XXIII ON SOME AQUATIC OLIGOCHAETE WORMS COMMENSAL IN *SPONGILLA CARTERI*

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I recently received from Dr. Annandale, of the Indian Museum, a specimen of a form of *Spongilla carteri*, Bwk., taken at Bheemanagar, Travancore, and sent by the authorities of the Trivandrum Museum to Calcutta. The specimen was stated to contain a number of aquatic Oligochaeta, and it was these which I undertook to examine.

The worms were found to be very numerous; they could be obtained in numbers by teasing any small fragment of the sponge, and could be picked out from the disintegrated portions of the sponge at the bottom of the bottle.

Thirty-eight specimens taken at random were prepared and mounted for microscopic examination; some were mounted unstained in glycerin and potash, some unstained and some stained in balsam. A first inspection showed that there was one specimen of *Pristina longiseta*, Ehrbg., and that all the rest belonged to the genus *Nais*.

As was to be expected, a certain number of the specimens were distorted in shape, and others had their dorsal setae entirely or almost entirely broken off. The rest were classified under the high power into three groups, as follows:—

(i) Forms without eyes, with obviously forked needles in the dorsal bundles.

(ii) Forms without eyes, with dorsal needles showing only a very fine forking, or in which forking was not evident.

(iii) Forms with eyes.

All the individuals of groups (ii) and (iii), and a number of those of group (i) (which were the most numerous), were submitted to detailed examination with the oil immersion lens.

As is well known, the usual mode of reproduction in the Naididae is the asexual, by fission. Sexual reproduction seems, in the majority of forms, to take place only at certain seasons of the year, and is comparatively rare; consequently the sexual organs have as yet been described only in a minority of the forms included in this family. It can hardly be doubted that descriptions of these organs, if they could be obtained, would give very great help in the task of discriminating the various species.

Signs of asexual multiplication were found frequently enough in the present specimens. There were no chains of two or more still unseparated animals; but a number of the individuals examined had evidently been recently separated, as shown by the blunt or square, sometimes obviously lacerated prostomium, and the small size of the ventral setae of segments ii—v; these last, it may be said, are new productions in the zone of budding, and hence are when first developed smaller than those of the segments posterior to them.

But unfortunately none of the specimens examined in the present instance showed any sign of sexual organs; and it is necessary therefore to fall back on other structures, and specially on the characters of the setae, in order to find marks capable of being used for purposes of diagnosis. As a matter of fact the current diagnoses of the known species of this and many other genera of the family are still based very largely on the setae; and the following accounts, though necessarily incomplete, have therefore the merit of affording a possibility of comparison with previously described forms.

The association between the worms and the sponge may be called a commensalism. A similar phenomenon has been recorded by Annandale (*Journ. and Proc. As Soc. Bengal*, N.S., Vol. II, No. 5, 1906), who found a *Chaetogaster* (*C. spongillae*) living in association with *Spongilla carteri* in Calcutta; in this case the commensal was only found in those parts of the sponge which had been killed or were dying, the healthy growing parts being quite free from them; Annandale accordingly supposes that it feeds on the organic débris left by the decay of the sponge. This supposition appears to be not improbable, since *Chaetogaster* is carnivorous,—exclusively carnivorous as far as I have observed the genus, I think; though Annandale (*Journ. and Proc. As. Soc. Bengal*, N.S., Vol. I, No. 4, 1905) speaks of having received from England a specimen in which the food probably consisted of diatoms and the like. The advantage to the *Chaetogaster* of a copious food-supply is obvious; there may also (Annandale, *l.c.*) be an advantage to the sponge in the liberation of the gemmules by the worm.

So far as I have observed, however, the other genera of the Naididae are pure vegetable feeders, and hence the advantage which the forms now under discussion receive from association with the sponge would appear to be rather that of protection; whether the advantage is altogether on their side, or whether they contribute anything in return, I am unable to say.

Of the species of *Nais* described below, one (*N. pectinata*) is undoubtedly new; but with regard to the others the question is not so simple. The form with eyes resembles very closely that described by me (*Memoirs Ind. Mus.*, Vol. I, No. 3) as *Nais variabilis*, Piguet, var. *punjabensis*. At the time when I described this form, however, I had not studied the genital apparatus, nor had Dr. Piguet published his account of the genital organs in

N. variabilis. These gaps have since been filled up (Piguet, *Rev. Suisse de Zool.*, Tome 17, Fasc. 1, 1909; Stephenson, *Rec. Ind. Mus.*, Vol. V, part 1); and Dr. Piguet, who has himself examined specimens of both forms, has (*loc. cit.*, p. 200) come to the conclusion that my worm should be called *N. communis*, Piguet, var. *punjabensis*. I accept Piguet's conclusion, and shall, therefore, refer to the form in what follows under this latter name.

