FOLIA PARASITOLOGICA (PRAHA) 32: 21—33, 1985.

REVIEW OF NOTOCOTYLUS SPECIES (TREMATODA: NOTOCOTYLIDAE) PARASITIZING RODENTS IN EUROPE[1]

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Abstract. Material of species of the genus *Notocotylus* Diesing, 1839 (Trematoda: Notocotylidae) parasitizing rodents in different parts of Europe are reviewed. Three species can be distinguished and therefore are accepted as valid: *N. noyeri* Joyeux, 1922; *N. neyrai* Gonzalez Castro, 1945; and *N. gonzalezi* sp. n.

In 1899, the French A. Lucet collected some trematodes from the caecum of one specimen of *Arvicola amphibius* (L., 1758) (= *A. terrestris amphibius* according to the last review of Reichstein 1982) (Rodentia: Arvicolidae) coming from Courtenay (Loiret, France). These flukes were then described by Joyeux (1922) as a new species named *Notocotylus noyeri*.

Gonzalez Castro (1945) found some notocotylids in the caecum of *A. sapidus* in Granada (Spain). The morphology of these specimens differed from that described by Joyeux (1922). Consequently, the Spanish author erected a new species with the name *N. neyrai*.

Nevertheless, Dubois (1951) had later the opportunity of reviewing the type material of *N. noyeri*. He verified that the description by Joyeux (1922) was partly deficient and concluded that both species do not differ, *N. neyrai* Gonzalez Castro, 1945 thus becoming a synonym of *N. noyeri* Joyeux, 1922. This synonymy has been accepted with concrete mention by Odening (1964, 1966), Odening and Bockhardt (1965) and Yamaguti (1971, 1975). On the basis of this fact and without referring to the question, numerous authors have always determined their European materials of *Notocotylus* parasitizing rodents as *N. noyeri*. Accordingly, until now this last species has been mentioned in the majority of European countries, more concretely in France (Joyeux 1922), Great Britain (Baylis 1928, 1939), GDR (Stammer 1955, Odening 1966, Odening and Bockhardt 1965), Poland (Soltys 1957), Czechoslovakia (Erhardová 1955, 1956, 1958, Tenora 1957, 1972, Prokopič and Genov 1974), Bulgaria (Dimitrova et al. 1962), Roumania (Chiriac and Popescu 1969), USSR (Skvortsov 1934, Vysotskaya 1948, Kirschenblatt 1948, Dubinin 1953, Razumova 1956, Morozov 1958, Merkusheva 1963, Shaldybin 1964 and other authors mentioned in the review by Ryzhikov et al. 1978) and Spain (Mas-Coma 1976, Mas-Coma and Gállego 1977).

Only Shaldybin (1965) distinguished the parasites found by him in *Clethrionomys glareolus* in Gorki Region (USSR) as a different species, which he denominated *N. wet-*

[1] The authors want to dedicate this paper to Prof. Dr. José González Castro, Director of the Department of Parasitology of the Faculty of Pharmacy of the University of Granada (Spain).

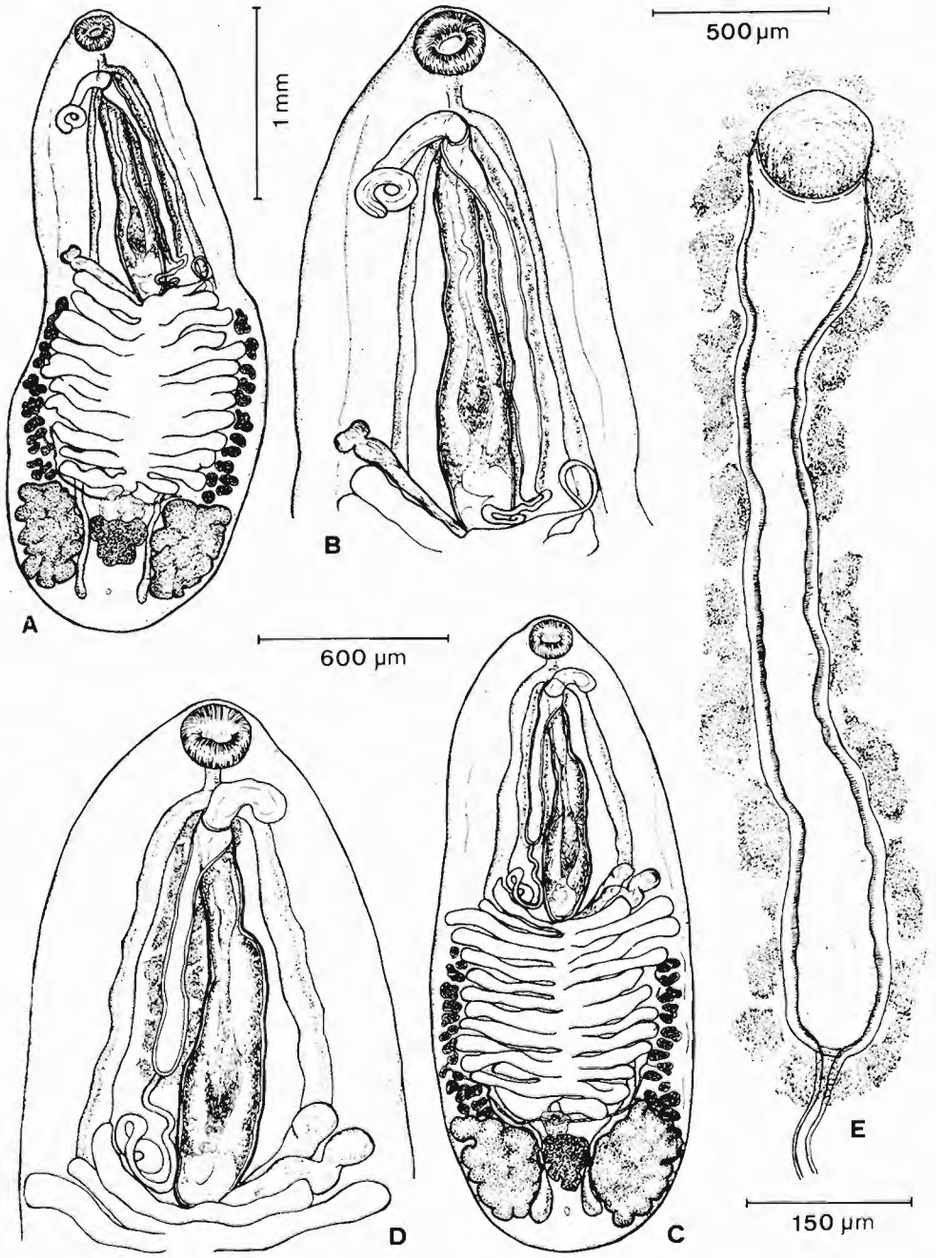

Fig. 1. *Notocotylus noyeri* Joyeux, 1922 (type specimens: A, C) total specimens in ventral view; B, D) anterior part of the same specimens in ventral view; E) detail showing metraterm and metratermic glands. A, C: scale 1 mm; B: 500 µm; D: 600 µm; E: 150 µm.

