A RECORD OF THREE CASES OF HUMAN INFECTION IN SOUTHERN AFRICA WITH A COMMON TAPEWORM OF RATS

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One of the commonest cestodes found in different species of South African rats is the tapeworm *Inermicapsifer madagascariensis* (Davaine, 1870). I have identified this species in the red veld rat—*Rattus* (*Aethomys*) *chrysophilus* (de Winton, 1897), in the blacktailed tree rat—*Rattus* (*Aethomys*) *paedalcus* (Sundevall, 1846), in the multimammate rat—*Rattus* (*Mastomys*) *natalensis* (Smith, 1834), in the single-striped grass rat—*Limniscomys griselda* (Thomas, 1904), in the four-striped rat—*Rhabdomys pumilio* (Sparrman, 1784), and the pouched rat—*Saccostomus campestris* (Peters, 1846). In addition, Baer (1926) also found it in the vlei rat—*Otomys irroratus* (Brants, 1827). Locally it has not yet been reported in the introduced European rats *Rattus* (*Rattus*) *rattus* and *Rattus* (*Rattus*) *norvegicus*.

Special interest is attached to this worm because, during the last 2 decades, it has also been found to infect children in Africa.

Baylis (1949) was the first to report the presence of this tapeworm in humans in Southern Africa; his material originated from a 2-year-old European child who had arrived in England from Nairobi a few weeks previously. After treatment 2 complete worms were eliminated. A detailed study showed that these worms were cospecific with worms obtained from a Tanganyika silvery mole-rat—*Heliophobius argenteocinereus* (Peters, 1846) and from *Mastomys coucha* [=? *Rattus* (*Mastomys*) *natalens*] which worms had been identified as *I. arvicanthidis* (Kofend, 1917).

The second record is by Fain (1950) who obtained his 2 immature specimens at the autopsy of a 6-year-old child in Ruanda-Urundi (Congo).

The third record is by Baer (1955), whose material consisted of about a dozen ripe segments passed in the faeces of a 3½-year-old child from Arusha, Tanganyika.

TAPEWORM SPECIMENS FROM HUMANS

In the helminthological collection at Onderstepoort there are 3 lots of tapeworms collected from humans, which I believe to belong to the same species reported on by Baylis, Fain, and Baer. One lot consists of 11 portions of a stained and mounted worm recovered from a European child after anthelminthic treatment at Pietermaritzburg,

Natal. Another lot consists of a few fragments of worm, also stained and mounted, passed by a European child at Salisbury, Southern Rhodesia. The third lot consists of mounted and unmounted fragments of a worm passed by a European child at Rustenburg, Transvaal.

The 3 lots of specimens are, unfortunately, partially digested and macerated; sufficient of the morphology is, however, still recognizable, so that a definite determination of the species can be made.

Pietermaritzburg Specimen

The 11 mounted strips of the specimen from Pietermaritzburg represent portions of one worm; the head and neck were unfortunately missing. The combined length of the strips is about 470 mm., with a posterior maximum breadth of 3 mm. The strobila is much stretched and flattened, so that the above measurements are probably in excess of the normal size of the worm. The internal organs are unfortunately not clearly stained.

Mature segments are shorter than broad, measuring about 0·5 mm. long by 0·85 mm. broad. The genital pores are unilateral and are situated just anterior of the middle of the lateral border (Fig. 1). The cirrus pouch is inconspicuous and oval, being about 0·12 mm. long by 0·06 mm. broad; the rounded testes, of which between 30 and 40 could be made out, are located both aporal and poral of the ovary, with a few testes joining these 2 groups posterior of the female glands. The aporal testes are about twice as many as the poral ones, which all lie posterior of the genital ducts. The ovary is fan-shaped and slightly poral in position; the most conspicuous organ is the lobed vitelline gland, which lies behind the ovary and is more centrally placed. The nearly ripe segments are slightly longer than broad, the hindmost being about 3·4 mm. long by 3·0 mm. broad; they are completely filled with about 120 egg capsules, each with 5 - 10 eggs, the majority of the capsules carrying 6 - 7 eggs each.

