# SIZE INCREASE IN POST-MEDIEVAL ENGLISH SHEEP: THE OSTEOLOGICAL EVIDENCE

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**ABSTRACT:** From the end of the medieval period to the end of the 18th century, the economic priorities of sheep farming over much of England shifted from an emphasis on wool and milk to one which valued meat as never before. With this change in priority came attempts to increase the carcass size and to 'improve' the conformation, and many present-day breeds owe their origins to this process. A general increase in size of sheep is reported in documentary records from this period, but there is little published supporting evidence from the archaeological record. This paper draws together some biometrical data from post-medieval sheep, and shows the size increase to have been gradual, piecemeal, and a phenomenon of the late 18th-19th centuries.

**KEYWORDS:** BONES, SHEEP, BIOMETRY, POST-MEDIEVAL, AGRICULTURAL IMPROVEMENTS

**RESUMEN:** Desde finales del Medioevo hasta la conclusión del siglo XVIII, las prioridades de la cría de ovino en gran parte de Inglaterra derivaron desde usos que enfatizaban la producción de lana y leche hacia aquellos en donde la producción cárnica asumió un papel preponderante. Estos cambios de prioridades produjeron estrategias encaminadas a incrementar las canales y optimizar la aptitud cárnica, fenómenos que se sitúan en el origen de muchas de las razas actuales. Si bien los registros documentales constatan tal incremento general de tallas, el registro arqueológico del proceso es muy menguado hasta la fecha. En este trabajo agrupamos información biométrica sobre ovejas post-medievales y demostramos que la tendencia al aumento de tallas ha sido un fenómeno gradual y esporádico, que se produjo fundamentalmente desde finales del siglo XVIII y durante todo el XIX.

**PALABRAS CLAVE:** HUESOS, OVEJA, BIOMETRIA, POST-MEDIEVAL, MEJORA AGRÍCOLA

## INTRODUCTION

Around the end of the 17th century, there were reckoned to be about twice as many sheep as people in England and Wales (Whitlock, 1978: 62), and it is a commonplace to regard the sheep as one of the cornerstones of national prosperity throughout the post-medieval period. Obviously there was substantial regional variation within the sheep population in England at any given time, but as a broad generalisation it can be said that the sheep of AD1500 was a different beast to that of 1800 or today. Through the post-medieval period, England, and to a lesser extent Wales and Scotland, saw the vigorous activities of the agricultural 'Improvers', at whose hands the appearance and productivity of the agrarian landscape was much changed. By 1630, the Earl of Bedford and his brilliant contractor Vermuyden had started work on the reclamation of the Fens, and the next few decades were to see a systematising of agricultural knowledge, and the dissemination of that information. In 1650, Richard Weston published his *Discours of Husbandrie*, and Blith's *English Improver Improved* appeared two years later. By the next decade, Forster and others were urging the use of the potato as a field crop, and Worlidge's *Systema Agriculturae* of 1669 brought ideas of mechanisation to the fore. Attention turned to livestock in Markham's *Cheap and Good Husbandry*, published in 1676. The second half of the 17th century also saw the introduction and rapid acceptance of a range of forage crops, notably turnips and legumes (Trow Smith, 1957: 256-257). It could fairly be said, then, that the period from 1650 to 1700 saw the Improvements thoroughly underway.

In parallel with the changes in drainage and cropping which were going on, new ideas about the breeding and feeding of livestock were coming in. The burgeoning urban markets encouraged the droving of cattle and sheep, with specialist grass farmers setting up specifically to fatten driven stock to meet urban demands. Quite suddenly, cattle and sheep were seen as important for their carcass as much as for their milk, wool, dung, and labour. Improvement of the sheep was a complex affair, balancing the development of a heavier fleece against loss of wool quality, and these qualities against improved carcass characteristics. The emergence of 'Improved' sheep, as some of our earliest recognisable breeds, is an 18$^{th}$ century phenomenon. John Ellman began work on the Southdown breed in 1778, a couple of decades later than Allom and Bakewell's early work on the Leicester breed (Whitlock, 1965: 129, 134). It was these two breeds which were to contribute the most to the breeds which typify today's sheep in Britain and many of its former colonies.

