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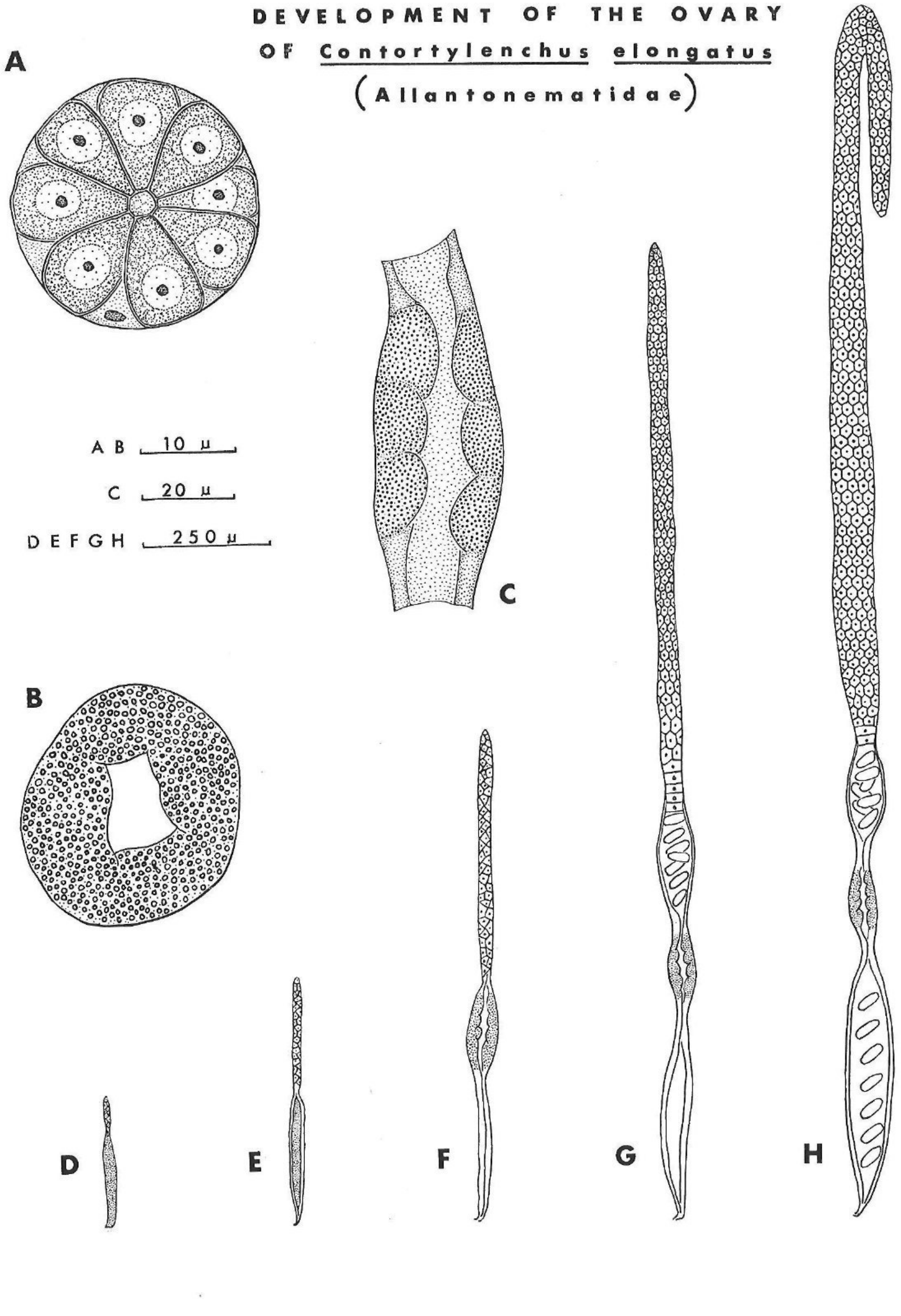
Note on the Ovary, Rachis, and Spermatheca of an Insect Parasitic Nematode, *Contortylenchus elongatus* (Massey, 1960) Nickle, 1963

WILLIAM R. NICKLE[1]

The morphology and development of the ovary of members of the insect parasitic nematode family Allantonematidae are unique, though little information is available on them. The spermatozoa are small. The free-living females (.60 mm in length) are fertilized in the frass of a bark beetle gallery or in the substrate where larval stages of host insects are present. Koriogamy is the normal type of fertilization. The copious sperm are packed tightly in the uterus. A parasitic sojourn in the body cavity of a suitable insect is required to complete the life cycle of the nematode. After the nematode gains entrance into an insect larva or pupa, it grows to 6–10 times its original length and 10 times in diameter. The ovary begins as a small (20 microns), fingerlike projection and grows to 100 times that length, so that eventually about 80% of the volume of a full-grown adult parasitic female is taken up by the gonad at the expense of other internal organs. Morphologically and physiologically the success of this egg-producing apparatus is centered about the rachis and the free flow of usable nutritive substances from the haemolymph of the host insect directly to the pseudocoelom of the nematode and to the developing oocytes.

