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STUDIES ON THE REMAINS OF DOMESTIC LIVESTOCK FROM ROMAN, MEDIEVAL AND EARLY MODERN LONDON: OBJECTIVES AND METHODS

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INTRODUCTION

After many years of inadequate funding and lack of organisation, rescue archaeology in the City of London was finally placed on a more secure footing with the establishment in December 1973 of a department of urban archaeology within what was then the Guildhall Museum, now part of the Museum of London. The creation of this new urban archaeological unit meant that, for the first time, large scale, controlled excavations of key sections of the City could be planned and executed well in advance of the destruction by the developers. Under the direction of its Chief Urban Archaeologist, Brian Hobley, the DUA has so far investigated up to 30 sites, and the information collected on the structural features uncovered during excavation has enabled a greater understanding of the growth and development of this historic city, arguably the most important urban site in Britain (Hebditch,1978; Hobley,1975 & 1977; Hobley & Schofield,1977).

On almost all of the sites investigated so far by the DUA, conditions for the preservation of organic remains have been favourable, and large quantities of well preserved animal bone have been recovered from them. Between October 1974 and December 1978, over 26,124 mammalian bone elements from nine sites were examined and reported on (Table I). For the purposes of this paper, I have brought together certain, selected information relating to this material in order to illustrate some of the lines of archaeozoological research carried out by the DUA as part of its post excavation programme. Since the remains of domestic livestock greatly outnumber those of the wild species, almost all of this research work has been centred on cattle, sheep and pig.

TABLE I : Mammalian bone from the City of London examined 1974 - 78

	Site	Year excavated	Historic period	Number of bone elements identified to species and part of skeleton	
				Domestic spp.	Wild spp.
1	Central Criminal Court	1966 - 69	Roman (2nd - 4th century ~~cent.AD~~)	168	0
2	Sir John Cass Primary School	1972	Roman, medieval & early modern (1st - late 17th century ~~cent.AD~~)	2,542	4
3	Baynard's Castle	1972 - 73	medieval & early Tudor (13th - 16th century ~~cent.AD~~)	11,168 *	212 *
4	Angel Court	1974	Roman & medieval (1st - 14th century ~~cent.AD~~)	1,319 *	5 *
5	Billingsgate Buildings (formerly known as the Triangle)	1974	Roman, Saxo-Norman & medieval (1st - 12th century ~~cent.AD~~)	4,100	35
6	Aldgate	1974	early modern (late 17th / 18th century ~~cent.AD~~)	(990)	(0)
7	Cannon Street	1975	Roman & medieval (2nd - 15th century ~~cent.AD~~)	183	5
8	New Fresh Wharf (area III, St. Magnus)	1975	Roman, late Saxon, Saxo-Norman, medieval & early modern (1st - late 16th century ~~cent.AD~~)	5,158	33
9	Cutler Street warehouses	1978	early modern (late 17th/early 18th century ~~cent.AD~~)	202 ‡	0

(1) (2) (5) (7) (8) (9) Unpublished. Copies of the level III archival reports on the bone from these sites are available on request to the DUA

(3) Armitage (1977)

(4) Clutton-Brock & Armitage (1977)

(6) Analysis not yet completed. Number of identified elements given in table refers to one deposit only

* Excluding number of ribs & vertebrae

‡ Ox horn cores only

SELECTION OF SKELETAL MATERIAL FOR ANALYSIS

Before I describe the research carried out on the remains of domestic livestock from London, it would be helpful to first briefly consider the type of material that is selected for analysis.

Not all of the animal bone that is excavated in London is considered suitable for detailed analysis. This is because the value of any given bone assemblage to archaeozoological research depends very much on the nature of the archaeological context in which it was found. As a general rule, only those collections of bones from large-sized, well-defined, and securely dated deposits warrant investigation. In the City of London these criteria are satisfied in what are here termed 'primary dumps' ie deposits of rubbish that originally had been collected fresh and straightway disposed of either in purposely dug refuse pits or else in wells or ditches that had fallen into disuse. To this category should also be added the deposits of rubbish heaped up as back-fill to the revetments and quays that once formed part of the Roman and medieval waterfronts along the northern bank of the River Thames.

Groups of bones extracted from what are here referred to as 'secondary' and 'tertiary' deposits are usually not included in the material to be analysed.

'Secondary deposits' are those dumps of refuse which contain a high proportion of derived material (ie material which has at one time been buried ~~el~~sewhere in the City and subsequently dug up and redeposited). Such deposits often contain residual items, making it difficult to asses the true age of the bone recovered from them. Although it is not, as yet, possible to distinguish between the bones from Roman, Saxon and medieval livestock, this material of mixed origin is nevertheless being kept in storage in the anticipation that techniques will be developed which should enable separation of the bone elements from the different historic periods.

'Tertiary deposits' include floor and occupation levels, as well as the infill to small gullies and ditches. All of these features generally contain only very small quantities of fragmented bone which has accumulated over a prolonged period. Information obtained from this class of material is

unlikely to add much to the picture already built up from analysis of the contents of the primary refuse pits on the site. Only when a particular phase of occupation of the site is represented solely by a floor, occupation level or small gully, is examination of this material considered to be justified.

SLAUGHTERYARD AND KITCHEN REFUSE

Diet

The bulk of the animal bone collected from sites in the City of London is recognised as the discarded refuse from slaughteryard and kitchen, and so provides a basis for investigating the diet in different historic periods.

There are three main methods used by archaeozoologists to assess the relative contribution that a species made to the diet, these are described as follows:-

1. 'Fragments method'

   This involves counting the number of identified bone elements from each of the meat yielding species. The essential problem with this approach is that the number of bones recorded for a given species depends very much on the degree of fragmentation. A high value recorded for domestic ox, for instance, may not be truely indicative of the importance of this animal over the other classes of livestock, but instead may simply be a reflection of the fact that certain of the larger limb bones had been smashed in order to extract the marrow. Because of the smaller quantity of marrow contained in sheep and pig bones, these may not have received similar treatment and, in consequence, will be recovered as single, intact elements.

2. Estimation of the'minimum number of individuals'

   The concept of'minimum number of individuals' (see Chaplin,1971,63-75) appears to be extremely popular with archaeozoologists and is widely adopted by them. But, on the basis of my work on the skeletal remains from London, I would seriously question the claim made by any worker dealing with the large quantities of bone from urban excavations that he is able to identify the bone elements which originate from a single individual. Almost all the elements found in urban rubbish dumps are from cuts of meat. The ox, sheep or pig carcass would have been split into two halves and then disjointed by the butcher, the cuts of meat then being sold to various households throughout the City. Parts of one animal were therefore widely distributed, and the chance of even a few of the previously associated skeletal elements eventually ending up in the same rubbish dump can be considered to be remote. Only very rarely do the Roman and medieval deposits in London yield articulated parts of domestic livestock. One example recently examined (Armitage,1979,25) comes from an early 12th century deposit New Fresh Wharf (area III, St.Magnus) and comprises a right humerus, radius and ulna from the forequarters of a pig aged between one and three years. The humerus is chopped completely through the shaft a third of the distance from the distal end. A similar group of bone elements with the humerus chopped in the same way can be seen in a modern 'leg of pork' bought today from a butcher's shop. Apart

from these very occasional remnants of whole joints of meat, all of the groups of articulated bones excavated so far in London have been dog or cat (which usually are found in situ either as entire or partially complete skeletons.

