Researchers in Schools

Huge Horses and Colossal Cows: Was there a Medieval 'Agricultural Revolution'?

Key Stage 4 Programme

Pupil Name

Coursebook Designed by Dr T Springer

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Uni Pathways launch event

Welcome to Uni Pathways! We are delighted to be able to launch the Uni Pathways programme with you. We hope that you are ready to embark on your Uni Pathways journey and that you enjoy the video.
You will be asked to pause the video at times to complete some work in this workbook, so make sure you have a pen / pencil to hand when you start the video.

By the end of the video, you will have

- Learnt about what studying at university means
- Learnt about some of the skills that you will develop during Uni Pathways
- Heard from pupils who have participated in Uni Pathways or The Scholars Programme (which is the same programme!)
- Heard from current university students talking about what life is like at university

If you are in school your teacher will play the video. If you are at home and logged in to a session with your teacher, your teacher will play the video and show it to you. If you are participating independently your teacher will email you the link to the video or the video file. There are opportunities for you to answer some questions, and you will be told when to pause the video to answer them.

Introduction to Uni Pathways

1. Write down what you think a supra-activity is

_____
_____
_____

2. Independent learning is

_____
_____
_____

3. Write down in your own words what resilience means, and come up with a different example to the one mentioned in the PowerPoint.

_____
_____
_____
_____

4. Why do you think analysis and evaluation skills are useful in your academic career? _____
_____
_____
_____
_____
_____

5. Why do you think analysis and evaluation skills are useful in life in general? _____
_____
_____
_____

6. What are the different types of learning that university students do?

Pupils' experience of Uni Pathways
You will now watch some pupils talk about their experience of learning a PhD topic and producing a final assignment. Some may refer to The Scholars Programme rather than Uni Pathways. As you heard in the introduction PowerPoint, The Scholars Programme is a very similar programme to Uni Pathways. Listen carefully and then respond to the questions below. Be prepared to share some of your responses with your peers.

1. How did the pupils describe talking about writing a long essay for their final assignment?

2. Write down something that one of the pupils mentioned was particularly interesting in their course.

3. What were some challenges that the pupils met?

Virtual campus tours
You will now go on a virtual tour of some universities! Once you have seen some of the university campuses, respond to the questions below.
Note down something that you liked out of any of the campus tours you saw. It may be a particular building, space, city etc.

1. Were there any similarities between the different university campuses? If so, what are the similarities?

2. If you had to pick one of those universities to go and visit in person, which one would it be and why?

3. Note down some of the societies that you could join at different universities

Meet university students!
You are about to virtually meet or hear from some current university students.
If you are virtually meeting them, think about what questions you would like to ask the students, share your questions with a partner and note those questions down in the space below.

If you are not meeting them but watching some videos that they have made, use the space below to note down what else you would like to find out about university. You can then ask your teacher during Uni Pathways tutorials!

Reflection
Congratulations on completing the launch of the Uni Pathways programme. Before you go, take some time to reflect on what you have learnt by answering the following questions:

1. Are there any aspects of university style learning that you would look forward to? If so, what are they?

2. What challenges do you think students face when learning at university? How would you try to overcome these challenges?

3. What skills do you hope to develop during your Uni Pathways course?

4. What part of Uni Pathways seems the most challenging for you?

5. What are you most looking forward to about Uni Pathways?

Timetable and Assignment Submission

Timetable – Tutorials

Tutorial	Date	Time	Location
1			
2			
3			
4			
5			
6 (Feedback)			
7 (Feedback)			

Timetable – Homework Assignments

Homework Assignment	Description	Due Date
Tutorial 1	Baseline Assignment: what was the 'Agricultural Revolution'?	
Tutorial 2	Zooarchaeological Methods	
Tutorial 3	Launceston Castle Livestock	
Tutorial 4	Comparing Case Study Evidence	
Tutorial 5	Draft Assignment	

Assignment Submission – Lateness and Plagiarism

Lateness	
Submission after midnight on the due date	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

Course Rationale

'Agricultural Revolution' is a highly controversial idea, which historians and archaeologists have argued about for decades. Despite many studies, they cannot agree on precisely what changed, when, and where. By the nineteenth century in England, the countryside and livestock had completely transformed. However, academics are still searching for answers to questions like "Why did change happen?", "Was it a 'revolution'?", and "How did this lead to modern farming?".

During this course, you will study this controversial idea of the 'Agricultural Revolution', and contribute to the continuing academic debate over when, where, how (and even if!) it happened. You will analyse data from real archaeological sites and combine skills from both science and history to identify key trends in the timing and extent of livestock change.

You will mainly use the study of animal bones to address the question and will analyse data from across England to recognise changes in livestock like age-at-death, species frequency and size. You will then use this information, alongside historical evidence and sources, to evaluate arguments for and against the 'Agricultural Revolution' in the late Medieval period.

'Cows at the trough' by Jacobus Vrijmoet is licensed under CC-BY-NC-SA 2.0

Uni Pathways Mark Scheme 2020

	Subject Knowledge	Critical Thinking	Written Communication
1st	The work shows a depth of knowledge and understanding of key concepts and scientific methods, through engaging with relevant sources. Knowledge is used to build and support highly effective arguments and explanations.	Analyses key scientific evidence, arguments, and reasoning. Interprets meaning and makes connections. Identifies and critically evaluates key scientific arguments and evidence, deciding on their credibility, strength, and relative significance, drawing convincing conclusions.	The work has a coherent flow and is well structured. The writing style is appropriate; scientific language and key subject-specific terms are used accurately and effectively to support the arguments and explanations made. There are no, or very few, errors in spelling or grammar. Consistent referencing, appropriate paragraphing and use of correctly labelled tables and graphs matching the style taught in the course.
2:1	The work shows an understanding of key concepts and scientific methods, drawing on relevant sources. Knowledge is used to build and support effective arguments and explanations.	Analyses relevant scientific evidence, arguments, and reasoning. Identifies and critically evaluates relevant scientific arguments and evidence, deciding on their credibility and strength, drawing reasonable conclusions. Shows some understanding of the relative value of evidence and arguments.	The work is well-structured. The writing style is appropriate; subject-specific language and key terms are used correctly. There are few errors in spelling or grammar. Mostly consistent referencing and use of tables and figures; matching the style taught in the course.
2:2	The work shows an understanding of key concepts and scientific methods, with no major misconceptions. Beginning to apply this knowledge to build and support effective arguments and explanations.	Identifies and uses basic scientific evidence, arguments, and reasoning. Showing some understanding of the quality of scientific arguments and evidence. Not yet showing understanding of the relative value of evidence and arguments.	The work has some structure. The writing style can sometimes be informal; occasionally subject-specific language and key terms are not used when it would be appropriate to do so. There are some errors in grammar and spelling do not get in the way of communicating the content. Referencing has some consistency; matching the style taught in the course Limited use of tables and graphs.
3rd	Shows a developing understanding of key concepts and scientific methods, with some misconceptions. Does not yet apply this knowledge to build and support arguments and explanations.	Beginning to analyse scientific evidence, arguments, and reasoning. Describes evidence and arguments, while not yet evaluating them.	The grammar, spelling, style, and structure of the work need improving in order to communicate ideas to the reader. Subject-specific language, key terms and references are not always used correctly. Limited, or no use of tables and graphs.

Baseline Assignment: Pupil Feedback Report

Name of Pupil	
Name of School	
Name of RIS teacher	Dr T Springer
Title of Assignment	Was there a late Medieval 'Agricultural Revolution' in livestock husbandry?

How your assignment is graded:

Grade	Marks	What this means
1st	70+	Performing to an excellent standard at A-level
2:1	60-69	Performing to a good standard at A-level
2:2	50-59	Performing to an excellent standard at GCSE
3rd	40-49	Performing to a good standard at GCSE
Working towards a pass	0-39	Performing below a good standard at GCSE
Did not submit	DNS	No assignment received by The Brilliant Club

Lateness	
Any lateness	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

Marks

OVERALL MARK / 100		FINAL MARK / 100 (including any deductions)	
DEDUCTED MARKS		FINAL GRADE	

If marks have been deducted (e.g. late submission, plagiarism) the teacher should give an explanation in this section:

Mark Breakdown and Feedback

Subject knowledge	
	mark
Critical thinking	
	mark
Written communication	
	mark

Final Assignment: Pupil Feedback Report

Name of Pupil	
Name of School	
Name of RIS teacher	Dr T Springer
Title of Assignment	Was there a late Medieval 'Agricultural Revolution' in livestock husbandry?

How your assignment is graded:

Grade	Marks	What this means
1st	70+	Performing to an excellent standard at A-level
2:1	60-69	Performing to a good standard at A-level
2:2	50-59	Performing to an excellent standard at GCSE
3rd	40-49	Performing to a good standard at GCSE
Working towards a pass	0-39	Performing below a good standard at GCSE
Did not submit	DNS	No assignment received by The Brilliant Club

Lateness	
Any lateness	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

Marks

OVERALL MARK / 100		FINAL MARK / 100 (including any deductions)	
DEDUCTED MARKS		FINAL GRADE	

If marks have been deducted (e.g. late submission, plagiarism) the teacher should give an explanation in this section:

Mark Breakdown and Feedback

Subject knowledge	
	mark
Critical thinking	
	mark
Written communication	
	mark

Subject Vocabulary

Word	Definition	In a sentence
Medieval	The time period in Europe between about 1100 and 1550AD.	Many castles were built in the Medieval period to defend towns.
Selective Breeding	The process of choosing animals with desired characteristics to reproduce.	Selective breeding by humans led to bigger and better animals.
Traction	The process of hauling heavy loads in farm work. For example, this can include ploughing fields or pulling carts.	Large horses are used for traction because they are very strong.
Veal	Meat taken from very young cattle, typically under about eight months old.	I went to the butcher and bought some veal for dinner.
Post-cranial	Any part of the skeleton which is not the skull or teeth.	The leg bones are examples of post-cranial bones.
Quantification	The process of counting identified animal bones. This provides us with meaningful data.	Quantification results suggested that cattle were more common in the past than horses.
Number of Identified Specimens (NISP)	The straightforward count of how many bones and teeth can be identified.	The NISP showed that lots of cattle and horse bones were identified on the site.
Minimum Number of Individuals (MNI)	An estimate of the number of animals on an archaeological site in the past.	The MNI results showed that there were five pigs on the site.
Age-at-Death	The age at which an animal died in the past.	There is a low age-at-death because the pig was killed for meat as soon as it was big enough.
Metrics	The method of measuring animal bones and teeth to investigate size and shape.	Metrics showed that cattle got bigger due to improved farming techniques.
Arable	The branch of farming concerned with growing crops.	Arable farming includes growing barley and wheat.
Pastoral	The branch of farming concerned with raising livestock.	Pastoral farming includes rearing animals like cattle and sheep.

Tutorial 1 – What is the 'Agricultural Revolution'?

'Medieval Farming' by Gilles de Rome is licensed under CC-BY-NC 4.0

What is the Purpose of Tutorial 1?

- I can define 'revolution', and explain how this relates to agricultural change
- I can describe key farming changes associated with the 'Agricultural Revolution'
- I can compare opposing views on the timing of the 'Agricultural Revolution'

Activity 1: What is a 'revolution'?

Discuss the definitions with your partner, and place the numbered definitions of 'revolution' in order from least to most appropriate in relation to Medieval livestock change:

Least appropriate ⟷ Most appropriate

Write down the most appropriate definition for 'revolution':

Activity 2: *What* was the 'Agricultural Revolution'?

After discussing with your partner, sort the farming changes associated with 'Agricultural Revolution' into whether they affected arable or pastoral farming, or both. If you are unsure of the definitions of either arable or pastoral, check your subject vocabulary page (pg. 8).

Arable	Both	Pastoral

Activity 3: *When* was the 'Agricultural Revolution'?

Read the extract below:

1) *Highlight* key information about the timing of the 'Agricultural Revolution'.

Dating the 'Agricultural Revolution' has become more uncertain since the initial debate in the first half of the 20th century. Beckett (1990) suggests that it is no longer commonly associated with the Industrial Revolution, and probably occurred before 1750. Clark (1991, 212) agrees, arguing that output per agricultural worker became "unusually high" in sixteenth-century England and thus the substantial development of the agricultural sector occurred before the 18th-19th century period associated with industrial progress. Kerridge (1967) argued that agricultural improvement took place between 1560 and 1767, with the core achievements occurring before 1673. Pressures like land hunger and population on sixteenth-century resources form the basis of Kerridge's argument – he states that these factors encouraged a reorganisation and improvement of agriculture which previous historians had overlooked (Beckett 1990, 6). He was also the first to question the impact of pioneering 18th century "innovators" such as Jethro Tull, Lord Townshend and Thomas Coke. He asserted that the reputation of those pioneers and the importance of agricultural change in the eighteenth century were overemphasised (Overton 1984, 121). Chambers and Mingay (1966, 12) also suggest that the supposed pioneers operated largely by trial and error, not necessarily appreciating the underlying motivation behind their actions. Finally, Overton (1996a, 4) asserts that not only was Townshend too young to have introduced the first turnips, but Jethro Tull was not the first to invent a seed drill, and Coke's practices may have caused harm to the land's productivity.

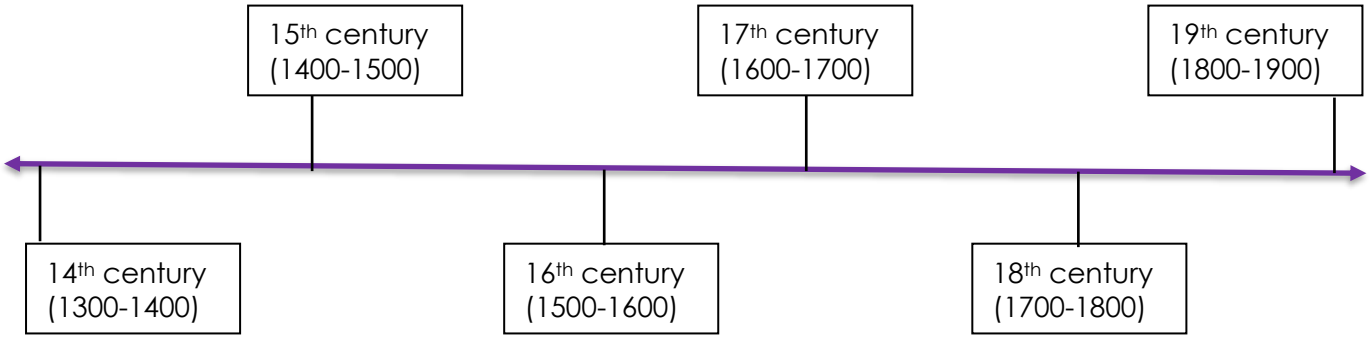
Despite these arguments placing the 'Agricultural Revolution' before the seventeenth century, the argument for a later revolution persists. For example, Campbell and Overton (1991) still argue for a later transformation, stating that "most rapid and profound transformation of technology and productivity" occurred after 1750. Their assertion that 1790 to 1820 was "an almost complete break with the past...over the working lives of one generation of farmers" is enough to convince them, and others, of revolutionary change in this period. Overton (1996a, 197) also asserts that there is insufficient evidence for an 'Agricultural Revolution' before the eighteenth century, as sixteenth-century yield increases were moderate and not suggestive of "agricultural triumph" (Overton 1996b, 17). This is mirrored by Mingay's (1977) assertion that, despite some farming development from the sixteenth century, improvement only gathered pace in the later eighteenth century. Hopcraft (1994) also maintains that revolutionary change did not occur until the seventeenth to eighteenth centuries, but states that rural changes in the fourteenth to sixteenth centuries, for example new technology, enclosure and emergence of small farmers, were crucial to that later development. This is supported by Chambers and Mingay (1966, 5), who admit that the foundations of agricultural change lie in the later Medieval period.

Overall, during modern studies, the 'Agricultural Revolution' was placed in the period between 1560 and 1880, occurring in up to five stages varying in timing throughout the country. While several historians argue for a later change, the fact that significant agricultural transformation occurred much earlier cannot be ignored. Recent consensus points to this 'revolution' being a more gradual process of improvement in multiple stages varying in timing and nature (Allen 1991; Beckett 1990). For example, Thirsk (1987, 57-61) suggests that changes were slower to appear in the North of the country, so transformation which occurred in the mid-sixteenth century in East Anglia may have taken over a century to reach Northern England. This may contribute to why historians have differed so greatly in their assessment of the timing of the 'Agricultural Revolution'.

Adapted from Fraser, T 2020: 'Livestock and Landscape: Livestock Improvement and Landscape Enclosure in Late and Post-Medieval England', PhD thesis, University of Sheffield

2) Using the information from the extract, try to place the 'Agricultural Revolution' on the timeline below, and write a sentence explaining why you have placed it at that time. Be prepared to share your answer with the group. You may wish to consider:

- Which time periods do researchers identify as key periods of change?
- Do you think the 'Agricultural Revolution' should be placed in a specific century or across several?
- Which historians agree with where you have placed the 'Agricultural Revolution'?



Baseline Assignment

Carefully read the extracts provided below about the 'Agricultural Revolution', and answer the following questions (300 words):

a) **Write a definition for the 'Agricultural Revolution' in your own words' and describe some of the key changes associated with it during the Medieval period.**
b) **Do you agree that farming change in the late Medieval period was a 'revolution'? (think about the definition of revolution, and the evidence presented in the reading).**

I particularly want to see your thoughts and opinions for part b – the **PEE** structure can help you with this:

Point	Make the point clearly
Evidence	Provide and explain evidence for the point (use evidence from the tutorial 1 reading and below)
Explanation	Explain why your point is relevant and important (relate it back to the question)

Baseline Assignment Success Criteria:

The table below explains what you should try to include in the baseline assignment to fulfill the mark scheme criteria:

Mark Scheme Skills	**Examples of success criteria to include**
Subject Knowledge	☐ Include the key subject-specific terms from your glossary. ☐ Use your subject-knowledge to support your argument. This includes referring to the reading extracts) ☐ Try to carry out some independent research (outside what we cover in tutorials). Explain how the sources you have used relate to your argument.
Critical Thinking	☐ Give reasons to back up your interpretation. You might find the PEE structure helpful.
Written Communication	☐ Check your writing to ensure that spelling, punctuation and grammar are correct throughout ☐ Remember to reference your sources correctly

Extract from Thomas, R. 2005: Zooarchaeology, Improvement and the British Agricultural Revolution, *International Journal of Historical Archaeology*, 9(2), 72-3

The Agricultural Revolution has long been described as a widespread technological change in British farming practice that led to a sustainable increase in agricultural productivity. From the early twentieth century until the 1960s there was little doubt in the minds of historians that this occurred between about 1760 and 1840 in a movement intimately associated with the Industrial Revolution (e.g. Beckett, 1990, p. 1; Ernle, 1912). This was a phenomenon that enabled the farming community to feed a population that had grown by ca. 20 million in this period (Kerridge, 1967; Mingay, 1969; Turner *et al.*, 2001, p. 211). Some of the traditional features perceived to have led to this increase in productivity included:

- parliamentary enclosure of land;
- introduction of new farming technology (e.g. the seed drill);
- new crops and crop rotations;
- improvement in livestock breeding (Beckett, 1990, p. ix; Overton, 1984, p. 119).