lugensis. This species was accepted by Yamaguti (1971: 715), but pointing out that its generic identity is doubtful (probably referring to the caecal diverticles present in this species). Nevertheless, Sharpilo (1973) synonymized later *N. wetlugensis* with *N. noyeri*. This synonymy was later accepted by Ryzhikov et al. (1978). Anyhow, Tenora et al. (1983) questioned it, because the characteristics as the processes in the intestinal branches and the number of vitellaria suggest a valid species.

A curious mention is that of Melnichenko (1961), who found some digeneans in *A. terrestris* from the Ukraine (USSR), determinating them as *N. marinus* Ginetsinkaya et Naumov, 1958. Later, Sharpilo (1973) synonymized *N. marinus* sensu Melnichenko, 1961 with *N. noyeri* too.

Finally, there is the erroneous mention of *N. noyeri* in *A. terrestris* and *Microtus arvalis* from Armenia done by Shcherbakova (1942). In this case the notocotylids had 4 rows of ventral glands and became later the type specimens of a new species and genus, *Tetraserialis stcherbakovi*, described by Petrov and Chertkova (1960). It shall be taken into account, however, that Dimitrova et al. (1962) have found intermediate forms (*Notocotylus* showing the tendency to have 4 rows of ventral papillae), thus questioning the validity and differentiation of the genus *Tetraserialis* from *Notocotylus*.

According to the literature, a lot of rodents from the family Arvicolidae (=Microtidae) act as definitive hosts of *N. noyeri*. Concrete species mentioned are: *Arvicola terrestris* (L., 1758); *A. sapidus* Miller, 1908; *Microtus* (*M.*) *agrestis* (L., 1761); *M.* (*M.*) *arvalis* (Pallas, 1779); *M.* (*M.*) *oeconomus* (Pallas, 1776); *M.* (*Pitymys*) *subterraneus* (de Sélys-Longchamps, 1836); *Clethrionomys glareolus* (Schreber, 1780); and *Ondatra zibethica* (L., 1766). There are also authors who have determined their parasites from birds as *N. noyeri* (see Ablasov and Iksanov 1958).

The life cycle of *N. noyeri* has been studied only by Odening and Bockhardt (1965) and Odening (1966) in Berlin (GDR). These authors found the following aquatic pulmonate gastropods acting as intermediate hosts: *Bathyomphalus contortus* (L.), *Anisus luecostomus* (Millet) and *A. vortex* (L.) (Planorbidae).

In spite of the fact that all above listed authors traditionally assigned their own materials to the species *N. noyeri* and none to *N. neyrai*, Simón-Vicente (1976) questioned the synonymy basing on his own findings of larval forms and adults parasitizing rodents in Salamanca (Spain). A first study done in this sense (Simón-Vicente et al. 1979) showed that the Spanish author was right and that there were three different forms for adults.

The present paper is a new review of this problem based on the analysis and comparison of numerous materials of *Notocotylus* from rodents coming from different localities of Europe and on the study of the life cycle, biology and ecology of the parasite found in Salamanca (Iberian Peninsula) in comparison with the life cycle described in Berlin by Odening and Bockhardt (1965) and Odening (1966).

MATERIALS

The following materials of adult flukes coming from natural infestation have been studied:

— Lodosa (Navarra, Spain): 227 specimens from *A. sapidus*;
— Viladrau (Barcelona, Spain): 22 specimens from *A. sapidus*;
— Alpujarras (Granada, Spain): 61 specimens from *A. sapidus*;
— Los Villares de la Reina (Salamanca, Spain): 1170 specimens from *A. sapidus* and 8 specimens from *Apodemus sylvaticus*;
— Guadramiro (Salamanca, Spain) 124 specimens from *A. sapidus*;
— Villanueva de los Escuderos (Cuenca, Spain): 17 specimens from *Microtus cabrerae* Thomas, 1906;

