

Chapter 1

What Uncle Paul Proposed to Talk About

"In these talks we shall have together," said Uncle Paul, as he sat with his nephews one evening in May under the big elder tree in the garden, "I propose to designate as 'friends' those forms of animal life that, though not domesticated or cared for by us, nevertheless come to our aid by waging war on insects and various other devouring creatures which would in the end, unless their excessive multiplication were kept in restraints by others besides ourselves, eat up all our crops and lay waste our fields; and it is these ravagers of the farmer's carefully tilled acres that I shall speak of as 'foes.'"

"What can man's efforts avail against those voracious hordes, multiplying as they do every year to an extent beyond calculation? Will we have the patience, the skill, the keenness of vision necessary for waging successful warfare on the tiniest species, often the most formidable, when the June-bug, despite its far greater size, baffles all the endeavors? Will he undertake to examine his fields and inspect every lump of soil, every spear of wheat, every separate leaf on his fruit-trees? For so prodigious a task the whole human race would be inadequate, even if it united all its efforts to this one end. The devouring hordes would reduce us to starvation, my children, had we not able helpers to work for us, helpers endowed with the patience that nothing can tire, a skill that foils all ruses, a vigilance that nothing escapes. To lie in ambush for the enemy, to track it to its remotest retreats, to hunt it unceasingly, and finally to exterminate it – that is their sole care, their never-ending occupation. Urged on by the pangs of hunger, they are relentless in their pursuit, both for their own sakes and on the behalf of their progeny. They live on those that live on us; they are the enemies of our enemies.

"Engaged in this work are the martins that just at present are circling over our heads, and the bats that fly around our house, the owls that call to one another from the hollow willow trunks in the meadow, the warblers that sing in the grove, the frog that croaks in the ditches, and many more besides, including the toad, which is an object of loathing to most people. Thanks be to God who has given us, to serve as guardians of our daily bread, the owl and the toad, the bat and the viper, the frog and the lizard! All these creatures, wrongfully cursed and shamefully abused by us, and foolish looked upon with repugnance and hatred, in reality lend us valiant assistance and should take a high place in our esteem. To repair the injustice they have suffered shall be my first duty as we come to each of them in turn. Thanks be to God who, to protect us from that great eater the insect, has given us the swallow and the warbler, the robin redbreast and the nightingale! These, the delight of our eye and ear, creatures of infinite grace – must I again raise my voice in their defense? Alas, yes, for their homes are ravaged by the barbarous nest hunter.

"It is my purpose now to acquaint you, my children, with these various helpers of man in his labors as tiller of the soil. I will tell you about their ways of living, their habits and their aptitudes, and the services they render us. My object will be attained if I succeed in imparting to you a little of the interest they deserve. I will begin with those that have teeth. But first let us take a glance at the shape and structure of teeth in general; for it is this that determines the kind of food required by the animal."

Chapter 2

Teeth

“Is it not true,” resumed Uncle Paul, “that each kind of work demands its own special tool? The plowman must have a plow, the blacksmith the anvil, the mason the trowel, the weaver the shuttle, the carpenter the plane; and these different tools, all excellent for the work to which they are applied, would be of no use in any other. Could the mason rough-cast his wall with a shuttle? Could the weaver weave his cloth with a trowel? Evidently not. Is it not true, then, that from the tool one may easily guess the kind of work it does?”

“Nothing could be easier, it seems to me,” replied Jules. “If I saw planes and saws hanging on the wall, I know that I am in a carpenter shop.”