3. 'Weight method'

The third method, and the one that I favour, was devised by Professor Kubasiewicz in 1956 (see Uerpmann,1978,310) and involves weighing all the bone from each species. The weight of the bone is then taken as being directly proportional to meat yield.

Among archaeozoologists, there is not, as yet, an agreed standard method whereby the relative importance of each species in the diet may be accurately ascertained. Different workers choose to employ different methods, and because of this their results are often not comparable. This unsatisfactory state of affairs may soon be rectified, when the working party set up by the International Council for Archaeozoology to review methodology reports on its findings. Meanwhile, each faunal analyst will have to decide for himself which of the available methods is the more reliable. For guidance on the relative merits and limitations of each of the three available methods mentioned previously, reference may be made to the papers by Watson (1972), Perkins (1973), Casteel (1977 & 1978) and Meadow (1978).

The 'weight method' has been applied to the bone from London and the results are shown in Fig. 1. The values presented in the diagram must be considered to give an approximate guide only to the relative contribution that each of the domestic and wild species made to the diet. This is because the calculations are based on bone material recovered by excavation, no allowance has been made for supplies to the City of boned meat (eg salted beef, pork and venison), items which leave no trace in the archaeological record. Furthermore, the picture is far from complete as information relating to the early and mid Saxon periods is lacking. Nevertheless, the following general observations may be drawn from the data that are available:-

1. The largest proportion (up to 86%) of the meat eaten in Roman, medieval and early modern times came from domestic ox.

2. Pig meat was an important element in the Roman diet, second only to beef. Davies (1971) has already stressed the part played by bacon and lard in the Roman military diet, and, on the evidence collected, it now seems that the predilection for pig meat extended to the civilian population, at least as far as London was concerned.

3. In all periods, meat from game animals such as Red deer, Roe deer and hare was not an important feature in the diet of the people living in London, but only supplemented it.

Analysis of the cattle bones from Baynard's Castle (Fig. 2) provides good evidence for a difference in the quality of the diet enjoyed by members of the different social classes of early Tudor London. The cattle metacarpal bones found in the refuse pits located within the castle grounds are much larger and more robust compared with those recovered from the City rubbish dump situated just outside the west wall of the building. Clearly, the beef eaten by the nobility was much superior in quality compared to that consumed by the commoner folk.

Butchery

Many of the bones of both domestic livestock and game animals from London have marks made by choppers and knives on them, showing evidence of butchery. Examination of the frequency with which certain of these marks occur and their position on individual bone elements has enabled the techniques associated with butchery in the different historic periods to be reconstructed. The evidence collected so far suggests that a change in butchery technique took place between the Roman and medieval periods. In the Roman material, the transverse processes of many of the thoracic vertebrae of cattle, sheep and pig have been chopped-off and the ribs removed. An operation that was probably performed whilst the carcass was lying either on the ground or on a table. The majority of the vertebrae of these same species from the medieval deposits, on the other hand, are cleaved along the medial line, showing that , as in modern butchery practice (see Rixson,1976a & 1976b; Meat and Livestock Commission,1977), the usual procedure was to suspend the animal by its hind legs off the ground and split the carcass into two halves before disjointing it.

SUPPLIES OF LIVESTOCK TO THE MEAT MARKETS OF LONDON

A knowledge of the change in organisation of supply of livestock to London which took place in the latter half of the 17th century is crucial to an understanding of the remains of cattle and sheep found on post-medieval sites in the City.

→ Cattle

As late as the Tudor period, one contemporary commentator could still report that London was fed 'principallie .... from some fewe shires near adioninge' (Fisher,1935; Everitt,1967), that is to say from Middlesex, Essex, Hertfordshire and Surrey. But in response to the very considerable growth in the population of London which took place during the latter half of the 17th century (during which the number of inhabitants increased from an estimated 130,000 persons in 1631 to over 500.000 by 1665 -- the Librarian, Guildhall Library 1978, pers. comm.) the area from which the City drew its supplies was progressively extended, until by the late 17th/early 18th century, the Metropolitan markets were receiving provisions from the 'whole body of the nation' (Defoe,1724 reptd. 1974, vol. I,59). The extent of London's influence on the economies of the various 'farming countries' throughout Britain at this time (see Kerridge,1968,41-180) may be gauged from the organisation of the cattle trade, which was carried out on a national basis. Cattle born and raised in the remoter regions of Britain (in Scotland, the Lancashire Plain and Wales) were shod and sent 'on the hoof' along well established drove roads to graziers operating in Gloucestershire, the south Midlands, Norfolk, Hertfordshire and Essex (Fig. 3). Here the store cattle were finished on grass or turnips, and the fattened 'beeves' subsequently sold to the City butchers for slaughter. In addition to the above traffic, large numbers of oxen were frequently sent to London from the west country ie from the counties of Wiltshire, Somerset, Devon and Cornwall (Skeel,1926; Fisher,1935; McGrath,1948; Haldane,1973; Armitage,1978a).

This movement of cattle over long distances which took place in the late 17th and early 18th centuries, means that the remains of cattle found on early modern sites in London are, in essence, often an admixture of Scottish and

Welsh runts, Lancashire longhorns, Dutch shorthorns (from Lincolnshire) and sundry other types from other parts of the country, including those from Surrey, Sussex and the Romney Marshes. It is not, as yet, possible to identify these regional stocks of cattle among the skeletal remains from archaeological sites. This may only be attempted when a type series of the horn cores of all late 17th and 18th century cattle has been compiled. Preliminary work has now started on the classification of 17th, 18th and 19th century cattle horn cores (Armitage,1979, in progress) and follows from the system for the description of the horn cores of cattle from Roman and medieval sites devised by Armitage & Clutton-Brock (1976).

→ Sheep

According to Daniel Defoe in his book A Tour Through the Whole Island of Great Britain published in 1724, the principal areas which furnished the City of London with the greatest quantities of mutton lay to the north, in Lincolnshire and part of Leicestershire (Fig. 4). The marsh sheep common to these areas were described by Defoe as being the largest 'breed' of sheep then to be seen in Britain (Defoe, 1724 reptd. 1974, vol.I, 84 & vol. II, 89). Sheep found in other regions of the country were of much smaller size. On the basis of these observations, it could be that the 11 bone elements of exceptionally large wether (castrate) sheep recorded from the late 17th/early 18th century deposits, Aldgate (Fig. 5 & Table II) are from the same group of large-sized, long-wooled sheep from Lincolnshire and Leicestershire that were mentioned by Defoe.

