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On some Paranoplocephala species (Cestoda: Anoplocephalidae) parasitizing rodents (Rodentia) in Europe

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ABSTRACT. Redescriptions of the species Paranoplocephala omphalodes (Hermann, 1783), P. blanchardi (Moniez, 1891) and P. gracilis Tenora et Murai, 1980, are given and a new species, Paranoplocephala janickii sp. n. is described. Historical and critical notes on the morphology and taxonomy are added to each description. Problems of the characterization of the genus Paranoplocephala Lühe, 1910 are discussed.

KEY WORDS. Paranoplocephala omphalodes, P. blanchardi, P. gracilis, redescriptions, Paranoplocephala janickii sp. n., Cestodes, Anoplocephalidae, morphology, taxonomy.

In order to revise the systematic status of some cestodes of the genus Paranoplocephala Lühe, 1910 parasitizing rodents in Europe, we have re-examined some species the material of which is deposited in Muséum d'Histoire Naturelle in Geneva (NHMG) and Zoological Department of the Hungarian Natural History Muséum (HNHM) in Budapest. The obtained results supplement a previously published study (TENORA, MURAI, VAUCHER, 1984).

HISTORY OF THE GENUS PARANOPLOCEPHALA LÜHE, 1910

The genus Paranoplocephala was established by LÜHE (1910) for the cestodes of the species Anoplocephala omphalodes (Hermann, 1783). Since the author had no material at his disposal, he based the generic diagnosis on the description and illustrations published by STIEDA (1862). However, the drawing and characterization of the uterus were interpreted incorrectly.

BAER (1923) recognized the genus Paranoplocephala Lühe, 1910 with a single species, P. omphalodes (Hermann, 1783).

In 1927, the same author transferred the genus Anoplocephaloides Baer, 1924 to the synonymy of the genus Paranoplocephala Lühe, 1910 and thus extended the species structure of this genus to seven species. His characterization of the uterus in members of the genus Paranoplocephala is based on the characterization published by LÜHE (1910): "Uterus sackförmig, quergestreckt, mit taschenartigen Ausbuchtungen" (see LÜHE, 1910); "Uterus en forme de tube transverse pouvant dépasser les vaisseaux excréteurs à la ventrale et devenant sacciforme et lobé" (see BAER, 1927).

JOYEUX and BAER (1936) proceeded in the same way as BAER (1927).

SPASSKY (1951) made a redescription of the genus Paranoplocephala. His generic diagnosis and uterus characterization were principally based on the diagnosis of previous authors: "At

the beginning, the uterus has a form of a long, transverse, entire band of cells, than it takes the form of a transverse tube, finally forming numerous, blind, sometimes branched diverticles" (see SPASSKY, 1951).

At this place we note that the descriptions of the uterus by BAER (1924, 1927), JOYEUX and BAER (1936) and SPASSKY (1951) do not conform with the figure of the uterus published by STIEDA (1862) in the first publication of form of the uterus of P. omphalodes. Such descriptions are no better than the bad interpretation of the uterus of P. omphalodes by LÜHE (1910).

LÓPEZ-NEYRA (1954) classified the genus Paranoplocephala Lühe, 1910 as the subgenus of the genus Anoplocephala Blanchard, 1848.

YAMAGUTI (1959) stated in his redescription of Paranoplocephala characterization that "gravid uterus transverse, with numerous outgrowths". He assigned to this genus the same species as RAUSCH (1946-1954) and added also A. bairdi Schad, 1954 = P. bairdi (Schad, 1954).

TENORA (1976) used SPASSKY's (1951) concept for the characterization of the genus Paranoplocephala, but, consistently with RAUSCH (1952 a), pointed out that "this genus appears to be heterogeneous and some species of this genus were not described completely and should be revised. This concerns primarily the species lacking an exact description of uterus". In contrast with the previous authors, he transferred the species Paranoplocephala indica Sawada et Papasarathorn, 1966 to the genus Flabelloskrjabinia Spassky, 1951. The same procedure was also used by RAUSCH (1976).

Until 1976, the genus Paranoplocephala had been placed in the subfamily Anoplocephalinae Blanchard, 1891 sensu Spassky, 1951 on the basis of the known characterization of the uterus, published for the first time by LÜHE (1910) (but in an erroneous sense of word): "The uterus of younger developmental stages has the character of a transverse tubus and gradually forms numerous sacculations".

In 1976, RAUSCH radically changed the opinion on the characterization of the genus Paranoplocephala Lühe, 1910. He restored the genus Anoplocephaloides Baer, 1924, to which he transferred many species of the genus Paranoplocephala. He redescribed the genus Paranocephala and characterized the uterus as follows: "Uterus at first rod-like, transverse, becoming reticulate and developing anterior and posterior sacculations".

Due to this characterization, particularly to the reticular character of the uterus during its development, the genus Paranoplocephala sensu Rausch, 1976 is closer to the subfamily Monieziinae Spassky, 1951 than to Anoplocephalinae Blanchard, 1851.

Moreover, RAUSCH (1976) placed the genus Aprostatandrya Kirschenblat, 1938 in the synonymy of the genus Paranoplocephala. This genus was included by SPASSKY (1951 a) in the subfamily Monieziinae Spassky, 1951 and was later divided by HUNKELER (1974) into two genera, Aprostatandrya (Kirschenblat, 1938) Spassky, 1951 and Sudarikovina (Spassky, 1951) Hunkeler, 1974.

TENORA and MURAI (1980) accepted RAUSCH' s (1976) concept, but overestimating the criterion "uterus overlapping or not overlapping lateral excretory canals", they erroneously created a situation in which even the species Andrya cuniculi (Blanchard, 1891) belonged to the genus Paranoplocephala.

TENORA, VAUCHER and MURAI (1981-1982) studied the development of the uterus in the type species of Paranoplocephala and Andrya. They arrived at the conclusion that at the gravid stage, it is identical (reticular) in both type species and they considered the possible synonymy of the genera Paranoplocephala and Andrya. Also RAUSCH (1976), who studied both P. omphalodes and A. rhopalocephala, was not sure whether the genera Paranoplocephala and Andrya were bona genus (see RAUSCH, 1976, p. 521-523).

TENORA, HAUKISALMI and HENTTONEN (1985) found many confusions in the generic classification of cestodes, now more or less conventionally placed in the genera Paranoplocephala and Andrya. On the basis of the facts published by TENORA, VAUCHER and MURAI in the years 1981-1982, they arranged the species P. omphalodes (Hermann, 1783), P. gracilis Tenora et Murai, 1980, and A. microti Hansen, 1949 in the genus Andrya.

TENORA, MURAI and VAUCHER (1984) reconsidered the characterization of the genera Andrya Railliet, 1883, Paranoplocephala Lühe, 1910 sensu Rausch 1976, and Anoplocephaloides Baer, 1924 sensu Rausch, 1976 and agreed in substance with RAUSCH' s (1976) opinion.

Although some authors did not accept the division of the family Anoplocephalidae into two subfamilies (YAMAGUTI, 1959, STUNKARD, 1961, JOYEUX and BAER, 1961) it should be stated that as regards the characters, the genus Anoplocephaloides belongs to the subfamily Anoplocephalinae Blanchard 1891 sensu Spassky, 1951 and the genera Paranoplocephala and Andrya to the subfamily Monieziinae Spassky, 1951 (i.e., to two different developmental branches).

In order to establish the exact structure of Paranoplocephala species, TENORA, MURAI and VAUCHER (1984) tentatively transferred to this genus many species previously placed in the genera Andrya or Aprostatandrya, but admitted that a revision of the concrete material should be made.

TENORA, MURAI and VAUCHER (1984) for the first time thoroughly analyzed the type species of the genera Andrya and Paranoplocephala and found a difference in the process of formation of their reticular uterus. In P. omphalodes, the uterus at its early stages has the form of a transverse, mucose sac and later it becomes reticulate, whereas in A. rhopalocephala the reticulation appears suddenly, without previous formation of tube or sac on the ventral side.