These developments were viewed by historians as being largely facilitated by a small number of key innovators. Robert Bakewell, for example, became famed for selectively breeding and improving domestic animals in Leicestershire; his "New Leicester" breed of sheep fattened quicker and had a greater proportion of saleable meat, and his "New Longhorn" cattle carried a larger amount of fat (Beckett, 1990, pp. 24–25).

Extract from Fraser, T. 2020: 'Livestock and Landscape: Livestock Improvement and Landscape Enclosure in Late and Post-Medieval England', PhD thesis, University of Sheffield

Despite a seemingly comprehensive list of factors pointing towards significant agricultural change during the Medieval period, many writers are reluctant to label it revolutionary. This may be due to the more recent suggestion that changes in productivity were gradual and complex, varying in nature across regions and terrain (Kerridge 1967). Thirsk (1987, 57-61) supports this, stating that the term 'Agricultural Revolution' should be abandoned due to an array of agricultural changes occurring slowly, with innovations adapted to meet the needs of each farming region. This recognition of agricultural change as slow and variable has led Mingay (1969, 481) to describe the phrase as little more than a "convenient label", masking a multitude of developments during a very broad time period. He goes on to state that to talk of the period as revolutionary is "to risk being considered a dangerous reactionary" (Mingay 1963, 123). Perhaps then, Overton (1984, 123) is correct in stating that the expression is "best dispensed with" as it is "beyond redemption".

Tutorial 2 – What can zooarchaeology tell us about past farming?

'Archeozoölogie-Referentiecollectie-Tibia-RCE' by unknown author is licensed under CC BY-NC 4.0

What is the Purpose of Tutorial 2?

- I can define zooarchaeology, and explain key methods like quantification, age-at-death and metrics
- I can discuss how zooarchaeology can help us to identify changes in the past
- I can analyse and interpret examples of zooarchaeological data

Zooarchaeological Methods:

Quantification:

Quantification helps zooarchaeologists to count the number of animals remains from archaeological sites. We do this using two methods:

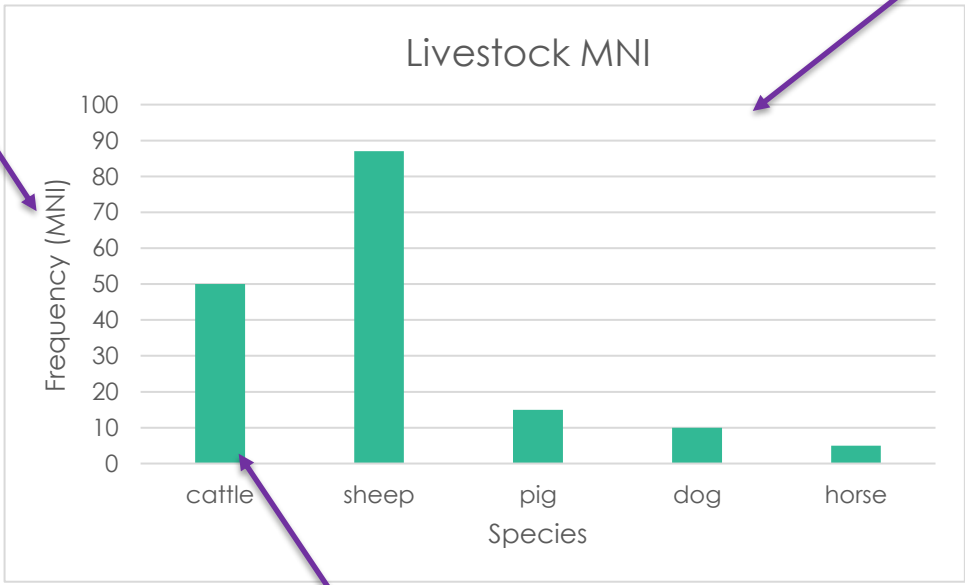
- **Number of Identifiable Specimens (NISP):** the straightforward count of how many specimens can be identified to a species or element (e.g. 4 cattle mandibles, 3 pig femurs).
- **Minimum number of Individuals (MNI):** the estimate of the number of whole animals that lived on an archaeological site. This is estimated using the most common element, though it can sometimes be unreliable.

Below is an example of a quantification graph:

To interpret this graph, you should consider:

- Which species is the most common? (sheep)
- Which species is the least common? (horse)
- Why might this be? (e.g. sheep are used for many purposes, like meat, milk and wool, whereas horses are not intensively bred for meat)

The quantification method used here is MNI, which gives an estimate of how many whole animals were on the site.



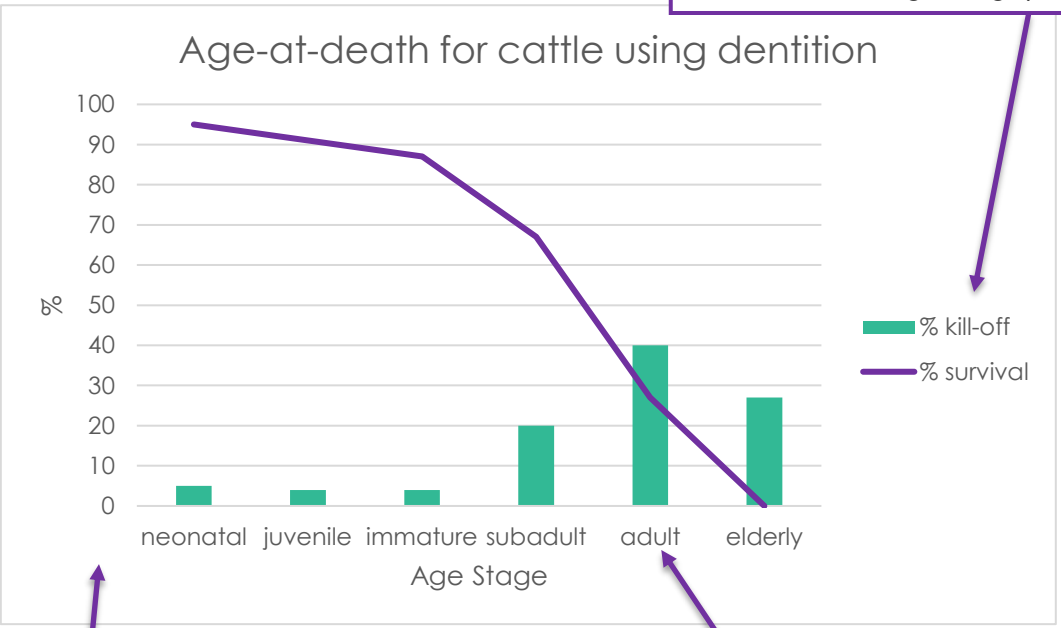
The number of each species is indicated by the height of the bar (e.g. there were 50 cattle on the site)

Age-at-death:

Working out age-at-death tells zooarchaeologists how old an animal was when it died. We use the eruption and wear of teeth to estimate the age of an animal. This is useful because it can help us to interpret what species were used for (for example, if many cattle from a site were around 2-3 years old when they died, they were likely used for meat).

Below is an example of an age-at-death graph:

We can either study the percentage (%) survival (the proportion of animals surviving to each age stage), or the % kill-off (the proportion of animals killed at each age stage)



To interpret this graph, you should consider:

- We are looking at the age-at-death of the whole herd, NOT one animal
- Which animal are we looking at? (for example, animals like cattle or pig are more likely to be killed early for meat than horse) (cattle)
- At which age stage was kill-off the most? (most killed as adults)
- What product(s) does this pattern suggest that the animals were used for? (cattle surviving into adulthood suggests use for products like traction, where the animal is not killed young)

The age is grouped into categories, from neonatal (just after birth) to elderly.

Size (metrics):

Zooarchaeologists use measurements to identify any changes in size in animals through time. We measure the size and shape of **bones and teeth**, as they can give us different information:

- The size of bones is affected by genetic AND environmental factors, which means that it is hard to be sure what a change is bone size is caused by.
- The size of teeth is mainly affected by genetic factors, which means that a change in tooth size likely indicates a genetic change in the herd.

Examples of **genetic** factors which affect animal size:

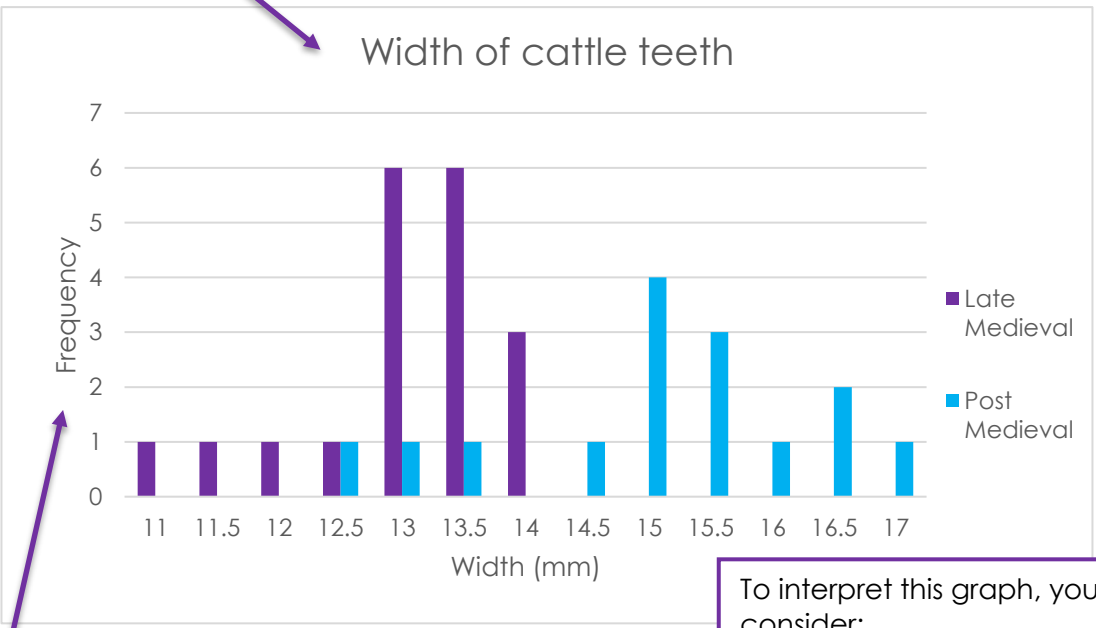
- Climate
- Geographic origin
- Nutrition
- Disease

Examples of **environmental** factors which affect animal size:

- Breed
- Sex
- Selective breeding
- Introduction of new population

Below is an example of a metric graph:

The graph compares the width of cattle teeth from different time periods, shown in different colours



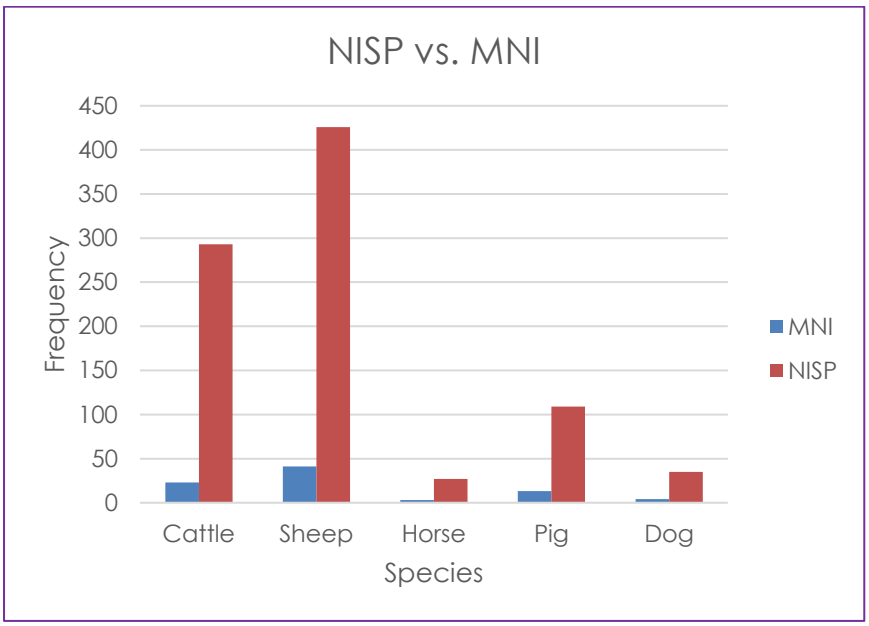
The bars show the frequency of each measurement (e.g. 6 late Medieval teeth were 13mm wide)

To interpret this graph, you should consider:

- Are the measurements similar or different for both time periods? Here the post-Medieval measurements (blue) are *bigger*
- Why might post-Medieval cattle be bigger? (they produced more meat and traction power)

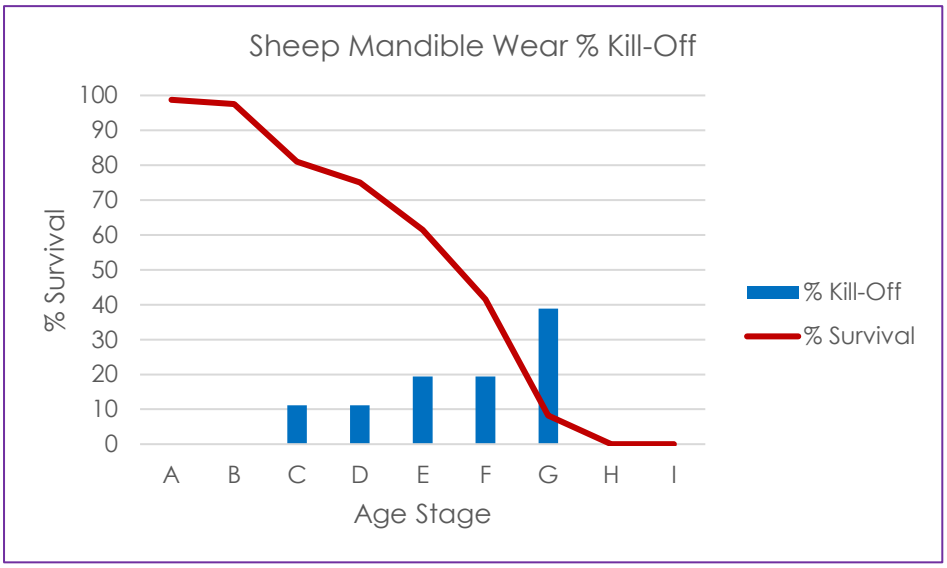
Activity 1: Interpreting zooarchaeological data

Look at the graphs provided and use the questions to interpret them. You should be prepared to discuss your answer with your pair and with the whole group.



Which species are the most and least common?

What do you think these species might have been used for?



stage	age
A	0-2 months
B	2-6 months
C	6-12 months
D	1-2 years
E	2-3 years
F	3-4 years
G	4-6 years
H	6-8 years
I	8-10 years

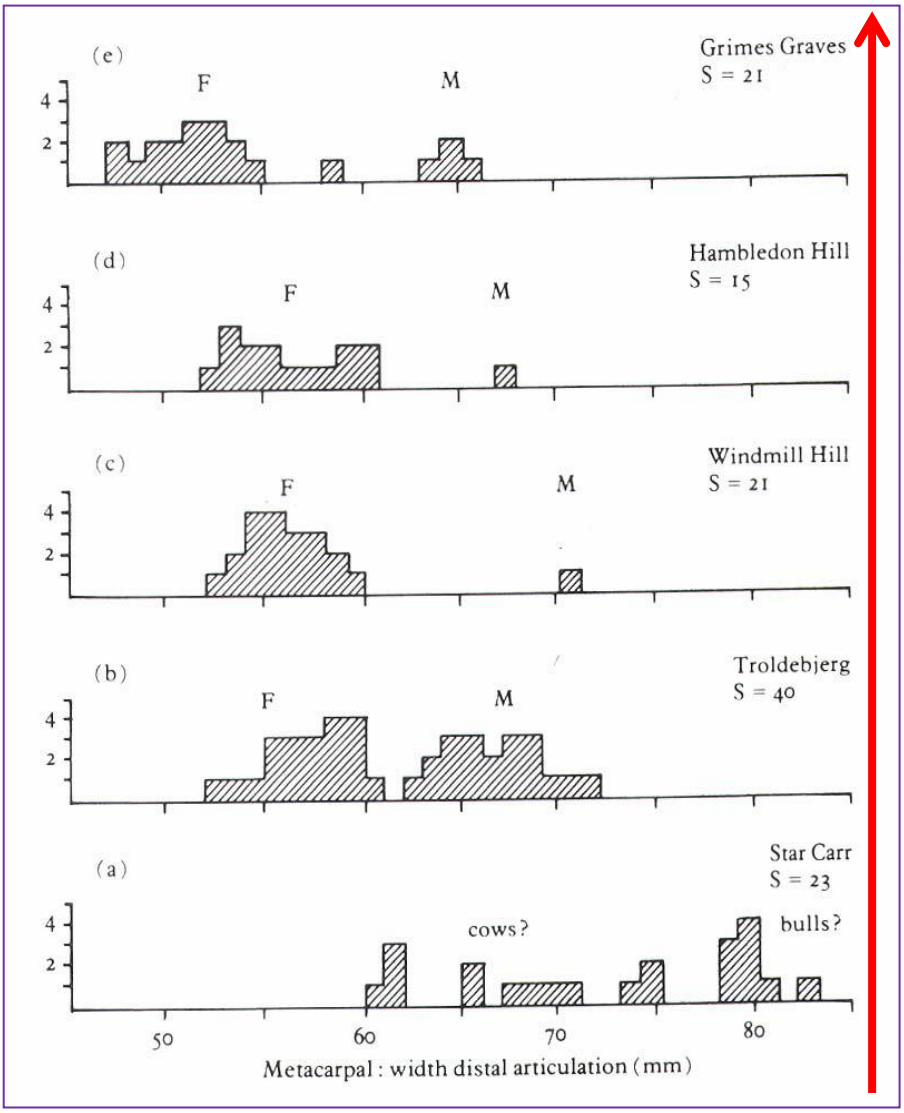
Which species does this graph show?

Which body part do archaeologists use to work out age-at-death?

At which age were the most animals killed? (use the key to give the age in years)

What does this suggest the animals were used for?

Graph showing width measurements of cattle leg bones:



5,500 years ago

6,000 years ago

6,500 years ago

7,000 years ago

10,000 years ago

Which species does this graph show?

In which time period are the measurements the largest?

When did the cattle measurements get smaller?

Why might this be?

Activity 2: How does zooarchaeology help us to study the 'Agricultural Revolution'?

Discuss in pairs: Read the livestock changes linked to the 'Agricultural Revolution' and tick which zooarchaeological method(s) you think would help to identify it: (some might need more than one!)

	Quantification	Age-at-Death	Metrics
1. Breeding or importing larger livestock	☐	☐	☐
2. More sheep used for wool trade	☐	☐	☐
3. Switch to horses for traction (from cattle)	☐	☐	☐
4. Increased veal specialisation	☐	☐	☐

Homework 2: Zooarchaeological Methods

A zooarchaeologist has excavated a site and wants to understand more about the animal bones they have found. Read the scenarios below and write down which method(s) would help, and *why*.

Remember, the zooarchaeological methods you can use are:

- Quantification (counting the amounts of species/ body parts)
- Age-at-death (finding out how old animals were when they died)
- Metrics (measuring the size of body parts to estimate the size of animals)

For example:
The zooarchaeologist could use quantification to estimate the number of sheep on the site, because that method tells us the amount of species present in the past.

