

Hammerschmidtella andersoni* sp. n. (Thelastomatidae: Oxyurida) from the Diplopod, *Archispirostreptus tumuliporus*, in Saudi Arabia with Comments on the Karyotype of *Hammerschmidtella diesingi

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ABSTRACT: *Hammerschmidtella andersoni* sp. n. (Thelastomatidae: Oxyurida) is described from the posterior gut of *Archispirostreptus tumuliporus* (Spirostreptida: Diplopoda) from Saudi Arabia. The new species is distinguished from all previously described species in the genus except for *H. manohari* by its slender shape and by the fact that the cephalic annules decrease abruptly in size after the first few annules. The 2 species are distinguished by the fact that the anterior, long annules alternate with short annules in *H. andersoni* but not in *H. manohari*. The new species further differs from *H. manohari* in having an unflexed testis, a much shorter tail in the male, and by the form of cytoplasmic processes surrounding the oral opening of the female. Finally, the new species is the only species in the genus in which a gubernaculum has been reported. The karyotype of *H. diesingi* is shown to be the same as that of *H. andersoni*, namely 5 in males and 10 in females.

KEY WORDS: Nematoda, Spirostreptida, haplodiploidy, chromosome complement.

In an earlier article (Adamson, 1984) cytological aspects of gametogenesis were studied in a species of *Hammerschmidtella* collected from *Archispirostreptus tumuliporus* from Saudi Arabia. The material represents a new species and is herein described as *Hammerschmidtella andersoni* sp. n., in honor of Professor R. C. Anderson (Department of Zoology, University of Guelph, Canada). In addition *H. diesingi* was studied cytologically to determine whether the karyotype was similar to that in *H. andersoni*. These data are reported herein.

Materials and Methods

Diplopods collected from Asir, Saudi Arabia, were fixed in 70% ethanol before dissection. Hosts were identified by Dr. J. P. Mauries of the Museum national d'Histoire naturelle (Laboratoire des Arthropodes) in Paris. Nematodes recovered from the posterior gut were stored in 70% ethanol before being cleared and studied in lactophenol and glycerin.

Cytological studies of *H. diesingi* were carried out on male and female worms recovered from *Periplaneta americana* from a colony housed in the Zoology Department (University of British Columbia, Vancouver, British Columbia). Worms were dissected in 0.066 M phosphate buffer and reproductive tracts were fixed for 5 min in a solution containing 70 parts ethanol to 25 parts acetic acid and 5 parts formalin. Preparations were squashed between slide and coverslip and chromosomes were drawn with the aid of a drawing tube attached to a microscope equipped with phase and Nomarski differential interference contrast.

***Hammerschmidtella andersoni* sp. n.**

Description (Figs. 1-15)