TENORA, HAUKISALMI and HENTTONEN (1985 b) studied the anoplocephalids of rodents in Finland. It is evident that Andrya kalelai Tenora, Haukisalmi, Henttonen, 1985 and ? Anoplocephaloides sp. are members of Paranoplocephala sensu Tenora, Murai and Vaucher 1984 (see the evolution of the uterus of A. kalelai, Fig. 10, and the form of the uterus of ? Anoplocephaloides sp., Fig. 12 in the paper of TENORA, HAUKISALMI and HENTTONEN, 1985 b).

It is also necessary to add some notes to the problem presented by RAUSCH (1976) and TENORA, MURAI, VAUCHER (1984), that Aprostatandrya Kirschenblat, 1938 is a synonym of Paranoplocephala Lühe, 1910. RAUSCH (1976) writes: "A comparison of P. omphalodes with A. macrocephala from rodents in North America has revealed no morphologic differences that I consider to have taxonomic significance at the generic level".

Since the publication of the original description of A. macrocephala Douthitt, 1915, type species of Aprostatandrya, no author has studied the material of A. macrocephala from its original host, Geomys bursarius. With the exception of the single, original record, all other findings of A. macrocephala, both from North America and Europe, originated from other species of rodents. They were not identified according to the original description, but according to the revision by RAUSCH and SCHILLER (1949). However, RAUSCH (1976) later characterized A. macrocephala as follows: "Compared with other species of the genus, including P. omphalodes, P. macrocephala is the least host-specific and the most variable morphologically, which suggests that it represents a complex of species".

The systematic position of P. omphalodes also remains unclear. Since 1783, when the first description was published, till 1976 this species was regarded as a member of the subfamily Anoplocephalinae (for the characteristics of this subfamily see SPASSKY, 1951). It was only in 1976 (compare RAUSCH, 1976) and some years later (compare TENORA and MURAI, 1980 and TENORA, VAUCHER and MURAI 1981-1982) that some of the authors wrote that the stage of reticular uterus appeared during the process of uterus development in P. omphalodes. On the basis of this feature this species belongs to the groups of species showing better agreement with the subfamily Monieziinae Spassky, 1951, the development of which is different.

MATERIAL AND METHODS

The results of our studies of the material of individual species are given below. As to the method of the species identification, the authors are not consistent in the opinion about the differentiating characters. The criteria used by different authors (particularly in identification keys) are various. For example DOUTHITT(1915) used the length of strobila, number of segments in the strobila, width of body, or geographical distribution for the differentiation of Andrya species. BAER (1927) preferred the opening of genital organs (unilateral, alternating), number of testes and host specificity for the identification of Paranoplocephala species. RAUSCH and SCHILLER (1949 a) came to the conclusion that testes distribution, testes number and ventral longitudinal excretory canal size were of no value per se in the differentiation of the North American species of Andrya and that the average egg diameter seemed to be a reliable character, especially in combination with the above-mentioned character. RAUSCH and SCHILLER (1949) used the following characters for the differentiation of closely allied species of Paranoplocephala: situation of testes in relation to lateral excretory canals, number of testes, and length: width ratio of gravid segments. SPASSKY (1951) identified the species of the same genus on the basis of genital opening, body length, zoogeographical distribution, hosts, and length of cirrus sac, whereas RYZHIKOV et al. (1978) used the genital opening, number of testes and cirrus sac length. TENORA, HAUKISALMI, HENTTONEN (1985) preferred the following criteria for the identification of Andrya species: genital opening and situation of testes in relation to other organs.

On the basis of our own experience we arrived at the conclusion that the following criteria (without any preference) may be used for the identification of Paranoplocephala species in various combinations:

- Vagina short or long in relation to cirrus sac. Not widely used as a criterion.
- Average diameter of scolex and suckers.
- Number of testes and their distribution.
- Situation of ovary: central, poral, aporal. This criterion is also not very exactly described.
- Character of seminal receptacle.
- Genital opening (unilateral, tending to alternation, irregularly alternating). This character has not been exactly set and is mostly described only as "unilateral" or "irregularly alternating".
- Affinity of the species to different species of hosts and its zoogeographical distribution.
- Average egg diameter.

RESULTS

1. Paranocephala omphalodes (Hermann, 1783) (Figs 1-7)

Material examined:

A) Material deposited in the Museum of Humboldt University in Berlin from Microtus arvalis, M. agrestis and Arvicola terrestris - described as "LECTOTYPE" by TENORA and MURAI, 1980.

B) 200 specimens of P. omphalodes from European rodents:
Microtus arvalis: Hungary and Czechoslovakia
M. agrestis: Federal Republic of Germany
M. nivalis: Czechoslovakia
Arvicola terrestris: Czechoslovakia
Pitymys subterraneus: Hungary
Clethrionomys glareolus: Czechoslovakia, Hungary, Spain and Switzerland
Cricetus cricetus: Hungary

The data of P omphalodes from Apodemus spp. (see TENORA and MURAI, 1980) need to be verified by new findings in these hosts.

DESCRIPTION (all measurements are in mm): Strobila 90 to 200 long, with 300-480 segments. Maximum width 2.5 to 4. Length: width ratio of mature segments 1:3-9, in postmature ones 1:4-8, in gravid ones 1:1.3-4. Scolex 1 mm long and 0.80-1.12 wide. Suckers 0.36-0.48 in diameter. Neck discernible, 1-1.5 long, in shorter animals with 200 segments neck is also short, 0.3-0.4 (see TENORA and MURAI, 1980 "P. blanchardi"). Genital pores serially or in "shorter ones" irregularly alternating, opening near middle of segments margin. Genital ducts passing dorsally across longitudinal excretory canals. Ventral canal large, 0.06-0.160 in diameter, dorsal canal 0.02-0.03. Cirrus sac size in mature segments 0.24-0.28 x 0.07-0.08 and 0.300-0.325 x 0.08-0.10 in postmature ones. Cirrus sac not overlapping or only slightly overlapping ventral excretory canal. Cirrus spinose. Internal seminal vesicle attaining dimensions 0.14 x 0.06 in mature, and 0.15 x 0.09 in postmature segments. External seminal vesicle present, 0.10-0.12 x 0.03, somewhat coiled. Testes varying between 35 and 60 in number in various hosts, distributed from the middle of vitelline gland (or from aporal part of ovary) to ventral aporal excretory canal, some overlapping. Testes 0.03 to 0.05 (average 0.045) in diameter. Vagina thick-walled tube, 0.110-0.150 long, about 0.030-0.050 wide in mature segments, reaching over midlength of cirrus sac. Seminal receptacle elongate, bottle-shaped, 0.30-0.60 x 0.08-0.150 in size. Ovary 0.45 – 0.80 wide and 0.12-0.28 long in last mature segments occupying the poral half (or 2/3, exceptionally 3/4) of the internal parenchyme. Vitelline gland somewhat lobed, 0.20-0.40 x 0.08-0.15. Uterus ventrally first visible as a transverse mucous sac slightly anterior to ovary and testes, becoming reticulate and developing anterior, interior and posterior sacculations. Uterus apparently overlapping ventral longitudinal excretory canals. Eggs spherical, 0.034-0.037 (average 0.035). Pyriform apparatus well developed.

NOTE: The history of the taxonomy of P. omphalodes was described in detail in the paper by RAUSCH (1976). Many questions concerning this species have been elucidated there.

Although P. omphalodes has often been reported from Europe as a parasite of different rodent species of the family Arvicolidae, the descriptions of the specimens collected are mostly lacking. If the descriptions are available, not only from Europe, but also from the U.S.A., there are great differences in metrical and morphological data (compare for example SPASSKY, 1951, ERHARDOVÁ and RYŠAVÝ, 1955. SCHMIDT, 1961, MURAI, 1970, RAUSCH, 1976, TENORA and MURAI, 1980, GENOV, 1984, TENORA, HAUKISALMI and HENTTONEN, 1985 and others).

To elucidate other points at issue, we present below the following facts.

The species Taenia omphalodes Hermann, 1783 = P. omphalodes (Hermann, 1783) was described very imperfectly from the host defined by HERMANN, 1783 as follows: "In unserer gewöhnlichen kleinen Feldmaus die aber einen etwas dicker Kopf hat, ...".