1. Which method(s) could the zooarchaeologist use to work out whether cattle were killed for meat, or kept for milk? *Why*?

2. Which method(s) could the zooarchaeologist use to find out when cattle were replaced by horses for traction? *Why*?

3. Which method(s) could the zooarchaeologist use to find out if larger pigs were producing more meat in the Medieval period?

Tutorial 3 – Case Study: Launceston Castle

'Launceston Castle Gatehouse' by Nilfanion is licensed under CC BY-NC 3.0

What is the Purpose of Tutorial 3?

- I can interpret real zooarchaeological data
- I can construct an argument and support it using zooarchaeological evidence

Background to case study:

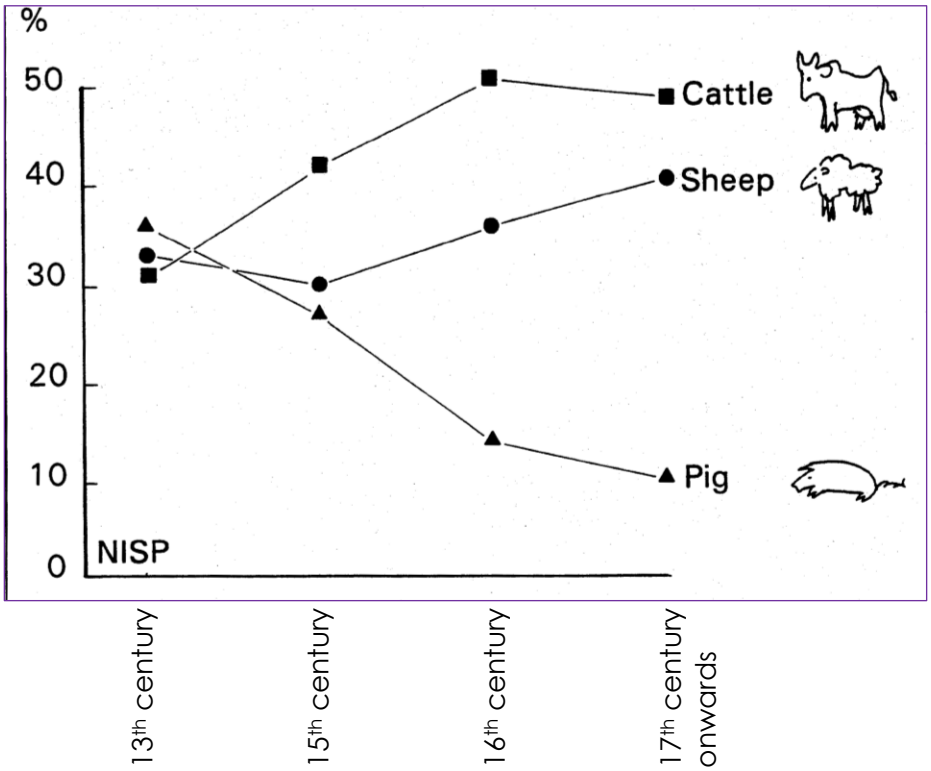
- Launceston Castle is a high-status castle site in Cornwall
- It was occupied from the 11th to the 17th century (1000 to 1800)

Activity 1: Livestock evidence from Launceston Castle

Look at the graphs below and interpret them by answering the questions. Be prepared to discuss and support your interpretation with the group.

Quantification:

Graph showing NISP from Launceston Castle:



1. Which species were the most and least common?

2. Describe how the numbers of different species change over time.

3. When do these changes happen for each species?

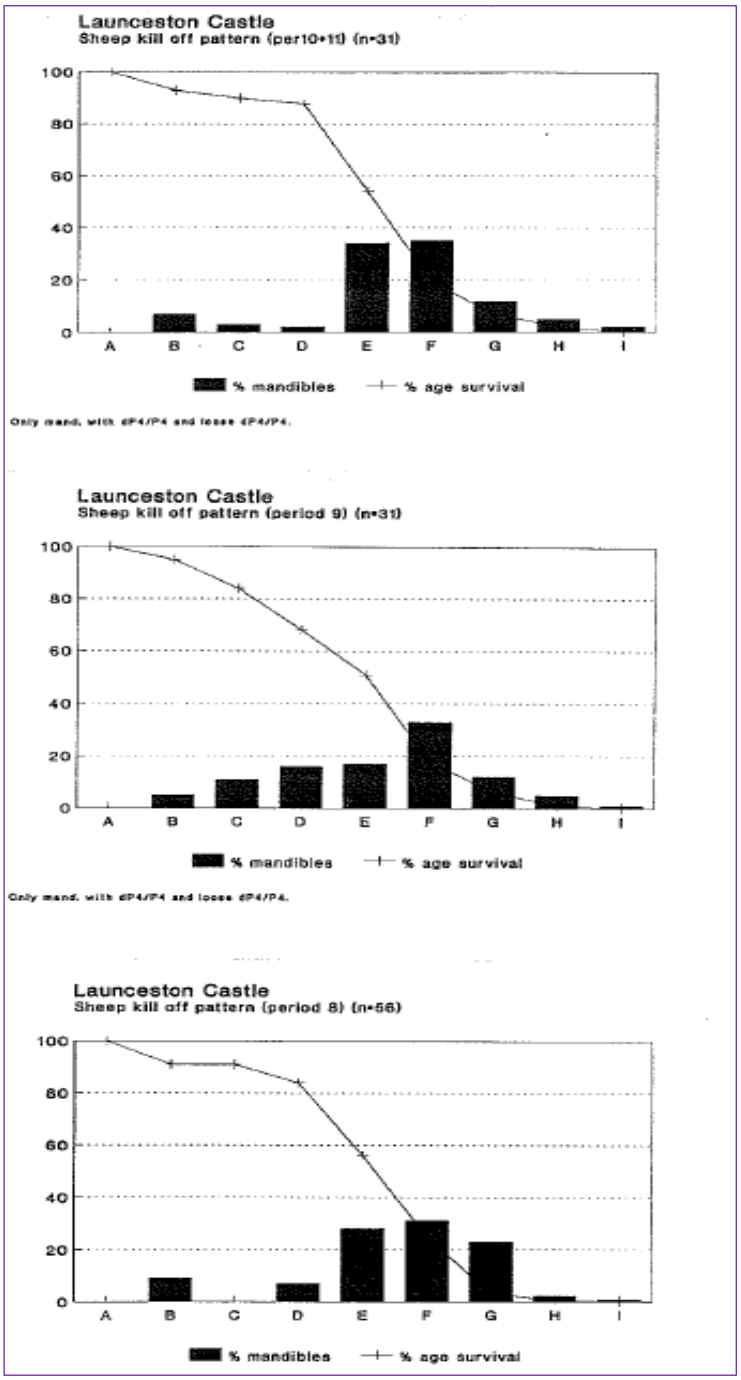
Age-at-Death:

Graph showing sheep age-at-death from Launceston Castle:

17th century

16th century

15th century



stage	age
A	0-2 months
B	2-6 months
C	6-12 months
D	1-2 years
E	2-3 years
F	3-4 years
G	4-6 years
H	6-8 years
I	8-10 years

1. Which species do these graphs show?

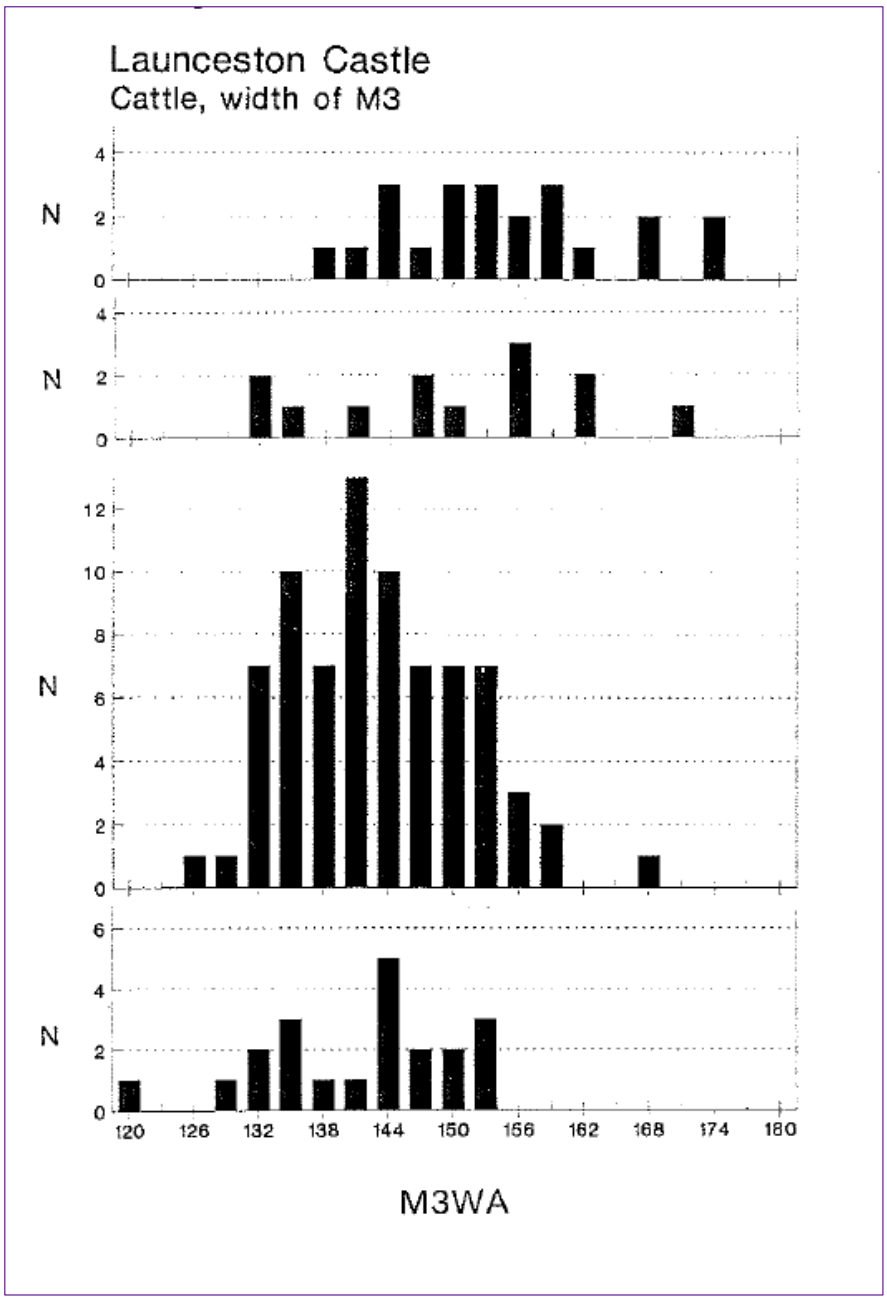
2. In the 15th century, at what age(s) were the most sheep killed at Launceston Castle? (use the key to give the age in years)

3. What do you think this suggests sheep were used for on the site?

4. Does this pattern significantly change in the 16th and 17th century? Explain *why*.

Metrics:

Graph showing width of cattle teeth through time:



1. Which species and body part do these graphs show?

2. Does the size of cattle teeth change through time? If so:
    a. How does the size change?
    b. When does the size change happen?

3. *Why* do you think this size change might have happened?

Activity 2: Did livestock change at Launceston Castle?

1. Based on the zooarchaeological evidence above, complete the table:

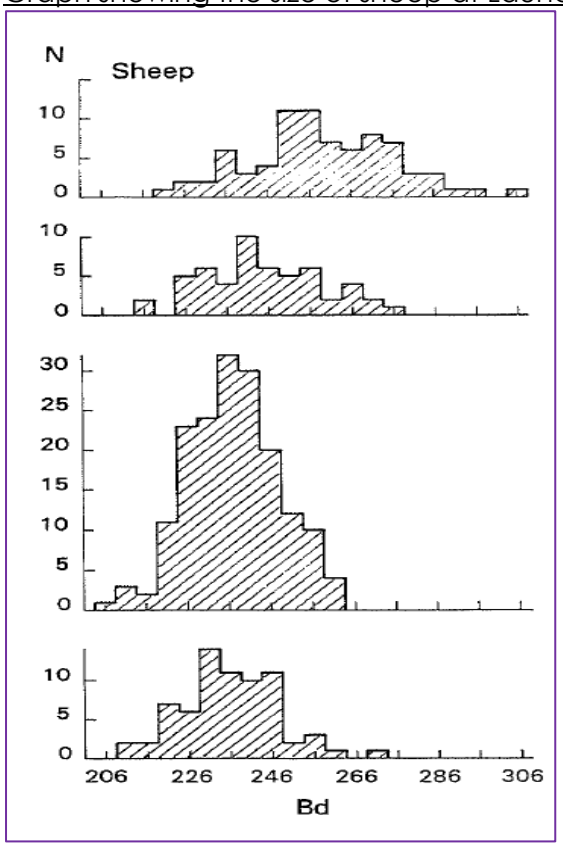
What changed at Launceston Castle? *When?*	What stayed the same at Launceston Castle?

2. Do you think this evidence suggests that a livestock 'revolution' happened at Launceston Castle? *Why*? (consider whether you think a *sudden* or *large* change happened in livestock numbers, age or size)

Homework 3: Launceston Castle Livestock

Interpret the following metric graph by answering the questions below: *Guidance on interpreting a metric graph can be found on page 19.*

Graph showing the size of sheep at Launceston Castle:



17th century

16th century

15th century

13th century

How does the size of sheep change through time?

When does this change happen?

Does the evidence from this graph support your answer to question 2 (page 29)? *Why/ why not?* **(In your answer you should consider whether you think a *sudden* or *large* change happened in sheep size).**

Tutorial 4 – Case study: Wharram Percy

'Wharram Percy Geograph' by Nyh is licensed under CC BY-NC 2.0

What is the Purpose of Tutorial 4?

- I can practice interpreting data from an archaeological site
- I can compare the evidence from different case studies
- I can assess the evidence for or against livestock 'revolution'

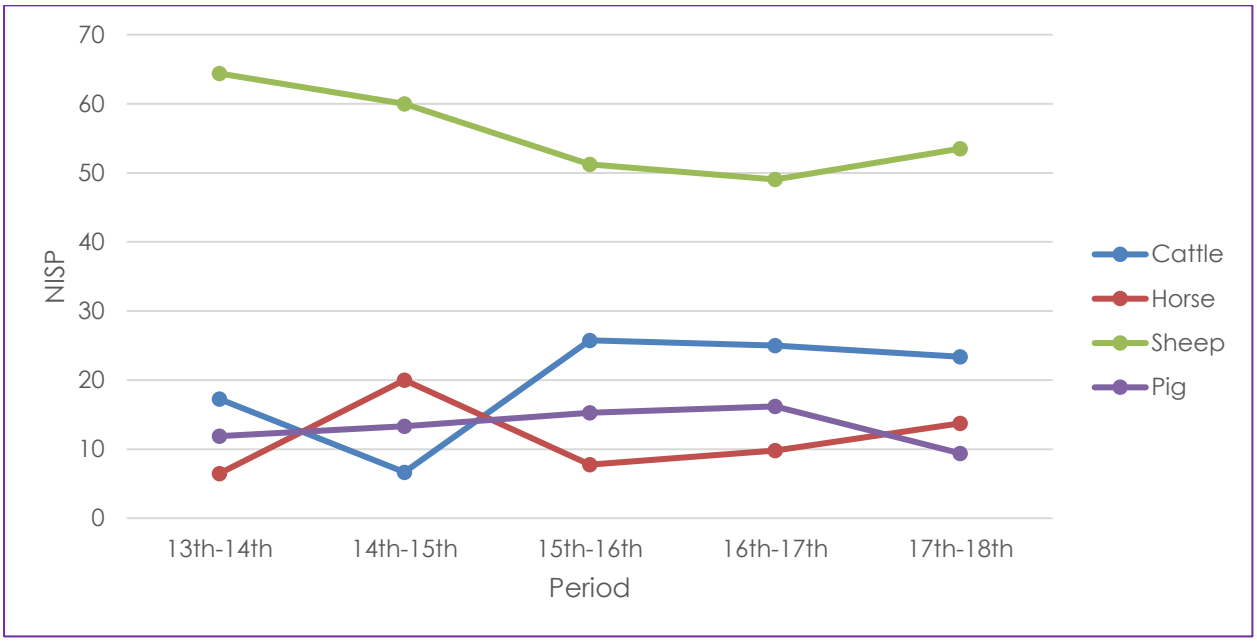
Background to case study:

- Wharram Percy is a rural village.
- The site was occupied from the 10th to the 17th century, before being totally deserted.

Activity 1: Livestock evidence from Wharram Percy

Discuss in pairs then write an interpretation for the graphs below using the prompts provided:

Graph showing the quantification (NISP) of species from Wharram Percy:



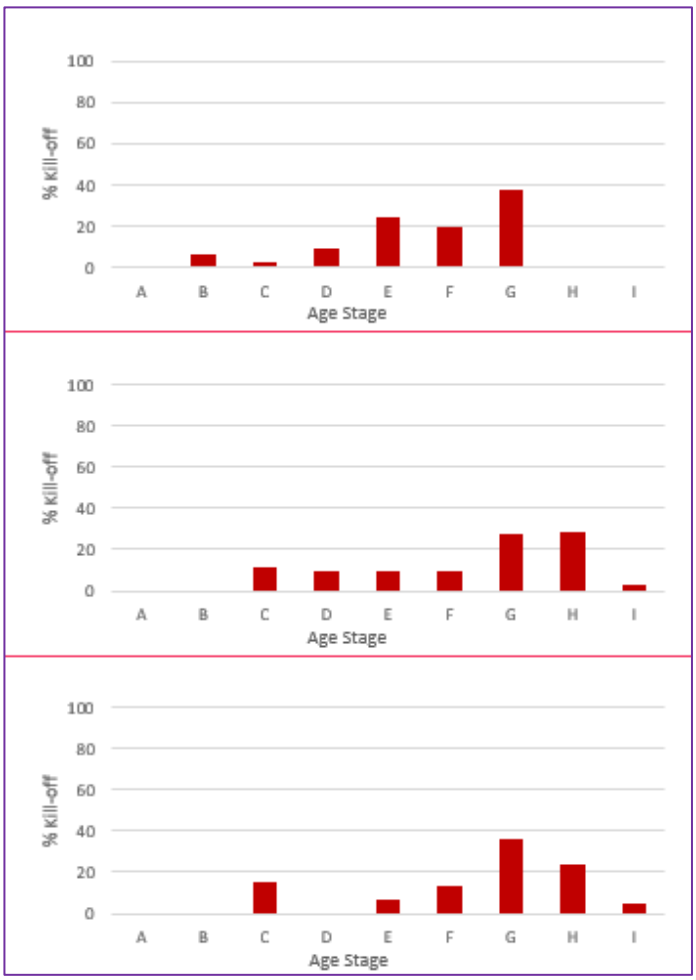
- Which species are the most/ least common?
- Do the numbers of livestock change through time?
- When do these changes happen?

