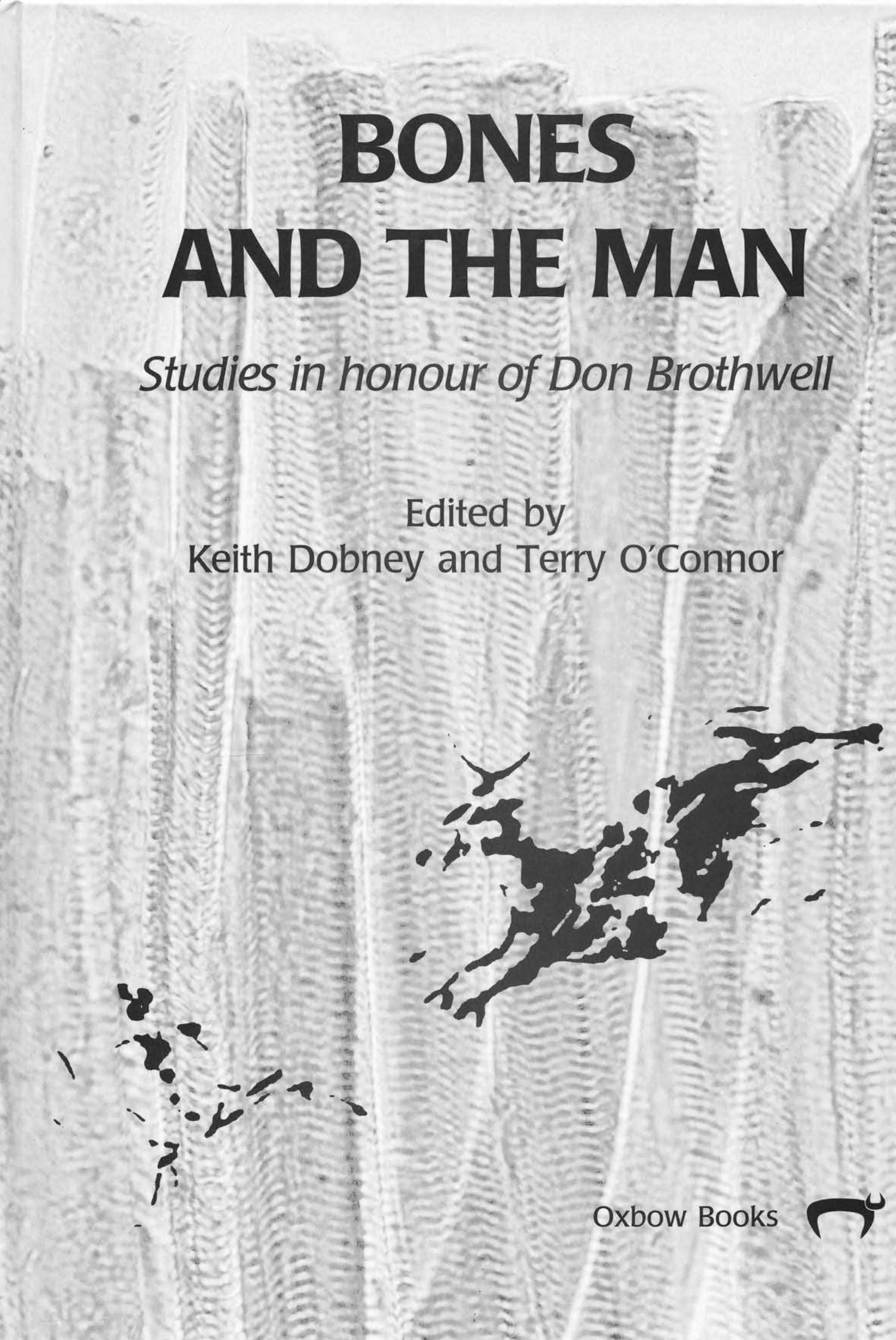

BONES AND THE MAN

Studies in honour of Don Brothwell

Edited by
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Oxbow Books

7. 'Size matters': how and why biometry is still important in zooarchaeology

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Introduction

Possibly no other subject divides the zooarchaeology world into two separate camps more than biometry: those who like it and those who hate it. Although the choice depends very much on personal attitudes and expertise it also relies on different traditions. For instance, some North American zooarchaeologists do not even measure bones, an attitude that probably horrifies many central European researchers. In the last two or three decades there has been a tendency to see biometrical studies as terribly old fashioned, almost a symbol of an obsolete approach to zooarchaeology divorced from mainstream archaeology. This idea developed as a consequence of the emergence – in the '60s – and spread – in the '70s and '80s – of 'processual archaeology'. Processual archaeology was by and large good news for zooarchaeology. The strong emphasis on systemic approach, experimental work and, to some extent, middle range theory, helped to centralise the role of the study of the animal bones and to stress its importance for archaeological understanding. It is indeed revealing that one of the classic books of the 'New Archaeology' was simply called *Bones* (Binford 1981). Nevertheless, processual archaeology, like any cultural trend, also brought with it a large baggage of preconceptions and biases. Taphonomy and butchery became the core of zooarchaeological investigations, the former because it could be replicated experimentally and observed ethnographically and the latter because it was the direct consequence of a human gesture, and in this respect emphasised the link between archaeology and anthropology. Though these were valuable areas of research they were unfortunately prioritised at the expense of more traditional subjects, such as biometry. This trend has been (and to some extent still is) particularly strong in North America and Great Britain. Other countries, less influenced by the processual thought, have continued to operate in the same way as they had done for decades – in some cases completely ignoring any taphonomic issues. The work done by the Munich school at Manching (Germany) (Boessneck *et al.* 1971) relied heavily on biometric analysis, and many zooarchaeologists based in central Europe have continued to operate in a similar vein in the following three decades.

The fact that processual archaeology has grown older and that many of its aspects have been re-evaluated should encourage zooarchaeologists to reconsider their priorities. In 1978 Joachim Boessneck and Angela von den Driesch wrote a plea for a more effective and extensive use of metric data from zooarchaeological assemblages. With the aid of a number of examples they showed how biometry can help in addressing important questions regarding species identifications, ecology and cultural history (Boessneck & von den Driesch 1978). This paper has a similar scope. It is not inappropriate that after more than twenty years similar concepts should be reiterated. It is unquestionable that in these last two decades animal biometry has continued to provide its useful contribution to archaeology, but it is also true – partly for the reasons discussed above – that the subject has not made any substantial progress. The large amount of research-driven analyses of animal bone measurements that has been carried out in the last few years should change all this. After a dormant period biometry has, in the late '90s, started to build the foundations for becoming one of the most rewarding areas of zooarchaeological research in the 21st century. Due to the opportunities offered nowadays by the sophistication of computer analysis and a better understanding of the factors affecting measurement variability, biometry can in fact be seen as one of the most 'modern' and effective tools for the zooarchaeologist. In the rest of this paper I will provide a few examples – whenever possible based on my original data – of the great diversity of approaches and research questions that biometric studies can address. It is hoped that this will contribute to dismissing the view that animal bone measuring is a tired and mechanical routine.