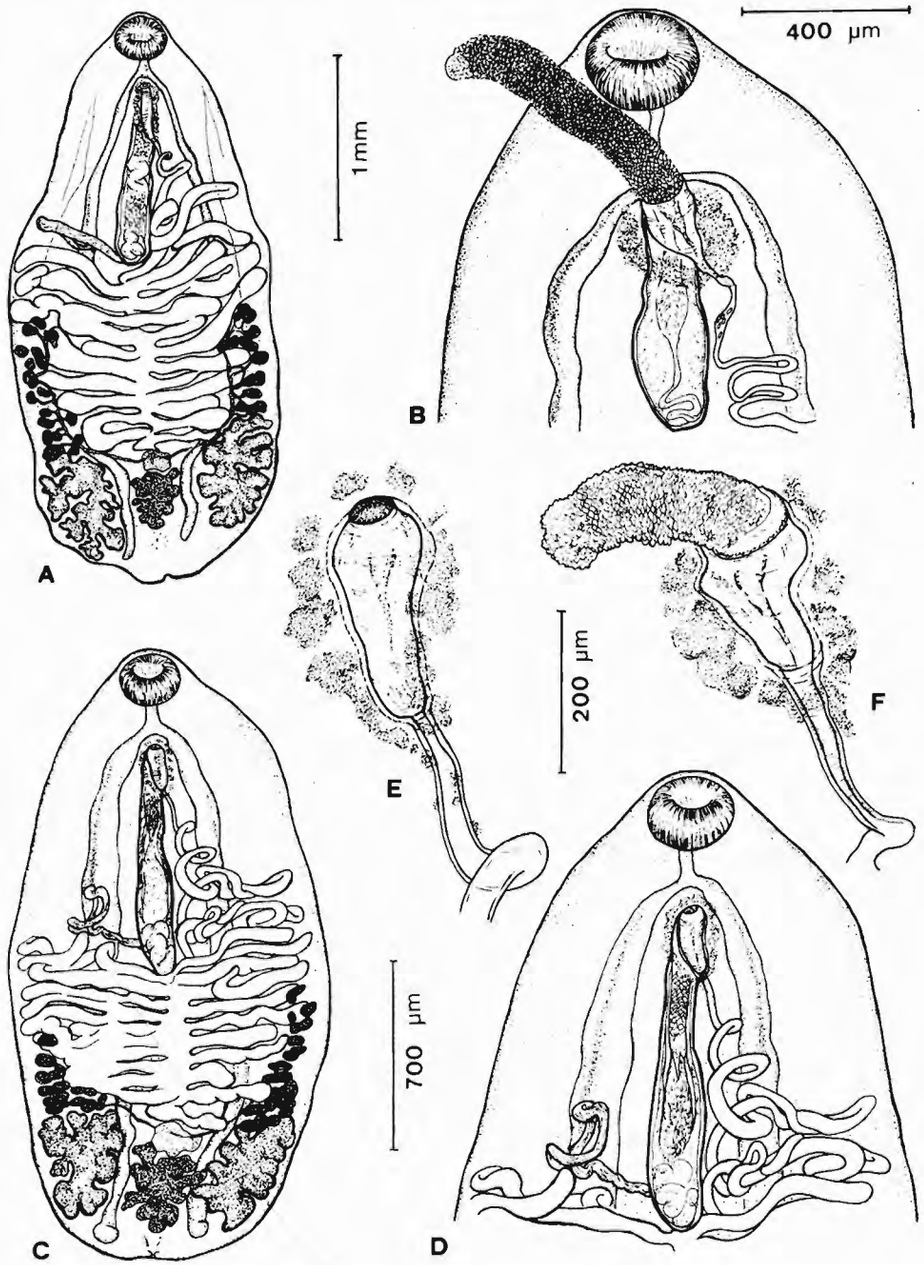

Fig. 2. *Notocotylus neyrai* Gonzalez Castro, 1945: A, C) total specimens in ventral view; B, D) anterior part of two specimens in ventral view; E) detail of last part of uterus showing metraterm and metratermic glands; F) same detail showing cirrus partly evaginated. A, C: scale 1 mm; B: 400 µm; D: 700 µm; E, F: 200 µm.

— Courtenay (Loiret, France): 6 specimens from *A. terrestris* (type specimens from *N. noyeri* Joyeux, 1922 gently loaned by M. Georges Dubois-Corcelles, Switzerland). In the Musée National d'Histoire Naturelle of Paris a tube containing 2 specimens could be found; this tube shows on its etiquette what follows: "Collection R. Blanchard; Cat. No. 666; Nom: *Notocotylus verrucosum*; hôte: *Arvicola amphibius* (caecum); Localité:Courtenay (Loiret); Recueilli par: M. Lucet; Date: 1889". As it can be seen, these data are exactly the same as those pointed out by Joyeux (1922), except the species name. This last author did not write the number of specimens in the tube in his paper, but these two specimens shall be considered undoubtedly as paratypes. These two specimens, conserved in alcohol, were gently loaned for study by M. Alain—G. Chabaud (Paris), but unfortunately they are today in a very bad state;
— Jeseníky (Czechoslovakia): 15 specimens from *M. subterraneus* and 13 specimens from *M. agrestis*;
— Pallasjärvi (Finland): 4 specimens from *M. oeconomus*, 12 specimens from *M. agrestis* and 6 specimens from *C. glareolus*.

RESULTS AND DISCUSSION

Comparative study of adult stages

The problems posed by notocotylids in general are related to the great intraspecific variability shown by the species and to the great similarities existing between different species (Kinsella 1971). Among the genus *Notocotylus* Diesing, 1839, the problems increase due to the great number of described species (see Yamaguti 1971, Groschaft and Tenora 1981), while the authors did not come to an agreement about which of the morphoanatomic elements have a systematic value.

The same problem arose in the present study. However, a comparative and detailed analysis allowed to distinguish three different forms on the basis of the following characters:

— Form A (Fig. 1): cirrus unarmed and smooth; metraterm large, long and rectilineal, followed all its length by a collar of glands. This form concerns the type specimens of the species *N. noyeri* described by Joyeux (1922) and parasites of *A. terrestris* in Courtenay (France);
— Form B (Fig. 2): cirrus strongly spined; metraterm short, forming a funnel surrounded by a glandular collar. This form concerns the species *N. neyrai* after the original description by Gonzalez Castro (1945) and the material here studied parasitizing *A. sapidus* from Lodosa, Viladraus Los Villares de la Reina and Guadramiro (Spain) and Jeseníky (Czechoslovakia), *A. sylvaticus* from Los Villares de la Reina (Spain), and part of the material parasitizing *M. cabrerae* from Villanueva de los Escuderos (Spain);
— Form C (Fig. 3): cirrus unarmed and smooth; metraterm not very long, forming initially some metratermic loops and finally a funnel-shaped end; metratermic glands run along the whole length of the metraterm (coiled part + funnel-shaped part). This form concerns the materials studied in this paper and parasitizing *A. sapidus* from Alpujarras, a part of the notocotylid flukes found to infect *M. cabrerae* from Villanueva de los Escuderos (Spain) and all the parasites of *M. oeconomus*, *M. agrestis* and *C. glareolus* from Pallasjärvi (Finland).

Results of the comparative morphometric study of these three forms are shown in Table 1. It can be seen that the measurements, as the size of body, oral sucker, testes and ovary and eggs and also the number of ventral papillae, vitelline follicles and principal uterine loops posterior to cirrus sac, overlap clearly in all cases. The only significant differences are the length of cirrus sac and metraterm and their ratio. These elements are related to structural characters as the spinulation or non-spinulation of the cirrus, the form of the metraterm itself and the extent of the metratermic glands.

