

Some Helminths of South African Lizards.*

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INTRODUCTION.

THE material forming the basis of this work was obtained from lizards, chiefly from the Wellington district. The collection also includes material from Tulbagh, Stellenbosch and Namaqualand. The original idea was to study the variations (if any) in the prevalency shown by the parasites throughout the entire year. The time factor did not, however, allow for this being carried out in its entirety, and collecting was only carried out systematically during the winter months of 1935.

Each lizard was carefully examined with a view to finding out if the parasites showed any organ specificity. Also, since but little is as yet known of the development of lacertilian parasitic helminths, special attention was paid to possible migratory forms. With this in view blood smears were taken, lungs were examined between two slides and the peritoneum and body muscles were also inspected.

The findings unfortunately were disappointing. This may be due to the fact that investigation was carried out during the winter months, when in all probability reproduction of the parasite, and hence infection of the host is at its lowest. No larvae or microfilaria were found in the heart or circulatory system, and in only two separate instances was one minute larva found in the lungs. At no stage was anything found in the body musculature.

Throughout the seven months during which the lizards were dissected, minute larvae were found occasionally coiled up, in the submucosa of the rectum, without, however, forming any cysts. More definite cysts, varying in size were, however, found,

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especially in *Agama atra*, in all the layers of the stomach wall, even extending into the connective tissue of the liver. The chances of finding different developmental stages in these cysts were apparently the same as between March and September. These cystic forms were not studied in detail, but upon a cursory glance appear to be *Physaloptera*. The rectal forms were not far enough advanced to show any diagnostic characters. (A fairly large percentage of the *Agama atra*'s showed an *Eimera* infection of the gall-bladder.)

The helminth parasites of lizards in South Africa do not seem to have received much attention. Tortoises, and to a lesser extent, snakes seem to have come in for a larger amount of investigation. Although Fuhrmann, Ortlepp and Baer have described worms collected at odd times from some odd individuals, the helminth fauna of South African lizards has not yet received the same amount of attention as that in other parts. Thus e.g. in this work for the first time members of the genera *Paradistomum* (TREMATODA), *Pharyngodon* and *Thelandros* (NEMATODA) are recorded from South African lizards. Thus far, however, no representatives of the genera *Tachygonetria*, *Atractis*, *Veversia*, *Oswaldocruzia*, *Ganguleterakis* and *Skrjabinelazia* have as yet been recorded from South African lacertilia.

The lizards collected seemed to be fairly heavily infected and none of the species found had been recorded before, although all belonged to previously described genera. New species of the following genera were obtained: *Paradistomum* (TREMATODA); *Oochoristica* (CESTODA); *Pharyngodon*, *Thelandros* and *Thubunaea* (NEMATODA). All these genera have been considered in detail, and in most cases it was found necessary to somewhat amend the existing generic diagnosis, so as to include variations which have been described since the formation of the generic diagnosis. This was especially the case with *Paradistomum*, *Pharyngodon*, and to a lesser extent with *Thelandros*. The genus *Thubunaea* does not seem to offer very constant generic diagnostic characteristics, and it was deemed advisable to consider this genus for the present as *sensu lato* rather than *sensu stricto*.

The species obtained show the following prevalency:

Species.	Host.	No. examined.	No. infected.	Infection %.
<i>Paradistomum zonuri</i>	<i>Zonurus cordylus</i>	Young: 5 Adult: 40	— 22	— 55
<i>Pharyngodon mabuiensis</i> ..	<i>Mabuia trivittata</i>	12	3	25
<i>Thelandros rotundus</i>	<i>Agama atra</i>	Young: 31 Adult: 74	15 67	48 91
	<i>Pseudocordylus microlepidotus</i>	1	1	—
<i>Thubunaea impar</i>	<i>Zonurus cordylus</i>	Young: 5 Adult: 40	1 10	20 25
<i>Oochoristica africana</i>	<i>Agama hispida</i>	18	5	28
<i>Do. var. ookiepensis</i>	<i>Scaptira knozi</i>	3	1	33

The parasites on the whole showed a high host-specificity—*Agama atra* and *Zonurus cordylus*, although collected from the same spot, each had its own specific fauna, viz. *Paradistomum* and *Thubunaea* for *Zonurus* and *Thelandros* and *Physaloptera* for *A. atra*. However, out of 105 *Agama atra*, one was found which harboured two immature forms of *Thubunaea*; this evidently was a case of aberrancy. Also the one *Pseudocordylus* examined contained some *Thelandros rotundus*, which is essentially the typical parasite for *A. atra*.

CLASS TREMATODA.

FAMILY DICROELIDAE.

SUB-FAMILY DICROCOELIINAE.

Genus PARADISTOMUM, (Kossack, 1910), Dollfus, 1922.

DICROCOELIINAE with body relatively wide, testes irregularly globular: separated from one another in all directions in the sagittal plane, more or less symmetrical and near to the ventral sucker, separated by the coils of the uterus. Vitellaria formed by a small number of relatively large follicles, not extending anteriorly beyond the testes, usually only commencing behind the level of the testes; intestinal caeca wide rather than slender or narrow.

For discussion on this generic diagnosis, see page 36.

Type species: *P. Rabusculum*, Kossack, 1910.

Paradistomum zónuri. n. sp.

The material examined was collected from the gall-bladder of *Zonurus cordylus* var. *flavus*, 22 out of 45 specimens examined were infected, the infection varying from as few as 3 relatively large parasites to 18 much smaller ones. Also one *Z. cordylus* var. *niger* was examined, whose gall-bladder contained 11 small worms, which proved to be the same as those from *Z. cordylus* var. *flavus*.

The worms are small, transparent and generally broadly oval. No spines were discernible. In the living specimens the posterior extremity was found to be very contractile, so that in extreme cases of protrusion the shape of the worm changed from a broadly oval form to a more narrow and elongate one. They show a large variation in size, varying from 2.40 to 5.7 mm. in length, with a maximum breadth of 1.36 to 3.8 mm., which is attained at about the middle of the body. The cuticle is delicate and smooth. The mouth and oral sucker are subterminal. The latter measures 373–591 μ laterally and 337–546 μ antero-posteriorly. The circular ventral sucker is situated medially, approximately on the level with the testes and measures 319–380 μ in diameter. It does not show up very well in the stained specimens but is seen more readily in the living specimens and in those mounted in glycerine jelly.

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The pharynx, which is globular and muscular, varies from 104 to 168 μ in diameter, and extends into the mouth completely (as in Fig. 2.) or partly (as in Fig. 1). The oesophagus is narrow and relatively short. The intestinal caeca are simple and broad and pass posteriorly along the sides of the body, extending nearly to the posterior end of the worm. The muscular excretory pore is at the posterior end of the body and leads into a fusiform excretory bladder. As mentioned above the posterior end of the body is contractible and can be protruded (vide Fig. 1).

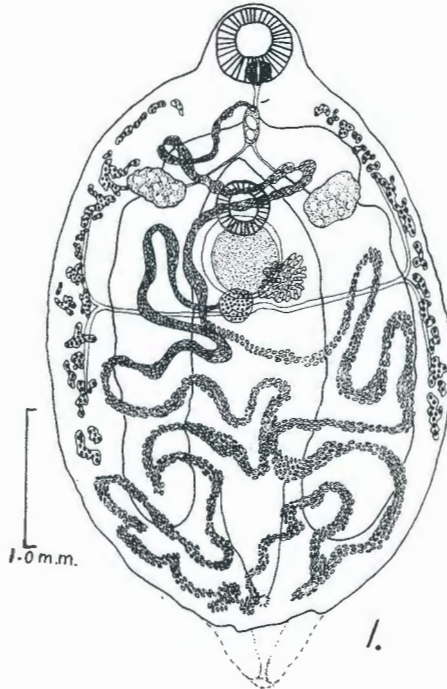


Fig. 1.—*Paradistomum zonuri* n. sp., ventral view.

The male genitalia comprise two testes, situated at a level slightly anterior to the ventral sucker. They are approximately equal in size and have their outlines irregular in preserved specimens. Due to large variations in size of the worms, the size of the testes varies largely, from 137–364 $\mu \times$ 228–546 μ . The vasa deferentia do not unite until just before entering into the cirrus sac, which latter varies from 200 to 409 μ in length; its position anteriorly extends from the ventral end of the pharynx to just very slightly overlapping the posterior border of the horizontal portion of the intestine. As seen from the figures its posterior end thus ends much anterior to the ventral sucker. The cirrus sac includes a vesicula seminalis, which is followed by a muscular cirrus capable of extrusion. The genital opening is situated ventrally to the oesophagus.

The female genitalia comprise a more or less circular ovary, 318–636 μ in diameter, situated just posterior to the acetabulum, medially or somewhat laterally to either side; a relatively small spherical ootype usually somewhat posterior to the ovary and a large irregularly lobed shell-gland, situated somewhat anterior to the ovary. The ovary is approximately twice the size of the shell-gland and the latter again approximately twice the size of the ootype. The receptaculum seminis and Laurer's canal were not seen either in the entire specimens, or in the serial sections.

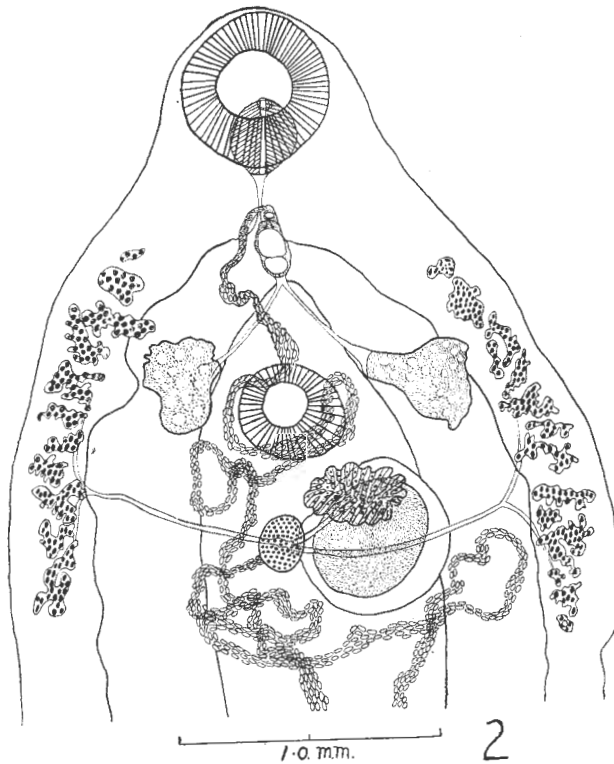


Fig. 2.—*P. zonuri* n. sp., ventral view anterior end.