The remaining specimens have no eyes, but here again there is an almost complete agreement in the characters of the setae with the last form and with the Punjab variety of *N. communis*. The question then is whether the presence or absence of eyes is of itself of specific value; and this point, as will be seen below, I have decided in the negative, giving this form varietal rank only, as var. *caeca*. I may add that *Nais bretscheri* is also described as having or as wanting eyes.

It is, however, noteworthy that specimens with well developed eyes and others in which they are completely absent should be found in such close association. It is at first sight tempting to suppose that, as in so many cases throughout the animal kingdom, so here, the exposure to light stimulates pigment formation and a life in darkness suppresses it; the eyes of the Naididae are mere pigment spots, and hence on this supposition it would be those specimens which inhabited the superficial parts of the sponge which developed eyes, and those which lived in its deeper parts which failed to do so. It seems to me rather doubtful, however, whether the conditions in an ordinary mass of *Spongilla carteri* would be so different at the surface and in the interior; and also whether the worms are so entirely sedentary as would be implied on this hypothesis.

I have added, for purposes of comparison, a description of the setae of what I regard as a typical specimen of *N. communis*, var. *punjabensis*, from Shalimar Gardens near Lahore, which I examined during the course of the present investigation in order to satisfy myself of the amount of similarity or difference between these several forms.

Pristina longiseta, Ehrbg.

One specimen only was seen. This was an extremely well marked example; the 'proboscis' measured ·175 mm. in length, while one of the characteristic elongated dorsal setae of the third segment was over half a millimetre (·54 mm.) in length, and thus reached far beyond the extremity of the proboscis.

It seems doubtful whether this animal could have been living within the sponge. The enormously elongated setae just mentioned could there have had no free play; they would have much impeded the animal's movements, and would probably very soon have been broken off. The fact that only one example out of thirty-eight was of this species is also, I think, significant. This one specimen was not improbably merely crawling on the surface of the sponge at the time it was taken.

Nais pectinata, sp. nov.

The greater number of specimens belong to this species; they are those which were at first separated from the rest by the obvious forking of the dorsal needles.

On examination with the oil immersion lens, however, I was surprised to find that these setae had an entirely different form from what I had supposed. Instead of being simply forked, they were in all cases ctenate, the two prongs at the sides being the strongest, and the interval between them being filled in by a number of extremely fine points, two, three, four, or five in number. It was these intermediate points which had not been detected with the ordinary high power (Zeiss DD, oc. 6); with this degree of magnification the outermost prongs are alone visible, and hence the setae appear to be bifurcate at their extremity. It is not always possible to count accurately the intermediate prongs even with $\frac{1}{12}$ in. oil immersion and compens. oc. 6, and recourse to a 12 oc. is sometimes necessary.

Such a form of dorsal needle has not hitherto been described in the genus; so far as I know, indeed, this type of seta has not previously been met with in the family, and the nearest approach would seem to be the fan-shaped dorsal needles of *Dero tonkinensis*, Vejd. It would therefore appear to be a character of quite sufficient importance to justify the erection of a new species.

The description of the animal is as follows:—

Length of single individual (preserved specimen) about 2 mm. *Prostomium* well marked, conical with rounded tip. No *eyes*. *Segments* 27—31.

The *buccal cavity*, in segment ii, is narrow and tubular; the pharynx, which succeeds it, extends from segment iii to iv.

The *cerebral ganglion* appears to be deeply bifid both in front and behind; it is broader from side to side anteriorly than posteriorly.

The *ventral setae* are of the usual type, and are differentiated into two groups, those of segments ii—v, and those posterior to these.

Those of segments ii—v are regularly 3 per bundle, are about 56 μ in length, and have a markedly thinner shaft, with its proximal portion less strongly curved than those of the posterior segments. The distal prong is $1\frac{1}{4}$ times as long as the proximal, but this latter is the thicker,—$1\frac{1}{2}$ to twice as thick as the former at its base; both prongs are slightly swollen near their bases. The nodulus is proximal to the middle of the shaft, the relations of the distal and proximal portions of the shaft being 4 : 3; the swelling of the nodulus is equal on both sides of the shaft (fig. 1*a*).

The posterior ventral setae are sometimes 2, often 3, not unfrequently 4, and occasionally 5 per bundle. In length they are 51—56 μ, the latter, longer measurement being that of setae towards the hinder end of the body. The shaft is thicker, and its

curve proximal to the nodulus is more marked, than in the anterior group of setae. The distal and proximal prongs of the fork are equal in length, the proximal being 2 or 2½ times as thick at its base as the distal, and both having a slight swelling near their base. The nodulus is equal on both sides of the shaft, and is situated distal to the middle in the proportion proximal : distal :: 5 : 4. (Pl. xi, fig. 1*b*).