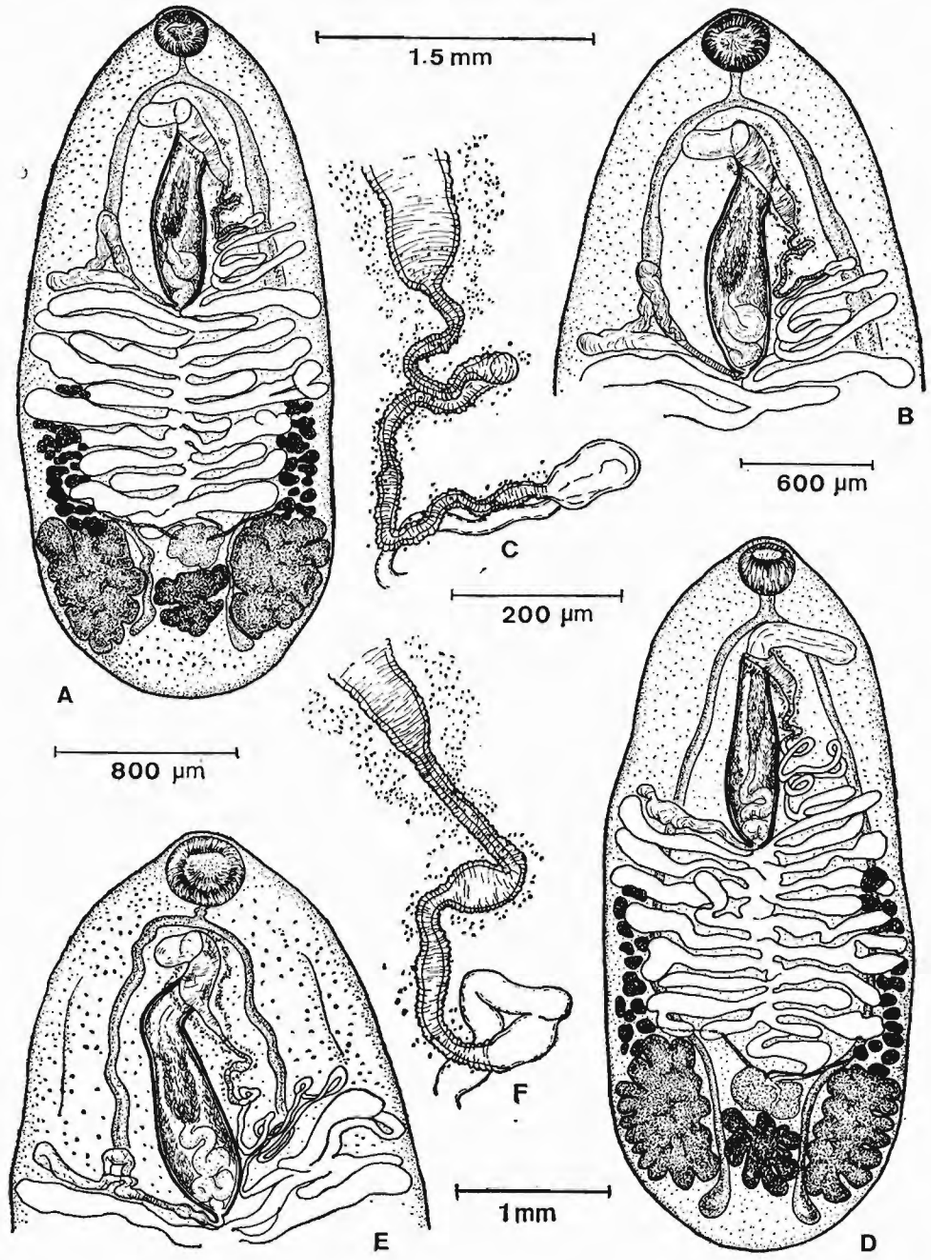

Fig. 3. *Notocotylus gonzalezi* sp. n.: A, D) total specimens in ventral view; B, E) anterior part of two specimens in ventral view; C, F) detail of last part of uterus of two specimens showing metraterm and metratermic glands. A: scale 1,5 mm; B: 600 µm; C, F: 200 µm; D: 1 mm; E: 800 µm.

Table 1. Morphoanatomic comparison of *Notocotylus* species parasitizing rodents in Europe

Species Form No. specimens studied Measurements done by	*Notocotylus noyeri* Form A n = 6 (type specimens) S. Mas-Coma		*Notocotylus neyrai* Form B n = 64 F. Simón—Vicente		*Notocotylus gonzalezi* sp. n. Form C n = 61 R. López—Román	
Ranges and means	E. V.	$\bar{X}$	E. V.	$\bar{X}$	E. V.	$\bar{X}$
Length	2917—4160	3457	1400—3850	2690	2761—4570	3680
Maximum width	1280—1435	1363	920—1800	1280	974—2134	1769
Oral sucker	213—258/182—232	225/201	156—285	219	262—391/188—345	328/296
Right testis	577—760/350—456	648/417	651—372/489—332	—	506—1039/303—626	806/515
Left testis	532—745/365—456	641/400	539—372/470—348	—	570—1067/368—681	872/529
Ovary	304—410/274—365	339/300	232—418/305—315	—	276—644	460
Cirrus sac	1094—1440/213—304	1251/249	490—990 (length)	839	649—1485/162—371	1149/301
Cirrus (evag. part)	291—714/86—115	495/98	198—720 (length)	511	—	—
Metraterm(total length)	630—1079	809	80—506	178	736—1231	983
Metraterm/cirrus sac ratio	1/1.1—1/2.3	1/1.6	1/5—1/6	1/6	1/0.9—1/1.6	1/1.2
No. ventral papillae/row	15/15/15	15/15/15	14—15/12—15/14—15	14/14/14	15/15/15	15/15/15
No. vitelline follicles right side	19—35	23	9—17	13	15—23	19
left side	15—31	22	11—17	13	15—19	17
No. uterine coils right side	11—17	13	7—12	9	9—11	10
left side	11—18	13	7—11	9	15—16	15.5
Eggs	21.6—25.2/10.8—14.0	23.4/11.9	21.0—24.0/10.0—14.2	22.0/12.2	21.6—23.4/9.0—11.0	21.9/10.2

All measurements in µm. E. V. = extreme values (= ranges); $\bar{X}$ = means.

