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ASCARIDOID NEMATODES OF AMPHIBIANS AND REPTILES : *ORNEOASCARIS*

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SUMMARY. The genus *Orneoascaris* is redefined so as to conform in part to the original definition of Skrjabin (1916). The proposal of Le Van Hoa (1960) that *Amplicaecum involutum* Gedoelst, 1916 is a synonym of *Orneoascaris chrysanthemoides* Skrjabin, 1916 is upheld, as is the transfer of *Amplicaecum colurum* (the type species of *Amplicaecum*) and *A. schoutedeni* to *Orneoascaris*. On the other hand Le Van Hoa's proposal to transfer other species formerly placed in *Amplicaecum* to *Orneoascaris* is not upheld. These are considered to comprise a heterogenous collection comprising several different genera. The following species are considered to be the only valid species so far known in *Orneoascaris* : *O. chrysanthemoides* Skrjabin, 1916 ; *O. schoutedeni* Baylis, 1940 ; *O. sandoshami* Yuen, 1963 n. comb. *O. colura* (Baylis, 1919) and *Amplicaecum pesteri* Rasheed, 1965 are regarded as synonyms of *O. chrysanthemoides*. Two female specimens collected from *Phoxophrys spiniceps* in Borneo are listed as *Orneoascaris* sp.

Nématodes Ascarides d'Amphiberis et de Reptiles : *Orneoascaris*.

RÉSUMÉ. Une nouvelle définition du genre *Orneoascaris* est donnée, en partie conforme à la définition originale de Skrjabin (1916). La proposition de Le Van Hoa (1960), de mettre *Amplicaecum involutum* Gedoelst, 1916 en synonymie avec *Orneoascaris chrysanthemoides* Skrjabin, 1916, est maintenue, de même que le transfert dans le genre *Orneoascaris* d'*Amplicaecum colurum* (l'espèce-type du genre *Amplicaecum*) et de *A. schoutedeni*. Par contre, la proposition de Le Van Hoa, de transférer dans le genre *Orneoascaris* les autres espèces placées précédemment dans le genre *Amplicaecum*, n'est pas maintenue. Ces espèces paraissent constituer un ensemble hétérogène comprenant plusieurs genres différents. Les espèces suivantes sont considérées comme les seules espèces valides connues jusqu'à présent dans le genre *Orneoascaris* : *O. chrysanthemoides* Skrjabin, 1916 ; *O. schoutedeni* Baylis, 1940 ; *O. sandoshami* Yuen, 1963 n. comb. *O. colura* (Baylis, 1919) et *Amplicaecum pesteri* Rasheed, 1965 sont mis en synonymie avec *O. chrysanthemoides*. Deux spécimens femelles trouvés chez *Phoxophrys spiniceps* à Borneo sont désignés comme *Orneoascaris* sp.

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Introduction

The genus *Orneoascaris* was proposed by Skrjabin (1916, undated) to contain the single species *O. chrysanthemoides* described from *Bufo* sp. in East Africa. The characteristic features of this genus were lateral cuticular expansions and ornamentation on the ventral surface of the male tail. Skrjabin stated that there was no intestinal caecum and that interlabia were absent.

In the same year Gedoelst (1916, 31st December) described *Ascaris involuta* from a chamaeleon *(Chamaeleo dilepis)* and *Ascaris bufonis* from a toad in the Congo and reported interlabia and an intestinal caecum in both species, but he did not mention any caudal ornamentation. Gedoelst's *bufonis* was renamed *gedoelsti* by Yorke & Maplestone (1926), who placed both *involuta* and *gedoelsti* in the genus *Amplicaecum* Baylis 1920, established for *Ascaris colura* Baylis, 1919, from an eagle, *Lophoaetes occipitalis*. Similar species described and placed in *Amplicaecum* were : *africanum* Taylor, 1924 from *Bufo regularis* in West Africa, also reported from *Rana nutti* and *Natrix olivaceus* in East Africa by Baylis (1929) ; *causi* Thwaite, 1926 from *Causus rhombeatus* (Africa) ; *novempapillatum* Sandground, 1933 from *Astylosternus robustus* (Cameroon). Baylis (1940) re-examined type specimens of *involutum, gedoelsti, africanum* and *causi*, concluded that all should be included within *involutum* Gedoelst, 1916, and recorded as a host another African frog *(Breviceps macrodactylus)* and the hinge-back tortoise *(Kinixys erosa)*. Baer (1959) reported *A. involutum* from *Bufo regularis* in the Congo and suggested that *novempapillatum* was close to *involutum* ; Sprent & Mines (1960) concluded that *novempapillatum* is a synonym of *involutum*. Sandground (1933b) recorded *A. involutum* from the snake, *Dispholidus typus*.

Comparing the original descriptions of *Orneoascaris chrysanthemoides* and *Ascaris involutum* [= *bufonis*] with specimens collected from *Bufo* sp. in Katanga, Le Van Hoa (1960, 1962) concluded that the two species are identical, Skrjabin having overlooked the interlabia and the intestinal caecum. He proposed that *Amplicaecum* Baylis, 1920 is a synonym of *Orneoascaris* Skrjabin, 1916, although he did not examine the type material of the type species of *Amplicaecum* i.e. *A. colurum* Baylis, 1919. He transferred 10 other species from *Amplicaecum* into *Orneoascaris*. Rasheed (1965) considered Le Van Hoa's proposal unjustified and designated specimens collected from a 'crested chameleon' from Cameroon as *Amplicaecum involutum*. Vuylsteke (1964) recorded *A. involutum* from *Xenopus laevis* and *Bitis cornuta*.

Several species regarded by various authors as different from *involutum* have been placed in the genus *Amplicaecum*. Those species occurring in anurans include : *A. numidicum* (Seurat, 1917) from *Rana ridibunda* in Algiers ; *A. brumpti* Khalil, 1926 from *Rana esculenta* in Corsica ; *A. cacopi* Chatterji, 1936 from *Cacopus systoma* in Burma ; *A. ranae* Gupta, 1959 from *R. tigrina* and *R. cancrivora* in Bangladesh ; *A. sandoshami* Yuen, 1963 from *Megophrys* sp. in Malaya ; *A. communis* Yuen, 1963 from *Kaloula pulchra, Bufo asper, B. melanostictus*, and *Rana cancrivora* in Malaya ; *A. pesteri* Rasheed, 1965 from *Bufo supercilioris* in Camaroon. Those species

collected from lizards include : *A. varani* Baylis & Daubney, 1922 from *Varanus salvator* in India ; *A. schoutedeni* Baylis, 1940 from *Varanus niloticus* in Zaire ; *A. alatum* Baylis, 1947 from *Tupinambis nigropunctatus* in Surinam ; *A. monitor* Khera, 1954 from *V. monitor* in India ; *A. iguanae* Wahid, 1961 from a lizard (*Iguana* sp.) in India ; *A. mackerrasae* Thomas, 1959 from *Varanus varius* in Australia. Species in snakes include : *A. excavatum* (Hsu & Hoeppli, 1931) from *Agkistrodon halys brevicauda* in China (see also Hsu & Hoeppli, 1938) ; *A. schikhobalovi* Mozgovoy, 1950 from *Natrix natrix* and *Coluber ravergieri* in the Moscow Zoo ; *A. robertsi* Sprent & Mines, 1960 from *Morelia spilotes* in Australia ; *A. longispiculum* Oshmarin & Demshin, 1972 from *Bungarus fasciatus* in Indo-China. Several species in *Amplicaecum* have been described from birds e.g. *A. ixobrychusi, A. capellae, A. phalacrocoraxi,* and *A. alii,* but they are described as having no dentigerous ridges. As the descriptions are inadequate, especially regarding the excretory system, and as the type material was not available to the present writer, they are not considered further here.

The question arises as to how many of these species should be transferred to *Orneoascaris*. Accordingly the present paper reports observations from re-examination of these species, using as far as possible either type material or specimens from the same host and locality. The type material of *involutum, gedoelsti, africanum,* and *causi* were not compared because Baylis (1940) had already established the identity of these species. The type material of *A. cacopi, A. excavatum, A. monitor, A. schikhobalovi,* and *A. longispiculum* were not available for re-examination. The type material of *alatum* has been considered in a previous publication (Sprent, 1983) and this species placed in *Freitasacaris*.

Material examined

Category A

(1) Type material of *Amplicaecum colurum* (1919.6.16.2-3), *A. sandoshami* (1963. 852-861), *A. schoutedeni* (1940.1.17.60-70) in the British Museum (Natural History).

(2) Type material of *pesteri* in the Collection of the Institute of Helminthology, St. Albans.

