

November 1994

Tales That Teeth Tell

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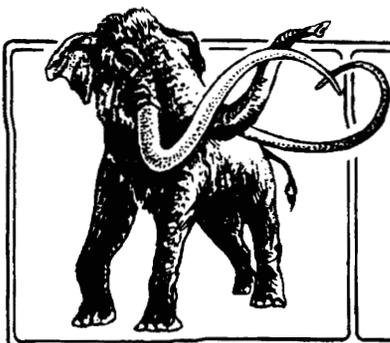


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Freeman, Patricia W. and Denham, Pauline R. Illustrator, "Tales That Teeth Tell" (1994). *Mammalogy Papers: University of Nebraska State Museum*. 28.

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Museum Notes

University of Nebraska State Museum
Edited by Brett C. Ratcliffe

November 1994
Number 89

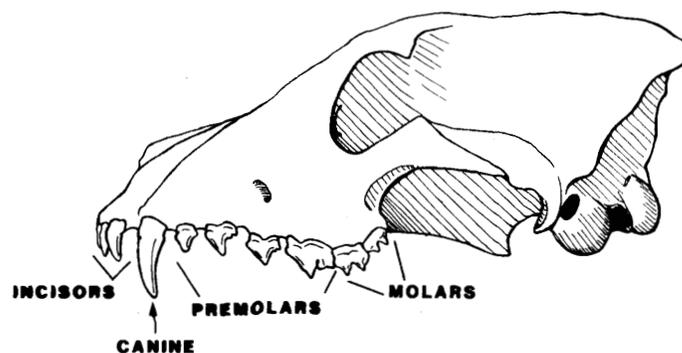
TALES THAT TEETH TELL

by Patricia W. Freeman, Curator of Zoology
Illustrations by Pauline R. Denham, Museum Artist

Many of us enjoy walking in the woods or prairie and looking for interesting natural items or behavior. My oldest child now takes delight in spotting and finding things before I do. Often we find skulls, teeth, and bones of mammals and, I suspect, many other people do too given the fact that many of these items are brought into the Museum to be identified. With just a little explanation about what mammals eat and the effect of these foods on the shapes of teeth, an observant person can start to categorize several common mammals if they know what to look for. Because dietary habits are reflected in the teeth of mammals, insect-eaters and meat-eaters look different from each other and from other mammals that eat everything. All three of these look different from plant-eaters. These broad categories of feeding are called insectivory, carnivory, omnivory, and herbivory, respectively. The pattern of bumps or ridges and valleys on the tops of the teeth is the *cuspid pattern*, and the hardest working teeth are the premolars and molars, or *cheekteeth*, that are just behind the front teeth. The cusp pattern on the cheekteeth is how we can tell the kinds of foods a mammal may eat.

STRUCTURE AND KINDS OF TEETH

Teeth are covered with a hard, rock-like substance called *enamel*. Indeed, enamel is the hardest mammalian (or, for that matter vertebrate) tissue; only three percent of enamel is organic material. Rocks have zero percent organic material. Slightly less hard tissue, but still harder than bone, is *dentin*. Dentin makes up most of the inside of the tooth and is covered by the protective layer of enamel.



The tooth is secured into its socket in the jaw with a softer material called *cement*. Cement is bone-like in hardness and replaces the enamel as a protective covering around the roots of the tooth below the gum line. In many mammals the layer of cement is thin and inconspicuous, but on mammals that specialize on plants, the layer of cement can be thick and obvious and form part of the crown of the tooth. Because teeth are so hard they can withstand all sorts of abuse from weather and time, fossilize, and are often the only clue to what we know about ancient mammals. Reading teeth to reveal what a mammal eats or might have eaten millions of years ago is not an uncommon pastime for people who study mammals (mammalogists) and fossil mammals (vertebrate paleontologists; see Museum Notes # 77, Fossil elephant teeth in Nebraska).

Mammals have several kinds of teeth in their mouth. The *incisors* at the front of the mouth are for nipping, plucking, and scraping. *Canines* are for holding and piercing and can be long and conical. *Premolars* are for shearing, cutting, and slicing

and come before the *molars*, which are for crushing and grinding. Incisors, canines, and premolars come in two sets: the baby teeth and permanent teeth. Most mammals, including ourselves, have low-crowned teeth that stop growing when adult size is reached. Plant-eaters or herbivores have high-crowned teeth because vegetation, believe it or not, is a hard substance to process. Often there is sand or grit mixed in with the food that wears down the tooth's grinding surface. Further, because plants and grass can be so abrasive many herbivores also have ever-growing teeth. These are teeth that do not stop growing when adult size is reached.



Actual size of skull of a shrew and a mole.

