

SOME MORE EGG-SHELL ENGRAVINGS

BY

A. J. D. MEIRING, M.Sc., Ph.D.

Professor of Zoology, S.A.N.C.; Hon. Curator, F. S. Malau Museum



THE PARASITES OF ARDEA MELANOCEPHALA FROM THE EASTERN PROVINCE

University of Fort Hare

Together in Excellence

BY

D. J. MJI, B.Sc.

*A Thesis submitted in part fulfilment for the degree of Master of Science
of the University of South Africa*

University of Fort Hare Library



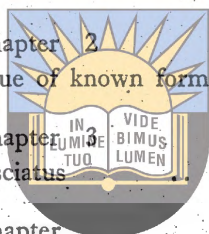
F007067272

FORT HARE

PUBLISHED BY
THE FORT HARE UNIVERSITY PRESS

CONTENTS

SOME MORE EGG-SHELL ENGRAVINGS	255
THE PARASITES OF ARDEA MELANOCEPHALA FROM THE EASTERN PROVINCE	
List of Abbreviations:	257
Preface and Acknowledgements	259
Chapter 1	
Diet and Habits	261
Chapter 2	
Incidence of Parasites and Catalogue of known forms	263
Chapter 3	
Mallophaga— <i>Ciconiphilus decimfasciatus</i>	268
Chapter 4	
Mallophaga— <i>Ardeicola ardeae</i>	273
Chapter 5	
Acarina— <i>Argas persicus</i>	276
Chapter 6	
Trematoda— <i>Nephrostomum ramosum tyumiensis</i> (nov. var.)	277
Chapter 7	
Nematoda— <i>Synhimatus invaginata</i>	285
Chapter 8	
Nematoda— <i>Desmidocercella kwalimanzi</i> (nov. sp.)	293
Chapter 9	
Technique	299
<hr style="width: 20%; margin: 0 auto;"/>	
References	301



University of Fort Hare
Together in Excellence

SOME MORE EGG-SHELL ENGRAVINGS

A. J. D. MEIRING, M.Sc., Ph.D.,

Professor of Zoology, S.A.N.C., Hon. Curator, F. S. Malan Museum

Since the publication of a paper on the engravings on Masarwa Egg-shells, (Fort Hare Papers Vol. I No. 1. 1945), I have very kindly been given three other ostrich egg-shells. Two were presented by Mr. G. A. Innes from Ghanzi in the Bechuanaland Protectorate and the other was forwarded by Miss M. Wilman and comes from the Kalahari. Only one of the Ghanzi shells bears any engraving and that consists only of two contiguous chevrons, formed by parallel incisions which are filled with a black substance, most probably charcoal and fat, (See fig. C.), apparently the owner's mark.

The Kalahari shell has two human figures which at first sight appear to be due to a similar technique and of similar age but on closer examination this was found to be incorrect. The hole at the top of the shell is nearly circular, its diameter varying from .85 to .9 mm. Both engravings have been made with a steady hand and there are comparatively few slips especially in Fig A. No pigment has been introduced into the incisions.

Of the two figures, Fig. A, seems the older, judging in the first place by the condition of the grooves. Here the depth of the grooves varies from .08 mm to .02 mm, the region depicting the head and breast being the deeper. At the buttocks and below the knees the shallowness seems to be due to wear of the egg-shell itself—perhaps due to being carried about and rubbed against other shells, etc.

Fig. B has clearer incisions, with a fresher appearance and seems to have suffered practically nothing from abrasion. The cuts are all more or less of the same depth and the figure, with a fairly constant depth of .06 mm. The sides of the groove are regular forming an open V with a very slightly deeper central incision and to all appearances has been executed with a smooth, sharp-pointed instrument, most probably of steel. Fig. A, on the other hand seems to have been engraved with a rough-pointed stone and the sides of the groove are irregular and more U-shaped than V-shaped. Apparently the egg-shell was very seldom handled after the engraving of Fig. B. The egg-shell at this time seems to have been buried in a calcareous soil until finally brought to light.

The shape of Fig. A conforms very closely to a large number of Pre-historic drawings on rock-shelters in South Africa. The attitude is very typical, with an arm on each side, and is pictured by practically all writers on "Bushman" Art in South Africa, see Wilman, Bleek, Obermaier, Tongue, etc. The next popular position is with both arms forward, but only very rarely are figures shown with both arms directed backwards (Bleek, Plate 71, and Tongue, Plate XXX with one figure.)

But it is especially in the ornamentation that the two figures differ so radically. Fig. A has, as is also shown in so many figures in rock paintings, a girdle and bands below the knee. Numerous plates by Bleek bear figures with girdles and kneebands (Plates 13, 14, 16, 33, 46, etc.) and in some figures especially do we get the same vast triangular torso, long slender neck, thin waist, rounded buttocks and shapely legs and it is reasonable to assume that one of the same people responsible for the rock-paintings was responsible for Fig. A, and that this figure was incised at more or less the same time. It is practically unnecessary to comment on the difference between the genitalia of the two figures except to draw attention to the typical Bushman form of Fig. A.

Fig. B, is devoid of ornamentation except for a head ring and marks at the back of the head which may perhaps represent beadwork. The Thonga people, for example, wear such a type of headdress. This figure, too, bears an eye and toes are shown, both these features being normally absent from "Bushman" figures while the peculiar fact of having both arms directed backwards has already been commented on. It is perhaps worthy of note that the figures reproduced by Bleek in Plate 71, apparently are taking part in a ceremonial dance and their stance is readily understandable.

The form of the whole body indeed bears very little similarity to those from rock-paintings and to my mind has been done at a much later period, and perhaps by an artist of a different people to that responsible for Fig. A. This of course is difficult to prove as the execution of artistic work may differ from individual to individual even of the same race. It is just the fact that the figures are so completely different in form, time, technique and execution, that one feels justified in assuming that the two artists were from different races and incised their works of art at different periods.

References for comparison of figures.

- Wilman, M. ; *The rock engravings of Griqualand W. and Bechuanaland.* Cambridge, 1933.
Bleek, D. F. ; *Rock Paintings in South Africa.* London, 1930.
Obermaier, H. and Kuhn, H. *Bushman Art.* London, 1930.
Tongue, Helen ; *Bushman Paintings.* Oxford, 1909.



University of Fort Hare
Together in Excellence

LIST OF ABBREVIATIONS

CIR.S.	—	Cirrus sac
D.E.	—	Ductes ejaculatorius
MT.	—	Metraterm
OV. DUC.	—	Oviduct
OV.	—	Ovary
O.T.	—	Ootype
L.C.	—	Laurex's canal
UT.	—	Uterus
PN.	—	Penis
V.S.	—	Ves. terminalis
Y.R.	—	Yolk reservoir
TA.	—	Intestine
INT.	—	Intestine
CUT.B.	—	Cuticular belt
OV. JEC.	—	Ovijector
VAG.	—	Vagina
E. V.	—	Excretory vesicle
E. T.	—	Excretory tube

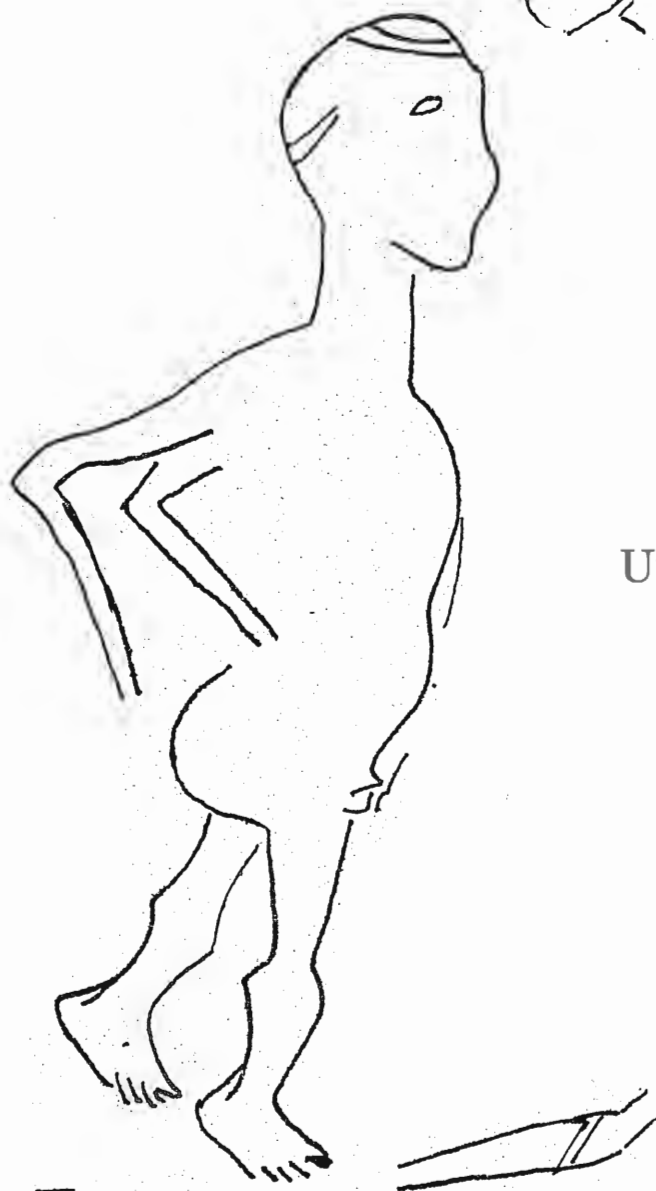


FIG. B.



University of Fort Hare
Together in Excellence

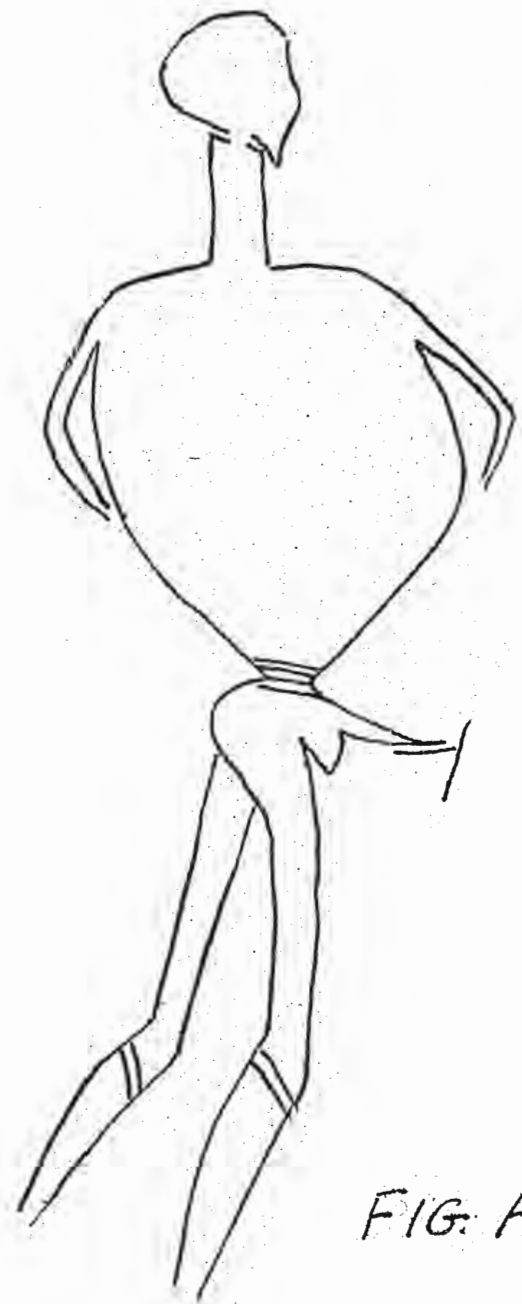


FIG. A.

FIG. C.

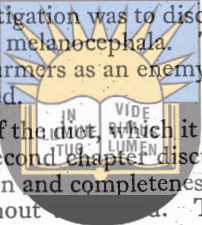
PREFACE

The present work was carried out in preparation for a dissertation for the degree of Master of Science (in Zoology), in the University of South Africa.

The author started this research with two aims in view. Firstly the author wished to meet a demand in a field of research which South African biologists seem to have neglected. It is true some parasitic research of a very high standard is being carried out in the Government Veterinary Laboratories at Ondêrstepoort but that work is mainly concerned with the parasitic infestation of domestic animals. Much work has however been done on South African birds and their ecology, but except for isolated parasites found by workers here and there, the list of Avian parasites as compiled by workers like Fuhrmann, et al, is still far from complete.

The second aim in carrying out this investigation was to discover the probable parasite chain linkages which might exist through the host *Ardea melanocephala*. The latter although protected by law in these provinces has a bad reputation with farmers as an enemy to poultry and game birds. This work indicates that this reputation is not deserved.

The first chapter deals with the analysis of the diet, which it was found consists chiefly of Arthropoda especially Acridiidae and Gryllids. The second chapter discusses the average parasitic incidence per type and tabulates for the sake of comparison and completeness parasite types which have already been described in other Ardeidan hosts throughout the world. The remaining chapters deal specifically with the individual parasites as they occurred in and on the host.



University of Fort Hare
Together in Excellence

ACKNOWLEDGEMENTS

The sincere thanks of the author goes to the South African Institute of Industrial and Scientific Research who provided the funds which made this work possible.

I am further greatly indebted to the following:

Dr. R. J. Ortlepp and Dr. G. Theiler who gave invaluable aid to the author with the loan of literature.

Mr. Taylor, Government Entomologist at Fort Beaufort who kindly lent the author an unpublished copy of his findings of the diet of *A. melanocephala*.

Professor A. J. D. Meiring, Head of the Department of Zoology, Fort Hare, for the advice, and encouragement to the author at all stages of this work.

CHAPTER I.

DIET AND HABITS

The material which forms the theme of this dissertation was collected from specimens of *Ardea melanocephala* (synonym—*Ardea atricellis*), shot on farms surrounding Fort Hare, and on the banks of the Tyumie River in the Victoria East District. This area is characterised by fairly dense *Mimosa* thickets with scattered marshland whilst the river bank has many tall trees on which the Herons sometimes rest, but their main roosting places are on tall trees on the Lovedale Grounds about half-a-mile from the river. Along the river bank are fairly extensive cultivated lands and this is where most of the specimens were shot. The herons showed a preference for fields of *Medicago* where an intensive insect fauna was observed.

Ardea melanocephala occurs throughout Africa, Madagascar and according to Starke and Sclater¹ is a straggler into Southern Europe. During the breeding seasons it is found sometimes associating in nests with *Bulbucus ibis*—the Cattle Egret, the distribution of which co-incides with that of *Ardea melanocephala*, except that the Egrets are also found in South Western Asia. When such heronries occur, the nests of *Ardea melanocephala* are generally placed on the higher branches while those of Egrets are found below them. These heronries are either built on high desolate trees away from domestic surroundings or posted on the tops of high trees growing amongst houses. To capture its prey the strong bill is poised for a time and then shot forwards like a javelin. The specimens examined were either shot from roosts in Egret-heron colonies, or from small groups of two or three, such groups generally including a stray grey Heron—*Ardea cinerea cinerea*.

One heronry of Egrets and Herons was specially observed on a pine tree approximately 80 feet high. Below this tree could be found several pellets or castings consisting of apparently undigested portions of food regurgitated by the roosting birds. These were comprised mostly of legs of grasshoppers and beetles, skeletal remains of Vertebrates, and those made of Mammalian fur.

For a qualitative study of the diet these pellets or castings prove to be very useful as in most cases the regurgitated animals are not too severely mutilated for examination. This method, however, only works with satisfaction in the case of an exclusively Heron colony like that examined by Mr. Taylor at Fort Beaufort. (His observations are described in an unpublished paper prepared for the journal "Ostrich" of the Ornithological Society of South Africa, and which he kindly loaned me).