(3) Specimens from *Megophrys nasuta* collected in the National Zoological Gardens, Washington D. C. by Dr D. R. Brooks and sent by Dr R. Lichtenfels (USNPC M75703).

(4) Specimens collected by Dr Malcolm Smith from *Phoxophrys spiniceps* in North Borneo (BMNH 1936.8.19.17-18).

(5) Specimens in the U. S. National Parasite Collection (41261) collected from *Varanus exanthematicus* in Tanzania.

Category B

(1) Specimens collected from *Rana ridibunda* in Corsica (1107JJ) and *R. esculenta* in France (507) and sent to the writer by Professor A. G. Chabaud from the Muséum d'Histoire Naturelle, Paris.

(2) Type material of *A. communis* (1963.822-851) in the British Museum (Natural History).

(3) Specimens in the U. S. National Parasite Collection collected by Dr R. E. Kuntz from various frogs in North Borneo.

(4) Specimens labelled *Amplicaecum ranae* (type material ?) in U. S. National Parasite Collection (67049) collected from *Rana tigrina* in Bangladesh.

(5) Specimens collected from *R. novaguineae* in West Irian (BMNH 1938.11.4.6-17).

(6) Specimens from preserved *Rana daemeli* in the Queensland Museum, Brisbane.

(7) Specimens collected by the writer in Burma, Bali, and Malaya from frogs and toads of various species (*Rana tigrina, R. leucoplax, Kaloula pulchrum, Bufo asper, B. melanostictus* and *Polypedetes* sp.).

Category C

(1) Type material of *Amplicaecum varani* (1923.1.22.15-20) and *A. iguanae* (1963. 361-363) in the British Museum (Natural History).

(2) Specimens in the U. S. National Parasite Collection (60658) collected from *Varanus nuchalis* in the Philippines.

(3) Specimens (BMNH 1965.142-151) from *Varanus* sp. ? collected in Berthampore, India by Dr. Clayton Lane.

(4) Type material of *A. mackerrasae* in the South Australian Museum, Adelaide.

(5) Specimens collected from the writer from *Varanus rudicollis* and *V. swartii* in Thailand and *V. gouldii* and *V. varius* in Queensland, Australia.

Category D

(1) Paratype specimens of *Amplicaecum robertsi* collected by the writer from *Morelia spilotes* in Queensland.

Examination of the above specimens indicated that they fall into four distinct morphological categories (A-D above). In the first three categories (A-C) the vulva in adult females at all stages of growth is situated anterior to the middle of the body, which is of more or less even width, there is a consistently present well-developed intestinal caecum, and the spicules are shorter than the ejaculatory duct.

Specimens in Category A resemble *O. chrysanthemoides* i.e. with interlabia, with ornate precloacal area, slender spicules, and caudal alae in the male ; they comprise

species which are here considered as belonging within the genus *Orneoascaris* Skrjabin, 1916 *sensu stricto*.

Specimens in Category B resemble *O. numidica* i.e. without interlabia, without ornate precloacal area, and with short, coarse, rod-like spicules ; they comprised species which are regarded as belonging to a separate genus to be defined in a later publication.

Specimens in Category C resemble *O. varani* i.e. with interlabia, without ornate precloacal area, and with alate spicules ; they comprise species also regarded as belonging to another separate genus to be defined in a later publication.

Specimens in the fourth category (D) comprised a species with interlabia, without ornate precloacal area, with alate spicules, resembling the descriptions of *A. excavatum*, *A. schikhobalovi*, and *A. longispiculum*, all four occurring in snakes. Unlike the first three categories, species in the fourth category (D) have the vulva situated behind the middle of the body, and in mature females the posterior part of the body is wider, tending to a trichuriform shape. The caecum is of inconsistent occurrence and less than a quarter the length of the œsophagus when present, and the spicules are longer than the ejaculatory duct. Species in the fourth category are regarded as belonging in *Ophidascaris* (See Sprent & McKeown, 1979) and will also be considered in a later publication.

Thus it was concluded that the species in *Amplicaecum* transferred by Le Van Hoa (1960) to *Orneoascaris* comprise a heterogeneous collection belonging to four different genera. Those species belonging in *Orneoascaris sensu stricto* are considered in this paper.

Orneoascaris Skrjabin, 1916

Small to medium-sized ascaridoids with characters of Ascaridoidea *sensu* Chabaud, 1965. Relatively large lips, slightly bulbous, with narrow isthmus, with dentigerous ridge all round margin, and with deep cleft in anterior margin. Pulp deeply divided anteriorly into two rounded lobes ; median lobe absent. Interlabia present. Cervical alae absent. Excretory pore and cervical papillae slightly behind nerve ring. Excretory nucleus relatively large, situated on left side in commissural part of excretory cell. Excretory system bilateral. Posterior end of œsophagus with granular lobes, no distinct œsophageal ventriculus present. Three nuclei of œsophageal glands relatively large. Intestinal caecum present, more than half length of œsophagus. Male with slender spicules, shorter than ejaculatory duct. Gubernaculum absent. Ventral precloacal ornamentation present ; lateral region of tail with conspicuous expansion of cuticle. Female with vulva anterior to middle of body. Uterus didelphic, opisthodelphic. Parasites of Old World frogs and toads, tortoises, frog-eating snakes, chameleons, monitor lizards, and occasionally crocodiles. Types species : *Orneoascaris chrysanthemoides* Skrjabin, 1916.

Specimens corresponding with the above generic distribution of *Orneoascaris* were found to comprise several distinct species as described below.

Orneoascaris chrysanthemoides Skrjabin, 1916

Synonyms : *Ascaris involuta* Gedoelst, 1916
Ascaris bufonis Gedoelst, 1916
Amplicaecum gedoelsti Yorke & Maplestone, 1926
Amplicaecum involutum Yorke & Maplestone, 1926
Amplicaecum africanum Taylor, 1924
Amplicaecum causi Thwaite, 1926
Amplicaecum novempapillatum Sandground, 1933
Orneoascaris novempapillatum (Sandground, 1933) Le Van Hoa, 1960
[?] *Amplicaecum chrysanthemoides* (Skrjabin, 1916) of Hartwich (1957)
Ascaris colura Baylis, 1919
Amplicaecum colurum (Baylis, 1919) Baylis, 1920
Orneoascaris colurum (Baylis, 1919) Le Van Hoa, 1960
? *Amplicaecum pesteri* Rasheed, 1965

(Plate I, 1-3, Plate II, 7-12, fig 1-16)

In spite of the absence of type material of this species and in spite of the statement by Skrjabin that interlabia and intestinal caecum are absent, the present writer agrees with Le Van Hoa (1960, 1962) that Skrjabin's (1916) description and figures leave little doubt that *chrysanthemoides* Skrjabin, 1916 and *involutum* Gedoelst, 1916 are the same species and it follows that species shown to be synonyms of *involutum* should also be included under *chrysanthemoides*. The following description is based on a series of specimens collected from *Bufo regularis* in Gabon, Africa and sent to the writer by Dr M. R. Baker.

Description

With characters of *Orneoascaris*. Small, slender ascaridoids, males slightly smaller than females. Labial region swollen *(fig. 1)*, lips almost square, base slightly wider than anterior margin, notch present in each of three free borders ; alate expansion present posterior to marginal notch *(fig. 2-4)*. Oral groove continuous with notch in anterior border *(Plate I, 1)*. Postlabial groove present, lips connected to body wall by narrow isthmus *(Plate I, 1-3)*. Slender interlabia with membranous