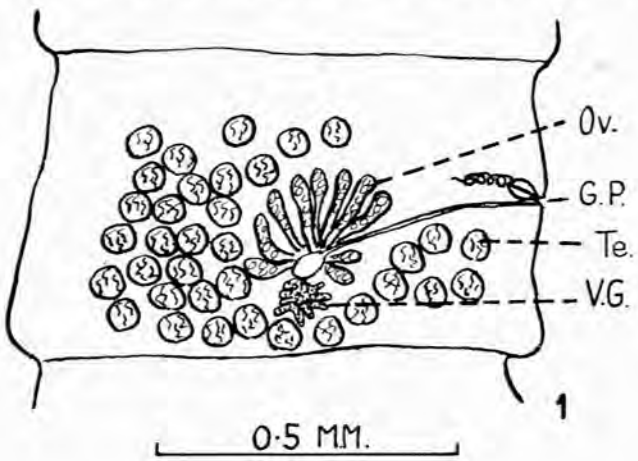

Fig. 1. Mature segment of *I. madagascariensis* from Pietermaritzburg, showing genitalia. (G.P.=genital pore, Ov.=ovary, Te.=testes, V.G.=vitelline gland.)

The excretory system could be followed in a few segments because a dark and granular deposition was present along portions of their length; there appeared to be 5 or 6 longitudinal canals united to each other by finer canals, thus forming a coarse meshwork. None of these canals, although mostly in the lateral fields, could be definitely identified as representing the usual dorsal and ventral longitudinal excretory canals.

Salisbury Specimens

The Salisbury specimens consist of 3 stained and mounted fragments and a scolex; the fragments consist of nearly ripe segments only; they are much macerated and somewhat contracted. The partially digested and mounted scolex is much flattened, measuring 0·75 mm. across; the 4 rounded suckers, each about 0·19 mm. in diameter, are clearly seen. A rostellum and hooks are entirely absent. The genital pores are unilateral, insignificant, and situated at about the middle of the lateral border just anterior of its centre. The ripest segments are almost square, measuring about 2 mm. long and broad; each is completely filled with about 100 egg capsules, each capsule carrying what appears to be 8 - 10 eggs.

Rustenburg Specimens

The specimens from Rustenburg consist of 4 stained and mounted fragments plus a number of detached pieces and ripe segments. All the fragments are much macerated. Except for one immature mounted fragment the rest of the material consists of segments carrying egg capsules; the unmounted fragment is about 60 mm. long and 2·5 mm. broad at its posterior end. The detached segments are somewhat barrel-shaped, being slightly longer than broad (Fig. 2).

In the mounted fragments the genital pores are all unilateral and just anterior of the centre of the lateral border. The cirrus pouch is small and oval, 0·12 mm. long by 0·06 mm. broad. Each segment carries from 110 to 125 egg capsules which fill the whole segment. As far as could be determined, each capsule carries 5 - 9 eggs, the majority carrying 7.

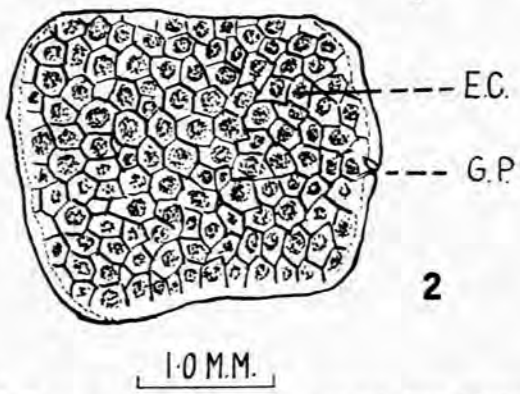

Fig. 2. Ripe segment of *I. madagascariensis* from Rustenburg, showing egg capsules. (G.P.=genital pore, E.C.=egg capsules.)

DISCUSSION

The similarities of the comparable segments of the 3 lots of worms have convinced me that they all belong to the same species. The presence of typical mature genitalia and a branched excretory system in the Pietermaritzburg

worm, and the presence of a head without rostellum or hooks in the Salisbury worm, place these worms in the genus *Inermicapsifer*. Nearly 20 species of this genus have been described, all of which, with few exceptions, are parasites of either Hyracoidea or Rodentia only, from Africa and Asia Minor. The exceptions are *I. madagascariensis* (Davaine, 1870) from man in Madagascar, *I. arvicanthidis* (Kofend, 1917) from rats and man in Southern Africa, *I. cubensis* (Kouri, 1938) from humans in Cuba, and *I. remotus* (v. Linstow, 1905) from a Brazilian ape. The description of the last-named is very incomplete and it may be ignored for practical reasons.

