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By

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A couple of months ago Mr. Pape, Engineer of the Copenhagen water supply, sent me some samples of a browncoloured sediment of bacteria from a height reservoir of a water supply in the western part of Sjælland. In this sediment was found a very great number of small Oligochæta up to several hundreds per c.cm.; Mr. Pape wanted these Oligochetes identified, and he also wished particulars as to their biology in order thereby to find out, if possible, some means of control. In spite of energetic efforts to exterminate them through perfect desiccation and careful cleaning and sterilization of the reservoirs with chlorine, sulphuric acid and other bactericidal means, it proved impossible to control the worms. In the course of a week several kilograms of a voluminous slimy deposit developed again in the height reservoir and covered the bottom with a layer more than 50 cm. thick; naturally, bacteriological investigations of the water in the pipe-net and the reservoir gave alarming results. The number of germs was between 68,000 and 1,000 per c.cm. water. They proved, fide Mr. Pape, to be lime microorganisms which feed upon dead bacteria and further decompose $Ca(HCO_3)_2$ in $CaCO_3$ and CO_2. The worms could only live a few hours outside the reservoir, although great masses of organic matter were present in the sample-bottles. It looks as if they can only thrive where there are unlimited quantities of bacteria. A closer microscopical investigation of the sediments revealed a rich fauna of Infusorians, Rotatorians, Nematodes etc., evidently all feeding on bacteria. In other water supplies exactly the same microfauna was present, and it therefore was of interest to examine the chemical composition of the water in these special localities. It proved to be

fairly constant in all the water supplies which were infested by the microfauna described above.

According to Mr. Pape's statement the composition of the water from one of the water-supplies was as follows:

	unfiltered water	filtered water
Residual on evaporation (desiccated by 130°)	610 mg/l	602 mg/l
Ammonia (NH_3)	1,3 -	1,3 -
Nitrite (HNO_2)	0 -	0 -
Nitrate (HNO_3)	0 -	0 -
Phosphoric acid (P_2O_5)	0 -	0 -
Chlorine (Cl)	101 -	100 -
Sulphuric acid (SO_3)	0 -	0 -
Carbon dioxide total	..	403 -
— — free	..	27 -
— — half-bound	..	188 -
Sodium bicarbonate ($NaHCO_3$)	97 -	98 -
Silicate (SiO_2)	19 -	21 -
Lime (CaO)	..	139 -
Magnesia (MgO)	..	48 -
Fe O	3,5 -	< 0,05 -
Mn 0	0,18 -	0,11 -
Oxygen used for combustion of organic matter (O_2)	..	..
	3,2 -	2,8 -
Total Nitrogen (N)	2,5 -	2,5 -
Hardness degree: total	..	20,7° -
Hardness degree: carbonate	..	20,7° -
Hardness degree: permanent	..	0° -
Hydrogen ion concentration	7,5 -	7,55 -

The filtered water thus contains great quantities of manganese, organic matter, sodium bicarbonate and total nitrogen. This water offers excellent conditions for development of bacteria, and on the other hand, the bacteria afford nourishment for other microorganisms and therefore the big continuous masses may develop, which are the proper source of nourishment for the Oligochetes. The lime micro-organisms are not present in the pipe net, but — like the worms — only in the height reservoir. The cause is that they both require the organic matter formed by the dead bacteria. Further the high pressure in

the pipes prevents the decomposition of $Ca(HCO_3)_2$ as the disengaged CO_2 cannot escape.