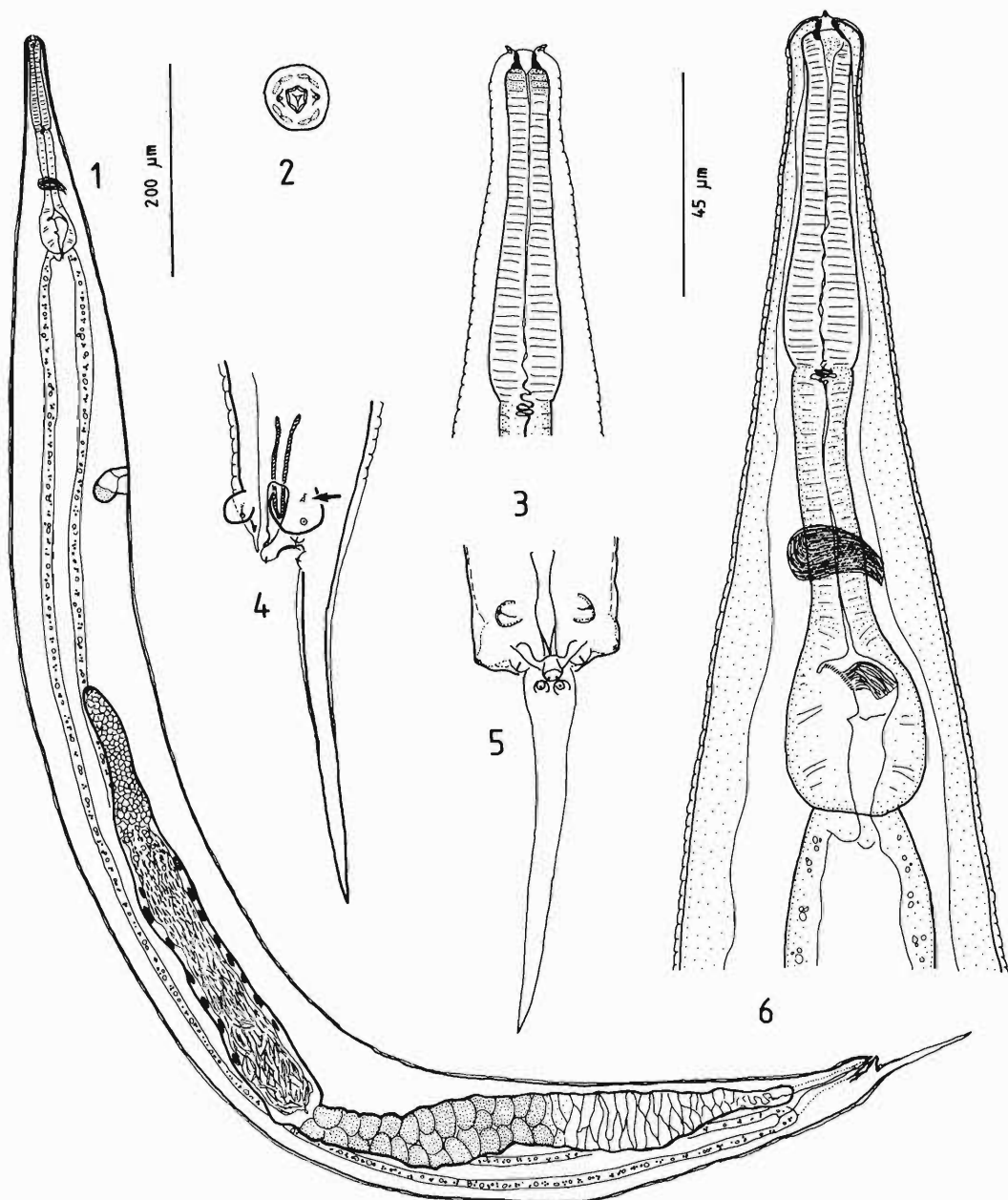
GENERAL: Slender worms with marked sexual dimorphism with respect to size.

MALE: Cephalic extremity pointed. Mouth opening hexagonal, surrounded by 4 submedian pairs of nerve endings, presumably representing outer labial papillae, and 2 pedunculate amphids. Inner papillae not observed.

Cuticle just posterior to cephalic extremity with tiny transverse striations about 2 μ m apart disappearing near level of anus. Narrow lateral alae extending from just posterior to level of base of esophagus to just anterior to anus.

Buccal capsule short, in form of narrow ring. Esophagus consisting of clavate corpus distinctly set off from cylindrical isthmus and elongate pear-shaped bulb. Nerve ring encircling isthmus. Testis outstretched, its anterior extremity just posterior to level of excretory pore. Caudal extremity truncate at level of anus bearing slender caudal appendage.

Five pairs caudal papillae, 1 pair subventral and 1 pair lateral preanal raised on fleshy lobes; 1 pair lateral adanal; 1 pair represented by 2 inconspicuous nerve endings on posterior anal lip; 1 pair at base of caudal appendage. Phasmids on fleshy lobes supporting lateral preanal papillae. Spicule short, simple. Small gubernaculum present.