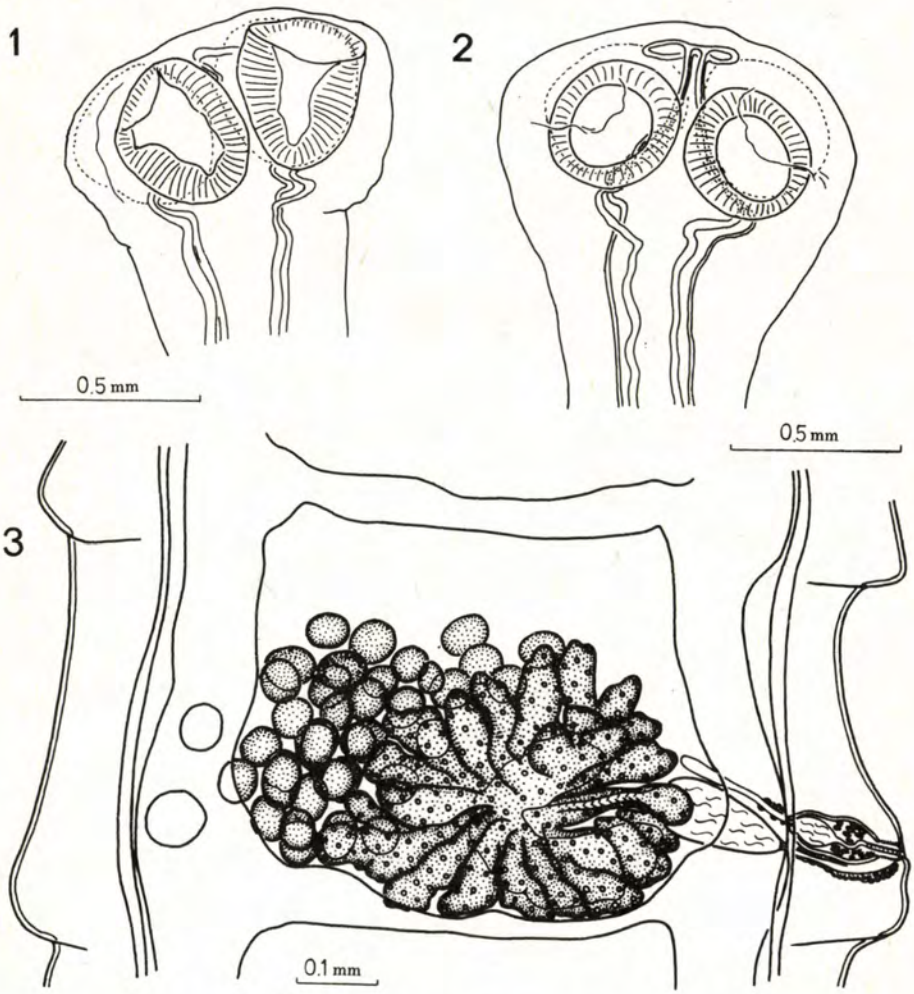
Other descriptions of this species appeared as late as in the 19th century. They are again very incomplete and the species may be identified only on the basis of the description and illustration by STIEDA (1862). As to the descriptions by DUJARDIN (1845) and LINSTOW (1878), we can only believe that really T. omphalodes Hermann, 1783 was involved.

Many detailed morphological characters of Anoplocephala omphalodes (Hermann, 1783) were described at the beginning of the 20th century by JANICKI (1906). On the other hand, some important metrical (as scolex, diameter, sucker diameter) or numerical (number of testes etc.) data are lacking and the material of A. omphalodes of JANICKI (1906) is a complex of spp.

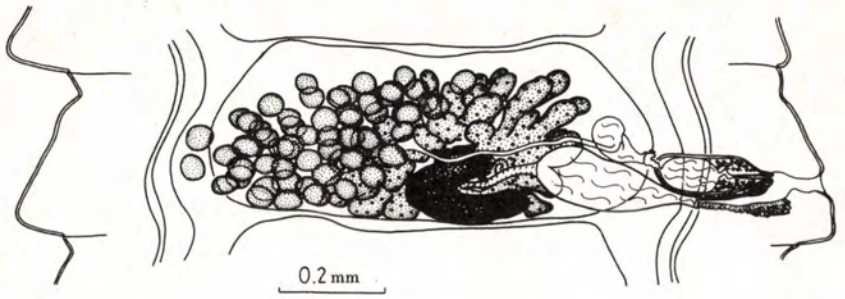
LÜHE (1910) established the genus Paranoplocephala. As it was said earlier, the author did not study any specimens of the type species (P. omphalodes), he incorrectly redrew the segment with uterus and thus caused an erroneous interpretation of uterus character, which was adopted in the literature for almost three-quarter of the century.

This character makes the genus Paranoplocephala very closely related to the genera Andrya and Aprostatandrya, but not to Anoplocephaloides.

Nevertheless, all these facts, i.e. the known close relation between the genera Paranoplocephala, Aprostatandrya and Andrya, the slight and hardly discernible differences between their characters (and between the species of these genera), as well as the difficulties in their correct identification, do not exclude the existence of synonyms, the identification of which is very difficult without actual material.



Figs 1-7: Paranoplocephala omphalodes (Hermann, 1783)
(1= scolex, host M. arvalis, Hungary; 2= scolex, host C. glareolus, Switzerland; 3= mature segment, host M. arvalis, Hungary; 4= mature segment, host C. glareolus, Switzerland; 5= mature segment, host M. arvalis, Hungary; 6-7= genital opening, cirrus, cirrus sac, vesicula seminalis interna, part of vesicula seminalis externa, vagina, part of seminal receptacle; 6= host C. glareolus Switzerland; 7= host M. arvalis, Hungary)



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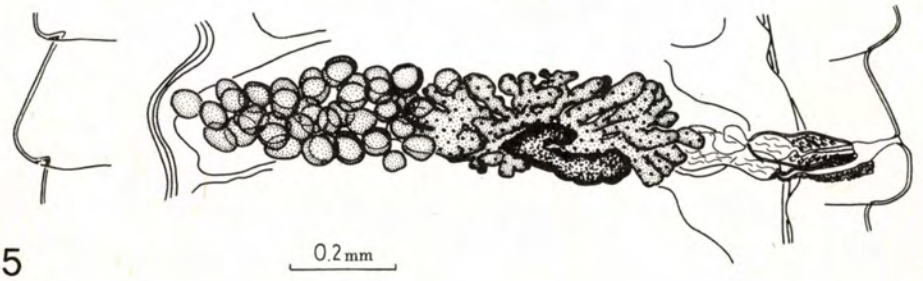

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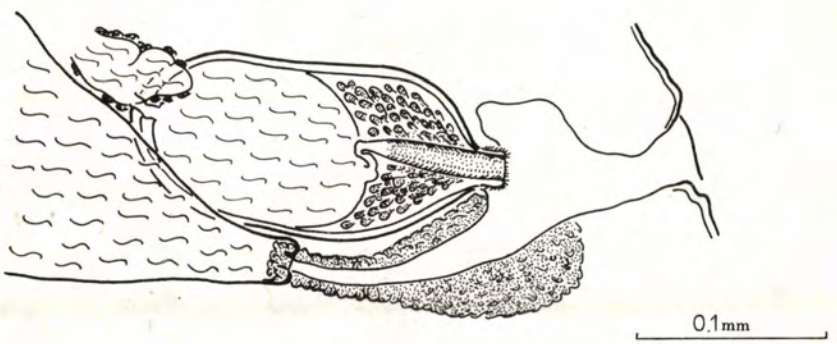

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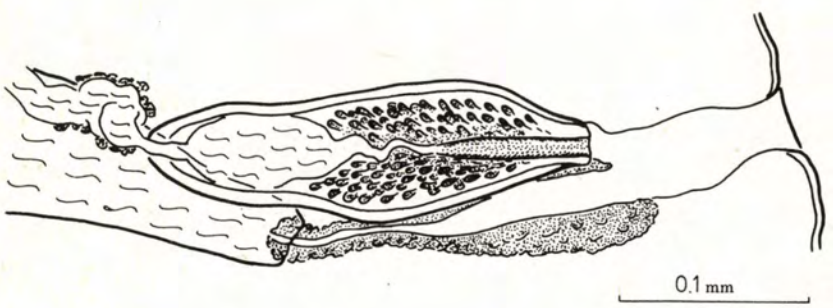

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BAER (1927) placed Bertia forcipata Linstow, 1904 in the synonymy of P. omphalodes.