In order to get more or less accurate qualitative and quantitative aspects of the diet, immediately after the specimens of *Ardea melanocephala* were shot the contents of the gizzard were carefully examined. In order to cover all the seasons, the birds were shot over a period of sixteen consecutive months, at the rate of one specimen every month.

Of the total number of specimens examined only nine have been recorded, the remaining seven having an exclusively insect diet and in very low numbers. The following analyses the diet thus :—

SPECIMEN	NATURE OF FOOD	NUMBER OF TYPES	% TYPES
A.	Acridiidae	75	100% Insect
	Coleoptera	23	
	Gryllidae	3	
	Sphingid larvae	18 (43 gms)	
	Other larvae	14 (8 ,,)	
B.	Acridiidae	119)	99.4% Insect .6% Arachnid
	Coleoptera	47)	
	Gryllidae	3)	
	Arachnid (Solpuga)	1	
C.	<i>Otomys irroratus</i>	1	7% Mammalian
	<i>Crangon vulgaris</i>	1	7% Crustacean
	<i>Microchaetes</i> (sp)	11	84% Annelid

SPECIMEN	NATURE OF FOOD	NUMBER OF TYPES	% TYPES
D.	Rana (sp.)	6	43% Amphibian
	Crangon vulgaris	3	22% Crustacean
	Acridiidae	1)	
	Coleoptera	2)	35% Insect
	Larval types	2)	
E.	Acridiidae	9	90% Insect
	Acontias plumbeus gracilicauda	1	10% Reptilian
F.	Acridiidae	31)	
	Coleoptera	1)	100% Insect
	Gryllidae	20)	
G.	Acridiidae	8)	
	Gryllidae	55)	99% Insect
	Larval types	4)	
	Otomys irroratus	1	1% Mammalian
H.	Otomys irroratus	1	100% Mammalian
I.	Acridiidae	31)	
	Gryllidae	1)	100% Insect

The remainder of the specimens examined varied in the contents of the gizzard from empty to a few insects.

From this table it is evident that the diet of *Ardea melanocephala* comprises a wide range of animal types both vertebrate and invertebrate. The diet of these 9 specimens contained:—458 insects and insect larvae, 4 crustaceans, 1 arachnid, 11 annelids, 6 amphibians, 1 reptile and 3 mammals.

By far the preponderating article of diet is insects, the other groups comprising a more or less secondary relish.

This observation agrees fairly closely with the analysis of the diet of *Ardea melanocephala*, carried out by Mr. Taylor from the regurgitated pellets, but differs from it as regards the high percentage of Mammalian and Reptilian types viz., 61% and 59% respectively.

The list of Vertebrates found by him under an exclusively Heron colony he examined during a course of six months comprises:—

MAMMALS :

Cryptomys hottentotus	.. .. .	8 specimens.
Otomys irroratus	.. .. .	1 specimen.
Mouse (sp.)	.. .. .	1 „

AVES :

Nestling Sylviidae	1 specimen.
--------------------	---------	-------------

REPTILES :

Mabuya capensis	.. .. .	13 specimens.
Agama species	.. .. .	1 specimen.
Acontias meleagris	.. .. .	1 „
Acontias plumbeus gracilicauda	.. .. .	1 „

AMPHIBIANS :

Rana delalandi	2 specimens.
----------------	---------	--------------

In the present work the list of Vertebrates stands out thus:—

MAMMALS :

Otomys irroratus	3 specimens.
------------------	---------	--------------

REPTILES :

Acontias plumbeus gracilicauda	1 specimen.
--------------------------------	---------	-------------

AMPHIBIANS :

Rana species	6 specimens.
--------------	---------	--------------

No nestlings or small birds were found, and although under the heronry which was under examination one, now and again, found dead nestlings of Egrets and Herons, those belonging to other types were never found.

The analysis by Mr. Taylor, therefore, gives a very high percentage of Vertebrate types, a difference which may be accounted for by the differences in the topographical lie of the two areas, the Fort Beaufort area being more open with less of the Mimosa thickets characteristic of the Alice environs, and perhaps also due to the fact that the specimens worked upon in Alice were mainly from cultivated fields instead of wild natural plains, where lizards and rats are usually found, although some of these specimens were shot when coming to their roosts in the evening; but it is of course impossible to say where they came from.

The idea, therefore, that *Ardea melanocephala* feeds chiefly on fish (Starke and Sclater¹) is not strictly correct. From the wide range of animal types which include aquatic types like Crabs, it is quite probable that where fish are available *Ardea melanocephala* would take them, as shown for instance by the infection experiment carried out by Ortlepp² in the feeding of parasitized *Gnathonemus macrolepidotus* to a young Black-headed Heron. Nor apparently do Frogs comprise one of the chief articles of diet as suggested by Roberts³. For of all the specimens examined, only in one were frogs met with, and the number obtained by Mr. Taylor seems to support this contention.

Due to the abundance of wet situations in this locality, frogs are on the whole fairly common, and one would have expected to find more of them if they were a chief article of diet.

Ardea melanocephala is, therefore, chiefly an insect feeder, preying heavily on the Orthoptera and Coleoptera. The Vertebrate types thus fall in its diet sheet, in proportion to the amount available in its particular range of predation.

From an appraisal of these facts it is evident that *Ardea melanocephala* is of considerable economic importance to Agriculture, because of the high toll it takes of insects injurious to horticultural products. Also if the incidence of a rodent population is fairly high within the predation range of *Ardea melanocephala*, then it must be assumed that these Herons are of considerable good as allies in the biological control of rodent-borne diseases.

As far as its negative effects in the predation on earthworms, it can be observed that this is negligible and the table clearly indicates that these occurred in only one out of sixteen Herons examined. As regards the Reptilian fauna, perhaps Mr. Taylor's observation is a correct surmise when he writes— "The bird probably does as much harm as good, for these creatures occupy a more or less neutral position in the scheme of things."

CHAPTER II.

INCIDENCE OF PARASITES AND A CATALOGUE OF KNOWN PARASITES OF CERTAIN ARDEIDAE

In examining the general incidence of parasites on the hosts, it was found that, of the Ectoparasites, the general prevalency of the Mallophaga was almost 100% while of the Endo-forms that of the Trematodes with 65% was the highest. The Nematodes show the next degree of general prevalency, being absent in six specimens out of sixteen Herons examined. Larval Argasids were recorded only from two hosts; but when the nests from a heronry of *Bulbucus ibis* and *Ardea melanocephala* were examined, they showed a high incidence of adult forms. As the nests examined were not from an exclusively Heron colony, the collection of either the larval forms from the hosts or the occurrence of tampsans in the nests, had to be controlled in order to establish that the parasites were not merely stragglers from the Egrets but were parasitic on *Ardea melanocephala*. Such a control was found in a verbal report from Mr. Taylor, Government Entomologist, Fort Beaufort, who had found the same Argasids from a tree which hitherto had been the abode of an exclusively Heron colony (*A. melanocephala*).

The following classes of parasites are represented :—

A. *ECTOPARASITES.*

- (i) Mallophaga (Two families—Menoponidae and Philopteridae).
- (ii) Arachnida (One family—Argasidae).

B. *ENDO-PARASITES.*

- (i) Trematoda (One family—Echinostomatidae).
- (ii) Nematoda (Two families—Acuariidae and Thelaziidae).

The total absence of Cestodes is a remarkable fact as it would be expected that a bird with such a wide range of feeding types, especially Arthropodan, would serve as a host for some of those Cestodes whose phoresis depends on Arthropodan vectors.

Of the two types of Mallophaga collected the Philopterid, *Ardeicola ardeae*, shows a more general prevalence having been recorded from all specimens examined. The Menoponid *Ciconiphilus decimfasciatus* exhibited a low frequency occurring on only six hosts. In its distribution over the body of the host, *Ciconiphilus decimfasciatus* was generally confined to the under-wing coverts and at the basal portions of the upper- and under-tail coverts. On the other hand, *Ardeicola ardeae* had a wider distribution over the host's body with no regional concentration—a fact perhaps due to the magnitude of the numbers of this species.

The relative frequencies of the two types of Mallophaga show as follows for six specimens :—

ARDEICOLA ARDEAE	CICONIPHILUS DECIMFASCIATUS
32	7
45	2
12	2
78	2
18	2
70	36
TOTAL 255	TOTAL 65

The Trematodes varied much in their density per host, the number collected per specimen ranging from a single individual to fifty odd. All these were confined to the posterior half of the duodenum and the proximal portion of the ileum. No pathological condition was observed and it would appear that these parasites lie free in the lumen of the gut. In one specimen which had a Trematode yield of fifty seven, the gut was apparently blocked, a condition which apparently would ultimately lead to stenosis.

The Nematodes comprise two species, *Synhimatus invaginata* found in the tunic of the gizzard, and *Desmidocercella kwalimanzi* (nov. sp.) found in the air-sacs, lungs and serous cavities of the Heron. The general incidence varied slightly, *S. invaginata* occurring in 43% of the hosts while *D. kwalimanzi* had a mean prevalence of 34%.

Several Nematode, Cestode and Trematode types have been described from several members of the family Ardeidae.

Some genera show an appreciably wide intrafamilial distribution. Of the Nematoda the genera *Contraecacum* (Raillet and Henry 1912) and *Porrocaecum* (Raillet and Henry 1912) occur in several Ardeidan host types, and Cram⁴ records the description of a male of *Porrocaecum serpentulus* from *Ardea melanocephala* found by Mönnig in the Transvaal. The Trematode genus *Clinostomum* also has a wide range of Heron host-types. In connection with *Clinostomes* and their occurrence on *Ardea melanocephala* mention might be made of a new species *Clinostomum v.d. horsti* (Ortlepp) described from *Ardea melanocephala*. Ortlepp² fed to a young Heron (*A. melanocephala*) a few specimens of *Gnathonemus macrolepidotus* heavily parasitized by *Clinostome meta-cercariae*. The adults of these occurred a few days later on the mucus membrane of the mouth and glottis. It might be observed that, whether *Clinostomum v.d. horsti* is a normal parasite of *Ardea melanocephala* or not, requires more conclusive evidence, as the present host-parasite relationship was artificially induced. According to

Ortlepp² Yamaguti (1933) also carried out similar infection experiments on a Heron using *Clinostomum complanatum* (Rudolphi).

As regards the Cestode parasites of Ardeidae several genera have been recorded from different parts of the world, and it is a striking fact that none of these Platodes have as yet been recorded from *Ardea melanocephala*.

The following is a world-representative catalogue of the known parasites of some of the members of the family Ardeidae as recorded from Cram⁴, Bedford⁵, Viana⁷ and Fuhrmann⁸:—

MALLOPHAGA

HOST	PARASITE
<i>Ardea cinerea</i>	<i>Ardeicolla ardeae</i> (Linne.) <i>Ciconiphilus decimfasciatus</i> (Bois. & Lac.) <i>Lynchia ardeae</i> (Macq.)
<i>Ardea comata</i>	<i>Ardeiphilus trochioxus</i> (Nitzsch). <i>Colpocephalum zonatum</i> (Rudow).
<i>Ardea egretta</i>	<i>Ciconiphilus decimfasciatus</i> (Bois. & Lac.)
<i>Ardea garzetta</i>	ditto.
<i>Ardea grayi</i>	<i>Lynchia ardeae</i> (Macq.)
<i>Ardea herodias herodias</i>	<i>Ciconiphilus decimfasciatus</i> (Bois. & Lac.)
<i>Ardea melanocephala</i>	ditto.
<i>Botaurus lentiginosus</i>	ditto.
<i>Botaurus stellaris</i>	<i>Ardeiphilus trochioxus</i> (Nitzsch). <i>Agathocera stellaris</i> (Dunne). <i>Philoapterus ovatus</i> (Giebel). <i>Pterallophus stellaris</i> (Buchholz).
<i>Bulbucus ibis</i>	<i>Lynchia ardeae</i> (Macq.)
<i>Casmerodius albus</i>	<i>Ciconiphilus decimfasciatus</i> (Bois. & Lac.) <i>Colpocephalum oreas</i> (Kellogg). <i>Neophiloapterus episcopi</i> (Kellogg).
<i>Demi-egretta sacra ringeri</i>	<i>Ciconiphilus decimfasciatus</i> (Bois. & Lac.)
<i>Ixobrychus minutus</i>	<i>Ciconiphilus decimfasciatus</i> (Bois. & Lac.) <i>Philoapterus sulcatus</i> (Piaget).
<i>Nycticorax nycticorax</i>	<i>Ciconiphilus decimfasciatus</i> (Bois. & Lac.)
<i>Nycticorax nycticorax maevius</i>	ditto.
<i>Phoeyx purpurea</i>	ditto.
<i>Pyrrherodia purpurea</i>	<i>Ardeiphilus trochioxus</i> (Nitzsch). <i>Ardeicola leucoprocta</i> Nitzsch).

TREMATODA

HOST	PARASITE
<i>Ardea cocoi</i>	<i>Clinostomum detruncatum</i> (Braunn). <i>Clinostomum marginatum</i> (Rud.) <i>Clinostomum sorbens</i> (Braunn). <i>Distomum trifolium</i> (Braunn). <i>Episthmium proximum</i> (Trav.) <i>Opisthorchis interreptus</i> (Braunn).

TREMATODA

HOST

Ardea cinerea

Ardea melanocephala

Ardetta minuta

Agamia agami

Botaurus minor

Botaurus stellaris

Butorides virescens

Butorides striata

Bulbucus ibis

Cancroma cohlearis

Florida caerulea

Garzetta garzetta

Herodias alba

Herodias egretta

Nyctanassa violacea

Nycticorax nycticorax naevius

Pilherodias pileatus

Syrigma sibilatrix

Tigrisoma brasiliensis

HOST

Ardea cinerea

Ardea comata

Ardeolla ralloides

Botaurus stellaris

PARASITE

Ascocotyle minuta (Looss).

Echinostoma bursicola (Creplin).

Echinochasmus beleocephalus (Lin.)

Echinochasmus oligacanthus (Lhe.)

Clinostomum v.d. horsti (Ortlepp).

Echinostoma spathulatum (Rud.)

Diplostomum grande (Dies.)

Echinochasmus aspersum (Wright)

Chaunocephalus ferox (Rud.)

Echinochasmus botauri

Pegosomum spiniferum (Ratz.)

Opisthorchis interreptus (Braunn.)

Ascocotyle angrense (Trav.)

Opisthorchis interreptus (Braunn.)

Nephrostomum ramosum (Sons.)

Clinostomum marginatum (Rud.)

Clinostomum heluans (Braunn.)

Echinostoma garzettae (McCall).

Pegosomum marginatum (Ratz.)

Clinostomum detruncatum (Braunn.)

Diplostomum grande (Dies.)

Opisthorchis interreptus (Braunn.)

Clinostomum heluans (Braunn.)

Clinostomum marginatum (Rud.)

Levinseniella simillina (Trav.)

Lyperosomum sinuosum (Trav.)

Odhneria odhneri (Trav.)

Parorchis proctobium (Trav.)

Clinostomum marginatum (Rud.)

Episthmium proximum (Trav.)

Opisthorchis interreptus (Braunn.)

Opisthorchis interreptus (Braunn.)

Nephrostomum limai (Trav.)

Opisthorchis interreptus (Braunn.)

Opisthorchis interreptus (Braunn.)

CESTODA

PARASITE

Anomotaenia leuckarti (Fuhr.)

Dilepis unilateralis (Rud.)