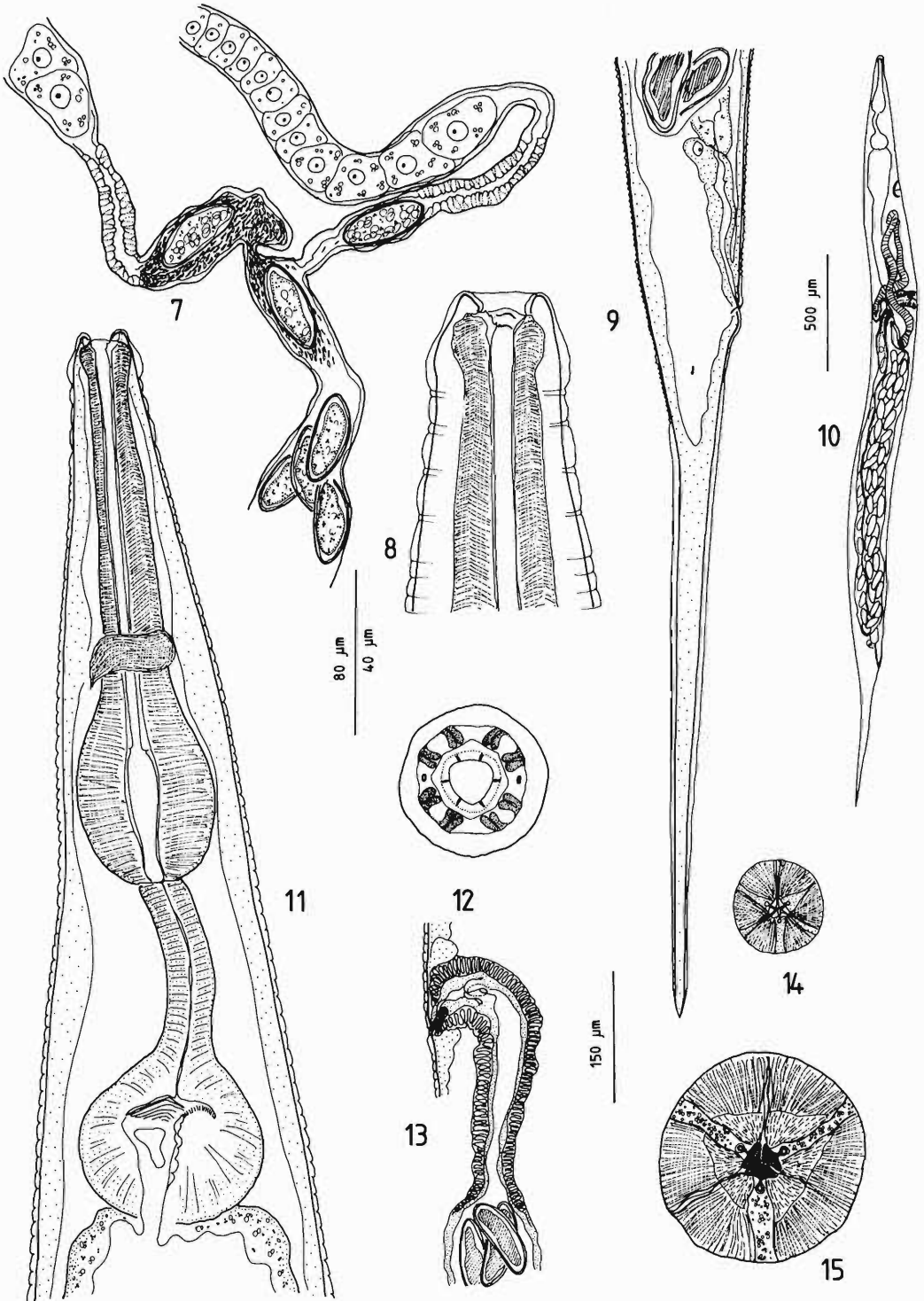
Figures 1–6. Male *Hammerschmidtella andersoni* sp. n. 1. Entire worm, lateral view. 2. Apical view. 3. Anterior extremity, ventral view; note pedunculate amphids. 4, 5. Caudal extremity, lateral and ventral views respectively; note phasmid (arrow). 6. Esophageal region, lateral view. Scale bars: 1 = 200 μm ; 2–6 = 45 μm .

FEMALE: Body increasing in width gradually posteriorly, reaching maximum width at mid-body and ending in long attenuate tail.

Oral opening subtriangular, surrounded by 6 inner papillae and 8 pairs of digitiform cyto-

plasmic processes, perhaps representing nerve endings of outer labial papillae.

Cuticle in anterior region bearing large cephalic annule 22–28 μm long followed by 4 annules about 1.5 μm long alternating with 4 an-



Figures 7–15. Female *Hammerschmidtella andersoni* sp. n. 7. Junction of oviduct with common uterus. 8. Cephalic extremity, lateral view. 9. Caudal extremity, lateral view. 10. Entire worm, lateral view. 11. Esophageal region, lateral view. 12. Apical view. 13. Vulvar region, lateral view. 14, 15. Cross sections through corpus and metacarpus, respectively. Scale bars: 7, 9, 13 = 150 µm; 8, 12, 14, 15 = 40 µm; 10 = 500 µm; 11 = 80 µm.

nules about 8 μm long; annules posterior to these about 4 μm long, disappearing just posterior to anus.

Ovaries, their blind ends just posterior to level of excretory pore, leading anteriorly, flexing posteriorly, and then flexing anteriorly before emptying into oviducts near level of vulva. Oviducts emptying into short paired uteri, fusing to form common uterus; common uterus leading posteriorly, flexing anteriorly about 100 μm from anus, and emptying into vagina.