JOYEUX and BAER (1936) also regarded P. blanchardi (Moniez, 1891) as a synonym of P. omphalodes.

SPASSKY (1951) considered B. forcipata Linstow, 1904 not to be a synonym of P. omphalodes and divided the latter species into two farms, "blanchardi" and "omphalodes". This concept has been adopted until the present time, particularly by Soviet authors (see summary in RYZHIKOV et al., 1978).

RAUSCH (1951, 1952) reported for the first time the occurrence of P. omphalodes in rodents in North America and pointed out that the finding of this species recorded by HARKEMA was erroneous and that A. microti Hansen 1947 was involved in that case.

In the opinion of TENORA and ZEJDA (1974), the specimens found in rodents from North America and identified as P. omphalodes belong in fact to a new cestode species.

COLLINS (1972) reported P. omphalodes in rodents from the Republic of South Africa (?, note of the authors) and regarded incorrectly P. acanthocirrosa Baer, 1924 as a synonym of this species.

RAUSCH (1976) reported P. omphalodes from rodents from North-eastern Siberia and Alaska and withdrew the species P. blanchardi and P. acanthocirrosa from the synonymy of P. omphalodes.

TENORA and MURAI (1980) redescribed P. omphalodes on the basis of their own material and the oldest available material studied by JANICKI, 1906. As to the character of the uterus development, they were of an opinion different from that of SPASSKY (1951, Russian text, p. 310, 311 : Uterus development like in P. brevis). They agreed with RAUSCH (1976) that the uterus takes a reticular character during its development.

RAUSCH (1982) repeatedly placed P. omphalodes to Holarctic elements.

TENORA, HAUKISALMI and HENTTONEN (1985) placed P. omphalodes to the genus Andrya.

In the present paper, the position of the testes in P. omphalodes is determined more exactly. The testes in the material studied by us always reached part of the ovary (Figs 3-5). In some cases, they extended up to the level of the middle of the vitelline gland (Fig. 4), in others behind the middle of the ovary (Fig. 3). The oldest data on the situation of the testes in this species were published by STIEDA (1862). In the figure drawn by this author the testes are situated aporally and do not overlap any part of the ovary. The similary position was observed only in the material shown in our Fig. 5 and in the specimens recovered from A. terrestris in Finland (compare TENORA, HAUKISALMI and HENTTONEN, 1985, Fig. 1). In our case (Fig. 5) the testes only slightly overlapped the aporal part of the ovary and were distant from the vitelline gland.

Also the ratio between the length of the cirrus sac and vagina is important for identification (see Figs 6, 7). The problem of the variability of P. omphalodes remains unsolved.

2. Paranoplocephala blanchardi (Moniez, 1891) (Figs 8-10)

Material studied: 29 specimens of 4 host species.

Hosts and localities:

Microtus arvalis - Switzerland, Cudrefin, 9 September, 1974. leg. VAUCHER, 3 specimens, MHNG 974/254, ex 120/41.

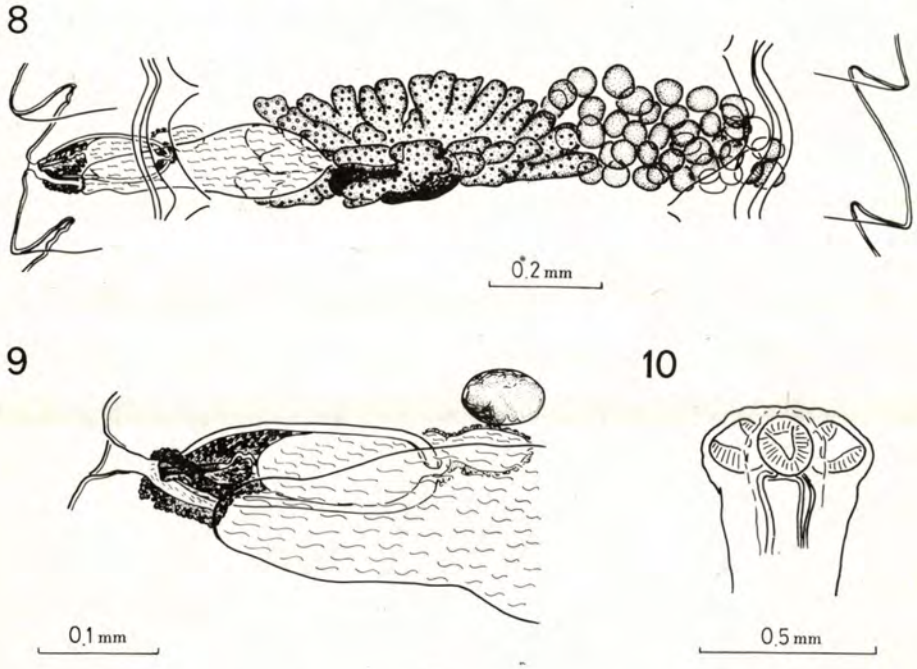
M. agrestis - Czechoslovakia, Vel'ka Fatra Mts, Lubochnianska dolina, 12-13 August, 1980, leg. MURAI, 4 specimens HNHM 1950/16289, 1958/16287.

Clethrionomys glareolus - Western-Hungary, Sopron Mts, Brennbergbánya, 25 April, 1972, leg. MURAI, 2 specimens, HNHM 3636.

Pitymys subterraneus - Western Hungary, Sopron Mts, Brennbergbánya, 24 September, 1971, leg. MURAI, 2 juvenile specimens, HNHM 3364; Czechoslovakia Nízke Beskydy Mts, Nižný Komarník, 19 September, 1979, leg. MURAI, 1 specimen, HNHM 1280/13910; Nízke Beskydy Mts, Huticko, Stebnická Huta, 13-14 September, 1979, leg. MURAI, 5 specimens, HNHM 1047/13527, 1111/13600, 1120/13613, 1125/13618, 1154/13669; Nízke Beskydy Mts, Becherov, 12 September, 1979, leg. MURAI, 2 specimens, 985/13393, 1017/13455; Čergov Mts, Hertnik, 26 August, 1980, leg. MURAI, 2 specimens, HNHM 2049/16496; Čergov Mts, Lenartov, 11 November, 1981, leg. MURAI, 2 specimens, HNHM 2704/23073, 2737/23115; Čergov Mts, Livov, 21-22 April, 1982, leg. MURAI, 6 specimens, HNHM 2749/23823, 2758/23893, 2768/23874, 2802/23887, 2818/23906, 2825/23917.

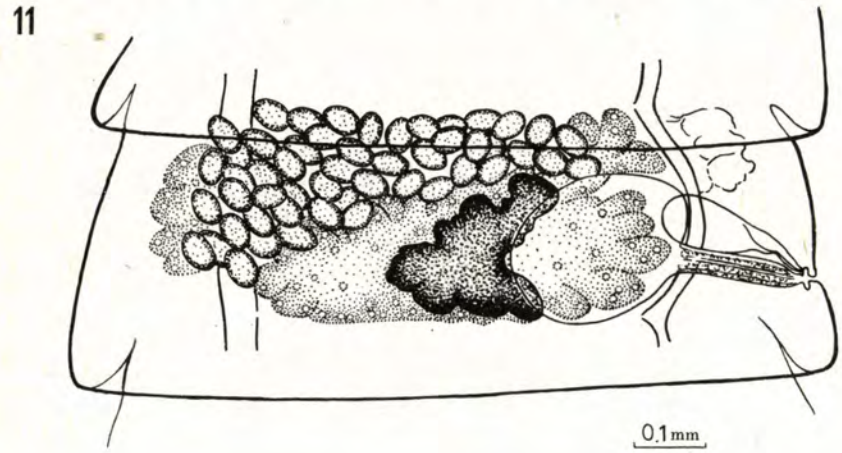
Pitymys subterraneus - Switzerland, Bretolet VS, 2. September, 1966, 7 September, 1968, 2 specimens, MHNG 966/105, 966/107 - erraneously recorded as P. gracilis (TENORA and MURAI, 1980).