Gryporhynchus cheilancristata (Wedl.)

Hymenolepis micro-cephala (Rud.)

Dilepis unilateralis (Rud.)

Gryporhynchus pusillus (Nord.)

Dilepis macrosphincter (Fuhr.)

Cyclastera fuhrmanni (Clerc.)

Gryporhynchus cheilancristata (Wedl.)

HOST	PARASITE
Butorides atricapilla	Hymenolepis ardeae (Fuhr.)
Butorides striata	ditto.
Butorides virescens	Dilepis unilateralis (Rud.)
	Hymenolepis ardeae (Fuhr.)
	Tetracisdicotyle macroscolecina (Fuhr.)
Garzetta garzetta	Dendrouterina herodiae (Fuhr.)
	Dilepis unilateralis (Rud.)
	Raillietina circumcincta (Krabbe.)
Herodias egretta	Dilepis unilateralis (Rud.)
Herodias timoriensis	Anomotaenia asymetrica (John.)
	Bancroftiella glandularis (Fuhr.)
Nycticorax caledonicus	Bancroftiella ardeae (John.)
Nycticorax nycticorax	Gryporhynchus pusillus (Nord.)
	Hymenolepis micro-cephala (Rud.)
	Tetraphothrium portigens (Molin.)
	Valipora mutabiles (Linton.)
Notophoxyx novae-hollandiae	Bancroftiella glandularis (Fuhr.)
Pilherodias pileatus	Dendro-uterina nycticoracis (Olsen.)
	Dendro-uterina lintoni (Olsen.)
Phoxyx purpurea	Anomotaenia (Fuhr.)
	Dilepis macro-spirincter (Fuhr.)
	Gryporhynchus pusillus (Nord.)
	Hymenolepis micro-cephala (Rud.)
	Larva of the manducatae (Jocaux).

NEMATODA

HOST	PARASITE
Ardea agami	Porrocaecum serpentulus (Rud.)
Ardea caerulea	Contraeaecum anderson (Verras).
	Porrocaecum serpentulus (Rud.)
Ardea cinerea	Contraeaecum micro-cephalum (Rud.)
	Desmidocerca aerophila (Skrjabin).
	Desmidocercella numridica (Seurat).
	Porrocaecum reticulatum (Lin.)
	Porrocaecum serpentulus (Rud.)
Ardea cocoi	Eustrongylidis ignotus (Jaeger.)
	Porrocaecum reticulatum (Lin.)
Ardea comata	Contraeaecum micro-cephalum (Rud.)
	Porrocaecum serpentulus (Rud.)
Ardea garzetta	Ascaridia aegyptiaca (Lin.)
	Eustrongylidis africanus (Jaeger).
Ardea grus	Ascaridia stroma (Lin.)
	Capillaria obtusiuscula (Rud.)
	Schistorophas bisuspis (Rud.)
Ardea herodias	Contraeaecum micro-cephalum (Rud.)
	Echinuria ardeae (Smith Fox & White).
	Eustrongylidis ignotus (Jaeger.)
	Eustrongylidis perpapillatus (Jaeger.)

Ardea leuce	Contraeaecum micro-cephalum (Rud.)
Ardea melanocephala	Eustrongylidis perpapillatus (Jaeger.)
Ardea minor	Porrocaecum serpentulus (Rud.)
Ardetta minuta	Contraeaecum micro-cephalum (Rud.)
Ardea nycticorax	Streptocara triaenuche (Wright).
	Synhimatus invaginata (Lin.)
	Contraeaecum micro-cephalum (Rud.)
	Contraeaecum rosarium (Connal).
	Porrocaecum reticulatum (Lin.)
	Synhimatus sagittata (Rud.)
	Tetrameres gynaeophila (Molin).
Ardea pileata	Porrocaecum serpentulus (Rud.)
Ardea scapularis	Porrocaecum serpentulus (Rud.)
Ardea stellaris	Contraeaecum micro-cephalum (Rud.)
	Synhimatus brevicaudata (Duj.)
Ardea violacea	Porrocaecum serpentulus (Rud.)
Ardeolla ibis	Tetrameres micropenis (Trav.)
	Habronema fcheuri (Seurat).
	Microtetrameres spiralis (Seurat).
	Synhimatus invaginata (Lin.)
	Tetrameres coccinea (Seurat).
Bulbucus lucidus	Synhimatus invaginata (Lin.)
Butorides striatus	Porrocaecum serpentulus (Rud.)
Butorides virescens	Contraeaecum micro-cephalum (Rud.)
Casmerodius alba egretta	Contraeaecum micro-cephalum (Rud.)
	Eustrongylidis perpapillatus (Jaeger).

CHAPTER III.

CLASS	...	.. :	—————	Insects.
ORDER	..	.. :	—————	Mallophaga.
SUPER-FAMILY	:	—————	Amblycera,	Kellogg.
FAMILY	.. :	—————	Menoponidae,	Mjoberg.
GENUS	.. :	—————	Ciconiphilus,	Bedford.
SPECIES	.. :	C. decimfasciatus,	Bois, & Lac.	

The present chapter is based on a collection of Mallophaga which occurred in comparatively small numbers as already stated in the previous chapter. Of the sixteen Herons examined, these occurred in only six hosts. In all 65 were recovered. They are generally confined to the under-wing coverts and at the basal portions of the upper- and under-tail coverts.

	FEMALE		MALE	
	LENGTH	WIDTH	LENGTH	WIDTH
HEAD .. .. .	.348	.585	.300	.474
PROTHORAX .. .. .	.198	.395	.142	.316
MESO-META-THORAX :	.174	.506	.142	.379
ABDOMEN :	1.343	.758	.885	.379
	2.063		1.469	

(All measurements in millimetres)

According to Bedford⁶ the chief characters for segregating the genera of Menoponidae appear to be :

- (i) The shape of the head.
- (ii) The absence or presence of either a slit or notch on the lateral margins in front of the eyes.
- (iii) The absence or presence of either a comb of minute spines or bristles of setae on the venter of the posterior femora and certain abdominal sternal plates.
- (iv) The male-genitalia. They usually differ but may be of the same type on various genera. They are usually the same in species belonging to the same genus and in some genera it is doubtful whether they are of specific significance.

In his work on the Menoponid genera and species, Bedford⁶ pointed out that the contemporary systematisation of the family Menoponidae into new genera and species was not always based on characters of real generic significance, as for example, the presence or absence of gastric teeth, or the state of development of the oesophageal sclerite. He accordingly revised the classification of some of the species, and in this work erected the genus *Ciconiphilus*, in which he included two species, *C. africanus*, Bedford, and *C. decimfasciatus*—formerly included in the genus *Colpocephalum*, Nitzsch, by Boisduval and Lacordavei.

In this text Bedford has identified several other species belonging to the genus *Colpocephalum* as synonymous with *C. decimfasciatus*.

Of the Mallophagan genera found on the Ardeidae the present specimens agree very closely with the genera *Ardeiphilus*, Nitzsch, and *Ciconiphilus*, Bedford. They differ, however, from *Ardeiphilus* mainly in the absence of combs on the fourth sternite, which characterise *Ardeiphilus*.

The present specimens are, therefore, included in the genus *Ciconiphilus* for which the generic diagnosis according to Bedford⁶ is as follows :—

Head : about one-third or less wider than long ; fore-head and temples rounded ; on each side of the fore-head, in front of the eyes, is a broad slit ; eyes well developed ; mandibles with a single tooth ; oesophageal sclerite and glands well developed ; antennae four-jointed the second segment with a large anterior expansion, the third constricted together.

Prothorax : with acute wings ; mesonotum short, separated from the metanotum by a suture, the latter with lateral margins divergent.

Legs : normal, the posterior femora with combs on the venter.

Abdomen : elongate-oval, with the apical segment rounded in both sexes ; tergites and sternites with well developed plates ; third sternite only with combs at the latero-posterior angles of the plate.

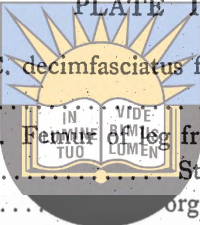
Male genitalia : with the basal plate rod-like.

As already mentioned, this genus contains two species—*C. africanus* and *C. decimfasciatus*. The present specimens do not agree with the former species mainly in the absence in *C. africanus* of the fasciate bristles on the posterior margin of the fourth tergite. It agrees, however, with *C. decimfasciatus*, Bois. and Lac. This conclusion was reached by comparison with the Onderstepoort specimens mounted by Bedford, and which I was kindly allowed to examine.

The present specimen is, therefore, identified as *C. decimfasciatus*.

C. decimfasciatus has been collected from several Ardeiden hosts as was indicated in Chapter II, of this work.

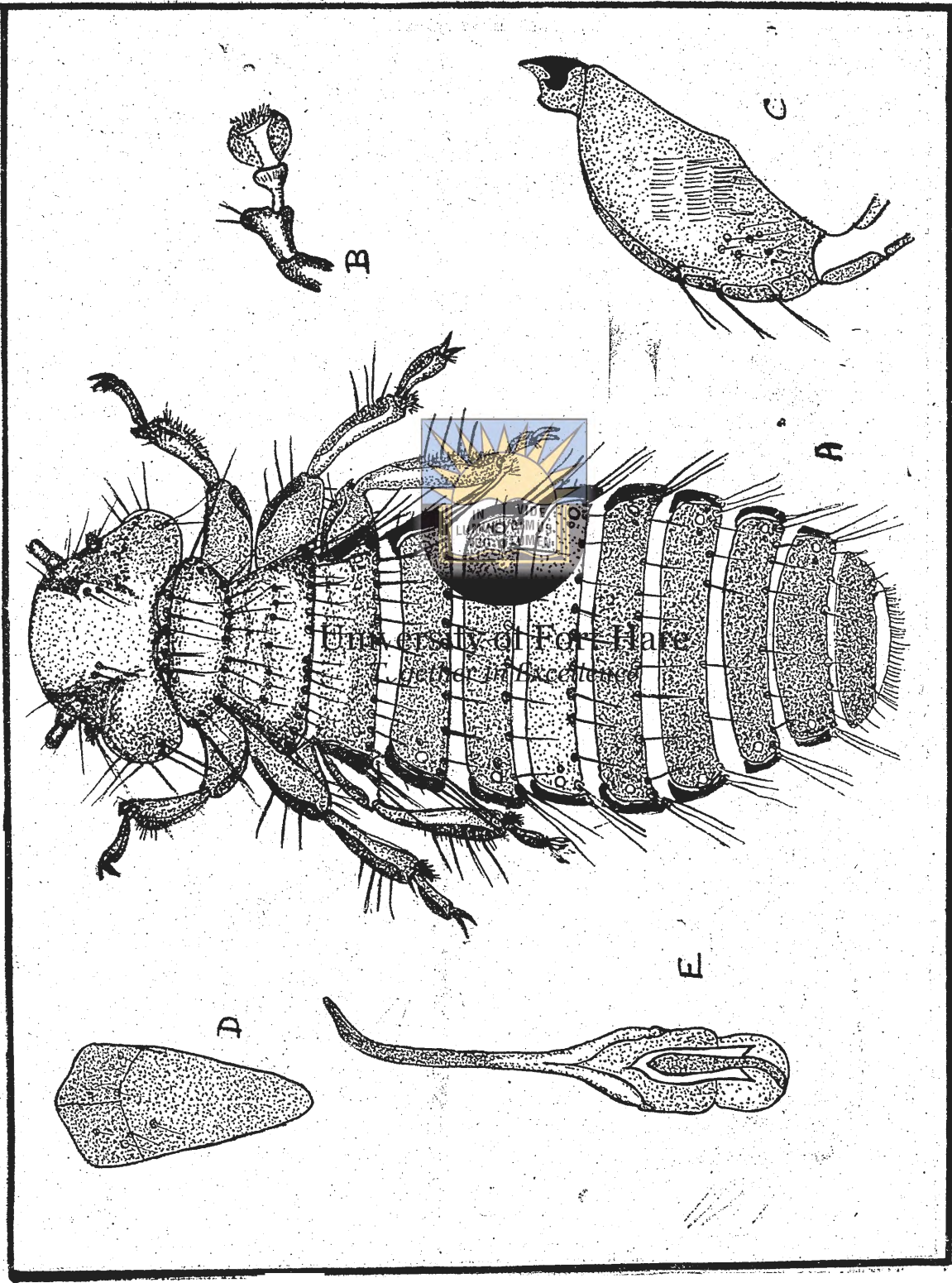
PLATE I.

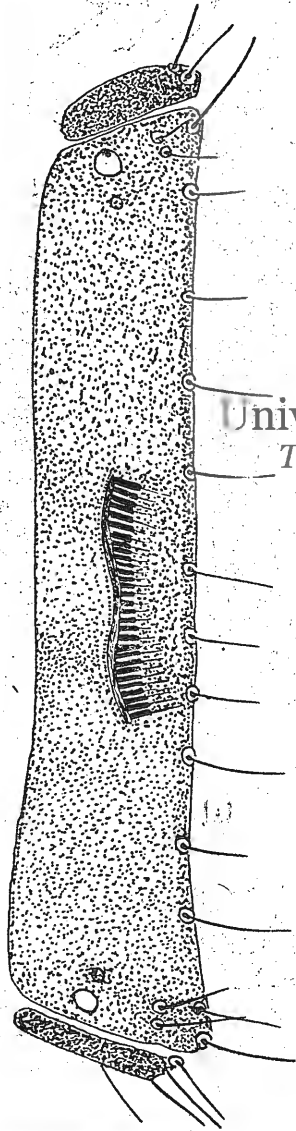
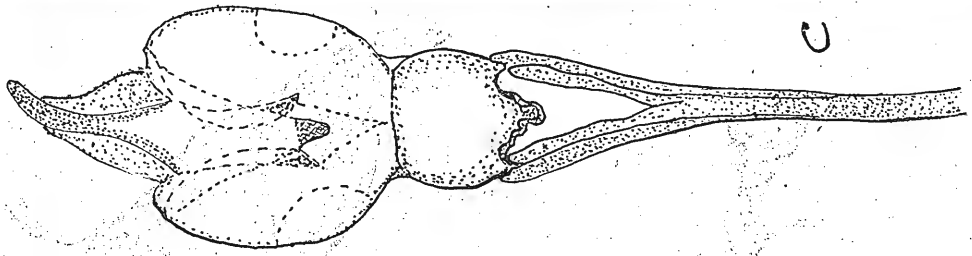
- 
- A. — Adult of *C. decimfasciatus* from dorsum.
 B. — Antenna.
 C. — Femur of leg from venter.
 D. — Sternal plate.
 E. — Organ of male.

University of Fort Hare
Together in Excellence

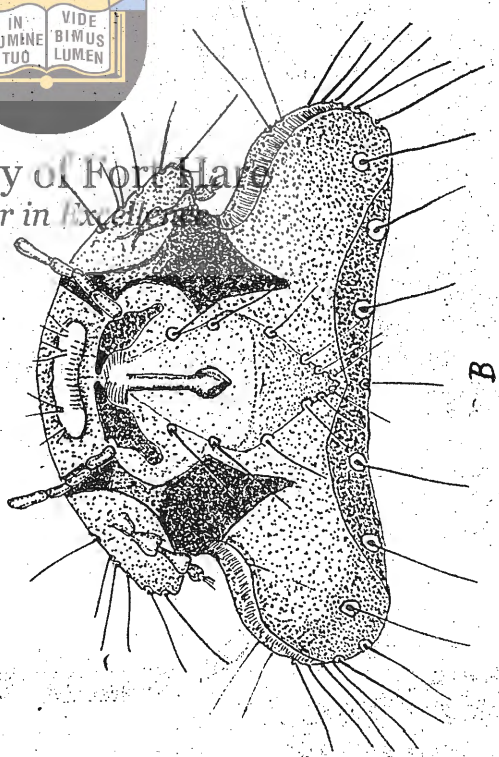
PLATE II.