Measurements

MALE (range of 5 paratypes): Length 1.11–1.44 mm. Maximum width 65–86 μm near midbody. Buccal cavity 2–3 μm and esophagus 148–168 μm long with corpus 62–71 μm long, isthmus and bulb 83–99 μm long and bulb 26–29 μm wide. Nerve ring 91–103 μm , excretory pore 290–384 μm long and anterior extremity of testis 408–562 μm from anterior extremity. Spicule 22–24 μm , gubernaculum 14–18 μm , and caudal appendage 71–83 μm long.

FEMALE (range of 5 paratypes): Length 3.00–3.53 mm. Maximum width 141–188 μm near midbody. Buccal capsule 3–6 μm and esophagus 391–457 μm long with corpus 240–275 μm , isthmus 73–99 μm and bulb 78–83 μm long. Maximum width of corpus 54–61 μm and bulb 75–81 μm . Nerve ring 132–160 μm , excretory pore 483–611 μm , anterior extremity of ovaries 674–769 μm , and vulva 877–1,041 μm from anterior extremity. Tail 579–679 μm long. Eggs 86–100 μm long and 32–43 μm wide (range of 12 specimens from all females).

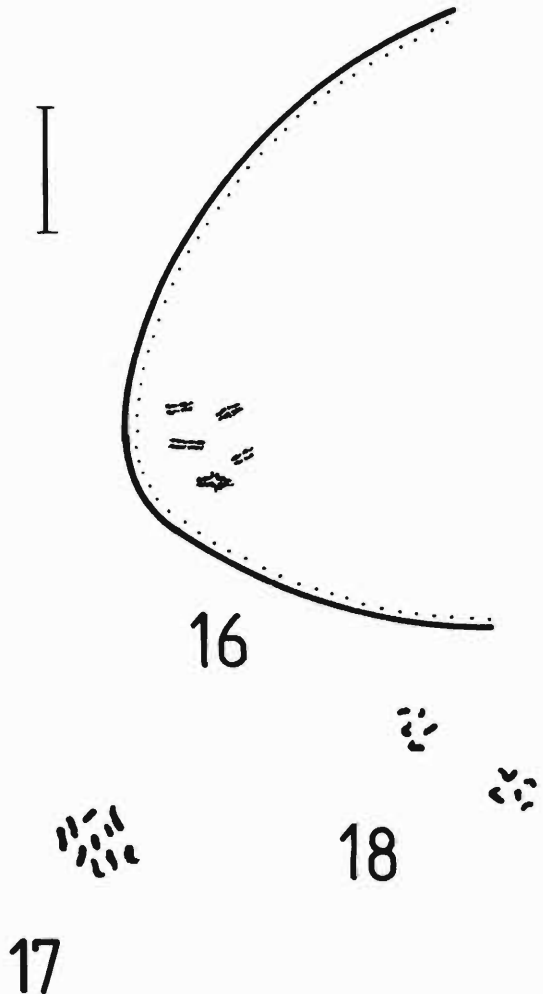
Specimens

Type and other specimens are deposited in the parasite collection of the Museum national d'Histoire naturelle (Laboratoire de Zoologie des Vers RA 143, Paris, France).

Gametogenesis in *H. diesingi* (Figs. 16–18)

Five chromosomes were observed in the germinative zone of the testis. Typical stages in meiosis were not observed and cells in the transformation zone of the testis contained 5 chromosomes with irregular, fuzzy outlines.

Ten chromosomes were observed in the germinative zone of the ovaries. Meiosis appeared normal. Ova nearest the oviduct contained 5 bivalents and figures representing the 2 meiotic divisions were observed. Ova developed only as far as the pronuclear stage in utero.



Figures 16–18. Chromosomes of *Hammerschmidtella diesingi*. 16. Metaphase of meiosis I in ovum showing 5 bivalents. 17. Metaphase plate from germinative zone of ovary showing 10 chromosomes. 18. Two metaphase plates from germinative zone of testis. Scale bar = 10 μm .

