Antlers—the Unbrittle Bones of Contention

In a discussion of giraffid horns and cervid antlers, Spinage[1] stated that the latter must be shed and regrown periodically, because bone is more brittle than horn and is often broken.

The evolution and changes in the form of antlers were undoubtedly induced by climatic and associated factors, and the annual cycle of growth, velvet removal and eventual shedding conform most strictly to the annual weather cycle in all temperate and boreal zone species[2]. Antlers damaged during the summer when they are soft and in velvet may continue to grow, sometimes to an aberrant final form, or growth may be arrested. In the latter event the antlers are sometimes not shed and regrown. If part of an antler is broken off during the rutting season or later, that is after the velvet has been rubbed off and the antler has hardened, no regrowth occurs but the antlers are shed as usual according to the periodicity exhibited by the species concerned. In any case, the rutting conflicts of most species are largely ritualized, antlers serving the function of display more than as jousting weapons which contact vigorously.

Perhaps less than 5% of shed antlers from caribou (*Rangifer tarandus*) and moose (*Alces alces*), for example, exhibit evidence of any breakage. When one or even two terminal tines are broken short, as occurs occasionally in Eurasian cervid species also, the mass lost is insignificant compared with that remaining. In observations of approximately a quarter of a million cervids of nine species I have recorded only one instance of breakage to the main beam itself and only two of breakage to the palm (which constitutes a large proportion of the antler mass in several species). In the former instance the beam was less than 1.5 cm in diameter and belonged to the tiny muntjac (*Muntiacus reevesi*). The losses of small parts of antler material from palms were observed in a moose and a fallow deer (*Dama dama*). Antler is less brittle than most bony material. Red deer (*Cervus elaphus*) and wapiti (*Cervus canadensis*) antlers can be flexed to some extent by hand and caribou antlers even more so. I have observed trotting bull caribou whose antlers flexed with the movement of the animal, and have observed the antlers "give" when two large bulls sparred quite gently. Collections of antlers shed by known red deer individuals indicate that breakage within an animal's lifetime may be the exception rather than the rule (personal observations and ref. 3). It is common practice among hunters in North America to eviscerate and butcher cervids, ranging from whitetail deer (*Odocoileus virginianus*) to moose, after hanging them clear of the ground by means of a mechanical hoist attached to the antlers. Because wapiti and moose may weigh up to 400 and 600 kg respectively, selection for weak and breakable antler material might operate negatively upon the eviscerator.

Considering the nutritional requirements imposed by the annual production of new and generally larger antlers, it would be an extreme over-compensation if renewal served as an allowance for possible breakage. The annual weather cycle determines the timing of anther renewal, the function and survival value of which is a consequence of the heirarchic and competitive nature of cervid behaviour[2,4]

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1 Spinage, C. A., *Nature*, **227**, 735 (1970).
2 Henshaw, J., *Nature*, **224**, 1036 (1969).
3 Vogt, E., *Neue Wege der Hege* (Neumann, Neudamm, 1936).
4 Geist, V., *Nature*, **220**, 813 (1968).

Red Stained Bones from Qumran

Chemical analysis of bones found in Qumran, on the Dead Sea, suggests that the members of the community of the Dead Sea Scrolls used the root of madder as a medicine to ward off evil spirits.

Bones which were stained a purplish red colour were found in seven out of ten human skeletons excavated from individual graves in the cemetery at Qumran[1]. Details of the bones and staining are given in Table 1.

Table 1 Bones and Staining

Grave	Bone	Age*	Sex	Position of stain
QG 3	Right femur	65	Male	Anterior aspect of the head to the neck
QG 4	All teeth	~40	Male	Cavum dentis to the root
QG 4	Right second metacarpal	~40	Male	Proximal and distal ends
QG 5	Left coxal bone	22	Male	Around the acetabulum and ischial tuberosity
QG 6	Left humerus	25	Female	Triangular shaped stain below the anatomical neck
QG 6	Left ulna	25	Female	Posterior aspect of the olecranon
QG 9	Right radius	65	Male	Capitulum region
QG 10	Left femur	25–26	Male	Diamond-shaped stain from the lesser trochanter to and including the gluteal tuberosity; an oblique line on the anterior aspect of the first third and a triangular stain above the condyles
QG 10	Left humerus	25–26	Male	Entire head stained as well as a triangular stain in the deltoid insertion region
QG 11	Right radius	45–50	Female	Upper part of the diaphysis near the bicipital tuberosity and near the distal end; greater visible dye concentration near the radial styloid process

* Age was determined by examination of the whole skeletons.

One specimen, the right radius from grave QG 9, was sectioned to reveal the medullary cavity, which was stained throughout the length of the bone, over almost the whole surface of the cavity. Tests for the fungus *Aspergillus versicolor* proved negative, and X-ray fluorescence and atomic emission spectroscopy revealed no differences between stained and unstained bones.

During long exposure to light and air the red colour disappeared from all parts of the bones except the medullary cavities. The stain also dissipated after a few hours in contact with chloroform, acetone or ethanol, and so we needed a rapid means of determining the cause of the staining.

We dissolved the bones in dilute hydrochloric acid and obtained a red suspension which yielded a red-brown precipitate when filtered. The precipitate was washed with acetone to give a red solution from which a red residue was obtained by evaporation at reduced pressure. The infrared absorption spectrum (at 5,000–650 cm^{-1}) of the residue, obtained by the potassium bromide pellet method, identified the stain as alizarin.

This dye, which comes from the root of the madder, *Rubia tinctorum*, was one of the most important natural dyestuffs of antiquity[2]. Bones of animals fed on madder become purplish-red[3], and in 1736 Belchier[4] discovered that ingestion of madder resulted in the staining of bones *in vivo*. Since then alizarin has been used in standard laboratory practice for the

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