Small samples and the scaling of animal bone measurements

One of the problems that zooarchaeologists must often deal with is the small size of many animal bone assemblages. Only very extensive excavations generally produce large bodies of zooarchaeological data. This problem affects in particular the reconstruction of kill-off patterns and dimensions of the animals, as only a relatively small percentage of the retrieved bones can be aged or measured. The increasing commercialisation of archaeology that has affected many countries has rendered this problem even more acute. Many excavations are carried out in a hurry and on a small scale to allow the development (or destruction) of an area to begin as soon as possible. These excavations are unlikely to produce animal bone assemblages of great significance and it is therefore important to pursue our quest for larger and more intensively excavated sites. It is, however, also important to try to make the most of small assemblages. They may not be ideal but they can still produce useful information and it would be a mistake to dismiss them as worthless.

Even if an assemblage provides several hundred measurements, once the data are divided up between different species, phases of occupation, body parts and types of measurements, these may still end up representing small samples. One possible way to overcome this problem is to merge different measurements of the same species on the same scale, so that, through their combination, they can provide larger samples. This can be achieved in a number of different ways, all of which are based on the comparison of the metric data from a site with a 'standard' measurement. Measurements are not plotted according to their absolute size, but by taking into account to what extent they are larger or smaller than the 'standard'. This allows for different measurements to be combined and plotted on the same graph. The different systems used to achieve this result are defined by Meadow (1999) as "size index scaling techniques".

The use of these techniques is not a recent development in zooarchaeology. They were described as early as the late '60s by Ducos (1968) and came to be more regularly used in Near Eastern studies since the publication of similar approaches by Uerpmann (1979) and Meadow (1981). The pros and cons and relative variation of these methods have recently been discussed by Meadow (1999), who has demonstrated that all these approaches have some validity and that they provide only marginally different results. Although it would be possible to refer to a long list of papers that have successfully used scaling techniques I still find it surprising that they are not more intensively used, as they seem to tackle one of the basic problems of zooarchaeological analysis. This consideration mainly applies to European and American studies, as in the Near East there seems to have been greater care in making the most of biometric data. For instance Meadow (1984), by combining different measurements on the same scale, proved size diminution in cattle, sheep and goat in the aceramic Neolithic period at the site of Merhgarh (Baluchistan), and also that the size of cattle and goat remained stable after that period, whereas the sheep size continued to decrease. Using Meadow's approach Grigson (1989) identified sex grouping in cattle measurements at Jericho and other sites of the 6th millennium in the Levant. She suggested a predominance of females related to intensive slaughtering of young males and possibly an early use of cattle milk and dairy products. More recently Vigne *et al.* (2000) have proved that pigs from an 8th millennium BC site in Cyprus were significantly smaller than their wild relatives on the Near East mainland and that they were therefore domestic. This important evidence for the early stages of domestication would have been much more difficult to analyse without the aid of size index scaling techniques.

It is likely that the reason why biometrical studies in the Near East seem to be carried out in greater depth is due to the high profile that questions related to the beginning of the domestication tend to have and the fact that most assemblages derive from research, as opposed to rescue, excavations. The situation in Europe is less satisfactory. A survey of animal bone reports from central England carried out by the author reveals that only 30% of them provide any kind of biometric information and even when assemblages with more than 300 identified specimens are selected the proportion barely reaches 50% (Fig. 7.1). Even when measurements are discussed, their analysis often only leads to rather dull results such as considerations about the animals being "quite large", "quite small" or simply in the range known for the period or area. Metric data only occasionally provide evidence that is easily interpretable and their analysis requires patience, dedication and experience. Whenever size index scaling techniques have been applied to British sites

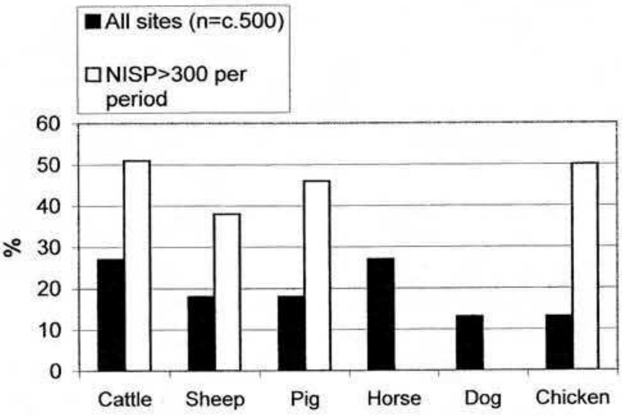

Fig. 7.1. Proportion of animal bone reports from central England that provide some biometric information.

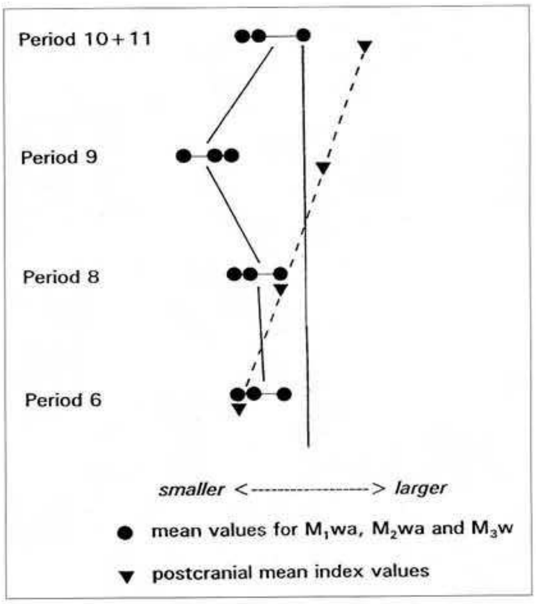

Fig. 7.2. Size changes in pig teeth and post-cranial bones from Launceston Castle using a log ratio for comparison with the Durrington Walls standard (Albarella & Payne 1993). wa = anterior width; w = maximum width; (from Albarella & Davis 1996).

they have provided interesting results (see below for examples), but a limited number of researchers have adopted such an approach.