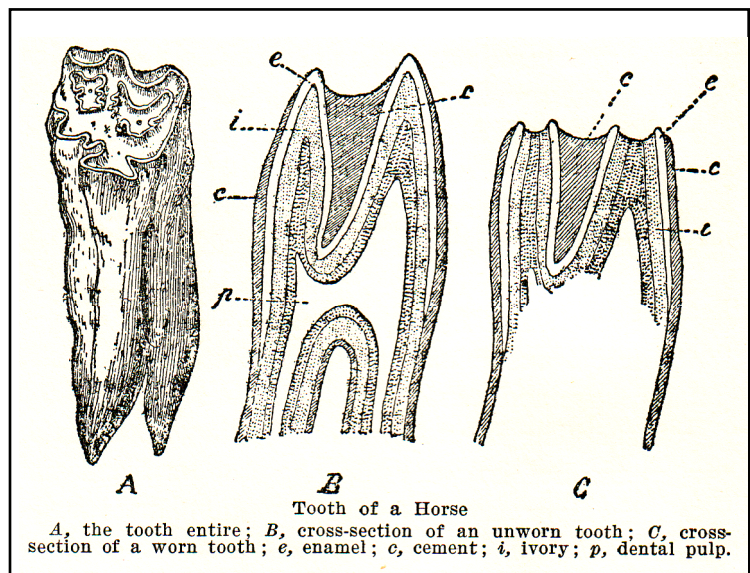
“And I should know,” said Emile, “from seeing an anvil, a hammer, and a pair of tongs, that I was in a blacksmith’s shop. But if I saw a mortar-board and a trowel, I should look around for a mason.”

“Well,” Uncle Paul went in, “every creature has its special task in creation’s great workshop, where all take part, all work, according to the design of Divine Wisdom. Each species has its mission – I might say its trade to follow – a trade that requires special tools just as does any work done by man. Now, among the innumerable trades of animals there is one that is common to all without exception, the most important trade of all, as without its life itself would be impossible: it is the business of eating.

“But all animals do not take the same kind of food. Some need prey, raw flesh, others fodder; some eat roots, others seeds and fruit. In every instance teeth are the tools used in the work of eating; so they must have the shape appropriate to the kind of food eaten, whether that be tough or tender, hard or easy to chew. Therefore, just as from his tool the artisan’s work may be inferred, so from the shape of its teeth one can usually tell the kind of food eaten by any animal.

“Herbivorous animals are those that live on grass, fodder, hay; and carnivorous animals are those that eat flesh. The horse, the donkey, the ox, and the sheep are herbivorous; the dog, the cat, and the wolf, carnivorous. The food of the herbivorous animal is tough, hard, fibrous, and must be ground for a long time by the teeth in order to be reduced to a paste-like mass suitable for swallowing and, after that for easy digestion. In this case the teeth in both the upper and lower jaw must have broad and almost flat surfaces that will come together and grind the food as millstones grind grain. On the other hand, the flesh eaten by the carnivorous animal is soft, easy to swallow, and easy to digest. All that the animal has to do is to tear it apart and cut it into shreds. So the teeth here must have sharp edges that come together and operate like the blades of a pair of scissors.

“I think I have said enough on that subject. Now, which of you will tell me what kind of food goes with each of



the teeth I show you here?"

And Uncle Paul laid before the hearers the two teeth pictured on these pages, with others to follow.

"The first tooth," said Emile, "is flattened and very wide at the top; it must crush and grind by rubbing against a tooth of the same kind in the opposite jaw. So it is the tooth of an animal that eats fodder."

"It is indeed," Uncle Paul replied, "the tooth of a herbivorous animal, a horse."

"The second," continued Emile, "is composed of several broad points with edges almost as sharp as knife blades. It must be meant for cutting flesh."

"Those winding folds that you see in the horse's tooth – what are they for?" asked Jules. "There is nothing like them in the wolf's tooth."

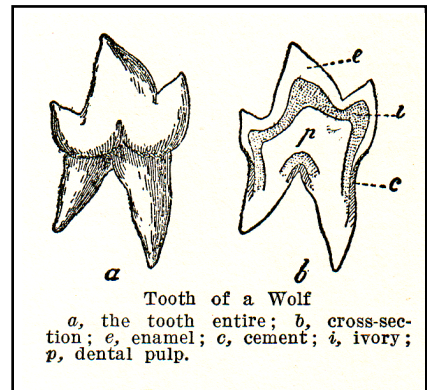
"I was going to tell you about them," his uncle replied. "If the horse's teeth had perfectly smooth surfaces, without any roughness to act as a grater, is it not true that the pressing and rubbing, each against the opposite tooth, they would simply crush the fodder or hay as you would crush it between two smooth stones without changing it into fine powder? Millstones, if they were polished like marble tables, would flatten the grain without making flour of it; they must be rough on the surface in order to seize the wheat during the grinding of the upper stone on the stationary lower one and to make it into powder. When by long use the surface is worn smooth, the stones are of no service until they are dented again with the hammer. Well, the folds of the horse's teeth may be likened to the roughness of a millstone: they project a little above the general surface of the tooth, making a sort of coarse file that tears to pieces blades of grass or hay when rubbed by the opposite tooth."