Table II: Sheep metatarsal bone. Estimation of stature[1].

Site	Historic period	No. of specimens	Estimated height at the withers (cm)	
			mean	range
1) Billingsgate Buildings (formerly known as the Triangle)	Roman (1st-2nd century)	9	62.5	58.5 - 66.7
2) New Fresh Wharf (area III, St.Magnus)	Saxo-Norman & medieval (11th-13th century)	15	58.2	54.0 - 63.5
3) Aldgate	early modern (late 17th/early 18th century)	11	76.3	70.8 - 80.5

NOTE: 1. Height at the withers calculated after the method of Teichert (as described by von den Driesch & Boessneck, 1974)

metatarsal bone: length X 4.54

INDUSTRIAL WASTE

Horn-working

Archaeologists working in the City of London occasionally come across dumped deposits of refuse made up almost entirely of the horn cores of cattle. Examples of just such deposits have been found at Angel Court (4th, 13th and 14th century), Aldgate (late 17th century) and Cutler Street (late 17th/early 18th century). All of the horn cores from these sites show evidence of having been hacked-off the skull by means of a cleaver or an axe, and they are therefore recognised as the discarded waste from horn-working industries. In horn-working, the horner removed the outer keratinous sheath from the bony core after it had been softened by immersion in boiling water. The unwanted core was then thrown away either amongst the general refuse or, as at Angel Court, Aldgate and Cutler Street, altogether in one collection of debris.

There are, as far as I know, no descriptions of the techniques associated with horn-working until the late 18th century. According to Fisher (1936) in his book on the history of the Horners Company, the horner was a member of the lower rather than the upper middle classes, and this explains why a number of wardens of the company were not sufficiently literate even to be able to sign their own name. All of the mysteries of the craft had therefore to be passed on by word of mouth and were not written down. The lack of documentary evidence means that information on the techniques of horn-working as practised before the late 18th century can only come from detailed examination of the material contained in the archaeological record. Examination of the marks left by choppers and axes on the specimens from Cutler Street (Armitage,1978b) has, for example, revealed the manner in which the butcher severed the horns from the head. According to the evidence collected, the standard procedure adopted was for the right and left horn cores (together with their outer sheaths and portions of the frontal and parietal bones) to be removed separately from the rest of the skull by a sweeping blow delivered across the back of the head. The presence, on the surviving fragment of parietal bone of many of the

specimens, of two or more chop marks clearly indicates that more than one strike with the cleaver or axe was often required before the horns were successfully detached. In some specimens, even the repeated blows to the back of the head failed to penetrate completely through the cranium, and an additional chop across the frontal bone, just above the orbit, had been necessary before the horns were finally broken free.

Buried horn does not survive for any length of time in the soil, usually only up to 15 years. As a result of this rapid decomposition, off-cuts of horn sheaths of cattle (as well as those of sheep and goat) are extremely rare on archaeological sites. Of the nine London sites examined so far (Table I) only one, Baynard's Castle, yielded examples of preserved ox horn (all of which came from waterlogged dumps). By far the most interesting pieces recovered from Baynard's Castle are two cut and pressed leaves of greenhorn thought to be lantern windows (Fig. 16). These are dated to the mid 14th century. Both specimens have marks made by grind stones and burnishing wheels on them, showing that the leaves have been smoothed and polished. Similar etched lines and scratches are to be seen on pieces of cut and polished greenhorn plate produced by the modern horn works at Kendal in Cumbria.

Not all the horn cores discarded by the horner were thrown into rubbish dumps. In the late 17th and 18th centuries, cattle horn cores from horners' workshops were usefully employed in the construction of garden walls. A Swedish visitor to this country in the mid 18th century, Pehr Kalm, mentions seeing the building of walls made of earth and cattle horn cores round allotments and meadows on the outskirts of London (Kalm,1748 reptd. 1892,69). According to the description of the mode of construction of these walls given by Kalm, cattle horn cores were laid horizontally in rows along the length of the wall, each row separated from the one above by a layer of earth approximately 15 cm thick. Within each wall there was thus an orderly arrangement of up to six courses of horn cores sandwiched between layers of soil; the horn cores acting as a bonding agent giving strength and stability to the otherwise flimsy structure. What appears to be just such a wall, dated on the ceramic

evidence and stratagraphic sequence to the late 17th/early 18th century, has recently (Armitage,1978b) been observed in the section of a workman's trial hole dug beneath the floor of one of the East India Company warehouses (warehouse E 2) at Cutler Street. In the diagram of the section cut through the feature at Cutler Street ~~wall~~ (Fig. 7, Contexts 30 to 35), the vertical series of distinct, alternate bands of horn cores and earth may be distinguished. It was this sequence that originally provided the clue as to the possible identity of the feature.

Bone-working

Many of the dumps of Roman, medieval and early modern rubbish in London contain, in addition to the fill of domestic refuse, the discarded waste from bone-working industries. Such waste frequently includes the sawn proximal and distal ends of cattle metatarsal bones (Fig. 8). The long straight shaft of this bone with its thick walls made it the ideal raw material for use in bone-working. After removal from the unwanted ends, the shaft was either turned on a lathe and fashioned into a knife handle, ~~alternatively, the shaft~~ or else was split longitudinally into 'slivers' of bone ~~for use~~ used in the manufacture of pins ~~or~~ and bodkins.

Measurement of the group of 80 metatarsal bones from Baynard's Castle (Table III) has revealed the precision taken in cutting through the bones. There is very little variation in the distance between the articular end and the point of sawing, with the observed values falling close to the mean. The position of a small, jagged protrusion of unsawn bone along the line of separation between the articular end and the shaft (where the sawing stopped and the end was 'snapped-off') has allowed the direction of sawing to be determined (Table IV). From the observations summarised in Tables III & IV, it is seen that the early Tudor bone-worker followed a set procedure when removing the unwanted ends of the bone from the shaft, with the line of separation and direction of sawing nearly always the same for each of the metatarsal bones. A similar picture has been established for the cattle metacarpal bones from Baynard's Castle (Armitage,1977,143-147).