Graph showing sheep age-at-death from Wharram Percy:

16th-18th century

15th-16th century

13th-14th century



stage	age
A	0-2 months
B	2-6 months
C	6-12 months
D	1-2 years
E	2-3 years
F	3-4 years
G	4-6 years
H	6-8 years
I	8-10 years

- At which age(s) are the most sheep killed?
- Does this change through time?
- What does this suggest sheep were used for?

Graph showing cattle measurements from Wharram Percy:

17th-18th century

15th-16th century

13th-14th century

- Does the size of sheep change through time?
- If so, when and how?

Activity 2: Case Study Comparison

Fill in the table below comparing the zooarchaeological data from Launceston Castle and Wharram Percy. Summarise the information by writing:

- *If* there was a change through time
- *When* that change happened.

Site Method	Launceston Castle	Wharram Percy
Quantification		
Age-at-Death		
Metrics		

Activity 3: Livestock 'Revolution'?

Using the information in the table above, do you think the zooarchaeological evidence from the case studies shows a 'revolution'? Be prepared to share you reasoning with the group.

Place a tick (✓) in the box if you think the method shows that there was a 'revolution', and a cross (✗) if you think it does not. For example, if you think that the quantification evidence from Launceston Castle shows a sudden or large change, put a tick in the first box.

Site Method	Launceston Castle	Wharram Percy
Quantification		
Age-at-Death		
Metrics		

Homework 4: Comparing Case Study Evidence

Using the evidence from the tutorial, write a paragraph to evaluate whether you think the evidence from Launceston Castle and Wharram Percy shows a Medieval livestock 'revolution'. You should:

- Choose **one** of the zooarchaeological methods to discuss
- State whether you think it shows a 'revolution', and *why*. You may wish to refer to the definition of revolution from tutorial 1.
- Use zooarchaeological evidence to support your argument.

Tutorial 5 – Was there an 'Agricultural Revolution'?

'A woman milking a cow, woodcut, 1547' by anonymous is licensed under CC BY-NC 4.0

What is the Purpose of Tutorial 5?

- I can integrate historical and zooarchaeological evidence to develop an argument
- I can explain how to summarise and reference academic sources
- I can plan a piece of academic work, including an introduction, logical paragraph structure and appropriate conclusion

Activity 1: Other evidence for 'Agricultural Revolution'?

Below are some extracts from academic sources about the 'Agricultural Revolution':

Fraser, T. 2020: 'Livestock and Landscape: Livestock Improvement and Landscape Enclosure in Late and Post-Medieval England', PhD thesis, University of Sheffield

Despite a seemingly comprehensive list of factors pointing towards significant agricultural change during the Medieval period, many writers are reluctant to label it revolutionary. This may be due to the more recent suggestion that changes in productivity were gradual and complex, varying in nature across regions and terrain (Kerridge 1967). Thirsk (1987, 57-61) supports this, stating that the term 'Agricultural Revolution' should be abandoned due to an array of agricultural changes occurring slowly, with innovations adapted to meet the needs of each farming region. This recognition of agricultural change as slow and variable has led Mingay (1969, 481) to describe the phrase as little more than a "convenient label", masking a multitude of developments during a very broad time period. He goes on to state that to talk of the period as revolutionary is "to risk being considered a dangerous reactionary" (Mingay 1963, 123). Perhaps then, Overton (1984, 123) is correct in stating that the expression is "best dispensed with" as it is "beyond redemption".

Albarella, U. 1997: 'Size, power, wool and veal: zooarchaeological evidence for late Medieval innovations', *Environment and subsistence in Medieval Europe*, 9, 19-30

"The most remarkable evidence of a change in the type of animals — and consequently in their use – between medieval and early modern times comes from bone measurements. Cattle, sheep and to some extent pig, domestic fowl and possibly horse all increased in size, and recent archaeological evidence suggests that the beginning of this trend is to be found already in the 16th century, and possibly earlier.

We have known this from archaeological and historical evidence for a long time, but recent archaeological work has thrown further light on the problem. The main findings of this more recent research can be summarised as follows:

a. In medieval times different sizes of cattle and sheep could be found in different regions of England. It seems that animals from peripheral areas, such as the west country and the far North, were smaller. The small size of Welsh and Cornish livestock is also mentioned in historical sources (Thirsk 1967)

b. The increase in size started, at least in some areas and for some species, earlier than was thought in the past. At Launceston Castle we have evidence of a substantial size increase already in the 16th century, and, although much smaller, in the 15th century. Very large 16th century animals have also been found at Lincoln (Dobney *et al.* 1996) and Camber Castle, Sussex (Connell & Davis in prep.). The presence of "improved" sheep in 16th century Cornwall is also mentioned by Carew (1602).

c. The size increase did not occur at the same pace and at the same time for all species. In cattle it was rather sudden, whereas in sheep much more gradual. In pig and domestic fowl, it occurred at a later stage, perhaps no earlier than the 17th century."

Davis, S.J.M. and Beckett, J.V. 1999: 'Animal Husbandry and Agricultural Improvement: The Archaeological Evidence from Animal Bones and Teeth', *Rural History*, 10, 1-17

"These zoo-archaeological indications of an early-onset of agricultural improvement in England support the findings of agricultural historians working from a more traditional viewpoint. In the medieval period animal were slaughtered relatively old and relatively small, while in later centuries they were relatively young, but larger animals. Greater care and selective breeding of cattle and sheep in the sixteenth and seventeenth centuries was made possible by general improvements to livestock nutrition…. Moreover, this size increase reflects increased sophistication of animal husbandry.

It follows from the argument presented in this paper that agricultural improvement in England was already under way in the fifteenth and sixteenth centuries, and that improvement in animal husbandry should be viewed more as a long-term and *gradual* development originating in the fifteenth century, rather than a *revolutionary* one which commenced sometime after 1760. Nor is such a conclusion out of line with current thinking. Overton, one of the few historians in recent years to quote zoo-archaeological evidence, has commented that 'the absence of improvement in the size of cattle is confirmed by archaeo-zoological evidence which suggests that the increase in the size of cattle took place between the middle ages and the sixteenth century, rather than later.

Overton, M. 1996: 'Re-Establishing the English Agricultural Revolution', *The Agricultural History Review*, 44(1), 1-20

If the criteria for an 'agricultural revolution' are taken to be unprecedented changes in output and in the productivities of land and labour, then it is the period after the mid-eighteenth century that emerges as having experienced such a revolution. It was during the eighteenth century that population was able to break through the ceiling of 5.5 million, that crop yields made a sustained improvement on medieval levels, and land and labour productivity were rising together. There were some productivity improvements in the seventeenth century, especially with livestock, but they cannot compare with the magnitude of changes in the eighteenth century. There were also some important changes in agricultural practice before the eighteenth century. Production was intensified from the sixteenth century, and was becoming more regionally specialized in the seventeenth, but it was not until after1750 that high yielding fodder crops were grown on a substantial scale. The arguments for an 'agricultural revolution' commencing in the sixteenth century therefore fail to carry conviction. There is some justification in the claim that breaking the distinction between pasture and arable is revolutionary, or at least is a change of potentially revolutionary significance, although the evidence on which the claim is based is open to varying interpretation.

In fact, the changes of most significance were concerned with livestock husbandry: the striking evidence from national prices suggests improvement in the yield of both wool and mutton during the first half of the eighteenth century, although cattle appear to be producing no more meat.

The verdict of this paper, that the agricultural revolution did not get underway until the eighteenth century, echoes the views of an earlier generation of historians although it is based on such new evidence. That evidence overwhelmingly favours the century after1750 as the period of most rapid and fundamental change in output and productivity, which were associated with equally unprecedented and fundamental changes in husbandry.

Using the information from the sources above, fill in the table with evidence *for* and *against* the 'Agricultural Revolution':

An example has been done for you using the first source.

Academic Source	Evidence **for** revolution:	Evidence **against** revolution:
***Example*: Fraser (2020)**	• Many factors pointing towards agricultural change.	• Changes were gradual and complex, and varied across the country
Albarella (1997)		
Davis and Becket (1999)		
Overton (1996)		

Activity 2: Final Assignment Planning

Use the table below to plan the structure and content of your assignment:

The following information will help you to plan and structure your paragraphs:

Point	Make the point clearly
Evidence	Provide and explain evidence for the point (use graphs and sources from tutorials 1 and 5)
Explanation	Explain why your point is relevant and important (relate it back to the question)

	Point	**Evidence**	**Explain**
Introduction	Introduce the topic of the essay, define a 'revolution', and outline your argument		
Example	Historical sources: significant increase in farming productivity BUT changes were gradual and complex, and varied across the country.	• Thomas (2005) • Fraser (2020)	Some historical sources suggest that new farming developments led to a significant increase in farming productivity (*list developments*). This could suggest that a 'revolution' in farming occurred in the Medieval period. However, the changes appear to have taken place over the wide time period between the 14th and 18th century (*give examples*). The changes were also likely complex and varied across the country, which suggests overall that livestock changes in the Medieval period were not a 'revolution' because, while the change was large, it was not sudden.
Paragraph 1:			

Paragraph 2:			
Paragraph 3:			
Conclusion	Summarise your essay and restate your argument		

Activity 3: Referencing

WHY reference?

- Gives credit to authors of sources you have used
- Supports your argument
- Demonstrates the variety of sources you have used
  Prevents you losing marks due to plagiarism. (copying)

WHEN should you reference?

- When you quote directly from a source
- When you summarise or rephrase information from a source (even if it is in your own words)
- When you include a specific statistic or fact from a source.

HOW to reference?

- Make sure you are consistent throughout your work
- Two parts...
  - ✓ **Marker in the text** – the easiest way is to use a number which links to that number in the bibliography
  - ✓ **Bibliography** – numbered list of sources you have used in your assignment (see examples in handbook).

Highlight where references should be included in this paragraph:

Plagiarism has been identified by experts as an area of concern for first year students adjusting to the expectations of writing at a university. However, plagiarism is not always committed intentionally. Some academics state that plagiarism in student writing is more often due to uncertainty about when and how to reference than a deliberate intention to cheat. Plagiarism issues are an area of confusion for many students beginning university. This results in "many misunderstandings, which coincide with high levels of unintentional plagiarism, bogus referencing and collusion".

Homework 5: Draft Assignment

Final Assignment Title: Based on zooarchaeological and historical evidence, was there a late Medieval 'Agricultural Revolution' in livestock husbandry?

(2000 words +/- 10%).

When writing your assignment, you should consider the following:

- Explain the definition of a 'revolution'
- Assess the key changes and timing of the 'Agricultural Revolution'
- Describe the zooarchaeological methods that can help us to identify changes in the past
- Conclude whether the zooarchaeological case studies support the idea of 'Agricultural Revolution'
- Try to refer to other sources of historical or zooarchaeological information to support your argument.
- Include an introduction to outline your essay, and a conclusion to summarise and testate your argument.

Your assignment should include data from case studies, as well as diagrams and independent research to support your argument.

Make sure that all graphs or diagrams included in your work are discussed in your writing. When carrying out independent research, make sure that you comment on the reliability of your sources, and reference them in the format discussed in tutorials. You can use the references provided, and/or search for more information on the agricultural revolution and changing size of livestock.

Success Criteria:

The table below explains what you should try to include in the final assignment to fulfill the mark scheme criteria:

Mark Scheme Skills	**Examples of success criteria to include in the final assignment**
Subject Knowledge	☐ Include the key subject-specific terms from your glossary. Demonstrate that you understand them by explaining their meaning and why they relate to the topic. ☐ Use your subject-knowledge to support your argument. This may include referring to diagrams. ☐ Try to carry out some independent research (outside what we cover in tutorials). Explain how the sources you have used relate to your argument.
Critical Thinking	☐ Give reasons to back up your interpretation. You might find the PEE structure helpful: o Point: clearly make a point o Evidence: explain the evidence for the point o Explanation: explain why the point is relevant and important (relate it back to the question). ☐ Consider whether your data is reliable, and how that might affect your interpretation. ☐ Try to make links to other topic areas that you have not discussed in tutorials. ☐ Comment on how reliable your sources are, and if they have any limitations.
Written Communication	☐ Organise your work in paragraphs with a logical order (planning really carefully will help here). ☐ Include a concise introduction to introduce the topic, and summarise what the essay will contain. ☐ Include a conclusion to summarise your key points and re-state your argument. ☐ Check your writing to ensure that spelling, punctuation and grammar are correct throughout ☐ Remember to reference your sources correctly

Tutorial 6 – Feedback tutorial

What is the Purpose of Tutorial 6?

- To receive feedback on your final assignment
- To respond to the feedback from your Uni Pathways teacher
- To write targets for improvement on your final assignment

Final assignment feedback from your Uni Pathways Teacher

(Remember to look at the mark scheme to help you understand what you have done well so far, and how you can do even better in your final assignment)

Here are three things that my Uni Pathways Teacher thought I did well in my draft assignment
•   •   •

Here are three things that my Uni Pathways Teacher thinks that I could do to get a higher mark in my final assignment
•   •   •

Tasks from my Uni Pathways Teacher to do during the feedback tutorial to help me improve
•   •   •
My response:

Actions I will take to improve my final assignment after this tutorial…
•   •   •

Hand in date for my final assignment:	

Tutorial 7 – Final tutorial

What is the Purpose of Tutorial 7?

- To receive feedback and a grade on your final assignment.
- To reflect on the programme including what you enjoyed and what was challenging.
- To ask any questions you may have about university.

Final assignment feedback from my Uni Pathways Teacher

Final mark:	University style grade:
Feedback: Here are three things that my Uni Pathways teacher thought I did well in my final assignment • • •	

Here are three things that my Uni Pathways teacher thinks I should remember for when I am doing this kind of study in the future
• • •

University

What questions do you still have about University after taking part in Uni Pathways?
•   •   •

Reflecting on Uni Pathways

What did you most enjoy about Uni Pathways?
•   •   •

What did you find challenging about the programme?	How did you overcome these challenges?
• • •	• • •

Appendix 1 – Referencing correctly

When you get to university, you will need to include references in the assignments that you write, so we would like you to start getting into the habit of referencing in your Brilliant Club assignment. This is really important, because it will help you to avoid plagiarism. Plagiarism is when you take someone else's work or ideas and pass them off as your own. Whether plagiarism is deliberate or accidental, the consequences can be severe. In order to avoid losing marks in your final assignment, or even failing, you must be careful to reference your sources correctly.

What is a reference?

A reference is just a note in your assignment which says if you have referred to or been influenced by another source such as book, website or article. For example, if you use the internet to research a particular subject, and you want to include a specific piece of information from this website, you will need to reference it.

Why should I reference?

Referencing is important in your work for the following reasons:

- It gives credit to the authors of any sources you have referred to or been influenced by.
- It supports the arguments you make in your assignments.
- It demonstrates the variety of sources you have used.
- It helps to prevent you losing marks, or failing, due to plagiarism.

When should you use a reference?

You should use a reference when you:

- Quote directly from another source.
- Summarise or rephrase another piece of work.
- Include a specific statistic or fact from a source.

How do I reference?

There are a number of different ways of referencing, and these often vary depending on what subject you are studying. The most important to thing is to be consistent. This means that you need to stick to the same system throughout your whole assignment. Here is a basic system of referencing that you can use, which consists of the following two parts:

A marker in your assignment: After you have used a reference in your assignment (you have read something and included it in your work as a quote, or re-written it your own words) you should mark this is in your text with a number, e.g. [1]. The next time you use a reference you should use the next number, e.g. [2].

Bibliography: This is just a list of the references you have used in your assignment. In the bibliography, you list your references by the numbers you have used, and include as much information as you have about the reference. The list below gives what should be included for different sources.

- **Websites** – Author (if possible), title of the web page, website address, [date you accessed it, in square brackets].
  - E.g. Dan Snow, 'How did so many soldiers survive the trenches?', http://www.bbc.co.uk/guides/z3kgjxs#zg2dtfr [11 July 2014].
- **Books** – Author, date published, title of book (in italics), pages where the information came from.
  - E.g. S. Dubner and S. Levitt, (2006) *Freakonomics*, 7-9.
- **Articles** – Author, 'title of the article' (with quotation marks), *where the article comes from* (newspaper, journal etc.), date of the article.
  - E.g. Maev Kennedy, 'The lights to go out across the UK to mark First World War's centenary', Guardian, 10 July 2014.

Appendix 1: Albarella 1997:

Albarella, U. 1997: Size, Power, Wool and Veal, *Environment and Subsistence in Medieval Europe – Papers of the 'Medieval Europe Brugge 1997' Conference* - Volume 09

Introduction

The late Middle Ages was a period of changes in England. The decline of the population and the desertion of vast areas of the countryside caused by the Black Death of the 14th century brought about a slow transformation of society and its economy. Farming and pastoral activities were much affected and gradual modifications in the cultivation of the land and the use of animals eventually led to that set of changes in agrarian practices usually called the "agricultural revolution" (*sensu* Kerridge 1967). These phenomena have for a long time been studied by social and agricultural historians but archaeology has also made a contribution. "The archaeologists have accumulated a mass of information, almost embarrassing in its sheer quantity, for the physical conditions of the past..." (Dyer 1989a, 3), but unfortunately this large bank of data is not easily accessible, hidden in large numbers of "site reports" and even more often never published. Data concerning agricultural life are mainly discussed in sections or appendices on human bones, animal bones and plant remains, which may be difficult to read for the non-specialist, and are often poorly integrated in the general interpretation of a site, let alone a wider geographic area. Fortunately a few syntheses have been made (see for instance Grant 1988 and Greig 1988), but there is still much to be done.

This paper aims to be a contribution in that direction. During the last ten years new archaeological evidence about changes in the use of animals in late medieval and early modern times has come to light. This evidence seems to confirm and complement what historians have been saying and it is, in this respect, most important. We have now direct archaeological indication that, probably since the 15th century and maybe earlier, the emphasis in the kind of use of the main domestic animals was in a process of transformation. The aim of this paper is to review our evidence for these innovations and to see how they contributed towards the creation of a new system of animal exploitation. Here I shall rely upon the information provided by a number of zooarchaeological studies carried out in different parts of England, but also on original work on the animal bones from three important medieval and post-medieval sites, which I have studied – with colleagues – during the last four years. The three main sites discussed here are conveniently situated in different parts of the country, and in particular in the west country (Launceston Castle: Albarella & Davis 1996), in central England (West Cotton: Albarella & Davis 1994 and forthcoming) and in East Anglia (Norwich, Castle Mall: Albarella *et al.* forthcoming) (Fig. 1).

Any overview runs the risk of oversimplifying the evidence. We are dealing with complex phenomena, which are subject to much chronological and regional variation, and are influenced by a large number of variables related to differences in society, the environment, the cultural context and so on. In my attempt at identifying general trends some of this variability and complexity will be left unmentioned. This does not mean that I am not aware of the fact that, for instance, what happened in the south of the country cannot be entirely applied to the north or that changes in marginal areas did not occur at the same pace as in more central regions. However, I also believe that only by trying to pose general questions, and when possible providing answers to them, can we reconstruct the way medieval people brought about the creation of modern farming.

Size increase

The most remarkable evidence of a change in the type of animals — and consequently in their use – between medieval and early modern times comes from bone measurements. Cattle, sheep and to some extent pig, domestic fowl and possibly horse all increased in size, and recent archaeological evidence suggests that the beginning of this trend is to be found already in the 16th century, and possibly earlier. This important phenomenon is reviewed elsewhere (Alba-

Fig. 1. - *Location of the main sites discussed in the text.*

rella & Davis 1996; Davis in press), and it will only be briefly discussed here.