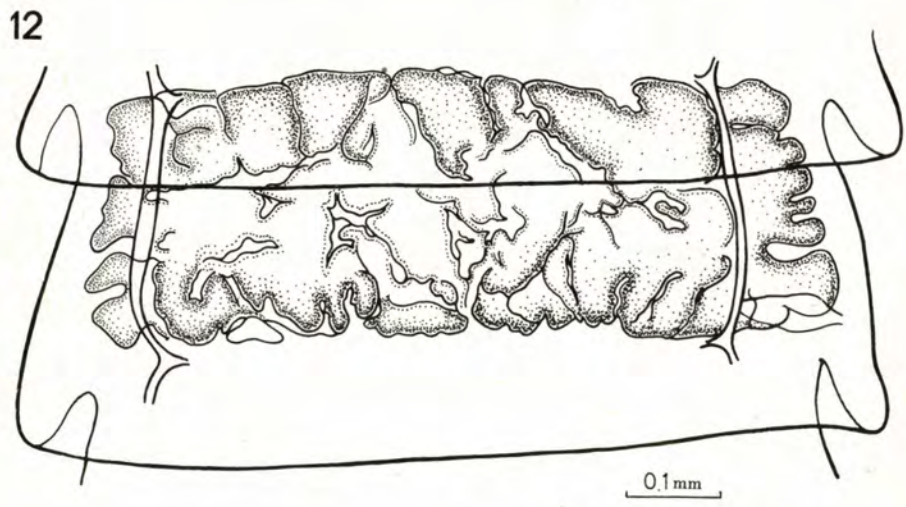
REDESCRIPTION: Strobila 40-60 (the oldest one 85) long, with 150-175 (198 in the oldest specimen) segments. Maximum width 2.8. Length: width ratio of mature segments 1:5-6,6, 1:4-7 of postmature and 1:3.1-4.5 of the old segments with ripe eggs. Scolex 0.36-0.40 long and 0.42-0.52 wide. Suckers 0.150-0.180 in diameter. Neck discernible but short and not smaller than the scolex. Genital pore unilateral, opening in middle part of the side of the



Figs 8-10: Paranoplocephala blanchardi (Moniez, 1891)
(8= mature segment; 9= genital opening, cirrus, cirrus sac, vesicula seminalis interna and externa, vagina, part of seminal receptacle, testes near vesicula seminalis externa (exception); 10= scolex; 8-10= host, M. arvalis, Switzerland, Cudrefin)

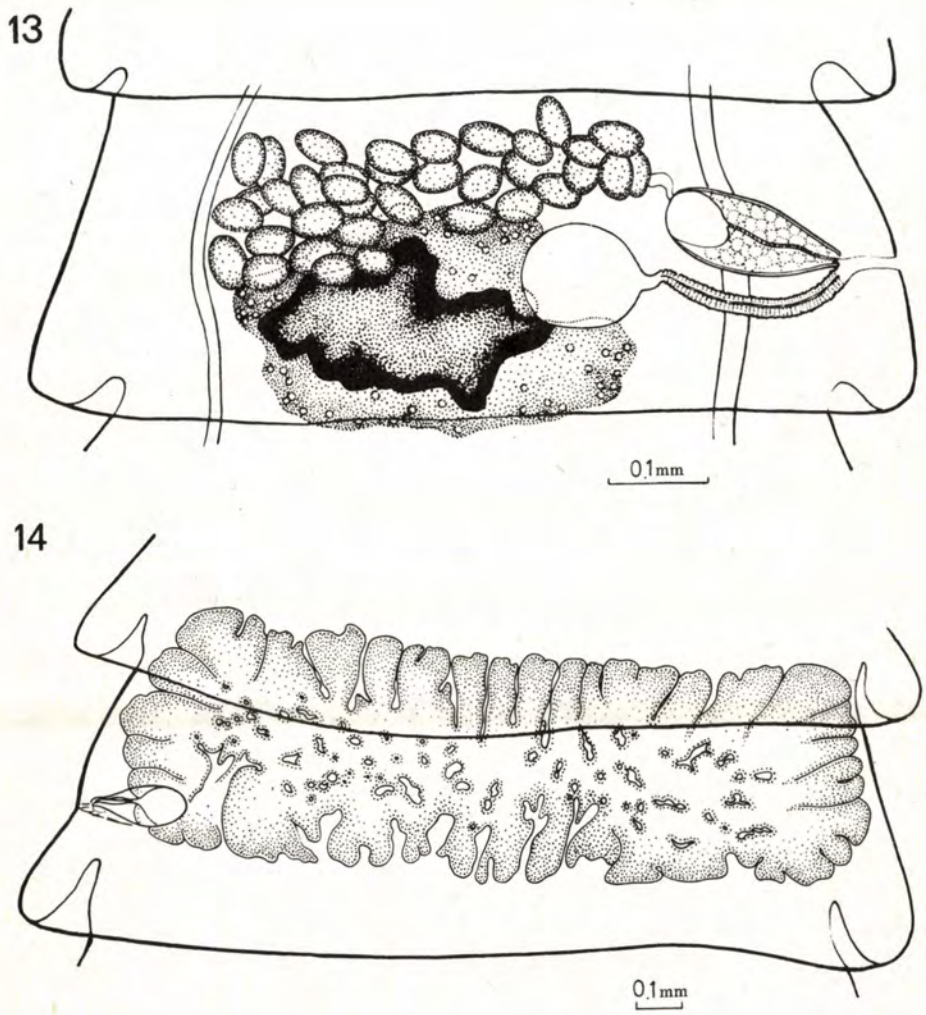
segments. Genital ducts passing dorsally across longitudinal excretory canals. Ventral canal 0.04-0.06 in diameter, dorsal canal 0.3-0.4 in diameter. Cirrus sac in mature segments 0.18-0.22 long and 0.06-0.10 wide. Maximum size of cirrus sac in postmature segments 0.25x0.11. Cirrus spinose. Cirrus sac slightly overlapping ventral excretory canal. Internal seminal vesicle attaining the size 0.06-0.11x0.04-0.06 in mature segments and 0.10-0.17x 0.08-0.10 in early gravid segments. External seminal vesicle present and somewhat coiled, with glandulose layer on its surface, 0.10-0.16x0.04-0.08 in size. Testes about 44-50 in number, distributed in one group from aporal part of ovary beyond the aporal ventral excretory canal, it is possible to find 1-2 testes anterior of the cirrus sac. Testes ovoid or globular, 0.04-0.08 (average 0.06) in diameter. Vagina short, thin-walled tube with glandulose layer on surface, 0.10-0.14 long and 0.02-0.03 wide in mature segments, reaching about 1/2





Figs 11-12: C. Joyeux's material and identification
"Anoplocephaloides blanchardi", host Microtus arvalis, locality Le Detroit, 4 August, 1924
(11= mature segment; 20= gravid segment)

(exceptionally 2/3) length of cirrus sac. Seminal receptacle 0.220-0.600 x 0.08-0.19, elongate and bottle-shaped. Ovary strongly lobed 0.28-0.30 wide and 0.60-0.75 long in last mature segments, occupying the poral 2 -4. sixth of the medullar parenchyme. Vitelline gland somewhat lobed, measuring 0.120-0.150 x 0.25-0.30. Uterus ventrally first visible as a transverse mucous sac, slightly anterior to ovary and testes, becoming reticulate and developing anterior, interior and posterior sacculations. Uterus apparently overlapping ventral longitudinal excretory canals. Eggs spherical 0.033-0.040 (average 0.036) in diameter. Pyriform apparatus well developed.



Figs 13-14: C. Joyeux material and identification "Paranoplocephala blanchardi, host M. agrestis, locality Buré, August, 1936, E. Murai determination 1980 - "P. gracilis" (19= mature segment; 20= gravid segment)

NOTE: The history of Paranoplocephala blanchardi (Moniez, 1891) is widely discussed in the paper of TENORA, HAUKISALMI and HENTTONEN (1985 a). These authors, like RAUSCH (1976), ascribe this cestode species to the genus Anoplocephaloides Baer, 1924 sensu Rausch, 1976. The data published in their paper should be supplemented with the following.

