

PARASITES OF THE RELICT FAUNA OF CEYLON

IX. Helminths from burrowing scincine lizards

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SUMMARY. A trematode and nematodes are reported for the first time from endemic burrowing scincines of Sri Lanka, namely the cosmopolitan trematode *Mesocoelium monas* (Rudolphi, 1819) from the small intestine of *Nessia burtoni*; and the nematodes *Kalicephalus brachycephalus* Maplestone, 1931 from the stomach of *Nessia smithi*; and *Meteterakis sinharajensis* Crusz and Ching, 1976 and *Parapharyngodon adamsoni* sp. nov., both from the large and small intestines and rectum of *Chalcidoseps thwaitesi*, *N. burtoni*, *N. didactyla* and *N. smithi*. The new species is distinguished from other species of the genus mostly by the relatively small size; very short and characteristically shaped male caudal appendage, which is generally about half the length of the spicule; and the very close, almost fused, ventral arrangement of the pair of papillae on it, which is the last of four pairs of male caudal papillae. There is also more evidence of burrowing herpetofauna having parasites similar to those, but much reduced in number and variety, of sympatric non-burrowing forms, from which it was derived.

Key-words: Trematode. Nematodes. *Parapharyngodon adamsoni* sp. nov. Reptilia. Endemic Scincinae. Sri Lanka.

Parasites de la faune relictive de Ceylan. IX. Helminthes, parasites de lézards scincinés fouisseurs.

RÉSUMÉ. Un trématode et des nématodes ont été découverts pour la première fois chez des scincinés fouisseurs, endémiques à Sri Lanka. Ont été identifiés le trématode cosmopolite *Mesocoelium monas* (Rudolphi, 1819) dans l'intestin grêle de *Nessia burtoni*; les nématodes *Kalicephalus brachycephalus* Maplestone, 1931 dans l'estomac de *Nessia smithi* et *Meteterakis sinharajensis* Crusz et Ching, 1976 et *Parapharyngodon adamsoni* sp. nov., dans le côlon, l'intestin grêle et le rectum de *Chalcidoseps thwaitesi*, *N. burtoni*, *N. didactyla* et *N. smithi*.

L'espèce nouvelle diffère des autres espèces du genre par la taille relativement petite; l'appendice caudal du mâle très court, de forme caractéristique, mesurant à peu près la moitié de la longueur du spicule; la disposition de la dernière paire de papilles caudales, presque fusionnées ventralement.

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Il apparaît à nouveau que l'herpétofaune fouissante a des parasites semblables aux parasites des formes sympatriques non fouissantes dont elle dérive ; cependant, ces parasites sont réduits quant au nombre et quant à la variété.

Mots-clés: Trématode. Nématodes. *Parapharyngodon adamsoni* sp. nov. Reptilia. Scincinés endémiques. Sri Lanka.

Introduction

« Diese Verbreitung muss als ein Relikt einer alten, einst viel grösseren aufgefasst werden, falls nicht, was bei wühlenden Scinken keine Unmöglichkeit wäre, eine Parallelentwicklung, also eine polyphyletische Erscheinung, vorliegt. »

Fritz Sarasin, 1910

The grouping of the acontias (so-called limbless skinks, or snake-skinks, or dart-snakes) into a separate reptilian saurian family Acontiidae (= Acontiadae, Gray, 1845), later reduced to a subfamily Acontiinae¹, of the family Scincidae, had been viewed with too many serious reservations until Greer's (1970) critical study of them using a variety of important criteria. The Sri Lankan forms, as dealt with by Deraniyagala (1953), are now considered as belonging to the subfamily Scincinae, which still has a remarkable but wider distribution than that thought of hitherto, being represented even in India by some species (Greer, 1970; Brygoo, 1984). The Sri Lankan forms are represented by the nine endemic species listed by Deraniyagala, but belonging only to two of his five endemic genera, namely *Chalcidoseps* and *Nessia* (Taylor, 1950; Greer, 1970). All these matters concerning taxonomic status and geographical distribution, and the interesting microevolutionary trends shown especially by the Sri Lanka scincines (Deraniyagala, 1953, 1965), make this group particularly worthy of study from a parasitological point of view.

