LXV.—*On* Odontobius ceti, *Roussel de Vauzème, a Nematode living on the Baleen of Whales.* By H. A. Baylis, M.A., D.Sc.

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Roussel de Vauzème described, in a series of communications to the 'Annales des Sciences naturelles,' a number of interesting observations on organisms living as parasites or commensals on Antarctic whales. Among these he gave an account (1834, *a*), under the name of *Odontobius ceti*, of a small Nematode to which considerable interest attaches owing to its unique habitat. It occurred in large numbers in a greyish-brown glutinous substance on the baleen-plates of a whale caught off the Falkland Islands.

Although several authors have since quoted Roussel's account of the worm, his description of it still seems to be the only one available, and the writer has failed to trace any subsequent record of the occurrence of the species. Roussel's account is mainly concerned with the mode of occurrence and habits of the worm, and, while his observations on living material are of great interest, his morphological description of the species is very brief.

The host, in the case of Roussel's material, was clearly the Southern right whale (*Balæna australis*), although he gives the determination of his whales incorrectly as *B. mysticetus* *. His Excellency the Governor of the Falkland Islands has recently presented to the British Museum (Natural History) a quantity of material collected by Mr. A. G. Bennett at Deception Island, South Shetlands, in April 1923. This was obtained by scraping the baleen of two species of whales—the blue whale (*Balænoptera musculus*, L.) and the finner or common rorqual (*Balænoptera physalus*, L.). In each case, besides other organisms, there are large numbers of a nematode which, in spite of the difference of hosts, is in all probability *Odontobius ceti*. The determination rests more particularly upon the figure given by Roussel (1834, pl. ix. fig. 3 A), which evidently represents a female worm, and shows the spiral coiling of the slender posterior end which is very characteristic of the females among Mr. Bennett's specimens.

The following description is based upon material from *Balænoptera physalus* :—

Odontobius ceti, Roussel de Vauzème, 1834.

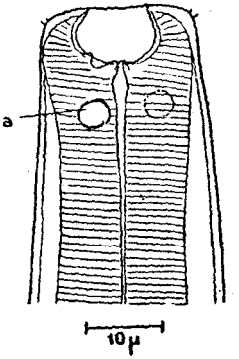
The body is elongated and slender, not tapering much anteriorly, but rather thicker in the œsophageal region than in the succeeding portion. The length varies between about 2·8 mm. and 4·75 mm. The maximum thickness, which in the male is at the level of the anus and in the female just in front of the vulva, is 0·04–0·06 mm. In the female the whole post-vulvar portion of the body is more slender than the pre-vulvar portion. The cuticular striations, if any, are exceedingly fine. There is a pair of lateral organs, or "amphids," situated a little behind the buccal cavity. These appear circular, but have a break in their contour, so that they are in reality very open spirals. The lateral fields apparently consist of a single row of cells with large nuclei. The anterior end is truncate. The diameter of the head is about 0·02 mm. Under a very high magnification two subdorsal and two subventral, exceedingly minute, cephalic bristles, or setiform papillæ, can be seen, and possibly there are others in a lateral position. These presumably represent the "pointes cornées" mentioned and figured by Roussel, though they are by no means so conspicuous as his figure indicates.

The mouth leads into a goblet-shaped buccal cavity which

* The writer is indebted to Sir S. F. Harmer, K.B.E., F.R.S., for the elucidation of this point.

is rather wider than deep, measuring about 0·007 × 0·012 mm. At the base of this cavity, at the entrance to the œsophagus, there are three blunt teeth. In addition to these, on what is

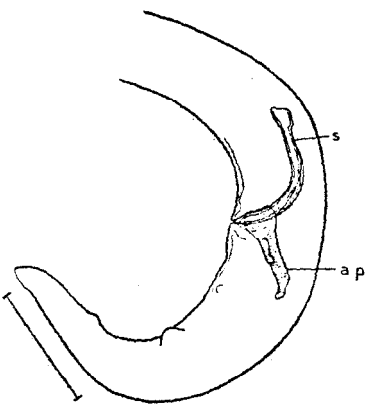
Fig. 1.