The involved synonomy of the other 3 species has been fully dealt with by Baer (1956). The position before the appearance of Baer's paper is briefly stated here:

There was doubt whether *I. cubensis* is a distinct species. Baylis (1949) was inclined to regard it as a species probably identical with *I. arvicanthidis*. Baer (1949), after examining many specimens collected from humans in Cuba, concluded that they all belonged to a single species of the genus *Inermicapsifer*, because they did not possess an armed scolex or a rostellum. He further concluded that this species, viz. *I. cubensis*, was closely related to *I. arvicanthidis*, from which it differed, however, by its smaller cirrus pouch and by the larger number of egg capsules in each of its ripe segments.

Fain (1950) examined the paratypes of *I. cubensis* and compared them with tapeworms identified as *I. arvicanthidis* from a child and from *Rattus (R) rattus* in the Belgian Congo; he concluded that the 2 species were the same, notwithstanding the fact that this tapeworm was not infrequently found in man in Cuba but never in Cuban rats, and further that the correct name was *I. arvicanthidis*.

Baer (1956) was fortunately able to carry out a detailed study of tapeworms from a child and a youth in Mauritius; this material had provisionally been identified as *Davainea madagascariensis*. The presence of an unarmed scolex with no rostellum showed that the worms did not belong to the family Davaineidae; a study of the morphological characters of the mature and gravid segments showed that these worms were indistinguishable from *I. arvicanthidis* as found in African rodents. He also now accepts the identity of *I. cubensis* and *I. arvicanthidis* as claimed by Fain. According to the priority law, Davaine's name has to be retained, the correct name now being *Inermicapsifer madagascariensis* (Davaine, 1870) Baer, 1956; with principal synonyms *I. arvicanthidis* (Kofend, 1917) and *I. cubensis* (Kouri, 1938).

The characters of my specimens are very similar to those given by the above-named authorities; I therefore have no hesitation in assigning these worms to the same species as theirs, viz. to *I. madagascariensis*. The reason why there are not more records of the occurrence of this species in Southern Africa is probably that the ripe segments are small, and, when passed with the stools, would be easily missed unless specially looked for.

The presence of this cestode of African rodents in the West Indies and the Mascarine Islands is probably owing, as suggested by both Baer and Fain, to its transportation from West Africa to the West Indies with the slave trade, and from there to the Mascarine Islands by Creole labour brought over by the French settlers. Outside Africa it has adapted itself exclusively to man and has never been found in rodents.

Murine Cestodes

It is perhaps not out of place to mention that murine species of the genus *Raillietina* (*Raillietina*) also occur in man. A critical survey of the records of human infections with these species has been made by Baer and Sanders (1956). Before 1956 there was much confusion in the generic and specific determinations of murine cestodes when recovered from man. Morphologically, the human parasites belonging to the above genus and to *Inermicapsifer* are very similar, the main distinguishing feature being the presence of an armed scolex and suckers in the murine cestodes, whereas the scolex carries no rostellum or any hooks in *Inermicapsifer*. In specimens passed in the stools, the scolex is the first portion of the strobila to be digested, and is consequently not often recovered. The generic determination of an acephalous strobila thus led to much confusion. Fortunately, the above-named workers have now clarified this situation and have shown that the position of the genital pore can also be used to differentiate human specimens of these genera. In *Raillietina* (*Raillietina*) the pore is situated anteriorly in the first third or quarter of the lateral border, whereas in *Inermicapsifer* its position is more central, being placed just anterior of the centre of the lateral border.

An interesting line for future investigation is the elucidation of the life history of this African murine tapeworm. The life history of no member of the genus *Inermicapsifer* is known, and consequently the mode of infection remains unknown. The Anoplocephalidae, to which family this genus belongs, embraces the well-known species of the genera *Anoplocepha*, *Moniezia* and *Cittotaenia*, parasites of horses, lambs and calves, and rabbits respectively. In these species minute grass-mites, belonging to the family Oribatidae of the Arachnida, are known to act as intermediate hosts; in these tapeworms, however, the eggs are liberated singly from the uterus and not in egg capsules as in species of *Inermicapsifer* or *Raillietina* (*Raillietina*); it is thus doubtful whether these small mites — also known as beetle mites — would be able to swallow these much larger egg packets. Ants and beetles eat the egg capsules of the raillietina tapeworms of poultry, and it is thus possible that these insects may also consume those of the inermicapsifers. Our rock rabbits — Hyracoidea — generally carry a heavy infection of these tapeworms; collection and dissection of various insects from the vicinity of rock-rabbit habitations might reveal the presence of cysticercoids of these parasites.

SUMMARY

Three cases of human infection in Southern Africa with a common rat tapeworm, *Inermicapsifer madagascariensis* (Davaine, 1870), are reported. The specimens were from children in Pietermaritzburg, Rustenburg and Salisbury.

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