The uterus with numerous transverse coils fills up the posterior part of the body, being disposed into an antero-posterior loop folded transversely, and some transverse loops anterior to the ovary. The eggs, which are thick and elliptical in shape are very numerous, are light in colour in the posterior loops. They are operculated at the one end and measure 24–28 $\mu \times$ 40–44 μ .

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The vitellaria consist of somewhat irregularly shaped follicles, relatively small, lying symmetrically along the sides of the body, external to the intestinal caeca; they extend from the level of the horizontal portion of the intestine to slightly beyond the posterior level of the ovary (Fig. 2) or as far back as the posterior third of the body (Fig. 1). The transverse vitelline ducts meet in the middle of the body, usually near the ootype, and is joined at this junction by a duct from the shell-gland.

Discussion: According to G. D. Bhalerao, 1929, the genus *Paradistomum* is divisible into two natural groups:—

(1) In which the cirrus sac reaches or partly over-laps the ventral sucker; in this group he included *P. (Distomum) mutabile*, (Molin, 1859), Travassos, 1919, *P. rabusculum*, Kossack, 1910; *P. (Eurytrema) crucifer*, (Nicoll, 1914), Travassos, 1919, and *P. (Paragonimus) trachysauri*, (MacCallum, 1921), Dollfus, 1922.

To this group should also be added *P. (Mesocoelium) sokolowi*, (Skrjabin, 1916), Travassos, 1919, whose description was overlooked by Bhalerao, and the recently described *P. excalotes*, Tubangui and Masilungan, 1935.

Although Bhalerao included *P. trachysauri* in this group it is evident from MacCallum's figure that the cirrus sac does not reach nor overlap the ventral sucker. MacCallum in his description does not mention its position. Similarly for *P. crucifer*, Nicoll, although he figures the cirrus sac as practically touching the ventral sucker, definitely states in his description that the cirrus sac does not reach the ventral sucker, so that *P. trachysauri*, MacCallum, 1921, and *P. crucifer*, Nicoll, 1914, cannot be included here.

The species, which are included in this group compare as regards their measurements, general structure and arrangement of organs as follows:—

TABLE I.
(All measurements in millimetres.)

	<i>P. mutabile</i> . ^{*,†}	<i>P. rabusculum</i> .	<i>P. sokolovi</i> .	<i>P. ercalotea</i> .
Shape of body.....	Broad, blunt at posterior end tapers anteriorly. (How- ever very variable.)	Roughly oval, widest part not far from posterior extremity.	Flat linguiform, narrowing towards hind end.	Ovoid, broader posteriorly than anteriorly.
Length.....	i. 3.58 — 3.84 ii. 1.5	1.53 — 1.73	3.7 — 4.34	1.1 — 1.8
Maximum breadth.....	i. 2.43 — 2.5 ii. 0.735	0.72 — 0.76	1.36 — 1.70	0.44 — 0.80
Where attained.....	Little behind centre of body	In posterior quarter	—	Posterior third.
Cuticle.....	Delicate and smooth.	Thin cuticle without spines.	Covered with small scale- like spines.	Smooth.
Oral sucker.....	i. 0.5 × 0.475 ii. 0.28	0.29 — 0.31	0.4 — 0.45	0.15 — 0.20 × 0.14 — 0.21
Ventral sucker.....	i. 0.7 ii. Slightly larger than oral	0.27 — 0.28	0.225 — 0.29 × 0.29 — 0.32	0.17 — 0.20
Position.....	Centrally, about $\frac{1}{4}$ distance of body from anterior end.	Anterior edge just reaching or slightly overlapping pos- terior margin of intestine	On borders of 1st and 2nd quarters of body length.	Between ant. and middle thirds, not overlapping caeca.
Pharynx. (diam.).....	i. 0.16 ii. 0.077	0.090 — 0.11	0.17 — 0.20	0.070 — 0.075 × 0.55 — 0.080
Structure and shape.....	Globular and muscular.	Rounded.	Spherical.	Spherical.
Oesophagus.....	Short.	Short and slightly coiled, 0.04 — 0.06	Absent.	0.07 — 0.11.
Intestinal caeca.....	Broad and end slightly in front of posterior end of body.	Very wide, stops 0.21 — 0.23 from posterior end of body.	Wide and reach hind end of body.	Wide, and extend to within 0.06 — 0.10 from post. end.

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TABLE 1 (continued).

	<i>P. mutabile</i> . ^{*2} .	<i>P. rabusculum</i> .	<i>P. sokolovi</i> .	<i>P. excalotes</i> .
Excretory pore and apparatus	At posterior end of body, leading into a fusiform bladder.	Ends terminally, is elongated and reaches anteriorly into region of shell gland.	—	Median, postero-dorsal, bladder voluminous, into 2 small branches behind shell gland.
Testes.....	i. 0.42 — 0.47 × 0.33 — 0.375 ii. 0.210 — 0.217	0.20 × 0.25	—	0.11 — 0.17 × 0.09 — 0.12
Position relative to ventral sucker.	Symmetrically on postero-lateral side of sucker.	Symmetrically posteriorly on either side, reaching to about middle of sucker.	On both sides of sucker somewhat posterior to it and project with lateral margins beyond those of intestine.	Symmetrically postacetabular, antovarial.
Shape.....	Rounded in living but irregular in preserved specimens.	Irregular in outline.	Irregularly oval and slightly lobed.	Oval to subglobular, smooth with sometimes indented margins.
Cirrus sac.....	i. 0.34 ii. 0.25	0.2 × 0.07	—	0.19 — 0.23 × 0.055 — 0.065
Position.....	From pharynx to slightly behind anterior border of ventral sucker.	From pharynx to apparently middle of ventral sucker.	In space between pharynx and ventral sucker, its posterior edge being dorsal to sucker.	From intestinal bifurcation to ant. border of acetabulum.
Genital aperture.....	On ventral side of pharynx..	Ventrally at posterior margin of pharynx.	Medially, anterior to ventral sucker.	Median, ventral to oesophagus.
Ovary.....	i. — ii. 0.098	—	Considerably smaller than testes.	0.10 — 0.11 × 0.14 — 0.16
Position.....	Posterior to testes, slightly to right side.	Immediately behind testes, slightly to one side.	Adjoins on posterior border of interior edge of left testis.	Immediately behind testes, to one side.
Shape.....	Varies considerably, from transversely elongated to irregularly lobed.	—	Irregularly round.	Transversely oval, may be slightly indented.

TABLE I (continued).

	<i>P. mutabile</i> *2.	<i>P. rabuscatum</i> .	<i>P. sokolovi</i> .	<i>P. ercolotes</i> .
Shell-gland.....	Centrally, slightly posterior to ovary.	Next to ovary, slightly posteriorly.	Not mentioned.	Smaller than or as large as ovary.
Laurer's canal and Receptaculum seminis	Both present.	R. seminis dorsal to ovary.	Not mentioned.	Both present.
Vitellaria.....	Confined to middle third of body.	Weakly developed, slightly posterior to mid-line, external to caeca, composed of few large follicles.	Begin at level of posterior edge of testes and reach border of third and hinder quarters of body. Consist of large No. of small follicles.	Moderately numerous follicles, external to caeca, from ant. level of testes to last $\frac{1}{4}$ of body.
Ova (in μ).....	i. 31 - 44 \times 19 - 24 ii. 40 \times 24	49 \times 28	32 \times 19	32.5 - 38.5 \times 21 - 23
Habitat.....	Liver.	Cysts in liver.	Intestine.	Gall bladder.
Host.....	<i>Acanthosaurus major</i> . <i>Ascalobotes mauritanicus</i> . <i>Lacerta muralis</i> . <i>Lacerta agilis</i> .	<i>Gymnodactylis geckoides</i> .	Chameleon.	<i>Catolotes calotes marmoratus</i> .

*2.—In *P. mutabile* the measurements given first in each case are according to Bhalerao, 1929, who evidently had larger specimens than Dollfus, 1932, whose measurements are given second. The details as to general structure and arrangement of organs are taken from Bhalerao.

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2. The group in which the cirrus sac ends much anterior to the ventral sucker. Examples:—

P. gregarinum, Tubangui 1929 (syn. *P. magnum* Tubangui 1928).

P. geckonum, Bhalerao 1929, and provisionally,

P. ceratophrae, (Looss 1908), Dollfus 1923.

Bhalerao 1936 added,

P. (Dicrocoelium) orientalis } Narain and Das 1929,

P. (Dicrocoelium) indicum }

P. paloensis, Tubangui 1933, and

P. moghei, Bhalerao 1936.

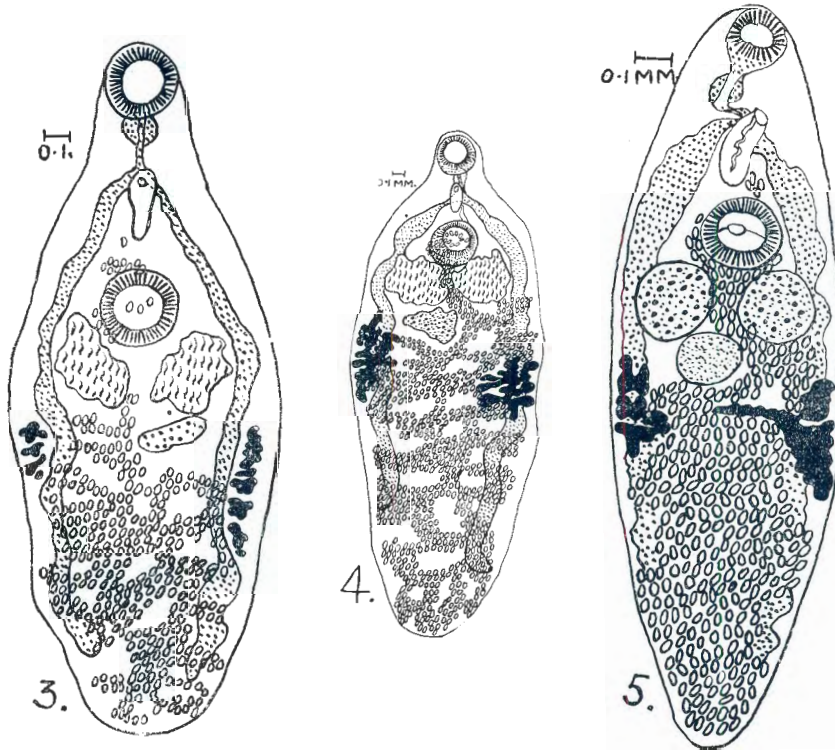


Fig. 3.—*P. parvissimum*—(After Travassos 1919).