A method of controlling the worms may be destruction of their food. If the water which enters the height reservoir could be treated in such a way that the bacteria cannot thrive in it, if e. g. it was freed from NH_3 and organic matter, then the worms would perish. By

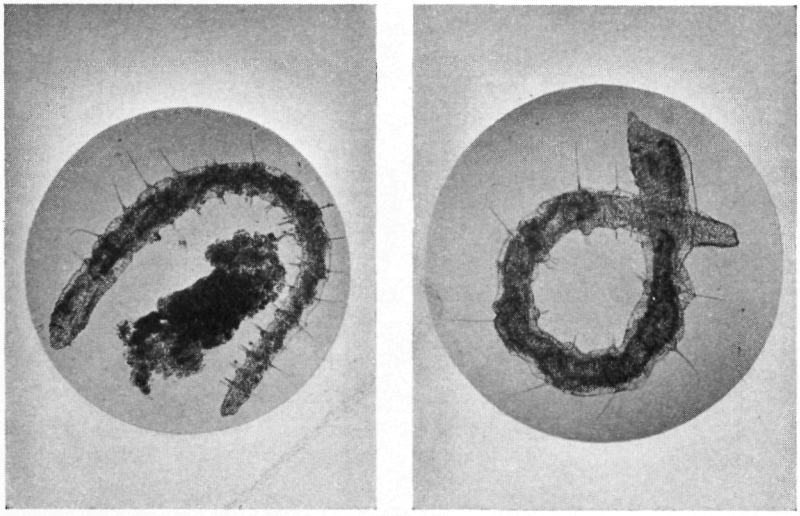

Fig. 1. *Nais communis* Piguet. To the left is seen part of the bacterial growth. (C. H. Pape phot.)

adding minimal quantities of active coal and ozone this result was easily obtained.

An investigation of the Oligochete which measures about 2 mm. in length showed that it was *Nais communis* Piquet (1906). In order to have the identification verified, some specimens were sent to Dr. Piguet, to whom I am much indebted for his valuable assistance, and to whom I wish to express my sincerest thanks. Dr. Piguet confirmed my determination.

As the species will probably prove to be very common throughout this country where the above mentioned conditions are present — and perhaps also in other places where it has hitherto been overlooked on account of its small size — a description of it is given here, accom-

panied by a few sketches. The species has not hitherto been recorded from Denmark.

The body is cylindrical, yellowish, now and then with brown pigment spots in the five foremost segments. The head is oblong or conical, the length of it twice the breadth at the base, but in most specimens the head has been withdrawn owing to the preservation. The eye spots which are present in most of the specimens are black transverse lines. Some of the specimens were destitute of eyes, a fact pointed out f. i. by Stephenson. This author has examined a number of specimens inhabiting a fresh water sponge, and he found that the greater part of them were blind. It was a natural supposition that life in the dark cavities of the sponge (and in the dark height reservoir in the present case) should cause the eyes to degenerate, but both among the specimens from the sponge and those from the reservoir there was a minority which had normal eyes. Stephenson points out that he has examined free living specimens without eyes. The presence or absence of eyes is thus a character without any systematic value.

The number of segments was 12—19 in the single individuals, and the length 1.5—2 mm. The specimens are thus on an average considerably smaller than in generally the rule.

The dorsal bundle of the setæ, beginning at the 5th segment, is composed of two setæ; one is long and hairlike, almost as long as the diameter of the body; the other is very short, hardly projecting from the skin, needle-shaped, faintly bifurcated and with hardly discernible nodulus. Piguet states that now and then two hairlike and two needle-shaped setæ may be present. I have never observed more than one. The ventral bundles beginning at the second segment are composed of 3—4 short and thick sigmoid setæ with rather deeply bifurcated distal ends. The under prong is shorter and thicker than the upper one.

The alimentary canal shows an undistinct, gradual swelling in the 7th and 8th segment.