- A. — Sternite with bristles.
 B. — Head of male from venter.
 C. — Male genital organ with the aecdaegeus protruding.





University of Port Harcourt
Together in Excellence



CHAPTER IV.

CLASS : _____ Insecta.
 ORDER : _____ Mallophaga.
 SUPER-FAMILY : _____ Ischnocera, Kellog.
 FAMILY : Philopteridae, Burmeister.
 GENUS : _____ Ardeicola, Clay.
 SPECIES : _____ A. ardeae, Linne.

The Mallophaga concerned in this chapter occurred in large numbers on all the Herons examined.

	FEMALE		MALE	
	LENGTH	WIDTH	LENGTH	WIDTH
HEAD .. .. .	.790	.490	.710	.442
PROTHORAX .. .. .	.269	.348	.237	.269
MESO-META-THORAX .. .. .	.316	.442	.285	.316
ABDOMEN	1.959	.506	1.644	.348
	3.334		2.876	

(All measurements in millimetres).

These specimens belong to the genus *Ardeicola*, Clay, 1935, for which the diagnosis is as follows:—

Species elongated and of medium size (2.5—5 mm).

Head : long and narrow, clypeus rounded in front; clypeal signature characteristic, being practically divided into two by a suture, and having on the upper half minute crescentic papillae or ridges, varying as to length and curvature in different species; antennal hands turned in towards each other at the clypeal suture; internal bands run posteriorly across the suture and pass outwards forming a goblet-shaped clear space in which lies the oral fossa; antennae five-jointed, normal in the female, in the male first joint is enlarged and the third joint has a lateral protuberance, generally small; pharyngeal sclerite and glands well developed.

Prothorax : small with sides very slightly divergent distally; pterothorax longer and slightly wider than the prothorax, bearing on each side of the posterior margin four or five pustulated hairs closely grouped in a clear oval space.

Abdomen : elongated; in female, tergal plates on segment I—VII separated in the middle-line. In the male a varying number of the posterior segments have complete transverse plates. Spiracles present on segments II-VII. Genitalia characteristic.

This diagnosis is after Clay¹⁰.

According to Clay¹⁰ this genus contains in addition the following:—

- A. stellare (Denny) from *Botaurus stellaris stellaris*.
- A. ciconiae (Linn.) from *Ciconia ciconia ciconia*.
- A. maculatum (Nitzsch & Giebel) from *Ciconia nigra*.
- A. raphidum (Nitzsch & Giebel) from *Plegadis falcinellus falcinellus*.

Original Literature on these specimens has not been available to the writer, but an examination of the specimens of *A. ardeae* prepared by the late Mr. Bedford in the Onderstepoort laboratories helped in the identification of this material as *Ardeicola ardeae*. Bedford⁵ recorded this specimen from *Ardea cinerea* in the Rustenburg District—Transvaal.

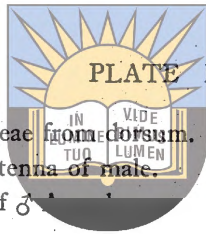
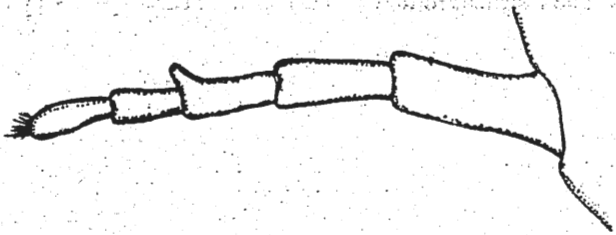
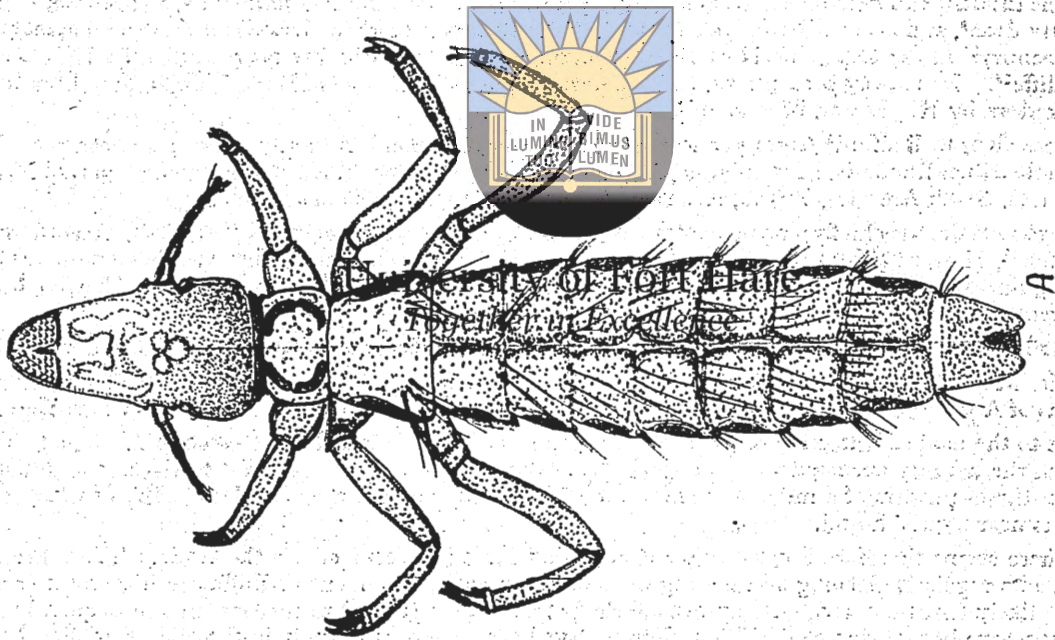
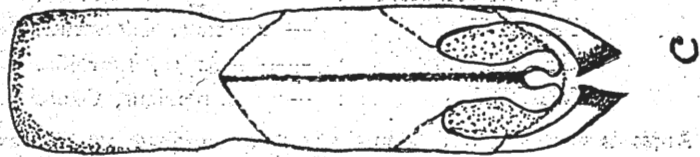


PLATE III.

- A. — Adult of *A. ardeae* from dorsum.
- B. — Antenna of male.
- C. — Genital organ of ♂

University of Fort Hare
Together in Excellence



UNIVERSITY OF FORT HARE
FORTHAMPTON, ALICE BATH

CHAPTER V.

CLASS :	—————	Arachnida.
ORDER :	—————	Acarina.
SUB-ORDER .. :	—————	Mesostigmata.
SUPER-FAMILY :	—————	Ixodoidea.
FAMILY :	—	Argasidae, Canestrini.
GENUS :	—————	Argas, Latreille.
SPECIES :	—————	A. persicus, Oken.

A number of Argasids were collected from the nests and the tree which was used as a roost by the Herons. The examination of the adult forms and the larval specimens which occurred on two hosts led to the identification of these specimens as *Argas persicus*, Oken. The key used is that given by Bedford⁵ for South African species.

The internal and external anatomy of *Argas persicus* have been fully described by E. Robinson¹¹ and J. Davidson⁹, and also by Patton and Cragg¹⁵. The life-cycle has been described by several authors—Lounsbury¹⁶ in the Cape, and Nuttall¹⁴ in Cambridge. Regeneration has been studied by Hindle and Cunliffe¹³. Its sensory perceptions, and the physiological significance of Haller's organ have been fully worked on by Hindle and Merriman¹².

According to Bedford⁵ *Argas persicus* occurs throughout South Africa, and has also been recorded from Southern Rhodesia, Mozambique, Belgian Congo, Egypt, Sudan, Algeria, Mauritius, part of North America, South America, Russia, Australia, Turkestan, Persia, India and China.

Argas persicus is chiefly a parasite of fowls but has been reported in several other birds. According to Bedford⁵, Howard (1908) recorded it from *Sagittarius serpentarius*, and it has also been taken off the wild guinea-fowl, *Numida papillata* (Linn.) and *Numida capensis*, at Oudh's River, Transvaal. The following birds are recorded by Bedford⁵ to have been found with this parasite:—

Struthio spp.; *Columba livia domestica*; *Anas boschas*; *Meleagris gallapavo*; and *Anser domesticus*.

Mr. Mokhehle whilst doing research work on avian parasites at Fort Hare, collected some larval forms of *Argas persicus* in 1946 from the Black Crow, *Heterocorax capensis capensis*, near Fort Hare.

As to the mode of infection of the roosts of the present hosts it is difficult to ascertain. The tree on which the heronry occurred was amongst houses, but in its vicinity the nearest fowl-run was situated about three-quarters of a mile away and the fowls certainly never came near the vicinity of the tree as this is near a girls' hostel.

There seems therefore but a slender chance that infection occurred via the fowls. The other inhabitants regularly sleeping and nesting in the same tree are specimens of *Bulbucus ibis* and it seems more likely that they have initially carried the parasites (as nymphs) to the tree and consequently the herons have become infected. These Egrets have been seen to run singly in the close neighbourhood of fowl-runs, sometimes very close to the fowls themselves. The Herons observed by me were never seen near fowl-runs although reliable information has been given that occasionally Herons venture very near the neighbourhood of poultry, and as this information may be correct the Heron itself may be the culprit.

CHAPTER VI.

CLASS	:	_____	Trematoda.
FAMILY	:	_____	Echinostomatidae.
GENUS	:	_____	<i>Nephrostomum</i> Dietz 1909.
SPECIES	:	—	<i>N. ramosum tyumiesis</i> (Nov. Var.).

The Trematodes belonging to this family occurred free in the posterior half of the duodenum and the proximal portion of the ileum. Both full-sized individuals and small immature forms occurred in the same niche, the incidence varying from one to fifty odd individuals per host, though generally each specimen had from ten to fifteen parasites.

The body of the sexually mature parasite is leaf-like, dorso-ventrally flattened, and obtusely rounded at the posterior extremity. From host to host the parasites range from a pinkish to a dirty white colour, the vitelline glands showing as darkened lateral fields.

The anterior extremity of the body in a dead specimen is curved ventrad and the straightened alcoholic specimens measured from 7.5 mms. to 10.6 mms. A live specimen with a length of 11.4 mms. examined in normal saline was observed to attain a length of 16.3 mms. in its maximal extended condition. When such extension occurs a bulbous wave, closely reminiscent of the so-called "Euglenoid movement" of some Protozoa, passes through the body of the animal and by the time it reaches the distal extremity the animal is a thin elongated specimen.

Whether such movements are an abnormal reaction of the parasites to a foreign environment, or normal attempts at locomotion it is hard to say. No change was observed in the space relations of the parasite in the petri dish. If perhaps such movements are of locomotory import then it might be suspected that the failure to register motion might be due to frictional difficulties at the interfaces.

The breadth of the animal across the uterine portion is half-way between the ovary and the acetabulum varies from 2.2—2.6 mms., whereas across the acetabular area it varies from 1.2—1.4 mms. In front of this area, i.e. from the post-acetabular level to the base of the collar, the body is relatively narrow—measuring from 0.70—0.80 mms.

There is a well developed collar, broadly kidney-shaped, with a slight dorsal depression, and a deep obtuse incurvature on the acetabular side, Plate 5. In transverse measurements it averages from 1.14—1.22 mms. while in the sagittal plane it varies from 0.47—0.51 mms. The collar is bordered by a single row of spines 48 in number of which the six smallest occur in the dorsal depression. They range from 0.022—0.041 mms. in length and from 0.013—0.031 mms. in breadth. There are four corner spines ranging from 0.059—0.072 mms. in length and from 0.034—0.041 mms. in breadth. The lateral spines have the average dimensions of 0.050—0.091 mms. in length and 0.028—0.050 mms. in breadth.

The oral sucker occurs more or less in the middle of the collar. Its walls are very thick, and the mouth aperture inside is small and circular. It is not circular in shape being longer along the transverse direction. This measurement varies from 0.269—0.484 mms.

A short distance from the collar at about 0.2 mms. from the oral sucker is a strongly muscular ventral sucker or acetabulum. It is funnel-shaped, extending downwards for a length of 1.25—1.30 mms. It is 0.869 mms. in diameter.

The body is uniformly covered with an aspicose cuticle, closely applied to a paler staining sub-cuticle, the components of which give the impression of closely packed anucleate columnar cells.

The mouth leads into a very short prepharynx only demonstrable in serial sections. This leads into a globular muscular pharynx, which measures from 0.284—0.411 mms. in length whilst in its transverse diameter it varies from 0.221—0.363 mms. In one of the specimens examined its muscular walls had a mean thickness of 0.063 mms.

The pharynx passes into a thin oesophagus varying in length from 0.253—0.320 mms. The intestinal bifurcation occurs behind the ventral sucker a short distance from its anterior border, giving rise to straight plain caeca, with no diverticula. These run towards the posterior end of the body and end blindly a short distance from it. As seen in sections the caecal walls are ciliated internally.

The vitellaria are discrete, regular follicular glands scattered in the lateral fields. They are confined to the peripheral areas and do not lie immediately round the caeca and neither do they encroach into the median intra-caecal field.

Towards the posterior end of the animal they become much fewer and reduced in size. Anteriorly they do not extend beyond the posterior level of the ventral sucker. The main lateral yolk ducts could not be identified beyond doubt but the transverse vitelline ducts are very obvious and open into an enlarged yolk reservoir. The yolk duct from the reservoir into the ootypic mass is hard to see due to an excessive concentration of dark glandular masses in the region of the ootypic mass, the reservoir itself being closely applied to the shell-gland complex.

The ovary is roughly oval in shape and lies more or less diagonally across the body of the animal. Its distance in front of the anterior testis is very irregular varying from 0.110—0.553 mms. whilst its actual length ranges from 0.411—0.645 mms. along its longest dimensions, and from 0.210—0.348 mms. across. The ovary is not a compact structure and as seen in sections, the maturing ova are loosely spread towards the centre. The ovary has, as its lodgement, a circle of parenchyma cells running round it as a mixed connective tissue sheath.

The oviduct is a tube with a mean diameter of 0.034 mms. It first runs transversely down to meet the Laurer Stieda canal, and after this runs towards the ootype. The spherical oval masses in the oviduct have a mean diameter of 0.009 mms.

The distal portion of the canal of Laurer first appears in sections, at a level above the ovary and then takes a slightly sinuous course running posteriorly and at the same time penetrating deeper to meet the oviduct.

It has a mean diameter of 0.019 mms. Its walls are thick and an oil-immersion objective reveals two layers to its wall—an inner thick layer of chitinous material, and an outer layer of dense muscular-tissue. No spermatid material was observed inside this canal.

The ootype is small, roundish and with an indefinite outline. It is much encroached upon by the enlarged elements of Mehli's glands. These appear to be unicellular bodies staining very deeply with eosin-haematoxylin. They are very numerous together in appearance densely spread over the ootype, and around the uterus, yolk-reservoir and oviduct in this region.

The uterus leaves the ootype from the right as a dilated tube which makes a more or less rectangular turn to lie above the ootypic mass, spiralling round once in the horizontal plane and then takes a short vertical loop across the horizontal branch and turns to run under the ovary. Beyond the ovary the uterus forms several transverse coils which are confined to the intracaecal filed. A short distance behind the ventral sucker the uterus becomes a straight tube which narrows down considerably to form a metraterm. At the commencement of the cirrus-sac it is very close to it; it gradually approaches the cirrus sac until it lies inside its walls. It ultimately unites with the cirrus to form a very short common genital atrium opening at the genital pore.