Table III: Cattle metatarsal bones. Length (mm) from articular end to point of sawing. Baynard's Castle, circa 1499 - 1500

1. Proximal end and part of shaft

Length class limits (mm)	No. specimens
0 - 5	
6 - 10	
11 - 15	
16 - 20	
21 - 25	4
26 - 30	14
31 - 35	14
36 - 40	10
41 - 45	3
46 - 50	
51 - 55	
56 - 60	

No. specimens =	45
Mean =	32.3 mm
Standard deviation =	4.7 mm
Standard error of the mean =	0.7 mm
Distribution =	symmetrical

2. Distal end and part of shaft

Length class limits (mm)	No. specimens
0 - 5	
6 - 10	
11 - 15	
16 - 20	
21 - 25	
26 - 30	
31 - 35	
36 - 40	
41 - 45	
46 - 50	2
51 - 55	8
56 - 60	9
61 - 65	9
66 - 70	6
71 - 75	1
76 - 80	
81 - 85	
86 - 90	

No. specimens =	35
Mean =	59.8 mm
Standard deviation =	6.5 mm
Standard error of the mean =	1.1 mm
Distribution =	symmetrical

NOTE: six distal ends of immature animals (with the epiphysis unfused and detached) have been omitted from the table

Table IV: Cattle metatarsal bones. Direction of sawing. Baynard's Castle, *circa* 1499 - 1500

1. Proximal end and part of shaft

17 out of 45	(38%)	sawn from medial side
9 " " "	(20%)	sawn from posterior side
9 " " "	(20%)	unknown (bone sawn completely through)
8 " " "	(18%)	sawn from lateral side
2 " " "	(4%)	sawn from anterior side

2. Distal end and part of shaft

30 out of 35	(86%)	sawn from posterior side
4 " " "	(11%)	unknown (bone sawn completely through)
1 " " "	(3%)	sawn from medial side

EVIDENCE OF LIVESTOCK IMPROVEMENT

The finding of massive horn cores of cattle dated to the 14th, 15th and 16th centuries on a number of sites in the City of London has identified the late medieval and early Tudor period as a time when significant advances were being made by the more enlightened and progressive of the livestock farmers in the keeping and breeding of cattle. For it is at this time that large-sized, long horned cattle first make their appearance in south eastern England, probably emerging as a result of improved livestock husbandry and possibly selective breeding within the local cattle population (Armitage,1979, in press).

From the lengths of the complete, adult metacarpal bones found in association with the large horn cores, the withers height of the largest of the improved cattle of the late middle ages has been estimated (after the method of Fock,1966) at 1.5 m (Armitage,1977,52). This compares with 0.9 m, the average height calculated for the short horned cattle of the preceeding high medieval period (12th and 13th centuries).

Research is continuing in order to establish if there is any relationship between the improved cattle of the later medieval/early Tudor period and the longhorn of the late 17th and 18th centuries, the skeletal remains of which were found during the 1974 excavation at Aldgate (Armitage,1979,in prep.) and, more recently (Armitage,1978b), at Cutler Street.

CONCLUSION

This paper has reviewed some of the principal lines of research that I have carried out between 1974 and 1978 on the remains of domestic livestock from Roman, medieval and early modern London. All of the topics that have been discussed here were chosen in order to demonstrate the way in which faunal analysis can provide information on a wide range of human activities, and, in so doing, make a significant contribution to the understanding of the history of urban settlements.

On the basis of the experience gained during four years of archaezoological research in the City of London, I am now of the opinion that work on animal bones from urban sites should not concentrate only on the zoological aspects of the material but must also encompass the cultural implications. The rewards from this approach promise to be substantial, but caution must be exercised for there is the very real danger that the archaeozoologist engaged in such work might be tempted to try to sqeeze too much information out of the available sources of evidence (see Clutton-Brock,1978).

In conclusion, I would like to say that the future for archaeozoological research in the City of London looks bright, for as new sites are made available for excavation each year and further animal bone is recovered, the scope for investigation will be greatly extended. This in turn will require the development and implementation of new techniques for analysing and interpreting faunal remains from urban contexts.

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CAPTIONS TO THE FIGURES:-

Fig. 1 Contribution made by each of the meat yielding species to the diet in different historic periods. Values of percentage frequency are based on the weight of bone (excluding rib & vertebra) excavated from refuse dumps in the City of London.

Fig. 2 Comparison of the size of domestic ox from two early 16th century dumps of refuse, Baynard's Castle, City of London. Scatter diagram based on measurement of complete, adult metacarpal bones (redrawn from Armitage,1977,Fig.11,54).

Fig. 3 Movement of store and fat cattle along the drove roads of Britain in the late 17th and early 18th centuries.

Fig. 4 Principal sheep-breeding areas supplying the meat markets of London in the 18th century.

Fig. 5 Roman, medieval and early modern sheep from the City of London. Size of metatarsal bone.

Fig. 6 Two pieces of cut and polished leaves of horn of the type used to glaze lanterns. Baynard's Castle, City of London. Mid 14th century.

Fig. 7 Section through a late 17th/early 18th century feature made of earth and the horn cores of cattle (Contexts 30 to 35). Cutler Street warehouses, City of London.

Fig. 8 (A) Complete ox metatarsal bone. (B) Ox metatarsal bone with the proximal and distal ends sawn through and the shaft (dotted line) removed.