It is the purpose of this paper to examine the archaeological evidence for the post-medieval Improvement of domestic sheep in England. The historical sources are first briefly examined to gain a view on what might be expected in the archaeological record and available data are then examined in the light of the historical evidence. In effect, this is a biometrical study of post-medieval sheep bones, but with the express aim of examining the evidence for changes in body size and conformation, and of assessing the timing of such changes.

## HISTORICAL SOURCES

One of the phenomena of the Improvements era, as mentioned above, was the appearance of books and papers entreating farmers and husbandmen to adopt this or that new practice. Some of these publications also convey information about the livestock of the day, thus providing a series of snapshots of sheep of the 17$^{th}$ and 18$^{th}$ centuries. The usefulness of these accounts varies, as the degree of improvement of a flock was generally, and not unreasonably, reckoned in terms of the speed with which an acceptable meat carcass could be obtained, or the weight of wool to be clipped from a certain number of sheep. Thus Thomas Davis' description of the late 18$^{th}$ century Southdown sheep as being "*...very good in their back and hind quarters ... full of wool*" (Whitlock, 1965: 129) is less than specific. Even illustrations such as those given by Low (1842) give stylised representations which appear to project characters of fleece type and face colour onto more or less idealised body forms.

There is a further problem with the contemporary written sources. The agrarian Improvers were at the forefront of developments, and were often substantial landowners. It has to be asked whether their descriptions of the new livestock refer to general changes which were going on nationally or merely to the latest developments on the lands of a particularly go-ahead husbandman. Archaeological material, on the other hand, and particularly that from towns, may be drawn from quite a different population, representing the generality of contemporary livestock. It may be misleading, therefore, to assume either that Bakewell's records tell us much about 18$^{th}$ century sheep in the East Midlands, or that the introduction of Improved stock in a particular area necessarily led to the replacement of all unimproved stock.

Those caveats having been entered, we can briefly examine what is known about the Improvement of English sheep. In an attempt to give a thumbnail sketch of the situation in about 1700, Trow Smith (1959: 36) gives the impression of a land populated by diverse regional types, all of them unimproved with respect to carcass conformation. Elsewhere, the same author categorically states that "*The history of the modern English sheep is almost entirely the tale of the modification of the ancient breeds by the blood of Bakewell's New Leicester Longwool and Ellman's new Southdown close wool*" (Trow Smith, 1951: 160). The raw material of Bakewell's work was the polled, long-woolled sheep of the East Midlands, probably of similar type to the sheep of the Cotswolds, and thought by some to have Roman antecedents (Trow Smith, 1957: 232). Bakewell succeeded in raising the carcass size appreciably, in an attempt to produce a large mutton carcass, but did so largely by developing a sheep inclined to deposit large amounts of fat, and at the expense of fleece quality. The main contribution of the New Leicester to the emerging Improved breeds, then, was an increase in overall size. Ellman's Southdowns were developed more for their short dense wool, but imparted to their descendants a rather stocky, short-limbed physique, and comparatively rapid growth. In osteological terms, then, we might expect to note Leicester-influenced sheep as being decidedly large, whilst Southdown-influenced sheep might have bones of appreciable robusticity, though not necessarily particularly long. In either case, we should not expect to see these influences in the archaeological record before the mid-18$^{th}$ century, and then, perhaps, only locally.

