A METHOD OF AGE DETERMINATION ON ARCHAEOLOGICAL AND MODERN CATTLE (*Bos taurus*) BY COUNTING OF TOOTH ANNULI IN THE CEMENTUM

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ABSTRACT

One of the methods to determine the individual age of cattle found in archaeological materials is to count the incremental lines (annuli) in the teeth. Another method is to detect the wear and, taking into account the type of soil and other external factors for each area, relate the degree of wear to age of the individual's. This paper describes the techniques used when sectioning the teeth and preparing the samples. A reference material comprising sectioned and stained teeth from recent cattle of known age is also described. Finally, the differences and the correlation between the two named age determination methods are discussed.

The technique of sectioning teeth for interpreting the increments in the dental cementum has been used for about 40 years. Initially the method was used on marine mammals.

Scheffer (1950) found in teeth from Pinnipedia growth layers which indicated the age. Laws (1952) observed that growth lines in the dentine of elephant seal corresponded to the age of the animal. This method has since been applied to archaeological finds of both wild and domesticated animals. Some works on modern and archaeological cattle (Coy et al 1982) and sheep (Rudge 1976, Saxon & Higham 1968) have been published. In all cases distinct incremental bands could be seen.

Coy et al (1982) observed that the correlation between the number of annual layers and dental attrition was higher in teeth from cattle found at archaeological excavations than for cattle of today.

On mammal teeth there are deposits of root cement which surrounds the whole root during the entire life of the animal. According to recent results from big ungulates, eg Bison, the cementum starts to develop even before the teeth erupts (Klevezal et al 1991).

Incisors from moose of different ages shows how the cement gets thicker with increasing age (fig 1). These kind of sections of the root show the growth lines. The theory is based on the fact that bands in the dentine and cement of animal teeth are influenced primarily by year cycles in the organism but also external factors such as food and climate (Klevezal 1988). These factors change regularly. During a year a yearly pattern is formed in the teeth and the age of the individual can be established using a method much like dendrochronology. Furthermore, the last deposited band in the cementum can be observed and this tells us which season the animal died.

Helen Grue (1984) in Denmark has analysed an incisor from an aurochs (*Bos primigenius*) from about 6500 BC. The tooth, having been well preserved in old calcareous sea floor, was in such good condition that Grue was able to prepare it for sectioning with a freeze microtome (fig 2). To understand during which season the aurochs drowned in the bog, Helen Grue studied the last deposited band. This was a light band and the breadth tells us that the aurochs died in late autumn at the age of about 18-20 years.

The enlargement in the figure shows the annual incremental lines of the aurochs more clearly. One layer represents one year's growth, comprising a "summer" and a "winter" band. The period of rapid growth - late spring, summer and autumn - appears light on stained thin sections, whereas the narrower dense band formed during winter and early spring becomes dark after staining. The first, inner layers, are well spaced and easy to count but the outer ones are more difficult to distinguish from one another. As the animal grows older the difficulty of determining the age of death increases.