Work by Albarella and Davis (1996), Albarella *et al.* (1997) and Dobney *et al.* (undated) has shown how the development and importation of new pig breeds in post-medieval times greatly affected the size of the bones but not that of teeth, as can clearly be seen once all measurements are plotted on the same scale (Fig. 7.2). The size ratio between bones and teeth is therefore a useful index to assess the level of improvement of a pig breed. A similar approach adopted for the analysis of sheep measurements from Norwich (Albarella *et al.* 1997) and Thetford (Albarella 1999a) in eastern England has proved that the homogenous size that we have in the past believed to be typical of the medieval sheep is, in fact, a myth. Variation occurs even when animals from the same area and period are considered.

Outside Britain, but still in Europe, it is once again Jean-Denis Vigne's work that provides a useful case study. By proving that the size of caprines in the French Cardial period was smaller than that of contemporary early Neolithic Italian and Corsican animals, Vigne (1999) showed that the size diminution consequent to domestication is a complex process, and that the sophistication of biometric analysis can offer important insights in this phenomenon. The large size of caprines on a site in Southern France led him to suggest the possibility of the existence of an Italian colony in that area.

As for North America, much of the biometric work in this part of the world has been carried out on post-Columban sites, which produce a type of archaeology that is comparable with that studied in Europe. One of the best applications of scaling techniques for this region is represented by the work carried out by Reitz and Ruff (1994) on the size of cattle in Spanish and Anglo-American colonies in the Caribbean islands and on the eastern coast of North America. The larger size of cattle from Hispanic colonies, southern locations and earlier periods opens all sorts of interesting questions on the nature of the colonisation of America.

Even when scaling techniques are not adopted, small assemblages of animal bones, as mentioned above, should not be dismissed. Occasionally they can provide surprisingly interesting results. Excavations carried out at Ford Place (Thetford), in eastern England, produced a very small assemblage of animal bones dated to the Saxo-Norman period (10th–11th century AD) (Albarella 1999b). Among these bones there was a discreet group of cattle horncores that provided the opportunity of comparing these measurements with contemporary data from another site in the same town (Albarella 1999b) and from the nearby town of Norwich (Albarella *et al.* 1997). The horncores from Ford Place proved to be different both in size and shape from those of the other two sites (Fig. 7.3). We are gradually reconstructing a picture of great complexity regarding the type and size of livestock present in early medieval England. Historical sources are almost totally silent on this subject, but zooarchaeological work has started filling this gap of knowledge. The existence of animals of different build in the same period and town opens a number of interesting questions about the contribution of local breeding,

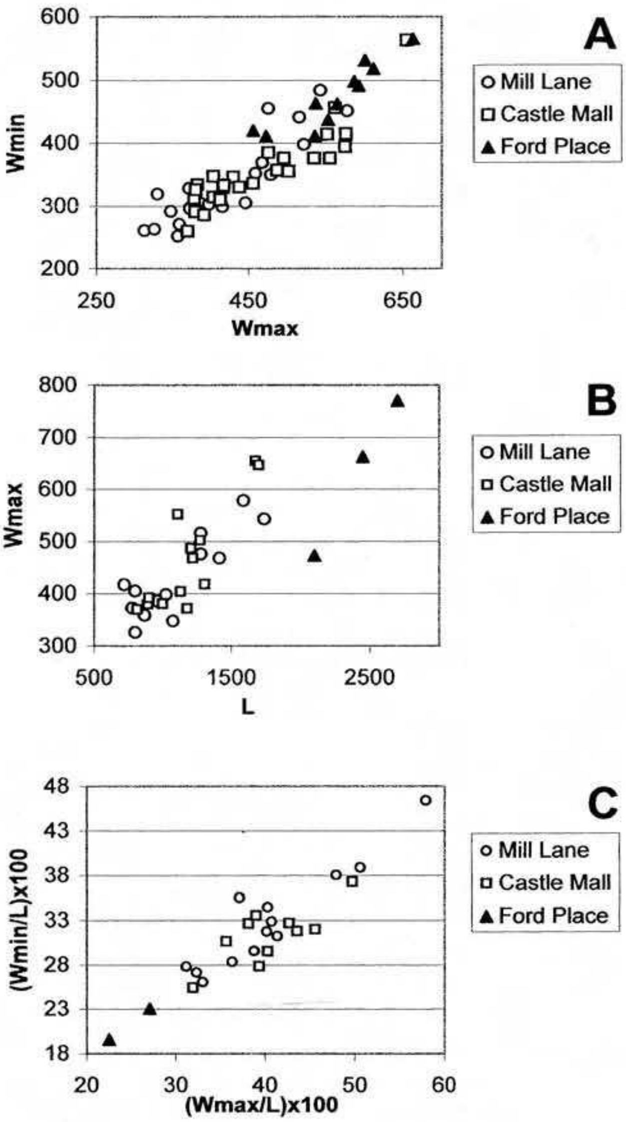

Fig. 7.3 Size (A and B) and shape (C) of cattle horncores at Thetford, Ford Place (10th – 11th century AD); Thetford, Mill Lane (10th – 12th century AD); and Norwich Castle Mall (late 9th – 11th century AD). Measurements in tenths of millimetres. L = length; Wmax = maximum width of the base; Wmin = minimum width of the base (from Albarella 1999b).

the introduction of livestock, the use of the land and the role of the market that will undoubtedly be further investigated in the next few years, through the important contribution of zooarchaeology in general and biometrical studies in particular.

Methodological problems with the use of scaling techniques

Bones and teeth vary in size according to age, sex, genotype, environmental conditions and other factors. Such variation does not occur homogeneously on all anatomical elements and in fact not even on different parts of the same bone. The combination of different measurements on the same scale will therefore cause a loss of resolution on the causes of size variation. Considering the immense advantage of gaining larger sample sizes, it is a price that is probably worth paying. It is, however, also important to try to reduce the negative effects that the combination of measurements has on our understanding of the patterns of variation of metric data. As we have seen above, bones and teeth can 'behave' in very different ways. Teeth tend to be much more conservative and therefore less affected by environmental factors as well as age and sex variation (Degerbøl 1963; Payne and Bull 1988). It is thus better not to combine bones and teeth as this could confuse or even obscure patterns of variation. Davis (1996) has recently proved that sheep post-cranial measurements vary in a similar fashion if located on the same axis, but this is not the case when lengths, widths and depths are compared with each other. It is reasonable to assume that this is not a species-specific phenomenon and that similar considerations can be extended to cattle, pig and other animals. Bearing this is mind, lengths, widths (i.e. medio-lateral) and depths (i.e. antero-posterior), whenever possible, should be analysed separately. This not only represents a reasonable compromise between the combination of *all* measurements and the analysis only of individual measurements, but can also encourage the analysis of shape variation, as we will see in the next section.