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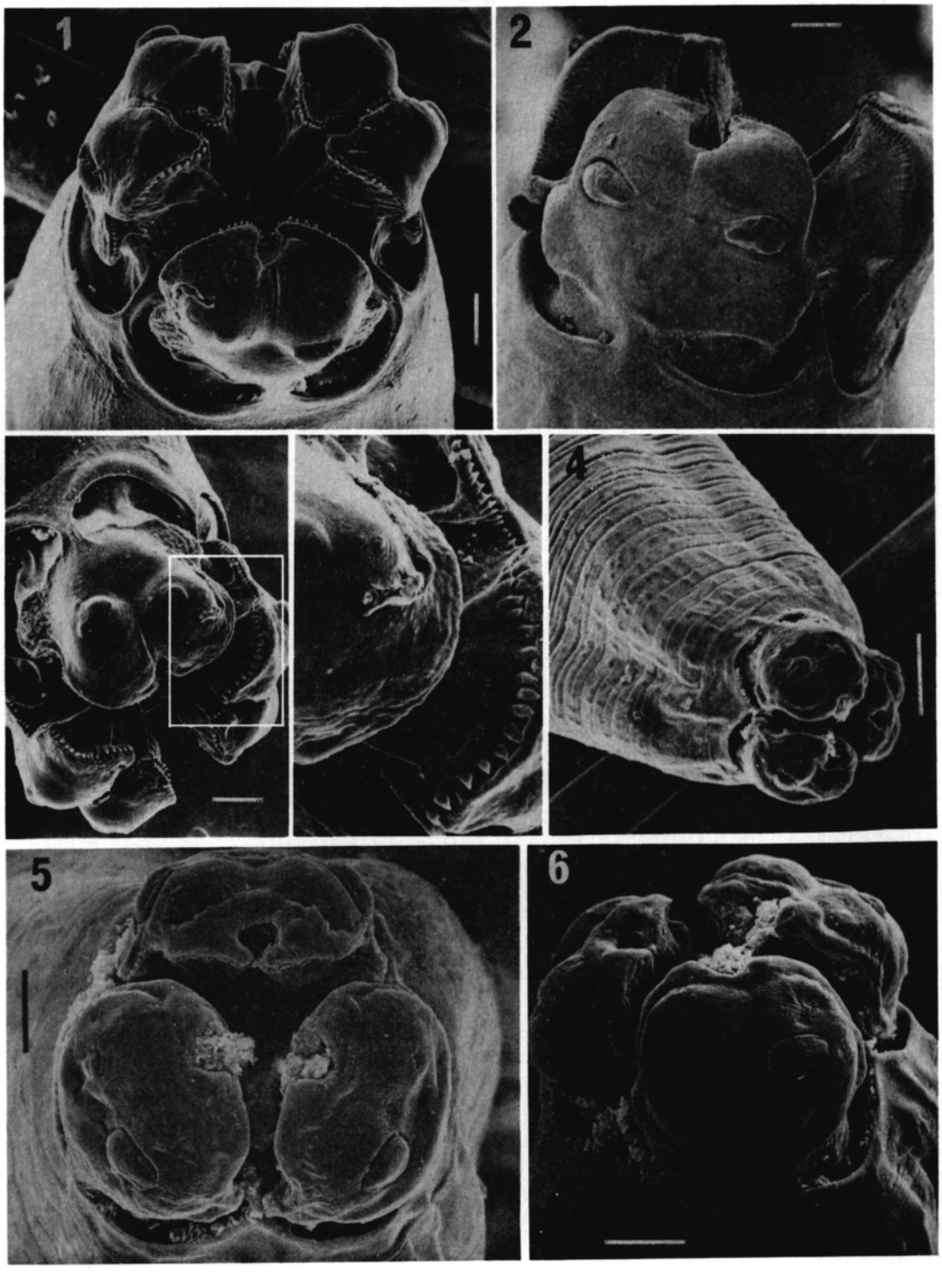
PLATE I.

Fig. 1 : En face view of lips of *O. chrysanthemoides* (0.03) ; *fig. 2* : Dorsal lip of *O. chrysanthemoides* (0.01) ; *fig. 3* : Subventral view of lips of *O. chrysanthemoides*, with closer view of denticles (0.04) ; *fig. 4* : Anterior end of *O. schoutedeni* showing small lips and coarse striations on body (0.1) ; *fig. 5* : En face view of lips of *O. schoutedeni* (0.05) ; *fig. 6* : Subventral view of lips of *O. schoutedeni* (0.05).

(Scale bar measurements (mm) in brackets)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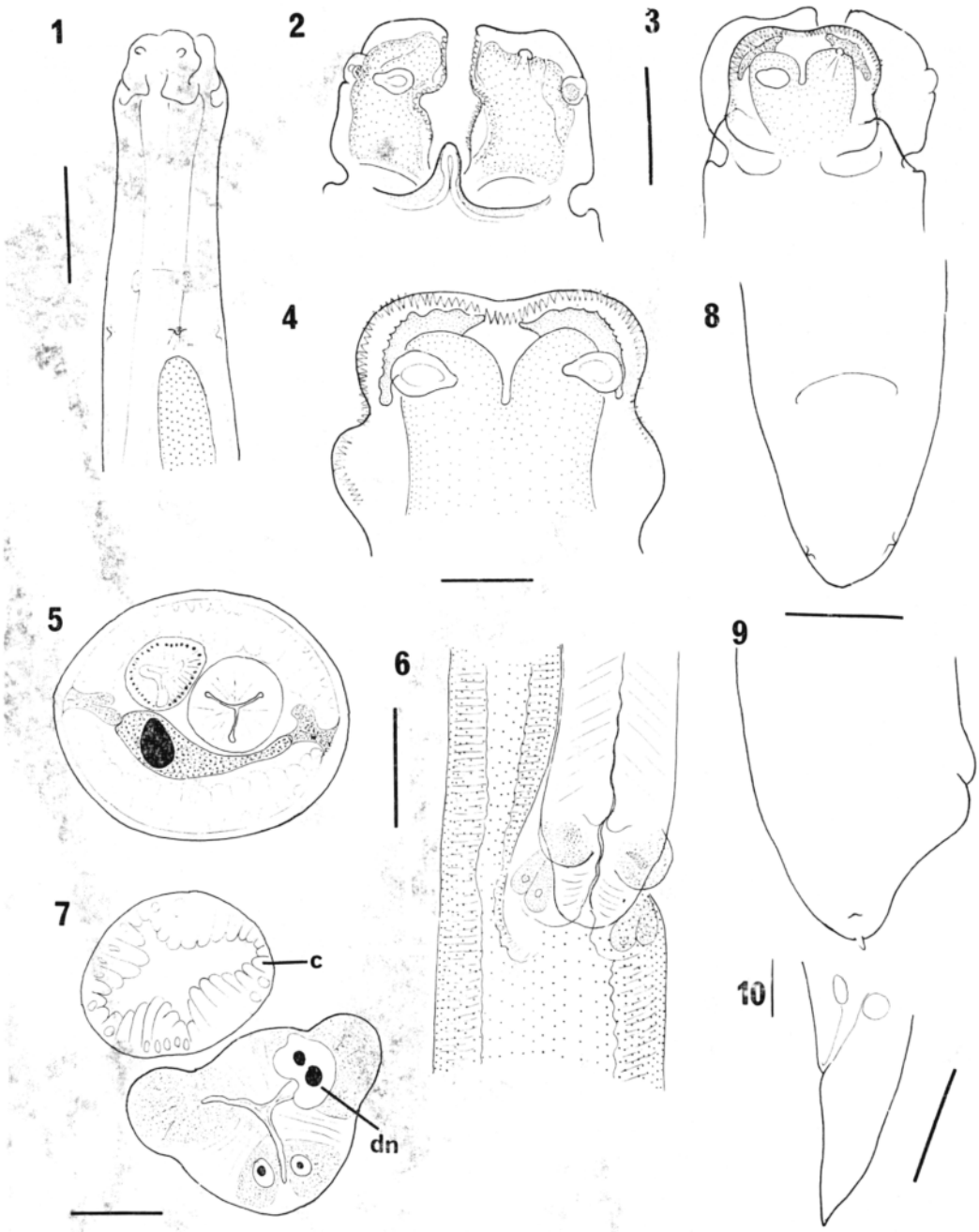

FIG. 1-10.

Fig. 1 : Dorsal view of anterior end of *O. chrysanthemoides* showing cervical papillae (0.25) ; *fig. 2 :* Lateral view of lips of *O. chrysanthemoides* (0.1) ; *fig. 3 :* Subventral lip of *O. chrysanthemoides* (0.1) ; *fig. 4 :* Dorsal lip of *O. chrysanthemoides* (0.05) ; *fig. 5 :* Section of *O. chrysanthemoides* showing excretory nucleus (0.1) ; *fig. 6 :* Posterior end of oesophagus of *O. chrysanthemoides* (0.1) ; *fig. 7 :* Section of caecum and oesophagus of *O. chrysanthemoides* showing nuclei of oesophageal glands (0.05) ; *fig. 8 :* Tail of mature female of *O. chrysanthemoides* ventral view showing phasmids (0.25) ; *fig 9 :* Lateral view of tail of mature female *O. chrysanthemoides* (0.25) ; *fig. 10 :* Lateral view of tail of immature female *O. chrysanthemoides* (0.1).