Modem breeds have larger bones than most animals found in archaeological sites. It is also known that specimens found in 19th, 18th and to some extent 17th century levels tend to be larger than medieval animals, though in most cases not as large as recent "improved" breeds. We have known this from archaeological and historical evidence for a long time, but recent archaeological work has thrown further light on the problem. The main findings of this more recent research can be summarised as follows:

a. in medieval times different sizes of cattle and sheep could be found in different regions of England. It seems that animals from peripheral areas, such as the west country and the far North, were smaller

(Albarella & Davis 1994). The small size of Welsh and Cornish livestock is also mentioned in historical sources (Thirsk 1967)

b. the increase in size started, at least in some areas and for some species, earlier than was thought in the past. At Launceston Castle we have evidence of a substantial size increase already in the 16th century, and, although much smaller, in the 15th century (Fig. 2). Very large 16th century animals have also been found at Lincoln (Dobney *et al.* 1996) and Camber Castle, Sussex (Cornell & Davis in prep.). The presence of "improved" sheep in 16th century Cornwall is also mentioned by Carew (1602)

c. the size increase did not occur at the same pace and at the same time for all species. In cattle it was rather sudden, whereas in sheep much more gradual (Fig. 2). In pig and domestic fowl it occurred at a later stage, perhaps no earlier than the 17th century.

How and why did this increase occur? The first question is far from easy to answer, but it is probably safe enough to say that it resulted from a combination of local improvement and introduction of different, larger breeds from the continent. The relative importance of these two components probably varied in different regions, but undoubtedly both played a role. The importation of large, "long legged" Dutch cattle in the 16th century is attested by historical sources (Trow-Smith 1957, 203), but surely other kinds of overseas livestock contributed to the improvement of local breeds, perhaps in a way similar to what had happened during the Roman conquest. An improved level of nutrition can also cause an increase in body size, not necessarily connected to a genetic change. However, our evidence from Launceston Castle and Castle Mall indicates that not only bones but also teeth became larger. Teeth are much more conservative in their structure and less susceptible than bones to environmental changes (Degerbøl 1963; Payne & Bull 1988). It is therefore likely that an increase in tooth size is related to the presence of a genetically different type of livestock.

An answer to the question "why" can be provided only once the other innovations have been discussed. It is quite obvious that larger animals provide more meat, but more important than the absolute body size of the adult animal is the speed of the development after birth. The archaeological evidence suggests that this could be obtained through the creation of faster growing animals, in many respects similar to the modern breeds. But to understand this phenomenon more fully we have to turn our attention to the changes which occurred in the kill-off patterns of the main livestock.

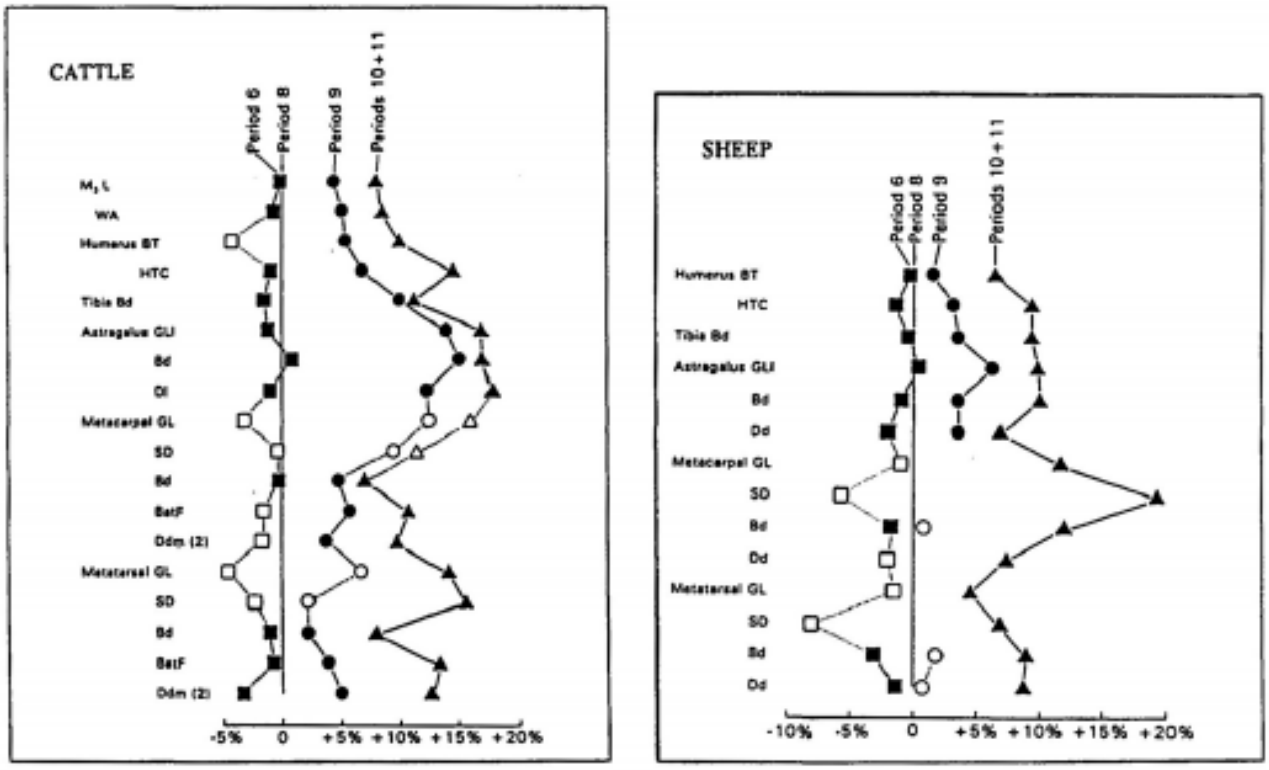


Fig. 2. - *Size increase in cattle and sheep at Launceston Castle (from Albarella & Davies 1996). Percentage differences from period 8 for selected measurements. Samples where n<10 are shown as open symbols. For a definition of the measurements see von den Driesch (1976) and Davies (1992).*
Period 6 = late 13th c., Period 8 = 15th c., Period 9 = 16th - early 17th c., Period 10 + 11 = late 17th-early 19th c.

Veal

Most cattle bones found in early medieval contexts from English sites belong to fully mature animals. However, in 15th-16th century and later contexts large numbers of bones and mandibles of calves are found alongside adult specimens (Grant 1988). This evidence is particularly striking at Norwich, where in contexts pre-dating the 15th century there are only mature animals, but there are plenty of juvenile specimens in later phases (Jones 1994; Moreno Garcia forthcoming; Albarella *et al.* forthcoming) (Fig. 3). At the Norwich site of St.Martin-at-Palace Plain, calf bones are found in contexts dated as early as the 14th-15th century (Cartledge 1987), which suggests that this change in the kill-off pattern might have occurred even earlier in Norwich than in other parts of the country. Further evidence for a change in the cattle mortality curve comes from other sites across England such as Exeter (Maltby 1979), Sandal Castle (Griffith *et al.* 1983), Leicester St.Peter's Lane (Gidney 1991b and 1991c), St.Andrew's Priory (O'Connor 1993), Launceston Castle and Lincoln (Dobney *et al.* 1996).

This new culling strategy for cattle may be associated with a major change in their use. During most of the Middle Ages cattle had mainly been exploited for their traction power, but with the increasing use of horses for ploughing and other agricultural activities, there was a change in the use of cattle, which, by post-medieval times, had, in many areas, mainly become a source of meat and milk (Trow-Smith 1957; Langdon 1986; Dyer 1991). The fattening and culling of young calves would have gone hand in hand with the production of high quality veal – very much sought after by townspeople (Thirsk 1967) – and the exploitation of cow milk for human consumption. Beef production also increased in importance and in some sites we have indeed a lower percentage of elderly animals in the later phases, but in none of these sites the difference is striking.

The relative importance of meat and dairy products varied in different areas: for instance in early modern Norfolk the emphasis was on meat production, whereas in Suffolk the opposite was the case (Overton & Campbell 1992). In some "marginal" areas such as Devon and Cornwall apparently the move away from the use of cattle for traction never occurred (Trow-Smith 1957). If this is indeed true, then the young calves found in 16th century contexts from the Cornish site of Launceston Castle might have been imported from further afield.

Horse power

It is suggested above that the changed kill-off pattern in cattle may be associated to the increasing importance of horses in agriculture. This phenomenon is well known from historical sources and it has been fully discussed by Langdon (1986). Langdon suggests that horses started replacing cattle as the main traction animals as early as the 12th century, but this was a very gradual phenomenon, and it is only in early modern times that the importance of horses reached its peak (see also Overton & Campbell 1992).

The archaeological evidence for these innovations in the use of equids comes from two main lines of evidence: the higher frequency of horses in bone assemblages from late medieval times and their increased size. Many factors contribute to the frequency of species found in faunal assemblages and its interpretation is therefore hardly straightforward. One further complication is that horses are not primarily meat animals and therefore their patterns of disposal tend to be different from those of cattle. For the same reason they are expected to be more frequent on sites where there was low meat consumption and rarer on sites where much meat was eaten. It is interesting in this respect to compare the frequency of horse bones at West Cotton, Launceston Castle and Norwich, Castle Mall (Fig. 4). In all sites there is a steady increase in horse frequency with time, but probably only at West Cotton – a rural site – can this be attributed to an actual change in the relative importance of different animals: our assumption was that in the late medieval period horses had started replacing cattle as the main traction animals (Albarella & Davis 1994). At Launceston Castle the higher number of horses in post-medieval times might merely be attributed to the fact that the site changed its status, and by the 16th century it was hardly used by the aristocracy. A lower status probably implies a lower consumption of meat and a higher frequency of non-meat animals – alongside horses dogs also become more common in the 16th century and later. At Castle Mall the very marked occurrence of horses in the latest phase is probably merely attributable to a change in disposal practices. Complications therefore exist and caution is necessary in interpreting the relative frequency of different species. Nevertheless, a general trend towards increase in horse frequency seems to be an actual feature of some late medieval sites.

The use of horses for ploughing probably encouraged the selection of larger and stronger animals. By the 14th century in France and England a large horse, defined as *"magnus equus"*, seems to be present, which suggests that some increase in size was taking

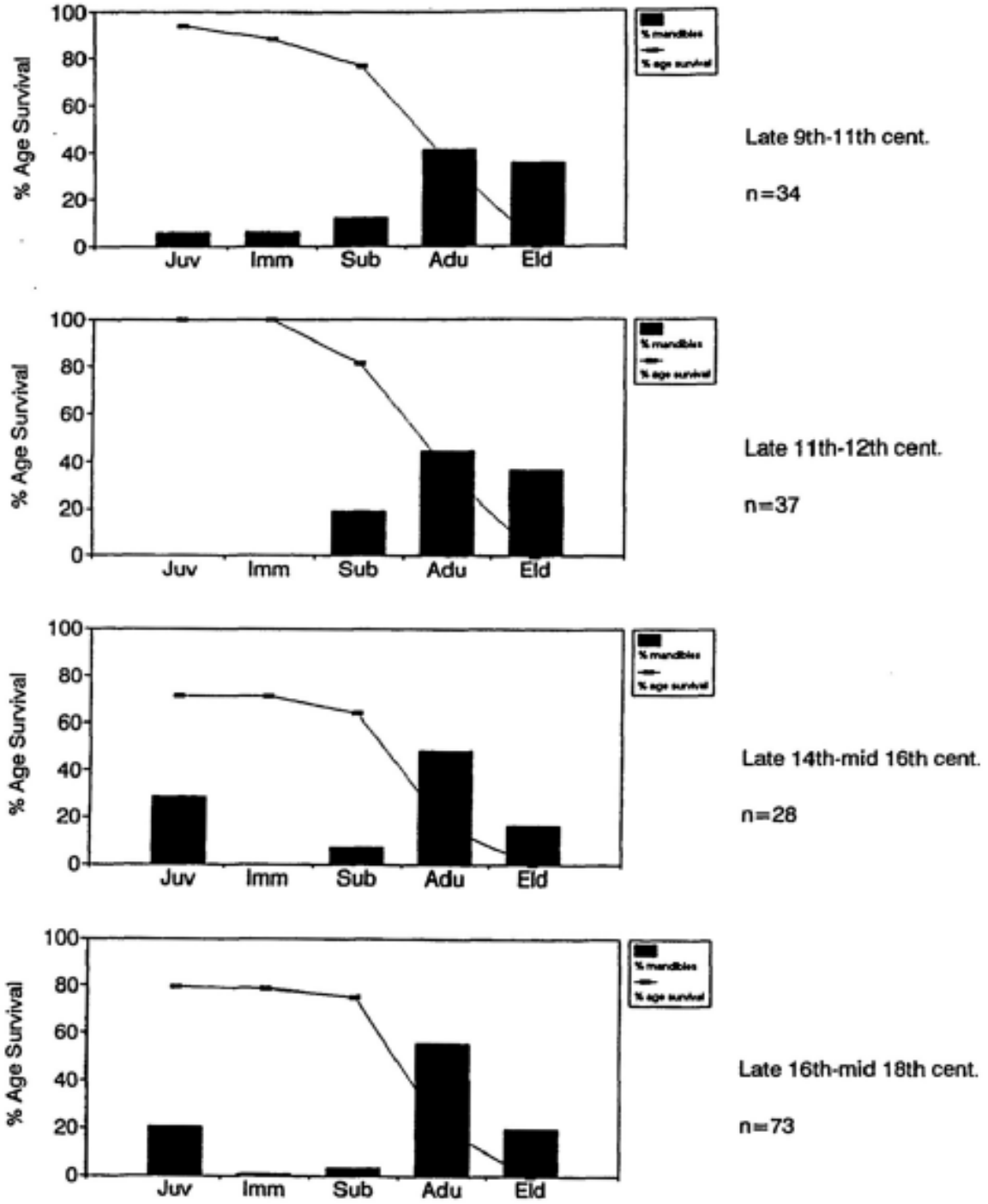


Fig. 3. - *Relative percentages of Cattle mandibles by age stage in different periods at Norwich, Castle Mall (from Albarella, Beech & Mulville forthcoming). Age stages are from O 'Connor (1988).* Juv = juvenile, Imm = immature, Sub = subadult, Adu = adult, Eld = elderly.

place (Langdon 1986). However, the archaeological evidence indicates that late medieval and 16th century horses were probably barely larger than a pony (the maximum height for a pony is 14 hands and 2 inches), yet somewhat larger than their Anglo-Saxon and early medieval predecessors (see Dobney *et al*. 1996 and Albarella *et al*. forthcoming). This suggests that horse breeders had made some progress towards the production of larger breeds.

Wool

It is hard to find a product more important than wool in the English medieval economy (Farmer 1991). By the beginning of the 13th century English wool was considered the best in Europe (Grand & Delatouche 1950) and it was exported in large quantities, either as raw material or as cloth. The wool trade probably reached its peak in the late 13th –

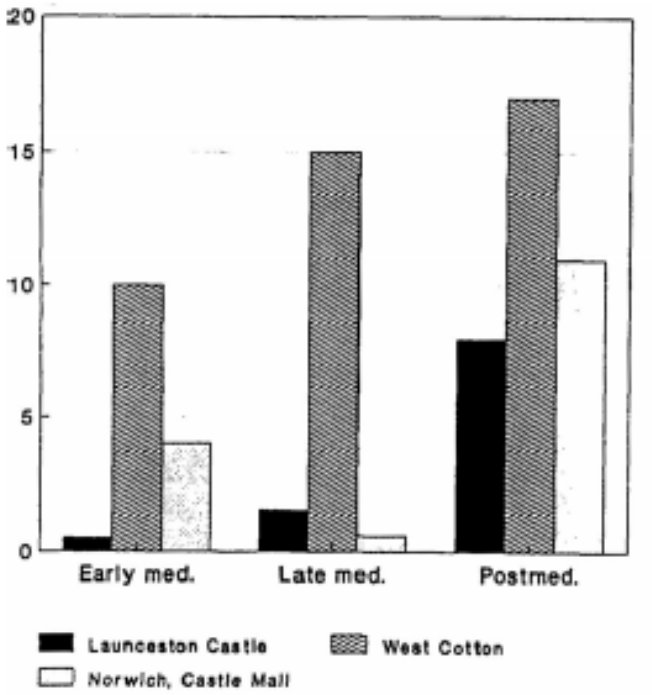


Fig. 4. - *Frequency of horse bones at Launceston, West Cotton and Castle Mall.*

early 14th century (Dyer 1988 and pers. comm.), and did not decrease in importance in later times, despite the pressure to produce more mutton (Trow-Smith 1957). In this respect the destiny of sheep exploitation was different from that of cattle, for which one main function – meat production – ended up replacing the previous one – traction power.

The ever increasing importance of sheep is not only attested by historical sources, but by also substantial archaeological evidence. In many archaeological sites the frequencies of sheep remains increase in later medieval and post-medieval times, mainly at the expense of pig (Grant 1988; Overton & Campbell 1992; Albarella & Davis 1994; Albarella *et al.* forthcoming). This increase probably reflects the rise of the wool trade. This assumption is reinforced by the study of kill-off patterns. A trend towards culling of older animals in late medieval and post-medieval periods has been found on many sites in different areas of England, such as Leicester St.Peter's Lane (Gidney 1991b and 1991c), Leicester, Little Lane (Gidney 1991a and 1992), Colchester (Luff 1993), West Cotton (Fig. 5), Launceston Castle, Lincoln (Dobney *et al.* 1996) and Norwich, Castle Mall. Although a few exceptions can be found – for instance at Exeter a large number of lambs were recovered in the post-medieval levels (Maltby 1979) – these findings suggest that wool production continued to be important in the 16th and 17th centuries.

Without doubt wool was important in Saxon and early Medieval times too, but then the main emphasis was on meat and possibly milk production. It is likely that the same flock was used for more than one purpose, with animals killed sufficiently young to provide good quality mutton. In later times sheep were only slaughtered after two or more fleeces had been taken. But even then mutton still had some importance. This is suggested by the fact that quite often the mortality peak is at about four years. Indeed Muffet (1655) advises that good mutton does not have to be older than four years. If the late medieval economy had been highly specialized in wool production we would expect an even older age for these animals. In fact a highly specialized husbandry is a contemporary phenomenon. In the past farmers tended to use animals for many purposes, though there could be an emphasis on one or two products.