In addition to the questions mentioned above we should also take into account that not all measurements are equally variable. Measurements of the shaft of long bones are for instance extremely variable, whereas articulations of late fusing long bones tend to be much less so (see Payne & Bull 1988; Davis 1996, 600; Albarella & Payne 1993). Uerpmann (1979) approached this problem by taking the standard deviation of different measurements into account in the calculation of the index to be used for plotting each measurement on the scale. An alternative way to deal with the problem is to select the measurements to be plotted according to their variance. The choice will mainly depend on the research questions. If we are interested in size, then such measurements as long bone shafts or the collum of the scapula, which are very age dependent, should be avoided. If we are instead interested in detecting age groups, for instance in an attempt to recognise seasonal killings (e.g. Rowley-Conwy 1997, Fig. 7.10), then these are exactly the measurements to use. It is probably good practice to calculate Pearson's coefficient of variations (V) (as defined in Simpson *et al.* 1960, 90) of all measurements before analysis. Measurements that have very high coefficients of variation should be excluded from any analysis of size. Horncores, which are only poorly correlated with body size, tend to have coefficients of variation greater than 10 (in sites I have studied cattle and sheep horncores have provided coefficients of variation ranging roughly between 10 and 30, which is much higher than is typical of long bone epiphyses), but they will still be very useful in detecting sexes and breeds.

Another question that needs discussion is the choice of the type of 'standard' that we should use to compare our measurements. A number of different approaches have been adopted in the past. Some researchers use, as a standard, the skeletons of one or two modern individuals of known sex and age (e.g. Uerpmann 1979; Meadow 1984). Others prefer to calculate the mean of a modern population of known sex and possibly age (Payne & Bull 1988; Davis 1996) or of an archaeological assemblage (Ducos 1968; Albarella & Payne 1993; Albarella & Davis 1996). All these standards have advantages and disadvantages. The use of one individual bears the risk that this single specimen could be anomalous and, being modern, perhaps inappropriate as a yardstick with which to assess the size of archaeological bones. The same problem obviously applies to the use of modern populations, but this has the advantage of reducing the risk of using a sample of one (or two, the average of a male and a female) for the calculation of the standard. Archaeological assemblages have the obvious disadvantage of not allowing control on sex and age, but at least they can offer a better comparison with other archaeological material: moreover they can be calculated from large samples that may be difficult to obtain in modern collections of skeletons. Since it is desirable to have standards from animals deriving from the same geographic region as the archaeological assemblage that needs analysing, one possible alternative would be to use, whenever this is available, any complete archaeological skeleton that can be aged and sexed and is found on the same site or in the same geographic area. There is not such a thing as the perfect standard, but the main purpose of the scaling technique is not to allow comparison between the standard and the archaeological data, but rather to use the standard for comparing data from different sites or different phases of the same site.

Despite any methodological problems, the advantages (which will be discussed further in the rest of this paper) of using scaling techniques seem to be too great to be ignored for much longer by zooarchaeologists. The last few years have witnessed an increase in their use, and it is in these works that some of the greatest advances in biometrical studies have been achieved. This trend will continue and it is likely that by the end of this decade at the latest this technique will have become widespread in zooarchaeological reports. It is encouraging that scaling methods are explained in one of the two zooarchaeology textbooks that have recently been published (Reitz & Wing 1999, 173–6) and at least mentioned in the other (O'Connor 2000, 117). Like any other aspect of archaeological analysis, caution is needed when interpreting the results. Meadow (1999, 295–6) provides a list of recommendations that should allow us to avoid some of the main pitfalls in the use of this method. In addition to Meadow's very comprehensive list, we should probably add that scaling techniques should not be regarded as a replacement – but rather as an integration – of the more conventional analysis of individual measurements. This latter method has the incontrovertible advantage of a greater control on the factors affecting variation and, whenever sufficient numbers of measurements are available, should be used as a matter of priority in any biometrical analysis. Scaling techniques will almost certainly provide additional information and support (or lack of it) to any trends detected in the study of individual measurements.

Shape matters too

Much of the biometrical literature in zooarchaeology is engaged with an evaluation of the size of animals. 'Size', however, can be an ambiguous concept. When we think of people we rarely think of them in terms of how 'big' or 'small' they are. More often we consider whether they are tall or short, fat or thin, have long legs, a short and stocky neck and so on. The same should apply to animals. The reason why zooarchaeological analysis is sometimes confined to the study of size is because when we analyse archaeological bones we sometimes forget that they were part of living creatures, whose general appearance we should try to reconstruct.

From an economic point of view what matters most about the 'size' of an animal is its weight. Although attempts of calculating weight from metric data have been suggested (e.g. Noddle 1973) they have never become widespread. This is because zooarchaeologists are generally interested in relative rather than absolute values and it is probably reasonable to regard bone measurements (widths and depths to a greater extent than lengths, see Davis 1996, 604) as a proxy for the weight of an animal. Withers heights can be used in combination with breadth measurements to gain a better idea of the general appearance of an animal. It is, however, unfortunate that estimates of withers heights based on bone lengths have sometimes been undertaken at the expense of any other biometrical analysis. It is puzzling to read reports that speculate about the size of animals on the basis of a handful of withers heights, when there are hundreds of width or depth measurements that are completely ignored. If we want to estimate the potential meat output of an animal, width measurements can not only be more common but also better suited for this type of analysis.

The problem is that any estimate of the size of an animal is inevitably entangled with an evaluation of its shape. The fact that the measurements we take must be interpreted as part of a complex and constantly changing living organism is undoubtedly a complication, but also an opportunity. Biometrical studies can go much further than simply evaluating the size – however this is defined – of an animal. In the rest of this chapter I will present a few examples of how metric analysis can tackle a wide series of issues that can be included under the general label of 'shape', and how this can help to explain important archaeological problems.