Odontobius ceti. Head of female; lateral view. *a.*, "amphid."

probably the dorsal side, there is another tooth situated in the wall of the cavity and projecting very little beyond it. The œsophagus is simple, without a bulb, but expanding

Fig. 2.



Odontobius ceti. Caudal end of male; lateral view.
a.p., accessory piece; *s.*, left spicule.
The scale represents 0·05 mm.

gradually posteriorly. Its length (measured from the extremity of the head) is 0·22–0·38 mm. The intestine is narrow immediately behind its junction with the œsophagus,

and then expands suddenly. The nerve-ring is situated at about the middle of the œsophagus. No excretory pore or gland has been made out.

In both sexes there is a small clear space at the tip of the tail, perhaps representing an adhesive organ or "spinneret." No definite caudal glands have been seen, but the caudal region contains more nuclei than any other part of the body, and some of these may belong to cells connected with the terminal organ already mentioned. The tail of the male, which measures 0·15–0·2 mm. in length, is curled ventrally and bears, apparently, three pairs of postanal papillæ, of which only the middle pair is large and conspicuous. There are two equal brownish spicules, which are flattened dorso-ventrally and have expanded proximal ends. They measure 0·06 mm. in length. A large and well-chitinized accessory piece embraces the distal ends of the spicules near the cloacal aperture, and is produced into a long and stout process passing obliquely backwards and dorsally. The greatest length of the accessory piece is about 0·036 mm. There is apparently a single testis, outstretched anteriorly.

The tail of the female is 0·25–0·38 mm. long. It is invariably curled dorsally, and usually forms a loose spiral coil. The vulva is situated very slightly behind the middle of the body (at 2·25 mm. from the posterior end in a specimen 4·75 mm. long), and leads directly into the uterus. The female genital apparatus is single, like that of the male, and lies entirely in front of the vulva. The terminal portion of the uterus, in mature females, contains from two to four large, unsegmented eggs, measuring about 0·1 × 0·047 mm. This portion of the uterus is separated from the rest of the genital tube by a modified region composed of large cells (probably glands). The ovary is long, running straight forward, and not reflexed.

The Genus Odontobius *and its Systematic Position.*

The general organization of the worm described above shows clearly that it belongs to the free-living group of Nematodes rather than to any of the strictly parasitic groups. It is, in fact, a free-living nematode that has taken to a semi-parasitic or commensal mode of life.

The general affinities of *Odontobius* were recognized by Nordmann (1840), Diesing (1851), Eberth (1863), Carus (1863), and Bastian (1865). Eberth gives a generic diagnosis (which is quoted by Bastian), but it is clear that this is based not on the genotype, *O. ceti*, which, apparently, he had not seen, but on certain other species described by

him and attributed to the genus. The presence, for example, of "two pairs of spicules, one large and one small" (*i. e.*, a pair of spicules and a pair of accessory pieces), mentioned in Eberth's diagnosis, indicates that these species are not congeneric with the form under discussion. However, in mentioning the presence of a buccal cavity armed with small teeth—a character omitted from the diagnosis, but given elsewhere,—Eberth (accidentally, as it seems, since the mouth-structure of *O. ceti* had never been described) gave the most important clue to the affinities of *Odontobius*. He places it correctly near to *Oncholaimus*, Duj. According to the excellent classification of the free-living Nematodes recently worked out by Micoletzky (1922), it seems clear that a form with the characters described above must fall into the subfamily Oncholaiminæ of the family Odontopharyngidæ. Several of the genera contained in this subfamily are exclusively, or almost exclusively, marine. Of these, *Odontobius* probably approaches most closely to *Oncholaimus*, in which both testis and ovary are occasionally single, and the accessory piece of the male, when present, is also single.

Remarks on the Biology of Odontobius.