Morphoanatomic differences

Respecting the species *N. noyeri* Joyeux, 1922 it must be pointed out that the original description by Joyeux (1922) was completely correct, except the dimensions and lobulation of the testes. However, Dubois (1951: 65, footnote) had already the occasion of confirming the error of Joyeux (1922) in this character and correcting it when publishing the results of this study of the type specimens of the French author. It must also be taken into consideration that Joyeux (1922) did not mention the existence of the metratermic glands, nor the unspined, smooth appearance of the cirrus surface.

Concerning the species *N. neyrai* Gonzalez Castro, 1945, we shall remind that this author distinguished the South-Spanish species from *N. noyeri* on the basis of the following elements: a) greater size of body and oral sucker in *N. neyrai;* b) anterior extremity of body more narrow in *N. noyeri;* c) ventral papillae generally less numerous in *N. nyerai* (13—14) than in *N. noyeri* (15); d) oesophagus longer and genital pore more anterior in *N. neyrai;* e) presence of 2—4 uterine coils at cirrus pouch level in *N. neyrai;* f) vagina longer and narrower in *N. noyeri;* g) cirrus shorter and strongly armed in *N. neyrai;* h) testes greater, elongate and well lobulated in *N. neyrai;* i) presence of a collar surrounding the vagina in *N. neyrai.*

The size of body and oral sucker cannot be accepted as valid arguments, these characteristics showing a great variability as shown in Table 1. Odening (1966), in the case of *N. noyeri*, and Kinsella (1971), in another notocotylid species, already referred to this fact. Kinsella (1971) showed that, according to the age of the parasite and the nature of the host, it is possible to obtain values of these two characters, which are significatively different at statistical level.

The numerous material studied and papers, as those by Odening (1966) and Kinsella (1971), do not allow to accept as sufficient the differing characters of anterior body width, oesophagus length, situation of the genital pore or the number of ventral papillae. The variability in this last element was also emphasized by Dimitrova et al. (1962), as mentioned before.

Respecting the dimensions and lobulation of testes, the data from Table 1 and the adequate correction done by Dubois (1951: 65, footnote 2) when indicating that "Contrairement aux indications de Joyeux (1922, p. 340), les testicules de *N. noyeri* sont allongés (600—750×400—450 μm, au lieu de 300 μm), à bord externe multilobé, et non arrondis ou ovalaires: sur les préparations totales ils étaient colorés dans leur partie centrale, mais la lobulation apparait encore nettement", which we could confirm in the type specimens of *N. noyeri*, allow us to refuse this feature without any doubt.

Thus, only four differing elements remain. They are all related features: 1. cirrus sac and cirrus; 2. metraterm; 3. uterine coils at the level of cirrus sac; 4. metratermic glands. Our studies have demonstrated that these four features are stable within a population. Their intraspecific variabilities do not overlap in the two species in question and therefore they are of differential systematic value.

1. Cirrus sac and cirrus: the cirrus sac in *N. noyeri* (form A) is significatively longer than that in our specimens of *N. neyrai* (form B). Nevertheless, Gonzalez Castro (1945) pointed out a length of 900—1500 μm for the cirrus sac of *N. neyrai*, data overlapping perfectly with that of *N. noyeri* (1094—1440 μm). Unfortunately, the cirrus can only be measured on its evaginated part. Anyhow, in spite of being not absolute, tha data are clearly different: the evaginated part of cirrus in the type specimens of *N. noyeri* measures 291—714×86—115 μm (mean 495×98 μm), whereas in the type specimens of *N. neyrai* it measured 450—475×100—150 μm. The surface

of the cirrus constitutes, however, the most clear distinctive mark. The cirrus of *N. noyeri* is smooth and unarmed, whereas that of *N. neyrai* presents a typical spinulation constituted by numerous conical prominences of blunt apex. These pointless spines are 4.5—7 μm long and are distributed all over the cirrus surface, except the terminal extremity in some cases.

2. Metraterm: the form and length of the metraterm (=vagina of Joyeux and of Gonzalez Castro) are the features generally considered to be of a systematic value for species differentiation. In our case, they allow an easy differentiation. *N. noyeri* presents a large, long and rectilineal metraterm, its width being quite uniform adopting a cylindrical aspect and running in parallel to the cirrus sac. The ratio of its length (630—1079 μm; mean 809 μm) and the length of the cirrus sac is 1:1—1:2.3 (mean 1:1.6). *N. neyrai* shows a short metraterm, initially narrow and enlarging quickly till reaching its maximal width at its terminal extremity before ending on the genital pore, thus adopting a funnel shape. Its length (80—506 μm; mean 178 μm) is significatively shorter than that of the metraterm in *N. noyeri*. The metraterm: cirrus sac ratio in *N. neyrai* is of 1:5—1:6 (1:2—2:3 after Gonzalez Castro 1945).

3. Uterine coils at the level of cirrus sac: this character is evidently related to the form and length of the metraterm. In *N. noyeri*, in which the metraterm is long, in general none or rarely only one uterine coil at cirrus sac level (secondary uterine loops lateral to cirrus sac to distinguish them from the principal ones posterior to the cirrus sac). In *N. neyrai*, due to the shortness of the metraterm, the uterus must extend always laterally to cirrus sac forming some uterine loops.

4. Metratermic glands: these structures coloured well, so that they can be perfectly observed in preparations. They surround the total length of the metraterm, thus making easy to follow this last one. Consequently, the distribution and extent of these glands are notably greater in *N. noyeri* than in *N. neyrai.*

Valid species and synonyms

The conclusion reached from the preceding chapter is the necessity of refusing the generally accepted synonymy between *N. noyeri* Joyeux, 1922 and *N. neyrai* Gonzalez Castro, 1945. Both species should be considered as valid and perfectly distinguishable. Accordingly, if the systematic value of the four above discussed features is accepted, it is necessary to erect a new species for the form C, for which we propose the name of *Notocotylus gonzalezi* sp.n. (Fig. 3).