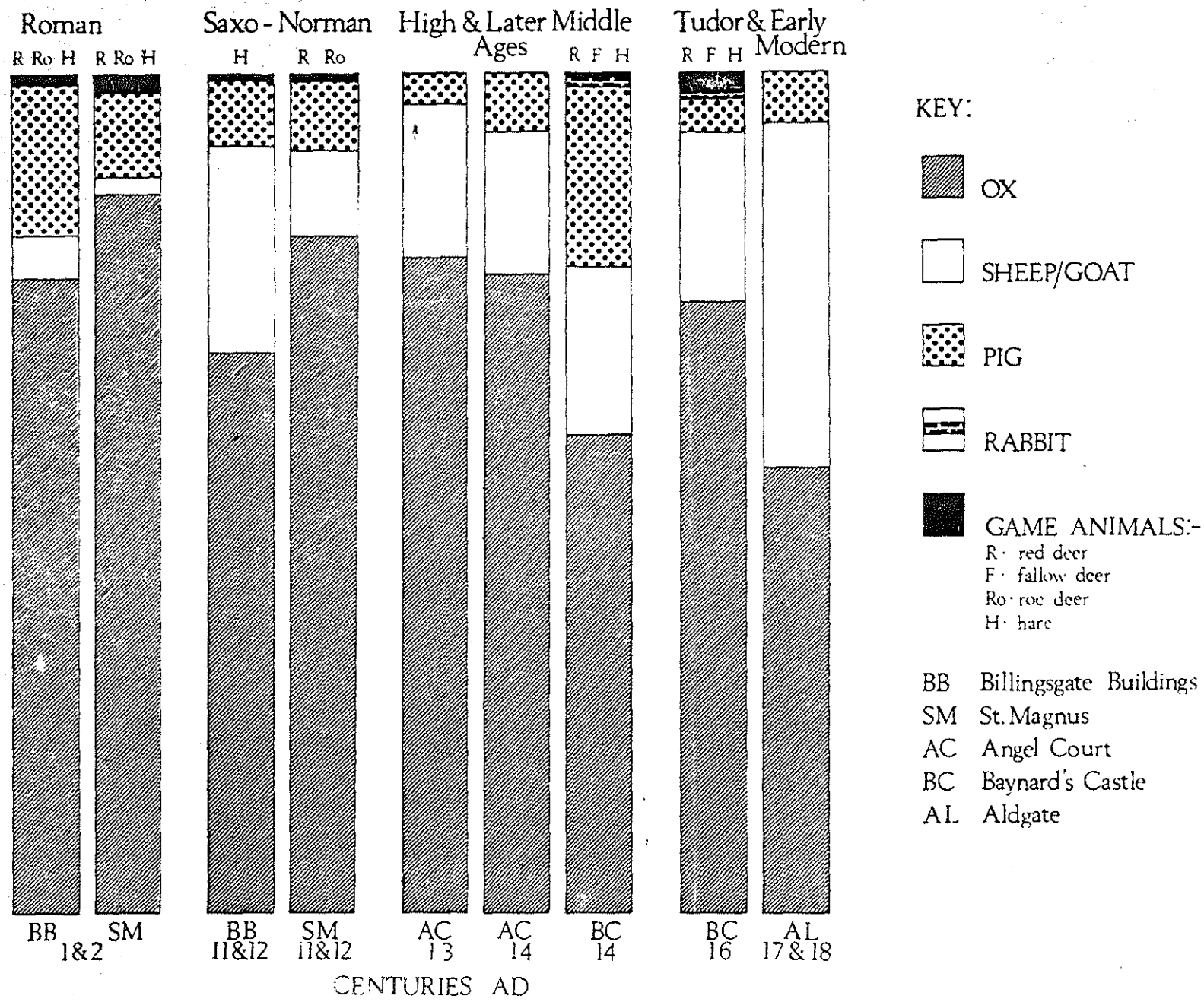

Roman
R Ro H
R Ro H
Saxo - Norman
H
R Ro
High & Later Middle Ages
R F H
Tudor & Early Modern
R F H
BB 1&2
SM
BB 11&12
SM 11&12
AC 13
AC 14
BC 14
BC 16
AL 17 & 18
CENTURIES AD
KEY:
OX
SHEEP/GOAT
PIG
RABBIT
GAME ANIMALS:-
R · red deer
F · fallow deer
Ro · roe deer
H · hare
BB Billingsgate Buildings
SM St. Magnus
AC Angel Court
BC Baynard's Castle
AL Aldgate

Fig. 1

Fig. 2

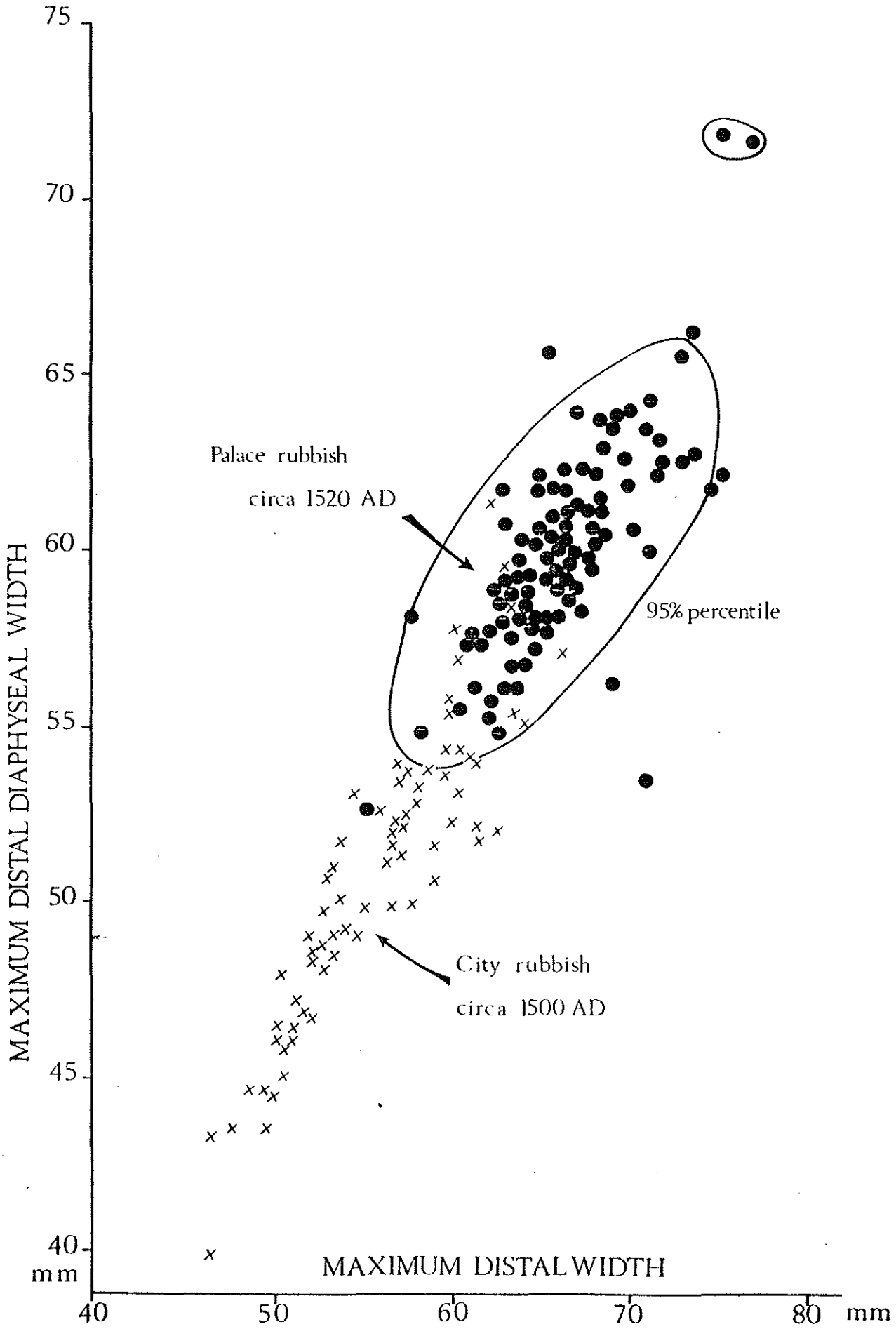

75
70
65
60
55
50
45
40
mm
MAXIMUM DISTAL DIAPHYSEAL WIDTH
Palace rubbish
circa 1520 AD
95% percentile
City rubbish
circa 1500 AD
MAXIMUM DISTAL WIDTH
40
50
60
70
80
mm