Only the author of the original description (MONIEZ, 1891) and latter JANICKI (1906) considered P. blanchardi bona species. Until 1976, when the paper by RAUSCH was published, the species P. blanchardi was regarded as a synonym of P. omphalodes. In that year, RAUSCH again considered P. blanchardi as bona species and assigned it to the genus Anoplocephaloides. As it is evident from the paper by TENORA, HAUKISALMI and HENTTONEN (1985 a), their concept of P. blanchardi probably includes more species.

We had the possibility of studying the material collected by JOYEUX in 1924 and 1936, which is deposited in Muséum d'Histoire Naturelle in Geneva. The material was recovered from Microtus arvalis, loc. Le Détroits, 4th August 1924 and from M. arvalis, loc. Buré, August 1936, and designated P. blanchardi (see Figs 11-14). This material was considered by BAER (1927) (personal communication of BAER to TENORA in 1969) to be bona species and the author (BAER, 1927) also synonymized A. dentata Galli-Valerio, 1905(!) with it. In the opinion of JOYEUX and BAER (1936), the material from the locality Buré was a synonym of P. omphalodes (see JOYEUX and BAER, 1936, p. 444, P. omphalodes, loc. Buré).

We have found, however, that in no case did the material (i.e. the material from 1924 and 1936) conform to the description of P. blanchardi published by BAER (1927) and to that of P. omphalodes (syn. P. blanchardi) by JOYEUX and BAER (1936): "Il y a environ 50 testicules situés dans la moitié antiporal du segment" (BAER, 1927). "Il existe une cinquantaine de testicules dans la partie antiporale du segment" (JOYEUX and BAER, 1936). In both cases (i.e. in the material from Le Détroit from 1924 and from Buré from 1936) the testes are situated in both poral and aporal parts of the segments (see fig. 11, 13). The cestodes (Fig. 11) closely resemble P. arctice Rausch, 1952 (compare the long cirrus sac). In 1980, the second author labeled one of the preparations of the material from Buré by the name P. gracilis. The close relation with P. gracilis is exhibited by the arrangement of the testes, the character of the seminal receptacle and the vagina: cirrus sac length ratio (1:1). New observations of this material shows, that the taxonomic position of this cestodes is not full clear (Fig. 13).

On studying our material from M. arvalis, loc. Cudrefin, September 1974, leg. VAUCHER, we found some basic characters which we consider, in comparison with the description by MONIEZ (1891), to be important for the identification of P. blanchardi:

- Cestodes parasitic in M. arvalis in Europe, characterized by unilateral genital pores.
- Cestodes of small size, about 50 mm in length.
- Cestodes the uterus of which has the type of Paranoplocephala.

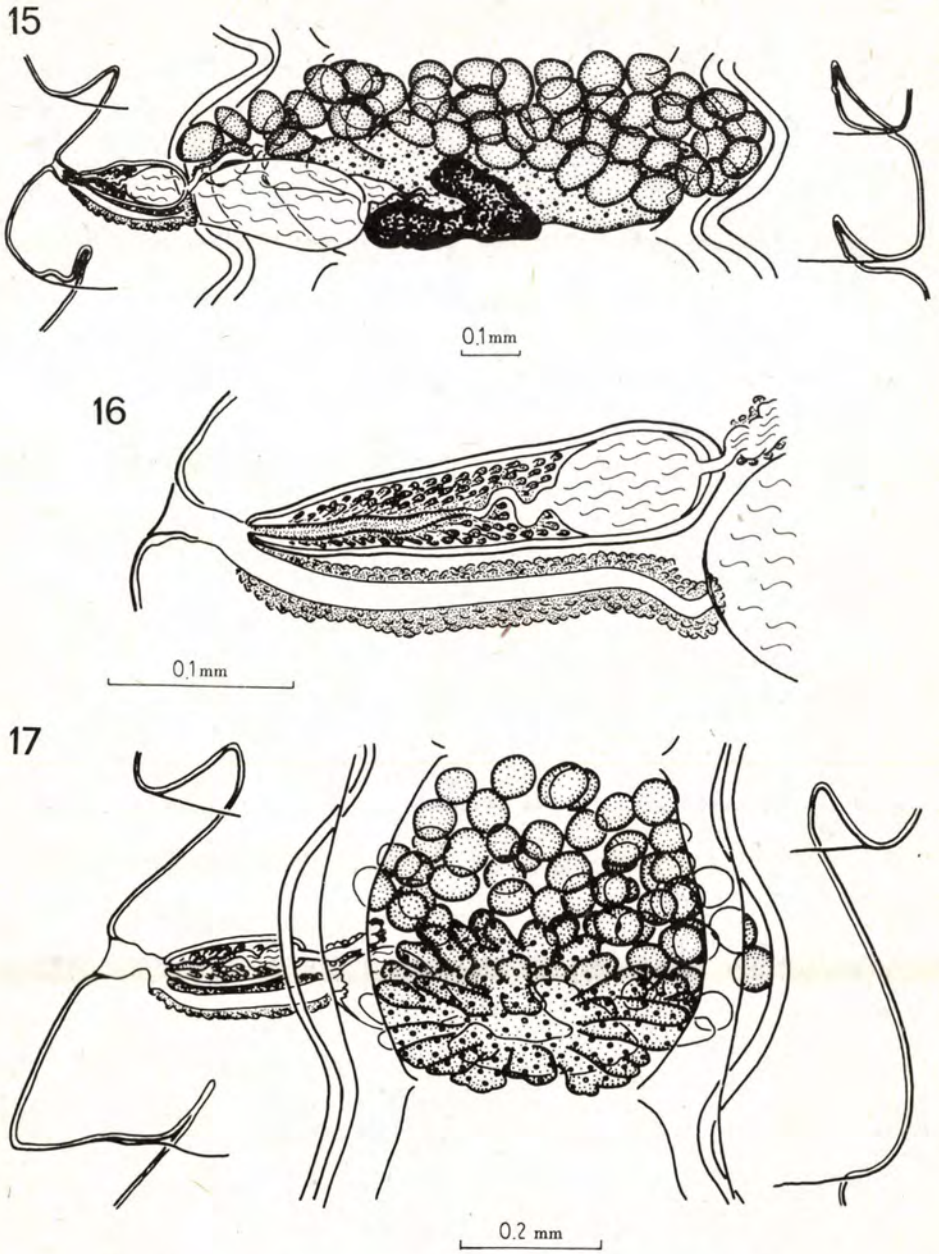
The specimens are very closely related to P. omphalodes, but differ from this species in the size and form of scolex and body, the cirrus sac: vagina length ratio, and the genital pores (unilateral) (compare Figs 6, 7 and 9).

We cannot even confirm the synonymy of P. campestris Cholodkowsky, 1912 and P. blanchardi. Due to our present knowledge of P. campestris it should be regarded rather as a species inquirenda.

Also the material identified as Anoplocephaloides cf. blanchardi by TENORA, HAUKISALMI and HENTTONEN (1985 a) does not belong to the species P. blanchardi. In this case further studies of a new material are necessary.

3. Paranoplocephala gracilis Tenora et Murai, 1980 (Figs 15-17)

Material studied: 60 specimens of the hosts Microtus agrestis, M. nivalis, Pitymys subterraneus, P. tatricus, Clethrionomys glareolus and Arvicola terrestris, material of first description (see TENORA and MURAI, 1980) and new findings from Pitymys tatricus Czechoslovakia, Vel'ka Fatra Mts, Lubochnianska dolina, 12 August, 1979, leg. MURAI.