Fig. 4.—*P. magnum*—(After Travassos 1919).

Fig. 5.—*P. lutzi*—(After Travassos 1919).

Bhalerao further remarked on the position of *P. ceratophrae* (Fig. 6 and 7), the name given provisionally by Dollfus 1923 to the distomid which Looss 1908 had figured but due to badly preserved condition had not identified. This parasite had been named *P. lanka* by Fernando, 1923, on giving a fuller description of what he was quite satisfied was the same parasite as that figured by Looss. (In the same region of the same host from the same locality). Since this quite naturally is contrary to the International code of Zoological Nomenclature, Bhalerao retained *P. ceratophrae*, so that *P. lanka* goes into synonymy.

The description of *P. parvissimum*, Travassos 1918 was not accessible to Bhalerao in India. Nor have I been able to obtain a description of it, but from a drawing (Fig. 3) given by Travassos, 1919, it is evident, since cirrus sac does not reach the ventral sucker, that it falls into the second group.

P. magnum (Fig. 4) and *P. lutzi* (Fig. 5) described and figured by Travassos, 1919, also fall into the second group, together with *P. trachysauri* and *P. crucifer*, which latter had been put into the first group by Bhalerao, and *P. zouuri*, n. sp.



Fig. 6.—*P. ceratophorae*—(Syn. *P. lanka*, after Fernando 1932).

Fig. 7.—*P. ceratophorae*—(After Looss 1908).

Dollfus, 1922, in considering *Dicrocoelium lanceolatum* (syn. *D. dendriticum*) as regards the shape of the body, the position and the form of the testes and of the ovary, and the extent and disposition of the vitellaria finds inter alia a considerable range of variations and combinations of variations as regards the testes. They may be placed obliquely to one another, symmetrically or in tandem. Further as regards shape they may be globular or elliptical, with the margins either entire, or partly entire and partly lobed or completely lobed. In another paper of his, 1922, he also discusses *Paradistomum mutabile* as regards external appearance, which he says, as the name implies, is particularly variable, depending on the amount of contraction and extension undergone. The maximum breadth, he finds, is thus not always at the same level, sometimes in front of and at other times behind the posterior third of the body. Similarly for the testes in *P. mutabile*, he finds that they also are variable as to size, shape and position, so that they may be in front of the posterior margin of the acetabulum, but usually partially posterior to the level of the posterior margin, but never entirely posterior to the acetabulum.

TABLE FOR GROUP (2).
(All measurements in millimetres.)

	<i>P. maynam.</i>	<i>P. latzin.</i>	<i>P. gregarinum.</i>	<i>P. gregarinum</i> var. <i>Oroderminosum.</i>
Length.....	2.0 — 4.0	1.5 — 2.5	* i. 1.91 — 2.60 ii. 3.31	3.38
Maximum breadth.....	0.8 — 2.0	0.5 — 1.0	i. 1.40 — 1.63 ii. 1.27	1.35 — 1.78
Anterior sucker.....	0.31 — 0.33	0.2	i. 0.36 — 0.38 ii. 0.34	0.28
Ventral sucker.....	0.30	0.2	i. 0.43 — 0.45 ii. 0.285	0.34
Pharynx (diam.).....	—	0.1	i. 0.131 — 0.15 ii. 0.12	0.105 — 0.12
Cirrus sac.....	2.1	0.2	ii. 0.35 × 0.06	—
Position of Cirrus sac.....	From level of pharynx to some distance in front of ventral sucker.	Appears to open at base of oesophagus and extends posteriorly to short distance in front of ventral sucker.	From slightly anterior to intestinal fork to some distance in front of sucker	Ventral side of pharynx to some distance in front of sucker.
Ovary.....	Slightly lobed.	Subspherical.	Lobed.	Lobed.
Diameter.....	0.24	0.13	i. 0.13 — 0.20 ii. 0.225 — 0.24	0.19 — 0.39 × 0.17 — 0.19
Testes.....	0.4 — 0.42	0.26	i. 0.23 — 0.32 × 0.17 — 0.20 ii. 0.20 — 0.34 × 0.13 — 0.18	0.25 — 0.32 × 0.18 — 0.24
Position relative to acetabulum	Postero-laterally.	Postero-laterally.	Postero-laterally.	Postero-laterally.
Ova (in μ).....	48 × 26	35 — 42 × 24 — 28	i. 35 — 38 × 22 — 24 ii. 32 — 38 × 21 — 24	31 — 33 × 21 — 22
Habitat.....	Bile-duct.	Bile-duct.	Gall-bladder.	Gall-bladder.
Host.....	<i>Philodryas scoti.</i>	<i>Lachesis lanceolatus.</i>	<i>Hemilactylus frenatus,</i> <i>H. gleadoni.</i>	<i>Mabuia dissimilis.</i>

* The first set of measurements given are according to Tubangui, 1928, and the second set according to Bhalerao.

TABLE FOR GROUP (2)—(continued).

	<i>P. geckonum.</i>	* <i>P. (Dicrocoelium) orientalis.</i>	<i>P. palbensis.</i>	<i>P. crucifer.</i>	<i>P. moghei.</i>
Length.....	2.0	5.0 — 5.5	4.75	0.7 — 0.8	2.3 — 2.7
Maximum breadth.....	0.085	2.5 — 3.0	2.43	0.35 — 0.40	0.65 — 0.75
Anterior sucker.....	0.32 × 0.30	0.39	0.38 × 0.48	0.18	0.22
Ventral sucker.....	0.22	0.44	0.44 × 0.48	0.15	0.24
Pharynx (diam.).....	0.125	0.10	0.16 × 0.20	0.04	0.075
Cirrus sac.....	—	—	0.40 × 0.12	—	0.205 × 0.1
Position.....	Dorsal side of pharynx to intestinal fork.	Ventral to intestine, from intestinal bifurcation to slightly overlapping latter.	From just behind pharynx to slightly overlapping posterior margin of intestine.	From just behind intestinal bifurcation to just in front of ventral sucker.	From intestinal bifurcation to short distance anterior to ventral sucker.
Ovary.....	Circular.	Rounded and feebly lobed.	Ovoid, with slightly indented surface.	Globular.	Slightly lobed.
Diameter.....	0.18	0.2	0.34 × 0.26	About same size as testes.	0.12 × 0.115
Testes.....	—	0.365	Right: 0.3 × 0.46 Left: 0.34 × 0.46	0.04	0.2 × 0.13
Position relative to acetabulum.	Postero-laterally.	Postero-laterally.	Postero-laterally.	On each side of posterior half of sucker.	Postero-laterally.
Ova (in μ).....	25 — 36 × 13 — 17	32.95 × 32.90	33 — 37 × 25	30 — 33 × 21	38 — 41 × 26 — 27
Habitat.....	Intestine.	Gall-bladder.	Gall-bladder.	Gall-bladder.	Liver Encapsuled ?
Host.....	<i>Gecko verticillatus.</i>	<i>Calotes versicolor</i> , <i>Hemidactylus flaviviridis.</i>	<i>Hydrosaurus postulosus.</i>	<i>Delma fraseri</i> (slow-worm).	<i>Calotes versicolor.</i>

* For discussion see page 37, as also for *D. indica*.

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TABLE FOR GROUP (2)—(continued).

	<i>P. trachysauri</i> .	* <i>Cephalogonimus trachysauri</i> .	<i>P. Ceratophorae</i> syn. <i>P. P. lanka</i> .	<i>P. zonari</i> .
Length.....	5.0	3.0	2.8	2.4 — 5.7
Maximum breadth.....	2.0	0.70	1.8	1.36 — 1.78
Anterior sucker.....	—	0.32	0.45	0.337 — 0.546 × 0.373 — 0.591
Ventral sucker.....	—	0.328	0.38	0.319 — 0.380
Pharynx (diam.).....	—	—	0.18	0.104 — 0.168
Cirrus sac.....	—	—	0.2 × 0.12	0.20 × 0.459
Position.....	Dorsal to caeca not overlapping the margins.	Indicated as being situated laterally at level of intestinal bifurcation.	Ventral to pharynx.	Ventral side of pharynx to slightly overlapping posterior margin of caeca.
Ovary.....	Circular.	Circular.	Irregular and lobed.	Circular.
Diameter.....	0.2	0.280	0.4	0.318 — 0.636
Testes.....	0.15	0.20	Right : 0.38 Left : 0.5 × 0.45	0.228 — 0.546 × 0.18 — 0.24
Position relative to acetabulum	Opposite, i.e. on level with.	On level, slightly anterior.	Asymmetrical in position, rt. one reaching to anterior level, lt. one to posterior level of sucker.	On level, slightly anterior.
Ova (in μ).....	50 × 20	40 × 20	40 — 44 × 20 — 28	40 — 44 × 24 — 28
Habitat.....	Gall-bladder.	Gall-bladder.	Gall-bladder.	Gall-bladder.
Host.....	<i>Trachysaurus rugosus</i> .	<i>Trachysaurus rugosus</i> .	<i>Ceratophora stoddarti</i> .	<i>Zonurus cordylus</i> .

* See page 36 for discussion on *Cephalogonimus trachysauri*.

In connection with variation in the shape of the body, disposition of organs, etc., it may here be noted that *P. crucifer* is apparently an atypical member of the genus *Paradistomum*, in that the body is relatively wider and plumper, the suckers larger and the genitalia much more posterior than in any of the other members of the genus.

Dollfus also finds a large variation as regards the size, shape and extent of the vitellaria in *P. mutabile*. This question of the vitellaria seems to be important, and I thus deem it advisable to consider it in the different species of the genus *Paradistomum*.

In his generic diagnosis, Dollfus, 1922, described them as being formed of a small number of relatively large follicles, not extending anteriorly beyond the level of the testes, usually only commencing behind the level of the testes.