INSECTIVORES

Insectivorous mammals are usually small but they have very characteristic teeth. Insectivores are fierce predators and include things like shrews, moles, and bats. All have big canines or incisors and all have a **W**-shaped cusp pattern on their upper cheekteeth. The **W**-shape is like a little zig-zag cliff, much like the zig-zag pattern on pinking shears that tailors use. The **W**-shape of the upper teeth fits neatly with the **W**-shape of the lower teeth in a vertical direction and the teeth are very good at chopping up food finely. Shrews and moles are secretive predators of insects. Shrews usually stay on top of the ground but can dive in and out of the leaf litter for insects and sometimes dig shallow tunnels and runways or use those of some other animal. Shrews are very active, nervous creatures that rarely rest and are not at all friendly. They commonly patrol for insects along logs and rocks and, because of their small size, can investigate small cracks and crevices for food. Nearly all of their diet consists of animals, mostly insects and their larvae; but also including earthworms, slugs, snails, centipedes, millipedes, spiders, salamanders, snakes, birds, mice, and other shrews. Some plant foods are eaten, particularly in the winter. Gardeners complain that shrews eat the roots of their rose plants. Because of their small size, shrews need to eat half of their weight or more each day. Insects are often disabled or paralyzed and then hoarded in a shrew's tunnel to be eaten at a

later time. The teeth of many species of shrews are pigmented a dark red, which is from iron deposits in the food.

Moles have similar teeth, but moles live differently from shrews. Moles dig their hunting space underground with their large, powerful, spade-like paws. Their tunnels become traps for invertebrates that wander or fall into the tunnel. Moles then patrol the tunnels and pick up the food that's fallen in. Moles are a bit larger and take larger insect prey.

Fortunately, we can easily see the **W**-pattern on the cusps in a larger animal like the opossum, which is not strictly insectivorous but still has most of the same features as the smaller insectivores. Skeletons of opossums are some of the most commonly found bones of any mammal in this area of the country. Opossums eat many different things but prefer animal foods over plant foods. Common items are insects such as grasshoppers, crickets, squash bugs, stink bugs, ground beetles, May beetles, and ants. Opossums are scavengers and will search under logs and rocks and through the leaf litter for food throughout the year. These slow moving animals also take advantage of carrion or animals that are already dead. A common and important food source is cottontail rabbits but so are dead opossums, house cats, skunks, squirrels, raccoons, moles, and mice. Other animal foods include birds and their eggs, reptiles and amphibians, snails, crayfish, and earthworms. During fall and early winter there is more fruit in the diet where berries, apples, and persimmons are common. Sometimes opossums will eat corn when nothing else is available. Opossums are common in towns and cities in Nebraska and are not so picky that they will not take advantage of the ready source of garbage and compost heaps for food.

The skull of the opossum has a large crest along the top. The space on either side of this crest is filled with muscles that control and power chewing. The volume of muscle is greater than the volume of brains inside the braincase, making the term "muscle head" an appropriate nickname for opossums. They are not particularly smart or fast, but they eat almost anything they can find. With their long canine teeth and sharp-edged cheekteeth, they can easily eat all sorts of animals. These characteristics have stood the opossum in good stead for millions of years.

CARNIVORES

Larger mammals that primarily eat meat are called carnivores. The meat is often that of other

vertebrates and, if it is not already bite-sized, it has to be cut off the bone with slicing teeth. Carnivores have several diagnostic features in their skulls and teeth. There is often a crest along the top of the skull like the opossum and long sharp canine teeth at the front end of the skull, but there is also a special pair of teeth in the toothrow that is modified for slicing off hunks of meat. The last upper premolar and the first lower molar work together as a pair called the *carnassial pair*. The steep vertical faces of the teeth shear past each other in an up and down motion. This special pair of teeth is located at the most powerful place along the jaw and is the place dogs and cats try to position their food for maximum crunch. The teeth of cats are the most specialized for eating meat, and their entire toothrow is modified for slicing through meat. The cusps are mostly vertical blades with few horizontal areas for crushing. Since premolars are the teeth that do most of the slicing in the toothrow, the upper row in a cat is all premolars. There is only a small nubbin of an upper molar and the only molar in the bottom row is the one that forms the carnassial pair with the last upper premolar. There are no crushing molars among the cheekteeth. We feed our domestic cats out of a can. But make no mistake, our pets are highly specialized for stalking prey and eating meat and have an enormous impact on small mammals and birds in our neighborhoods. On islands where there have been no predators, the introduction of domestic cats has eliminated the native fauna in a short period of time. Cats are efficient, meat-eating machines.

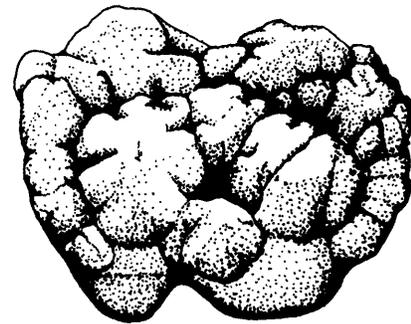
Teeth of dogs or coyotes are not as specialized as those of cats and are modified for other kinds of foods. Coyotes are very successful and abundant animals for this very reason. While coyotes eat rabbits and mice most of the time, they also scavenge dead animals and eat fruits and seeds at certain times of the year. In the toothrow of the dog or coyote there is both a slicing function and a crushing function. The two upper molars located behind the last premolar (the shearing upper tooth that is part of the carnassial pair) are broad, horizontal crushing surfaces. In bears and skunks these horizontal areas are so predominant that we put these mammals into a different category of feeding called omnivory. These are animals that eat everything and no one thing exclusively.