The *dorsal setae* are regularly arranged in bundles of one hair- and one needle-seta. On one occasion a bundle of three was seen, composed of two needles and one hair. They begin in segment vi. The *hairs* are smooth, in length nearly or quite equal to the diameter of the body. The *needles* have a length of 56 μ; the shaft is straight except in its distal third, where it is slightly sickle-shaped; the end is ctenate, the outer prongs on each side are the strongest, the intermediate prongs are fine, and 2, 3, 4 or 5 in number; some irregular forms were seen (fig. 1 *d.e.f.*). The nodulus is rather a slight angle in the shaft than a distinct swelling; it occurs at the junction of middle and distal thirds (fig. 1*c*).

Nais communis, Piguet, var. *punjabensis*.

Three specimens were observed.

In *length* they were about 2 mm. *Segments* of the one perfect specimen 26. The *prostomium* appeared shorter and more rounded than in the previous species, or than in perfect specimens as met with in Lahore; but I do not lay any stress on this, since this part may have been contracted in these specimens, or, which I think more probable, the individuals had only recently been separated,—perhaps separated spontaneously at the time of killing. The facts that, while the pharynx extended to segment v, the *alimentary canal* posterior to this showed no recognizable differentiation into oesophagus, stomach, and intestine; and that in one (stained) specimen the *brain* was much shorter from front to back than from side to side, I am inclined to explain in the same way,—*i.e.*, by supposing that the anterior part of the body had not yet completed its full differentiation. The *eyes* were laterally situated at the level of the mouth, were of moderate size, and of a deep purple colour; there were no 'Nebenaugen.

The *ventral setae* of segments ii—v were 86 μ in length, the shaft thinner than in those of posterior segments, and only slightly curved. The distal prong of the fork was 1½ times as long as the proximal, the latter, on the contrary, being 1½ times as thick at its base. The nodulus was slightly proximal (proximal : distal :: 8 : 9); the swelling of the nodulus was slightly more marked on that side of the shaft which corresponds to the longer prong of the fork. (Fig. 2*a*.)

Posterior to segment v the ventral setae were 70—75 μ in length, with shaft moderately curved, and thicker than in the case of the anterior segments. The distal prong of the fork was very slender, only a little (up to 1⅕) longer than the proximal, and

slightly swollen near its base; the proximal prong was more than twice as thick as the distal. The nodulus was distinctly distal to the middle (proportions varying,—proximal : distal :: 11 : 9 or 8 : 7), and was slightly more prominent on the side of the shaft corresponding to the distal prong. (Fig. 2*b*.)

The number of the ventral setae per bundle was either three or two throughout.

The *dorsal setae* were of two kinds, hair-setae and needles. The hair-setae were somewhat shorter than the diameter of the animal. The needles projected very little from the surface, and were in length 54—56 μ. The shaft was straight, except for a very slight curve in its distal portion; its extremity was very finely double-pointed. The nodulus was rather a slight angle on one border of the shaft than a definite swelling; it was situated at the junction of the distal and middle thirds. (Fig. 2*c*.)

The dorsal bundles consisted always of one hair and one needle.

Nais communis, Piguet, var. *caeca*, n. var.

These forms were more numerous than those with eyes, with which, for the rest, they closely correspond.

The *length* was about the same. *Segments* 24—27. In one example the dorsal setae began on segment v, in the rest on segment vi.

The *ventral setae* were in bundles of 2 or 3 throughout. In segments ii—v they were 80, 90, or 94 μ in length, the shaft possessing a slight double curve, and a thickness estimated as about $\frac{3}{4}$ of that of the setae in the more posterior segments. The distal prong had a slight swelling near its base, and was $1\frac{1}{4}$ times as long as the proximal, which latter was $1\frac{1}{2}$—$1\frac{2}{3}$ as thick. The nodulus was more prominent on the side corresponding to the distal prong, and was situated proximally to the middle point of the shaft (proximal to distal 8 : 9 or 9 : 10). (Fig. 3*a*.)

In segments from vi onwards the length of the ventral setae was 71, 81 or 87 μ; the shaft was thicker and more strongly curved than in the anterior segments; the distal prong equal to the proximal in length, or very slightly longer, but only half, or even less, as thick at its base. The nodulus, more prominent on the side of the distal prong, was distal to the middle, but its exact position was somewhat variable (proximal : distal :: 8 : 6, or 19 : 14, or 10 : 9). (Fig. 3*b*.)