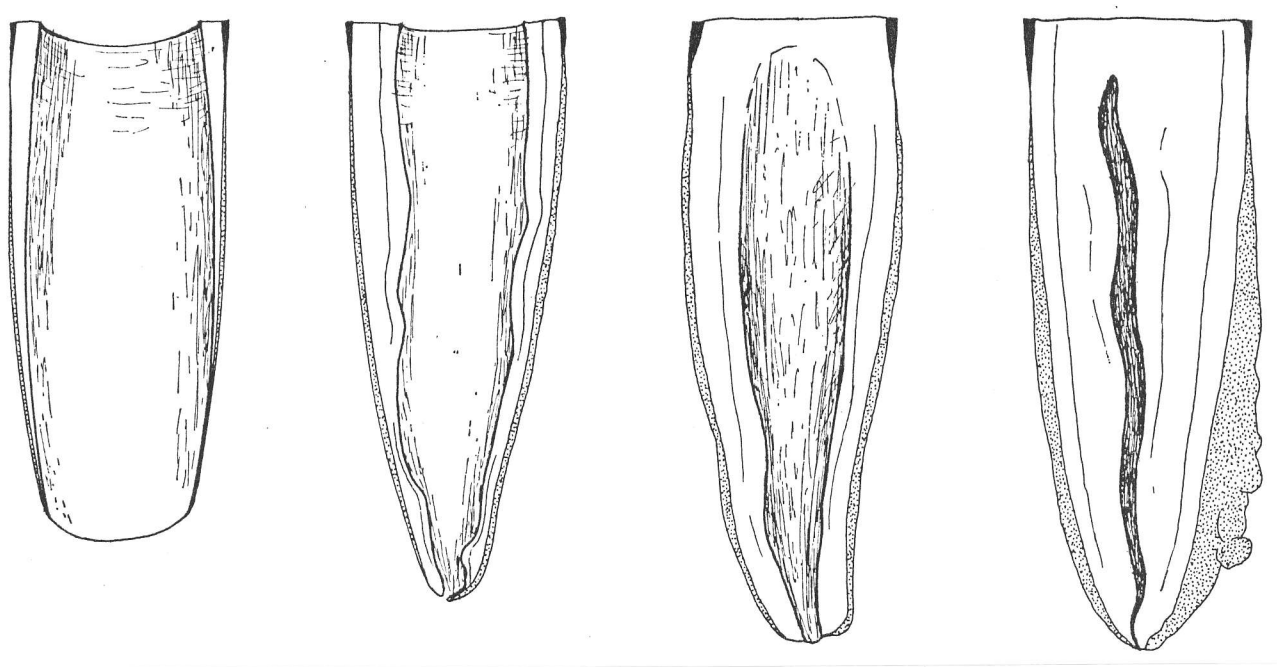

Fig 1. Incisors from moose in different ages. From left to right: a calf aged 6 months, a 1-year old, a 3-years old and a 15-years old moose. You can see the teeth in longitudinal sections and the cement thickness increases with higher age. The cement is marked in black (after Sergeant and Pimlott 1959, fig 2.) (With permission from Journal of Wildlife Management).

My examination

In contrast to sheep and pigs, it is fairly common that cattle in osteological material from towns dated to the Medieval Period, that is the 12th to 15th century, and the Post-Reformation Period, ie, the 16th to 18th century have reached adult age before slaughter. The question is however: how long were the cows and oxen kept in production?

In Swedish written sources the age of the animals is never mentioned. The information given about their ages is for example that an ox was used for three springs in agricultural labour or that a cow gave birth to three calves (Myrdal 1987).

In my studies of faunal assemblages I use normal methods for age determination: fusing of epiphyses and eruption and attrition of teeth. The attrition of teeth is recorded using the method published by Grant in 1982.

The mandibular molars are assigned an index number which increases with dental attrition. As the attrition is highly dependent of pasturage this method becomes less accurate as the cattle advance in years. The teeth in my investigation come from the 17th century layers of the town of Falun in the mid-part of Sweden. In the town there is a copper mine which has been known since the 16th century. We know from written sources that oxen were used as working-animals in the mine. My question is, how old did the oxen get?

In the osteological material from the town I found a large number of mandibles from cattle with all molars preserved, so I could study dental attrition carefully, (fig 3).

In order to compare the methods I plan to section the teeth from Falun and compare these results to the dental attrition. My first results on modern cattle teeth indicate that cementum bands provide much more reliable and detailed information than wear stages. The results of my own work and of Beasley (in preparation) indicate that cementum bands provide much more reliable information about age of death, and also afford the possibility of determination of season of death.

At the moment I am working on building up a reference collection with sectioned teeth from modern cattle with known data. All the cattle mandibles I get from the slaughter house have a number and therefore I can get all the information I need from the breeder (fig 4). In this case we have a cow named Rosa. Breed, sex, time of birth and age are specified. Number of calves is valuable information when the bands are interpreted.