The dilated loops of the uterus in the region of the ootype are filled with seminal material, and it might be that in this way the function of a receptaculum seminis is discharged as this structure was not observed on any of the genital ducts.

The eggs are fairly numerous. They are oval and have thin delicate shells. Their measurements vary from 0.100—0.130 mms. in length and from 0.050—0.060 mms. in breadth. Apparently the eggs when laid are already in an advanced state of development. The most advanced stage observed, shows an elongate embryo which has already acquired a collar.

There are two testes in the posterior half of the body, median, and tandem. Their mesial axis passes roughly through the centre of the ovary, the ootype, the acetabulum, the genital pore and the oral sucker. The testes are compact and very irregular in outline though roughly ovoidal. The distance between the ootype and the anterior testis varies much from specimen to specimen. It has been found to range from a minimum of 0.12 mms. to a maximum of 0.32 mms. with the anterior tip of the testis either lying in the same horizontal plane as the ootype and only a few microns from it, or lying against the yolk reservoir in the same plane or abutting slightly above the shell gland complex. In one specimen examined, with a testis of 0.62 mms., 21% of this length abutted over the shell gland complex i.e. in a plane above that of the ootype.

The anterior testis is in most cases smaller than the posterior testis. The size of the testis and their relative topography along the mesial axis of the animal show a very inconstant relationship, as the following table indicates:—

	A.	B.	C.	D.	E.
Length of Trematode	8.500	7.500	11.100	8.300	10.500
Length of Anterior Testis .. .	0.459	0.632	0.331	0.474	0.410
Length of Posterior Testis .. .	0.632	0.727	0.821	0.537	0.390
Diameter of Anterior Testis .. .	0.616	0.711	0.363	0.427	0.379
Diameter of Posterior Testis .. .	0.490	0.648	0.679	0.443	0.205
Distance between Testes .. .	0.079	0.000	0.237	0.079	0.110
Length of Ovary	0.632	0.648	0.585	0.490	0.411
Cross-section of Ovary	0.284	0.269	0.348	0.269	0.210
Distance between Testis & Ovary .. .	0.158	0.158	0.553	0.111	0.110

The vasa deferentia were not observed in the testicular area; they appeared, however, in the acellular region as thin ducts lying side by side and surrounded by thin glandular tissue. The diameter of each vas deferens is 0.003 mms. The two vasa deferentia unite to form a common vas deferens, which increases in calibre over a range of ten microns after union to be 0.028 mms., whilst the cirrus-sac at the same level measures 0.072 mms. across.

The vesicula seminalis is formed by the dilation of the common vas deferens. The first limb of the seminal vesicle at its first sectional appearance has a diameter of 0.066 mms. and the cirrus-sac measures 0.203 mms. across. The seminal vesicle forms a double loop in the vertical plane and about half-way across the double loop, the cirrus-sac has a diameter of 0.246 mms. The vesicula seminalis passes into a relatively short but coiled ductus ejaculatorius. This passes into a small muscular inerm penis which unites with the metraterm at the level of the testes to form a short genital sinus running against the muscles of the ventral sucker. It is 0.110 mms. in extent and its diameter is 0.019 mms.

Above the level of the seminal vesicle the uterus becomes incorporated into the cirrus-sac and runs against its wall. The cirrus-sac lies directly dorsal to the ventral sucker starting from its anterior half.

The elements of the pars prostatica first appear as thin glandular cells surrounding the vasa deferentia inside the cirrus-sac. They then become denser and larger in the region of the seminal vesicle and continue to surround the genital duct up to the genital sinus.

The family Echinostomatidae is characterised by a Y-shaped excretory system. In this Echinostome however, there is a small excretory vesicle at the posterior extremity. This has a small outlet duct which opens sub-terminally to the exterior. This duct has an average diameter of 0.038 mms. Its walls are highly muscular. The parenchyma cells are arranged radially in its vicinity and the whole region appears dark due to the abundance of dark-staining bodies. The regular outline of this vesicle is however, soon disfigured by a number of body sinuses in communication with it. These latter are very numerous especially in the post-testicular area, being smaller in the higher levels. As seen in serial sections, the shape of this vesicle is extremely variable from specimen to specimen, probably due to muscular contraction.

On either side of the vesicle are excretory tubes as shown in Plate 5. The individual tubes do not present a uniform bore; although they preserve on either side a remarkable symmetry in relation to the vesicle. At the level of the posterior testis the outermost tubes vanish, ending blindly. The two innermost tubes on either side persist into the higher levels of the body. Flame cells were not observed, either in alcoholic specimens treated with stains, and sectioned, or in live specimens examined in normal saline.

Within the excretory vesicle and the body sinuses was observed a corpusculated agglutinate or colloid. When stained in Picro-Saure-fuchsin, this colloidal matter resolves into cellular plates with definite nuclei.

DISCUSSION

This specimen accords most in its general features with the genus *Nephrostomum*, Dietz 1909, for which the generic diagnosis is as follows:—

Body dorso-ventrally flattened; collar broad and kidney-shaped with a slight dorsal depression, and a strong ventral indentation; collar spines in one dorsal unbroken row; small in the neighbourhood of the dorsal middle-line, becoming bigger posteriorly at the flanks; cuticle smooth; prepharynx very small; oesophagus extremely short; ventral sucker strongly muscular posteriorly, funnel-shaped, long, not entirely in the first quarter of the body; cirrus-sac small; lying dorsally to the anterior part of the acetabulum; testes in the hinder half of the body, median, compact, and tandem. Ovary diagonal, median, a short distance in front of the testis; yolk-glands laterally placed extending from the posterior to the hinder end of the posterior level of the acetabulum; uterus long strongly coiled; eggs numerous, 0.102—0.108 mms. in length and 0.061—0.068 mms. broad.

(Translation from Dietz¹⁷.)

From available literature it appears that this genus contains two species, *Nephrostomum ramosum*, Sonsino 1895, and *Nephrostomum limai*, Travassos 1922. The latter was described by Travassos¹⁸ from the Ardeidan host *Syrigma sybilatrix*. The former was first described by Sonsino as *Echinostomum ramosum* in 1895 and redescribed by Looss (1901), Odhner (1902); and then Dietz redescribed it and reclassified it by creating a special genus *Nephrostomum* to contain this species. He collected his material from *Bulbucus ibis*.

The present species agrees closely with Dietz's measurements and the following table indicates to what extent the agreement holds:—

	MEASUREMENTS IN MMS.	
	N. RAMOSUM	SPS. DESCRIBED
Length of mature parasite	1.500 — 1.610	1.500 — 11.400
Width of collar	1.560 — 1.610	1.140 — 1.220
Corner spines length	0.060 — 0.068	0.059 — 0.072
Corner spines breadth	0.027 — 0.040	0.034 — 0.041
Lateral spines length	0.055 — 0.070	0.050 — 0.091
Lateral spines breadth	0.027 — 0.040	0.028 — 0.050
Depression spines length	0.012 — 0.014	0.022 — 0.041
Depression spines breadth	0.007 — 0.008	0.013 — 0.031
Oral sucker	0.380 — 0.430	0.269 — 0.484
Pharynx length	0.290 — 0.310	0.284 — 0.411
Pharynx breadth	0.190 — 0.230	0.221 — 0.363
Oesophagus length	0.169 — 0.185	0.253 — 0.320
Length of Ventral sucker	1.250 — 1.560	1.250 — 1.300
Breadth across uterine portion	3.300 — 3.400	2.200 — 2.600
Length of ovary	0.662 — 0.735	0.411 — 0.648
Breadth of ovary	0.261 — 0.308	0.210 — 0.348
Testis diameter	0.624 — 0.693	0.205 — 0.822
Distance of ovary in front of testis	0.385 — 0.462	0.110 — 0.553
Eggs length	0.102 — 0.108	0.100 — 0.130
Breadth (Eggs)	0.061 — 0.068	0.050 — 0.060

From this table it is clear that the specimens which were in the hands of Dietz were more robust than our material. And also Dietz¹⁷ reports that the material which was collected by Sonsino was still more robust than his, even to the extent of 18 mms., i.e. a difference of 50% in length between his material and that of Sonsino.

The present specimens agree fairly closely with Dietz's material as the above table illustrates and perhaps if compared with Sonsino's material the small differences in measurements which come out between this material and Dietz's would still be greater. Some of our material is even 100% and over smaller than Sonsino's giant Trematodes, which Dietz regards as conspecific with his material.

Secondly, although the present material would seem to be closely related to *Nephrostomum ramosum* as shown for example by the occurrence of forty-eight collar spines grouped into four "corner" spines and six small spines in the dorsal depression, yet there are certain differences which in our opinion warrant the separation of our material into a new variety:

(i) In an essay on the systematic position of the Lepodermatidae Baer¹⁹ stresses the evolutionary significance of the excretory system in Digenea. According to him, Odhner stresses the fact that of all the systems the excretory system seems to be the most constant, and that according to the work of Cort and Faust the shape of the excretory vesicle serves as a constant character in the systematisation of the digenetic Trematodes.

In his diagram Dietz¹⁷ has figured the excretory system of *Nephrostomum ramosum* as a plain Y-shaped system with no vesicle; in the present specimens an enlarged excretory vesicle, with its accessory canals, and an irregular system of body spaces opening into it has been found.

(ii) From his description Dietz¹⁷ does not refer to the exact shape of the oral sucker which in our case has the posterior side more or less elongated as illustrated in Plate 5, nor does his diagram figure it thus.

(iii) The length of the oesophagus in our material almost double the length of the oesophagus in Dietz's material.

(iv) The testes in the specimens examined by Dietz were more regularly oval, whilst in our case they vary much in shape and size.

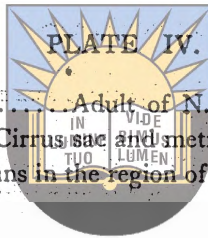
(v) Lastly there seems to be a striking difference in the size of the spines found in the dorsal depression of the collar—these being more robust in our material.

Whilst perhaps it might be felt that these points are of sufficient specific importance to warrant the separation of this species from *Nephrostomum ramosum*, yet it is our considered opinion that the agreement on several points of taxonomic significance, e.g. in the number and position of the collar spines is too great to justify such a step.

The present specimens are, therefore, diagnosed as a new variety of *Nephrostomum ramosum* which shall be known as *Nephrostomum ramosum tyumiensis* (Var. Nov., the name Tyumi being the historical valley in which the hosts lived, and where the present research was carried out.



University of Port Hare
Together in Excellence

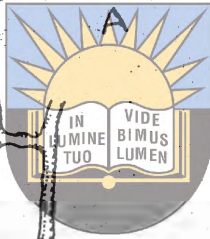
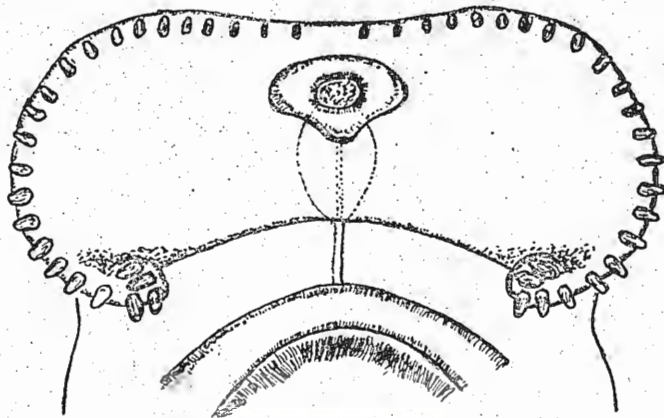


- A. — Adult of *N. ramosum tyumiensis*.
- B. — Cirrus sac and metraterm over the sucker.
- C. — Genital organs in the region of the egg-shell complex.

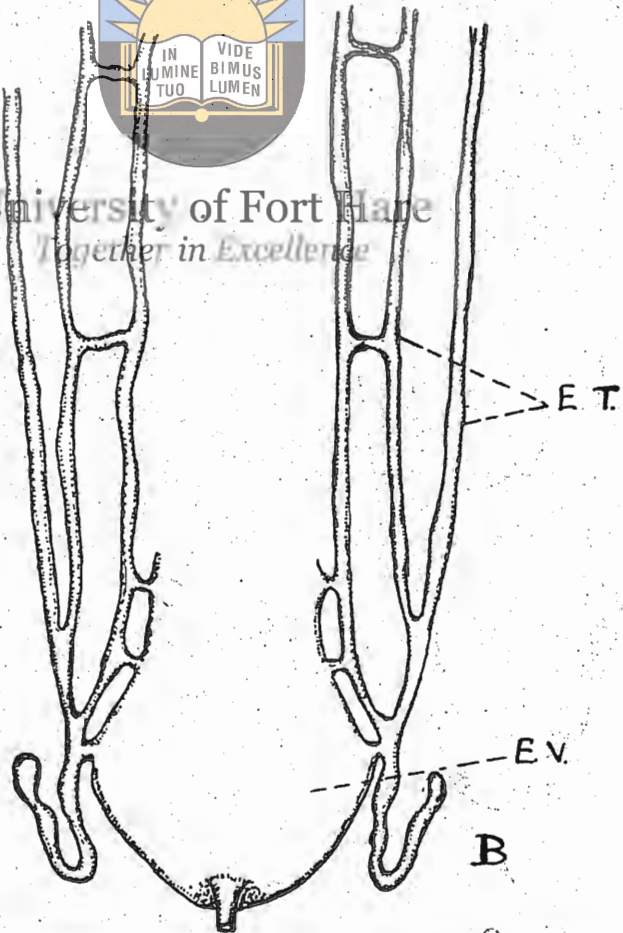
University of Fort Hare
Together in Excellence

PLATE V.

- A. — Collar of *N. r. tyumiensis*.
- B. — Excretory system of *N. r. tyumiensis*.



University of Fort Hare
Together in Excellence



CHAPTER VII.

CLASS	.. :	—————	Nematoda.
SUPERFAMILY	: :	—————	Spiruroidea.
SUB-FAMILY	: :	—	Acuariidae, Seurat 1913.
GENUS	.. :	—	Acuaria, Bremser 1811.
SUB-GENUS	.. :	—————	Synhimatus.
SPECIES	.. :	—	<i>S. invaginata</i> , Lin. 1901.

Of sixteen Herons examined, eight were found to harbour a certain type of small Nematode in the gizzard. When dead this Nematode is found embedded in the stratum corneum of the gizzard, but in the live state, the Nematode is attached at one end, with the body free in the alimentary ingesta. The Nematode is whitish in colour, and the cuticle is quite transparent when the specimens are examined alive in Ringer's solution. There is a big disparity in the numbers of the two sexes present; there are always only a very few males to be found in a fairly large population, the ration being more or less two or three males out of every fifteen specimens.

The Nemas are characterised by their possession of four cuticular cordons at the anterior extremity, the cordons being apparently raised portions of cuticle which extend from the anterior extremity backwards for about one twentieth of the body length, and then curve forwards, and instead of reaching the anterior extremity, anastomose in pairs on the lateral areas, as shown in Plate 6.

The cordons begin as narrow strips but gradually become broader, remaining more or less constant round the posterior bend and in their recurrent portions. The cuticular signature on the cordons comprises thin delicate ridges or striae which are finely incised, giving the appearance of delicate scalloping, when seen under high power. As seen in the specimens, the cordons are quite plain and do not have the marginal sinuations depicted in Plate 6 (D), a condition which arises after fixation of the specimens and probably due to shrinkage.