Fig. 3

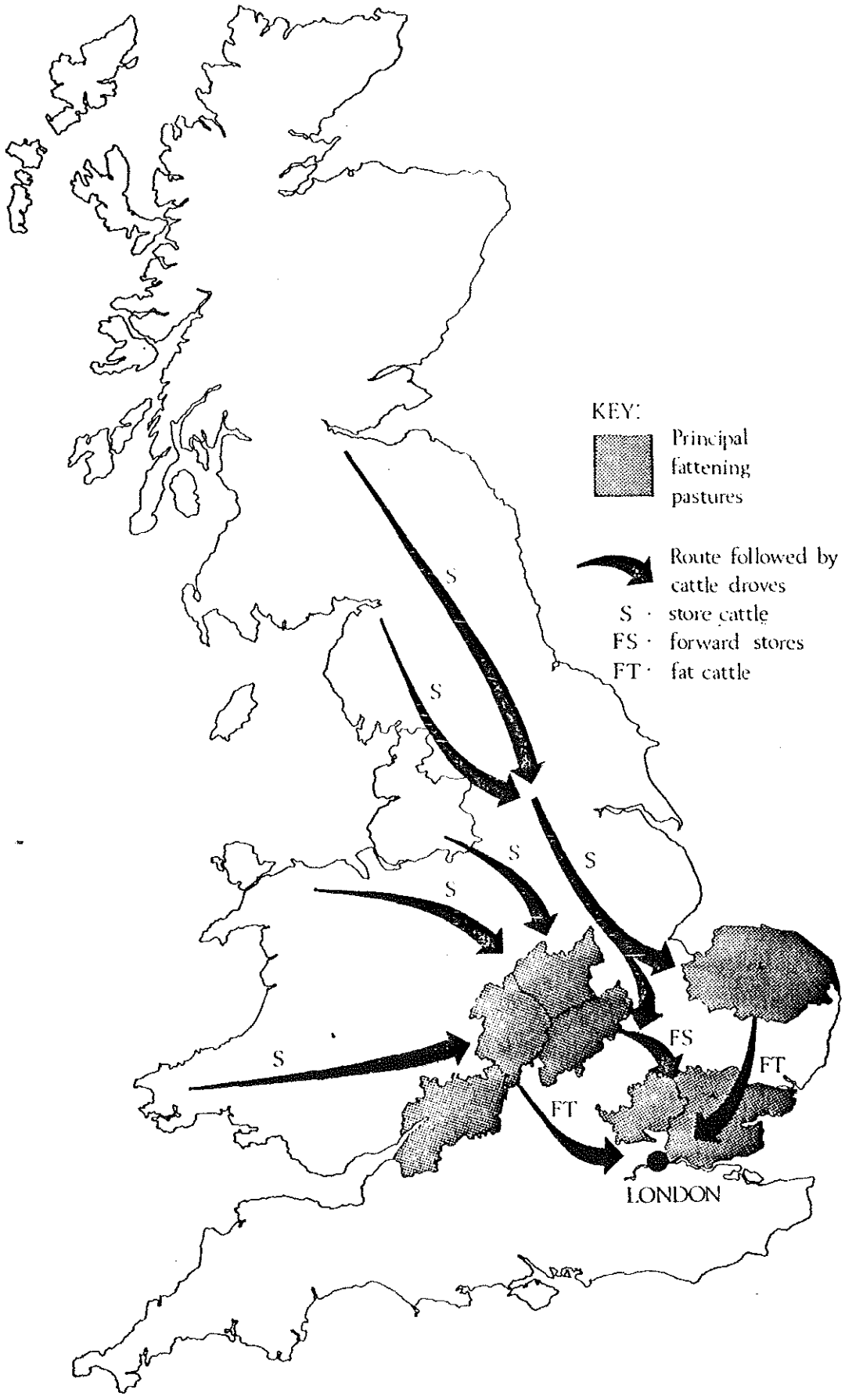
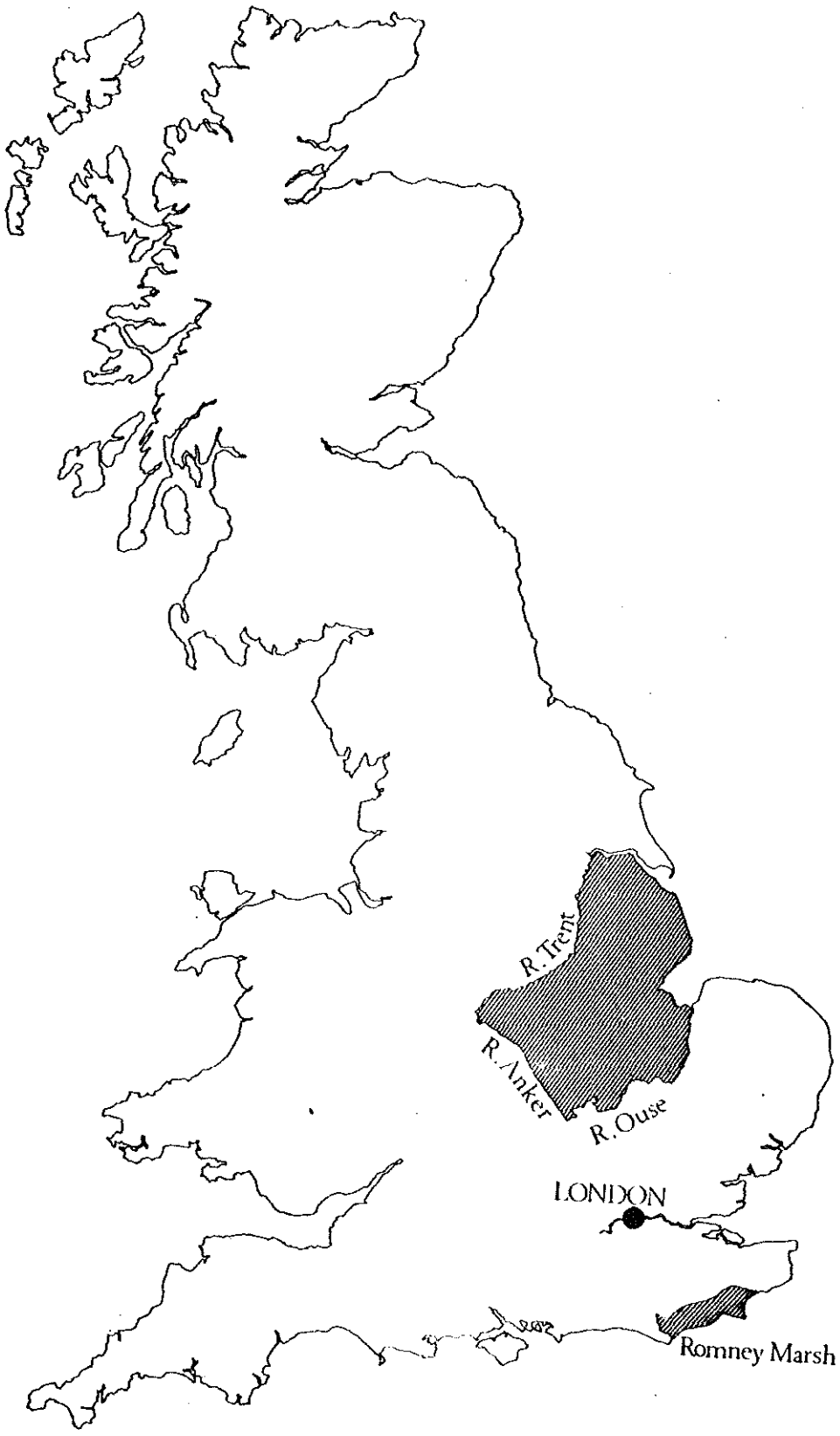