One of the most traditional uses of biometrical data is aimed at the identification of species. This is normally achieved through the plotting of pairs of measurements that highlights the fact that they are differently correlated in different taxa (e.g. Payne 1969). Ratios of measurements or multivariate analysis are also sometimes adopted (e.g. Eisenmann 1986, 99–104). This is a well-established technique and it will therefore not be discussed further in the rest of this paper.

Another well-known aim of biometrical analysis is the identification of gender in sexually dimorphic species. The most studied anatomical elements for this purpose are metapodials, particularly of cattle. Howard (1963) suggested the use of indices based on the ratio between metapodial greatest lengths and either distal or mid shaft breadths to attempt the identification of different sexes in cattle. She did not plot the indices in a scatter diagram, but many authors after her did, generally looking at the distribution of the greatest length versus the distal width/greatest length ratio. This approach has been widely adopted in the last three decades, sometimes leading to slightly optimistic sex identifications (Howard had in fact showed that a great overlap occurs between groups, particularly when bones of castrated animals are considered). Variations to this approach have been proposed and scatterplots with ratios on both axes (Bd/GL and SD/GL *sensu* von den Driesch 1976), which make the graphs size independent, were used at Manching (Boessneck *et al.* 1971), and in more recent cases (see Luff 1993; Albarella & Davis 1996; Albarella 1999a) (Fig. 7.4). A close analysis of metapodial data has highlighted

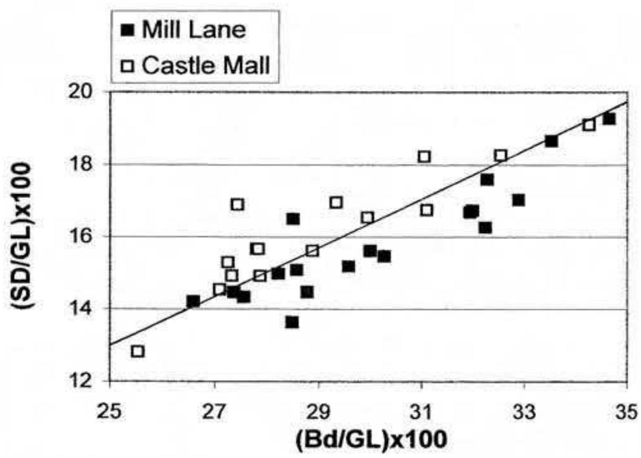

Fig. 7.4. Shape of cattle metapodials at Thetford, Mill Lane (10th – 12th century AD); and Norwich Castle Mall (late 9th – 11th century AD). Note that most of the Mill Lane specimens plot below the diagonal line, whilst most of the Castle Mall specimens are above it.

the fact that many elements, apart from sex, can contribute to the creation of clusters in the shape distribution of metapodials. Breeds (or regional types) rather than sex differences have in some cases been suggested as a more likely explanation (Albarella 1997a). Only a few years after Howard's publication German authors such as Fock (1966) and Reichstein (1973) warned about the possibility that breed differences could obscure sex differences.

Size-independent diagrams similar to those built for metapodials have also been attempted on astragalus measurements (Albarella & Davis 1996; Albarella 1999a) (Fig. 7.5). The differences between groups are much less pronounced than for metapodials, but they can still be visible. This can therefore represent a useful type of analysis, alternative or complementary to that carried out on metapodials. It can be particularly beneficial for sites in which few metapodial lengths can be taken, as complete astragali tend to be found in much greater numbers. The results obtained from these bones can very productively be compared with horncore measurements, which are highly sex dependent and vary greatly in different breeds. Size-independent scatterplots used for the site of Castle Mall (Norwich, England) (Albarella *et al.* 1997, Fig 27C) emphasise differences in shape between medieval and post-medieval cattle horncores. Although recent work is increasingly drawing attention to the risk of over-interpreting or even mis-interpreting data on cattle metapodial shape, it is also opening new avenues of investigation that can contribute to equally interesting archaeological questions.

In a previous section I have stressed the use-

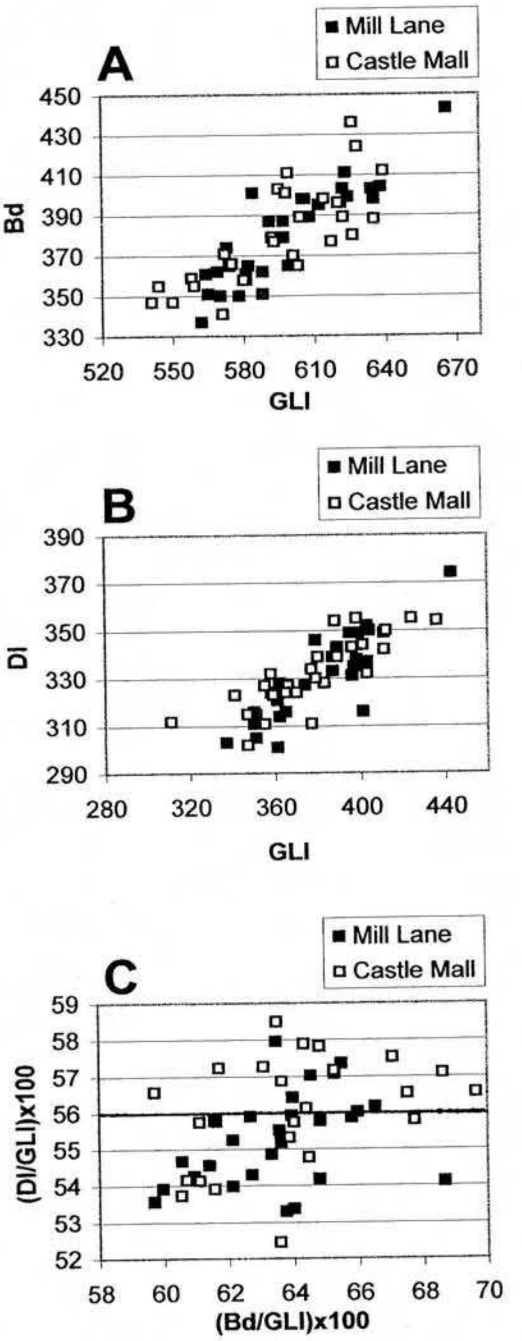

Fig. 7.5. Size (A and B) and shape (C) of cattle astragali at Thetford, Mill Lane (10th – 12th century AD); and Norwich Castle Mall (late 9th – 11th century AD). Measurements in tenths of millimetres. Note that in (C) most of the Mill Lane specimens plot below the line, whilst most of the castle Mall specimens are above it (from Albarella 1999a).