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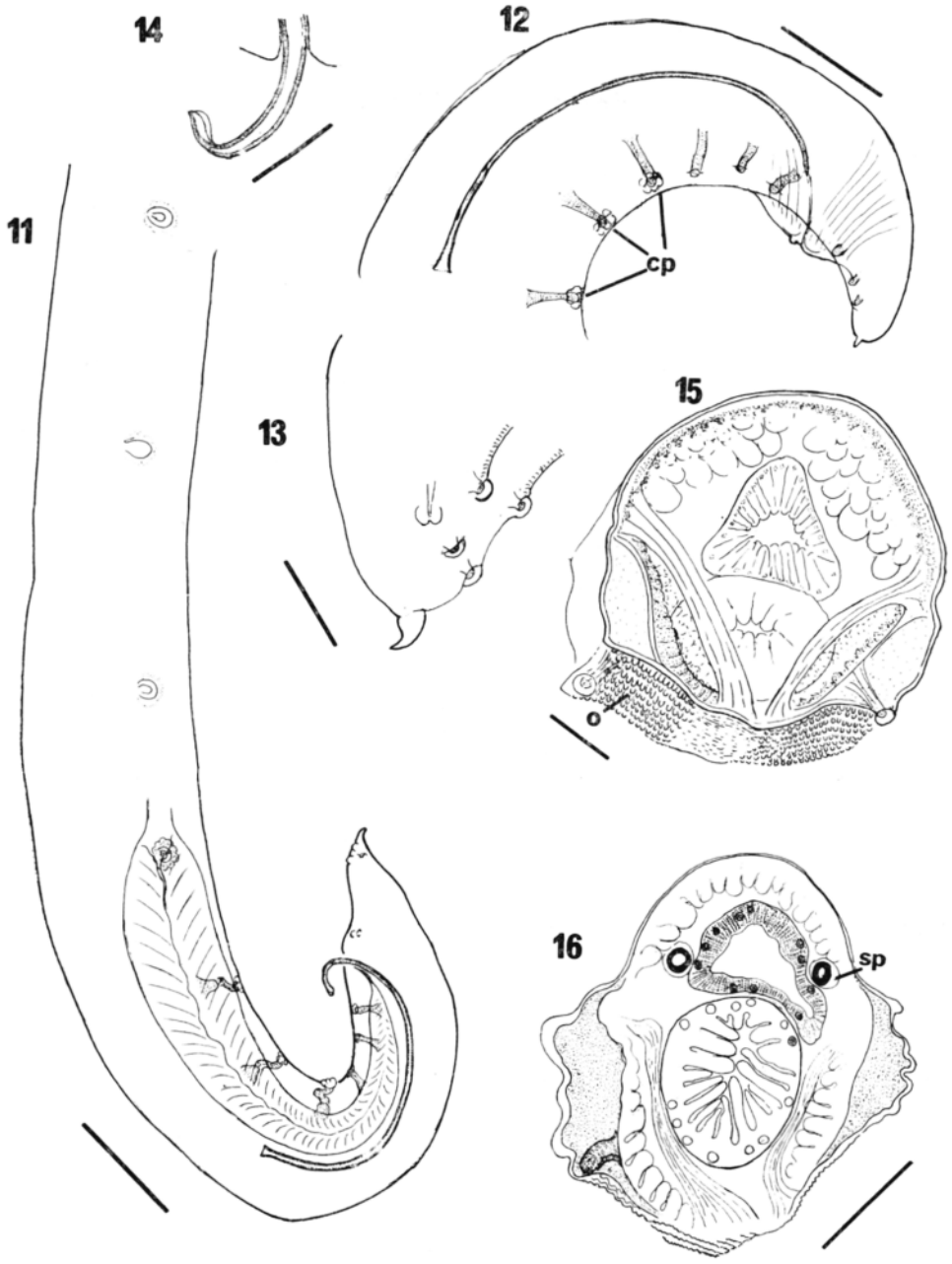

FIG. 11-16.

Fig. 11 : Tail region of male *O. chrysanthemoides* showing spicules and ejaculatory duct (0.25) ; *fig. 12* : Tail region of male *O. chrysanthemoides* showing slight cloacal prominence (0.25) ; *fig. 13* : Tip of tail of male *O. chrysanthemoides* showing postcloacal papillae and phasmid (0.05) ; *fig. 14* : Tip of spicule of *O. chrysanthemoides* (0.05) ; *fig. 15* : Cross section of male tail of *O. chrysanthemoides* anterior to spicules showing ventral precloacal ornamentation (0.05) ; *fig. 16* : Section of male tail of *O. chrysanthemoides* in region of spicules showing lateral cuticular expansions (0.1).

(Scale bar values in mm in brackets).

edges, slightly less than half length of lips. Denticles relatively large, extending around whole border of lips *(Plate I, 3)*. Labial pulp deeply cleft into two rounded lobes with hammer-like anterior prolongations *(fig. 4)*. Oesophagus 6-18 % of body length, decreasing in relative length with increase in body length, gradually widening posteriorly ; terminal part granular with several rounded lobes *(fig. 6)*. Nucleus of dorsal œsophageal gland prominent, situated on right side of dorsal sector slightly invading subventral sector on right side *(fig. 7)*. Nuclei of subventral glands smaller, situated in ventral part of subventral sectors *(fig. 7)*. Conspicuous valve present between œsophagus and intestine. Rectal glands prominent. Intestinal caecum on left side, more than half length of œsophagus, in some specimens extending almost as far as excretory pore *(fig. 1)*. Excretory pore at level of nerve ring ; excretory system comprising two posterior lateral filaments joining to form commissure containing large excretory nucleus and continuing forwards as two short, anterior lateral excretory filaments and excretory duct. Cervical alae not present. Cervical papillae inconspicuous, pit-like, level with excretory pore *(fig. 1)*.

Female with vulva situated at 27-39 % of body length from anterior end. Vagina short, sinuous, turning posteriorly to join short undivided uterus, about same length or shorter than vagina, dividing into two branches. Eggs oval, relatively large, with finely pitted surface ; 0.055-0.077 × 0.074-0.117 mm. Tail becoming relatively shorter with growth in body length *(fig. 8-10)*, with conical, terminal mucron ; phasmids about 1/5th distance from tip of tail to anus.

Male with tail curved ventrally with sharp, conical mucron *(fig. 11-13)*, subventral region of tail broadly thickened, in cleared specimens giving appearance in ventral view of wide cuticular expansion extending from anterior end of ejaculatory duct to point halfway between cloaca and tip of tail, enclosing ventral precloacal wrinkled ornamented area with cuticle thrown into longitudinal and transverse furrows and ridges *(Plate II, 10-12)*. Nine to fourteen, usually 11-13, precloacal papillae, anterior six or seven anterior to ejaculatory duct sessile, posterior six to eight pedunculate and located in subventral expansions ; tips of several papillae, especially seventh to tenth, subdivided to give chrysanthemoid appearance *(fig. 11)* as figured by Skrjabin (1916). On each side of tail, two subventral postcloacal papillae near tip of tail and one paracloacal papilla with double termination or two single paracloacal papillae. Phasmids lateral, midway between subventral papillae *(fig. 13)*. Median precloacal papilla close to anterior rim of cloaca *(Plate II)*. Spicules very slender, cylindrical, about half to three quarters length of ejaculatory duct, 3.4-

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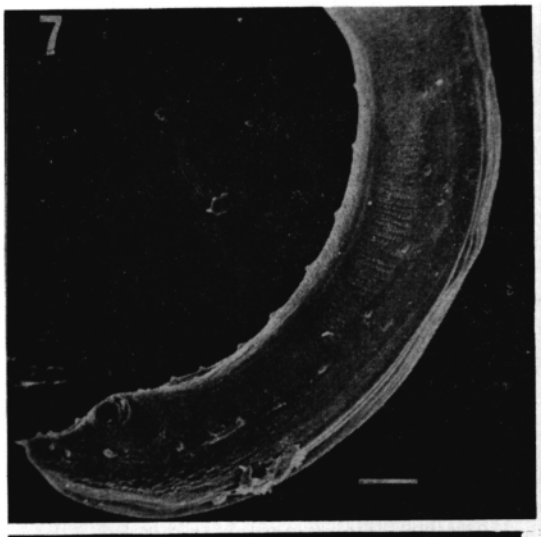
PLATE II.

Fig. 7 : Tail region of male *O. chrysanthemoides* showing areas of ornamentation (0.05) ; *fig. 8 :* Lateral view of tip of tail of male *O. chrysanthemoides* showing prominent cloaca, postcloacal papillae, and phasmid at arrow (0.01) ; *fig. 9 :* Ventral view of tail region of male *O. chrysanthemoides* showing median precloacal papilla and postcloacal papillae (0.01) ; *fig. 10 :* Precloacal region of male *O. chrysanthemoides* showing lateral cuticular expansions (0.05) ; *fig. 11 :* Precloacal ornamentation on tail of male *O. chrysanthemoides* (0.01) ; *fig. 12 :* Closer view of Text fig. 11 (0.002).