OMNIVORES

Omnivores are found in many groups of mammals. Raccoons, skunks, and bears are from the

carnivore group. Pigs are from the group consisting of deer and cows and, of course, we humans are from the group composed of monkeys and apes where omnivory has become the specialized condition. Cheekteeth of omnivores are squarish and characterized by low, rounded cusps. Crushing, not slicing, is the main function of these teeth and, as a result, vertical surfaces are rare while horizontal surfaces are common. Motion of the jaws is still vertical but there is also a side to side movement as well.

Skulls and teeth of raccoons and striped skunks are common in Nebraska and both mammals eat a great variety of foods. Raccoons eat pretty much what is available whether plant or animal. Main plant foods consist of wild fruits (persimmons, grapes, plums, chokecherries, blackberries, and Osage oranges), grasses and sedges, both soft and hard corn, and hard items like acorns, pecans, and other nuts. Common sources of meat include invertebrates found on the ground or under rocks and in rotten logs, chicks from nests of ground-nesting birds, and carrion. Water-dwelling prey from shallow pools, like crayfish, clams, fish, and insects, are favorite items. Insect prey such as beetles, grasshoppers, crickets, yellow jackets, and insect larvae are commonly eaten as well as spiders, snails, earthworms, frogs, snakes, turtles and their eggs, mice, squirrels, rabbits, and muskrats. Eggs of ground-nesting birds and wounded ducks and geese are also on the menu.



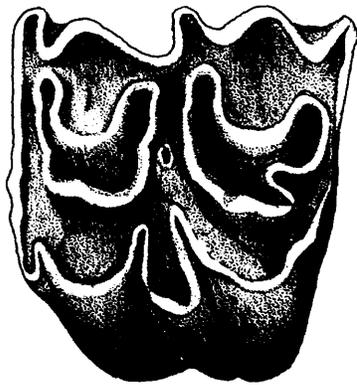
Omnivorous tooth of a pig.

Skunks also eat plant and animal foods in about equal proportion, but the proportion of insects, the preferred food, increases in spring and summer. Skunks are particularly good at digging up insect larvae. Many of these larvae are agricultural pests. Cheekteeth of skunks have both vertical cutting edges as well as large areas for crushing. Skunks will catch and eat small vertebrates but tend to eat larger ones as carrion. Fruits, nuts, and grains are also part of the diet.

Pigs, like raccoons and skunks, can and will eat any available food. Cheekteeth of pigs are unique. The crown of the tooth is covered with small, stout cusps. These are conical in young pigs, but as the teeth are worn down the surface of the tooth flattens and only the circular bases of the conical cusps are apparent. Pigs root around in the ground with their snout, which is a powerful structure and is supported by bone called the rooting bone. They seek out tubers, nuts, seeds, insect larvae, and carrion but also catch and eat small vertebrates. Pigs are unusual for their group because most are herbivores, animals that eat plants and little else.

HERBIVORES

Herbivores have the most specialized teeth of any mammal. Deer and cattle have crescent or



Herbivorous tooth of a cow.

moon-shaped cusps that lie in the long direction of the jaw. The outline of the crescent cusps wear down with age as the surface of the tooth flattens. The resulting outline is the hard enamel part of the tooth, which remains ridge-like. In between are valleys of dentin and cement that remain as valleys because they are a softer material than enamel and get worn away more. The different wear characteristics of enamel and dentin (and cement) is what makes the grinding surface in the teeth of plant-eating mammals unique. When upper and lower teeth of herbivores come together on a

mouthful of salad, the teeth do not chop up and down on each other, but rather they grind on each other from side to side. The edges of the enamel ridges are constantly being sharpened by movement of the opposing teeth across each other's surface and, as a result, cut up vegetation in a horizontal rather than vertical motion. Horse teeth have the enamel ridge/dentin valley arrangement but



Herbivorous tooth of a horse.

the surface pattern is a bit different. Although much smaller, squirrels, other rodents, and rabbits use the same ridge/valley arrangement to grind up their diet of plants and plant parts. The pattern illustrated on the reverse side shows the higher outside edge of enamel encircling the interior valley of dentin and, though small, the teeth are just as effective in grinding up plants.

Learning to look at teeth to tell something of a mammal's diet is fun and increases the enjoyment of any walk for naturalists of all ages and skills. If the naturalist is anything like my daughter, the skull or tooth becomes a prized possession and gets shown off at school. These treasures finally rest in a box of curiosities on a shelf in her room. It was boxes and cabinets of curiosities like these that were the origins of museums of natural history.