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The Vascular Supply of the Teeth of the Domestic Cat

C. C. Nutting

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In preserving the delicate larval forms alive in aquaria, for study we found difficulty, and only succeeded by using large glass dishes (scrupulously clean) They were kept from direct sunlight and the water was changed or fresh quantities added every three or six hours, as the case might require.

Several methods were adopted for fixing and preserving the material, according to the character of the specimens in hand.

Medusæ were successfully prepared by—

1. Placing into solution, until they sink to bottom:

$\left\{ \begin{array}{l} 10\% \text{ CuSO}_4 - 100 \text{ c. c.} \\ \text{Sat. sol. Hg Cl}_2 - 10 \text{ c. c.} \end{array} \right.$

2. Into 5% $\text{K}_2\text{Cr}_2\text{O}_7$ —1-7 days.
3. Wash thoroughly in water.
4. Graded alcohols, 35-90.

Larger Jelly-fish and Ctenophopes were preserved for histological purposes by using—

1. Erlicki's fluid, 6-10 days.
2. Wash in water slightly acid.
3. Graded Alcohols, 33-90.

Crustacean larva were treated.

1. Sat. aq. sol. Hg Cl_2 —5 minutes.
2. Wash with 33% alcohol and transfer through graded alcohols to 90%.

Other methods were tried but best results were obtained by using those above described.

Surface collections from tropical waters are intensely interesting to the student of animal life. There in the surface water of the sea he finds the great nursery of marine forms, both plant and animal. Further, we are informed, sufficient reason warrants the statement that, likewise, all living forms had origin in minute, free-swimming organisms upon the bosom of the ocean in past ages. A candid study of the life histories of typical animals—in which they pass from a simple cell through various metamorphic stages to the adult forms—confirms the doubtful in the doctrine of evolution. And a true conception of relationships existing between members of so called families reveals the truth of the oft repeated statement, that "the ocean is the original haven of all life." The more we become conversant with marine life the more definitely are we impressed with the fact that it is from that source we must ask further information, that shall throw light upon many Biological problems at present unsolved.

THE VASCULAR SUPPLY OF THE TEETH OF THE DOMESTIC CAT.

C. C. NUTTING, IOWA CITY.

After all that has been written about the anatomy of the domestic cat it would seem a hopeless task to find any facts of real importance in a field so carefully gleaned by Wilder and Gage and a host of other writers of the past and present.

While pursuing investigations on the teeth of the mammalia as a preparation for lectures on Comparative Odontography before the Dental Department of the State University of Iowa, the writer became convinced that there were certain radical misconceptions among anatomists and histologists as to the manner in which the blood is distributed to the teeth. It is quite possible that this has already been correctly stated by some writer unknown to me. If such is the case it is evident that little heed has been given to the matter by English and American authorities, among whom I have been unable to find a single clear and lucid, as well as correct account of the vascular supply of the teeth. This, then, is my excuse for adding to the already multitudinous contributions to the anatomy of the domestic cat. Dissections and microscopic preparations of injected decalcified teeth of the cat, and also of the rat, in which the entire jaw with all the teeth has been ground down to the requisite thinness, show conclusively that the manner in which the teeth obtain their vascular supply is not understood or at least not properly expressed by the best authorities accessible to the student.

This matter obtains a further importance in view of the strong probability that there is no great difference between the human and feline anatomy in this particular, and a likelihood that the errors in the one case have been paralleled in the other.

First—What is the present teaching as to the method by which the teeth are supplied with blood? The following quotations will be sufficient to answer this question.

¹“The pulp contains the nerves and blood vessels of the tooth, which pass into the pulp through the foramen at the point of the fang.” ²“This (the pulp cavity) communicates with the external surface of the tooth by a small aperture at the apex of the root.” ³“The blood vessels and nerves penetrate by a little orifice at the extremity of each root.” ⁴“The vessels of the pulp are very numerous; three or four arteries enter at the apical foramen.” ⁵“The lower teeth derive their vascular supply from the branches given off to each tooth by the inferior dental artery, itself a branch of the internal maxillary.” ⁶“The pulp consists of a soft connective tissue, and some nerve fibres which pass into the pulp cavity along with the blood vessels by a minute canal at the apex of the fang.” ⁷“The arteries and nerves, which are derived from the internal maxillary and fifth pair respectively enter by the aperture at the point of each fang.” ⁸“The dental and incisor arteries during their passage through to the substance of the bone give off a few twigs which are lost in the cancellous tissue, and a series of branches which correspond in number to the roots of the teeth; these enter the minute apertures at the extremities of the fangs and supply the pulp of the teeth.”