(Scale bar measurements (mm) in brackets)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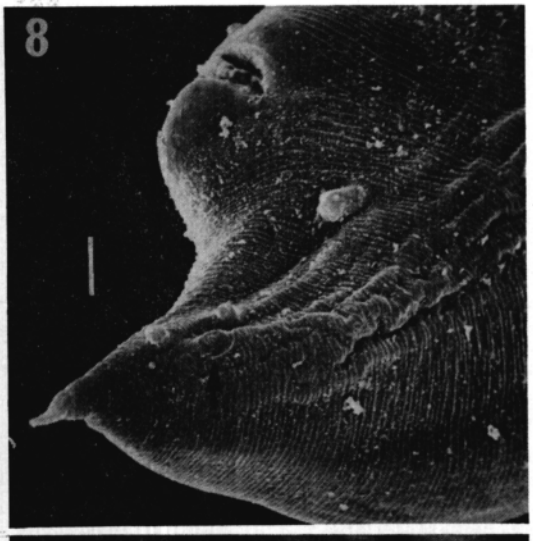
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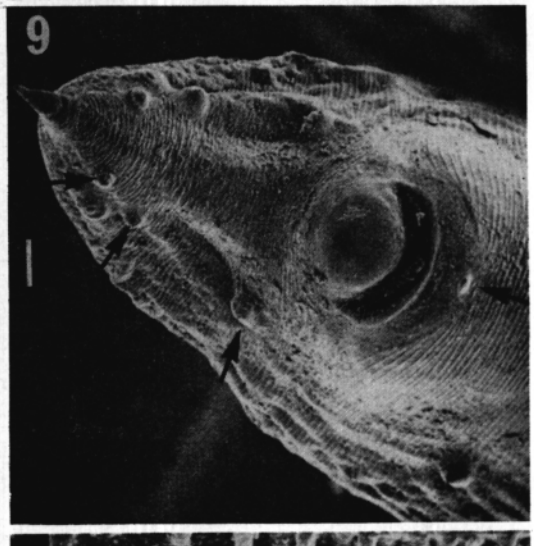
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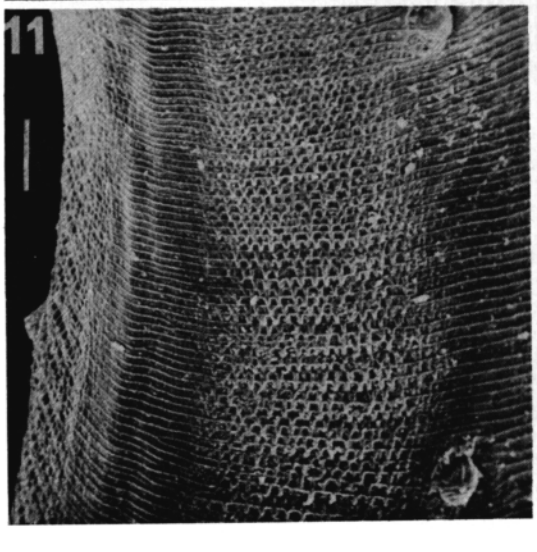
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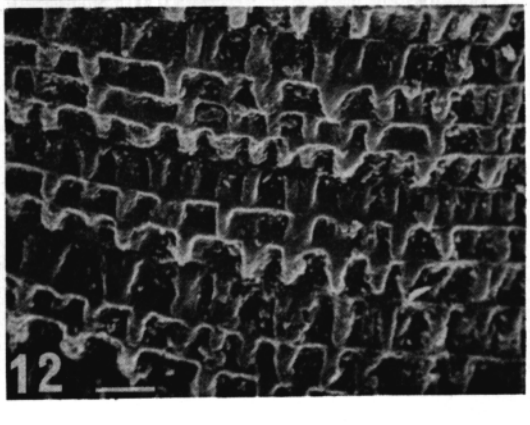
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6.7 % of body length, anterior end funnel-shaped, tip with short rounded expansions giving slightly swollen appearance *(fig. 14)*. In some specimens, especially specimens with protruding spicules, region of cloaca raised to variable extent into prominent mound *(fig. 12; Plate II, 8-9)*. Body measurements of *O. chrysanthemoides* are shown in *Table I*.

TABLE I. — Measurements (mm) of *O. chrysanthemoides* in anuran hosts in Africa.

	Males	Females
Number of specimens	29	12
Length	7.6 -29.7	10.8 -58.3
Width (maximum)	0.16-0.55	0.30- 1.3
Width (at O/I junction)	0.16-0.50	0.26- 0.97
Subventral lip (length)	0.05-0.21	0.09- 0.31
Interlabia	0.02-0.09	0.04- 0.15
Nerve ring	0.44-0.66	0.31- 1.1
Excretory pore	0.57-0.77	0.31- 1.2
Oesophagus (length)	1.3 -3.8	1.9 - 6.4
Caecum	1.1 -2.6	0.64- 3.2
Vulva (from ant. end)		3.8 -17.3
Tail	0.13-0.31	0.17- 0.41
Spicules	0.42-1.2	
Ejaculatory duct	0.58-1.8	

Forms which appeared to be fourth stage larvae were found among adult specimens. Their lips resembled those of the adults, but the interlabia were more shallow and the margins of the oral groove were more conspicuous, appearing like six pointed teeth around the oral margin. It was not possible to differentiate males from females. The smallest adult male was 7.5 mm in length. Fourth stage larvae measured 2.8-5.1 mm. The smallest female containing eggs was 22 mm in length.

The largest specimen observed was a female 95 mm in length and was collected from *Kinixys erosa*. The largest female specimen collected from anurans was 56 mm.

Type material : Lost (according to Hartwich, 1957)

Other material : MNHN 708G ; 87Q ; BMNH 1914.9.3.12-15 ; 1940.1.17.60-70 ; 1963.852-862 ; 1966.12 ; 1971.938 ; *C.I.H. *(A. pesteri)* ; DPUQ 4243.

Type host : *Bufo* sp.

Other hosts : Toads and frogs of Africa : *Bufo regularis, B. maculatus, B. supercilioris, Rana nutti, Astylosternus robustus, Breviceps macrodactylus, Xenopus laevis,*

* C.I.H. now C.I.P. = Commonwealth Institute of Parasitology.

Arthroleptis stenodactylus (new host record) ; Lizards : *Varanus niloticus, Chameleo dilepis,* 'crested chameleon' ; Chelonians : *Kinixys erosa* ; Snakes : *Natrix olivaceus, Bitis cornuta, Dispholidus typus, Causus rhombeatus* ; Crocodiles : *Crocodylus niloticus* (new host record)

Type locality : East Africa

Other localities : West & Central Africa

Location in host : Stomach and intestine.

The type material of *Orneoascaris colura* (Baylis 1919) comprises only two female specimens (BMNH 1919.6.16.2-3). They are about the same size and shape as mature females of *O. chrysanthemoides*, i.e. 46 mm in length. The lips are the same shape and form. There is a conspicuous collar forming the posterior edge of the postlabial groove and connecting the three interlabia. In all respects these specimens appear closely similar to *O. chrysanthemoides* ; the tail is short and smoothly rounded with a terminal mucron. The collection of this species in an eagle *Lophoaetes occipitalis* in West Africa is probably, as suggested by Baylis (1947), the result of spurious infection through predation on frogs or toads. It seems unlikely even though *Orneoascaris chrysanthemoides* manifests a low degree of host-specificity, that this is an example of a more permanent host transference to a bird. However, as mentioned previously, it should be noted that several species attributed to the genus *Amplicaecum* have been described in birds in India. Unfortunately the inadequacy of their descriptions precludes consideration of their affinities. This species was the type species of *Amplicaecum* Baylis, 1920. The absence of a male specimen and the wide difference in host preclude its being positively identified with *O. chrysanthemoides*. On the other hand it clearly fits the above description of *O. chrysanthemoides* insofar as the female is concerned and accordingly it is placed as a probable synonym.

It seems likely that *Amplicaecum pesteri* Rasheed, 1965 can be regarded as a synonym of *O. chrysanthemoides*, but the material is too blackened to determine this with certainty. Only two males were found, one was immature and the spicules were not visible, the other was very dark. The females were not complete specimens. It appeared that the only difference between this species and *O. chrysanthemoides* is the greater prominence of the cloaca, a feature which requires observation in living specimens before its taxonomic significance can be assessed. The lips and interlabia, the size of the denticles, and the relative length and form of the spicules as well as other features of the male tail resemble *O. chrysanthemoides*.