"I think I see a danger threatening the herbivorous animal," put in Jules at this point. "Those projecting folds must soon be worn down by rubbing against one another, just the same as the roughness on the millstone. If smooth millstones can't make flour without being roughed again, no more can the herbivorous animal's worn teeth go on grinding."

"That is provided for, admirably provided for, my boy. Everything in this world is arranged so that it can do its work: a wisdom that nothing escapes watches over the smallest details; everything, even to a donkey's jaw, shows this to be so. Listen, and judge for yourselves.

"There are two different substances in a tooth: one very hard, a little like glass and called enamel; the other quicker to wear out, but very difficult to break, and known as ivory. These two substances are combined in different ways, according to the animals diet. In the horse, the sheep, the ox, the donkey, and many other herbivorous animals the ivory makes up the main part of the tooth, while the harder substance, the enamel, extends in winding sheets throughout the former, projecting a little above its surface in a fold which varies in form in the different kinds of animals. So, then, it is the enamel, a substance as hard as a pebble, that composes the folds in the herbivorous animal's teeth. From the rubbing of the lower teeth against the upper the ivory wears away faster than the enamel, so that the folds of the latter embedded in the mass of the tooth have their cutting edges brought above the general level as fast as required, and thus the grinding surfaces are kept in constant repair. You see how it is: in the donkey's food-mill, for instance, the millstones re-roughen themselves as fast as necessary for the chewing of the thistle; the machinery is self-repairing even while at work."

"What you tell us, Uncle, is wonderful," commented Jules. "I never should have



Tooth of a Wolf
a, the tooth entire; b, cross-section; e, enamel; c, cement; i, ivory; p, dental pulp.

guessed that such an arrangement was necessary for chewing a thistle."

"And only the other day," put in Louis, "I kicked out of my way a jaw-bone that was lying in the road. How gladly should have I looked at it closely if I had known all these things!"

"Ignorance always kicks things aside like that, my boy, but science is interested in everything, knowing that it can always learn something. But let us return to the teeth of the carnivorous animal and examine those of a wolf.

"Here are irregularities of the nutmeg-grater, the parallel ridges of the file, and the roughness of the millstone would be of no use, since the animal's food is to be torn into shreds and not chewed into paste. For the wolf's food cutting blades are needed – sharp scissors which are hard enough not to become blunt. Hence the working edges of the wolf's teeth are not flat like millstone, but shaped rather like pointed chisels. The ivory forms the central body of the tooth, making it tough and strong, while the enamel, harder but more brittle, is spread as a continuous layer over the tooth and furnishes the requisite cutting edges. In like manner a skillful cutler, when he wishes to make an edged tool that will cut well and at the same time withstand violent blows, makes its central mass of iron, a tough material that bears considerable violence without injury, but is not hard enough to furnish a keen cutting edge, with fine steel, which combines excessive hardness with fragility of glass. The best that man can contrive in the making of edged tools is met with perfection in the teeth of carnivorous animals."

"If I understand you, then," said Jules, "ivory, which is not so hard as enamel, but less brittle, forms the outside layer. Ivory makes the teeth strong; enamel makes them cut."

"Yes, that is it."

"Now, I don't know which is the more wonderful, the donkey's or the wolf's set of teeth."

"Both are wonderful, as both are admirably adapted to the kind of work they have to do,"

"What surprises me most," Emile interposed, "is that a lot of things we should never pay any attention to turns out to be very interesting when Uncle Paul explains them to us. I never should have thought that the time would come when I should listen with pleasure to the history of a tooth."

"Since that interests you," said Uncle Paul, "I will continue the subject a little further and will tell you about human teeth, about yours, my boy, so white and so well arranged, and so admirably adapted for biting a slice of bread and butter."