## THE ARCHAEOLOGICAL DATA: FIRST FIND YOUR SHEEP

It is a curious yet consistent phenomenon of English archaeological sites that post-medieval deposits are seldom excavated in any manner worthy of that verb, and seldom produce well-stratified series of artefacts and bones. Occupation of 16$^{th}$ to 18$^{th}$ century date is often co-located with modern occupation, and often within modern towns. The shallow burial of post-medieval layers renders them susceptible to destruction by later excavation for cellars or foundation trenches, or to rapid removal by excavators in search of earlier occupation. There is something of a shortage of post-medieval 'finds' from English sites, and this limits the scope of the present paper. Happily, a few sites have yielded substantial bone assemblages of appropriate date and adequate stratigraphical integrity, and the study which follows depends heavily on the author's work on material from a number of sites in York.

Archaeological bone assemblages provide a data set which consists of the disarticulated, and often fragmented, elements of an unknown number of different individuals. Examination of size variation has to proceed by studying specific skeletal elements, rather than by examining the whole skeleton of each individual, and by utilising measurements taken on those isolated elements. We may decide that the sheep in a particular assemblage will be represented by their tibiae, and examine the size range represented by measurements from a sample of tibiae drawn from the assemblage, taking that sample of measurements to represent the size range and distribution of the sheep population represented by the tibiae. If we then draw from the same assemblage a sample of metatarsals and take appropriate measurements, we cannot assume that the population represented by the metatarsal measurements is the same as that represented by the tibiae, as there will probably be some individual sheep which are represented in the assemblage by tibiae but not by metatarsals, and viceversa. This difference in sampled populations may be most marked when systematic, large-scale butchery has led to the deposition of highly selected assemblages, characteristic of particular butchery processes (O'Connor, 1993). Measurements taken on different elements from the same assemblage may therefore give different information.

How useful are bone measurements as a measure of body size? Live sheep are measured and assessed in terms of variables such as weight or shoulder height, whereas archaeological ones are measured in terms of the length or width of isolated bones. One would intuitively expect a large sheep to have bigger bones than a small sheep, and a strong positive correlation between bone measurements and body size can be shown (e.g. see O'Connor, 1982: 82). There is something of a problem of scaling, however. The weight of an animal is directly proportional to its volume, which is in turn directly proportional to the cube of any linear dimensions, most animals being three-dimensional. The degree of univariate biometrical variation encountered in a given sample thus understates the variation in body weight or volume amongst the population which that sample represents. Thus if the largest and smallest individuals in a sample differ in linear measurements by a ratio of only 1:1.2, the ratio in body weight terms should be $1{:}(1.2)^3$, or 1:1.76. A relatively small difference in bone measurements can represent a quite substantial difference in gross size.

Growth rate, measured as the speed of attainment of adult body size, was one of the parameters on which the early Improvers judged their success, and it is a difficult variable to measure from archaeological material. Fortunately, some parts of the skeleton may reflect in their adult morphology the rate of growth during earlier stages of development. This is particularly the case with the metapodials of sheep, which Tschirvinsky (1909), Hammond (1932) and Palsson & Verges (1952) showed to develop adult characteristics related to the rate of growth pre and post weaning. To summarise their conclusions, gross bone size alone may reflect overall carcass size, but the relationship between gross size and length in the metapodials may yield information about the growth and maturation pattern of the sheep. Rapid growth *in utero* and pre-weaning will favour length growth in the metapodials, with circumferential growth 'catching up' as length growth decelerates towards the time of fusion of the epiphyses. Thus relatively short and thick metapodial bones may be typical of a fast maturing population, whilst relatively long and slender metapodials may be more typical of a slow-maturing, albeit large, breed.

## METHODS OF ANALYSIS

Biometrical studies of bones utilise a wide range of analytical techniques, and this is not the place to attempt a full survey. Some methods will be more appropriate than others to the questions being addressed here, and these methods require brief description.