The description of *O. chrysanthemoides* given above corresponds with descriptions of *A. involutum* by previous observers, except that the spicule length in the description of Baer (1959) was given as 1.6 mm, i.e. slightly longer than observed by the present writer.

Orneoascaris schoutedeni (Baylis, 1940) Le Van Hoa, 1960
Synonym : *Amplicaecum schoutedeni* Baylis, 1940
(Plate I, 4-6 ; fig. 17-22)

Baylis (1940) described *Amplicaecum schoutedeni* from specimens collected from the stomach and lung of *Varanus niloticus* in Zaire. Baylis considered that the following features justified recognition of these specimens as a distinct species : cloaca in male opening on conspicuous prominence, denticles small and inconspicuous, and spicules relatively short. Paratype specimens of this species were observed by the present writer to resemble *O. chrysanthemoides* very closely with regard to shape of body and form of oesophagus, but the lips differed quite markedly in their shape *(fig. 17-19)*, their width being greater than the length, the borders rounded, the denticles extremely small compared with those of *O. chrysanthemoides* and the interlabia were shallower. The female tail was more conical than rounded, with a more prominent mucron *(fig. 21)*, the vulva was situated at 31 % of the body length from the anterior end, and the eggs were larger (according to Baylis (1940) the eggs measure 0.14-0.17 × 0.072-0.084 mm). In the male the cloaca opened on a prominence *(fig. 20)*, but as pointed out above a prominence occurred also in some specimens of *O. chrysanthemoides*. It seems possible that the cloacal region may be distensible in the living nematodes and thus its prominence may vary in the fixed state. The spicules in *O. schoutedeni* are somewhat stouter *(fig. 20)* than in *O. chrysanthemoides*, as well as being shorter relative to body length (1.8-2.3 %). As described by Baylis (1940) the arrangement of the caudal papillae does not differ from *O. chrysanthemoides*. In all specimens examined there were 14 or 15 precloacals, the first seven being sessile, the last seven or eight being situated in the caudal alae. The precloacal region was ornate as described above for *O. chrysanthemoides*. The specimens of *O. schoutedeni* examined by the writer were smaller than the co-type specimens described by Baylis, but they corresponded except for size. Body measurements of these specimens are shown in *Table II*. The values are mostly smaller than those given by Baylis as might be expected.

Six female specimens in the U.S. National Parasite Collection collected from *Varanus exanthematicus* in Tanzania appeared to belong in this species, although absence of a male made identification doubtful. The lips and interlabia *(Plate I, 4-6 ; fig. 22)* resembled those of *O. schoutedeni*, the denticles were very small, and the eggs measured 0.12-0.15 × 0.077-0.105 mm, i.e. close to those measured by Baylis for *O. schoutedeni* and somewhat larger than those of *O. chrysanthemoides*. Measurements of these specimens are shown in *Table II*.

Type material : BMNH 1940.1.17.60-70

Other material : USNPC 41261

Type host : *Varanus niloticus*

Other hosts : *V. exanthematicus*

TABLE II. — Measurements (mm) of *O. schoutedeni*.

	ZAIRE		TANZANIA
	Males	Females	Females
Number of specimens	2	1	5
Length	21.1 - 24.6	19.6	45.0 -49.2
Width (maximum)	0.44 - 0.57	0.53	1.2 - 1.3
Width (at O/I junction)	0.38 - 0.42	0.42	0.76 - 0.85
Subventral lip (length)	0.077- 0.079	0.086	0.15 - 0.19
Interlabia	0.021	0.028	0.043- 0.055
Nerve ring	0.41 - 0.56	*	0.65 - 0.78
Excretory pore	0.54 - 0.58	0.48	0.73 - 0.85
Oesophagus (length)	1.8 - 1.9	1.8	2.3 - 3.8
Caecum	0.85 - 1.1	1.3	1.4 - 2.7
Vulva (from ant. end)		6.2	12.1 -18.1
Tail	0.23 - 0.26	0.14	0.33 - 0.50
Spicules	0.45 - 0.49		
Ejaculatory duct	1.1 - 1.2		

* not measured

Type locality : Zaire

Other localities : Tanzania

Location in host : stomach, lung

Orneoascaris sandoshami (Yuen, 1963) new combination

Synonym : *Amplicaecum sandoshami* Yuen, 1963

(Plate III, 13-18 ; fig. 23-26)

The type material of this species collected from the Asiatic horned frog *(Megophrys nasuta)* in Malaya was found to resemble *O. chrysanthemoides* in having lips that are almost square, conspicuous denticles, and prominent interlabia *(fig. 23)*. The posterior end of the oesophagus, length of caecum, relative position of the vulva (at 36 % of body length from anterior end), size of eggs (0.080-0.114 × 0.053-0.074 mm), and the ornamentation and arrangement of papillae on the male tail (11-13 precloacals), all appeared identical with *O. chrysanthemoides*. On the other hand the female tail was more conical *(fig. 26)*, the spicules *(fig. 24)* slightly stouter and shorter, i.e. only 2.5-3.0 % of the body length, compared with 4-5 % in *chrysanthemoides*, and the cloacal region was very prominent in some male specimens examined by the writer *(fig. 25)*. In these features the specimens resembled *O. schoutedeni*. On account of the cloacal prominence *O. sandoshami* was regarded by Yuen (1963) as being close to *O. schoutedeni*, but the features whereby Yuen (1963) differentiated

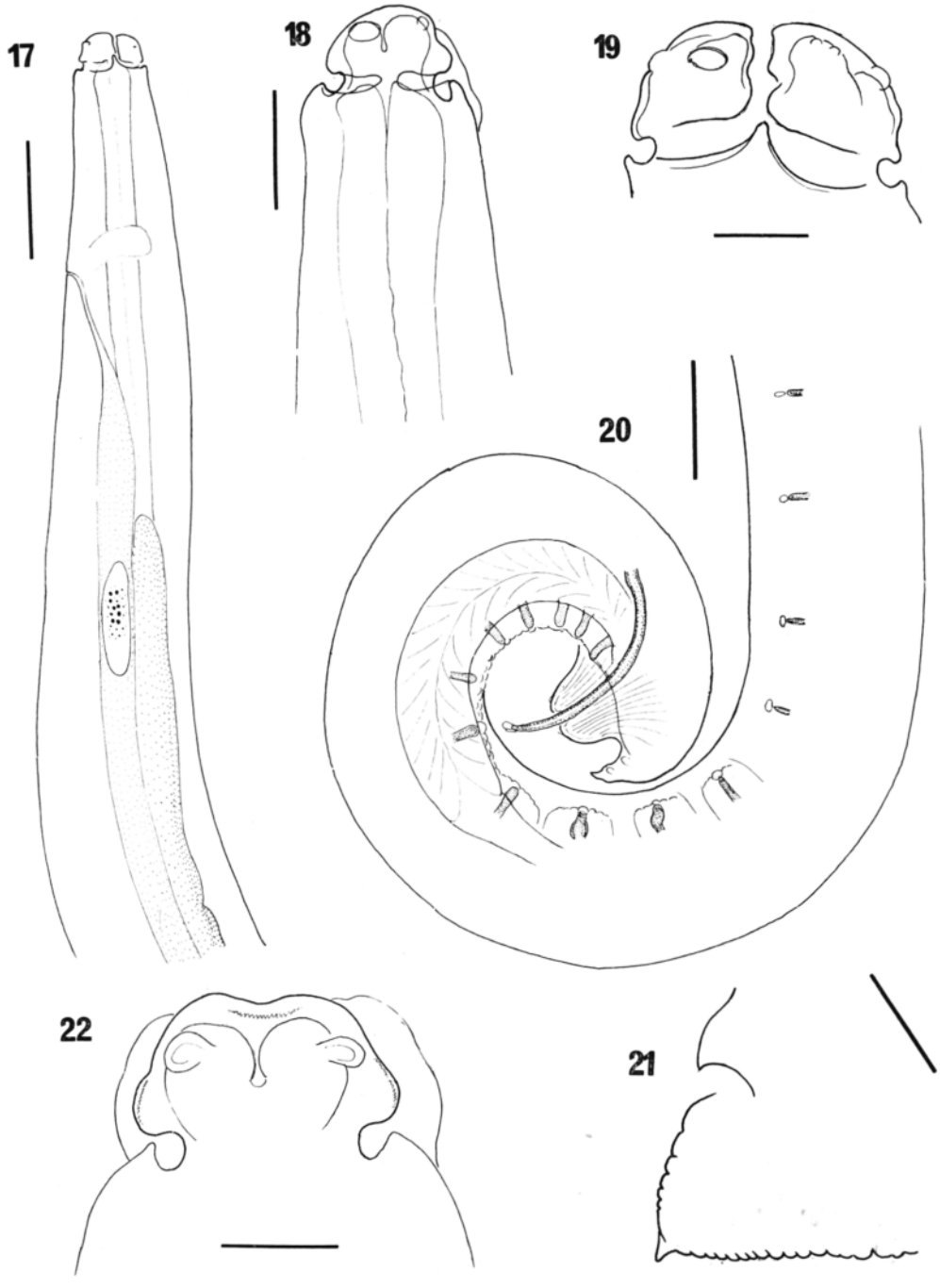


FIG. 17-22.