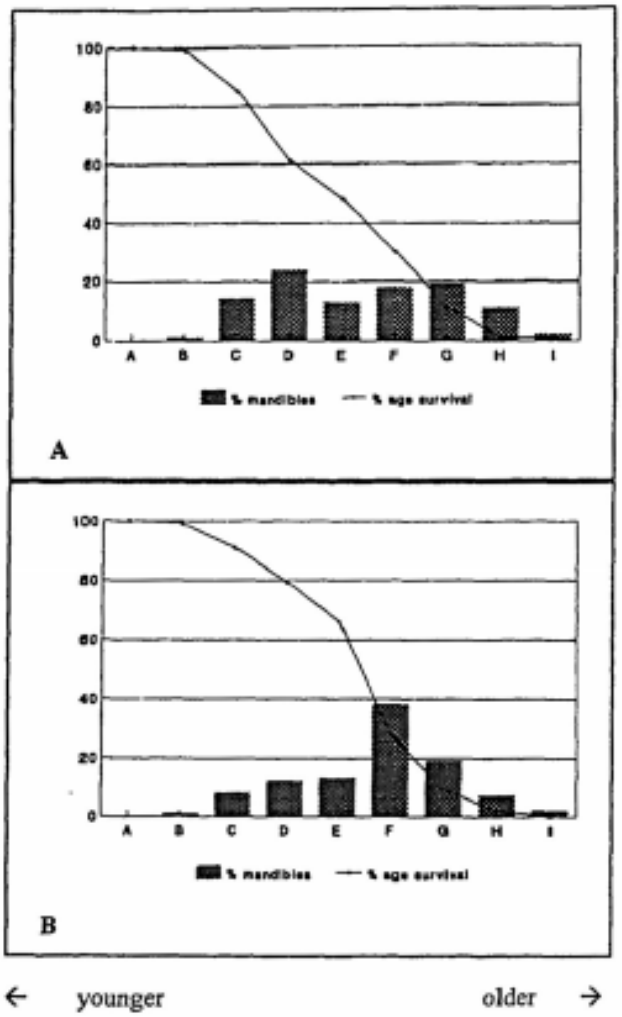


Fig. 5. - *Relative percentages of Sheep mandibles by age stage in different periods at West Cotton (from Albarella & Davies 1994). Age stages are from Pyne (1973).*
A. West Cotton, Early Medieval, n=99.
B. West Cotton, Mid-Late Medieval, n=99.

Appendix 2: Thomas 2005:

Thomas, R. 2005: Zooarchaeology, Improvement and the British Agricultural Revolution, *International Journal of Historical Archaeology*, 9 (2), 71-75

Zooarchaeology, Improvement and the British Agricultural Revolution[1]

Richard Thomas[2]

This paper seeks to revisit the debate concerning the nature and timing of the British Agricultural Revolution. Specifically, it considers how zooarchaeological evidence can be employed to investigate later-medieval and post-medieval "improvements" in animal husbandry. Previous studies of animal bone assemblages have indicated that the size of many domestic species in England increases from the fifteenth century—an observation that has been used to support the writings of those historians that have argued that the Agricultural Revolution occurred several centuries prior to the traditionally ascribed date of 1760–1840. Here, zooarchaeological data are presented which suggest that the size of cattle, sheep, pig and domestic fowl were increasing from as early as the fourteenth century. However, it is argued that the description of these changes as revolutionary is misleading and disguises the interplay of factors that influenced agricultural practice in the post-Black Death period. This paper concludes with a plea for greater awareness of the value of collecting and analysing faunal data from the eighteenth and nineteenth centuries to enable the historically attested productivity increases of the traditionally dated Agricultural Revolution to be examined archaeologically.

KEY WORDS: zooarchaeology; improvement; Agricultural Revolution; animal husbandry; England.

INTRODUCTION

Understanding "improvement" in agriculture has been a central element of historical studies of the feudal/capitalist transition. The British Agricultural Revolution, in particular, has engendered a massive amount of debate in the

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literature, concerning its nature, timing and even existence. The principal focus of historical studies in this topic has tended to be land management and crop husbandry, partly reflecting the unsuitability of livestock data. As Albarella (1997), Davis (1997) and Davis and Beckett (1999) have demonstrated, however, archaeological animal bone assemblages have the potential to investigate this issue, since they enable long-term changes in animal husbandry to be charted.

In this paper, a review of previous historical and zooarchaeological debates concerning the nature of and timing of the Agricultural Revolution is outlined. This is followed by the presentation of faunal evidence from two recently studied sites, which challenge current perceptions of the nature of improvements in animal husbandry in later-medieval and post-medieval England. These data provide the opportunity to re-consider the conceptual validity of the Agricultural Revolution.

HISTORIOGRAPHY OF THE "AGRICULTURAL REVOLUTION"

The Agricultural Revolution has long been described as a widespread technological change in British farming practice that facilitated a sustainable increase in agricultural productivity. From the early twentieth century until the 1960s there was little doubt in the minds of historians that this occurred between about 1760 and 1840 in a movement intimately associated with the Industrial Revolution (e.g. Beckett, 1990, p. 1; Ernle, 1912). This was a phenomenon that enabled the farming community to feed a population that had grown by ca. 20 million in this period (Kerridge, 1967; Mingay, 1969; Turner *et al.*, 2001, p. 211). Some of the traditional features perceived to have led to this increase in productivity included:

- parliamentary enclosure of land;
- introduction of new farming technology (e.g. the seed drill);
- new crops and crop rotations;
- improvement in livestock breeding (Beckett, 1990, p. ix; Overton, 1984, p. 119).

These developments were viewed by historians as being largely facilitated by a small number of key innovators. Robert Bakewell, for example, became famed for selectively breeding and improving domestic animals in Leicestershire; his "New Leicester" breed of sheep fattened quicker and had a greater proportion of saleable meat, and his "New Longhorn" cattle carried a larger amount of fat (Beckett, 1990, pp. 24–25).

While Marc Bloch recognised, as early as 1931, that the term "Agricultural Revolution" was the consequence of a "slow process lasting from the late Middle Ages to the eighteenth century" (Verhulst, 1990, p. 17), it was not until the 1960s that many of Lord Ernle's ideas, and the evidence upon which they were based, were more convincingly challenged; Eric Kerridge was perhaps the most

influential opponent in this regard. Kerridge (1967) forcefully argued that many of the innovations or practices that were viewed as constituting an eighteenth-century revolution in agriculture, did not occur at all, were insignificant, or occurred much earlier (Overton, 1984, p. 121). Indeed, he sought to argue that the Agricultural Revolution occurred in the sixteenth and seventh centuries and only received "finishing touches" from the likes of Bakewell (Kerridge, 1967, 1969). While Kerridge's interpretation of the evidence was not unquestionably accepted (see, for example, Mingay, 1969), by the 1970s the period encompassed by the Agricultural Revolution was generally considered to range from 1560 to 1880, occurring in anywhere up to five stages and "varying considerably in its timing across different farming regions" (Beckett, 1990, pp. x, 9; Overton, 1996a).

More recent historical studies have *broadly* divided the study of this subject into two camps. One school contends that the change in agricultural practice, previously termed "the Agricultural Revolution," was not revolutionary at all, but was rather a long and gradual process, which may have comprised various stages of significant development that varied considerably in space and time (Allen, 1991; Beckett, 1990; Thirsk, 1987). The other school has maintained that the concept of an Agricultural Revolution is valid and asserts that while earlier improvements in agricultural practice did occur, only the eighteenth and nineteenth centuries are deserving of that appellation because of the *magnitude* of change (Campbell and Overton, 1993; Mingay, 1989; Overton, 1996a, 1996b; Turner *et al.*, 2001).

Archaeology is well placed to contribute to this field of contention since it provides a line of enquiry that is independent of the historical crop and livestock data upon which the noted interpretations have largely been constructed. Indeed, a recent archaeological study has lead to the formulation of an alternative understanding of agricultural "improvements," arguing that not just one revolution occurred in the eighteenth and nineteenth centuries but many, with different regions following their own unique trajectories (Williamson, 2002, pp. 158–159). As both Overton (1984, p. 131; 1996a, p. 12) and Williamson (2002, p. 165) note, one of the key problems in the analysis of historical data has been that animal output and improvements in livestock are difficult to measure. Crucially, zooarchaeological evidence has the potential to redress this problem.

THE ZOOARCHAEOLOGY OF "IMPROVEMENT"

From a methodological standpoint, there are two principal means by which zooarchaeological data can be used to explore the issue of "improvement": through the examination of changes in the conformation (size and shape) of animals, as established through the measurement of particular skeletal elements, and through the analysis of mortality profiles.

As Reitz and Ruff (1994, p. 699) note, animal body size is controlled by the complex interplay of both genotypic (genetic) and phenotypic (environmental)

factors. In domestic animals, for example, previous archaeological studies have shown how the conformation of animals can be influenced by environmental adaptation and geographical origin (e.g. Cossette and Horad-Herbin, 2003; Reitz and Ruff, 1994) and husbandry strategies (e.g. Higham and Message, 1969). Analysis of medieval and post-medieval fauna from Britain has also demonstrated that size and shape change can provide a proxy indicator of deliberate attempts to "improve" animal productivity (Albarella, 1997; Davis, 1997; Davis and Beckett, 1999). In the latter context, biometrical analyses can provide indications of the causes of change since tooth size is largely dictated by genotype and is less affected by environmental conditions during development, while the size of the post-cranial skeleton can be influenced by both genotypic and phenotypic factors. In effect, an increase in the size of skeletal elements, in the absence of a size change in teeth, might signify an "improvement" in nutritional intake, while any change in the size of teeth could be a consequence of selective breeding or the introduction of new stock.

Analyses of ageing data also have the potential to identify animal "improvement" since animals that fattened quicker may have been slaughtered at an earlier age—a development that would have facilitated an increased supply in meat. Such an interpretation requires the assumption that skeletal maturation (i.e. epiphyseal closure and dental eruption) was decoupled from flesh growth rates through selective breeding. While historical evidence indicates that this had occurred by the eighteenth century, with Bakewell's new breeds of sheep being slaughtered at 2 years of age (Beckett, 1990, p. 25; Chambers and Mingay, 1966, p. 67), Daniel Defoe, who published a three-volume travel guidebook to Britain in the 1720s, noted that bullocks and sheep fattened very slowly (around 4 years of age) (Chambers and Mingay, 1966, p. 67). Thus, if the historical evidence is reliable, it seems unlikely that the separation of skeletal development and soft-tissue mass occurred prior to the eighteenth century. Moreover, while changes in mortality profiles are identifiable through the analysis of epiphyseal closure and tooth eruption and wear data, these may be affected by a range of other husbandry decisions, such as increasing consumer demand for tender meat; the emergence of more specialised farming (such as dairying and veal production); or changing emphasis on particular products (such as those required for the wool and cloth trade).

A supplementary means by which selective breeding might be identifiable is through the presence of certain congenital traits, such as the absent hypoconulid (third pillar) in cattle and sheep lower third molars (Miles and Grigson, 1990), or the congenital absence of the second premolar (Andrews and Noddle, 1975). Although it is hypothesised that these conditions might provide indications of gene flow, the full potential of this technique is yet to be fully realised (O'Connor, 2000, p. 122).

While the benefits of these approaches are clear, such data must not be interpreted uncritically. Firstly, we have to question the extent to which a change in the

conformation of domestic animals in later-medieval and post-medieval Britain is a marker of increased productivity. If we consider the statement made by Gervase Markham (a late sixteenth-/early seventeenth-century writer and poet) that "the larger that every cow is, the better she is" (cited in Davis and Beckett, 1999, p. 13), then such an assumption would appear valid. Furthermore, by the sixteenth century, substantially built Dutch cows were being imported into various parts of England for breeding (Trow-Smith, 1957, p. 203). However, we must consider the evidence presented by Kerridge (1967, pp. 313–314) who, in discussing the new stock associated with the Agricultural Revolution, noted that while the Midland Plain pasture sheep produced large quantities of mutton and wool, the animals had shorter legs. It is equally possible that other "improvements" may have had no discernible impact on the conformation of the skeleton, but resulted in developments of other desired characteristics, such as increased milk production, or finer quality meat or wool. Finally, it should be noted that "improvement" in one commodity might have resulted in deterioration of other aspects of the animal. For example, while Bakewell's New Longhorn cattle were more fatty, they produced less milk and, despite their superior growth rate, his New Leicester sheep were unsuited to exposed environments (Beckett, 1990, p. 24).

Clearly, the zooarchaeological data are not unproblematic, but integrated with other lines of evidence they provide a potentially valuable source of information regarding "improvements" in animal husbandry in medieval and post-medieval Britain. In the following sections previous and new approaches to this theme of investigation are considered.

Previous Research

In the late 1990s, a number of zooarchaeological studies were published regarding the timing and nature of improvements in animal husbandry in later-medieval and post-medieval England. By plotting histograms of measurements of specific bones, an increase in the size of cattle and sheep between the fifteenth and seventeenth centuries was observed on a number of sites (Davis and Beckett, 1999, Table II). The size increase in cattle appears to have been rather sudden, for sheep it was a much more gradual phenomenon, while "improvements" in pig and domestic fowl were not observed before the seventeenth century (Albarella, 1997, p. 21). For the most part, this evidence consisted of post-cranial bone data, however, evidence from Launceston Castle, Cornwall (Albarella and Davis, 1996) and Castle Mall, Norwich (Albarella *et al.*, 1997) (Fig. 1), also revealed an increase in the size of cattle and sheep teeth. Thus, it was argued that the variation was at least partly a consequence of the introduction of new stock or artificial selection. This evidence was initially used to support the argument of historians such as Kerridge, that the Agricultural Revolution occurred earlier than originally supposed (e.g. Davis, 1997, p. 413), although a later reinterpretation

Appendix 3: Davis and Beckett 1999:

Davis, S.J.M. and Beckett, J.V. 1999: 'Animal Husbandry and Agricultural Improvement: The Archaeological Evidence from Animal Bones and Teeth', *Rural History*, 10, 1-17

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Animal Husbandry and Agricultural Improvement: The Archaeological Evidence from Animal Bones and Teeth*

SIMON J. M. DAVIS and JOHN V. BECKETT

In the choice therefore of your sheepe, choose the biggest boned, with the best wooll; ... These sheep ... are alwaies the best butchers ware, and goe soonest away in the market': Gervase Markham, *Cheape and Good Husbandry for the Well-Ordering of All Beasts and Fowles, and for the Generall Cure of their Diseases* (London, John Harison, 1631), pp. 108–9.

Agricultural historians have long been aware that a major increase in productivity and output characterised the so-called 'agricultural revolution'. Usually, however, this has been measured by indirect means: the fact, for example, that English farmers were able to feed some 3 million more people in 1700 than in 1540, and almost 20 million more in 1880 than in 1750.[1] Since mouths were fed without recourse to massive imports – which would have had significant economic implications for the industrial revolution – and since these increases in output were achieved while the agricultural labour force was in steep relative decline, the obvious implication is that productivity was increasing. Measuring such changes has proved complex, partly because data were not collected in a systematic fashion prior to the 1870s, and partly because such evidence as we have relating to prices and rents hardly represents an adequate proxy for productivity. In general terms, the best material has been for the grain acreage, particularly for wheat and barley.[2]

Evidence relating to animals, despite their overall importance in the agricultural economy, has proved much more elusive. 'There is', as Mark Overton has recently written, 'no direct evidence of livestock weights or yields of livestock produce which could be used to measure output per animal before the nineteenth century'.[3] This is

particularly unfortunate given that he has argued elsewhere in relation to the agricultural revolution that 'the key development was the integration of grass and grain and the ability to support a higher density of livestock while simultaneously extending the arable area'.[4] With stocking densities much higher than in the Middle Ages, wheat and barley yields, which were at medieval levels until the early eighteenth century, began to improve rapidly from about 1710 as the mean yields of wheat, barley, rye and oats simultaneously bettered the earlier standards of productivity.[5] Campbell and Overton have gone even further to suggest that in Norfolk the technological innovations on the arable were known as early as the thirteenth century. The reason that they were not more widely used until the seventeenth and eighteenth centuries was all to do with developments in the livestock sector, especially the doubling of stocking densities. As a result, advances in livestock productivity far outweighed those for crops, so that the livestock sector emerges as the more dynamic over the whole period from the thirteenth century onwards.[6]

Overton has taken the view that evidence for livestock prices and for the prices of their products (meat and wool), and the ratio between the two, might be indicative of output per animal. The price of cattle divided by the price of beef per pound, for example, should give some indication of the number of pounds of beef per animal. Although he tried to correlate the available evidence, Overton concluded that 'unfortunately (and rather surprisingly) there are no livestock prices series for the century after 1760'. His conclusion was that 'for what they are worth, the price-ratios indicate no change in the productivity of cattle between the mid-sixteenth and the mid-eighteenth centuries, but an increase for both mutton and wool of some 78 per cent during the first half of the eighteenth century, in comparison with the preceding century'.[7]

Overton's approach is that of the standard economic/agrarian historian: he uses straightforward price evidence (where it is available) to act as a proxy for measuring animal product output. However, with animals there is a problem of what the data may indicate. An increase in the sale price of sheep, cattle and pigs may reflect not simply market conditions, but changes in the nature of the animals, changes in feeding practices, even changes in breeding. Agricultural historians have never been very confident about dealing with such matters. For most livestock farmers in the past the emphasis of their work was on fattening rather than breeding. Improvements in livestock required selective breeding, the creation of new breeds, or the improvement of native breeds by crossing with newer varieties. Crossing of animals, in an attempt to improve the quality of output, had taken place for centuries, as farmers sought – pragmatically – to improve the weight and quality of the beasts they took to market.

Agricultural historians have undertaken relatively little work on this aspect of animal husbandry. The pioneer was G.E. Fussell in the 1920s and 1930s. In 1929 he addressed the question of 'whether there was an improvement in the average size of cattle, as meat supply, in the course of the 18th century'. He sought to do this by collecting together contemporary evidence of dead weights for animals brought to Smithfield and other meat markets. Fussell adjudged the evidence 'confused and unreliable', and sought instead to find more about different breeds 'to discover how great an increment of meat was gained by better methods of breeding directed specifically towards that purpose'. As a result of his researches, Fussell concluded that there was an increase in the volume

of meat production not through any real increase in either the number or size of animals, but 'in the change from oxen to horses for ploughing, and the consequent release of stock for fatting at an earlier age'. Thus, the increase in size – such as it was – together with 'the earlier maturity of the beasts', was his explanation of change in the eighteenth century, which he thought rather more realistic than vague dead stock figures culled from contemporary guesstimates.[8] Yet in a number of later articles Fussell was able really only to describe the different animals to be found in eighteenth-century England, usually on the basis of contemporary comments, particularly the *General Views* produced for the Board of Agriculture and the work of William Marshall. Such sources seldom if ever offered the level of statistical accuracy which would enable us to quantify changes in the quality, as well as the size, of animals, and in any case – as is well known – many of the figures quoted in the *General Views* were often little more than impressionistic comments. Fussell was forced, in other words, to fall back on description rather than analysis.[9]

Fussell wrote before there were many statistics available and at a time when the agricultural revolution was still seen as the product of a handful of heroic figures. As a result, he thought it best not to go too far: 'it would be little less than absurd to belittle the achievements of the great stockbreeders of the eighteenth century'.[10] These achievements were such that 'the foundation of all the modern breeds had been laid by 1800, and they possessed characteristics and possibilities much more valuable than their ancestors'.[11] Robert Bakewell of Dishley, near Loughborough, was often regarded as a pioneer of the agricultural revolution for his work in stockbreeding, which began around 1745. Bakewell was not alone, but his reputation was forged by his methods. He selected more rigorously than many of his contemporaries, breeding only from the finest animals. His fame rested largely on the 'New Leicester', a breed of sheep which fattened rapidly and had a high proportion of saleable flesh to bone.[12] What he achieved was a profitable meat animal which grew quickly, permitted the farmer a higher turnover of stock, and ensured a more efficient use of grazing resources. Even so, his achievements need to be kept in perspective. The flesh of the 'New Leicester' was regarded as 'coal-heavers' mutton because of the high proportion of fat to meat, and not fit for genteel dinner parties. Others followed where Bakewell led, but the pioneers often worked with only a handful of followers, so that it was not until well into the nineteenth century, and in conjunction with High Farming, that the importance of quality in livestock spread from the progressive few to the general run of farmers.[13]

Intensive mixed husbandry brought a substantial increase in sheep numbers, since folding or ranging sheep on turnips or clover leys brought advantages in dung and secondary commercial commodities. Improvements in feed, with the introduction of forage crops, increased both the number and weight of sheep in mixed farming systems. New breeds did not automatically bring carcass weight increases, but they did cut the age of slaughter which increased the supply of meat and in turn reduced the market price. The new breeds of sheep were ready for the butcher in two rather than four years. As animals were fed for less time before they went to market, and the quantity of saleable flesh from each animal increased, the price of meat fell. Contemporaries believed that this produced an increase in *output* independent of the work of the pioneer breeders,

and consequently selective breeding was only slowly adopted. Progress was further hampered by a combination of farmer conservatism, the relative backwardness of the biological sciences, and the lack of attention traditionally paid to grassland.[14]

To summarise, almost all the work done on animal husbandry has addressed qualitative issues because of the difficulty of assessing output other than by price evidence. Most of the statistical evidence used by Moore-Colyer in volume 6 of the *Agrarian History*,[15] together with the appendix to the same volume, was drawn from contemporary data. Those data have now been exhausted, and yet there remain considerable gaps in our knowledge. Changes in animal size might be important as a means of determining alternative or additional key factors. Is there, therefore, an alternative approach? The rest of this paper is primarily designed to look at likely changes in livestock as measured through size variations in cattle and sheep bones from medieval and post-medieval archaeological sites. An attempt will be made, albeit of a somewhat preliminary nature, to look at important questions about the age of slaughter, the relationship between bone size and animal size, and the more or less precise ageing of slaughter through teeth analysis, as well as questions relating to regional specialisation and environmental factors.