Behind the posterior edge of the cordons, on its margin, there is situated on either lateral surface a cervical papilla or spine which is tricuspid. It is directly continuous with the cuticle, there being no basal portion. The papillae are more strongly developed in the female than in the male, the two outer cusps being slightly more developed than the middle one.

When kept in Ringer's solution, for three to five days, the cuticle remains quite transparent and only becomes opaque in alcohol preserved specimens. Generally the cuticle shows annular striations, these are more evident in the female than in the male probably due to the more robust form of the body. Such striations become progressively broader towards the hinder end.

The mouth has two lateral lips and opens into a slightly expanded portion of the vestibule. The vestibule is long and highly chitinized, which chitin also appears to be transversely striated. It passes into a muscular portion of the oesophagus which is relatively narrow, anteriorly gradually becoming thickened, until, immediately following a constriction, it forms the glandular portion of the oesophagus, much thicker than the muscular portion. This portion is the longest and, where it passes into the intestine, has a strong constriction.

MALE :

The males are thin and wiry and when killed tend to coil up into several loops. They are slightly shorter than the females, their length varying from 9.5—10.1 mms. Applying Cobb's formula to one specimen, the measurements are :—

$$\begin{array}{cccc} 2.85 & 47.85 & 50.02 & 99.2 \\ \hline 1.26 & 2.53 & 2.53 & 0.28 \end{array} = 10.1$$

Measurements for the cuticular structures of this specimen are :—

Greatest length of cordon	.. .. .	: 0.49 mms.
Length of recurrent portion	.. .. .	: 0.30 "
Distance of tricuspid spine from anterior end	: 0.60	"
Maximum width of cordoned area	.. .. .	: 0.095 "

The cuticular striations anteriorly average from 0.004 mms. to 0.006 mms., becoming progressively wider to an extent of 0.009 mms. in the more distal regions.

The caudal alae are thick and vesicular and not spread out laterally in leaf-like arrangement, but extend over most of the lateroventral surface of the body. They originate at a distance of 0.99 mms. in front of the cloacal opening. The striations on them are broader and towards the distal extremity have a mean width of 0.013 mms. The cloacal opening is on an elevated portion of the body and in the specimen examined extended 0.032 mms. beyond the surface of the body. The opening is not simple and appears to have lips. The post-anal prolongation of the body is 0.078 mms. in length.

There are two spicules, the right one well developed and robust, and the left one very thin and flexible as can be seen when it is handled with a needle. The right spicule measures 0.864 mms. in length. It appears to be an ensheathed structure with its distal extremity bent and protruding as a digitiform process from the sheath. At its proximal end, it is slightly knobbed and measures 0.051 mms. across its broadest portion, and then maintains a more or less constant diameter of 0.034 mms. The left spicule measures 0.46 mms. and from its extreme flexibility appears to be non-functional and atrophied.

In the male the measurements of the pharyngo-oesophageal complement are as follows, for a specimen of 10.1 cms. length:—

Length of the pharynx	0.285 mms.
Length of anterior oesophagus	0.900 "
Length of posterior oesophagus	3.600 "

The chitin-lining of the vestibule is 0.003 mms. thick whilst the average external diameter of the vestibule is 0.016 mms.

FEMALE:

The females are more robust than the males and also slightly longer. They vary from 10.9—12.3 mms. in length. In one female of length 11.5 mms. and average thickness of 0.363 mms., the measurements of the cuticular structures are as follows:

Greatest length of cordon	0.474 mms.
Length of recurrent portion	0.321 "
Distance of tricuspid spine from anterior end	0.537 "
Maximum width of cordoned area	0.101 "

Anteriorly the cuticular striations of the female are 0.005 mms. wide and increase posteriorly to 0.013 mms. As seen in live specimens the posterior termination of the cuticle appears quite plain and normal, but in killed material the cuticle generally forms a campanulate invagination with the body severely contracted and only its post-anal prolongation lying in the bell. Whether this telescopic invagination of the cuticle is a normal feature in the live state, cannot be said with definiteness, but the cuticle has been observed invaginating gradually in specimens that were being examined in Ringer's solution.

The body proper of the female is characterized by a thumb-like tail which is wanting in the male. The tail is a pointer of the body displaced to one side of the mesial axis. It has a mean diameter of 0.013 mms. and a length of 0.05 mms. At the base of the tail lies the cloacal opening next to the vulva. In a specimen of 12.3 mms. from which measurements were taken, the cuticular bell projected for a distance of 0.225 mms. from the base of the tail, whilst its breadth at this level was 0.157 mms. At the same level the body width inside the cuticle was found to be 0.094 mms.

The pharyngo-oesophageal apparatus of a female of length 11.5 mms. has the following measurements

Length of the pharynx	0.298 mms.
Length of anterior oesophagus	1.25 "
Length of posterior oesophagus	3.7 "

The external diameter of the vestibule averages 0.016 mms. whilst the chitin lining of its walls has a mean thickness of 0.006 mms. The diameter of the anterior oesophagus at its thickest portion is 0.095 mms., whilst that of the posterior oesophagus averages 0.158 mms.

Alcohol preserved specimens even when cleared with Langeron's lactophenol or with Creosotum do not show the arrangement of the genital organs due to the gravid nature of the uterus filled with eggs.

The ovijector at the posterior extremity sometimes shows in these specimens, but the examination of live specimens kept in Ringer's solution was found to be very helpful, as the course of the uterus can be followed with the movement of the eggs. This, however, had also to be supplemented with a micro-dissection of the parts concerned.

The single ovary is a long tubular structure, which makes a double coil as shown in Plate 7 (B), the coils lying round the oesophagus. It arises insensibly from the oviduct, at first narrow but gradually enlarging to a maximum and then narrowing down to end with a well defined rounded extremity. The component cells of the ovary are very clearly defined, being more or less rounded pentagonal cells with clear centrally situated nuclei. They are largest at the thickened portion of the ovary, where they are most evident but become progressively small towards the tip of the ovary.

The oviduct passes above the oesophagus and as it leaves the ovary becomes a very thin duct which passes by an abrupt step to the beginning of the uterus. This is at first relatively narrow and is a more or less regular tube. At its proximal portion the uterus appears to be glandular and to be composed of denser tissue, an observation supported by the fact that eggs are only seen a short distance from this area.

The uterus then runs backwards, dilating to form a baggy structure which is either doubled up on itself in some cases, or runs straight back towards the posterior of the animal. On reaching this portion, it then runs under or above the ovijector and then makes a complete turn to run forwards for a short distance, and then recoils again, to run to the ovijector at the posterior end.

Posteriorly the vulva opens next to the anus into a small depression. The vulva leads into a thickened and highly muscular ovijector nearly globular in shape. This measures 0.876 mms. in length and across its broadest diameter it is 0.689 mms. It has a very thin lumen lined with chitin. This lumen has an internal diameter of 0.017 mms. in its undistended condition. At its vulvar extremity it is controlled by well developed muscles acting as a sphincter, their action having been well observed in a live specimen during the act of fecundation. The ovijector passes into a tube which in several specimens examined makes a somersault curve as it proceeds forwards without any apparent histological differentiation into vaginal and uterine portions. As seen in live specimens in the act of fecundation, the vagina would seem to comprise that length of this tube where the eggs become arranged into a single row as illustrated in Plate 7 (A). On the termination of the tube beyond this which is filled to capacity with eggs would thus mark the end of the uteroduct.

DISCUSSION

From the foregoing description these Nematodes accord well with the sub-family Acuariinae, Railliet, Henry and Sisoff 1912, and with the genus *Acuaria*, Bremser 1811, for which the generic diagnosis is as follows:—

Acuariinae: With two simple lateral lipa; cephalic extremity without any cuticular thickenings or shields, but with four cordons in the form of ridges or grooves, directed posteriorly frequently turning forwards again and uniting on the lateral surfaces; cervical papillae behind the nerve-ring; lateral flanges absent; vestibule with thick walls usually transversely striated, oesophagus cylindrical, consisting of two parts.

MALE: Posterior extremity rolled spirally, caudal alae present; four pairs of pedunculated pre-anal papillae and a variable number of post-anal papillae.

FEMALE: Posterior extremity blunt; vulva usually in the posterior third of the body; ovijector short; uteri divergent; oviparous.

Parasites of the oesophagus and gizzard of birds. (After Yorke and Maplestone²⁰).

In 1912, Railliet, Henry and Sisoff separated the members of the genus *Acuaria*, Bremser 1811, into five subgenera viz:—

- (i) *Acuaria* (Bremser 1811) Railliet, Henry and Sisoff 1912.
- (ii) *Cheilospirura* (Diesing 1861) Railliet, Henry and Sisoff 1912.
- (iii) *Synhimatus*, Railliet, Henry and Sisoff 1912.
- (iv) *Dispharynx*, Railliet, Henry and Sisoff 1912.
- (v) *Hammania*, Railliet, Henry and Sisoff 1912, (Syn.: *Echinuria*, Solowiow 1912 and elevated to a genus by Yorke and Maplestone 1926).

These sub-genera differ mainly in the disposition of their cuticular cordons, whether they are recurrent or not, or recurrent and anastomosing or not. They are, therefore, different in that the cordons in:—

- (i) Acuarria are directed backwards and not anastomosing.
- (ii) Cheilospirura are directed backwards and not anastomosing, the difference between this sub-genus and Acuarria being in the disposition of the spicules.
- (iii) Synhimatus are recurrent and anastomosing in pairs on the lateral surfaces.
- (iv) Dispharynx are recurrent but not anastomosing.
- (v) Hammania are not recurrent but anastomose posteriorly.

From this analysis the Nematodes under question agree best with the sub-genus Synhimatus for which the diagnosis according to Yorke and Maplestone²⁰ reads:—

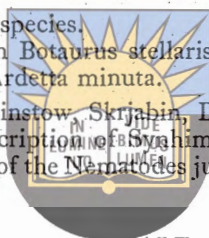
Cordons recurrent, and anastomosing on each lateral surface, cervical papillae tricuspid when seen.

Male: With unequal and dissimilar spicules, ordinarily five pairs of post-anal papillae.

Amongst others this sub-genus contains the following three species which have been described from certain Ardeidae:—

- Synhimatus alata from Ardea species.
 Synhimatus brevicaudata from Botaurus stellaris.
 Synhimatus invaginata from Ardetta minuta.

The original works of Rudolphi, Linstow, Skrjabin, Dujardin and Gendre on the foregoing species have not been available, but the description of Synhimatus invaginata by Skrjabin 1924, quoted by Cram⁴ compares favourably with that of the Nematode just described as the following tables illustrates:



MALE
 University of Fort Hare
 Together in Excellence
 MEASUREMENTS IN MILLIMERTES
 S. INVAGINATA NEMATODE
 DESCRIBED

Length of body	.. .. .	10.45 — 11.10	9.7 — 10.100
Length of pharynx	.. .. .	0.25 — 0.27	— 0.285
Anterior oesophagus	.. .. .	0.96 — 0.97	— 0.900
Posterior oesophagus	.. .. .	.. .. .	3.600
Greatest length of cordons	.. .. .	.. .. .	0.490
Lateral anastomosis of cordons	.. .. .	0.30	0.300
Distance of papilla from anterior end	.. .. .	0.63	0.600
Origin of alae in front of cloaca	.. .. .	0.80	0.990
Length of right spicule	.. .. .	0.90	0.860
Length of left spicule	.. .. .	0.47	0.460

FEMALE

MEASUREMENTS IN MIL

	S. INVAGINATA	NEMATODE DESCRIBED
Length of body	12.200 — 12.800	11.500 — 12.300
Length of pharynx	0.280 — 0.310	0.300
Anterior oesophagus	.. .. .	1.250
Posterior oesophagus	3.500 — 3.600	3.700
Greatest length of cordons	.. .. .	0.474
Lateral anastomosis of cordons	.. .. .	0.321
Distance of papilla from anterior end	.. .. .	0.537
Eggs: length	0.027 — 0.029	0.025 — 0.028
Eggs: breadth	0.018 — 0.019	0.016 — 0.019

From these considerations the Nematodes in question are taken to belong to the species *Synhimatus invaginata* (Linstow, 1901) Skrjabin 1924.

According to Cram⁴ *S. invaginata* occurs under the tunic of the gizzard, and has been collected from *Bulbucus lucidus*, *Ardeola ibis*, and *Ardea purpurea*. It has been reported, in Germany, Corsica, Algeria, and French Guinea. Its life history is not known.

In spite of this recorded agreement, however, there are certain differences which perhaps are real and must be placed on record:—

- (i) The pre-anal and post-anal papillae said to occur in the male have not been observed in the material examined.
- (ii) As regards the two symmetrical papillae on each lip also mentioned by Cram⁴ is her generic diagnosis of the group—these too could not be made out.
- (iii) A point too, which is important is that there is only a single ovary and female genital tube whilst in the diagnosis of Yorke and Maplestone, these are apparently double as the "uteri" are said to be divergent. This point is either not a generic feature or the present specimens should not fall into this genus. On the other hand this divergence might only be typical of the sub-genus *Synhimatus*, a condition which would necessitate the separation of the sub-genus from its present rank and elevate it to a generic status. Such a scheme has been followed already by Cram⁴ though apparently more from a point of systematic convenience than from any facts of internal anatomical divergencies as no mention of this fact is made by her.

If the material which was in the hands of Gendre 1913 is identical with the material collected from the gizzard of *Ardea melanocephala* then something can be said against the diagrams of Gendre as pictured by Cram, viz:—

The diagram of the posterior portion of the female, figures the uterus as a plain tube with no regional modification into a muscular ovjector. Either the material which was in the hands of Gendre was defective or the two specimens under discussion are not conspecific.

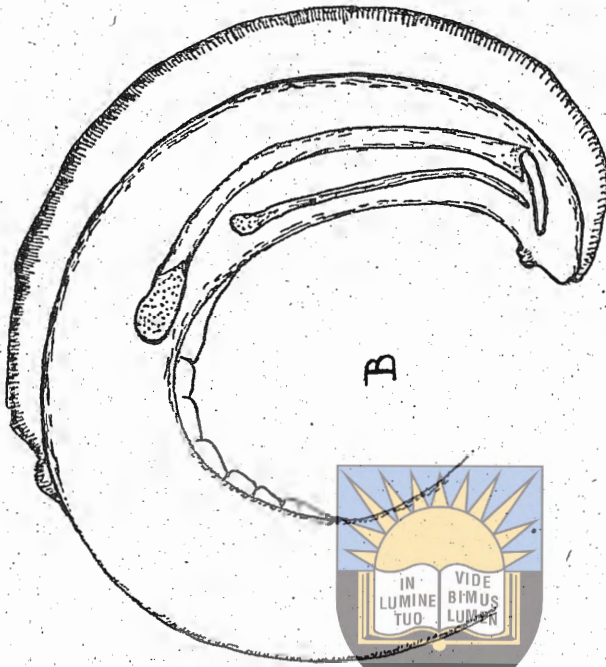

 PLATE VI.

- A. — Anterior extremity of *S. invaginata* ♀.
- B. — Posterior extremity of *S. invaginata* ♂.
- C. — High Power view of cordons.
- D. — Cuticular cordoned area.

University of Fort Hare
Together in Excellence

PLATE VII.

- A. — Posterior region of ♀ genital duct of *S. invaginata*.
- B. — Anterior region of ♀ genital duct of *S. invaginata*.
- C. — Posterior view of the ♀ body whole.

