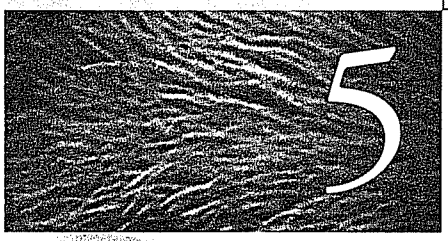
CHAPTER



5 HORNS AND ANTLERS

In modern mammals, horns and antlers are confined to the ungulate orders Artiodactyla and Perissodactyla. However, the fossil record includes horned mammals in other orders, even the Rodentia. Head **excrescences** or outgrowths in living mammals may be divided on the basis of structure and method of formation into five major types.

TRUE HORNS

True horns, which occur only in the family Bovidae (buffaloes, sheep, goats, cattle, antelopes, etc.), are unbranched and permanent. Each is composed of an inner bony core that is an extension of a frontal bone and an outer layer of true **horn,** formed from keratinized epidermis (Fig. 5.1). *Note!* "Horn" can refer either to the entire structure (e.g., a cow's horn) or to the keratinized material that forms the sheath, or to the sheath itself. A true horn grows from its base throughout the adult life of the animal, but neither the bony core nor the keratinized portion is shed. Portions of the sheath are often worn away, and in some species parts or layers of the sheath may regularly break away (O'Gara and Matson 1975), but the entire sheath is not shed. In many horned bovids, each season's growth produces a ring at the base of the sheath (Fig. 5.2), and counts of these annual rings have proven useful in determining the age of wild sheep and certain other species.

Horns may be present on both sexes or may occur only on males. When present on both sexes, they are usually larger on the males. A few breeds of domestic bovids (e.g., Aberdeen Angus, polled Hereford) are hornless. Horns usually occur as a single pair; however, one living bovid, the four-horned antelope, *Tetracerus quadricornis,* has four well-developed horns (Fig. 5.3).

5-A Examine horns and horn cores of a variety of bovids. Note differences in size, length, and curvature.

PRONGHORNS

Pronghorns are found among modern mammals only on the North American pronghorn, *Antilocapra americana,* the single living species of the family Antilocapridae. Their basic structure (Fig. 5.4) is similar to that of the bovid horn, consisting of a permanent, unbranched, bony core that is part of the frontal bone, and an epidermal horny sheath. However, in pronghorns, the horny sheath is shed annually and is branched, having a small anterior projection or prong. When the sheath is about to be shed, it becomes loose, and a new one begins to form on the bone core. O'Gara and Matson (1975) have described this process in detail. Female pronghorns are sometimes hornless and frequently lack prongs. The horns of the males are larger than those of the females.

5-B Compare the horns (both cores and sheaths) of a pronghorn with those of the bovid series examined above. How do the horn cores differ? (Be sure to use a goat in your comparisons.)

ANTLERS

Antlers occur on males of all deer except the Chinese water deer (*Hydropotes inermis*) of the family Cervidae, and are found in both sexes of the genus *Rangifer,* the reindeer and caribou. Fully developed antlers are entirely

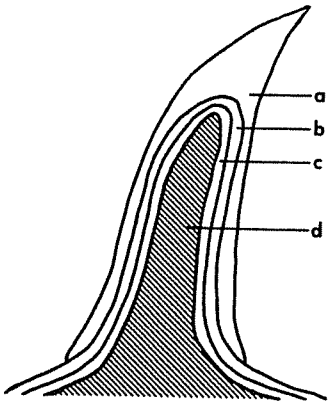


Figure 5.1 Diagrammatic section of a bovid horn: a, horn or keratinized epidermis; b, epidermis; c, dermis; d, bone.
(L.P. Martin)

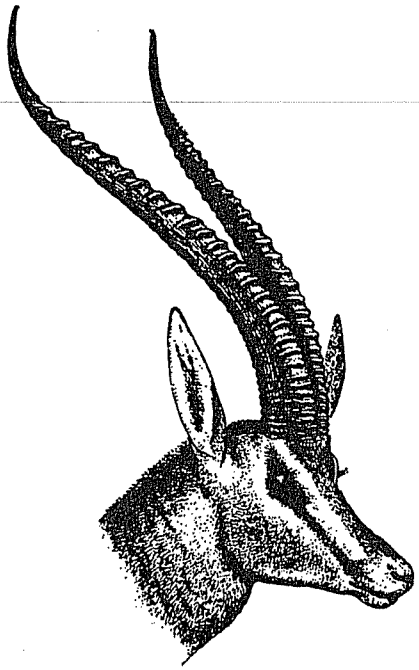


Figure 5.2 Head of Grant's gazelle, *Gazella granti.* Note the growth rings at the bases of the horns.
(Flower and Lydekker 1891)