Unfortunately, these four morphoanatomic features of systematic value do not allow to discuss the possible validity of the species *N. wetlugensis* Shaldybin, 1965. According to the original description (Shaldybin 1965), the presence of intestinal processes and the number of vitelline follicles are the only elements which allow its differentiation, as pointed out by Tenora et al. (1983). In the present paper, we decided to give it the status of species inquirenda, thus referring to the necessity of reviewing the type specimens.

The problem now posed is to know what species the numerous European authors really found. Only in some cases, where an enough complete description was given, it is possible to elucidate the question. After the analysis of our materials and the literature data, the systematics is as follows:

A) *Notocotylus noyeri* Joyeux, 1922 Fig. 1

Syn.: *N. noyeri* sensu Soltys 1952; ? *N. noyeri* sensu Ablasov and Iksanov 1958.
Notes: in both cases the redescriptions were insufficient but the figures suggest that the determination was perhaps correct.

B) *Notocotylus neyrai* Gonzalez Castro, 1945 Fig. 2

Syn.: *N. noyeri* sensu Skvortsov 1934; sensu Tenora 1957, 1972; sensu Dimitrova et al. 1962; sensu Odening 1964, 1966; sensu Odening and Bockhardt 1965; sensu Mas-Coma 1976, Mas-Coma and Gállego 1977.
Notes: Odening (1964 1966) and Odening and Bockhardt (1965) did not refer to the spinulation of the cirrus in spite of the fact that all their specimens possessed always a strongly spined cirrus (Odening pers. letter to Mas-Coma 29. 8. 1977).

C) *Notocotylus gonzalezi* **sp.n.** Fig. 3

Syn.: *Notocotylus* form C in Simón-Vicente et al. 1979; *Notocotylus* sp. in Tenora et al. 1983.
Material studied: Holotype from *Arvicola sapidus* Miller, 1908 (Rodentia: Arvicolidae), Capilleira (region of Las Alpujarras, province of Granada, Spain), 7 January 1975, lgt. Prof. Dr. Ramón López-Román.

Paratypes: 61 specimens from *A. sapidus* of Capilleira, 5 specimens from *Microtus cabrerae*, Villanueva de los Escuderos (provincia de Cuenca, Spain), 4 specimens from *M. oeconomus*, 12 specimens from *M. agrestis* and 6 specimens from *Clethrionomys glareolus*, all Pallasjärvi (Finland).

Trematoda Notocotylata Skrjabin et Schulz, 1933; Notocotyloidea Price, 1932; Notocotylidae Lühe, 1909; Notocotylinae Kossack, 1911; *Notocotylus* Diesing, 1839. Description (based on 25 specimens): Body smooth, elongate, oval to elliptical, flattened, with edges incurved ventrally. Length 2761—4570 μm (mean 3680 μm), maximal width 974—2134 μm (1769 μm). Ventral glands arranged in 3 longitudinal rows, each of 15 glands. Oral sucker well developed, subterminal, 262—391× ×188—345 μm (328×296 μm). Oesophagus short. Caeca terminating near posterior extremity, more or less sinuous but never showing diverticles. Testes lobed, symmetrical, extracecal, close to posterior extremity, the right one 506—1039×303—626 μm (806×515 μm) and the left one 570—1067×368—681 μm (872× ×529 μm). Cirrus pouch strongly developed, 649—1485×162—371 μm (1149×301 μm). Cirrus muscular, smooth, nonspined. Genital pore median, slightly postbifurcal. Ovary lobed, between two caeca in testicular zone, 276—644 μm (460 μm), with shell gland complex in front. Vitelline follicles 15—23 in number extending longitudinally in both pretesticular extracaecal fields. Uterus forming transverse loops overreaching caeca as far as vitellarian fields, with 9—11 uterine coils at the right side and 15—16 at the left one, where it ends constituting a well differentiated metraterm, initially more or less coiled and finally enlarged and funnel-shaped. The total length of the metraterm (coiled part + funnel-shaped part) is accompanied by the metratermic glands and is of 736—1231 μm (983 μm), which represents a ratio of 1/0.9—1/1.2 of metraterm length/cirrus pouch length. Eggs 21.6—23.4×9.0— —11.0 μm (21.9×10.2 μm), filamented at each pole. Parasitic in caecum of rodents of the family Arvicolidae in Europe.

Differential diagnosis: shown on p. 25 and 28

Note: in the case of the Finnish materials, the metraterm length of 200—420 μm, given by Tenora et al. (1983), is the only feature which does not correspond with the description in the present paper, because this measurement given for the Finnish flukes does not refer to the total length of metraterm, but only to its last, enlarged, funnel-shaped part.

D) *Notocotylus wetlugensis* Shaldybin, 1965 species inquirenda

Syn.: *N. noyeri* Joyeux, 1922 according to Sharpilo (1973) and Ryzhikov et al. (1978), but questioned by Tenora et al. (1983).
Notes: in the book by Ryzhikov et al. (1978: 158—159) there is an original drawing by Sharpilo which clearly shows a rectilineal, long metraterm as in *N. noyeri* and caecal diverticles; the cirrus is not figured, but it is spined after the description. These three features do not coexist in any of the above-mentioned *Notocotylus* species. Thus, *N. wetlugensis* is perhaps a valid species.

The conclusion of the review of the above-mentioned data is that the species more frequent in European rodents is *N. neyrai* and secondarily, but with much lower frequency, *N. gonzalezi* sp.n. The rarity of *N. noyeri* shall be emphasized; in fact it was found certainly for the first time in France by A. Lucet (type specimens). This fact suggests perhaps that it is a parasite typical of birds, as already pointed out by Ablasov and Iksanov (1958). Evidently the majority of authors, if not all, have mistaken their determinations. Therefore, the review of all these materials shall be done in the future.

KEY FOR DETERMINATION OF *NOTOCOTYLUS* SPECIES PARASITIZING RODENTS IN EUROPE

Only the three species of accepted validity and systematic status are included in the following key.

1. Cirrus strongly spined; metraterm short (metraterm : cirrus sac ratio = 1 : 6), forming only the final uterine funnel . . . . . *N. neyrai* Gonzalez Castro, 1945
— Cirrus unarmed and smooth 2
2. Metraterm large, long (metraterm : cirrus sac ratio = 1 : 1.6) and rectilineal . . . . . *N. noyeri* Joyeux, 1922
— Metraterm not very long (metraterm: cirrus sac ratio = 1 : 1.2), forming initially some uterine loops and finally a terminal funnel . . . . . *N. gonzalezi* sp. n.