KEY:
Principal fattening pastures
Route followed by cattle droves
S · store cattle
FS · forward stores
FT · fat cattle
S
S
S
S
S
S
FS
FT
FT
LONDON

Fig. 4



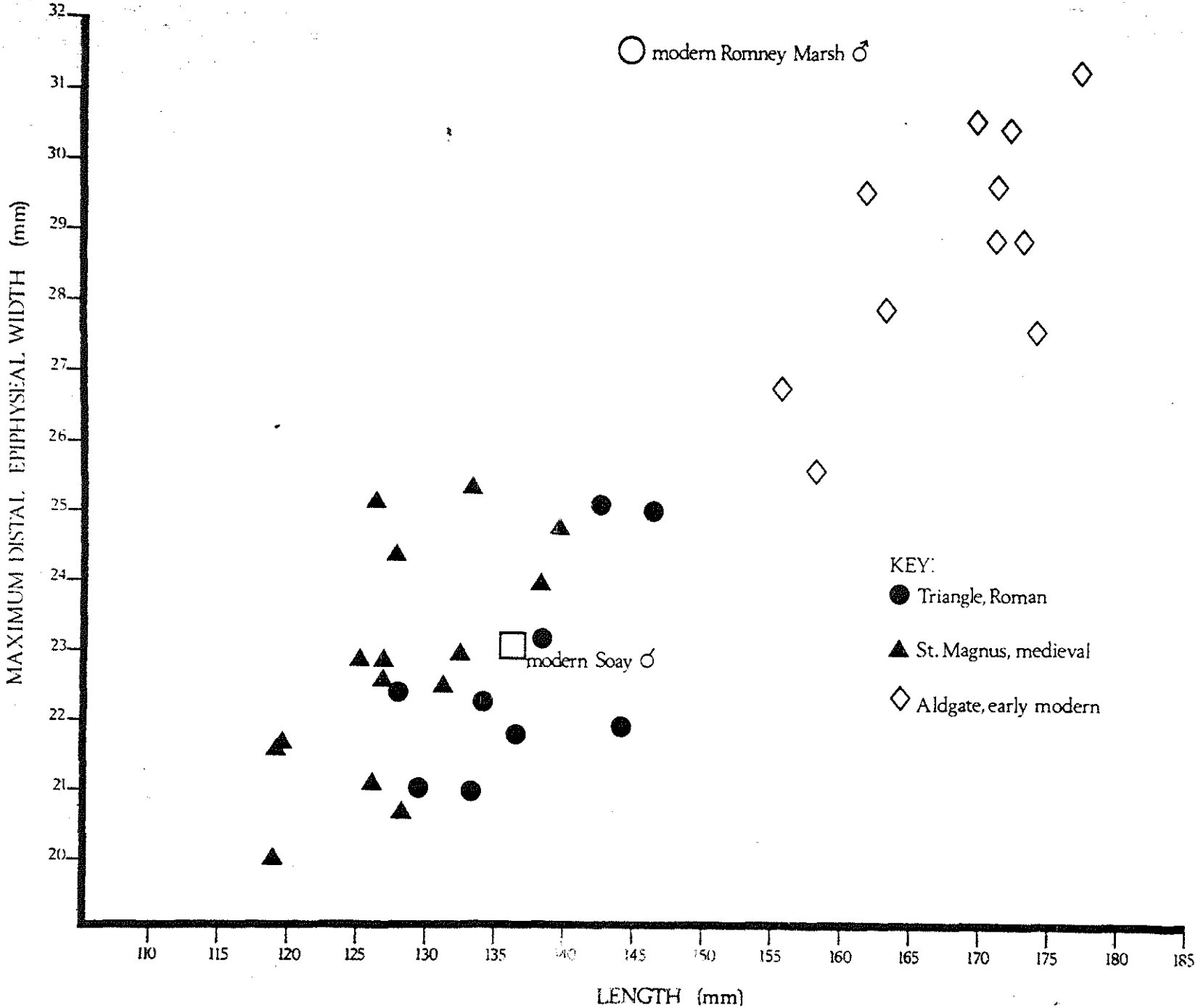

modern Romney Marsh ♂
modern Soay ♂
KEY:
Triangle, Roman
St. Magnus, medieval
Aldgate, early modern
MAXIMUM DISTAL EPIPHYSEAL WIDTH (mm)
LENGTH (mm)
32
31
30
29
28
27
26
25
24
23
22
21
20
110
115
120
125
130
135
140
145
150
155
160
165
170
175
180
185