Chitwood and Chitwood (1950) reported a rachis in the ovary of oxyurids, ascarids, strongylids, spirurids, thelastomids, and some tylenchs. Thorne (1949) showed the rachis of *Anguina tritici* to be a large, pulpy, cellular region encircled by a thin layer of oocytes. The rachis of *Ascaris lumbricoides* is a definite cyl-

[1] Contribution from the Research Institute, Research Branch, Canada Department of Agriculture, Belleville, Ontario, Canada. This work was initiated as part of a thesis submitted for the degree of Doctor of Philosophy at the University of California, Davis, California. Present address: Nematology Investigations, USDA, ARS, Beltsville, Maryland.


DEVELOPMENT OF THE OVARY
OF Contortylenchus elongatus
(Allantonematidae)
A
B
C
D
E
F
G
H
A B 10 μ
C 20 μ
D E F G H 250 μ

inder apparently composed of a bundle of nutritive chords (Hirschmann, 1960). Three genera of allantonematids are known to possess a rachis. Zur Strassen (1892) illustrated it in *Bradynema*, and Bovien (1937) reported one in *Heterotylenchus*. Warren (1941) described the rachis in *Howardula* as consisting of vacuolated cytoplasm without nuclei.

As a result of a study undertaken to gain information which might be of taxonomic value at the specific level, new information on the development of the ovary after penetration of the host and also on the rachis and spermatheca of *Contortylenchus elongatus* (Massey, 1960) Nickle, 1963, was uncovered in a search for structures of taxonomic value and is presented here.

A rachis is visible in serial sections of the ovary of *C. elongatus* (Fig. 1A). The rachis begins at the cap cell and extends with an increasing diameter to the region where the oocytes are largest and are arranged in pairs or singly. This rachis is similar to that illustrated by Chitwood and Chitwood (1950) for the oxyuroid, *Spironoura affine* Leidy, 1856. This central longitudinal core of the ovary has an unknown function. Of the two possible functions that will be considered, the first has more merit. If the oocytes derive their nourishment osmotically from the pseudocoelom of the nematode or indirectly by way of the haemolymph of the host, then the rachis may function morphologically solely as a central point of attachment for the oocytes and not nutritionally. In this case, as the wall of the ovary contains large nuclei, these cells may function by allowing nutrients to pass to the oocytes from the body cavity. A second possibility exists that the rachis may contain a bundle of fibrils or nutritive chords that are fed by the germarium or cap cell and extend to each oocyte. This situation is true in many insects and is indicated in *Ascaris*. Thousands of strands would be necessary in this case and their presence could not be confirmed in the sections examined. The cap cell is not very well developed and it is unlikely that it is capable of feeding as many as 8,000 oogonia. Nematodes that possess a rachis normally have a prolific reproductive potential and are often parasitic. Probably all genera in the Allantonematidae have a rachis.

The spermathecae of *C. elongatus* (Figs. 1B, C) appear as a series of pockets in the wall of the oviduct. In all probability the spermatozoa are stored inside the swollen cells. The mode of entrance could not be determined. The location of this region is constant, which indicates that a definite structure is present. The spermatozoa in the infective stage female (Fig. 1D) are transported anteriorly by undulations of the oviduct during the enormous expansion of the ovary and of the nematode after her entrance into the host insect (Fig. 1E, F). The sperms are stored in or along the wall of the oviduct (Fig. 1F) and are available for fertilization of the ova as they pass this region. The time required for the gonad to develop from that of the infective stage female (Fig. 1D) to the much enlarged gonad of the mature female (Fig. 1H) is from 2 to 3 weeks. The life history of the parasite is essentially synchronized with its host.

SUMMARY

The development of the ovary including the rachis and spermatheca of an insect parasitic, allantonematid, *Contortylenchus elongatus* (Massey, 1960) Nickle, 1963, is discussed, and the unique ovarial development and the formation of the spermathecae of this nematode are described and illustrated. It is believed that all members of the family Allantonematidae have a rachis which facilitates morphologically the massive reproduction of these parasites.

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Fig. 1. A–C. Sections of the ovary of *Contortylenchus elongatus*. A, Oocytes arranged about a central rachis; B, transverse, through spermathecae; C, longitudinal, through spermathecae. D–H. Periodic development of nematode ovary in host. D, ovary of infective stage female; E, shortly after entrance into host; F, sperm moved into spermathecae; G, ova before fertilization; H, mature ovary.

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