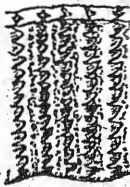


B



University of Fort Hare
Together in Excellence

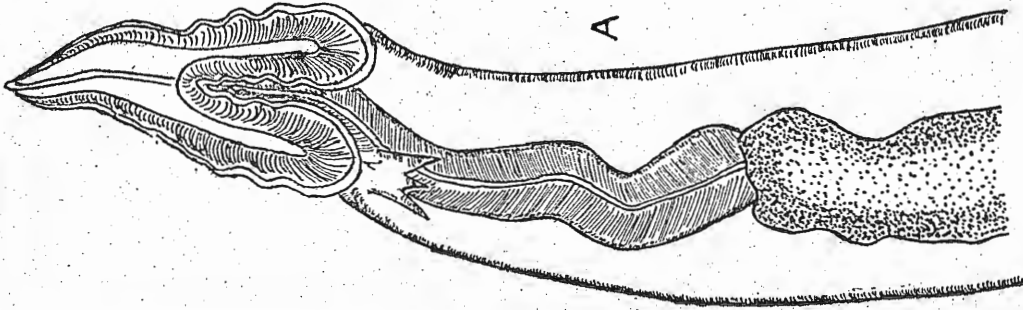
A



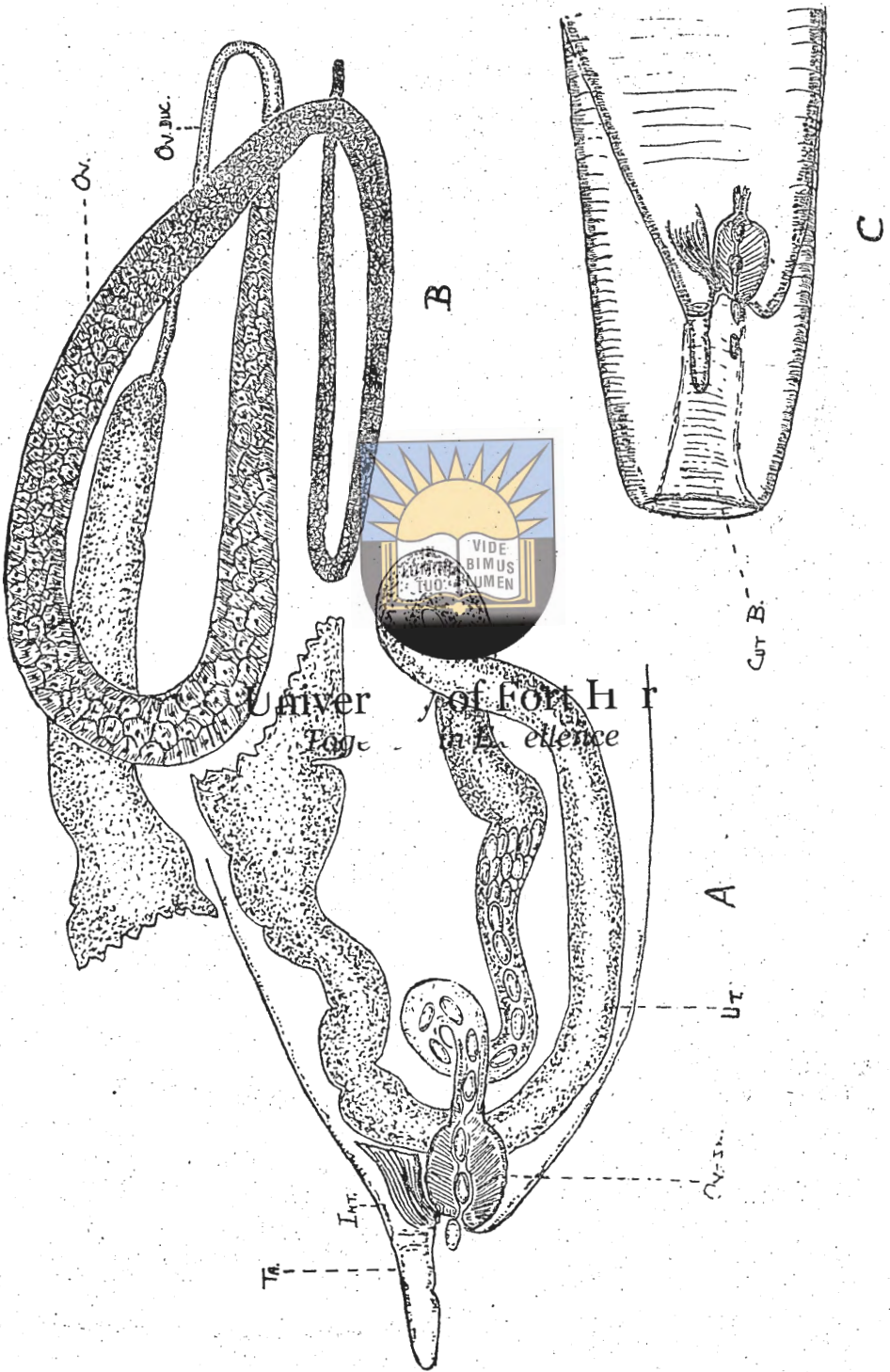
C



A



C



University of Fort Hare
Page 14
in Excellence

CHAPTER VIII.

CLASS :	_____	Nematoda.
SUPERFAMILY :	_____	Spiruroidea.
FAMILY .. . :	_____	Thelaziidae, Raillet 1916.
GENUS .. . :	Desmidocercella, Yorke and Maplestone 1926.	
SPECIES .. . :	_____	D. kwalimānzi (Nov. Sp.).

The material belonging to this genus comprised several males and females, collected from the body cavity, the air-sacs, and the lungs of some of the hosts. One of these Nematodes was found in the pericardium of one host-heron, but it is suspected that this was a case of wandering.

When alive these Nematodes are transparent but after killing with hot 70% alcohol assume a white opaque colour. They are small filliform Nematodes which taper to a rounded extremity for the posterior two-thirds of the body. The cuticle is apparently smooth, but on focussing deeply with a high-powered microscope, a delicate transverse striation is discernible. The cervical papillae at the level of the nerve-ring described by Seurat²¹ in *Desmidocercella numidica*, Seurat 1920, are wanting and the lateral flanges figured by him for the same species do not occur in the present specimens.

The mouth is at the anterior end, is terminal, and is provided with two broad lips which are whole and not subdivided into lobules. On each lip is a pair of large refractile papilliform organs, which are submedian in position, and prominent at the anterior extremity. The mouth opens into an infundibuliform vestibule which is heavily chitinised. The chitin wall in the region of the mouth abutts laterally on either side, forming short thickened buttresses, which lie on either side of the mouth cavity. The oesophagus is short, subcylindrical, and divides into two parts: a narrow anterior muscular portion, and a thickened, posterior glandular portion. The sub-divisions are roughly marked by the anterior neural commissure, which encircles the oesophagus in this area. The latter is about one-ninth of the total length of the Nematodes in both males and females. The posterior thickened oesophagus narrows down rather abruptly to pass together in the anterior to the exterior at the hinder end of the body.

MALE:

The males are on the average 2—3 mms. shorter than the females. When killed the posterior end of the body becomes curved ventrad. The dimensions of one of them by Cobb's formula are:—

.705	14.7	50	98.4	
<hr/>				4.4
1.43	3.6	5.0	2.03	

The vestibule is 0.031 mms. deep and 0.007 mms. broad. It passes into an oesophagus of a total length of 0.648 mms. The anterior muscular portion measures 0.1 mms. in length and 0.028 mms. in breadth. The posterior glandular portion is 0.548 mms. long and 0.056 mms. broad, across its widest portion. This then passes into a straight plain intestine of an average diameter of 0.038 mms. The cloaca is a dilated portion of the distal part of the intestine where it receives the spicule sheaths. Its aperture is 0.059 mms. from the posterior extremity.

The excretory pore occurs at a level posterior to that of the nerve-ring, being 0.174 mms. from the anterior end.

There are two spicules, unequal and dissimilar, and there is no gubernaculum. The right spicule is the largest, and is a boomerang-shaped structure with a length of 0.395 mms. It is more or less uniform in diameter though it tapers slightly towards its distal end. The left spicule is shorter and broader, and is also slightly curved and differs considerably in shape from the other. It is 0.126 mms. long, being 0.019 mms. broad at its proximal portion and gradually tapers to 0.006 mms. at its distal extremity.

The genital papillae comprise a single pair of sessile refractile organs immediately behind the cloacal opening. There are no pre-anal papillae.

In *Desmidocercella numidica*, Seurat²¹ describes a subterminal patch in the females only, which he calls a cuticular button. Solonotzin²² describes the same patch which he also regards as a cuticular

structure in *Desmidocercella incognita*, Solonotzin 1932. This patch, which is quite a constant feature in both males and females, appears to be sub-cuticular, in our observations in these specimens.

FEMALE:

The females are longer than the males. The dimensions by Cobb's formula of a 7 mms. specimens are:—

$$\frac{.45 \quad 9.0 \quad 7.9 \quad 88.7}{.90 \quad 2.9 \quad 2.7 \quad 1.4} = 7.0$$

The vestibule is 0.032 mms. deep and 0.009 mms. broad. The thin anterior muscular portion is 0.125 mms. in length, and measures 0.034 mms. across. The thicker glandular portion has a length of 0.473 mms. and has a diameter of 0.064 mms. across its widest area. It then passes into an intestine which in the anterior region has a mean diameter of 0.047 mms. The anal opening is ventrally situated at a distance of 0.079 mms. from the posterior extremity.

The excretory pore is placed at a distance of 0.158 mms. from the anterior end. From it runs a short duct which divides into two branches, occluded by the subcuticular hypodermal tissue. Seurat²¹ observed this duct in *Desmidocercella numidica*, and found that it entered a Ventral Gland below the oesophagus. No such Ventral Gland has been observed in the present species. As regards its physiological function and that of the lateral excretory canals there is still much disputed argument. They have since Leuckart's time been described as excretory, but Lapage²³ says there is no real evidence to support this. According to him Von Kennitz compared the hypodermal tissue surrounding the lateral canals, to which an excretory function has been ascribed, more to a liver than a kidney and Mueller suggested that Leuckart named the so called excretory system thus for morphological reasons. After extensive experimentation on the pH of the secretion and its chemical nature, Mueller according to Lapage²³ concluded that the lateral canals are not excretory and the only form of excretion in Nematodes is diffusion through the cuticle. In *Desmidocercella incognita* there is a Ventral Gland in Anisakinac where there are no lateral canals is not excretory either. He attributes to it the secretion of some "saliva" suggesting that this may in blood-sucking species play a part as an anti-coagulin. Lapage²³ maintains that this observation is strengthened by the significance of the fact that the "excretory pore" has moved forward to the anterior end, where the fluid it discharges comes into direct contact with the tissues on which these species are apparently feeding. He also confirms the idea that the Ventral Gland and the lateral canals are apparently more digestive in function than excretory as has heretofore been suggested.

There are two uteri, and two ovaries lying in the anterior and posterior fields respectively. The uterus from the anterior ovary runs backwards for about half the length of the uterus from the posterior ovary and then curves forwards to unite with its other fellow from the back, to form the vagina.

The ovaries unlike those of *D. numidica* are not contiguous, but lie opposed a good way from each other. Each is a small oblongish body with small nucleated cells; it measures on the average, 0.032 mms. by 0.063 mms. The oviduct arises insensibly from the ovary and in each case forms a characteristic loop in the anterior and posterior fields. It is 2.6 emms. in extent and thickens gradually to maintain a more or less constant diameter of 0.047 mms.

The origin of the utero-duct is marked by an abrupt thickening of the genital duct from 0.047 mms. to a tube the diameter of which at its proximal end is 0.079 mms. It then increases in diameter to a maximum of 0.19 mms., and it is in these regions a slightly convoluted duct. According to Seurat²¹ the dilated portion of the uterus, observed by him in *D. numidica* is the seminal receptacle. The uteri then gradually diminish in size and meet to form a common genital duct which opens at the vulva, situated a little in front of the oesophago-intestinal junction, at a distance of 0.553 mms. from the anterior end. This common genital duct is 1 mm. in length and is differentiated into a distal muscular portion, the ovijector, about .5 mms. in length and with an average diameter of 0.079 mms., and a less muscular portion, slightly thicker than the ovijector, being 0.095 mms., across, and formed by the uterine confluence. In all the females examined no eggs were present.

The female as in the male also has a characteristic sub-terminal patch. Solonotzin found that this patch in *D. incognita* was beset with spiny hairs, which, however, were missing in the male.

DISCUSSION

From this description the Nematode examined appears to belong to the genus *Desmidocercella*, Yorke and Maplestone 1926 and is, therefore, probably related to the genus *Desmidocerca*, Skrjabin 1916. The following table, however, throws it into the genus *Desmidocercella*, Yorke and Maplestone 1926 :—

	Length of Oesophagus	Situation of Vulva	Genital Papillae	Structure of hinder end
<i>Desmidocerca</i>	2/3 the length of the body	In hinder end	None	Short filiform processes.
Skrjabin 1915				
<i>Desmidocercella</i>	1/8-1/9 length of the body	Anterior	1 pair post-anal	Cuticular swellings
Yorke and Maplestone 1926				
Species under discussion	1/9 length of the body	Anterior	1 pair post-anal	Cuticular swellings.

The present species is, therefore, put in the genus *Desmidocercella* for which the generic diagnosis is as follows :—

Thelaziidae : body short ; mouth with two lateral trilobed lips, each bearing two pairs of large head papillae, the more lateral inserted at the base of the lips ; lateral areas broad ; lateral flanges present ; cervical papillae at the level of the nerve-ring ; vulva very short and infundibuliform ; oesophagus short ; one eighth to one ninth the length of the worm, and clearly divided into two parts.

Male : Posterior extremity blunt, tail short, bluntly rounded and bare at its tip ; caudal alae absent ; a pair of post-anal papillae immediately behind the cloaca ; spicules very unequal.

Female : Tail short, bluntly rounded, furnished with two small lateral subterminal cuticular swellings, vulva anterior, situated near the posterior end of the oesophagus ; amphidelphys.

Parasites of the air-sacs of aquatic birds. (After Yorke and Maplestone²⁰).

Desmidocercella numidica is the type-species of this genus described from an unnamed Heron. It was formerly included in the genus *Desmidocerca*, Skrjabin 1916, for which the type-species is *D. aërophila*, Skrjabin 1916, collected from the air-sacs of *Ardea cinerea*. Yorke and Maplestone separated the then *D. numidica* from this genus and erected the genus *Desmidocercella* to contain this species. Solonotzin²² later added a new species *D. incognita* from the air sacs of the pheasant *Phalacrocorax carbo*.

The present species differs from *Desmidocercella numidica*, Seurat 1920, in the following points :—

- (i) The lips are not subdivided into three lobes and bear one pair of head papillae.
- (ii) There are no cervical papillae at the level of the nerve-ring.
- (iii) There are no lateral flanges.
- (iv) Both the male and female possess the subterminal cuticular patches.
- (v) The presence of the chitinous buttresses of the vestibule at the anterior region.

It agrees, however, with it in the fact that :—

- (i) The oesophagus is one ninth the length of the Nematode.
- (ii) The vestibule is infundibuliform.
- (iii) The oesophagus is in two portions, an anterior muscular portion and a posterior glandular portion.
- (iv) The body is bluntly rounded at both extremities in both the male and the female.
- (v) The vulva is situated at the anterior oesophageal region.
- (vi) The female genital organs are amphidelphic in disposition.
- (vii) There are two post-anal papillae, one on either side, immediately behind the cloacal aperture, and the spicules are very unequal.

It differs also from *D. incognita* by the fact that in *D. incognita* :—

- (i) there are four pairs anal papillae, two pairs pre-anal and two pairs post-anal.
- (ii) the vulva is the posterior half of the body.
- (iii) the sizes and shapes of the spicules differ from those of the present species.
- (iv) the cuticular swellings of the female are beset with spiny hairs.