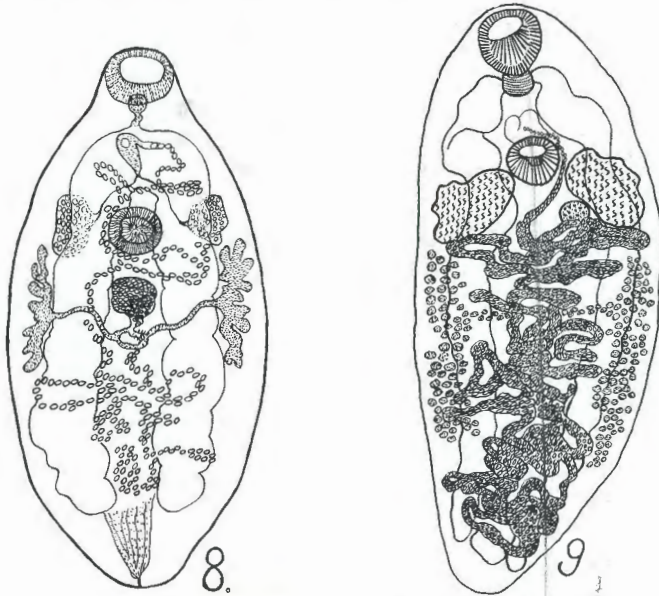


Fig. 8.—*P. trachysauri*—(After MacCallum 1921).

Fig. 9.—*P. sokoolowi*—(After Skrjabin 1916).

In *P. mutabile*, according to Dollfus, there may be up to a dozen follicles (Figs. 4 and 5, Dollfus) extending anteriorly to ventral sucker, or at other times only 3 to 6 follicles (Fig. 2, Dollfus) not extending anteriorly to the ventral sucker; with decrease in the number of follicles there is a corresponding increase in the size of the follicles, so that the follicles at their maximum size are much larger than those found in any of the other species. Dollfus' discussion includes *P. rabusculum*, *P. mutabile*, and *P. crucifer*.

In *P. magnum* (Fig. 4) and *P. lutzi* (Fig. 5) the vitellaria consist of a few relatively large follicles, tending to be on the whole smaller than those of *P. mutabile*, but likewise not extending anteriorly beyond the testes. In *P. trachysauri* (Fig. 8) the vitellaria tend to be compact and voluminous, a state of affairs

that is also met with in *P. crucifer*, and in *P. ceratophorae*, as figured by Fernando (Fig. 6). In this latter species, however, they tend to extend anteriorly beyond the testes (cf. Looss' figure). In *P. parvissimum* (Fig. 3) and *P. rabusculum* there are a relatively small number of medium sized follicles posterior to the testes, and, lastly, in *P. gregarinum*, *P. geckonum*, *P. orientalis*, *P. paloensis*, *P. excalotes* and *P. zonuri* we find that the follicles consist of a relatively large number of small to medium sized (e.g. *P. ceratophorae* as figured by Looss, Fig. 7) follicles, extending anteriorly beyond the level of the testes to as far as the genital pore in *P. ceratophorae* and *P. zonuri*. Posteriorly they extend as far back as slightly in front of the posterior end of the intestinal caeca e.g. *P. geckonum*. In *P. sokolowi* (Fig. 9) there are a very large number of small follicles, which, however, only commence behind the level of the testes.

Thus we find in the genus *Paradistomum* that the vitellaria vary from a small number of relatively large follicles, not extending anteriorly beyond the testes, to a large number of relatively small follicles, extending anteriorly beyond the testes. This variability of the vitellaria is also met with in the genus *Lyperosomum* Braun, 1902 and in the genus *Eurytrema* Looss, 1907. It is hence proposed that the generic diagnosis of the genus *Paradistomum* be further amended to include this range of variation. Fernando, 1932, also points out the inadequacy of Dollfus' diagnosis in respect of the vitellaria.

The *generic diagnosis* would thus be as follows:—

DICROCOELLINEAE with body relatively wide; testes irregularly globular, separated from one another in all directions in the sagittal plane, more or less symmetrical and near to the ventral sucker, separated by the coils of the uterus; vitellaria consisting either of a small number of relatively large follicles or of a larger number of relatively small follicles, which may extend anteriorly beyond the testes; intestinal caeca wide rather than slender or narrow.

Discussion on—

Cephalogonimus trachysauri.

MacCallum, 1921, described from the gall-bladder of *Trachysaurus rugosus*, besides *Paragonimus trachysauri*, a second trematode which he named *Cephalogonimus trachysauri*.

From a consideration of MacCallum's figure and description it is fairly evident that this worm is ruled out from the genus *Cephalogonimus*, on the position of the ovary and of the testes and the character of the uterus. This view was also expressed by Chandler, 1923, who excluded it from that genus and thought that it should be placed in a new one. This was followed up by Moghe, 1930, who excluded it from his key to the species of *Cephalogonimus*. Johnston, 1932, on comparing the worm with *P. trachysauri* states: "It will be noticed that the two are very similar and the general organography is practically the same. Apart from the difference in size, and especially in breadth, the main differences are the extension of the uterus beyond the ends of the intestine, the more

voluminous and more lobed crura, and the (probably) more forward position of the genital aperture. The species is obviously a *Paradistoma* and closely related to, it not identical with, the preceding species (i.e. *P. trachysauri*). In view of the differences noted, it is advisable to rename it as *P. maccallumi*, since the specific name is already preoccupied in the genus. Dollfus, 1922, has emphasised the variability occurring in *P. mutabile*."

While agreeing with Johnston, that the two worms are very similar and that the general organography is practically the same, I do not think that the differences he stresses are large enough to warrant the formation of a new species. The difference in respective sizes, especially in breadth between the two worms may be accounted for by the different amounts of contraction undergone; a narrowing of the body would at the same time account for the intestinal caeca in the "*Cephalogonimus*" being narrower and less lobulated than in the *Paragonimus*. The other difference i.e. the more forward position of the genital aperture is as Johnston states a 'probable' one, since MacCallum could not see the important terminations of the uterus and the cirrus sac, "though they disappeared behind the mouth and pharynx to terminate on the dorsal surface of the anterior end". Lastly, although the ova for his '*C. trachysauri*' measure $40 \times 20 \mu$ and those for *P. trachysauri* $50 \times 20 \mu$, it appears most likely that the worms differentiated by him as belonging to two separate genera are nevertheless identical in both generic and specific respects. Thus *Cephalogonimus trachysauri*, MacCallum, 1921 (nom. nov. *Paradistomum maccallumi*, Johnston, 1932) and *Paragonimus trachysauri* MacCallum, 1921, are identical, and hence *C. trachysauri* is to be considered as synonymous with *Paradistomum trachysauri*.

Discussion on—

Dicrocoelium orientalis, Narain and Das 1929 and

D. indicum, Narain and Das 1929.

Bhalerao 1936 included *D. indicum* and *D. orientalis*, Narain and Das 1929, in genus *Paradistomum*, since as he states both species appropriately belong here and not in genus *Dicrocoelium*.

While agreeing with him as regards position of the latter species on account of the wide intestinal caeca and structure of the vitellaria, I certainly do not as regards *D. indicum*.

Fernando 1932 also suggested that this parasite might belong to the genus *Paradistomum* but from a consideration of the description and figure it is evident that this species is a valid *Dicrocoelium* in that the vitellaria have the arcrescent structure—composed of widely separated follicles, which are connected by a narrow branching strand—typical for the genus *Dicrocoelium* and not the relatively compact vitellaria as found in the genus *Paradistomum*.

Further the worm has the narrow intestinal caeca and the elongate shape of *Dicrocoelium* as opposed to the wide intestinal caeca and more or less oval shape of *Paradistomum*.

In this connection it may be mentioned that in *P. parvissimum*, Travassos 1918 and 1919, *P. magnum* and *P. lutzi*, Travassos 1919, the intestinal caeca also tend to be rather narrower than is usual in the other species of *Paradistomum*, thus linking it with the genus *Dicrocoelium* and perhaps with the genus *Platynosomum*.

Since, however, the vitellaria consist of the compact follicles, typical for *Paradistomum*, the 3 species by Travassos can be taken as valid members of this genus.

From the general consideration of the three genera, *Paradistomum*, *Dicrocoelium* and *Platynosomum* it is seen that it is difficult to differentiate between them, and that the classification of the DICROCOELIINÆ is in need of revision.

Validity of P. Zonuri as a new species.

From a comparison of *P. zonuri* with the other species listed in Table 2, it is evident that it tends to agree most closely with *P. trachysauri*, *P. ceratophorae* and *P. crucifer* in the somewhat similar relative positions of testes and acetabulum; the other species listed in Group (2) can, since the testes in all are postero-lateral to the acetabulum, be taken as different from *P. zonuri*.

In *P. crucifer*, it is evident from Nicoll's figure that the testes are only on the same level as the posterior quarter of the sucker; the relative sizes of the sucker and testes being in the proportion of about 4:1, which is quite different from the state of affairs in *P. zonuri*; so that the comparison can be brought down to be one between *P. zonuri* on the one hand and *P. trachysauri* and *P. ceratophorae* on the other.

Although the relative positions of the testes and of the acetabulum agree in the two species, the posterior border of the testes in the new species tends to be slightly more anterior to the acetabulum. Further, from the figures it is clear that the position of the cirrus sac, the shape of the intestinal caeca, the structure and extent of the vitellaria, the size and the position of the ovary and the size of the ova ($50 \times 20 \mu$ for *P. trachysauri* and $40-44 \times 24-28 \mu$ for *P. zonuri*) easily differentiate these two species.

The measurements of *P. zonuri* and *P. ceratophorae* agree very closely, yet it is evident that the character of the vitellaria, the shape and position of the cirrus sac, the shape of the oesophagus, and of the ovary, and the somewhat different position of the testes relative to the acetabulum, easily distinguish the two species.

The worm thus described from *Zonurus cordylus* is proposed as a new species of the genus *Paradistomum*, namely *Paradistomum zonuri*.

Host: *Zonurus cordylus* var. *flavus* and var. *niger*.

Habitat: Gall-bladder.

Locality: Du Toit's Kloof, Wellington, C.P. and Jonker's Hoek, Stellenbosch, C.P.

Types in Onderstepoort Helminthological Collection.

CLASS CESTODA.

FAMILY ANOPILOCEPHALIDÆ.

SUBFAMILY LINSTOWINÆ.

Genus *Oochristica*, Luhe, 1898.

Definition: *Linstowinae* of medium size, adult segments often much longer than broad. Genital pores irregularly alternate; genital ducts between or dorsal to excretory vessels. Excretory system generally with secondary ramifications. Numerous testes, but may be less than 10; genitalia median. Uterus a transverse tube, which may ramify and resolve itself into egg capsules, with but one egg to each.