The data on the autopsies (host, sex of host, locality of host, and date of collection, habitat of parasite, parasite number and sex of parasites) are deposited in the Dept. of Zoology, University of Peradeniya and in the Museum of Paris, No. H 4472.

These burrowing skinks were best obtained during not-so-dry seasons in the foot-hills, by shallow digging of soil at leaf-litter and rubbish heaps, and generally in the evening and early morning, since they are most active at night.

1. The scincid subfamily names « Acontianinae » (Deraniyagala, 1953) and « Acontinae » (Greer, 1970) are changed to « Acontiinae », in keeping with the guide-lines provided by the International Code of Zoological Nomenclature. The latinized grammatical stem of the Greek word « akontias » (genitive: « akontiou ») is « aconti ». Hence, « Acontiinae ».

Sri Lanka has nine species of these skinks, all endemic and relict: *Chalcidoseps thwaitesi*, *Nessia burtoni*, *N. didactyla*, *N. monodactyla*, *N. smithi*, *N. sarasinorum*, *N. layardi*, *N. hickanala* and *N. deraniyagalai*. While *N. smithi* has long been known to be restricted to the Gammaduwa area only, and *C. thwaitesi* mostly to the Gammaduwa area and rarely also the Kandy area, both species can still be seen today without difficulty especially in forest and plantation habitats in these areas. Some others however, such as *N. layardi*, were more widely distributed until deforestation, and subsequent urbanization and industrialization, reduced their numbers considerably or wiped them out almost completely.

The present report is based on a study of the only helminth specimens, 103 in all, collected from 86 host specimens belonging to the four scincine species *C. thwaitesi*, *N. burtoni*, *N. didactyla* and *N. smithi*. The parasites identified were the trematode *Mesocoelium monas*, and the nematodes *Kalicephalus brachycephalus*, *Metelerakis sinharajensis* and *Parapharyngodon adamsoni* sp. nov., in that order of increasing frequency for the nematodes.

The work at various localities was not confined to collecting burrowing skinks only. Other herpetofauna, both endemic and non-endemic, was also collected, and even examined for parasites. Some of the latter, for example the pharyngodonid nematodes, will form the subject of a future study in this series. It also became obvious, as expected, that the non-burrowing forms carried a wider variety of parasites, which included cestodes, pentastomids and ectoparasites as well, all of which were absent from the burrowing skinks.

Mesocoelium monas (Rudolphi, 1819)
(Trematoda: Digenea: Mesocoeliidae)

Nine specimens of a trematode were collected from the small intestine of *Nessia burtoni* at Migahatenna and at Opatha near Hiniduma. They were lightly flattened, fixed in Bouin's fluid, and stained in potassium alum carmine.

In all details of structure and measurements they were found to belong to the species *Mesocoelium monas* (Rudolphi, 1819; *sensu* Freitas, 1963). Marked variations in shape and size were seen in mature specimens collected from even the same individual host.

This species has already been recorded in Sri Lanka from the small intestine of the Asian tree-frog *Rhacophorus maculatus* in Colombo (as *Mesocoelium burti* Fernando, 1933), the endemic tree-frog *Rhacophorus eques* in the montane region of Ohiya (as *Mesocoelium marrsi* Fernando, 1933) and the endemic burrowing amphibians *Ichthyophis glutinosus* in Kandy (Crusz and Santiapillai, 1982) and *Ichthyophis pseudangularis* in Talgaswela (No. 725, 29 April 1983) (Crusz, unpubl. work). This last locality is also inhabited by *Nessia burtoni*, and belongs to the same southwestern sector of Sri Lanka as Migahatenna and Opatha where this trematode is now shown to occur.