On the grounds of these differences the present species appears to be a type which has not yet been described. This species is, therefore, named *Desmidocercella kwalimanzi*, (*Nov. sp.*), kwalimanzi being the common name of *Ardea melanocephala* in these areas.

REVISION OF THE DIAGNOSIS OF THE GENUS DESMIDOCERCELLA

Solonotzin²¹ suggests that the diagnostic features of the genus *Desmidocercella*, Yorke and Maplestone, 1926, should be modified in such a way that the differences which are specific should not be mentioned. At present such differences appear in the diagnosis for the genus, a situation due to the fact that since its erection from *Desmidocercella numidica*, the genus has, in spite of addition of other species, never been revised to be sufficiently accommodative of these different but closely affined forms. So for instance :—

- (i) The presence of a cervical papilla at the level of the nerve-ring is only confined to the type of the genus and is not recorded from the other known types.
- (ii) The presence of lateral flanges also at the anterior end is another such character which does not appear to be of generic import—but is a specific divergence.
- (iii) Also the diagnosis by the exact topography of the vulva as anterior, whereas in *D. incognita*, the same organ is disposed posteriorly—and this latter specimen is without doubt closely related to *D. numidica*. The exact locality of the vulva would, therefore, appear to be of no taxonomic significance in this group.
- (iv) The number of post-anal papillae for the genus is defined as a single pair and allowance is not made for the presence of any pre-anal papillae. This again, however, appears to be too inconstant a feature to warrant its mention as a generic character.

The up-shot of such an appraisal seems to suggest the revision of the generic diagnosis of the genus *Desmidocercella* to read thus :—

The laziidae : body short ; mouth with two lips whole or sub-divided, each bearing one or two pairs of large head papillae ; vestibule well developed, and funnel shaped ; oesophagus one eighth to one ninth of the length of the worm, and in two parts.

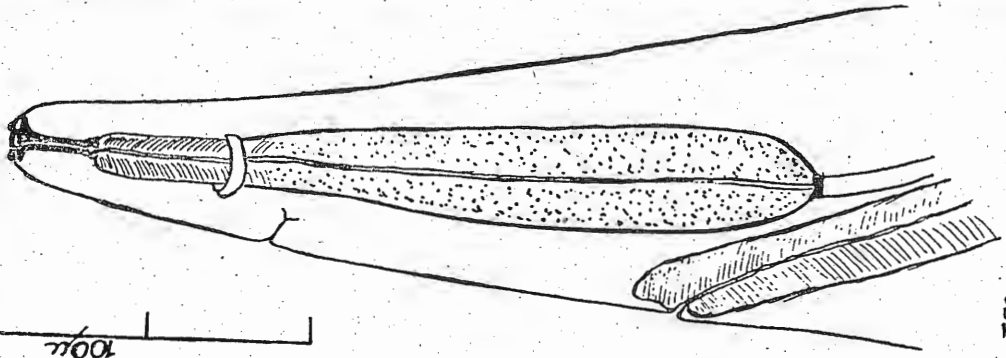
Female : tail short, bluntly rounded, furnished with two small, lateral, sub-terminal cuticular swellings ; position of vulva variable ; amphidelphys.

Male : posterior extremity bent ; tail short and bluntly rounded, with or without cuticular swellings post-anal papillae present and few in number, pre-anal papillae present or absent ; spicules unequal.

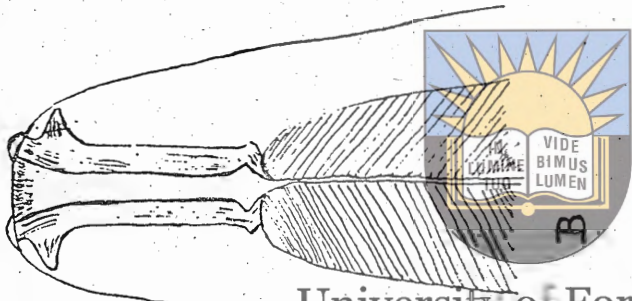
Parasites of the air-sacs of aquatic birds.



- A. — Posterior extremity of ♂ *D. kwalimanzi*, ♂.
- B. — Anterior extremity of *D. kwalimanzi* highly magnified.
- C. — Genital organs of *D. kwalimanzi*, ♀.
- D. — Anterior extremity of *D. kwalimanzi* ♀.



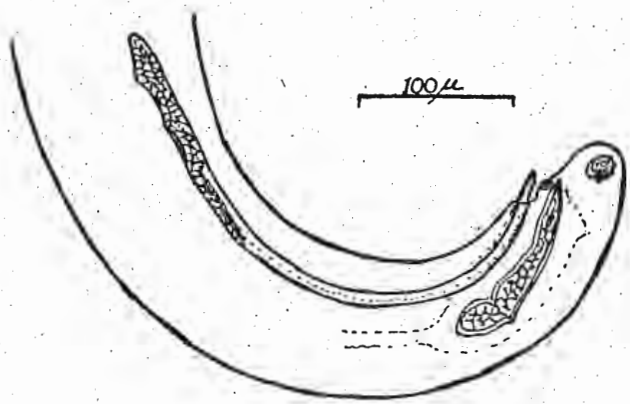
D



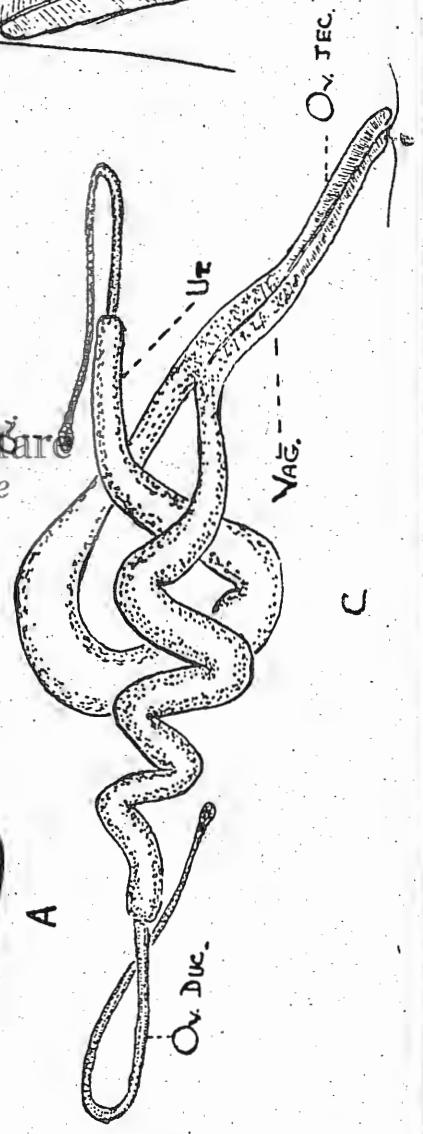
University of Fort Hare
Together in Excellence



50μ



A



C

CHAPTER IX.

TECHNIQUE

The host specimens after being shot were enclosed in a clean glass fumigating vessel, in which some Carbon bisulphide was introduced. The ectoparasites in this way died in situ and were then hand-picked. To collect more, the birds were defeathered on a white back-ground and then the parasites collected and preserved.

MALLOPHAGA : These are preserved in 70% alcohol. To make permanent preparations of the specimens the following procedure is adopted :—

The specimens are first heated in a 10% solution of potash in a test-tube for 10-15 minutes. After heating, the specimens are then transferred into distilled water and pricked with an entomological pin and then pressed with the head of the pin to expel the contents of the body that have not been washed out by the potash. The specimens are then dropped into 70% alcohol and passed up into 100% where they are left for 10-15 minutes. Bedford¹⁵ suggests the use of clove-oil as a clearing agent, but xylol mixed with terpineol in the proportion of xylol: clove oil :: 2: 1 was more satisfactory as clove-oil tended to contract the specimens severely. The specimens are then mounted in Canada balsam and examined by a microscope.

ACARINA : To preserve tannans in their natural colours, the prescription recommended by Mönnig for ticks has been adopted: A solution of 1% formaldehyde is shaken with a few drops of chloroform, more chloroform being added until saturation point is reached. The excess chloroform is then removed, and into the solution live ticks are placed and the tube is stoppered air-tight for 3 months.

The examination of adult specimens is done mostly by incident light reflected tangentially which helps to accentuate surface irregularities. Perpendicular lighting is sometimes employed.

Theiler suggests that larvae should be cleared in glycerine and studied under the microscope after making permanent mounts with gum arabic. It was found, however, that glycerine tended to disfigure the specimens, the same method used for lice being followed with the larvae.

For procuring internal parasites, the internal organs were carefully examined with the help of magnifiers. Some organs, e.g. lungs, kidney, and liver were thoroughly teased out after a general examination and examined in normal saline between pressed slides under a dissecting microscope.

The contents of the intestine after removal from the alimentary tract were agitated with distilled water in a stoppered flask, allowed to settle partially and then decanted, the mother liquor being examined with binoculars. The residual precipitate was further agitated by centrifuging in glycerine medium and then examined on a slide with a low-powered microscope. The same procedure was employed in examining the contents of the gall-bladder.

The intestine after removal of the faeces, and obvious parasites, was further cut into short lengths and examined with a hand lens, and the mucosa scraped off into a dish of water and then examined for smaller parasites against a dark back-ground.

To detect any Filarial Nemas blood-smears were made and treated with Jenner's solution or with the Leishman Romanowsky stain.

NEMATODA : These when found alive were first examined in Ringer's solution with a low-powered microscope. This type of examination was found to be very useful as the specimens tend to become extremely opaque after fixation. In this state the cuticle is very transparent and with the movement of the eggs in the case of the females the exact disposition of the genital ducts is rendered more easily discernible. The Nematodes are then fixed in hot 70% and then preserved in this medium with 5% glycerine.

In examining such material it is necessary to use a clearing medium. 50% glycerine, as usually recommended, was at first used but this was later abandoned as it had the disadvantage of disfiguring the specimen though it did the clearing thoroughly. Langeron's lactophenol was then used, and al-

though this cleared the specimens well the details of the spicules in the male, and the disposition of the ovijector in the female could not be discerned. To render them more evident, beech-wood creosote was tried with great success. In using this the specimens are first transferred into 95% alcohol for 2-3 days to allow for a thorough penetration of this alcohol after which they are then transferred into the creosote. When clear they are then examined free on a slide by a low-powered microscope, and then when necessary rolled under a cover-slip on a slide.

After examination the creosote must be removed from the specimens as they tend to become very dark in colour if returned into the alcohol without removal of the creosotum. This is avoided by immersing the parasites in 2% acid alcohol (70%) solution for at least 8 hours after which they are transferred into the preserving-medium.

In cases where certain details of internal anatomy were not observed, the Nematodes were opened out by means of needles and then rolled under a cover slip, on a slide.

All the measurements except that of the length of the Nemas were taken with the help of an ocular micrometer, the value of each of whose divisions had been previously calabrated. In the study of Nematodes great attention is attached to the relative lengths and widths of various parts of the entire animal. Two system of measuring Nemas, those of Cobb and de Man are in use. Cobb's system was followed.

In Cobb's system the measurements are from the anterior end to a given point and the width at each point is measured. Then the results, each as a percentage of the body length, are tabulated in two rows, the length above, the widths below, the body length itself at the end in millimetres. The measurements are obtained by making a scale-drawing with a camera-lucida, giving the long axis as a line and the widths at the various points as short cross-lines.

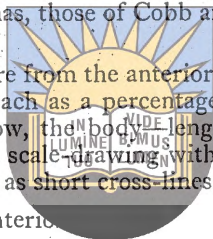
The lengths measured are from the anterior

- (i) To the base of the pharynx or vestibule.
- (ii) To the end of the oesophageal gullet.
- (iii) To the vulva in females and the uterus in males.
- (iv) To the anus.

TREMATODA : These were first examined alive in normal saline and then fixed in Zenker's fluid in which they are left for 24 hours and then finally washed in running water. The fixed specimens are then preserved in 70% alcohol with 5% glycerine.

Toto-mounts were made using Borax carmine, Delafield's haematoxylin, and Ehrlich's acid haematoxylin.

For detailed anatomical study the material was embedded in paraffin wax and sectioned; the best sections were found to be 10 microns in thickness. These were stained with haematoxylin and counter-stained with eosin in 90% alcohol. From such sections the detailed anatomy was then followed by reconstructon.



University of Fort Hare
Together in Excellence

REFERENCES

1. Starke and Sclater. *The fauna of South Africa. Vol. IV.* pp. 61-62, 1906.
2. Ortlepp, R. J. On the metacercaria and adult of *Clinistomum v.d. horsti* (Sp. Nov.) A trematode parasite of Fishes and Herons.
Onderstepoort Jnl. Vet. Sci. and Anim. Ind. Vol. 5, No. 1, pp. 51-58, 1935
3. Roberts, A. *The Birds of South Africa.* pp. 20, 1940.
4. Cram, E. B. Bird Parasites of the Nematode sub-Orders Strongylata, Ascaridata and Spirurata.
Proc. U.S. Nat. Mus. Bulletin 140, 1927.
5. Bedford, G. A. H. *18th Rep. of Dir. of Vet. Serv. and Anim. Ind. Part I,* pp. 500, pps. 275-279, 1932.
6. Bedford, G. A. H. Notes on Menoponidae with Description of New Genera and Species.
Onderstepoort. Jnl. Vet. Sci. and Anim. Ind. Vol. 12, No. 1. pp. 121-122; pp. 139-147, 1939.
7. Viana, L. Tentativa de Catalogacao das Especies Brasileiras de Tremadeos Reimpresso.
Memorias do Instituto Oswaldo Cruz. Tomo XVII. Fac. I., 1924.
8. Fuhrmann, O. Les Taenias des Oiseaux.
Memoires de l'Universitié de Neuchatel. Tome Huitieme, 1932.
9. Davidson, J. *Parasitology VI.* pp. 217-256, 1914.
10. Clay, T. *P.Z.S. par III,* pp. 614-615,
11. Robinson, E. *Parasitology VI (i),* pp. 20-48, 1913.
12. Hindle and Merriman. *Parasitology V,* pp. 203-216, 1935.
13. Hindle and Cunliffe. *Parasitology VII,* 1914.
14. Nuttall, G. H. F. *Parasitology XII,* 1920.
15. Patton and Cragg. *A Text-book of Medical Entomology—*1913.
16. Lounsbury, C. P. The Fowl-tick, its life-cycle and habits.
Agric. Jnl. Cape of Good Hope, XXIII, 1903. pp. 264.
17. Dietz, E. *Die Echinostominden der Vogel.* pp. 423-426, 1910.
18. Travassos L. Informacoes sobre a fauna helminthologica de Matto Grosso.
A. Folha Med. Ann. III, No. 24. pp. 187-190, 1922.
19. Baer, J. G. Description of a new genus of Lepodermatidae with a systematic essay on the family.
Reprint from *Parasitology Vol. XVI., No. 11,* 1924.
20. Yorke, W. and Maplestone, P. A. *The Nematode parasites of Vertebrates.* pp. 316-326, 1926.
21. Seurat, L. G. Sur une filaire due Heron cendre. *Bull. Soc. Hist. Nat. Afr. Nord. Vol. II,* pp. 142, 1920.
22. Solonotzin. Zentralblakt fur. Bakt. Para und Infekt. *Eerste abt. Band 124. Orig.* pp. 363-365, 1932.
23. Lapage, G. *Nematodes parasitic in Animals.* pp. 87-95, 1937.