On the whole, the principal mode of reproduction in the Naididæ is asexual, by fission. Sexual individuals are comparatively seldom found; in some genera even never described. As a rule the asexual reproduction in Naididæ seems to progress more slowly in winter than during the summer months. Piguet has examined a number of different species and found that the number of specimens possessing fission zones is much greater in the warm season than during the

winter. *Nais communis*, however, forms an exception and shows the opposite condition. The present material dating from the months of January and February highly supports this fact. Chains consisting of 2—3 individuals — but never more — are present in great numbers as well as great quantities of animals which evidently have just separated from the chains. None of the specimens are sexually ripe. The greatest length of a chain amounted to 3.5 mm. The number og segments (n) in front of the fission zone varies from 10 to 21. (Piguet (1906, p. 249)) states n to be 15.86 in the summer and 14.46 in the

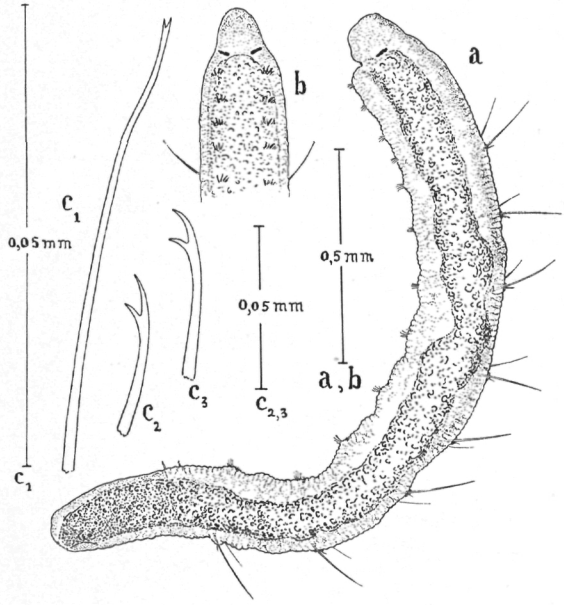

Fig. 2. *Nais communis* Piguet. a. total animal; b. anterior end dorsally; c. bifurcated needle-shaped bristle; c_2, c_3. ventral setæ. (Poul H. Winther del.)

winter.) In the specimens under consideration n was found to be a little lower, which was to be expected, since the animals were taken in winter time in a somewhat more northern latitude.

According to Piguet 1906 the testes are to be found in the fifth segment, the ovaries in the sixth segment attached to the dissepiments $^4/_5$ and $^5/_6$.

The great number of individuals in the height reservoir during winter time must probably be explained, partly by the fact that we

have to deal with a Naid which contrary to the common rule has its fission process in winter, and partly as the result of an extremely rapid fission beginning already when the animals are only abt. 1.75—2 mm. long. This may certainly be accounted for by the conditions of nourishments in the reservoir being exceptionally favourable.

There is hardly any doubt that the worms have not been able to stand the almost complete sterilization of the reservoir carried out during several months once a week — at any rate only a small quantity of the worms compared with the enormous number which constantly developed in the cause of a week could possibly survive. I try to explain their occurrence in the reservoir by the presumption, that they enter the latter in a fairly small number, with the pipe water. Their natural habitat is the underground water from where they penetrate into the pipes, where they are rather difficult to detect. In the reservoir they meet so exceptionally favourable life conditions that fission takes place very quickly, whereby their number is increased so enormously that there will be millions of them when the reservoir is cleaned next time. This also agrees with the fact that when the engineers succeded in controlling the bacteria, the worms too disappeared from the water.

I have had an opportunity to watch living individuals. They crept or swam slowly and sluggishly about in the brown bacteria-deposits, easily conspicuous by their light colour and the constant flow of the contents in the alimentary canal and the rapid blood circulation. The cephalic lobe seemed to act as a tentacle which was rhytmically projected and withdrawn, when the worm forced its way into the brown deposits. I never saw it swim actively in the water.

Nais communis was originally described from Switzerland, but is later reported from great parts of Central Europe; from rivers and rivulets, lakes and ponds; in small numbers it has been taken in cold brooks in Bohemia. Furthermore, it is known from Italy, France, Great Britain. It thus has a very wide range, but according to Schuster (1915, p. 73) it was nowhere taken in great numbers, but always in a few specimens at each locality.

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