These findings confirm not only the remarkable ubiquity and morphological variability of *Mesocoelium monas*, as convincingly shown by Freitas (1963), but also that burrowing amphibian and reptilian hosts tend to become parasitized, though

more sparsely, by helminth species acquired apparently from sympatric non-burrowing herpetofauna (Crusz and Santiapillai, 1982).

Kalicephalus brachycephalus Maplestone, 1931
(Nematoda: Strongylida: Diaphanocephalidae)

Although of a total of 86 burrowing skinks examined for parasites, 36 were found to be infected, and 103 helminths, mostly nematodes, were collected from them, only a single male specimen of *Kalicephalus brachycephalus* was found. It was from the stomach of *Nessia smithi* at Nagalla. The site of infection indicates recent poor adaptation or even accidental infection.

This normally rectophilous nematode has already been reported from the intestine of the colubrid snake *Aspidura trachyprocta* at Horton Plains (Crusz and Sanmugasunderam, 1974) and probably also, according to Schad (1962), from *Typhlops braminus* in Colombo, Sri Lanka. Both these snakes are burrowing forms, a fact which confirms the contention that there is a community of parasitic forms among burrowing hosts, though very poorly represented in the endemic and relict ones.

Meteterakis sinharajensis Crusz and Ching, 1976
(Nematoda: Ascaridida: Heterakidae)

Thirty two specimens (11 males and 21 females), clearly belonging to the species *Meteterakis sinharajensis*, were recovered from the large intestine and rectum, and on one occasion even the stomach, of *Nessia didactyla* at Dewatura (near Namunukula), and *Chalcidoceps thwaitesi* and *Nessia smithi* at Nagalla (Gammaduwa).

This species was originally described (Crusz and Ching, 1976) from the burrowing uropeltid snake *Pseudotyphlops philippinus* from the same locality near Namunukula, and from the agamid lizard *Lyriocephalus scutatus*, which is known to take often to burrowing, from Godekande near the Sinharaja forest; and later (Crusz and Santiapillai, 1982) from the amphibian *Ichthyophis orthoplicatus* from the same locality near Namunukula, and *I. glutinosus* from Kandy and Gammaduwa. All these hosts are endemic to Sri Lanka, and the study of their parasites amply confirms the similarity that exists in helminth faunal complex between burrowing amphibians and burrowing reptiles (Crusz and Santiapillai, 1982).

Parapharyngodon adamsoni sp. nov.
(Nematoda: Oxyuroidea: Pharyngodonidae) (Figs. 1-12)

Sixty one nematode specimens (19 males, 42 females) were collected from *Chalcidoseps thwaitesi*, *Nessia smithi* and *Nessia burtoni*, at various times and localities. A detailed study showed that they belong to a hitherto undescribed species.

The specimens were freshly collected from the rectum, or the large or small intestines, of their hosts, fixed in hot 70 % ethanol, and stored also in fresh 70 % ethanol. Glycerol to prevent drying up of stored specimens was not used for worms

collected after 1984, in view of the advice against its use (Durette-Desset, 1984). In fact, specimens collected earlier were transferred to ethanol without glycerol.

For microscopic study, specimens were cleared in glycerol, or lactophenol. The latter, however, was soon found to be unsatisfactory owing to its tendency to weaken the cuticle to the point of damaging specimens. Despite the advice against its use, we still find glycerol the most satisfactory for clearing very small nematodes, as structural details show up well in it.