Dr. G. V. Black, in his work on the periosteum and peridental membrane, comes nearer a correct statement of the manner in which blood is supplied to the teeth than any other writer whom I have been able to consult. He says:

¹Prof. Wm. Turner, Enc. Britannica, Vol. VII., p. 234.

²Prof. W. H. Flower, Enc. Britannica, Vol., XV., p. 349.

³Human Physiology, Flint, p. 191.

⁴Dental Anatomy, Tomes, p., 106.

⁵Dental Anatomy, Tomes, p. 36.

⁶The Essentials of Histology, Schafer, p. 123.

⁷Quain's Anatomy, Ninth Edition, p. 550.

⁸Gray's Anatomy, p. 523.

"The blood supply of the peridental membrane is very bountiful in the young subject. The larger arteries enter the alveolus mostly at the apical space, or rather one or two vessels enter here and immediately break up into smaller ones. One or two of these enter the root canal to supply the pulp of the tooth, while the others, from four to six or eight, pass down along the sides of the root to supply the peridental membrane. In their passage down the membrane these divide into many branches, a considerable number of which enter the haversian canals of the alveolar wall or receive branches from that source."⁹ My own sections convey a somewhat different impression. By far the greater number of arteries enter the alveolus in the spaces between the roots, of molars, and none of these, so far as I can discover, go directly to the root canal and thence to the pulp. A very large number of vessels enter the peridental membrane from the entire extent of the alveolus.

Dr. Black seems to have drawn his conclusions largely from sections of teeth of the lower animals, such as the sheep, dog, cat and pig. Indeed, I can find no one who seems to have made a special study of injected human teeth ground down in situ. The extreme difficulty of securing suitable material for such investigations may account for this fact.

From the above quotations, which give all that is said on the subject by a number of our best and most recent authorities, it is evident that they understand the blood to be supplied to the teeth in the following manner:

The internal maxillary and inferior dental arteries supply the teeth of the upper and lower jaws by giving off a branch to each root, the branch entering by a single aperture at the apex of the root. We are also given to understand, although definite statements seem painfully deficient, that the branch which supplies each root passes from the main artery (internal maxillary or inferior dental), directly through the peridental membrane, and thence through the single apical foramen to the pulp. The present writer considers that he has demonstrated an essentially different method of supplying the blood to the teeth; at least of the domestic cat and the rat. The points of special importance are:

First. The inferior dental artery is not a single vessel; on the contrary, after entering the inferior dental foramen, it divides, within the canal, and the divisions anastomose and redivide in the most irregular and perplexing manner.

Second. There is nothing at all resembling the single branches of this artery which are supposed to be given off to supply each root; on the contrary, by far the largest and most numerous branches of this artery pass into the alveolar spaces between the roots of the teeth, and then break up into a maze of small vessels, most of which ultimately pass into the peridental membrane, considerably above the apex of the root.

Third. No vessels, so far as my series of sections shows, pass directly through the peridental membrane below the apex of the root, and thence upward into the pulp. On the contrary, a multitude of vessels enter the peridental membrane throughout its extent and pass downward toward the apices of the roots, where they enter foramina, through which the pulp is reached. The blood is thus distributed, first to the membrane, which is exceedingly vascular, then conducted by vessels in the membrane to the apices of the roots.

⁹Periosteum and peridental membrane, Black, p. 85.

Fourth. The blood does not ordinarily enter each root by means of a single apical foramen as commonly taught. On the contrary there are usually several, sometimes more than a dozen such foramina in a single molar root after the animal has reached maturity.

The above statements indicate such a radical change of view regarding the vascular supply of the teeth that something more satisfactory than mere assertions will doubtless be expected. In order to meet this reasonable expectation the illustrations accompanying this account have been prepared with considerable care. The sections from which the drawings are taken are injected and not decalcified, and were prepared by the writer, who still has them in possession. It will be understood that the views here advanced are based on numerous dissections and sections besides those illustrated by the drawings.