Oochristica Africana, n. sp.

A large number of these worms were collected from the small intestine of *Agama hispida*. The mature specimens i.e. specimens possessing egg capsules containing embryos, varied largely in length, from 11.8–42.0 mm. with a maximum width of 0.637–1.00 mm. The segments tend to be slightly wider at the genital pore, which in some is situated on a distinct prominence. The scolex measures 0.30–0.59 mm. across the suckers, the latter measuring 116–120 μ in length and 92–100 μ in breadth.

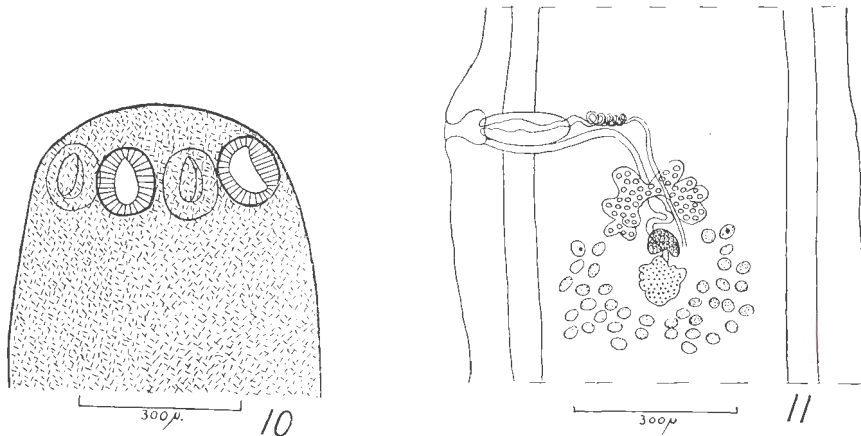


Fig. 10.—*Oochristica africana* n. sp.—scolex, dorsal view.

Fig. 11.—*O. africana* n. sp.—mature segment, ventral view.

The scolex (Fig. 10) is followed by an unsegmented portion as broad as the rest of the strobilus, which maintains a more or less uniform width throughout its entire length. The segments are somewhat indistinctly separated from one another, and are all, except the posterior ones, wider than long. The anterior ones are considerably longer than broad.

The excretory system represents the typical disposition of four winding vessels, two dorsal and two smaller ventral ones.

Although rudiments of the genital organs, or at least of their ducts appear far forward, mature segments only begin to appear later on, at about the twelfth segment in the smaller, and at the 25th. segment in the largest worm. There are about five segments with fully developed organs in the smaller, up to thirteen segments in the larger worms, before the appearance of the uterus. The latter rapidly obscures the other organs and these soon degenerate. The gravid segments number from one or two in the smaller worms, up to eight in the larger worms.

In the mature segments (Fig. 11) the ovary and the vitelline gland are the most conspicuous organs. The former is situated approximately in the centre of the segments, and consists of two lateral portions connected by a narrower bridge, and the whole, when fully developed, measures 0.18-0.20 mm. across at the widest part. The yolk gland is irregularly globular in shape and is smaller than the ovary. It lies immediately behind the latter. A small shellgland is situated between the ovary and the vitelline gland.

The testes number from 27-48, and occupy the posterior part of the segment, being situated posteriorly and extend somewhat laterally to the female glands. A few even extend as far forward as to lie on the level with the mid line of the ovary. The testes are mostly circular to somewhat oval in outline, being from 41 μ -46 μ in diameter.

The male and female ducts open at the base of a shallow muscular genital sinus. The sinus has a narrow distal portion and a wider proximal cavity, into which the cirrus can be seen protruding from the cirrus sac. The latter measures 0.100-0.126 mm. in length and extends past the excretory vessel. The vas deferens is coiled on its distal portion and proximally can be seen as far as the level of the shell gland. The vagina, which enters the genital sinus behind and somewhat ventrally to the cirrus sac, widens out into a receptaculum seminis just posterior to the ovary, and is seen to run backwards over the shellgland to the vitelline gland.

Out of 17 specimens that were stained and mounted only seven were found to have segments with fully developed ova, of which the outer membrane measures 71.3-75.9 μ , and the oncosphere 39.1-48.3 μ . The segments with these fully developed ova numbered only one or two to a worm, except in one exceptionally long worm, when they numbered eight.

Discussion: Fuhrmann, 1924, described *O. theileri* from the same host as the above. According to Meggit, 1934, *O. theileri* is synonymous with *O. (Taenia) trachysauri*, Maccallum, 1921; these two being the only species in the genus in which the testes are arranged in two isolated groups; further, the presence of cuticular spines lining the genital sinus, separates them from all others in the genus.

Johnston, 1932, found specimens in *Trachysaurus rugosus*, which he identified as *O. Trachysauri*. According to him, the testes are much more numerous and are not distributed into two groups, as indicated in the original description and drawings given

by Maccallum. This, together with the facts (a) that Maccallum indicates the cirrus sac as extending past the excretory canal, whereas in Johnston's specimens the opposite tends to be the case, and (b) larger measurements given by Johnston, differentiate Johnston's worm from Maccallum's *O. trachysauri*, unless the latter author was guilty of some errors of observation on points which are of acknowledged specific importance. Should, however, the worms described by Johnston actually be specimens of *O. trachysauri*, it is evident that then a synonymy can hardly be said to exist between it and *O. theileri*.

In *O. africana* n. sp. the testes were not found in two isolated groups, but in a continuous band. An immature segment in one specimen showed the testes in two not very widely separated groups, but this was the only segment with this arrangement. Further, no cuticular spines were found in the sinus. This, together with the much larger all round measurements, shows *O. africana* n. sp. to be a different species from *O. theileri* as described by Fuhrm., 1924.

From a comparison with the other species of *Oochoristica* from lizards, as shown in the accompanying table, it is evident that the data agree with none of the other species. Hence this species from *Agama hispida* is proposed as a new species, namely *Oochoristica africana*.

Host: *Agama hispida* var. *distans*.

Habitat: Small intestine.

Locality: Wellington, C. P.

Oochoristica africana n. sp. var. *ookiepensis*.

The material consisted of two worms obtained from the intestine of *Scaptira knoxi*, being 112 and 115 mm. long, with a maximum breadth of 0.892 to 1.047 mm. The cuticle is smooth and devoid of any wrinkles and the segments are hardly separated at all from one another. Anteriorly they are much broader than long, but the mature proglottids are slightly longer than broad. I only succeeded in obtaining one scolex in a somewhat damaged condition. It measured 0.364 mm. across the suckers, the latter being somewhat longer than broad, measuring 0.138-0.161 mm. in length, and 0.105-0.112 mm. in breadth. The excretory vessels are somewhat indistinct in the complete specimens, the two dorsal vessels being only slightly discernible.

Genital Organs: Rudiments of the genital ducts are visible in almost the earliest distinguishable segments. Mature segments (Fig. 12) appear at about the 42nd. segment and continue up to the 80th segment. Completely gravid segments commence at about the

122nd. segment and continue for 10 segments. These gravid segments are distinct from one another, being somewhat narrower at the joints.

The ovary is situated slightly nearer the poral side, but more or less in the middle of the transverse axis of the segment. It consists of two almost distinct, somewhat triangular lobes, the connecting bridge between the lobes being much reduced and in some segments appearing to be absent. The lobe towards the aporal side tends to be larger than the other one. Behind the ovary is the vitelline gland, somewhat circular in outline and approximately half the size of the combined lobes of the ovary. A small shell gland is situated in the space between the vitelline gland and ovarian lobes, and may slightly overlap either one or both of the structures.

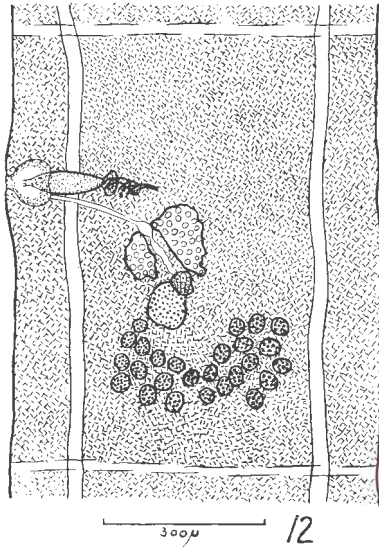


Fig. 12.—*O. africana* var. *ookiepensis*—mature segment, ventral view.

The testes number from 23 to 30 and occupy a position posterior and somewhat lateral to the vitelline gland. They are roughly dispersed into two groups, which generally connect up, but which can *not* be stated to be two distinct groups. The testes are mostly circular in outline, their maximum diameters varying from 37–46 μ .

The male and female ducts open into a somewhat shallow lateral genital sinus, situated at approximately the junction of the 1st and 2nd thirds of the segments' length. The genital pores are irregularly alternate, but the sinus is somewhat obscured by muscular tissue which has neither radiating muscle-fibres as in *O. agamae*, nor a cuticula of minute spines as in *O. theileri*. The sinus has a narrow distal portion which opens to the exterior and a wider proximal portion, into which the cirrus sac protrudes. The latter is an elongate structure 92–160 μ in length and extends well past the excretory vessel. The vas deferens is coiled in its distal portion

and its course can be traced as far as the level of the ovary. The vagina opens into the sinus somewhat posteriorly to the cirrus. Between the lateral portions of the ovary it widens out into a receptaculum seminis, which, however, was not equally prominent in all the segments. From the receptaculum a somewhat wide duct can be traced to the shell-gland.

The uterus with ova begins to appear at about the 75th segment, just somewhat anterior to the ovary, but is soon visible all over the segments, and with the development of the uterus the other genitalia begin to disappear until in the gravid ones only the genital sinus and ducts are visible. When the ova are fully developed the outer membrane measures $73.6-92.0 \mu$ in diameter, and the oncosphere itself $40.4-48.3 \mu$ in diameter.

Discussion: From the Table given below it is seen that this worm does not agree in its measurements and features with any of the other species of *Oochoristica* described from lizards. It tends to agree with *O. africana* n. sp. but differs from it in that the total length is much longer.