Discussion

In addition to the new species, there are 11 nominal species of *Hammerschmidtella*: *H. diesingi* (Hammerschmidt, 1838), the type species, *H. blatta orientalis* (Hammerschmidt, 1847), and *H. macrura* Diesing, 1850, from *Blatta orientalis* in Europe; *H. neyrae* Sanchez, 1947, from *Periplaneta orientalis* (= *Periplaneta americana* or *Blatta orientalis*) in Spain; *H. gracile* (Leidy, 1850) from *Periplaneta americana* in North America; *H. periplaneticolae* (Singh and Singh, 1955), *H. aspiculus* Biswas and Chakravarty, 1963, and *H. bareillyi* Sharma and Gupta, 1983, from *Peri-*

planeta americana, *H. singhi* Rao and Rao, 1965, from *Corydia* sp. (Blattoidea), and *H. manohari* Rao, 1958, from *Spirostreptus* sp. (Diplopoda) in India; *H. acreana* Kloss, 1966, from *Eublaberis* sp. in Brazil (Basir, 1956; Rao, 1958; Kloss, 1966).

Chitwood (1932) considered *H. blatta orientalis*, *H. macrura*, and *H. gracile* to be synonyms of *H. diesingi*. *Hammerschmidtella periplaneticola* was considered a synonym of *H. diesingi* by Kloss (1966). *Hammerschmidtella bareillyi* and *H. singhi* are poorly known and the characters used to distinguish them from the type species (see Rao and Rao, 1965; Sharma and Gupta, 1983) are of dubious value. They may be synonyms of *H. diesingi*. The species is apparently nearly cosmopolitan in *Periplaneta americana* and *Blatta orientalis*.

Hammerschmidtella andersoni sp. n. most closely resembles *H. manohari*; both are slender worms with a de Man value, V, of about 0.30, and in both, the size of annules on the cephalic extremity of females decreases abruptly after the first few annules. In other species in the genus, annule length decreases gradually as one moves posteriorly. The arrangement of annules in female *Hammerschmidtella* spp. is constant and an excellent diagnostic character. In *H. andersoni* there is a long cephalic annule followed by 4 short (1.5 μm) annules alternating with 4 longer (about 8 μm) annules before annules decrease abruptly in length to about 4 μm . The arrangement is similar in *H. manohari* except that the long anterior annules do not alternate with short annules. Aside from differences in the cephalic annules, the new species differs from *H. manohari* in having an unflexed testis, a much shorter tail in the male, and by the form of the cytoplasmic processes surrounding the oral opening and visible in the apical view of females; these latter form 8 heart-shaped masses in *H. manohari* and 8 pairs of digitiform masses in *H. andersoni*. Finally, *H. andersoni* is the first species in the genus in which a gubernaculum has been reported.

Most thelastomatids are amphidelphic and the uteri fuse at the vagina. In *Hammerschmidtella*, however, the ovaries are parallel and oviducts

lead through paired uteri of variable length, fusing to form a long common uterus. The paired uteri are extremely short in *H. andersoni* but are over a millimeter long in *H. diesingi*. Unfortunately, this character has not been recorded in other species in the genus.

The Thelastomatidae are considered the most primitive family of the Oxyurida. In a previous study, Adamson (1984) reported on the chromosome complement of *H. andersoni* and an undescribed species of *Thelastoma*. Both were found to be haplodiploid. *Hammerschmidtella diesingi* is only the third Thelastomatidae that has been examined cytologically. Its chromosome complement, like that of *H. andersoni*, is 5 in males and 10 in females. This supports the hypothesis that haplodiploidy is the primitive form of reproduction in the Oxyurida.

Acknowledgments

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Literature Cited

- Adamson, M. L. 1984. L'Haplodiploidie des Oxyurida. Incidence de ce phénomène dans le cycle évolutif. Annales de Parasitologie Humaine et Comparée 59:387-413.
- Basir, M. A. 1956. Oxyuroid parasites of Arthropoda. A Monographic study. 1. Thelastomatidae. 2. Oxyuridae. Zoologica, Stuttgart 106:1-79, 13 plates.
- Chitwood, B. G. 1932. A synopsis of the nematodes parasitic in insects of the family Blattidae. Zeitschrift für Parasitenkunde 5:14-50.
- Kloss, G. R. 1966. Revisão dos Nematoides de Blattaria do Brasil. Papeis Avulsos do Departamento de Zoologia (São Paulo) 18:147-188.
- Rao, P. N. 1958. Studies on the nematode parasites of insects and other arthropods. Arquivos do Museu Nacional Rio de Janeiro 46:33-83.
- , and V. J. Rao. 1965. A description of a new species of the genus *Hammerschmidtella* Chitwood, 1932 (Nematoda; Oxyuridae). Rivista di Parassitologia 26:9-12.
- Sharma, R. K., and L. N. Gupta. 1983. A new entomogenous nematode, *Hammerschmidtella bareillyi* from *Periplaneta americana*. Revista Iberica de Parasitologia 43:319-323.