Figs 15-17: Paranoplocephala gracilis Tenora et Murai, 1980
(15= mature segment, host P. subterraneus, Czechoslovakia; 16= genital opening, cirrus, cirrus sac, vesicula seminalis interna, vagina, part of seminal receptacle, host P. subterraneus, Czechoslovakia; 17= mature segment, host M. agrestis, Czechoslovakia)

DESCRIPTION. Medium sized anoplocephalid, strobila craspedote, 60-120 long, with 290-350 segments. Maximum width 1.5-2.5 (exceptionally 3). Average size of 10 adult specimens 100 x 2.1. Length: width ratio of mature segments 1:2-6, of postmature ones 1:4.5-10, of gravid segments 1:3-7. Scolex 0.35-0.42 long and 0.37-0.60 (average 0.45) wide. Suckers 0.18-0.24. Neck discernible, about 0.8 long. Genital pores unilateral, opening in middle of the side of the segments. Genital ducts passing dorsally across longitudinal excretory canals. Ventral canal 0.05-0.08 in diameter, dorsal 0.01-0.025 in diameter. Cirrus sac in mature segments 0.18-0.20 long and 0.07-0.09 wide. Maximum size of cirrus sac in postmature segments 0.25-0.28-0.09. Cirrus sac not overlapping ventral excretory canal. Cirrus spinose. Internal seminal vesicle attaining the size of 0.05-0.08 x 0.06-0.13. External seminal vesicle present and somewhat coiled. Testes about 40-55 (average 50) in number, distributed in poral and aporal part of segments, anteriorly to the female organs and extending beyond both sides of the excretory canals. Testes 0.07-0.08 (average 0.075) in diameter. Vagina thick-walled tube, 0.20-0.30 long and 0.04-0.06 wide in mature segments, as long as the cirrus sac. Seminal receptacle round or ovoid, 0.22-0.50 x 0.11-0.18 in size. Ovary 0.3-0.65 wide and 0.15-0.21 long in mature segments, occupying the poral 3/4 of the internal parenchyme. Vitelline gland somewhat lobed, measuring 0.16-0.30 x 0.06-0.14. Uterus first ventrally visible as transverse mucous sac, slightly anterior to ovary and testes, becoming reticulate and developing anterior, interior and posterior sacculations. Uterus overlapping ventral longitudinal excretory canals. Eggs spherical, measuring 0.037-0.048 (average 0.043) in diameter. Pyriform apparatus well developed.

NOTE. The species P. gracilis is known from the territories of Czechoslovakia, Hungary, Roumania, Poland and Switzerland (TENORA and MURAI, 1980, MURAI, MÉSZÁROS and STOLLMANN, 1984), from Finland (TENORA et al., 1985), and Bulgaria (GENOV, 1984). In the paper of TENORA, HAUKISALMI and HENTTONEN (1985a) it was considered as member of the genus Andrya.

A revision of the uterus development, however, confirmed the original description, in the genus Paranoplocephala. As to the Paranoplocephala species described from Europe, according to the present state of knowledge P. gracilis is a member of the species group known in Europe (see also P. ondatrae Rausch, 1948 and P. janickii sp. n. in the present paper) in which the testes are situated in both the poral and aporal parts of the segments (Figs 15 and 17). Another important character of this species is the ratio of the cirrus sac: vagina lengths, which is mostly 1:1 (Fig. 16). Also the seminal receptacle adhering to the opening of the vagina is characteristical in its oval shape.

Our new findings supplement also the knowledge of the variability of the mature segments, which are square or oblongated, elongate in a right-left direction.

Until the present time, the alternation of genital pores in P. gracilis has been reported only in one case (see Fig. 43 in the paper by TENORA and MURAI, 1980). The cestode specimen involved had a long series of genital pores on one side and another series on the other side. In all other cases the genital pores were markedly unilateral.

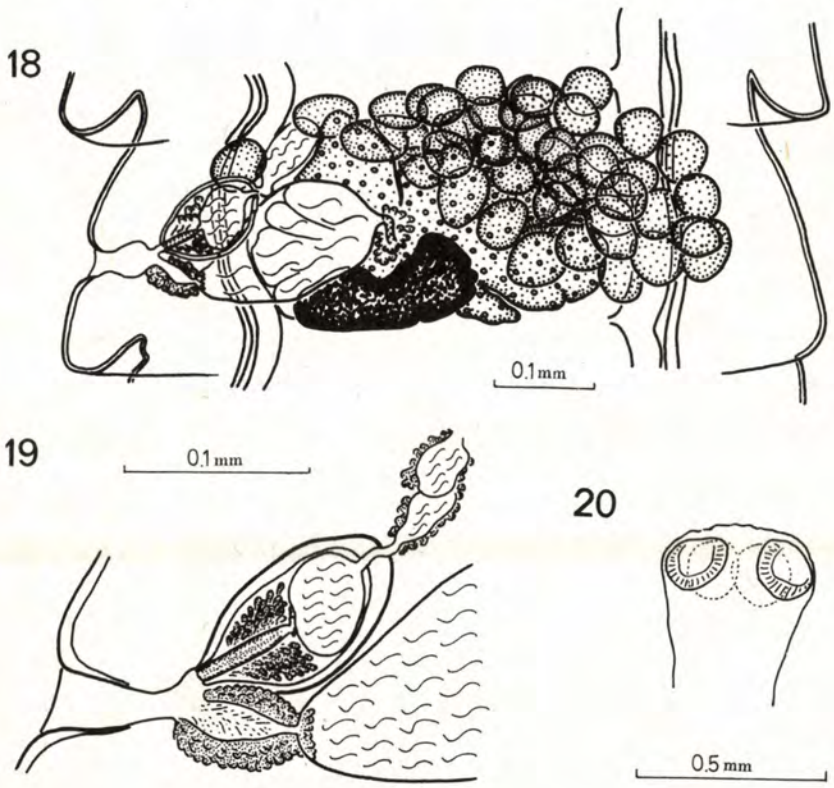
On the basis of the material brought to Geneva personally by Prof. S. MAS-COMA from Spain, we suppose that P. gracilis also occurs in A. terrestris in Spain. The material published by WAHL (1967) under the name A. caucasica (see WAHL, 1967, p. 152, Fig. 4) probably also belong to P. gracilis.

4. Paranoplocephala janickii sp. n. (Figs 18-20)

Material studied: 60 specimens from Microtus arvalis.
Localities and serial numbers of preparations.

HOLOTYPE: West Hungary, County Vas, Bük, 24 July 1975, from the intestine of Microtus arvalis, leg. MÉSZÁROS, - 2 slides, No 6722/1 deposited in the HNHM, No. 6722/2 in MHNG.

PARATYPES: All specimens from the typical host Microtus arvalis; West Hungary, County Vas, Bük, 28. February, 1973, leg. MURAI, HNHM 4389; Bük, 23 March, 1973, leg. MURAI, HNHM 4408; Bük, 22 March, 1973, HNHM 4410; Bük, 23 March, 1973, leg. MURAI, HNHM 4414/1 and 4414/2; Bük, 23 March, 1973, leg. MURAI, HNHM 4418/1, 4418/2; Bük, 23 March, 1973, leg. MURAI, HNHM 4435; Bük, 24 August, 1973, leg. MURAI, HNHM 4971/2; Bük, 24 August, 1973, leg. MURAI, HNHM 4979/2, 4979/3; Bük 19 September, 1973, leg. MÉSZÁROS, HNHM 5022; Bük, 14 September, 1973, leg. MÉSZÁROS HNHM 5104; Bük, 14 November, 1973, leg. MATSKÁSI, HNHM 5242; Bük, 15 November, 1973, leg. MATSKÁSI, HNHM 5276; Bük, 15 September, 1973, leg. MATSKÁSI, HNHM 5283; Bük, 20 March, 1974, leg. MURAI, HNHM 5507/1; Bük, 6 June, 1974, leg. MÉSZÁROS, HNHM 5613; Bük, 6 June, 1974, leg. MÉSZÁROS, HNHM 5621; Bük, 26 June, 1974, leg. MURAI, HNHM 5668; Bük, 26 June, 1974, leg. MURAI, HNHM 5670; Bük, 24 July, 1974, leg. MURAI, HNHM 5752/1, 5752/2; Bük, 24 July, 1974, leg. MURAI, HNHM 5754; Bük, 25 July, 1974, leg. MURAI, HNHM 5840/2; Bük, 25 July, 1974, leg. MURAI, HNHM 5848/1; Bük, 25 July, 1974, leg. MURAI, HNHM 5854/1; Bük, 14 August, 1974, leg. MURAI, HNHM 5912; Bük, 14 August, 1974, leg. MURAI, HNHM 5921/1, 5921/2; Bük, 14 August, 1974, leg. MURAI, HNHM 5923/1, 5923/2; Bük, 15 August, 1974, leg.