Although it also tends to be a little larger as regards the maximum breadth, measurements of scolex and sucker, size of cirrus sac, number of testes, and size of ova, its measurements, however, to a large extent include the range for the respective organs in *O. africana* n. sp. Further, in both species a shell gland and a receptaculum seminis are present, the latter varying slightly in position. The cirrus sac in both passes beyond the excretory vessel, extending somewhat further across in this species. In both, the testes are posterior and lateral to the ovary, and although they reach further anteriorly in *O. africana* n. sp. this might be due to the larger number of testes and due to the fact that the segment is somewhat shorter in *O. africana*. (Both figures are drawn to the same scale.)

Lastly, the structure of the ovary seems to be slightly different, in that in the species from *S. knoxi*, the lobes tend to have lost the connecting bridge which is fairly pronounced in *O. africana*; also the genitalia, or the least their ducts, are seen to develop fairly early behind the scolex in the species from *S. knoxi*, as opposed to *O. africana*, in which a fairly long unsegmented portion was present.

Taking all these facts into consideration, I do not think that there are enough differences between *O. africana* n. sp. and the worm from *S. knoxi*, to be of specific value, and thus propose the worm from *S. knoxi* as a variety of *O. africana*, namely *Oochoristica africana* n. sp. var. *ooskiepensis*.

Host: *Scaptira knoxi*.

Habitat: Small intestine.

Locality: O'okiep, Namaqualand.

CLASS NEMATODA.

SUPERFAMILY OXYURIODEA.

FAMILY OXYURIDAE.

SUBFAMILY OXYURINAE.

Genus: PHARYNGODON Diesing, 1861.

Definition: Oxyurinae, Mouth with three small lips; cuticle with or without lateral flanges; vestibule absent; oesophagus with a posterior globular bulb containing a valvular apparatus and separated from the rest by a slight constriction; excretory pore behind the oesophageal bulb. Posterior extremity of the body in both sexes obliquely truncate ventrally at the level of the cloaca, rounded and prolonged as a long subulate tail, provided with spines or smooth.

Male: With caudal alae which may be continuous with the lateral flanges; one pair of preanal and two of pedunculated postanal papillae, the cloaca is at the end of the body just before the commencement of the subulate tail; spicule imperfectly chitinized or even absent.

Female: Anus near the end of the body shortly before the commencement of the subulate tail; vulva near the middle of the body or anterior to this; oviparous, eggs very elongate and oval.

Parasites of reptiles, and amphibia (after Yorke and Maplestone). (For amended generic diagnosis see page 50.)

Type species: P. spinicauda, (Dujardin, 1845).

Pharyngodon mabuiensis n. sp.

The material examined consisted of 28 males and 30 females. They are rather small worms, the males being from 1.229-1.966 mm. long, with a maximum thickness of 0.112-0.176 mm., and the females from 4.2 to 4.7 mm. long with a maximum thickness of 0.237-0.309 mm.; the body is thickest at about its middle from where it tapers gradually towards both extremities in both sexes, ending posteriorly in a thin caudal tail, having a thick and smooth cuticular covering.

The cuticle is thick and transversely striated. Mouth terminal, surrounded by three small inconspicuous lips (Fig. 13); cylindrical oesophagus ending in a posterior bulb armed with chitinous blades; a slight constriction separates the bulb from the oesophagus (Fig. 19). In the male the total length of the oesophagus and bulb varies from 0.30-0.368 mm., the transverse diameter of the bulb being 0.060-0.076 mm. In the female these measurements are 0.537-0.573 mm. and 0.092-0.108 mm. respectively.

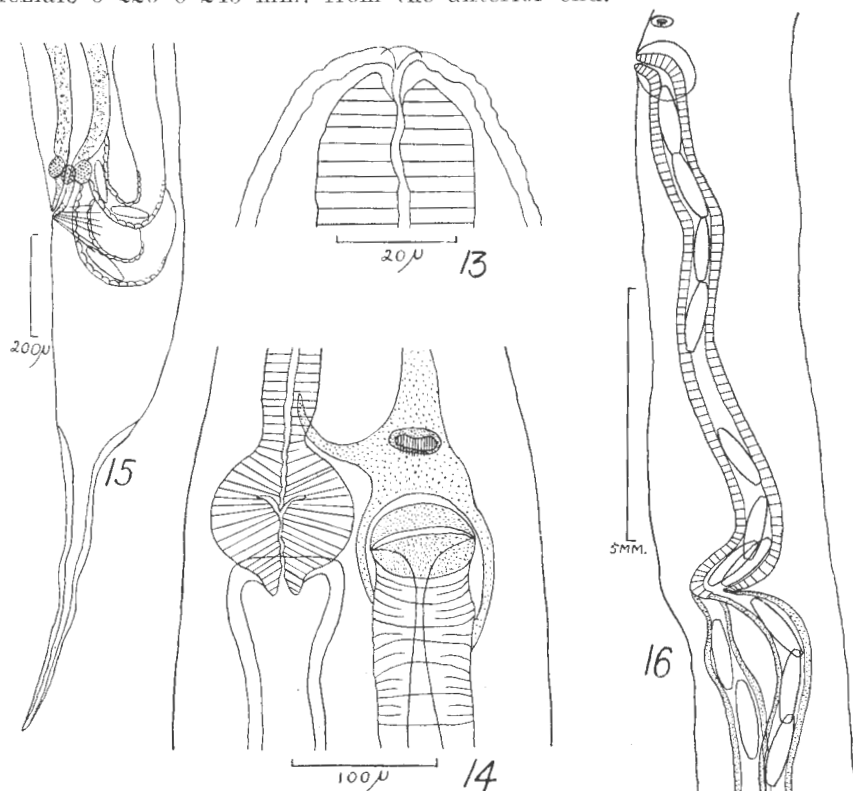
TABLE OF OOCYDIFORM SPECIES

Species.	Length in mm.	Breadth in mm.	Scolex in μ .	Sucker in μ .	Length of cirrus sac in μ .	Extent of cirrus sac.
<i>Agamæ</i> Baylis, 1919 (also in ophidia).....	80	1.5	450-650	175	150	? to excretory vessel.
<i>ameivæ</i> Beddard, 1914.....	25	1.5	—	—	250	to excretory vessel.
<i>brasiliensis</i> Fuhrm, 1927.....	120	1.0	—	—	150	just past excretory vessel.
<i>breslaui</i> Fuhrm, 1927.....	40	0.8	140	54	220	? to excretory vessel.
<i>amphishaenæ</i> Rud., 1819.....	20-30	1.2	850-900	230	950	nearly to aporal margin.
<i>crassiceps</i> Baylis, 1920 (also in ophidia).....	28-80	0.8-1.4	200-1,000	30	83-150	—
<i>lagrangei</i> Joyeux and Houdemer, 1927.....	60	2.5	400	—	250	well past excretory vessel.
<i>parva</i> Baylis, 1929.....	8-11	0.3-0.5	220-240	100-110	125	one-third of segment.
<i>theileri</i> Fuhrm, 1924.....	4-8	0.85	300-400	140	120	to or past excretory vessel.
<i>trachysauri</i> , Maccallum, 1921.....	50	1.0	330	150	180	past excretory vessel.
<i>trachysauri</i> ? (by Johnston, 1932).....	100-250	0.50-0.65	0.32-0.35	120-130	120	not reaching excretory vessel
<i>tuberculata</i> Rud., 1819 (also in ophidia).....	200	2.0	162 \times 320	110	260-300	well past excretory vessel.
<i>zonari</i> , Baylis, 1919.....	80-102	3.0	900-1,000	500	250	not to excretory vessel.
<i>africana</i> , n. sp.....	11.8-42.0	0.637-1.00	300-590	116-120 \times 92-100	100-126	Past excretory vessel.
do. var. <i>ookiepenis</i>	11.2-11.5	0.892-1.047	364	138-161 \times 105-112	92-160	Past excretory vessel.

PP. FROM LACERTILIA.

No. of testes.	Arrangement of testes.	Receptaculum seminis.	Diam. of egg in μ .	Diam. of oncosphere in μ .	Remarks.
39-40	Posterior to ovary	Present	60	37	} These four according to Meggitt, 1934, should be taken as synonymous.
50	Posterior to ovary	Absent	—	—	
40-50	Posterior to ovary	Absent	46	21-27	
60	Posterior to ovary	—	—	—	
70-80	Anterior, lateral and posterior to ovary	—	—	—	Distinguished by the extent of cirrus sac.
20-30	Posterior to ovary	Present ?	27-30	13	} Distinguished by large maximum breadth.
50-60	Posterior to ovary	Present	50	18-20	
14-16	Posterior and lateral to ovary	—	35-40	20-25	Distinguished by fewer testes, their arrangement and size of cirrus sac.
26-30	In 2 groups posterior to ovary	Present	60	30-40	} Meggitt takes these two synonymous, especially in that the testes are arranged in two groups posterior to ovary.
56	In 2 groups posterior to ovary	Absent ?	—	—	
65-80	Posterior to ovary	Present	4-3	2.5-3	For discussion see page 40.
20-40	Posterior to ovary	Absent	44	28-30	Distinguished by extent of cirrus sac, large size and number of testes.
60-90	Anterior, lateral and posterior to ovary	Absent	—	—	Distinguished by anterior extension of small testes and small cirrus sac relative to breadth of segment.
27-48	Posterior to ovary	Present	71-76	39-48	Has a definite bridgè between lobes of ovary.
23-30	Posterior to ovary	Present	74-75	40-48	Lobes of ovary not distinctly joined.

The excretory pore (Fig. 14) is strengthened by a thick chitinous rim and carries a row of stout elongated cirri along its anterior end. It leads to an excretory reservoir connected to 4 excretory canals, arranged roughly in the form of an X. The right hand anterior canal is much larger than any of the other three. In the female the excretory pore is 0.418–0.464 mm. from the anterior end and is usually situated on a level with the oesophageal constriction, but was also found more posteriorly, on a level with the anterior third of the oesophageal bulb. In the male the excretory pore is 0.103–0.161 mm. behind the oesophageal bulb, and 0.369–0.437 mm. from the anterior end. The Nerve Ring encircles the oesophagus at about its middle, in the male 0.112–0.124 mm. and in the female 0.220–0.240 mm. from the anterior end.



Pharyngodon mabuiensis n. sp.

Fig. 13.—Cephalic extremity enlarged.

Fig. 14.—Excretory apparatus and female genital opening, ventral view.

