods and poisons from medieval Chester. Journal of the Chester Archaeological Society 58 (for 1972-3), 55-67.

Wilson, D.G. (1979): Horse dung from Roman Lancaster: a botanical report. Archaeo-Physica 8, 331-349.

Wing, E.S. & Brown, A.B. (1979) Paleonutrition: method and theory. London: Academic Press

Yudkin, J. (1969) Archaeology and the nutritionalist. in The Domestication and Exploitation of Plants and Animals ed. P.J. Ucko & G.W. Dimbleby, pp. 547-552, London: Duckworth.

Winton, A.L. and Moeller, J. (1906) The Microscopy of Vegetable Foods New York: Wiley.

present day considering the recent availability of Brassica pekinensis ('Chinese leaves') as a winter salad. The main emphasis for future work should be collaboration between specialists to obtain maximum information, more analytical work aimed at identifying more types of remains and quantifying the results, and research aimed at particular areas of past diet, such as different diet through the year, as in Lent.