fulness of size index scaling techniques in combining measurements and therefore in tackling the problem of small samples of metric data. There is, however, another great advantage in the use of this method, which is represented by the possibility of observing how distributions of different measurements compare with each other. The work of Payne and Bull (1988) on pig measurements is mainly aimed at emphasising this aspect, using the decimal log ratio between the 'standard' and the actual measurement (Simpson *et al.* 1960). The log ratio technique, first introduced in zooarchaeology by Meadow (1981), is probably the most commonly used of the scaling techniques. Payne and Bull showed that if the distance between the mean of each measurement and the standard tends to be constant, we can assume that the animals of the archaeological population under analysis are similar in shape to the standard. If the mean tends to fluctuate, getting closer or further from the standard according to the measurement, then we can assume that the archaeological pigs are built differently from the standard. This approach can obviously be extended to the comparison of different archaeological populations.

The use of the log ratio technique to detect shape differences represents a powerful tool that has surprisingly been under-used. Scaling techniques have almost exclusively been used to increase sample sizes through the merging of different measurements. Yet much useful information can be gained by the analysis of shape differences between populations. The difference in the relative size of postcranial bones and teeth between medieval and post-medieval pigs has been mentioned above. Even if we concentrate exclusively on dental measurements it is possible to detect other interesting trends. The analysis of pig tooth measurements from the medieval site of West Cotton (Northamptonshire, England) (Albarella & Davis 1994) was carried out using a 'standard' calculated from a large assemblage of late Neolithic British pigs (Albarella & Payne 1993). The various teeth of the medieval pigs were all smaller than the standard but not proportionately so. In particular, the 3rd molar was relatively smaller than the 2nd, which, in turn, was smaller than the 1st (Fig. 7.6). This is an interesting line of evidence to pursue further. The more pronounced size diminution of teeth located at the back of the jaw might represent a discriminant character between more modern (though still unimproved) animals and others, such as the Neolithic pigs, which were still relatively close to the wild ancestors. It may not be chance that the 3rd molar is the most common element used in the distinction of wild boars and domestic pigs. Payne and Bull (1988) have proved that this is the most variable of all molars. As such it could have been the most susceptible to modification as a consequence of domestication, perhaps in reaction to the shortening of the snout.

The work by Clutton-Brock *et al.* (1990) on Soay sheep and Davis (1996; 2000) on Shetland sheep provide a very useful platform for the interpretation

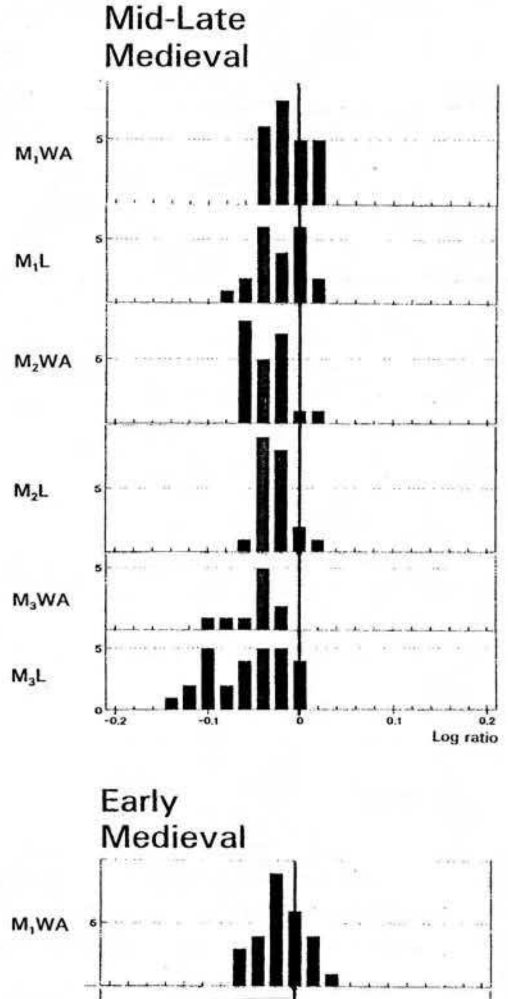

Fig. 7.6. Variation in West Cotton pig tooth measurements using a log ratio for comparison with the Durrington Walls standard (Albarella & Payne 1993) (from Albarella & Davis 1994).

of sheep measurements from archaeological sites. Work on modern populations aimed at a better understanding of the variability of different measurements may not appear related to archaeological questions, but it is eventually of the utmost importance. In order to refine our archaeological interpretation we need to improve our understanding of the biological factors affecting metric variation. Using the standard values suggested by Davis (1996) it was not only possible to highlight differences in size between different populations of medieval sheep in England but also to detect interesting differences in shape. For instance a comparison of sheep measurements between Saxo-Norman levels at sites in Norwich and Thetford indicates that the sheep from the latter site were taller but had similar widths and smaller depths (Fig. 7.7). In other words the animals from Thetford were all in all more slender, a characteristic common to the cattle from the same site (Albarella 1999a). Norwich and Thetford are not far away from each other (they are both located in Norfolk) and it might have seemed obvious to assume that they had livestock of a similar type. Perhaps Thetford had poorer pastures that affected the quality of the diet and consequently the build of the animals. It is also possible that Norwich, a larger town, had a greater opportunity to import a different type of livestock from other areas of the country. Whatever is the correct explanation, this result should alert us to the fact that there is a potential to say more about the medieval sheep than the rather bland fact that it was smaller than the improved animal that originated in the late medieval or early modern period. There is little doubt that there was regional variation and that a more careful analysis of biometrical data will eventually provide us with very useful data concerning efficiency of breeding in different areas, regional traditions, market economy, movement of livestock and of course many other subjects.