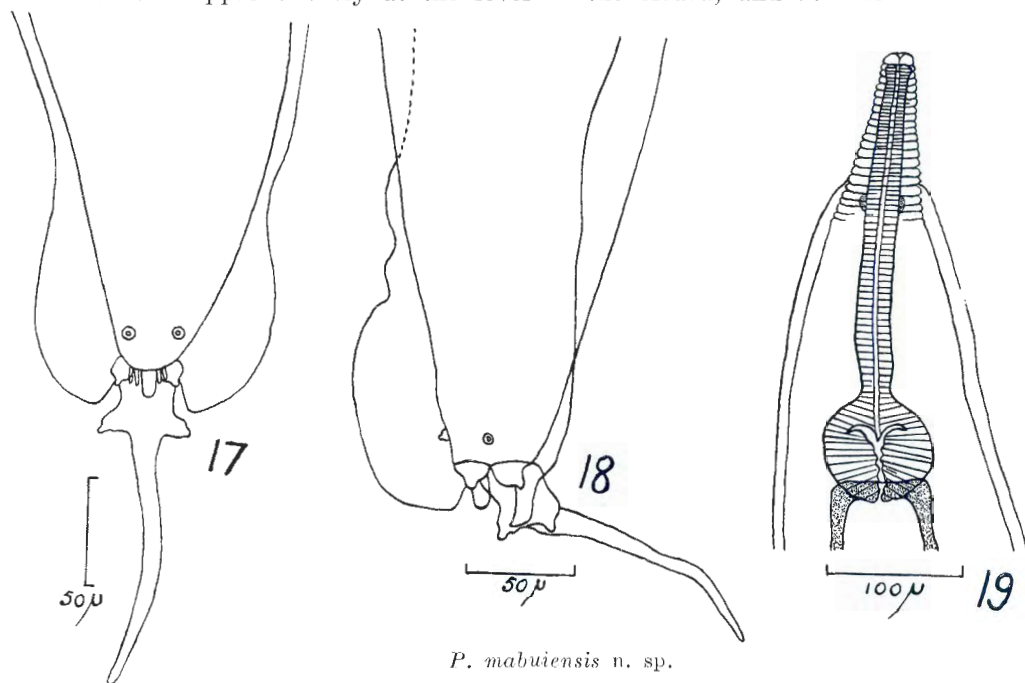
Fig. 15.—Female tail, showing posterior extremities of genital organs, lateral view.

Fig. 16.—Female genital organs, lateral view.

Female: Lateral lines and alae absent. Anus 1.047–1.128 mm from tip of tail (Fig. 15). Vulva with conspicuous projecting lips opens 0.064–0.084 mm. behind excretory pore (Fig. 14). Varies in position from being on a level with middle of the oesophageal bulb to as far back as the posterior end of the bulb. The vagina, which is usually filled with eggs, is long and muscular and runs

parallel with the body wall, dividing into two convergent uteri (Fig. 16), which pass into the slightly wider ovaries posterior to the anus (Fig. 15). The ovaries run forward ending up in acute points. Eggs are long and narrow, flattened slightly along the one side and measure $144-160 \mu \times 44-56 \mu$. The shell is thin and is lined by a clear vitelline membrane. Eggs have opercula, provided with plugs, at both ends.

Male: The body is cut abruptly behind the cloaca on the ventral side and continues back dorsally as a narrow elongated tail $0.140-0.160$ mm. long. Lateral alae are present. They arise $0.092-0.120$ mm. from anterior end (Fig. 19). Anteriorly they are narrow, varying from $10-16.1 \mu$ in breadth, but posteriorly they widen out to attain a maximum breadth of $32-34 \mu$ (Fig. 17 and 18), to end approximately at the level of the cloaca, and at their free



P. mabuiensis n. sp.
 Fig. 17.—Male caudal extremity, ventral view.
 Fig. 18.—Male caudal extremity, lateral view.
 Fig. 19.—Male cephalic extremity, dorso-ventral view.

ends extend somewhat beyond. This widened-out portion attains a length of $1.11-1.38$ mm. Caudal alae are absent. The caudal papillae (Figs. 17 and 18) consist of three pairs, all of which are sessile, with nipple-like terminations. The anterior pair is small, definitely preanal and directed outwards. The middle pair is larger, situated on a level with the anus and is directed backwards. The last pair is the largest, is situated on the dorsal extension of the body, is directed sideways, and behind them the delicate and elongate tail commences. The ventral prolongation of the body behind the anus is present as a conspicuous narrow and elongate structure, which is flanked on either side by a pair of small rod-like projections (Fig. 17). These latter are not conspicuous, and in

some specimens only a single one appears to be present on each side. As in *P. megalocerca*, Skrjabin, 1916, and *P. inermicauda*, Baylis, 1923, no spicule could be made out.

Affinities: This parasite has by far its closest affinities with *P. mabuyae*, Sandground 1936. In fact at a cursory examination the two species appear to be identical.

The caudal papillae in the male have not only the same number and structure but also the same arrangement. However, Sandground's serrated cuticular ridge or row of irregular spines on either side of the ventral prolongation of the body, is apparently different from the pair (in some specimens a single one only) of small rod-like projections of *P. mabuiensis*. Further no spicule could be discerned as opposed to a possible one for *P. mabuyae*.

In the female no lateral alae are present in *P. mabuiensis*.

From a comparison of a table of measurements of the new species, Sandground had apparently a much larger parasite, but we have the smaller female of *P. mabuiensis* (about $\frac{2}{3}$ size) possessing a tail more than $1\frac{1}{2}$ times as long as that of *P. mabuyae*.

Our form is thus taken to represent a distinctly new species, for which the name *P. mabuiensis* is proposed.

Host: *Mabuya trivittata*.

Habitat: Rectum.

Locality: Wellington, C.P.

Types in Onderstepoort Helminthological Collection.

Discussion on the genus Pharyngodon.

Sandground 1936 remarks on the gradual reduction of the caudal alae in the male and is of opinion that this may be interpreted as an evolutionary tendency towards the condition as found in the genus *Thelandros*.

This reduction of the caudal alae corresponds with a reduction in the length of the stalks of the papillae. Thus in the type species, *P. spinicauda*, we find one pair preanal sessile papillae, 2 pairs pedunculated postanals and a pair of arched prolongations of the body wall supporting the broad cuticular flanges or caudal alae.

In *P. extenuatus*, *P. auziensis* and *P. tarentolae* the posterior pair no longer helps to support the caudal alae. At the same time the stalks of these papillae become reduced in length so that finally in *P. tectipenis* they are completely reduced and papillae sessile.

In *P. laericauda* further reduction is noticed—caudal alae are very narrow and almost absent. Also both pairs of pedunculated papillae are replaced by sessile ones, but still have prolongations of ventro-lateral body wall present. This latter fact is, however, not noticed in the species mentioned below.

In *P. mabuyae* and *P. mabuiensis* we have the final consummation of this reduction in that there is no trace of caudal alae, and further in *P. megalocerca* the lateral alae do not even widen out posteriorly.

In the female, the tail is long and may be spinose, *P. spinicauda* and *P. extenuatus*, but is usually smooth.

From the above it thus seems advisable to amend the generic diagnosis to include the range of variations noted.

The female, maybe, offers more constant taxonomic features in the conspicuous excretory pore and vulva situated just behind it anteriorly in the region of the oesophageal bulb, and in the elongate eggs, provided with opercula at each pole. (Sandground 1936).

The amended *generic diagnosis* would thus be: OXYURINÆ of small size: mouth usually with 3 small lips*, cuticle with or without lateral flanges; vestibule absent; oesophagus with a posterior globular bulb containing a valvular apparatus and separated from the rest by a slight constriction. Posterior extremity of the body in both sexes obliquely truncate ventrally at the level of the cloaca, rounded and prolonged as a long subulate tail, provided with spines or smooth.

Male: posterior extremity exhibits a variation as from a condition in which the caudal alae may be present and supported by one pair (usually sessile) preanal papillae and two pairs of pedunculated postanal papillae, through a condition when only one pair of the postanals supports the caudal alae, to, lastly, a condition in which caudal alae are absent and all the papillae sessile.

Female: Anus near the end of the body, slightly before the commencement of the subulate tail; vulva in the anterior half of the body usually situated slightly behind the conspicuous excretory pore, which leads into an X-shaped excretory reservoir. Oviporous, eggs very elongate and oval, provided with an operculum at each pole.

Parasites of reptiles and amphibia.

Type species: *P. spinicauda*, Dujardin 1845.

KEY TO SPECIES OF PHARYNGODON.

A useful table and key to the species of *Pharyngodon* was given by Spaul, 1926. This has now been enlarged to include *P. tiliquae*, Baylis, 1930, *P. warneri*, Harwood, 1932, *P. cesarpintoii* and *P. tracasossi*, Pereira, 1935, *P. mabuyae*, Sandground, 1936, and *P. mabuensis* n.sp. The genus also includes besides these, three species described from the female specimens only, viz., *Pharyngodon* sp. Thapar, 1925, *P. batrachiensis*, Walton, 1929, and *P. armatus*, Walton, 1933. The two species by Walton are the only members of the genus recorded from Amphibian hosts.

* In *P. hindlei* the lips are slightly bilobed.

SOME HELMINTHS OF SOUTH AFRICAN LIZARDS.

	<i>P. tiliquae.</i>		<i>P. hindlei.</i>	
	♂	♀	♂	♀
Length.....	1.8-1.9	2.65-3.2	2-4	4-6
Width.....	0.11-0.15	0.2-0.25	—	—
Length of Oesophagus.....	0.35-0.37	0.43-0.50	0.44	0.64
Diameter of bulb.....	0.06-0.07	0.105-0.115	—	—
Nerve Ring fr. ant. end.....	0.14-0.17		0.163	0.160
Excr. pore fr. ant. end.....	0.64-0.73		0.86-0.88	
Tail length (total).....	0.10	0.59-0.75	0.125-0.15	0.37
Arrangement of anal papillae, in male.....	Somewhat forked within caudal alae		Adanal pair forked, within caudal alae	
Length of spicule.....	Not seen.		42μ	
Characteristic of lateral lines.....	In both sexes narrow, begin between bulb and excr. pore		Along length of body	2 lateral crests uniting in V-shaped structure.
Female tail.....	Smooth.		Smooth.	
Position of vulva.....	Immed. behind excr. pore		70μ behind excr. pore	
Egg (in μ).....	140 × 60		139 × 32	
Habitat.....	Rectum.		Intestine.	
Host.....	<i>Tiliquae scincoides.</i>		<i>Tiliqua scincoides.</i>	

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TABLE COMPARING CHIEF FEATURES OF THE GENUS PHARANGO
(All measurements¹ in mms.)