The use of archaeological bone measurements to help determine when sheep and cattle increased in size, and therefore to try to estimate when improvements in animal husbandry started, began with the work of Philip Armitage who looked at material recovered from excavations in the city of London.[16] Armitage's work was part of a research programme over the past half century in which important developments have taken place in the study of animal remains from archaeological sites. This science is known as zoo-archaeology, and one important aspect of it is the measurement of animal bones and teeth, generally mandibular teeth and limb-bones. Cattle and sheep are the obvious animals to test for increases in size. Armitage found bones of large cattle which came from levels dated between the thirteenth and sixteenth centuries, and the present article is a continuation of his work using finds from subsequent studies. It will be suggested that improvements to livestock were indeed under way at least by the sixteenth century.

The idea of using animal remains in this way as a means of developing our knowledge of changes in agriculture is quite new to historians of the subject. Zoo-archaeology is not mentioned in the pages of the *Cambridge Agrarian History of England and Wales*, or in most textbooks, and we are well aware that there are many problems involved with the interpretation of the data. It is easy enough to assume that an increase in size reflected an improvement in the animal, and that therefore animal bone size can be used to indicate periods of change. Such an assumption, however, pays no attention to the age of slaughter. It *may* tell us when sheep and cattle increased in size, from which we *may* assume that such increases measure improvements in husbandry. We shall, however, *not* make too many assumptions on the basis of the evidence we have gathered; rather, in this article we shall point to the potential of zoo-archaeological evidence for measuring changes in animal weights and sizes, and therefore as a potential means of analysing one other aspect of the agricultural revolution. By using evidence from English medieval and post-medieval sheep and cattle we hope to point agricultural historians in the direction of a source which has previously been neglected, but which may have significant implications for our understanding of agricultural change.

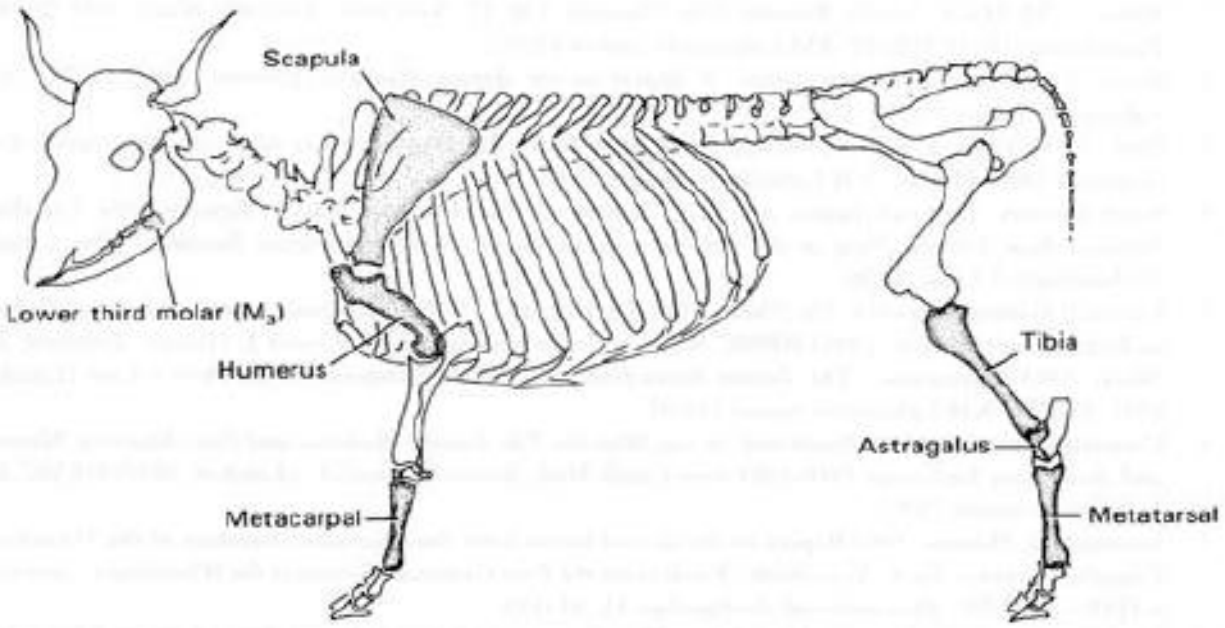

Figure 1. Sketch of a bovid skeleton to show the location of the bones whose measurements are discussed in this article.

What follows are two sets of comparisons of sheep and cattle measurements from archaeological sites (a) *synchronous* – within the medieval period across England and (b) *diachronous* – in various sites through time from medieval through to post-medieval (see table 1 which also gives the locations of the bones of the animals whose measurements are discussed below). Figure 1 shows which bones are considered here.

Table 1
Sites with animal bone measurements discussed herein

Site and location (arranged geographically)	dates (in centuries) of main assemblages of animal bone	source of data
Closegate, Newcastle	13th– 17th	Davis, 1991 [1]
Prudhoe Castle, Northumberland	11th–19th	Davis, 1987 [2]
Coppergate, York	early med	O'Connor, 1986 [3]
Lincoln	4th–post-med	Dobney *et al* . (1996) [4]
Leicester The Shires	mid–late med	Gidney, 1991a and 1991b [5]
Castle Mall, Norwich	9th–18th	Albarella, *et al* . (1997) [6]
Whitefriars, Coventry	mid 16th	Holmes, 1981 [7]
West Cotton, Northants	12th–15th	Albarella and Davis, 1994 [8]
Burystead and Langham Road, Northants	7th–15th	Davis, 1992 [9]
St. Frideswides, Oxford	12th–17th	Stallibrass, 1988 [10]
Okehampton Castle, Devon	13th–18th	Maltby, 1982 [11]
Exeter, Devon	12th–19th	Maltby, 1979 [12]
Launceston Castle, Cornwall	late 13th–1840	Albarella and Davis, 1996 [13]
Camber Castle, Sussex	c.1540–1640	Connell, Davis and Locker 1997 [14]

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1. Simon J. M. Davis, *Faunal Remains from Closegate I & II, Newcastle, Tyne and Wear, 1988 & 1990 Excavations* (1991). HBMC AM Laboratory report 81/91.
2. Simon J. M. Davis, *Prudhoe Castle, A Report on the Animal Remains* (London, 1987) HBMC AM Laboratory report 162/87.
3. Terry P. O.'Connor, *Hand-Collected Bones from Seven Medieval Deposits at 16–22 Coppergate, York* (London, 1986) HBMC AM Laboratory report 20/86.
4. Keith Dobney, Deborah Jaques and Brian Irving, *Of Butchers and Breeds: Report on the Vertebrate Remains from Various Sites in the City of Lincoln* (Lincoln Archaeological Studies 5, the Lincoln Archaeological Trust, 1996).
5. Louisa J. Gidney, *Leicester, The Shires, 1988 Excavations: The Animal Bones from the Medieval Deposits at Little Lane* (London, 1991) HBMC AM Laboratory report 57/91. Louisa J. Gidney, *Leicester, The Shires, 1988 Excavations: The Animal Bones from the Medieval Deposits at St. Peter's Lane* (London, 1991) HBMC AM Laboratory report 116/91.
6. Umberto Albarella, Mark Beech and Jacqui Mulville *The Saxon, Medieval and Post-Medieval Mammal and Bird Bones Excavated 1989–1991 from Castle Mall, Norwich (Norfolk)* (London, 1997) HBMC AM Laboratory report 72/97.
7. Jonathan M. Holmes, 1981 Report on the animal bones from the resonance chambers of the Whitefriars Church, Coventry. In: C. Woodfield, 'Finds from the Free Grammar School at the Whitefriars, Coventry, c.1545–c.1557/58', *Post-medieval Archaeology* 15, 81–159.
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Large faunal assemblages whose dates span the medieval–post-medieval periods are not common, and post-medieval assemblages are especially rare. There are all sorts of reasons why this is the case. Post-medieval man probably used the whole animal more efficiently, and disposed of his garbage in a more effective way, than his predecessors, while the vast range of buildings erected in England since the nineteenth century may have destroyed many such deposits. In addition, archaeologists have shown rather less interest in biological remains from 'late' levels than from earlier ones. However, as table 1 shows, in recent years several medieval and post-medieval bone assemblages have been studied. These are mostly from castles and towns. Although the numbers of bones from post-medieval levels are often small, the site of Launceston Castle in Cornwall, with its large deposits both medieval and post-medieval is a notable exception.[17]

The zoo-archaeological evidence suggests that the sizes of animals varied across the country. This is hardly surprising. Indeed, agricultural historians are well aware of the regional diversity in English agriculture.[18] Although the zoo-archaeological evidence is not strong on the point because data have not been collected from every region, it seems likely that cattle and sheep were smaller in the more outlying regions such as Cornwall and Northumberland than in central England. In the medieval period there seems to

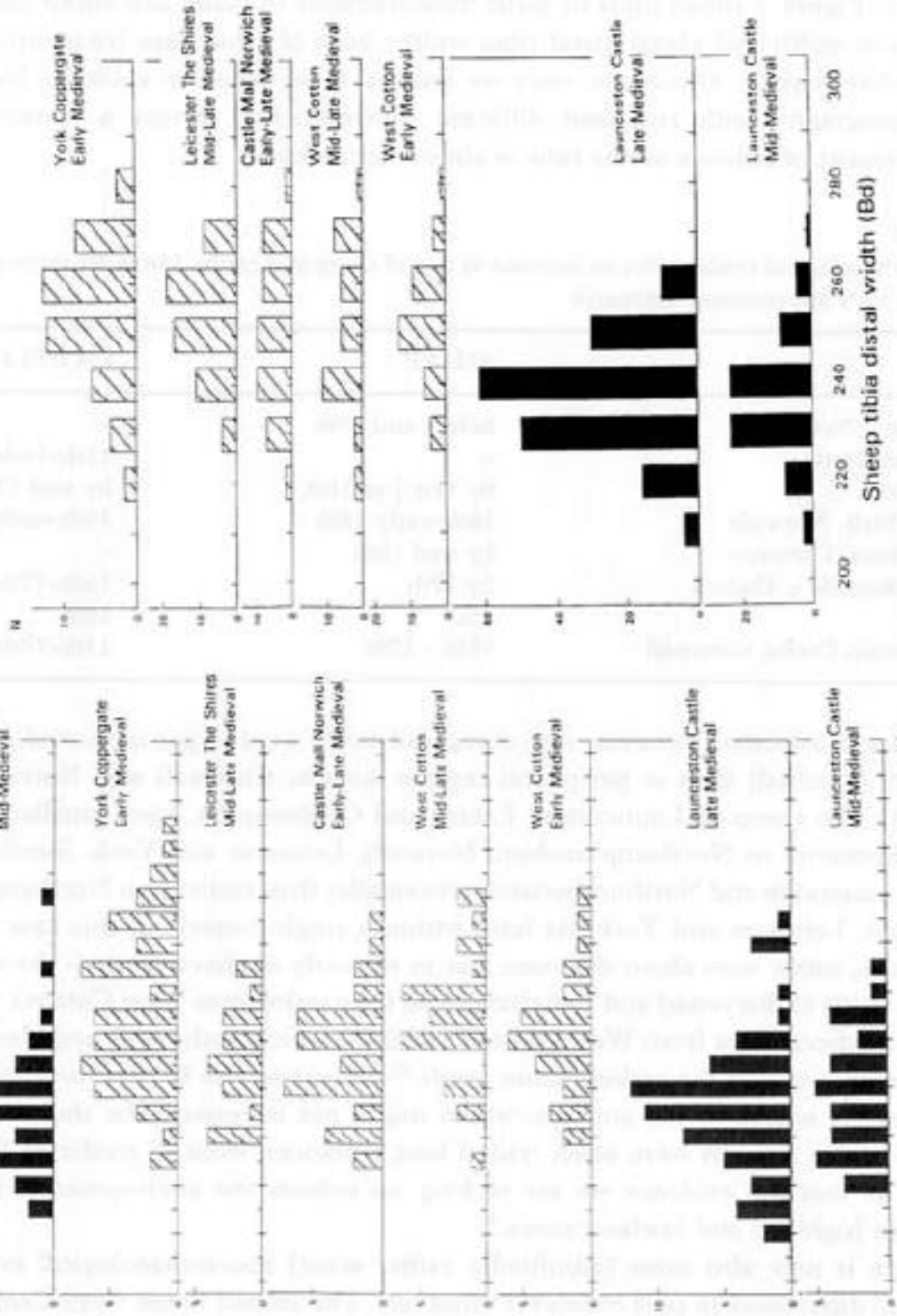

Figure 2. Synchronous variation in the size of sheep and cattle in medieval England. Distal widths (Bd) of medieval sheep tibiae and distal widths (Bd) of medieval cattle astragali in different parts of England. Vertical scales represent the numbers of specimens, horizontal scales are in tenths of a millimetre. Hatched plots are from sites in central England, solid plots are from sites (Launceston, Cornwall and Prudhoe, Northumberland) in peripheral regions.

have been considerable variation in the size of cattle and sheep in different parts of the country. Figure 2 shows plots of some measurements of cattle and sheep bones (cattle astragalus width and sheep distal tibia width; both of which are frequently taken by zoo-archaeologists). Of course, once we start to bring together evidence from such a wide geography with attendant different environmental factors a variation in the development of animals across time is almost inevitable.

Table 2
Zoo-archaeological evidence for an increase in size of sheep and cattle. Dates are given in centuries and are very approximate estimates.

	SHEEP	CATTLE
Closegate, Newcastle	before end 17th	–
Prudhoe Castle	–	15th–16th
Lincoln	by first ½ of 16th	by mid 17th
Castle Mall, Norwich	16th–early 18th	16th–early 18th
Whitefriars, Coventry	by mid 16th	–
St. Frideswide's, Oxford	by 17th	16th–17th
Exeter	15th	16th
Launceston Castle, Cornwall	15th - 17th	15th–17th

Figure 2 indicates, however, that sheep and cattle were larger in central parts of the country (hatched) than in peripheral regions such as Cornwall and Northumberland (black). The sheep at Launceston, Exeter and Okehampton, were smaller than their contemporaries in Northamptonshire, Norwich, Leicester and York. Similarly, cattle from Launceston and Northumberland were smaller than cattle from Northamptonshire, Norwich, Leicester and York. At least within a single county, in this case Northamptonshire, cattle were about the same size in the early medieval period: the cattle from Saxon levels at Burystead and Langham Road (two miles from West Cotton), are similar to the medieval ones from West Cotton, and in Norwich both cattle and sheep were of similar large size in the earlier Saxon levels.[19] Of course, the key to our understanding may be the source of the animals, which might not necessarily be their final resting places. Since animals were often traded long distances, even in medieval England, it could be that the evidence we are picking up reflects the environmental differences between highland and lowland zones.[20]

There is now also some (admittedly rather scant) zoo-archaeological evidence for regional differences in post-medieval times too. The animal bones from Camber Castle in East Sussex, occupied between c.1540 and 1640, indicate that the sheep in early post-medieval Sussex were larger than their contemporaries in Cornwall and Norfolk.[21] Certainly the Cornish historian Richard Carew believed his local sheep were comparatively small. Writing in 1602 he noted that:

> What time the shire, through want of good manurance, lay waste and open, the sheep had generally little bodies and coarse fleeces, so . . . But since the grounds began to receive enclosure and dressing for tillage, the nature of the soyle hath altered to a better graine, and yeeldeth nourishment in