Simple univariate analysis, whether by the traditional histogram of a single measurement, or by the use of descriptive statistics such as the arithmetic mean, will allow sample values for a particular measurement to be summarised. This may itself be all that is required, though the problems mentioned above of relating bone size to body size have to be kept in mind. For most assemblages, it may be an acceptable starting assumption that the data are normally distributed, and thus that mean and standard deviation-based methods of analysis are appropriate. Bivariate plots, such as scattergrams, are widely utilised to examine variability in the relationship between two variables, often in order to identify morphological sub-groupings within the sample. Such an approach may be appropriate here if growth rate is to be considered by an analysis of size and length in the metapodials. A range of multivariate, mostly eigenvector-based, methods can be applied. Most present difficulties when missing data are encountered, as is usually the case with archaeological bone measurements, and in any case may be more appropriate to studies of shape variation rather than the simple assessment of size which the present study requires. It is a common observation that principle components analysis of bone measurements shows size to be the main parameter of variation.

Analysis of a sample of measurements of a particular skeletal element requires that there should be enough specimens of that element in the assemblage to provide a sample large enough to bring the significance of any statistical results into an acceptable range. This may be a problem in all but the largest of archaeological assemblages, and techniques have been developed which allow measurements from different skeletal elements to be drawn together into one dataset. These are largely based on the 'standard animal' approach (O'Connor, 1991: 272-274), by which the sample measurements are compared with the corresponding measurements on a single complete individual, and are re-expressed as a ratio of the standard measurement. Measurements from a range of elements are thus reduced to a common base, and can be incorporated into a single sample to describe the sampled population. Derived from this is the log-ratio method, which plots individual sample measurements as the $\log_{10}$ of the ratio of the standard. These standard animal approaches also have the advantage that the known body size of the standard can be used to give some degree of calibration to the sample size range.

These are some of the methods available to a study of this kind. The most important thing in choosing the method to be used is to keep in view the questions being addressed, and not to be carried away on a magic carpet of software-package output.

## THE DATA FROM YORK

Two decades of excavation in York have led to the recovery of very large quantities of often well-preserved animal bones. Amongst this embarras de richesses, there are several comparatively well stratified post-medieval assemblages which serve to give a series of samples spanning the period from the late 15$^{th}$ century to the early 19$^{th}$ century. For the most part, these are assemblages in which selective disposal has led to an over-abundance of sheep metacarpals, providing a large sample of biometrical data for this element. There is, of course, the possibility that selective disposal could indicate selection for slaughter in the first place, and thus that the sample will represent an atypical subset of the population. It is assumed here that this is a biasing factor which would arise only infrequently and which is unlikely to have a major effect on the analysis.

Five samples from York are used here, chosen for their good dating evidence and integrity, and are listed below in chronological order. It should be noted that the abbreviated sample codes given below apply only to this paper and not to the excavation archives.

BF2806 - Context 2806 Bedern Foundry site (Richards, 1993). A 'garden soil' dated to the late 15$^{th}$ century.

BSW5268 - Context 5268 Bedern South-West site (Richards, in prep.). A surface deposit dated to the late 15$^{th}$ to early 16$^{th}$ century. Similar in date and content to BF2806, and deposited only a few tens of metres away from it.

ALD9 - Period 9 deposits, 1-5 Aldwark (Hall *et al.*, 1988). A series of dumps and pit fills, apparently parts of the same extensive deposit with much bone debris. Dated to the early 16$^{th}$ century.

W1094 - Context 1094, 118-26 Walmgate (O'Connor, 1984). Part of an extensive deposit of sheep bones apparently related to a tannery, and dated to the early 18$^{th}$ century.

BSW5027 - Context 5027, Bedern South-West. A dump of refuse with much bone, dated to the early 19th century.