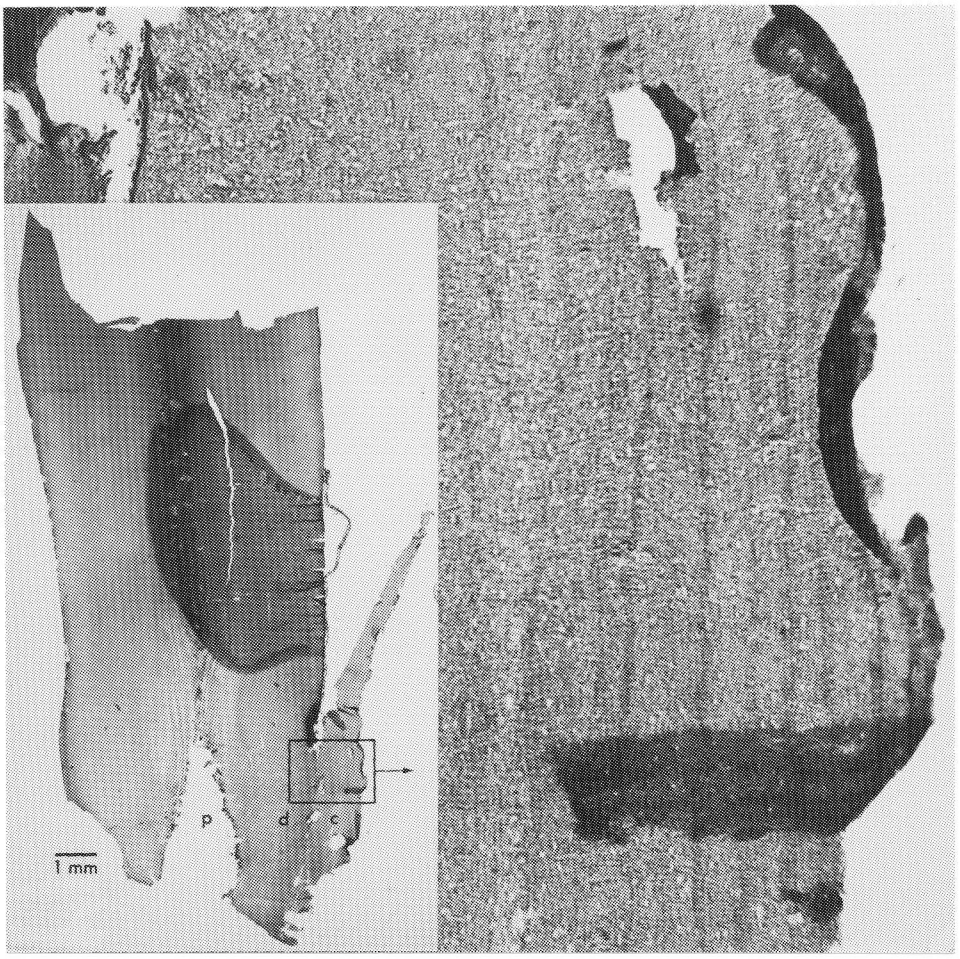

Fig 2. Thin-section of one of the incisors of the Prejerup Aurochs. The annual incremental lines are clearly seen on the enlargement to the right. Around the pulp is the dentine and outside the dentine you can see the root cement, p; pulp cavity, d; dentine, c; cementum (after Aaris-Sorensen & Strand Petersen 1986 p.113).

Method and technique

The method I use for age determination in teeth from the modern mandibles with known age is microtome sectioning.