Figs 18-20: Paranoplocephala janickii sp. n.
(18= mature segment; 19= genital opening, cirrus, cirrus sac, vesicula seminalis interna, vesicula seminalis externa, vagina, part of seminal receptacle; 20= scolex, 18-20= host M. arvalis, Bük, Hungary, Holotype)

MURAI, HNHM 5932; Bük, 15 August, 1974, leg. MURAI, HNHM 5933/1; Bük, 15 August, 1974, leg. MURAI, HNHM 5935; Bük, 17 October, 1974, leg. VAJDA, HNHM 6153/1, 6153/2; Bük, 17 October, 1974, leg. VAJDA, HNHM 6156; Bük, 17 October, 1974, leg. VAJDA, HNHM 6160; West Hungary, County Vas, Bozsok, 23 August, 1973, leg. MURAI, HNHM 4941/1, 4941/2-3; Bozsok, 25 August, 1973, leg. MURAI, HNHM 4945; Bozsok, 14 August, 1974, leg. MATSKÁSI, HNHM 5073; Bozsok, 14 August, 1974, leg. MURAI, HNHM 5865/5; Bozsok, 14 August, 1974, leg. MURAI, HNHM 5874; Bozsok, 14 August, 1974, leg. MURAI, HNHM 5885; Bozsok, 26 September, 1974, leg. MURAI, HNHM 6020/3; West Hungary, County Vas, Vép, 23 July, 1974, leg. MURAI, 5860/1, 5860/10, 5860/12; County Pest, Gödöllő Hills, Babat, 26 August, 1978, leg. DEMETER, HNHM 7949/1, 7949/2; Babat, 19-21 August, 1979, leg. DEMETER, HNHM 8369/1, 8369/2-3; Babat, 17 October, 1979, leg. DEMETER, HNHM 8869/1-2; Babat, 17 October, 1979, leg. DEMETER, HNHM 8874.
France, Chamu, 9 September, 1943, ex Microtus arvalis, leg. JOYEUX, Coll. MHNG, 2 specimens.

Localization in the hosts: small intestine. Intensity: 1-8 specimens.

DESCRIPTION: Strobila 40-100 long (average of 15 adult specimens 50) with 260-330 segments. Craspedote. Width 1.6-2.5, in average 2.0. Length: width ratio of mature segments 1:4-6, of postmature ones 1:4-9 of old segments with ripe eggs 1:3.2-6. Scolex 0.30-0.44 long and 0.32-0.45 wide. Suckers 0.17-0.22. Neck discernible, 0.5-0.7 long. Genital pores unilateral, opening in middle of the side of the segments. Genital ducts passing dorsally across longitudinal excretory canals. Ventral excretory canal 0.04-0.07 in diameter, dorsal canal 0.015-0.025 in diameter. Cirrus sac in mature segments 0.170-0.220 long and 0.07-0.09 wide, lemon-shaped. Maximum size of cirrus sac in postmature segments 0.25 x 0.095. Cirrus sac only slightly overlapping ventral excretory canal. Cirrus spinose. Internal seminal vesicle attaining the size of 0.05-0.08 x 0.07-0.10 in mature segments, and 0.08-0.09 x 0.11-0.14 in early gravid segments. External seminal vesicle present and somewhat coiled, 0.06-0.12 x 0.04-0.08. Testes 50-55 (60) in number, 0.04-0.06 (average 0.05) in diameter, distributed in aporal and poral part of segments anteriorly to the female genital organ, in aporal part of segments overlapping beyond ventral excretory canal. Vagina a short, thick-walled tube, 0.09-0.14 (maximum 0.16) long and about 0.045-0.07 in diameter in mature segments, reaching midlength (maximum at 2/3 of the length) of cirrus sac. Seminal receptacle elongate, bottle-shaped, 0.12-0.20 x 0.20-0.36 in size. Ovary occupying the poral 2/3 of the medullar parenchyme, 0.37-0.49 wide and 0.12-0.19 long in last mature segments. Vitelline gland somewhat lobed, measuring 0.18-0.28 x 0.08-0.13. Uterus ventrally first visible as transverse mucous sac, slightly anterior to ovary and testes, becoming slightly reticulate and developing anterior, interior and posterior sacculations. Uterus apparently overlapping ventral longitudinal excretory canals. Eggs spherical, 0.03-0.04 (average 0.040) in diameter. Pyriform apparatus well developed.

The new species is named in honour of Dr. Constantin JANICKI, professor of zoology in Varsovie, who made the first detailed description of paranoplocephalid cestodes, on the occasion of the 110th anniversary of his birth.

DIFFERENTIAL DIAGNOSIS, P. janickii sp. n. is most closely related to P. gracilis Tenora et Murai, 1980 in the situation of the testes in both aporal and poral parts of the segments. The characters differentiating between P. janickii and P. gracilis are as follows:

- metrical: P. janickii n. sp. is smaller than P. gracilis
- cirrus sac: vagina length ratio 1:0.5-0.65 in P. janickii n. sp. and 1:1 in P. gracilis.

The comparison data of P. gracilis and P. janicki sp. n. are shown in Table 1.

P. ondatrae Rausch, 1948 is also a related species of P. janickii sp. n., both have testes anteriorly to the ovary. It differs in the number of testes (P. ondatrae has 80, the sp. n. 40-55 testes); the form of the seminal receptacle, and all metrical characters (see TENORA and MURAI, 1980).

Table 1 Morphological data of Paranoplocephala gracilis Tenora et Murai, 1980 and P. janickii sp. n. (all measurements in mm)

	P. gracilis	P. janickii sp. n.
Length of strobila	60 - 120 (av. 100)	40 - 100 (av. 50)
Width of strobila	1.5 - 2.5 (av. 2.1)	1.6 - 2.5 (av. 2.0)
Scolex diameter	0.37 - 0.60	0.32 - 0.45
Sucker diameter	0.18 - 0.24	0.17 - 0.22
Cirrus sac size	0.18 - 0.20 (mature) 0.25 - 0.28 (postmature)	0.14 - 0.17 (mature) 0.17 - 0.22 (postmature)
Cirrus sac : vagina length ratio	1 : 1	1 : 2 (1.6)
Vagina length	0.20 - 0.30	0.09 - 0.14 (max. 0.16)
Ovary size and position	0.30 - 0.65 poral 3/4 of middle field	0.37 - 0.49 poral 2/3 of middle field
Size and form of seminal receptacle	0.22-0.50 x 0.11-0.18 round or ovoid	0.20-0.36 x 0.08-0.12 bottle-shaped
Testes position	aporal and poral overlapping both v. excretory canals	more in aporal part, less in poral part, anteriorly to ovary, crossing v. excretory canals
Testes number	40-55 (av. 43)	40-55 (av. 48)
Egg diameter	0.037 - 0.048 (av. 43)	0.036 - 0.042 (av. 40)
Hosts	Microtus agrestis, P. subterraneus, P. tatricus, Clethrionomys glareolus, Arvicola terrestris	Microtus arvalis

Of the other Paranoplocephala species, P. janickii sp. n. resembles most P. blanchardi (Moniez, 1891), differing from it in the position of the testes.

Other related species described from the U.S.A. are: P. communis, (Douthitt, 1915) and P. macrocephala (Douthitt, 1915). P. janickii sp. n. completely differs from both in the cirrus sac: vagina length ratio.

TENORA, F. — MURAI, É. — VAUCHER, C.: Néhány európai rágcsálókban élősködő Paranoplocephala fajról (Cestoda: Anoplocephalidae)

A szerzők új szempontok szerint végzett morfológiai elemzés alapján adják néhány, európai rágcsálókban élősködő Paranoplocephala faj részletes leírását: Paranoplocephala omphalodes (Hermann, 1783), P. blanchardi (Moniez, 1891), P. gracilis Tenora et Murai, 1980. Egy tudományra új faj leírására is sor kerül: P. janickii sp. n., a mezei pocok élősködője magyarországi és francia lelőhelyekről.

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