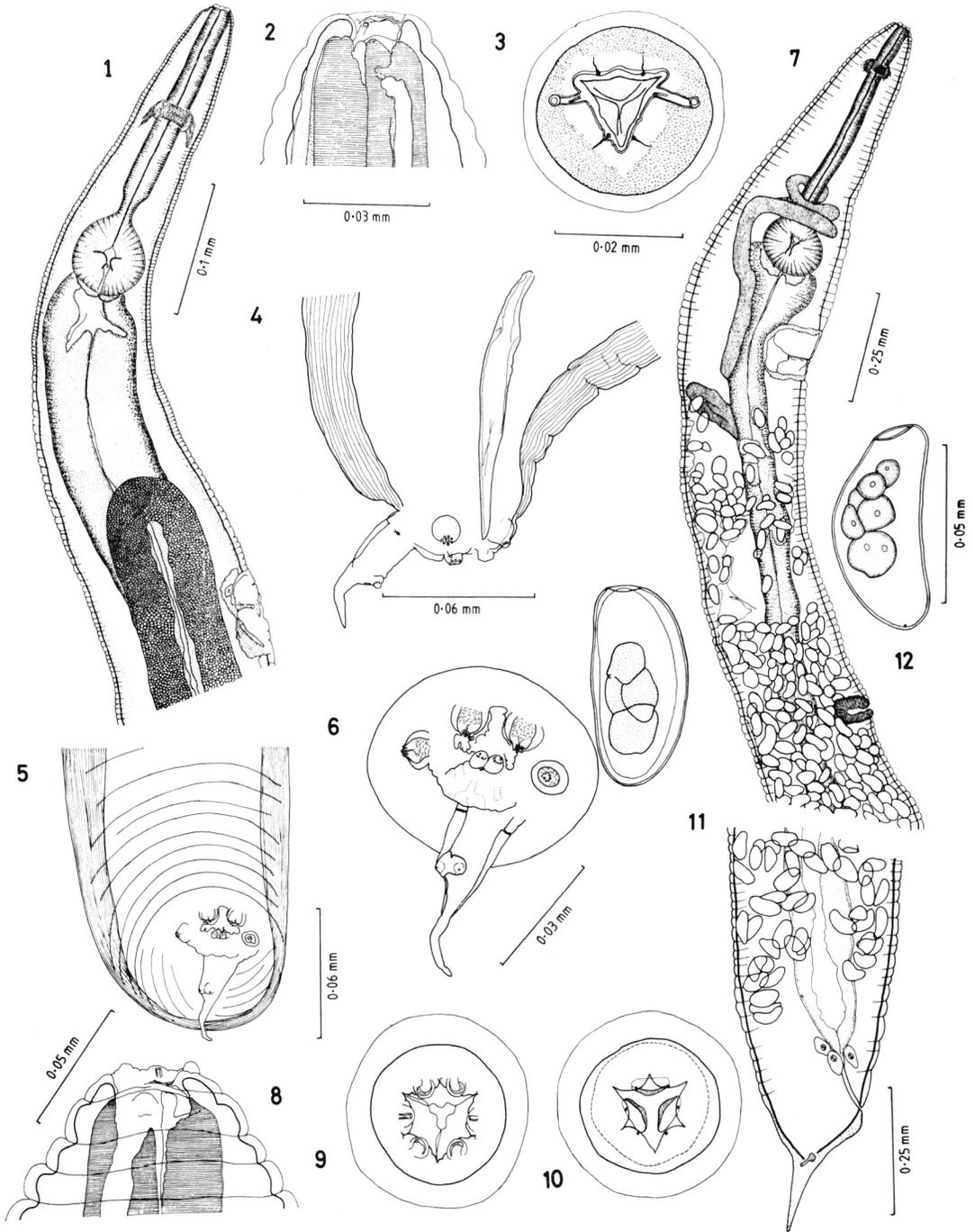
Description

Small, robust worms. Females larger and stouter than males. Cephalic extremity flat. Distinct transverse annulations on body cuticle throughout length, except postanally. Oral opening subtriangular, surrounded by one dorsal and two subventral cuticular membranes, which differ in size and shape in male and female worms. Three cuticular plates, one dorsal and two subventral, also differing in size and shape in the two sexes, on anterior end of oesophagus.

TABLE I. — *Parapharyngodon adamsoni*.