It was found that drawings were more available than photographs, for the reason that the thickness of the sections and the irregularity of the vessels required a depth of focus which could not be secured by use of the camera. Although all drawings are necessarily interpretations of the artists views, it is hoped that there is nothing misleading in the illustrations herewith presented. They may be considered correct in so far as they do not represent a single vessel pursuing a course not found in the sections examined.

In conclusion, your attention is called to the fact that this matter has a practical bearing. The teeth of the Carnivora, as Owen says, so closely correspond in their intricate structure both with each other and with those of the "Quadrumana" as not to require separate discussion. More than this it is highly improbable that there should be any essential difference between the teeth of the cat and those of man in the method of furnishing blood to this important structure.

Dr. A. O. Hunt, dean of the dental faculty of the State University, says that the excessive hemorrhage sometimes attending extraction of the teeth is due to the breaking of the septum between the teeth, which, as my sections show, contains large branches of the dental arteries. If these arteries penetrated directly to the pulp through the root excessive hemorrhage would always result from the pulling of the tooth. It makes a vast practical difference whether a multitude of minute vessels or one large vessel is broken. In the former case, little hemorrhage would result, while in the latter it would be a serious matter. These sections are necessarily thick, as thin sections would fail to show the continuity of the vessels, a vital point in the investigations upon which this paper is based. The sections, although quite thick, were rendered sufficiently translucent by long immersion in benzole, after which they were mounted in Canada balsam.

Nutting: The Vascular Supply of the Teeth of the Domestic Cat

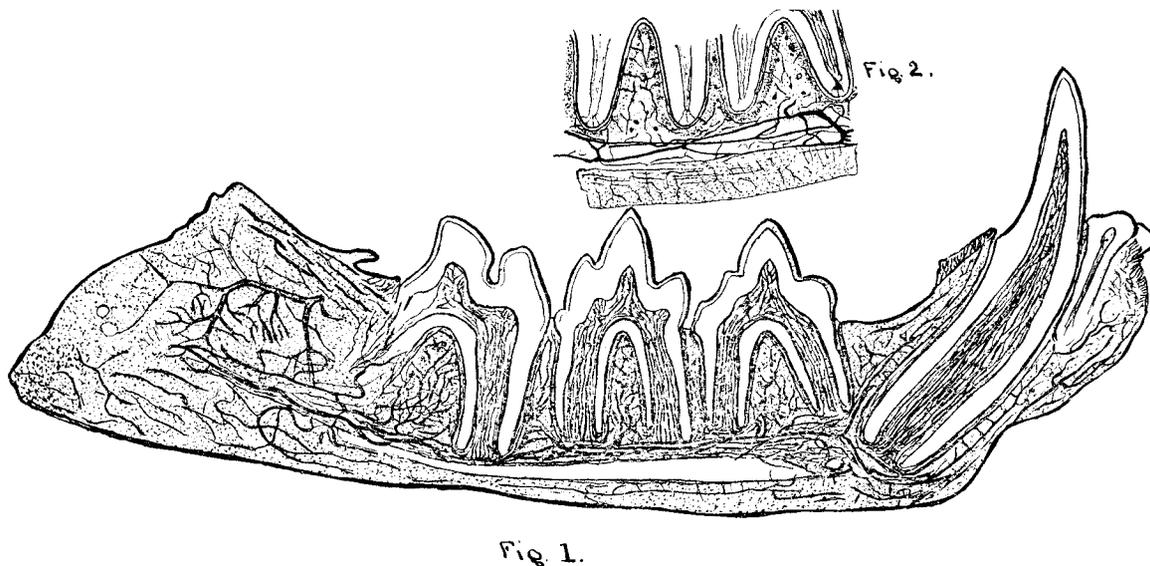


Fig 1.

PLATE II.

FIG. 1. Vertical longitudinal section of lower jaw and teeth of cat, showing vascular supply.

FIG. 2. Vertical longitudinal section of roots of two lower molars and underlying portion of jaw of cat, showing anastomosing branches of the inferior dental artery. Drawn from section made by author.