The *dorsal setae* were regularly one hair-seta and one needle per bundle. The hairs were in length equal to about $\frac{3}{4}$ the diameter of the (preserved) animal's body. The needles were in length 53—58 μ, with a shaft in which a very slight double curve might or might not be recognizable. The extremity was finely bifurcate, the prongs short, equal in length, one thicker than the other at the base. The nodulus, a slight fusiform swelling, was distally situated (distal : proximal :: 4 : 13). (Fig. 3*c*.)

I subjoin, for purposes of comparison, a description of the

setae of a specimen of *N. communis*, var. *punjabensis*, from Shalimar, near Lahore.

Ventral setae of segments ii—v:—length 94 μ, shaft not much curved, thinner than those of the more posterior segments. Distal prong half as long again as proximal, the latter being twice as thick at its base. Nodulus equal on both sides of shaft, slightly proximal (12 : 13). Four setae per bundle. (Fig. 4*a*.)

In segments vi and onwards:—length 84-87 μ, shaft stouter and more curved than in anterior segments; distal prong 1½ times as long as proximal, which latter is double as thick at base; nodulus equal on both sides of shaft or slightly more marked on the side of the distal prong; distal to middle (4 : 5, or, in a more posterior segment, 11 : 16). Commonly four setae per bundle, sometimes five, or three. (Fig. 4*b*.)

Dorsal setae in bundles of one hair- and one needle-seta; the latter 69 μ long, the shaft slightly curved beyond the nodulus in the form of a sickle, and very slightly in the reverse direction proximal to the nodulus; finely bifurcated at the extremity; nodulus distal (3 : 8). (Fig. 4*c*.)

I may perhaps be permitted to add a few words in regard to this form, with reference to Piguet's criticisms in his recent paper (*Rev. Suisse de Zool.*, Tome 17, Fasc. 1, 1909). An examination of the reproductive organs has, as already mentioned, resulted in approximating this form to *N. communis* rather than to *N. variabilis*, to which latter, however, the setae of the Punjab variety show the greater resemblance. A renewed examination of the 'thorn-like projections' of the dorsal setae, and the facts that such projections may be present on the ventral setae also (though rarely), and that (in a *Pristina*, for example) they may cluster round the dorsal setae in such lengths and numbers as to give the seta the appearance of a miniature ostrich feather, has convinced me that Piguet is right in supposing them to be a cryptogamic growth.

With regard to Piguet's suspicion that there may have been more than one species or variety of *Nais* among the specimens which I used for my description,—and that my account of the variations in the dorsal setae may be due to this cause, I will not at present venture an opinion, since I have not yet had time for a renewed investigation. But I do not expect to be able to record any very large number of aquatic Oligochaeta from the environs of Lahore. With the exception of artificial tanks in pleasure gardens or in connection with manufactories, and the canal, the only body of water is the river Ravi. The artificial tanks, much to the detriment of zoological studies, undergo periodical cleansing,—I think much more frequently nowadays than some years ago; and the irrigation canal runs for a few days, and is then dry for a longer or shorter period,—hence it is useless in this connection. There are no natural freshwater ponds or pools except in the rains; and the months from October to June inclusive are (with

the exception of a few showers in January) rainless. It seems unlikely, therefore, that a large variety of forms should ever be discoverable in this neighbourhood.

I am in complete agreement with Piguet when he says, "pour distinguer sûrement les *Nais* indiennes les unes des autres, et pour établir leur rapports avec les espèces dejà connues, il faudra étudier à fond leur appareil génital." But it is improbable that any more material from the same source as that described in the present paper will reach me, and the chances, in any case, would be against its including any sexual specimens; as Piguet says, "à moins d'une chance rare, ce n'est qu'en poursuivant ses recherches pendant des années, en toute saison et dans des milieux aquatiques aussi variés que possible, qu'on peut espérer se procurer un matériel de Naïdidées sexuées permettant une étude un peu approfondie." It seemed better, therefore, to give the above descriptions as they stand.

The position, briefly, is this. *Nais communis*, var. *punjabensis*, has been shown by its sexual organs to be closely related to *N. communis*; and this is expressed by making it a variety of this latter species, though its setae have, on the whole, a greater resemblance to those of *N. variabilis*. I have examined a form with eyes from Travancore, which, as far as can be ascertained, is so similar to the above mentioned variety from the Punjab that it appears mere hair-splitting to separate them. A form without eyes also occurs along with the last, identical with it, it would seem, in every other respect, so far as can be seen from an examination of the available material. If the Travancore form with eyes is a variety of *N communis*, then so will be this latter. But these conclusions will be subject to revision in case sexual specimens become available for examination.