Biometry as an analysis of butchery, trade and social status

The ultimate reason why we measure animal bones is *not* to reconstruct the body size or even the general build of animals that lived in the past. Rather we take measurements to answer questions regarding ancient people and their life. Bearing this is in mind it is easy to see how biometry has a potential that can be applied to a variety of interesting archaeological questions. Hard-line processual archaeologists have dismissed the analysis of metric data in favour of that of butchery practices without realising that bone measurements can in fact provide

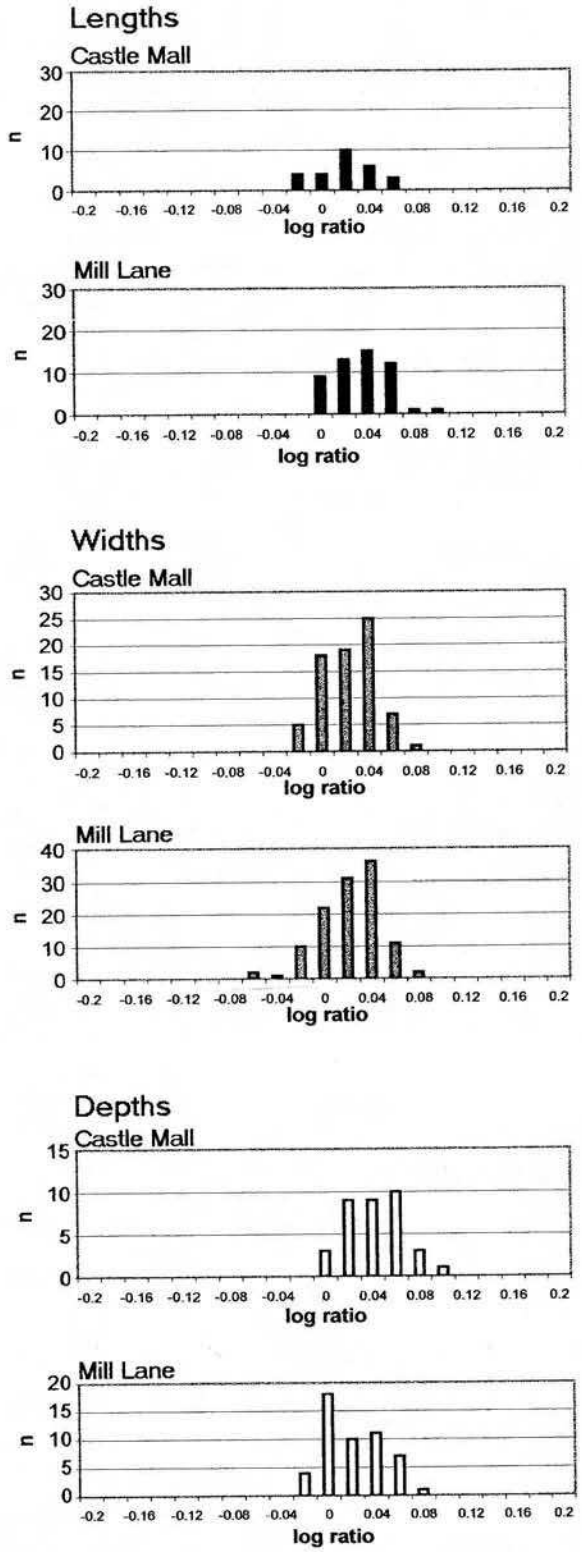

Fig. 7.7. Comparison of sheep/goat measurements from Norwich, Castle Mall (late 9th – 11th century AD) and Thetford Mill Lane (10th – 12th century AD). Lengths, widths and depths are compared with a standard sample of unimproved Shetland ewes (0 in the histograms) (Davis 1996), using the log ratio technique (Simpson et al *1960). Shaft measurements are not included (from Albarella 1999a).*

information regarding the treatment of animal carcasses. The analysis of pig measurements from the mid Bronze Age site of La Starza in southern Italy showed that tooth measurements had a general unimodal distribution and a relatively low coefficient of variation. Post-cranial bones were mostly comparable in size, except for a number of large outliers not observed among the teeth (Fig. 7.8). These larger specimens were interpreted as belonging to wild boars, while the more numerous group of smaller measurements was thought to derive from a population of domestic pigs (Albarella 1999c). The absence of wild boar teeth was explained by the fact that the primary butchery of these animals was carried out off-site, where the head, which is heavy and cumbersome to carry, would have been discarded. This interpretation was aided by the use of the log ratio technique that allowed a direct comparison of tooth and bone measurements. Whether this interpretation is correct or not, it represents an example of how metric data can be used to tackle questions that go beyond a mere analysis of size.

Moving to a different subject, biometry has provided an important contribution to the understanding of the mechanisms of expansion of the Roman Empire and the relationship between Roman and native cultures. Teichert (1984) demonstrated that in Germany large cattle were mainly confined to the area of the *Germania Romana*. A few of these big beasts were also found in *Germania Libera*, and were probably the result of a trade between the local populations and the invaders. Large cattle were no longer found after the retreat of the Romans. Lauwerier (1988) found similar evidence in the Dutch Eastern River area, but here the situation within the Roman occupied area was more complex. In some sites large (presumably imported) and small (presumably local) animals co-existed, whereas in others animals of an intermediate size were found. These animals were interpreted as a product of the interbreeding between imported and native animals.

As concerns Britain, similar considerations were made regarding the size of cattle at the Roman city of Lincoln (Dobney *et al.* undated) and at the rural villa of Great Holts Farm, Essex (Albarella 1997b). At this latter site some massive cattle metapodials were found. They presumably derived from recently imported livestock that had not yet interbred with local animals. There was also evidence of the importation of exotic plants and possibly fishes and, though more tentatively, of the practice of high status activities (Murphy *et al.* 2000). The presence of large animals fits well with the idea of a community strongly oriented towards a cultural contact with the continent.