Fig. 17 : Left lateral view of anterior end of *O. schoutedeni* showing excretory nucleus and caecum (0.25) ; *fig. 18 :* Subventral view of lips of *O. schoutedeni* (0.1) ; *fig. 19 :* Lateral view of lips of *O. schoutedeni* (0.05) ; *fig. 20 :* Tail region of male *O. schoutedeni* showing cloacal prominence (0.25) ; *fig. 21 :* Tip of tail of female *O. schoutedeni* (0.1) ; *fig. 22 :* Dorsal lip of *O. schoutedeni* (specimen from *V. exanthematicus*) (0.1).

(Scale bar values in mm in brackets).

O. sandoshami from *O. schoutedeni* were not confirmed. Only by the form of the lips could these two species be differentiated. In the present writer's view this species is close to *O. chrysanthemoides* because of similarity of the lips. Cleared specimens, apart from the prominent cloaca, differed only in the shorter, stouter spicules. The prominent cloaca was not evident at 10 mm or 13 mm, but was evident at a length of 20 mm.

In the only sectioned specimen of *O. sandoshami* available to the writer, the form and arrangement of the nuclei of the oesophageal glands resembled those in *O. chrysanthemoides*, but the cuticle covering the anterior part of the body was thicker and adjacent to the lateral chords cuticular supporting bars were visible within the cuticle. The excretory commissure was relatively less conspicuous and narrower than in *O. chrysanthemoides* the excretory nucleus was relatively smaller.

One fourth stage larva was observed ; the length was 7.1 mm, oesophagus 1.1 mm and the vagina was situated at 47 % of the body length. The denticles were relatively larger than in adults and restricted to the middle part of the margin. There was a ventral interlabium, but there were no lateral interlabia. Body measurements of specimens from Malaya and North Borneo are shown in *Table III*.

TABLE III. — Measurements (mm) of *O. sandoshami*.

	MALAYA		BORNEO	
	Males	Females	Males	Females
Number of specimens	2	1	2	4
Length	10.4 -25.4	25.7 -33.5	12.9 -28.8	23.0 -50.0
Width (maximum)	0.22 - 0.58	0.48 - 0.62	0.24 - 0.52	0.36 - 0.91
Width (at O/I junction)	0.21 - 0.50	0.48 - 0.63	0.23 - 0.43	0.34 - 0.71
Subventral lip (length)	0.07 - 0.19	0.16 - 0.22	0.11 - 0.17	0.15 - 0.24
Interlabia	0.025- 0.046	0.046- 0.069	0.040- 0.062	0.062- 0.089
Nerve ring	0.33 - 0.71	0.55 - 0.82	0.44 - 0.75	0.58 - 0.92
Excretory pore	0.37 - 0.88	0.60 - 1.0	0.46 - 0.85	0.62 - 1.1
Oesophagus (length)	1.7 - 3.9	3.8 - 5.0	2.1 - 3.5	3.3 - 5.9
Caecum	1.3 - 3.0	3.0 - 3.6	1.6 - 2.4	2.7 - 4.5
Vulva (from ant. end)	—	9.2 -14.2	—	8.5 -19.2
Tail	0.17 - 0.46	0.23 - 0.31	0.19 - 0.31	0.24 - 0.50
Spicules	0.34 - 0.77	—	0.55 - 0.69	—
Ejaculatory duct	0.62 - 1.8	—	0.83 - 1.6	—

Type material : BMNH 1963.852-861

Other material : USNPC 75703

Type host : *Megophrys* spp.

Other hosts : *M. nasuta*

Type locality : Kuala Lumpur, Malaya

Other localities : North Borneo

Location in host : intestine

Orneoascaris sp.

(fig. 27)

Two female specimens collected from the agamid lizard, *Phoxophrys spiniceps*, in North Borneo cannot be included with any of the above mentioned species because the male is unknown. Their lips are small relative to the body width *(fig. 27)*, their interlabia resemble those in *O. schoutedeni* and the striations of the cuticle are coarse (at the region of the oesophago-intestinal junction the cuticular striations are 0.018 mm compared with 0.006 mm in *O. chrysanthemoides*). In the shape of the lips and size of the denticles these specimens most closely resemble *O. schoutedeni*. The position of the vulva was at 28-43 % from the anterior end and the eggs measured 0.11-0.12 × 0.077-0.092 mm, i.e. about the same size as in *O. schoutedeni* and larger than in *O. sandoshami*. Measurements of these specimens are shown in *Table IV*.

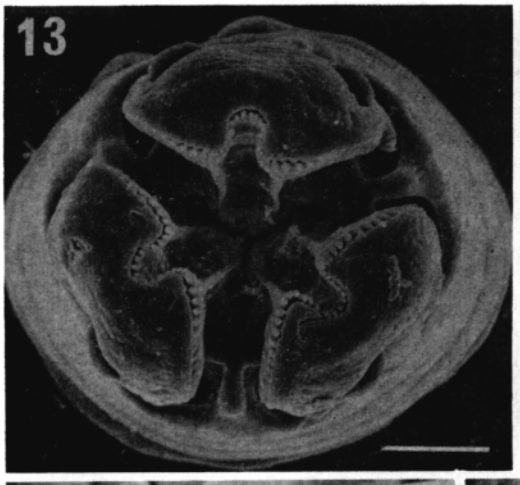
TABLE IV. — Measurements (mm) of female specimens of *Orneoascaris* sp. from *Phoxophrys spiniceps* in North Borneo.

Number of specimens	2
Length	11.7 -18.1
Width (maximum)	0.42 - 0.47
Width (at O/I junction)	0.31 - 0.46
Subventral lip (length)	0.05 - 0.06
Interlabia	0.019- 0.02
Nerve ring	0.29
Excretory pore	0.34
Oesophagus (length)	1.1 - 2.8
Caecum	0.54
Vulva (from ant. end)	4.9 - 5.0
Tail	0.10 - 0.17

PLATE III.

Fig. 13 : En face view of lips of *O. sandoshami* (0.05) ; *fig. 14* : Dorsal lip of *O. sandoshami* (0.05) ; *fig. 15* : Ventral view of lips of *O. sandoshami* (0.05) ; *fig. 16* : Ventral view of tail of male *O. sandoshami* showing cloacal prominence and lateral cuticular expansions (0.1) ; *fig. 17* : Tip of tail of male *O. sandoshami* showing precloacal median papilla and postcloacal papillae (0.05) ; *fig. 18* : Precloacal ornamentation and precloacal papilla of *O. sandoshami* (0.025).