	Male (12)	Female (6)
Body length	1.312 -2.304	2.763 -4.066
Body width (maximum)	0.098 -0.360	0.295 -0.652
Buccal cavity length	0.0082	0.0082-0.0123
Nerve ring from anterior end	0.082 -0.148	0.090 -0.098
Oesophagus length (with bulb)	0.230 -0.422	0.586 -0.950
Isthmus	0.0164-0.0205	0.0205
Bulb length	0.057 -0.120	0.123 -0.232
Bulb width	0.053 -0.119	0.144 -0.164
Excretory pore from anterior end	0.451 -0.759	0.787 -1.025
Spicule length	0.062 -0.120	—
Caudal appendage length	0.033 -0.053	0.123 -0.164
Anus from posterior extremity	—	0.197 -0.328
Vulva from anterior end	—	1.455 -1.743
Egg dimensions	—	0.057 -0.087
		×
		0.029 -0.069
Lateral alae from anus	0.164 -0.267	—
Annulations (distance apart)		
— anterior	0.0041-0.0082	0.0164
— posterior	0.0041-0.0185	0.0205-0.0246
Phasmids	0.011	0.135 -0.164
	(from caudal appendage papillae)	(from posterior extremity)

Measurements in millimeters.



FIGS. 1-6. — *Parapharyngodon adamsoni* sp. nov., male.

Fig. 1: Anterior third, lateral view (specimen no. 710). Fig. 2: Cephalic extremity, lateral view (784). Fig. 3: Superficial apical view (784). Fig. 4: Caudal extremity, lateral view (784). Fig. 5: Caudal extremity, ventral view (779). Fig. 6: Caudal extremity, ventral view (779).

FIGS. 7-12. — *Parapharyngodon adamsoni* sp. nov., female.

Fig. 7: Anterior half, lateral view (716). Fig. 8: Cephalic extremity, lateral view (789). Fig. 9: Superficial apical view (789). Fig. 10: Apical view, optical section through base of buccal capsule. Dotted line is outline of oesophagus (789). Fig. 11: Caudal extremity, lateral view (716). Fig. 12: Eggs (776).

Male: Six tiny inner papillae present at oral end, two of which are lateral, in association with the amphids. Outer papillae not recognizable. Lateral alae present, beginning near level of oesophagus and ending 164-267 μm anterior to anus, not abruptly, but after narrowing gradually into a thin membrane. Excretory pore further posterior to level of oesophageal bulb than in female. Testis extends anteriorly from about middle of body and turns posteriorly a little anterior to level of excretory pore, before leading to vas deferens. Tail truncate, with very short caudal appendage, which is mostly about half the length of the spicule, and which narrows abruptly just behind last pair of caudal papillae, the postpapillar portion being generally shorter and of much less than half the original width. Spicule narrow proximally, dilating from a little anterior to the middle, and attenuating posteriorly towards a bluntly pointed distal end. Four pairs of caudal papillae, of which the three anterior pairs are rosette: one pair pre-anal, one pair adanal, one pair immediately behind anus, and one pair situated ventrally on the caudal appendage. The papillae of this last pair are in such close proximity that they appear to fuse with each other ventrally. Six rectal glands present. Phasmids a short distance anterior to the pair of papillae on the caudal appendage.

Female: Oral opening surrounded by six prominent elevations: each of the four submedian elevations with a terminal outer papilla and a tiny inner papilla just inside buccal cavity; each lateral elevation with an amphid and tiny inner papilla. Excretory pore closer to level of oesophageal bulb than in male. Didelphic, prodelphic. Ovaries lead anteriorly for a short distance anterior to oesophageal bulb, where they turn posteriorly, coiling round oesophagus, and lead to oviducts and uteri. Uteri unite to form common uterus just anterior to anus. Vulva just anterior or posterior to midbody. Eggs with subterminal operculum, those nearest the vulva carrying embryos in morula stage. Caudal extremity slightly rounded and ending in a short caudal appendage which is slightly curved dorsally. Anus slit-like, with salient posterior lip. Three rectal gland cells present. Phasmids a short distance from posterior extremity, at or just posterior to level of anus.