Recent work on other British sites is providing

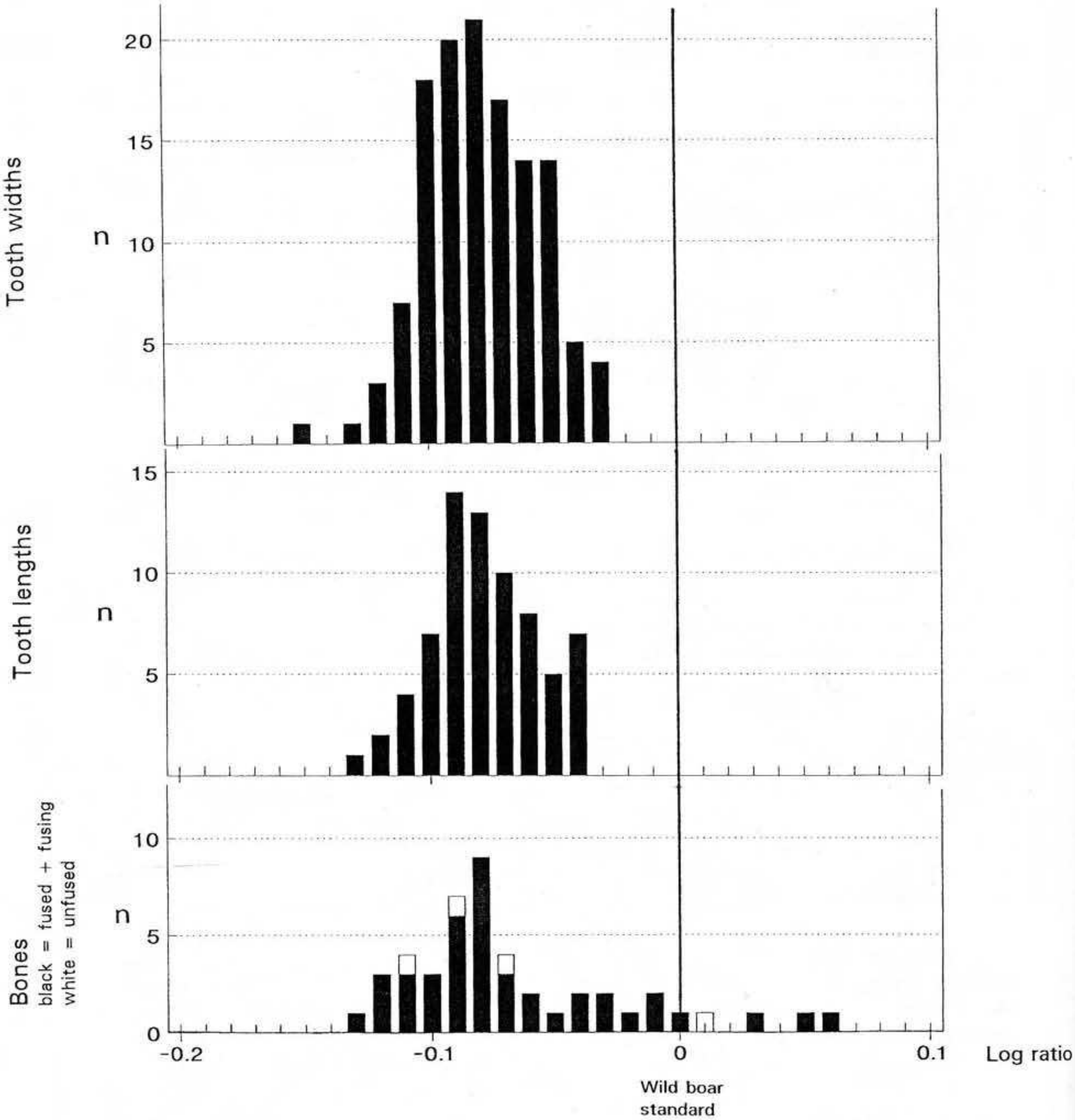

Fig. 7.8. Variation in pig tooth and post-cranial bone measurements from La Starza (middle Bronze Age) using a log ratio for comparison with the wild boar standard from Kizilcahamam (Payne & Bull 1988) (from Albarella 1999c).

additional information. Data from the small town of Elms Farm, Essex (Johnstone & Albarella in prep.) indicate that not only cattle, but also horse and sheep – this latter at a later date – increased in size with the arrival of the Romans. This confirms what had already been found at Scole-Dicklenburgh (Norfolk, eastern England), where late Roman sheep proved to be larger than their Iron Age equivalents (Baker 1998) and at Nazeingbury (Essex, south-east England), where an increase in horse size between the late Iron Age and the Romano-British period had been noted (Huggins 1978). If it is easy to understand why the Romans may have wanted to import larger and stronger horses, which would have been more effective as war, status and possibly working animals, it is more difficult to explain the increase in sheep size. The pre-Roman British husbandry had a strong emphasis on sheep breeding. This declined with the arrival of the Romans, who relied to a much greater extent on cattle. Why would the Romans thus import new sheep? Does the later increase (in comparison with cattle) perhaps suggest that its cause was not the introduction of new animals but local improvement? Is this interest in sheep improvement related to the partial return to a pre-Roman style of husbandry that typifies the end of the Roman period (see King 1999)? Were the Romans more preoccupied with getting themselves integrated with local populations or rather in showing off their cultural superiority, perhaps symbolised by the larger and more efficient livestock?

Despite the extensive work that has already been carried out on Roman sites biometrical analysis keeps providing interesting insights on the nature of the Roman conquest. The publication of a new wave of data and information will undoubtedly present us with the opportunity to open new and stimulating lines of research.

Conclusions

Biometry is a complex but useful subject that has been reduced to a bland and merely descriptive exercise in too many archaeological works of the last two or three decades. Trends that have emerged in the last few years indicate that this situation is changing and that we are gradually getting a better understanding of the mechanisms that operate behind biometrical variation. This is putting us in a position in which we can better contribute to the investigation of a wide range of archaeological questions. This is, however, no reason to feel complacent. Biometrical analysis requires a careful, thorough and in some cases time consuming approach. The availability of computer facilities makes this work much easier than it used to be, but the pressure exercised by the needs of an increasing commercialised archaeological world represents a potential threat. It is only by producing good quality work, well integrated with the rest of the archaeological evidence, that we can draw attention to the importance of this type of analysis, and the need for it to be funded.

Another possible problem for the future of biometrical work is represented by the fact that the professional figure of the biologically trained zooarchaeologist is gradually becoming rarer. All in all this is a sensible move. Bioarchaeological disciplines belong within archaeology and in that context should be taught. It is, however, also true that we have hitherto thrived on the variety of expertise existing within bioarchaeology and environmental archaeology in general. The inevitable homogenisation of bioarchaeology training that we are going to face must be compensated by the introduction of greater elements of biology, including biometry, in the teaching of archaeology courses.

A final difficulty to be faced is the still existing split between biometrically and non-biometrically oriented zooarchaeologists. This, however, does not reflect any real difference in a theoretical approach to archaeology, but it is rather based on the idiosyncrasies of different researchers or schools of research. All disciplines that can provide useful information on the past life of people should be treated with equal respect and interest. Preconceptions on the possible use of any analytical tools reflect lack of confidence and narrow-mindedness more often than the existence of different research agendas. It is likely that in the next few years scepticism towards the potential of biometry will be regarded as unproductive and old fashioned as the acritical and uncontextualised attention to bone measurements that has sometimes afflicted zooarchaeological work of the recent past.

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