Acknowledgements. The authors gratefully acknowledge Prof. Dr. A. G. Chabaud (Paris), Prof. Dr. G. Dubois (Corcelles), Prof. Dr. J. Ranque (Marseille), Prof. Dr. K. Odening (Berlin) and Prof. Dr. C. Vaucher (Genéve). The figures were done by M. C. Fusté (Barcelona) under the direction of Prof. Dr. S. Mas-Coma.

ОБЗОР ВИДОВ РОДА *NOTOCOTYLUS* (TREMATODA: NOTOCOTYLIDAE), ПАРАЗИТИРУЮЩИХ У ГРЫЗУНОВ В ЕВРОПЕ

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Резюме. Дан обзор видов рода *Notocotylus* Diesing, 1839 (Trematoda: Notocotylidae), паразитирующих у грызунов в разных частях Европы. Различаются три вида, которые считаются валидными: *N. noyeri* Joyeux, 1922, *N. neyrai* Gonzalez Castro, 1945, *N. gonzalezi* sp. n.

REFERENCES

ABLASOV N. A., IKSANOV K. I., Trematode fauna of piscivorous birds of Kirgizia. Rab. Gelm. 80-let. Skrjabin. Izd. AN SSSR, Moskva: 15—22, 1958. (In Russian.)
BAYLIS H. A., Records of some parasitic worms from British vertebrates. Ann. Mag. Nat. Hist., ser. 10: 329—343, 1928.
—, Further records of parasitic worms from British vertebrates. Ann. Mag. Nat. Hist., ser. 11: 474—498, 1939.
CHIRIAC E., POPESCU A., Contributions à la connaissance des trématodes des rongeurs de la Roumanie. Acta Parasit. Polon. 16: 61—68, 1969.
DIMITROVA E., GENOV T., KARAPCHANSKI I., The helminth fauna of rodents in the Petrich and Gotse Delchev Areas. Izv. BAN 7: 81—120, 1962. (In Bulgarian.)
DUBININ V. B., Parasite fauna of mice and its changes in the Volga River delta. Paraz. Sb. Zool. in-ta AN SSSR 15: 252—276, 1953. (In Russian.)
DUBOIS G., Etude des Trématodes nord-américains de la collection E. L. Schiller en revision du genre *Notocotylus* Diesing, 1839. Soc. Nauchâtel. Sc. Nat. 74: 41—76, 1951.
ERHARDOVÁ B., Die Helminthofauna der mäuseartigen Nagetiere des Nationalparks in der Hohen Tatra. Zool. Ent. Listy 4: 353—364, 1955. (In Czech.)
—, Parasitische Würmer der Nagetiere in der Tschechoslowakei. Čs. Parasitol. 3: 49—66, 1956. (In Czech.)
—, Parasitische Würmer der Nagetiere in der Tschechoslowakei. Čs. Parasitol. 5: 27—103, 1958. (In Czech.)