Discussion

The only pharyngodonid nematode species recorded so far from Sri Lanka are *Parapharyngodon acanthura* (Linstow, 1904), a « species inquirenda » according to Adamson and Nasher (1984), from the garden lizard *Calotes versicolor*, and *P. megaloon* (Linstow, 1906), also a « species inquirenda » named only from inadequately described female specimens, from the gecko *Hemidactylus leschenaulti* (see: Adamson, 1981). Baylis (1936), however, lists *P. maplestoni* Chatterji, 1933 from *C. versicolor* and *Hemidactylus flavoviridis* in Sri Lanka, an identification which is somewhat doubtful.

The present form differs from these and other species of the genus, and particularly from *Parapharyngodon micipsae* (Seurat, 1917), which it resembles most

(see: Adamson and Nasher, 1984), especially in its combination of the following characters: relatively small body-size; male lateral alae not ending abruptly but narrowing gradually into thin membranes before ending posteriorly; very short male caudal appendage, which is mostly about half the length of the spicule; close proximity to each other of the two caudal appendage papillae, such that they appear fused ventrally; and the abrupt narrowing of the caudal appendage just behind its papillae, the narrow distal portion being generally shorter than the more than doubly wide proximal portion.

The species is therefore considered to be a new one, and is named in appreciation of Dr. Martin L. Adamson's significant contributions to our knowledge of pharyngodonid nematodes.

Other specimens of *Parapharyngodon* collected by us from other reptiles as well, such as geckoes and non-burrowing skinks, will form the subject of a separate study, which will also review the previously inadequately described forms from Sri Lanka.

Hosts and localities: *Chalcidoseps thwaitesi* (Günther, 1872) at Nagalla (823 m) in Gammaduwa area in Central Province (type host); *Nessia smithi* (Deraniyagala, 1934) at Gammaduwa (720 m) and at Opalgalla (610 m) and Nagalla, in Gammaduwa area; *Nessia burtoni* (Gray, 1839) at Talgaswela (64 m) and Opatha (30 m) in Southern Province, and Matugama (12 m), Athweltota (122 m) and Migahatenna (15 m) in Western Province.

Type-specimens: holotype and paratypes are for the present deposited in the Department of Zoology, University of Peradeniya, Sri Lanka (Reg. No. RTS 44). However, steps are being taken to transfer the most important type-specimens of this series of papers to the British Museum (N. H.) in London, and the Muséum National d'Histoire Naturelle in Paris.