* First the mandibles are boiled for about two hours

* Registration of the dental attrition according to Grant (1982)

* The teeth to be sectioned are extracted

* The height of the crown is measured to calculate the index

* The crown is sawn off

* The roots are decalcified in a 5% HNO_3 for at least 24 hours, depending on the size

* Then the roots will be neutralised in 5% sodium carbonate (Na_2CO_3) for 24 hours

* The roots are then rinsed in running water for 24 hours

* After this preparation the roots are soft and can easily be sliced in the freeze microtome

* Samples of different thicknesses, 10 to - 25 microns, are taken from the same root

* Both transverse- and longitudinal sections are taken for comparison

* Staining with Mayer's haematoxylin to make the bands more clearly visible

* Mount on glass slides

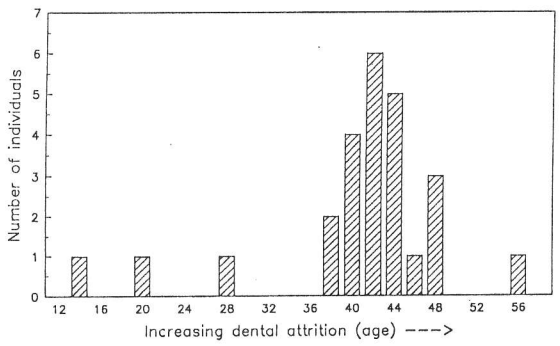

Fig 3. Teeth attrition of cattle, from Falun. Molars from mandible with an index-number higher than 36, according to Grant's method, are more than 4-5 years old. The question is however, how much older?

The farmer's name	Nils Nilsson
Telephone number	00 00 00
Number of the cattle	12 324
Race	Cross-breeding
The father SRB	Swedish Red and White Cattle
The mother SKB	Swedish Hornless Cattle
The grandfather SLB	Swedish Lowland Cattle
Sex	Female
Born	1979-11-07
Age	10 years
Calves	1982-03-23 1983-04-08 1984-03-31 1985-04-19 1986-06-08 1987-05-16 1988-05-17
Castration	----------
Paturage	May-June-October
Winter food	50% hay, 50% groats (oats, grain, concentrated fodder)
Slaughter	1989-05-29 Rosa had pneumonia

Fig 4. This is my standard form for information from the breeder.

The scientist, Laws, took cross-sections of the canine tooth of elephant seal (fig 5). As you can see he got very clear bands, but with cross-sections there is a risk that the deposit bands are wrongly interpreted because of irregularities in cementum. Therefore I prefer longitudinal sections which gives the best results (fig 6).

To read these bands is very difficult; it requires a lot of experience and routine. To use age determination of cementum bands, it is necessary to have knowledge of when the different zones are deposited.

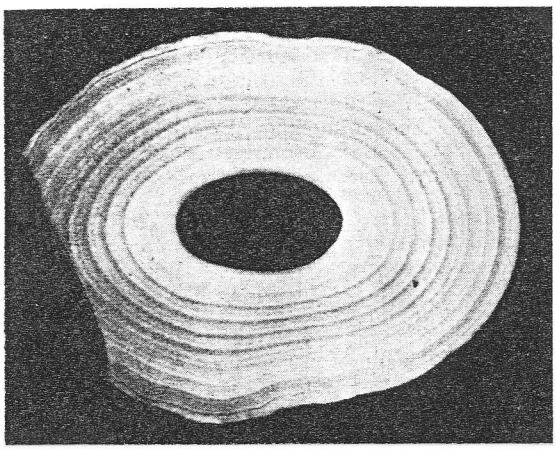

Fig 5. Cross-section of canine tooth of elephant seal. The age of the animal is represented by nine bands (after Laws 1952). (Copyright © 1952 Macmillan Magazines Ltd).

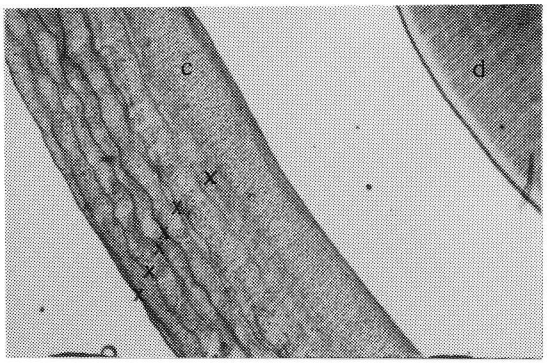

Fig 6. This is a longitudinal-section from the first molar from a cow, six years old. d=dentine, c=cementum.

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