Fig. 5

Fig. 6

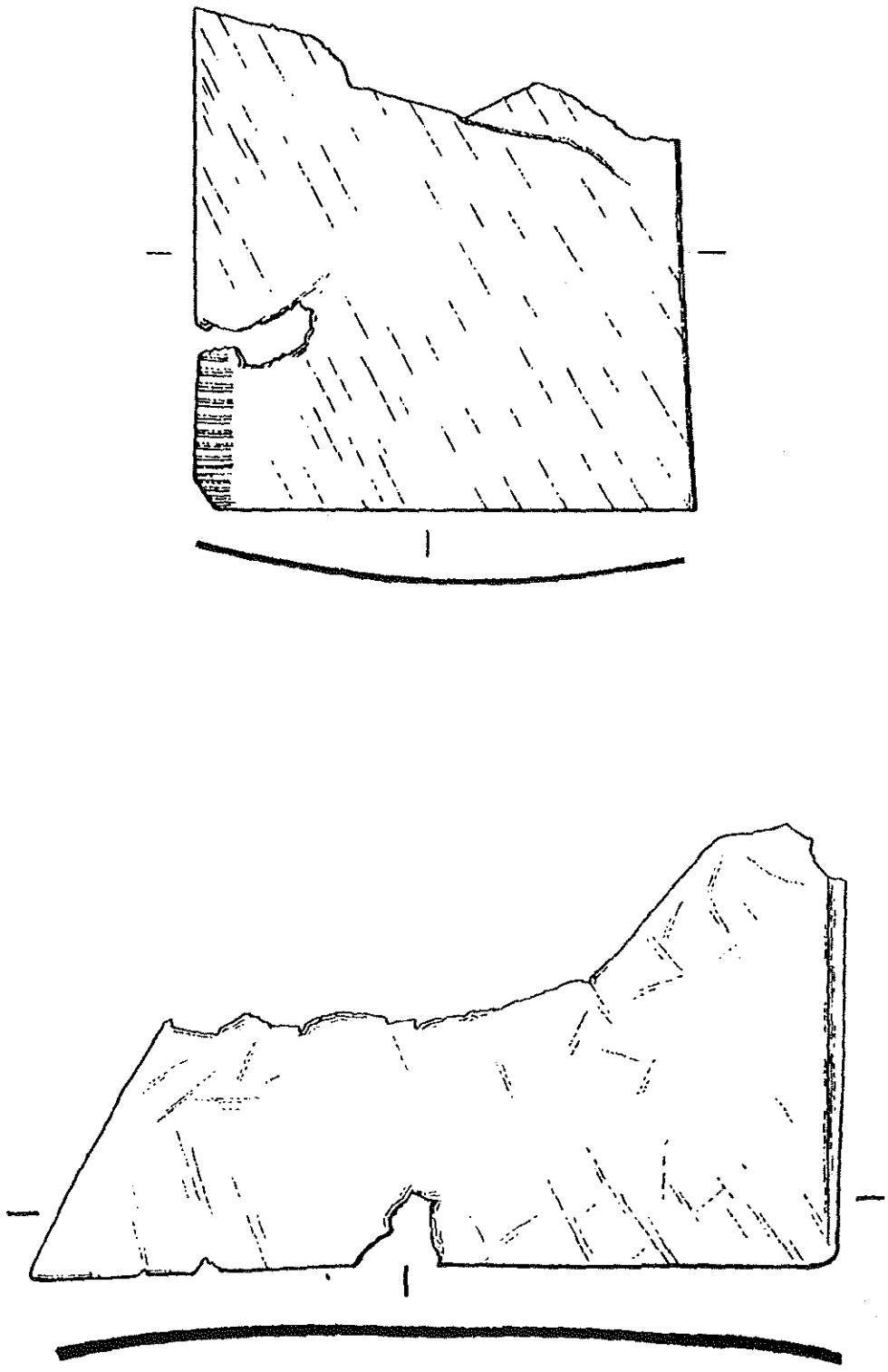
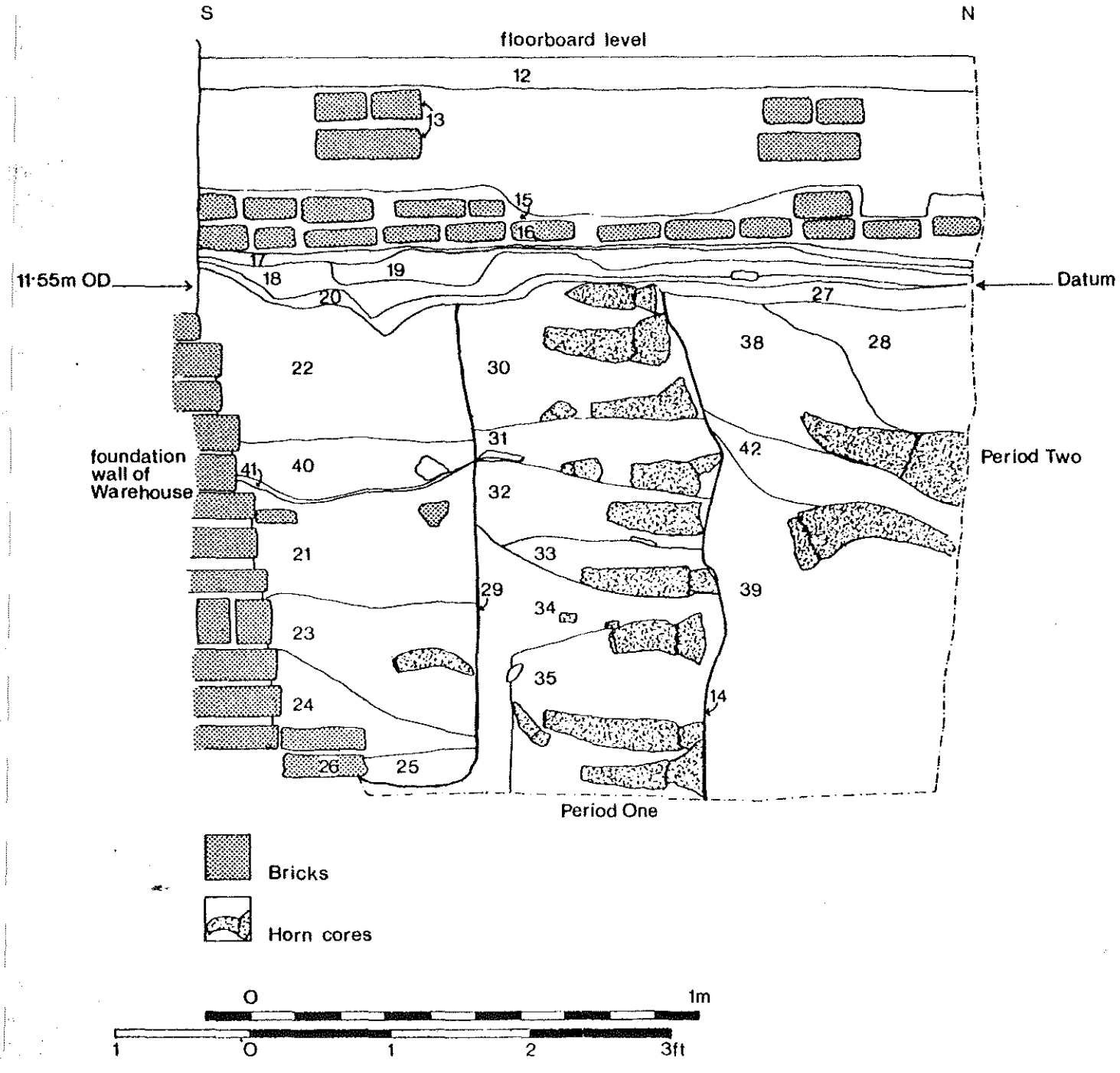


Fig. 7



CUTLER STREET WAREHOUSES
Trial hole 2: Section 1

MM & ABL

Fig. 8