bony structures (Fig. 5.5B) that are branched in older adults of most species and are shed periodically (annually in the temperate zones). While the antler is growing, the bone is covered with skin, the **velvet** (Fig. 5.5A), which carries blood vessels and nerves supplying the growing bone. When the bone is fully ossified, the velvet is shed. After each mating season in the temperate zones, the bony antler is shed, and in the spring a new set begins to grow (Fig. 5.6).

The antler forms from the **pedicel,** an extension of the frontal bone. A **burr** marks the point of separation between the permanent pedicel and the deciduous antler.

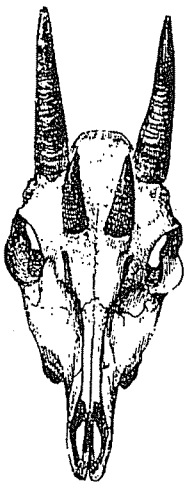


Figure 5.3 Skull of the four-horned antelope, *Tetracerus quadricornis,* the only living bovid with more than one pair of horns.
(Owen 1868:625)

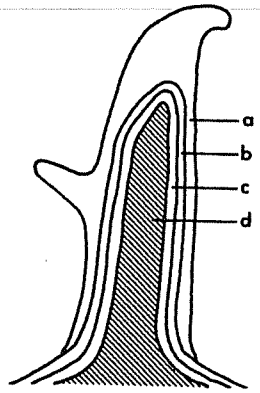


Figure 5.4 Diagrammatic section of a pronghorn: a, keratinized epidermis; b, epidermis; c, dermis; d, bone.
(L.P. Martin)

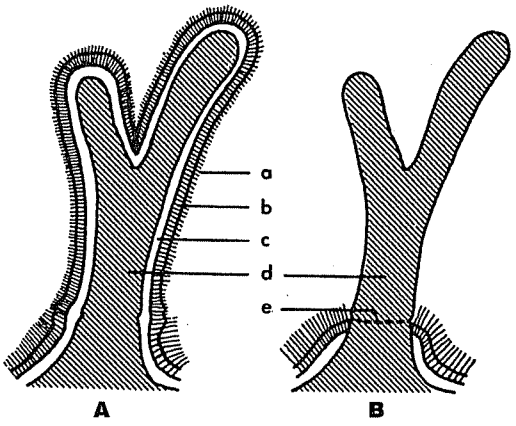


Figure 5.5 Diagrammatic section of antler with (A) and without (B) velvet: a, hair; b, epidermis; c, dermis; d, bone (or antler); e, abscission line at region of burr.
(L.P. Martin)

Figure 5.6 Stages in the growth of antlers of the red deer, *Cervus elaphus.*
(Sokolov 1959)

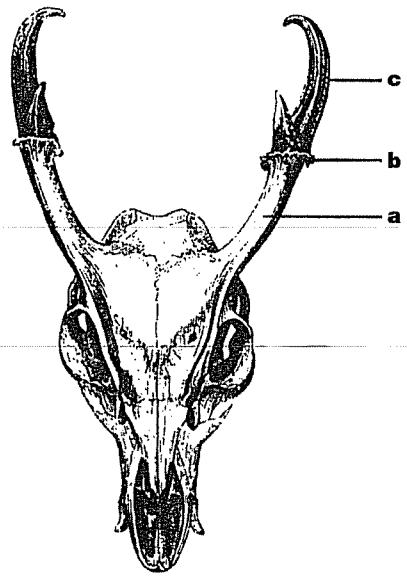


Figure 5.7 Skull of a male muntjac, *Muntiacus muntjak,* a deer with unusually long pedicels: a, pedicel; b, burr; c, antler.
(Owen 1866)

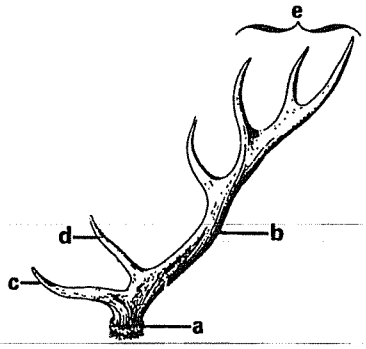


Figure 5.8 Red deer, *Cervus elaphus,* antler: a, burr; b, beam; c, brow tine; d, bez tine; e, crown.
(Sokolov 1959)

