NEMATODES ATTACKED BY PROTOZOA AND TARDIGRADES

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Observations were made on a ciliate protozoon, Urostyla sp., ingesting live nematodes but apparently unable to digest them. Tardigrades, Macrobiotus sp., were also observed attacking and feeding on nematodes.

Amoeboid protozoa are known to attack nematodes (Weber, Zwillenberg & Van der Laan, 1952; Winslow & Williams, 1957), and Doncaster (1956) reported a ciliate protozoon, Stylonichia portulata, ingesting moribund nematodes. Recently another ciliate protozoon, Urostyla sp. was observed ingesting live nematodes.

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Unidentified tardigrades have been reported attacking nematodes, (Hutchinson & Streu, 1960) and we have observed Macrobiotus sp., attacking and feeding on nematodes.

Ingestion of nematodes by protozoa (Fig. 1).

Many individuals of the ciliate protozoon Urostyla sp. and many nematodes (Rotylenchus, Tylenchorhynchus and saprobes) were extracted from a pot of soil in which Agrostis tenuis had grown for a year. A water suspension of the soil was sieved and organisms in the residue were allowed to filter through a cotton wool pad into clean water overnight. The following morning many Urostyla, measuring about 300 μ in length, were seen to ingest nematodes up to nearly 1 mm long. The smaller ones were sometimes completely ingested, but rarely more than about a third of the body length of the largest nematodes was taken into the Urostyla. The large ones were usually soon dropped and showed no ill effects, except that a deposit resembling mucus adhered to the cuticle and to it particles of debris became attached. However, either the head or the tail of the nematode, whichever was ingested first, often gradually protruded from the side or aboral end of the Urostyla until the protozoon pellicle was finally ruptured. For at least several minutes the protozoa, thus damaged, continued to swim about with undiminished activity, the nematode usually adding an undulatory movement of its own.

A few Urostyla were found containing a nematode coiled up and motionless, protruding nowhere. In an attempt to find out whether nematodes were digested, eight Urostyla completely, or almost completely enclosing nematodes, were pipet-
ted into a watch glass and re-examined after 3 hrs. Six nematodes had escaped and were apparently unaffected and two *Urostyla* still contained their prey. Two of the *Urostyla* had disappeared. While under observation one or two *Urostyla* each containing a large, active nematode were seen suddenly to rupture and then disintegrate, and it seems probable that this may be common.

After 48 hrs in the presence of active nematodes, most of the *Urostyla* had become encysted.

Ten freshly extracted *Urostyla* from the same source were placed in 5 ml of water in a watch glass, together with eggs, larvae and adults of *Ditylenchus destructor* and some potato starch grains. It was not until about 2 hrs later that the *Urostyla* began to ingest both nematodes and starch, but after 18 hrs two of the ciliates had disappeared, seven had encysted and only one was still active.

Populations of this *Urostyla* sp. apparently cannot survive on nematodes and this protozoon should not be regarded as a predator of nematodes, even though it may ingest them in certain circumstances.

**Tardigrades as predators of nematodes** (Fig. 2).

Le Gros (1958) states that tardigrades sometimes attack nematodes in addition to rotifers and other tardigrades, and Hutchinson & Streu (1960) reported unidentified tardigrades attacking nematodes in the U.S.A. and Ceylon.

In October, 1960, tardigrades and nematodes were extracted together from samples of turf from Swansea, Wales by a technique similar to that described in the preceding section. From the key given by Le Gros (1958) the tardigrades were identified as *Macrobiotus* sp.

Although the tardigrades could not move about very rapidly in the water extract, a great many succeeded in fastening on to nematodes moving near them. They showed no preference for size of prey. Distinct tears were made in the nematode cuticle by the action of the tardigrades' oral stylets. Nematodes reacted vigorously for a time, but they eventually became immobile whether or not the tardigrade was still attached. It seemed possible that a toxic secretion had been passed into the nematode.

Tardigrades could maintain a hold even on large, vigorously moving nematodes such as monochids, and, from examination of dead and preserved specimens, the nematode seemed to be drawn partly into the mouth of the tardigrade by suction when the nematode was held transversely or with one end enclosed in the tardigrade's mouth tube. Signs that some of the body contents of the nematode had been withdrawn by the tardigrade were often seen and many nematodes had more than one tear in their cuticle. Occasionally, two tardigrades were seen attached to one nematode and a moribund enchytraeid was fed on extensively by at least six tardigrades.

Ciné film records were made of *Urostyla* ingesting nematodes and of *Macrobiotus* preying on nematodes.