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REFERENCES

- ADAMSON M. L. : *Parapharyngodon osteopili* n. sp. (Pharyngodonidae: Oxyuroidea) and a revision of *Parapharyngodon* and *Thelandros*. *Systematic Parasitology*, 1981, 3, 105-117.
- ADAMSON M. L., NASHER A. K. : Pharyngodonids (Oxyuroidea; Nematoda) of *Agama adramitana* in Saudi Arabia with notes on *Parapharyngodon*. *Canadian J. Zool.*, 1984, 62, 2600-2609.
- BAYLIS H. A. : Nematoda. I. Ascaridoidea and Strongyloidea. The Fauna of British India, including Ceylon and Burma. *Taylor and Francis*, London, 1936, 408 p.
- BRYGOO E. R. : Systématique des lézards Scincidés de la région malgache. XIV. Le genre *Pyzomeles* A. Grandidier, 1867. *Bull. Mus. nat. Hist. nat.*, Paris, 1984, 4^e sér., 6, A, 769-777.
- BRYGOO E. R. : Les types Scincidés (Reptiles, Sauriens) du Muséum national d'Histoire naturelle Catalogue critique. *Bull. Mus. nat. Hist. nat.*, Paris, 1985, 4^e sér., 7, A (suppl.), 126 p.
- CHATTERJI R. C. : On a new nematode, *Parapharyngodon maplestoni* gen. nov., sp. nov., from a Burmese lizard. *Ann. Trop. Med. Parasit.*, 1933, 27, 131-134.
- CRUZ H., CHING C. C. : Parasites of the relict fauna of Ceylon. VI. More new helminths from Amphibians and Reptiles, with a new host-record and redescription of *Acanthocephalus serendibensis* Cruz and Mills, 1970. *Ann. Parasitol. Hum. Comp.*, 1976, 50, 531-558.
- CRUZ H., SANMUGASUNDERAM V. : Parasites of the relict fauna of Ceylon. III. Nematodes from a Rhacophorid frog and reptiles of the hill country. *Ann. Parasitol. Hum. Comp.*, 1974, 48, 767-795.
- CRUZ H., SANTIAPILLAI A. : Parasites of the relict fauna of Ceylon. VIII. Helminths from *Ichthyophis* spp. (Amphibia: Gymnophiona). *Ann. Parasitol. Hum. Comp.*, 1982, 57, 317-327.
- DERANIYAGALA P. E. P. : A Coloured Atlas of Some Vertebrates from Ceylon. 2. Tetrapod Reptilia. *Ceylon National Museums*, Colombo, 1953.
- DERANIYAGALA P. E. P. : Some aspects of the fauna of Ceylon. *J. Ceylon Br. Roy. Asiatic Soc.*, N. S., 1965, 9, 165-219.
- DURETTE-DESSET M. C. : Techniques de récolte, de fixation et de conservation des nématodes parasites de vertébrés. *Systematic Parasitol.*, 1984, 6, 218.
- FERNANDO W. : Contributions to Ceylon helminthology. 3. *Mesocoelium burti*, sp. nov., *Mesocoelium marssi*, sp. nov., and *Haplorenchis pearsoni*, sp. nov. *Ceylon J. Sci. (B)*, 1933, 18, 9-18.
- FREITAS J. F. T. : Sobre os gêneros *Thelandros* Wedl, 1862 e *Parapharyngodon* Chatterji, 1933, com descrição de *Parapharyngodon alvarengai* sp. n. (Nematoda, Oxyuroidea). *Mémorias do Instituto Oswaldo Cruz*, 1957, 55, 21-45.
- FREITAS J. F. T. : Revisao da familia Mesocoeliidae Dollfus, 1933 (Trematoda). *Mémorias do Instituto Oswaldo Cruz*, 1963, 61, 177-312.
- GRAY J. E. : Catalogue of the Specimens of Lizards in the Collections of the British Museum. *E. Newman*, London, 1845.
- GREER A. E. : A subfamilial classification of scincid lizards. *Bull. Mus. Comp. Zool.*, 1970, 139, 151-183.
- GREER A. E. : The systematics and evolution of the Subsaharan Africa, Seychelles, and Mauritius scincine scincid lizards. *Bull. Mus. Comp. Zool.*, 1970, 140, 1-23.
- LINSTOW O. VON : Nematodes in the collection of the Colombo Museum. *Spolia Zeylan.*, 1904, 1, 91-104.
- LINSTOW O. VON : Helminthes from the collection of the Colombo Museum. *Spolia Zeylan.*, 1906, 3, 163-188.
- SANDGROUND J. H. : Scientific results of an expedition to rain forest regions in Eastern Africa. VI. Nematoda. *Bull. Mus. Comp. Zool.*, 1936, 79, 341-366.
- SARASIN F. : Über die Geschichte der Tierwelt von Ceylon. *Zool. Jahrb.*, 1910, suppl., 12 (1), 1-160.
- SCHAD G. A. : Studies on the genus *Kalicephalus* (Nematoda: Diaphanocephalidae). II. A taxonomic revision of the genus *Kalicephalus* Molin, 1861. *Can. J. Zool.*, 1962, 40, 1035-1165.
- TAYLOR E. H. : Ceylonese lizards of the family Scincidae. *Univ. of Kansas Sci. Bull.*, 1950, 33, 481-518.