The pedicel is usually very short, but in the muntjacs, *Muntiacus,* it is as long as or longer than the antler (Fig. 5.7). The antler usually consists of a main stem, the **beam,** with a variable number of branches or **tines.** The first tine to arise from the beam, immediately over the forehead, is termed the **brow tine,** and the second is termed the **bez tine.** The points of the summit of the antler are collectively termed the **crown** (Fig. 5.8). The pair of antlers together are termed the **rack.** Commonly, all of the branches of the antler are essentially cylindrical, but in some species, as in the moose, *Alces alces,* they are more or less expanded and flattened. Such flattened antlers are termed **palmate** antlers (Fig. 5.9A).

In the white-tailed deer, *Odocoileus virginianus,* the first indication of future antler growth begins at about nine months when small, paired bulges first appear on the frontal bones and rapidly develop into the pedicels. The first antlers start to grow from the pedicels at about 18 months. These begin to harden at the base, and the process continues toward the tip. The growth is very rapid and may be completed in 14 weeks. By late summer or early fall, growth is completed, blood circulation in the velvet becomes sluggish, and the skin dies. The antlers are rubbed against trees and brush until the velvet hangs in shreds and falls off. After the mating season, absorption just under the burr results in a plane of weakness, and the antlers fall off. In the spring, the cycle begins again with new growth.

The number of points or tines displayed by an individual increases with age until the largest number for the individual is reached when the animal is in its prime. Antler development is influenced by several factors other than age (genetics, nutrition, hormone levels, etc.); thus, it is never possible to determine the absolute age of any animal merely by counting the number of tines (see Chapter 33). Nutrition plays an important role in antler development, and undernourished individuals will never have as many tines or as well-developed racks as properly nourished individuals of the same age. In most deer, antlers are secondary sex characters; thus, their formation is also controlled by