For each sample, measurements have been taken from adult metacarpals, following definitions given in Driesch (1976). Four variables have been taken as being the most useful for defining the overall size of specimens: the maximum length (GL), the proximal medio-lateral width (Bp), the distal medio-lateral epiphysial width (BFd), and the minimum medio-lateral shaft width (KD). Table 1 gives summary statistics for these four variables for the York samples, and gives comparative data for samples of Soay and Clun Forest sheep.

| SAMPLE | MEAN | S.D. | N. CASES |
|---|---|---|---|
| **BF2806** | | | |
| GL | 119.0 | 7.11 | 40 |
| Bp | 21.9 | 0.94 | 40 |
| BFd | 25.0 | 1.03 | 40 |
| KD | 13.3 | 0.80 | 40 |
| **BSW5268** | | | |
| GL | 120.5 | 13.97 | 25 |
| Bp | 22.5 | 1.23 | 25 |
| BFd | 24.7 | 1.10 | 25 |
| KD | 13.5 | 0.94 | 25 |
| **ALD9** | | | |
| GL | 115.8 | 8.87 | 60 |
| Bp | 21.7 | 1.08 | 60 |
| BFd | 24.3 | 1.34 | 60 |
| KD | 13.1 | 1.01 | 60 |
| **W1094** | | | |
| GL | 120.3 | 8.21 | 50 |
| Bp | 22.4 | 1.32 | 50 |
| BFd | 25.3 | 1.53 | 50 |
| KD | 13.4 | 1.16 | 50 |
| **BSW5027** | | | |
| GL | 129.5 | 8.17 | 25 |
| Bp | 25.2 | 1.39 | 28 |
| BFd | 27.2 | 1.74 | 22 |
| KD | 15.3 | 1.30 | 28 |
| **SOAY** | | | |
| GL | 116.2 | 4.93 | 69 |
| Bp | 19.8 | 1.01 | 70 |
| BFd | 22.2 | 1.10 | 70 |
| KD | 12.4 | 0.92 | 70 |
| **CLUN FOREST** | | | |
| GL | 131.0 | 8.19 | 22 |
| Bp | 26.2 | 2.32 | 22 |
| BFd | 29.2 | 2.40 | 22 |
| KD | 17.6 | 1.69 | 22 |

**TABLE 1.** Mean, standard deviation, and number of cases for measurements of sheep metacarpal samples from York post-medieval sites. Data for a sample of Soay sheep from Hirta, St Kilda, and a sample of Clun Forest sheep are given for comparison.

Table 1 shows there to be little difference in gross size between the five samples, other than between BSW5027 and the others, showing the early 19th century sample to be, on average, of larger bones than the earlier samples. Perhaps the simplest way to investigate both size and shape change with time is to utilise the log ratio method, and to re-express the sample mean values for the four variables considered here as log ratio values with respect to the Soay sample means. Table 2 gives the log ratio values.

| | GL | Bp | BFd | KD |
|---|---|---|---|---|
| **BF2806** | .010 | .044 | .052 | .029 |
| **BSW5268** | .016 | .057 | .046 | .036 |
| **ALD9** | .002 | .041 | .040 | .022 |
| **W1094** | .015 | .054 | .056 | .034 |
| **BSW5027** | .047 | .106 | .088 | .091 |

**TABLE 2.** York sample means expressed as log ratio values with respect to a modern Soay sample.

Table 2 makes clear several points. First, the 19$^{th}$ century sample BSW5027 stands out with respect to the others, confirming the overall greater size of individuals in this sample. Second, the log ratio values are generally lower for the greatest length measurement than for the other, medio-lateral, measurements, showing that the greatest development away from the unimproved 'wild' form of the Soay sample has been in developing the cross-sectional dimensions of the bone, not the length. Third, the log ratio value for the shaft width is appreciably higher in BSW5027, indicating an increase in the relative size of the diaphysis by the early 19$^{th}$ century. This last detail is quite important. Apart from reflecting overall body size as against shoulder height, a relatively short and robust metacarpal form may be indicative of fast growth and early maturity of carcass conformation (Palsson & Verges, 1952). In short, the modern form of the bone is developing by the early 19$^{th}$ century, and not before, at least in these samples. By way of confirmation, the sample means were reexpressed as log ratio values with respect to sample means obtained from 22 modern Clun Forest sheep (Table 3). The average of the four values obtained for BSW5027 was just -.027, with GL being particularly close to standard at -.001, whilst the averages for the other samples ranged between -.071 and -.086. These figures confirm that bones in sample BSW5027 approach the form of those of modern, 'Improved' sheep much more closely than those of the other samples.