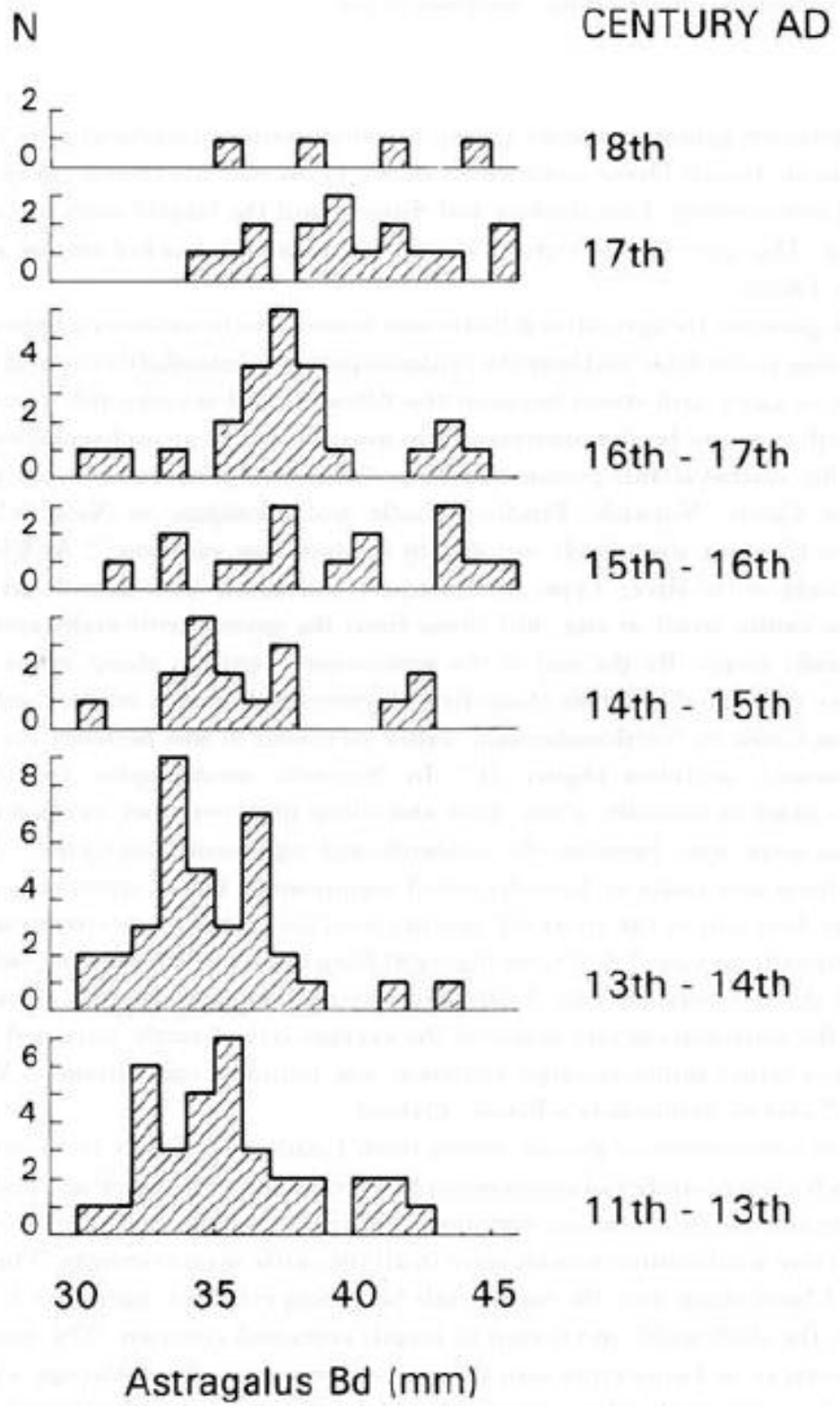

Figure 3. Cattle size variation at Prudhoe Castle, Northumberland. Measurements in millimetres of astragalus distal width (Bd). Vertical scale represents numbers of specimens (From Simon J. M. Davis, *Prudhoe Castle, A Report on the Animal Remains*, HBMC AM Laboratory report 162/87, 1987.

greater aboundance, and goodnesse to the beastes that pasture thereupon: so as by this meanes . . . Cornish sheepe come but little behind the easterne flockes for bignes of mould, finenesse of wooll, often breeding, speedie fatting, and price of sale. . . .[22]

By the eighteenth century we have plenty of contemporary comment as to the varying size of animals. Daniel Defoe commented in the 1720s that the largest sheep were to be found in Leicestershire, Lincolnshire and Sussex, and the largest oxen in Lincolnshire and Sussex. The agricultural writer Thomas Davis later remarked on the small breed of cattle in Devon.[23]

The key question for agricultural historians relates less to variations between regions than to change across time, and here the evidence points unmistakably towards an increase in the size of cattle and sheep between the fifteenth and seventeenth centuries. This increase with time can be demonstrated from most sites with an archaeological sequence spanning the medieval and post-medieval periods, and particularly from the Exeter, Launceston Castle, Norwich, Prudhoe Castle and Closegate in Newcastle sites. At Launceston Castle it was clearly not due to random size variation.[24] At Closegate, on the north bank of the River Tyne, in Newcastle, thirteenth- to sixteenth-century sheep bones were rather small in size, but those from the seventeenth–eighteenth centuries were generally larger. By the end of the seventeenth century, sheep in the Newcastle region were considerably larger than their thirteenth–sixteenth century antecedents.[25] At Prudhoe Castle in Northumberland, cattle increased in size between the fourteenth and seventeenth centuries (figure 3).[26] In Norwich, stratigraphic control was not sufficiently exact to pinpoint when cattle and sheep underwent an increase of size, but they did so some time between the sixteenth and eighteenth centuries.[27] A long-run study of sheep and cattle in Lincoln noted significantly larger specimens in contexts dated to the first half of the sixteenth century and, for cattle, in specimens dated to the mid-seventeenth century.[28] At Exeter (figure 4) from the sixteenth century, 'an increasing number of sheep possessed larger bodies and stouter legs' and 'there is some indication that from the sixteenth century onwards the average size of cattle increased'.[29] Similar, if sometimes rather impressionistic evidence, was found at excavations at Whitefriars, Coventry,[30] and St Frideswide's Priory, Oxford.[31]

The most comprehensive picture comes from Launceston Castle in Cornwall (figure 5), for which a large number of measurements were taken for medieval and post-medieval bones. Between the fifteenth and sixteenth centuries, and continuing thereafter, it was possible to find a substantial size increase in all the cattle measurements. There was also a change of bone shape with the metatarsals becoming relatively narrower at their distal ends while the shaft width in relation to length remained constant. The measurements of cattle astragali at Launceston also show a contemporary shape-change, although the results are less striking than the metatarsals.[32] A small but statistically significant increase in size was also found in sheep, although somewhat later, primarily between the sixteenth and early nineteenth centuries. Sheep at Launceston underwent their 'major' size increase one or even two centuries after cattle. The size increase of the sheep seems to have been rather more gradual than that of the cattle.

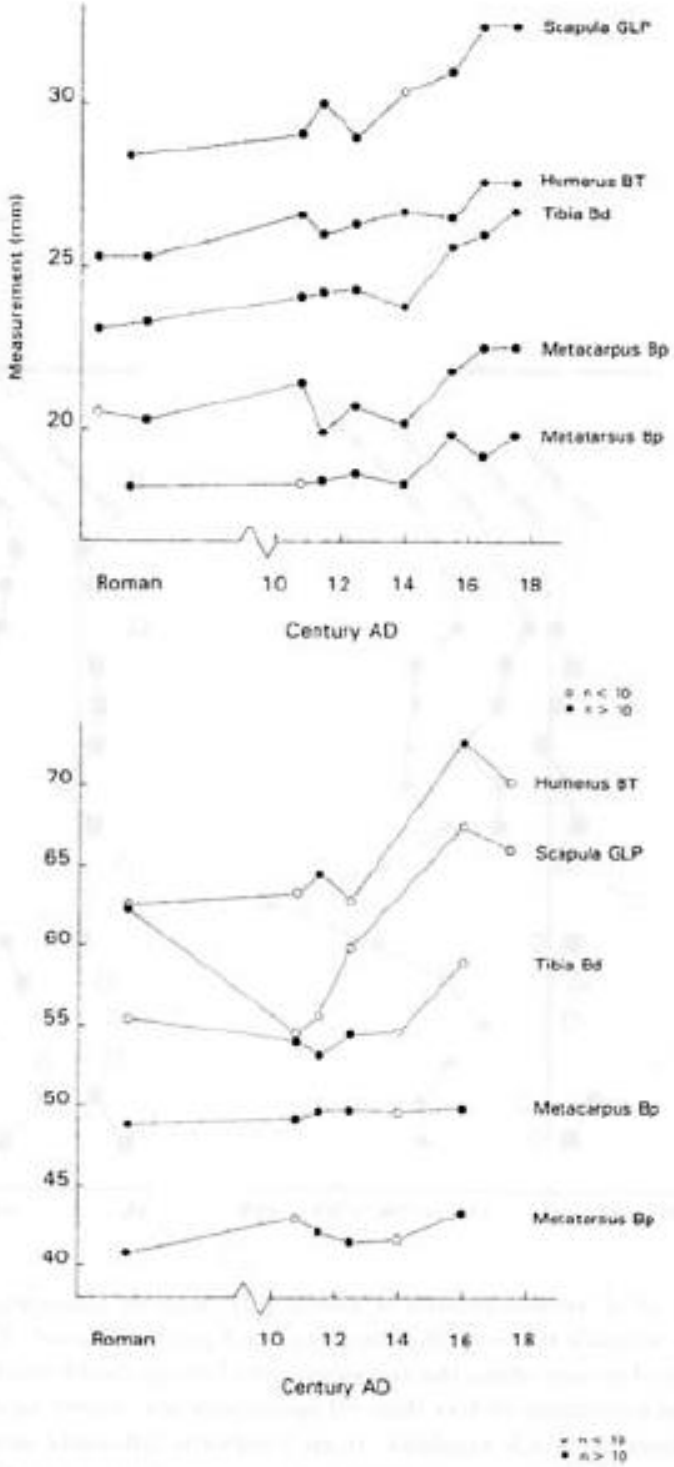

Figure 4. Sheep and cattle size variation at Exeter. Plots of the mean values of measurements of several bones (from Mark Maltby, *The Animal Bones from Exeter 1971-1975*, Exeter Archaeological reports, 1979, Sheffield University, Department of Prehistory and Archaeology. Samples consisting of less than 10 specimens are shown as open symbols, samples more than 10 are shown as black symbols. GLP: length of the articular end, BT: medio-lateral width of the trochlea, parallel to the axis of rotation of the joint, Bd: distal width, Bp: proximal width. For details of how measurements were taken see Angela von den Driesch, *A Guide to the Measurement of Animal Bones from Archaeological Sites*, Peabody Museum Bulletin 1, Cambridge Mass., Harvard University, 1976.

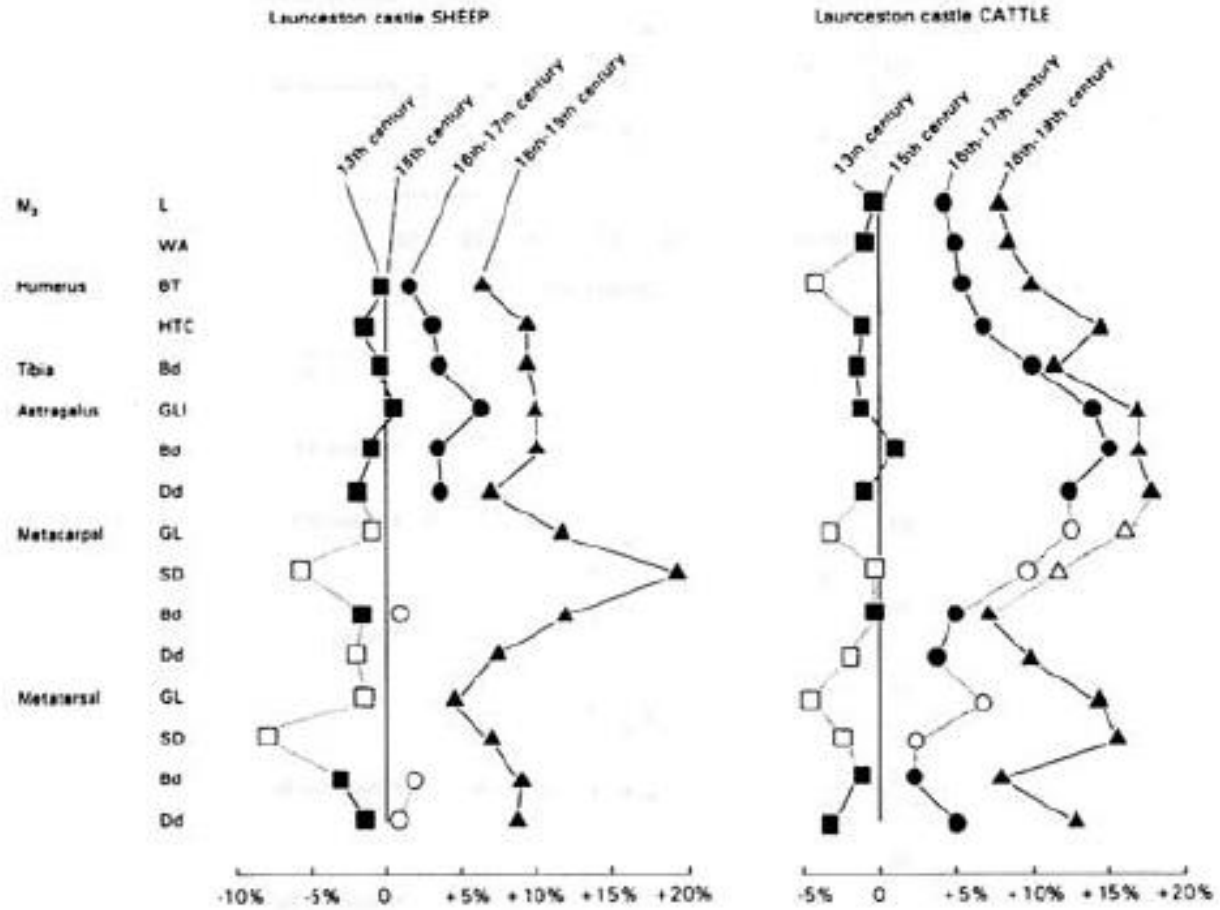

Figure 5. Summary of all measurements of sheep and cattle at Launceston Castle to show the size increase of these animals between the medieval and post-medieval. The diagrams show the percentage differences of means taking the measurements from period 8 (mid–late fifteenth century) as a baseline. Samples consisting of less than 10 specimens are shown as open symbols, samples more than 10 are shown as black symbols (from Umberto Albarella and Simon J. M. Davis, 'Mammals and Birds from Launceston Castle, Cornwall: Decline in Status and the Rise of Agriculture' *Circaea*, 12 (1996), 1-156.

Why should these changes have occurred? The most obvious point to make is that the variations in bone/tooth size discussed here are not simply an illusion reflecting differences in the age of slaughter of the animals. Many of the measurements are for widths and depths of the articular ends of long-bones whose epiphyses or growing ends are fused, i.e. they are fully adult. Once fusion of epiphyses occurs, little or no further increase in bone growth can take place. Moreover, teeth such as cattle third molars, once erupted, cannot increase in size. Unlike fish and many reptiles, measurements of mammalian bones with fused epiphyses are therefore age-independent. Size may change as a result of the effects of many different factors. Owing to sex-linked size characteristics, a sudden change in the sex ratio would produce a change in the mean size of a sample of bones. However, at least in the case of Launceston, there is no evidence for a change in the sex ratio of cattle to one with a greater proportion of adult males to females. Moreover, artiodactyl molar teeth show little if any sexual dimorphism.[33] Certainly at Launceston the increase in size of the animal is unlikely to have been due to a shift in the sexual composition of the samples (i.e. from samples with fewer males to samples with more males), and it is probably safe to rule out a variation of the sex-ratio as a factor here (see figure 5 at the top right hand side the plot showing the increase in length and width of cattle third molar teeth). Another possibility is that the post-medieval size increase reflects the adoption of the practice of castration. Castration is known to delay epiphysial closure which permits continued growth of long-bones.[34] However, results from work in progress indicate that castration does not alter the widths of the articulations of long-bones and most of the measurements considered here are widths.[35] (Animal bones from archaeological sites are generally broken and so length measurements cannot be taken.) We conclude therefore that a real (perhaps even a genotypic) size increase must have occurred in these animals. It is fitting to quote Markham: 'Touching the bignesse of bone, the larger that every cow is, the better she is; for when either age, or mischance shall disable her for the paile, being of large bone, shee may bee fed, and made fit for the shambles, and so no losse, but profit, and any other to the paile as good and sufficient as her self'.[36]

Further evidence to support the argument that cattle underwent a real change in size comes from the simultaneous alteration of (a) bone-shape, (as at Launceston Castle, mentioned above) and (b) the reduced frequency of a dental anomaly at Launceston between the mid to late fifteenth century and the sixteenth and seventeenth centuries. In artiodactyls the lower third molar tooth is characterised by having three pillars. The third pillar, the hypoconulid, is somewhat smaller, and occasionally fails to develop. At Launceston we recorded 14 out of 108 in the medieval layers and only 1 out of 47 in the post-medieval layers of cattle M_3s with reduced or missing hypoconulids. The probability that such a change is due to chance is less than 5%.[37]

However, there is a further issue which needs to be addressed, the *age* of slaughter. If there was change across time, this could skew the analysis, and it is clear from the Launceston evidence that there was such change between the medieval and post-medieval periods. Analysis of dental eruption and wear stages indicates that in the thirteenth to fifteenth centuries less than 20 per cent of the cattle were under 3 years old at slaughter, reflecting perhaps beeves derived mainly from retired dairy/breeding and work animals.

The situation later changed with approximately 60 per cent of the cattle aged under three years, suggesting a shift towards greater emphasis on the production of beef and dairy products and a countrywide increase in specialisation. Grant mentions an 'increase in the percentage of young animals in later deposits at some sites', a change which she attributes to the increasing importance of cattle as meat suppliers.[38] Trow-Smith suggests that during the sixteenth and seventeenth centuries the cow shifted in importance from a beast of traction to become a breeder of meat and supplier of milk.[39] Maltby notes an increase of young cattle in the sixteenth century and onwards at Exeter,[40] and Griffith *et al* ., note many more young cattle jaws in the seventeenth century at Sandal castle.[41]. In his summary of animal remains from monastic sites, O'Connor notes that at St Andrew's priory 'the fifteenth and sixteenth centuries seem to have seen an increase in . . . the exploitation of newly-weaned cattle for veal', and similar results are now reported at Lincoln, Norwich, Camber Castle and Launceston.[42]

These zoo-archaeological indications of an early onset of agricultural improvement in England support the findings of agricultural historians working from a more traditional viewpoint. In the medieval period animals were slaughtered relatively old and relatively small, while in later centuries they were relatively young, but larger animals. Greater care and selective breeding of ruminants in the sixteenth and seventeenth centuries was made possible by general improvements to livestock nutrition – the introduction and spread of new fodder crops, innovations such as water meadows, and the increased use of horses for cultivation.[43] Moreover, this size increase reflects increased sophistication of animal husbandry.

It follows from the argument presented in this paper that agricultural improvement in England was already under way in the fifteenth and sixteenth centuries, and that improvement in animal husbandry should be viewed more as a long-term and *gradual* development originating in the fifteenth century, rather than a *revolutionary* one which commenced sometime after 1760. Nor is such a conclusion out of line with current thinking. Overton, one of the few historians in recent years to quote zoo-archaeological evidence, has commented that 'the absence of improvement in the size of cattle is confirmed by archaeo-zoological evidence which suggests that the increase in the size of cattle took place between the middle ages and the sixteenth century, rather than later'.[44] No particular sources are cited for this argument, but this paper suggests there is relevant evidence to argue for an improvement from the medieval into the post-medieval period.

Zoo-archaeological work can never stand on its own as an indicator of agricultural improvement, but in view of the relatively poor quality of animal husbandry data from which agricultural historians usually work, it offers an alternative means of viewing a question which is widely recognised as important for our understanding of agricultural change. It may be that there are other ways of measuring productivity which have yet to be fully exploited,[45] but this evidence, drawn from an alternative approach, must point us in a helpful direction for future research. We wonder whether historical sources tend to emphasise theory rather than practice and to present an idealised picture of the achievements of great men, whereas bones have the potential to record practice rather than theory and to measure the activity of the population at large.

Acknowledgements

We are grateful to Sebastian Payne for his encouragement, and to him and Umberto Albarella, Matt Canti, Paul Halstead and Michael Turner for reading earlier versions of this article. Umberto Albarella, Mark Beech and Jacqui Mulville kindly allowed us to quote from their unpublished report on the animal bones from Castle Mall, Norwich. Simon Davis is grateful to the late Barbara Noddle who, several years ago, drew his attention to the debate concerning the beginnings of the Agricultural Revolution.

Notes

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