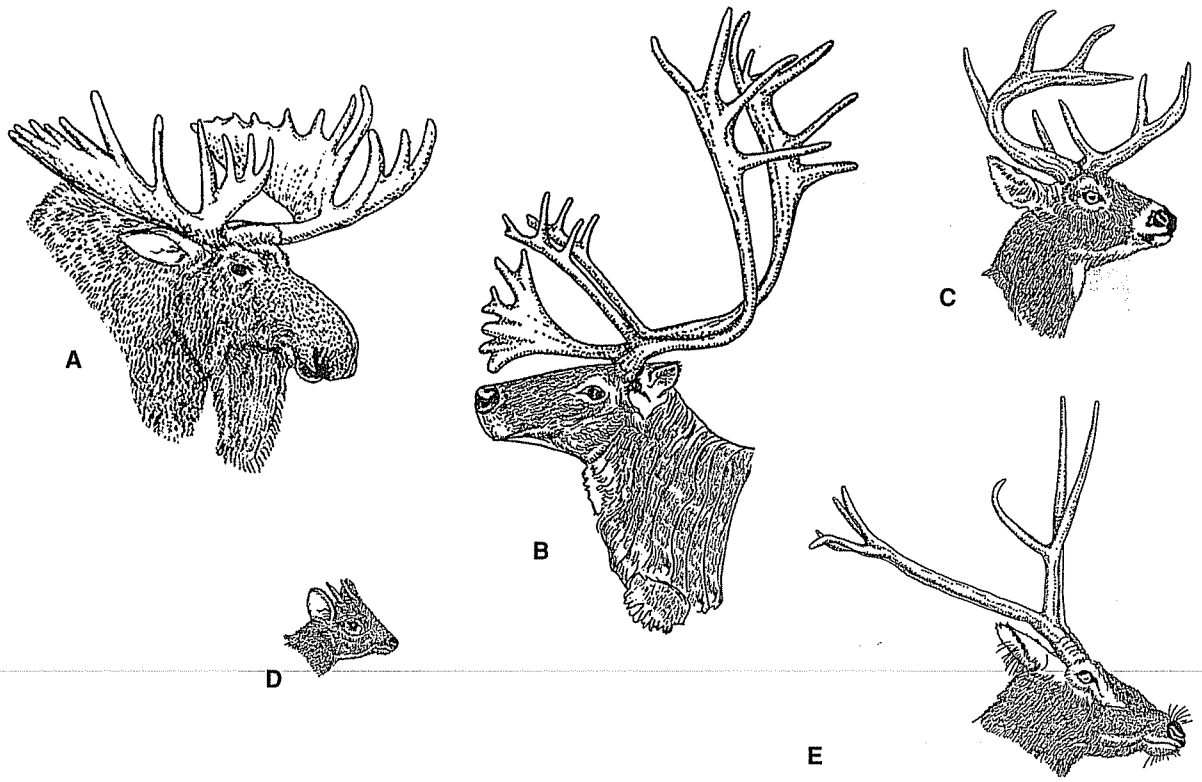


Figure 5.9 Relative sizes and configurations of antlers, Cervidae. (A) Moose, *Alces alces,* with palmate antlers; (B) caribou, *Rangifer tarandus,* where both sexes have antlers; (C) white-tailed deer, *Odocoileus virginianus;* (D) pudu, *Pudu puda,* with small spike antlers; (E) Père David's deer, *Elaphurus davidianus.*
(Feldhamer et al. 1999:337)

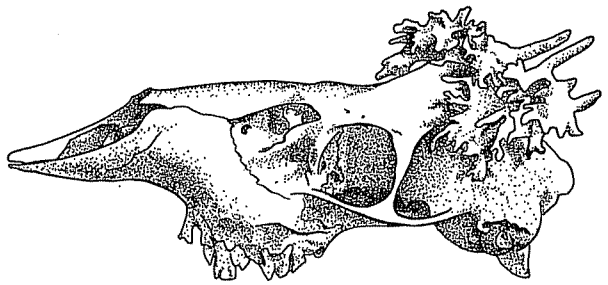


Figure 5.10 Skull with deformed antlers from a castrated male white-tailed deer, *Odocoileus virginianus.*
(Michael Gilliland)

male hormones. Injury to the testes or other factors influencing hormonal production may result in stunted or deformed antlers (Fig. 5.10). In very old males, poor nutrition or reduced hormonal production will frequently result in antlers consisting of a single spike or a rough burr. Deformed antlers are frequently seen. Although these may be the result of hormonal or nutritional deficiencies, they are frequently due to mechanical injury to the antler while it is in velvet and still growing.

5-C Compare skulls or racks of *Odocoileus* collected in different seasons. What has caused the small grooves visible on a mature antler?

5-D Examine racks of *Odocoileus* of different ages. What factors influence the differences in antler complexity? Which, if any, can you age absolutely?

5-E Locate the burr, beam, brow tine, bez tine, and crown on a white-tailed deer, mule deer, wapiti, moose, and caribou. How do the general size and arrangement of these racks vary?

Giraffe "Horns"

The primary head protuberances of giraffes and male okapis, Giraffidae, consist of a pair of short, unbranched, permanent, bony processes that are situated over the sutures between the frontal and parietal bones and are permanently covered with skin and hair (Fig. 5.11). They ossify from distinct centers, the **ossicones,** and then fuse to the skull (Goss 1983:67). Thus, they are not projections of the frontal bones as are the head excrescences of

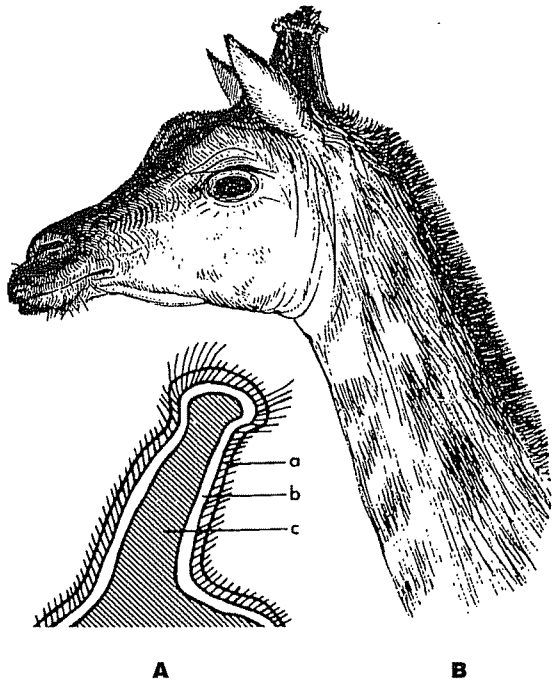


Figure 5.11 (A) Giraffe "horn"; a, hair-covered epidermis; b, dermis; c, bone. (In younger animals, a suture is present between the frontal bone and the "horn," as shown in Figure 27.11.) (B) Head of giraffe, *Giraffa camelopardalis.*
(A, L.P. Martin; B, Giebel 1859:369)

other types of artiodactyls. "Horns" are present in both sexes of giraffes and even in newborn animals. Anterior to the paired "horns" of giraffes, a median protuberance of the frontal bone is frequently present in some populations (see Fig. 27.1). This "third horn" increases in size with the age of the individual.