| | GL | Bp | BFd | KD | MEAN |
|---|---|---|---|---|---|
| **BF2806** | -.042 | -.077 | -.068 | -.121 | -.077 |
| **BSW5268** | -.036 | -.065 | -.074 | -.114 | -.072 |
| **ALD9** | -.054 | -.081 | -.080 | -.128 | -.086 |
| **W1094** | -.037 | -.067 | -.064 | -.116 | -.071 |
| **BSW5027** | -.001 | -.016 | -.032 | -.060 | -.027 |

**TABLE 3.** York sample means expressed as log ratio values with respect to a modern Clun Forest sample.

## OTHER ASSEMBLAGES

To supplement the York data, samples have been assembled from five other English towns. In each case, the bones were measured by the author: the source of the material is given below. The five samples are:

LBC - late 15th century specimens from Site 100, Baynards Castle, London (Armitage, 1977). Access courtesy of Dr J. Clutton-Brock, Natural History Museum, London.

HM - 16th century material from Mytongate, Hull. Access courtesy of Town Docks Museum, Hull, and Humberside Archaeology Unit.

ST29 - 16th century material from feature 102, Stafford Castle. Access courtesy of Dr. Madeleine Hummler.

CTW - 16th century material from Coventry Town Wall excavations (Bateman & Redknap, 1983). Access courtesy of Barbara Noddle, University of Wales.

LBE - late 17th - early 18th century material from Broadgate East site, Lincoln. Access courtesy of City of Lincoln Archaeology Unit.

These five samples were measured to give a dataset directly comparable with that from York. The data are listed in Table 4 and should be examined in comparison with the Soay and Clun Forest data in Table 1. Overall, there is marked similarity in size across the five samples. The earliest sample,

| | MEAN | S.D. | N. CASES |
|---|---|---|---|
| **LBC** | | | |
| GL | 119.0 | (9.89) | 4 |
| Bp | 21.2 | 0.93 | 43 |
| BFd | 24.4 | 1.17 | 81 |
| KD | 13.0 | 0.89 | 58 |
| **HM** | | | |
| GL | 115.6 | 7.07 | 16 |
| Bp | 21.9 | 1.19 | 17 |
| BFd | 24.9 | 1.32 | 18 |
| KD | 13.2 | 1.26 | 18 |
| **ST29** | | | |
| GL | 120.9 | 6.34 | 26 |
| Bp | 21.7 | 0.88 | 26 |
| BFd | 23.7 | 1.09 | 26 |
| KD | 12.5 | 0.88 | 26 |
| **CTW** | | | |
| GL | 122.7 | 5.56 | 11 |
| Bp | 22.3 | 1.38 | 26 |
| BFd | 25.3 | 1.03 | 14 |
| KD | 13.7 | 0.90 | 27 |
| **LBE** | | | |
| GL | 123.9 | (5.75) | 5 |
| Bp | 21.8 | 1.12 | 13 |
| BFd | 25.5 | 1.56 | 17 |
| KD | 13.5 | 1.31 | 11 |

**TABLE 4.** Mean, standard deviation, and number of cases for measurements of sheep metacarpal samples from London, Hull, Stafford, Coventry, and Lincoln. For comparison with York data and modern standard samples see Table 1.

LBC, shows the lowest mean values, with the only markedly disparate value being the mean GL value for the HM sample from Hull. Interestingly, though perhaps only fortuitously, this is best matched by the ALD9 sample from York (Table 1), of similar date and only 60 km away across the Wolds. The data in Table 4 are generally consistent with all but the latest of the York samples.