The fauna and flora of the baleen plates of whales seem to provide a very interesting example of symbiotic association, though it is uncertain whether there is any real interdependence between the associated organisms. Roussel de Vauzème describes *Odontobius* as living in a layer of "tartar," a line in thickness, on the solid portions of the baleen-plates. This material, he says, is composed of an upper layer of white rounded "eggs," which are opaque and glistening, and contain "a substance which appears to be the unhatched embryo of a worm." Immediately below this layer he found another thicker layer, resembling brick-dust. Under a lens this was seen to be composed of "eggs" like the others, but brown, empty, and "showing a hole through which the worm has emerged." They were stuck to the baleen by means of a whitish cement, but easily separated. He remarks that at the beginning of winter in the Falklands the upper layer of white opaque "eggs" existed only in occasional spots, or not at all; while in summer, at the height of the whaling season (from October to January), the plates were covered with it.

In a further paper (1834, *b*) Roussel describes certain "vesicles" adhering by their bases to the horny tissue of the baleen, and hidden by the "oviform material." He says

that on removing the granular layer these objects are found projecting here and there, and compares their appearance to that of bottles standing on a table. These bodies he regards as "polyps" inhabiting bottle-shaped capsules, and names *Pirolina ceti*.

Woodcock and Lodge (1921) have described, under the name of *Hæmatophagus megapteræ*, a remarkable ciliate Protozoon from the baleen-plates of *Megaptera nodosa*. *Hæmatophagus* assumes a number of different shapes, including elongated sedentary forms inhabiting tubular envelopes, smaller vase-like forms, and ovoid resting forms of various sizes. It is interesting to note that among the type-material of *H. megapteræ*, now in the British Museum (Natural History), Nematodes occur which appear to be identical with those described above from *Balænoptera*, so that *Megaptera nodosa* is another host for *Odontobius ceti*.

The material from *Balænoptera* now described includes, besides the worms, diatoms of several kinds and numerous ciliate Protozoa, some of which Dr. Woodcock, who has kindly examined them, thinks probably identical with *Hæmatophagus megapteræ*. In addition to the more obvious ciliate forms, there are large numbers of ovoid bodies of various sizes, and these may be "resting stages" corresponding to those described by Woodcock and Lodge *. At first some of the smaller ovoid bodies, showing a distinct hyaline envelope, were taken to be the eggs of *Odontobius*, but on further examination this view had to be abandoned. The smallest of them are nearly twice the size of the eggs observed in the uterus of the female worms.

In view of all the above-mentioned facts, the writer is inclined to believe that the "polyps" of Roussel may have been Protozoa somewhat allied to *Hæmatophagus megapteræ* †, and that Roussel was mistaken in regarding the rounded bodies forming the "tartar" as the eggs of *Odontobius*. It seems more probable that they were "resting stages" belonging to the supposed protozoa.

The question arises, what becomes of the eggs laid by the females of *Odontobius*? Although the output of eggs by each individual female is evidently very small, the whole

* Tubular forms seem to be absent, and Dr. Woodcock thinks the forms found represent a later phase of the life-cycle of the animal.

† Dr. Woodcock thinks that the pyriform shape precludes the possibility that Roussel's "polyp" was identical with *Hæmatophagus*, but agrees that it may have been some kind of Stentorid in a gelatinous envelope.

colony must give rise to a very large number. Yet no eggs have been found free among the material. It seems possible, therefore, that the eggs are carried away by the stream of water passing between the baleen-plates, and that their further development takes place in the sea, the larvæ probably hatching there and depending upon chance for their passive introduction into the mouth of another whale.

As regards the food of *Odontobius*, Roussel supposes, with great probability, that the worms feed on minute particles of organic matter which the sifting action of the fringes of the baleen allows to escape. The worms, according to his account, remain with their coiled tails fixed in the layer of material covering the baleen, and stretch their anterior ends across the intervals between the plates. They may also, however, uncoil their tails and wander freely in the "tartar."

One of the most interesting statements made by Roussel is that *Odontobius* has the power of reviving when moistened after having been exposed for some time to the air. He says that if a baleen-plate which has been almost dried by four or five days' exposure be plunged again into sea-water, the worms revive and stretch out their heads again. If the baleen left ashore is wetted with rain, the same effect is produced. Unfortunately, these observations are not given in sufficient detail to show whether the "revived" worms were really alive, or whether they merely expanded and straightened out in water, as Nematodes commonly will, after having been reduced to a collapsed condition by drying.

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