5-F Examine a "horn" of a giraffe (Fig. 5.11) or okapi and compare the structure to that of a true horn and of an antler in velvet (see Fig. 5-5A) .

RHINOCEROS "HORNS"

The only living nonartiodactyls to possess keratinized hornlike structures on the head are the rhinoceroses of the order Perissodactyla (see Fig. 26.4). The rhino "horn" (sometimes called a *hair horn,* although the fibers making up the horn are not formed like true hair) does not have a distinct core and sheath but is a solid mass of hardened epidermal cells that are formed from a cluster of long **dermal papillae** (Ryder 1962). The cells formed around each papilla constitute a distinct horny fiber resembling a thick hair. These fibers are cemented together by a mass of epidermal cells that grow up from the spaces between the fibers. They differ from true hairs in growing from a dermal papilla that extends up into them, rather than from an epidermal follicle extending down into the dermis (Fig. 5.12A). The skin bearing the

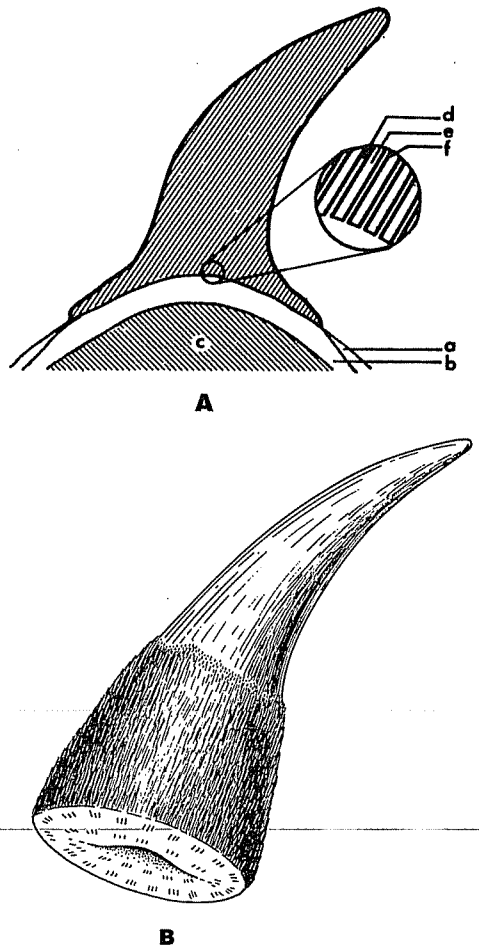


Figure 5.12 (A) Section of a rhinoceros "horn": a, epidermis; b, dermis; c, bone; d, dermal papilla; e, matrix of epidermal cells; f, fiber. (B) Rhino "horn" showing surface features.
(A, L.P. Martin; B, Kent and Miller 1997:112)

horn is situated over the fused nasal bones. These bones are generally enlarged and have a rough surface that ensures firm seating of the skin and horn (see Fig. 26.4). In species with two horns, the second is positioned over the frontal bones. The horns are conical and frequently curve posteriorly. In some species, they may reach a length of 4 feet (1.2 meters).

5-G Examine a rhino "horn" (see Fig. 5.12B) and note its fibrous texture. What is the reason for the deep pores in the base?

5-H Examine a rhinoceros skull (see Fig. 26.4). Where is/are the horn(s) situated in relation to the skull bones?

FUNCTION

Horns, antlers, and other excrescences from the head region of mammals serve a number of functions. The

primary function of these structures is apparently to better enable males to carry out combat among themselves and thereby gain access to mates (see Ewer 1968; Geist 1966; Goss 1983; Schaffer and Reed 1972). Secondarily, they may serve as display structures, as indicators of social status, as protection against predators, and as devices to deposit secretions from glands onto objects (e.g., trees and rocks) in their environments. Removal of tines or otherwise reducing the size of an antler or horn often causes a decrease in the social status of the affected individual (Goss 1983 and Suttie 1980, for review). Some scientists have suggested that the antlers of the Cervidae could serve as thermoregulatory devices by facilitating heat loss. Goss (1983), however, did not think that the thermoregulation argument was convincing because species from tropical and warm environments tend to have small antlers and those from colder climates have the largest antlers.