Table 5 re-expresses the data in Table 4 as log-ratio distances from the Soay and Clun Forest standards. Seen as a summary, the CTW and LBE samples show the greatest distance from the Soay standard sample, but are still a long way away from the Clun Forest sample and from the early 19$^{th}$ century BSW5027 sample from York. Thus the 16$^{th}$ to 17$^{th}$ century samples are showing some change from the 'primitive' mean size and bone conformation, but not to the extent seen in the early 19$^{th}$ century sample. Obviously, this is only a brief examination of a few samples, but the general consistency between results from several different towns lends support to some preliminary conclusions.

| | GL | Bp | BFd | KD | MEAN |
|---|---|---|---|---|---|
| **From Soay sample** | | | | | |
| **LBC** | .010 | .030 | .041 | .021 | .026 |
| **HM** | -.002 | .044 | .050 | .027 | .030 |
| **ST29** | .017 | .040 | .028 | .003 | .022 |
| **CTW** | .024 | .052 | .057 | .043 | .044 |
| **LBE** | .028 | .042 | .060 | .037 | .042 |
| **From Clun Forest sample** | | | | | |
| **LBC** | -.042 | -.092 | -.078 | -.132 | -.086 |
| **HM** | -.054 | -.078 | -.069 | -.125 | -.082 |
| **ST29** | -.035 | -.082 | -.091 | -.149 | -.089 |
| **CTW** | -.028 | -.070 | -.062 | -.109 | -.068 |
| **LBE** | -.024 | -.080 | -.059 | -.115 | -.070 |

**TABLE 5.** Data from Table 4 re-expressed as log ratio distances from Soay and Clun Forest samples (data in Table 1).

## CONCLUSIONS

By the end of the medieval period, English sheep seem to have been somewhat different to the unimproved Soay-like animals of prehistory, but still a long way short of their modern descendants. In terms of gross size, sheep of the 15$^{th}$ and 16$^{th}$ centuries seem to have been similar to the smaller modern hill breeds, and probably similarly slow-maturing. Differences from the Soay sample given here are more marked in the epiphysial measurements than in shaft length or breadth, suggesting that 16$^{th}$ century sheep were fairly bulky for their shoulder height, but not particularly big overall. The slower rate of change in diaphyseal morphology may indicate that maturation characteristics were still broadly similar to those of earlier 'unimproved' sheep, both in terms of rates of growth, and the timing and rate of epiphysial fusion. No great size increase is apparent in the slightly later LBE sample from Lincoln, nor in the W1094 sample from York, both of which belong to the half-century immediately pre-dating the historically-recorded Improvements. Only in the early 19$^{th}$ century sample from York do we see substantially larger sheep, clearly different to their post-medieval forebears, yet still appreciably smaller than the modern Clun Forest sample. In a way, then, the late

18th century date for the Improvement of English sheep is confirmed by the archaeological data to hand. The lack of substantial size increase in the LBE sample from Lincoln, in the heart of the East Midlands, would seem to indicate that the development of the relatively big Lincoln Longwool breed in the late 18th century involved more than just taking in hand an already large local variety and selecting for wool characteristics. Some systematic breeding-up of carcass size must also have taken place.

The size and morphology of the 16th-17th century samples is consistent with a continuing emphasis on wool and milk, rather than meat, production. There is little evidence of any attempt to increase either overall size or growth rate. This is not to say that there were no local experiments with developing larger or meatier sheep. Recognising that a particular ewe or ram tends to engender larger offspring than another requires only observation, not a deep knowledge of genetics, and local, or short-lived, experimentation must be allowed at any period. However, the archaeological data presented here are largely from towns, and thus from sites of marketing and consumption, where minor differences between flocks will have been obscured. The data therefore offer a series of samples of large catchments, and confirm that carcass improvement in English lowland sheep was essentially a late 18th century phenomenon, as changing demands altered the farmers' perception of that most versatile of domestic animals.

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