(Scale bar measurements (mm) in brackets)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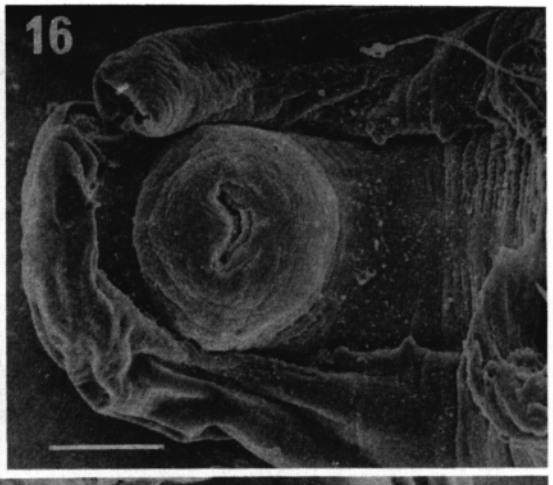
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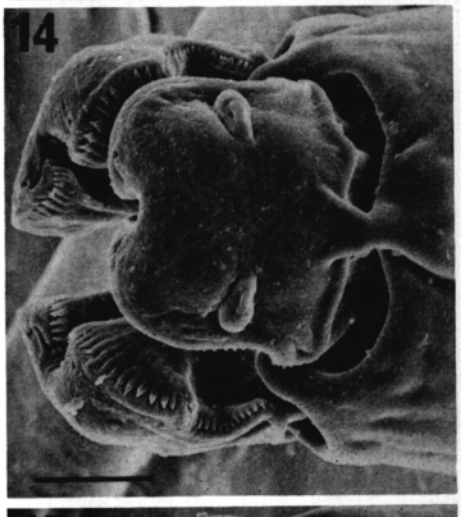
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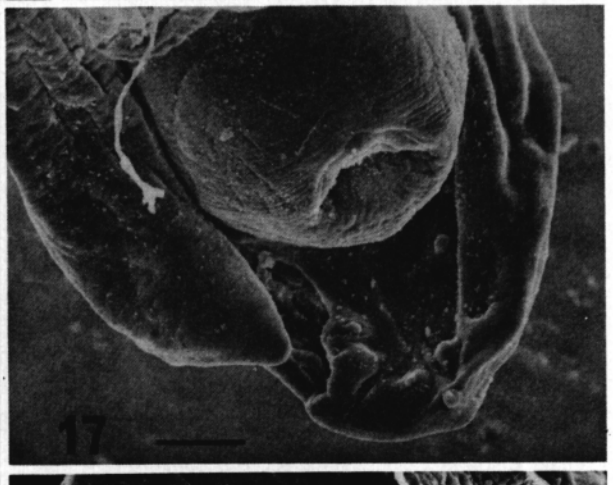
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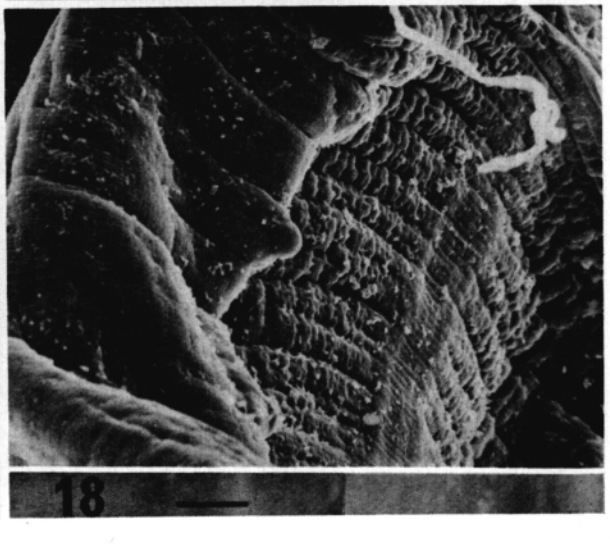
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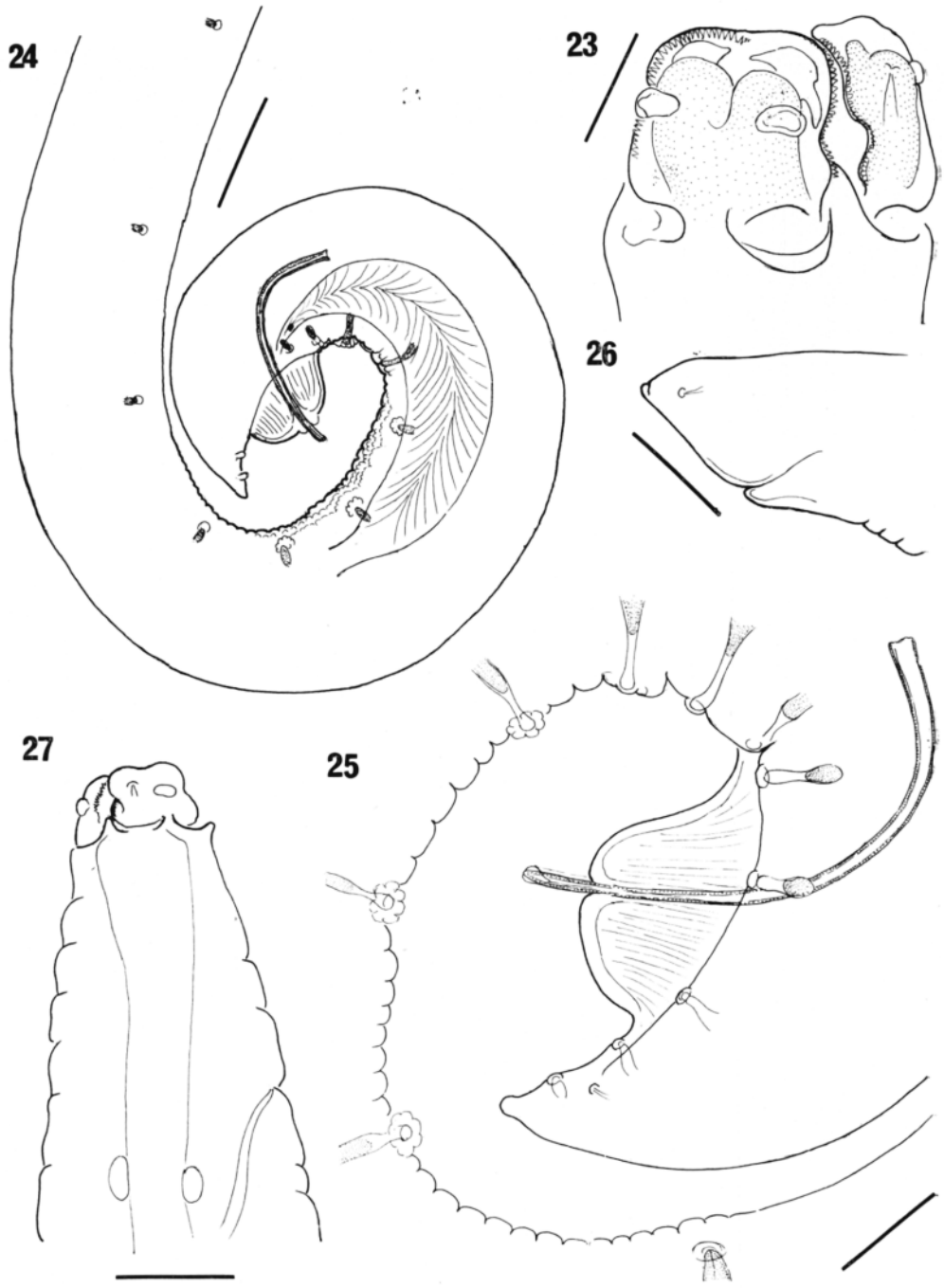

FIG. 23-27.

Fig. 23 : Dorso-lateral view of lips of *O. sandoshami* (0.1) ; *fig. 24 :* Tail of male *O. sandoshami* showing precloacal ornamentation (0.25) ; *fig. 25 :* Tip of tail of male *O. sandoshami* showing precloacal prominence (0.1) ; *fig. 26 :* Tip of tail of female *O. sandoshami* (0.25) ; *fig. 27 :* Lateral view of anterior end of *Orneoascaris* sp. from *P. spiniceps* (0.1).

(Scale bar values in mm in brackets.)

Type material : BMNH 1936.8.19.17-18
Other material : none known
Type host : *Phoxophrys spiniceps*
Type locality : Mt. Murud, North Borneo
Location in host : not stated

Of all species so far known in the genus *Orneoascaris*, these specimens correspond most closely with *O. schoutedeni*. This similarity is of interest in that *O. schoutedeni* and these specimens were collected from lizards.

Discussion

Contrary to the opinion of Le Van Hoa (1960) who regarded the ventral ornamentation of the male tail as an artefact, the present writer upholds the opinion of Skrjabin (1916) that the ornamentation of the male tail in *Orneoascaris sensu stricto* is a basic feature of this genus, differentiating the above described group of species from other species comprising *Orneoascaris sensu lato* listed by Le Van Hoa (1960).

The ornamentation of the cuticle in the precloacal area as well as the marked lateral thickening of the cuticle and the chrysanthemoid appearance of several of the precloacal papillae indicate some degree of specialization in the genus so that it cannot be regarded as a primitive form. Indeed its evident absence from the New World and Australia suggests a recent origin in the Old World Tropics, perhaps not until the Tertiary when barriers to anuran migration had become established.

On the other hand the interlabia, the small number of precloacal papillae, the capacious intestinal caecum, and possibly the posterior end of the oesophagus with its lobular form, may indicate affinities with Heterocheilinae. In lip structure *Orneoascaris* most closely resembles *Ophidascaris* and there is the possibility that the former genus was ancestral to the latter. Species in frogs may have given rise to species in frog-eating snakes through host-succession-extension (Sprent, 1982).

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List of abbreviations used for figures.

c = caecum ; cp = chrysanthemoid precloacal papillae ; dn = nucleus of dorsal œsophageal gland ; o = precloacal ornamentation ; sp = spicule.

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