GONZALEZ CASTRO J., *Notocotylus neyrai* n. sp., parásito cecal del *Arvicola sapidus*. Rev. Ibér. Parasit. 5 (t. extra.): 127—149, 1945.
GROSCHAFT J., TENORA F., Reorganization of suborder Notocotylata (Trematoda). Acta Sc. Nat. Brno 15 (8): 1—46, 1981.
JOYEUX Ch., Recherches sur les Notocotyles. Bull. Soc. Path. Exot. 15: 331—339, 1922.
KINSELLA J. M., Growth, development, and intraspecific variation of *Quinqueserialis quinqueserialis* (Trematoda: Notocotylidae in rodent hosts. J. Parasitol. 57: 62—70, 1971.
KIRSCHENBLATT J. D., Materials to the helminth fauna of rodents in Armenia. Tr. Zool. in-ta AN SSSR 8: 317—339, 1948. (In Russian.)
MACKO J. K., On the subspecies in parasites with respect to helminths. Folia parasit. (Praha) 30: 107—116, 1983.
MAS-COMA S., Contribución al conocimiento de la helmintofauna de micromamíferos de Espaňa. Tesis Doct., Fac. Farmacia, Univ. Barcelona, 527 pp., 1976.
—, GALLEGO J., Conocimientos actuales sobre la helmintofauna de micromamíferos (Insectivora: Rodentia) en Espaňa. In: M. Cordero del Campillo et al. (Ed.), Indice-Catálogo de Zooparásitos Ibéricos. III. Cestodos, IV. Nematodos y Anejos, León: 165—205, 1977.
MELNICHENKO O. D., Trematodes of the water rat. Nauch. Zap. Cherkasi Derzhavini Pedagog. Inst. 16: 15—16, 1961. (In Russian.)
MERKUSHEVA I. V., Helminths of rodents. In: Fauna and ecology of parasites of rodents, Minsk: 53—117, 1963. (In Russian.)
MOROZOV J. F., Materials on the helminth fauna of rodents and insectivores in Bialowiez virgin forest. Tr. Zap. Okhot. Khoz., Belovezhskaya pushcha 1: 151—175, 1958. (In Russian.)
ODENING K., Zur Trematodenfauna von *Nettapus c. coromandelianus* in Indien. Angew. Parasit. 5: 228—241, 1964.
—, Physidae und Planorbidae als Wirte in den Lebenszyklen einheimischer Notocotylidae (Trematoda: Paramphistomida). Z. Parasitenkd. 27: 210—239, 1966.
—, BOCKHARDT I., Der Entwicklungszyklus des Trematoden *Notocotylus noyeri* Joyeux, 1922, im Raum Berlin. Deutsch. Akad. Wiss. Berlin 7: 51—52, 1965.
PETROV A. M., CHERTKOVA A., A new trematode from rodents *Tetraserialis stcherbakovi* gen. nov., sp. nov. (Notocotylinae Kossack, 1911). Helminthologia (Košice) 2: 307—311, 1960. (In Russian.)
PROKOPIČ J., GENOV T., Distribution of helminths in micromammals (Insectivora and Rodentia) under different ecological and geographical conditions. Studie ČSAV 9: 1—159, 1974.
RAZUMOVA J. N., Parasite fauna of *Arvicola terrestris* L. Uch. Zap. Sev.-Osetinsk. Ped. in-ta 20: 277—285, 1956. (In Russian.)
REICHSTEIN H., *Arvicola terrestris* (Linnaeus, 1758) — Schermaus. In: J. Niethammer, F. Krapp (Eds.), Handbuch der Säugetiere Europas, Akademische Verlagsgesellschaft Wiesbaden, Band 2/I, Nagetiere II: 217 bis 252, 1982.
RYZHIKOV K. M., GVOZDEV E. V., TOKOBAYEV M. M., SHALDYBIN L. S., MATSABERIDZE G. V., MERKUSHEVA I. V., NADTOCHIY E. V., KHOKHLOVA I. G., SHARPILO L. D., Key to the helminths of rodent fauna in the USSR. Cestodes and trematodes. Izd. Nauka, Moskva, 231 pp., 1978. (In Russian.)
SHALDYBIN L. S., Helminth fauna of mammals in Nordvin state preserved region. Uch. Zap. Gor'kovsk. Gos. Ped. In-ta im. Gor'kogo 42, ser. Zool., Gelmint. Sb. 3: 52—81, 1964. (In Russian.)
—, A new trematode of *Clethrionomys glareolus*. Uch. zap. Gor'kovsk. gos. Ped. In-ta im. Gor'kogo, Gelmint. Sb. 4: 93—105, 1965. (In Russian.)
SHARPILO L. D., Helminths of rodent fauna in the Ukrainian SSR. C. Sc. Thesis, 1973. (In Russian.)
SHCHERBAKOVA E. V., Studies on rodent fauna in Armenia. Izv. FAN SSSR, No. 1—2: 15—16, 1942. (In Russian.)
SIMON-VICENTE F., MAS-COMA S., LOPEZ-ROMAN R., TENORA F., GALLEGO J., Caracterización morfológica y sistemática de los *Notocotylus* (Trematoda: Notocotylidae) de Roedores europeos. II. Cong. Nac. Parasit. (León, 1—4. 10. 1979), 2.1.1: 89, 1979.
SKVORTSOV A. A., Studies on helminth fauna of *Arvicola terrestris* (L.) Vest. Mikrobiol., Epidemiol. Parazitol. 13: 317—326, 1934. (In Russian.)
SOLTYS A., Badania nad robakami pasożytniczymi drobnych gryzoni Parku Narodowego w Bialowieży. Acta Parasitol. Polon. 5: 487—504, 1957.
STAMMER H. J., Die Parasiten deutscher Kleinsäuger. Verh. Deutsch. Zool. Gesellsch. Erlangen, Zool. Anz. Suppl. 19: 362—390, 1955.
TENORA F., Zur Helminthofauna der Kleinsäuger in Altvatergebirge, ČSR. Čs. Parasitol. 4: 351—354, 1957. (In Czech.)
—, Notes on the analysis of helminth fauna of the common vole *Microtus arvalis* (Pall.). Acta Univ. Agric. 20: 655—666, 1972.
—, HENTTONEN H., HAUKISALMI V., On helminths of rodents in Finland. Ann. Zool. Fennici 20: 37—45, 1983.
VYSOTSKAYA S. O., Parasite fauna of *A. sylvaticus* in North Caucasus. Paraz. Sb. Zool. in-ta AN SSSR 10: 193—196, 1948. (In Russian.)
YAMAGUTI S., Synopsis of Digenetic Trematodes of Vertebrates. Vol. I. Keigaku Publishing Co., Tokyo, 1074 pp., 1971.
—, A Synoptical Review of Life Histories of Digenetic Trematodes of Vertebrates. Keigaku Publishing Co., Tokyo, 590 pp., 1975.

Received 15 November 1983.

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FOLIA PARASITOLOGICA (PRAHA) 32: 33 1985.

NEW FINDINGS OF SOME HELMINTHS IN RODENTS FROM FINLAND

The first results concerning the occurrence of parasitic worms in small rodents in Finland were published within the framework of the Czechoslovak-Finnish culture cooperation in 1983 (Tenora F., Henttonen H., Haukisalmi V., Ann. Zool. Fennici 20: 37—45). In the years 1982—1983, new helminthological material was collected in 3 localities and 517 rodents were examined: 210 *Clethrionomys glareolus*, 66 *C. rutilus*, 173 *C. rufocanus*, 50 *Microtus oeconomus*, 5 *M. agrestis* in the locality Pallasjärvi, 3 *Ondatra zibethica* in the locality Lemmi and 10 *M. agrestis* in the locality Tvärminne. The new records of helminths are given below.

1. *Corrigia vitta* (Dujardin, 1845)

This species (15 specimens) was found in the locality Pallasjärvi in the liver of one specimen of *C. rufocanus*. The morphological characters of this species are very variable and it occurs in many hosts in Europe (see Ryzhikov K. M. et al., Opredelitel gelmintov gryzunov fauny SSSR (Key to the helminths of rodents of the fauna of the USSR, 232 pp. 1978)). The locality Pallasjärvi (Finnish Lapland) is the most northern locality in which this trematode species has been found and this is the first record in the territory of Finland.

2. *Quinqueserialis quinqueserialis* (Barker et Laughlin, 1911)

This species (15—46 specimens) was found in the caecum of all the 3 dissected specimens of *O. zibethica* in the locality Lammi. This is the first record in Finland.

3. *Hydatigera taeniaeformis* (Batsch, 1786), larv.

A larva of this cestode species was recovered from the liver of *O. zibethica* in the locality Lammi. Our record supplements the earlier data on this species in Finland (see Lahtinen H.: Tukismaailma No 5, 6, 1957, Tenora F. et al., 1983).

4. *Mesocestoides lineatus* (Goeze, 1782), larv.

More than 100 larvae of this species were found in the body cavity of *M. agrestis* in the locality Tvärminne. This is the first record in Finland.

5. *Heligmosomum yamagutii* Chabaud, Rausch et Durette-Desset, 1963

This nematode was found in the small intestine of *C. rufocanus* in the locality Pallasjärvi. This is a new host for this parasite in Finland. From the same locality, *C. glareolus* and *C. rutilus* were already recorded as hosts. (Tenora F. et al., 1983).

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