<i>P. mamillatus.</i>		<i>P. spinicauda.</i>		<i>P. inermicauda.</i>	
♂	♀	♂	♀	♂	♀
2.9	3.62	1.4-1.8	4.0-4.7	1.7-1.8	4.05-4.7
0.19	0.42	—	0.23	0.11-0.14	0.31-0.38
0.52	0.52	0.30	0.45	0.27-0.32	0.44-0.48
—	—	—	—	0.05-0.067	0.11-0.13
—	—	—	0.15	0.063-0.10	0.14-0.16
—	—	0.565	0.985	0.45	0.8-0.87
0.15	0.48	0.125	0.96	0.12-0.16	0.9-1.0
Within caudal alae		Within caudal alae		Within caudal alae	
21 μ		60 μ		Not seen	
♂ Cuticular inflation between lateral and caudal alae		Lateral alae along body	2 lateral crests along length of body	Lateral alae along length of body	Two lateral crests along body
Smooth?		Spiny.		Smooth.	
—		1.0-1.05 from anterior end		0.95-1.03 from anterior end.	
140 × 40		155 × 51		150-170 × 57-70	
—		Rectum.		—	
—		<i>Ptyodactylus oudrii.</i> <i>mauritanica.</i>	<i>Tarentola</i>	<i>Tarentola annularis.</i>	

p51-52a

p51-52c

p51-52b

PHARANGODON

<i>P. auziensis.</i>		<i>P. extenuatus.</i>		<i>P. cesarpintoi.</i>	
♂	♀	♂	♀	♂	♀
1.27-1.8	5.25	2.4-2.8	6.6	1.61-1.81	2.4-2.8
0.10-0.195	0.47	0.19-0.23	0.4	0.14-0.16	0.43
0.30-0.396	0.47	0.27-0.34	0.49	0.21-0.26	0.29-0.32
—	—	—	—	0.06-0.07	0.08-0.09
0.14	0.12	0.13	—	0.13	0.13
0.50-0.53	0.636	0.66	0.636	0.44-0.48	0.50-0.80
0.12-0.29	0.72	0.42-0.48	1.26	—	0.60-0.74
Anterior pair of postanals forked; post. pair outside alae.		Post. pair outside alae.		Within caudal alae. 1st pair post-anals slightly forked.	
40 μ .		70 μ .		Not seen.	
Lateral alae along length of body.	Two lateral crests along body.	Lateral alae along length of body.	Two lateral crests along body.	Alae from ant. end to posterior extremity.	Alae along whole body in young, but disappear in mature forms.
Smooth.		Spiny.		Smooth.	
0.684 from anterior end.		0.696 from anterior end.		0.07 behind excr. pore.	
147 \times 38		154 \times 31		132 \times 37	
Caecum.		Intestine and Caecum.		Large intestine.	
<i>Tarentola mauritanica.</i> <i>Congylus ocellatus.</i>		<i>Lacerta ocellata.</i>		<i>Cnemidophorus lemniscatus.</i>	

p51-52b

p51-52d

p51-52c

<i>P. travossosi.</i>		<i>P. warneri.</i>	
♂	♀	♂	♀
1.74-1.96	3.7-5.29	2.25-3.0	3.4-4.6
0.21	0.5-0.6	0.15-0.17	0.13-0.20
0.3-0.38	0.48-0.54	0.5-0.51	0.55-0.70
0.08	0.12	0.08-0.09 × 0.11-0.12	0.12-0.13 × 0.13-0.14
0.14-0.15	0.18	0.16-0.20	0.16-0.18
0.5-0.64	0.6-0.9	0.8-1.1	0.9-1.05
—	0.5-0.98	0.1-0.13	0.5-0.7
Within caudal alae.		Within caudal alae.	
Not seen.		Not seen.	
Alae from end of oes. to pos- terior extremity.	Absent.	Not mentioned.	
Smooth.		Smooth.	
0.05-0.07 behind excr. pore.		Immediately behind excr. pore; 1-1.2 from lips.	
157 × 45.		125-130 × 34-36	
Large intestine.		Rectum.	
<i>Ameiva sp.</i>		<i>Cnemidophorus sexlineatus.</i>	

p51-52c

p51-52d

(Continued overleaf.)

	<i>P. tectipennis.</i>		<i>P. laevicauda.</i>	
	♂	♀	♂	♀
Length.....	1.4-1.6	2.65-3.0	1.85	2.7-5.0
Width.....	1.35-2.0	0.35-0.375	0.3	—
Length of Oesophagus.....	0.33-0.37	0.38-0.40	0.185	0.54-1.0
Diameter of bulb.....	—	—	—	—
Nerve Ring fr. ant. end.....	—	—	—	—
Excr. pore fr. ant. end.....	0.40-0.45	0.46-0.475	Level of bulb.	
Tail length (total).....	0.20-0.27	0.25-0.49	0.31	0.45-0.83
Arrangement of anal papillae, in male....	Posterior pair outside caudal alae.		Posterior pair outside caudal alae.	
Length of spicule.....	Absent.		70 μ .	
Characteristic of lateral lines.....	Expanded T-shaped lateral alae along length of body.		Confined to posterior region of body.	
Female tail.....	Smooth.		Smooth.	
Position of vulva.....	0.46-0.48 from ant. end.		Immed. behind excr. pore.	
Egg (in μ).....	150 \times 36.5		160 \times 31	
Habitat.....	—		Rectum.	
Host.....	"Grey" Lizard.		<i>Acanthodactylus blanchi.</i> <i>Scinus officinalis.</i> <i>Acanthodactylus pardalis.</i>	

p53-54b

TABLE FOR PHARYNGODON (Continued).

<i>P. tarentolae.</i>		<i>P. mabuiensis.</i>		<i>P. mabuyae.</i>	
♂	♀	♂	♀	♂	♀
1.1	3.6	1.23-1.97	4.2-4.7	2.0-2.3	6.6-7.1
0.06	0.48	0.112-0.176	0.24-0.31	0.25	0.465
0.2	0.42	0.30-0.37	0.54-0.57	0.43-0.46	0.65-0.69
0.054	0.105	0.06-0.076	0.09-0.108	—	—
0.0625	0.125	0.112-0.124	0.22-0.24	0.34	0.46-0.50
0.29	0.54	0.37-0.44	0.42-0.46	0.63	0.63-0.85
0.115	0.65	0.14-0.16	1.05-1.13	0.18-0.21	0.65-0.71
Posterior pair outside caudal alae.		Caudal alae absent.		Caudal alae absent.	
Absent.		Absent.		85-90 μ . Possibly absent.	
Reduced.		♂ at 0.09-0.12 from ant. end, widening out posteriorly. ♀ Absent.		Present in both males and females. ♂ Narrow bands in ant. region. ♀ Widen post.	
Smooth.		Smooth.		Smooth.	
0.64 from ant. end.		0.064-0.084 behind excr. pore.		0.69-0.87 from ant. end.	
163 \times 50		144-160 \times 44-56		170-178 \times 45-50	
—		Rectum.		Rectum.	
<i>Tarentola delanandii.</i>		<i>Mabuya trivittata.</i>		<i>Mabuya varia varia.</i>	

p53-54a

p53-54c

<i>P. megalocerca.</i>		<i>P. sp.</i>	<i>P. batrachiensis.</i>	<i>P. armatus.</i>
♂	♀	(Females only).	(Females only.)	(Females only.)
1.02-1.5	4.0	3-4	4.2	3.5
0.136-0.2	0.34	—	0.36	0.24
0.27-0.35	0.6	0.40-0.55	0.56	0.28
0.065-0.085	0.17	—	0.15 × 0.125	0.15 × 0.15
—	—	—	0.165	0.175
0.187	0.34	0.86	0.61	0.36
0.46-0.51	1.054	0.54-0.70	0.9	0.5
Caudal alae absent.		—	—	—
Absent.		—	—	—
Along length of body.		Two parallel crests from bulb to posterior extremity.	Indistinct, may be absent.	Conspicuous lateral flanges present.
Smooth.		Smooth.	Smooth.	Smooth.
Ant. to middle of body length.		80 μ behind excret. pore.	1.8 from anterior end.	1.5 from anterior end.
170 × 55		132 × 60	35 × 100 (1 celled).	60 × 100 (4-8 celled).
Caecum.		Intestine.	Intestine.	Intestine.
Gecko.		<i>Egernia cunninghami.</i>	Tadpole of <i>Rana pipiens</i> .	<i>Rana pipiens</i> <i>R. clamitans.</i>

p53=54b

p53-54c

A. *Caudal alae of male present.*

(a) *Male caudal alae include posterior pair of postanal papillae.*

1. Anterior pair of postanals forked.

I. Preanals sessile.

Lateral bursal processes present.

—**P. tiliquae**, Baylis, 1930.

II. Preanals pedunculated.

Lateral bursal processes absent.

a Spicule present.

Lateral crests in female unite in V-shaped structure.

Female tail narrows abruptly.

—**P. hindlei**, Thapar, 1925.

β Spicule absent.

Lateral alae present in young females, but disappear in mature forms; female tail tapers gradually.

—**P. cesarpinto**, Pereira, 1935.

2. Anterior pair of postanals not forked.

I. Cuticle of male, between posterior end of lateral alae and beginning of caudal alae, inflated on either side.

—**P. mamillatus**, Linstow, 1897.

II. Cuticle of male not inflated at junction of lateral and caudal alae.

a Tail of female spiny,
Spicule in male present.

—**P. spinicauda**, Dujardin, 1845.

β Tail of female smooth.

Spicule imperfectly chitinised or absent.

1. Tail of female tapers gradually to a point.

x. Genital cone in male provided with cuticular fold.

—**P. warneri**, Harwood, 1932.

y. No cuticular fold to male genital cone.

—**P. travossosi**, Pereira, 1935.

2. Tail of female narrows abruptly behind anus. Very wide lateral alae in male.

—**P. inermicauda**, Baylis, 1923.

(b) *Caudal alae of male do not include posterior pair of postanal papillae.*

1. Anterior pair of postanals forked.

—**P. auziensis**, Seurat, 1917.

2. Anterior pair of postanals not forked.

I. Tail of female spiny,

Lateral alae widen out posteriorly.

—**P. extenuatus**, Rud, 1819.

II. Tail of female without spines,

α Expanded lateral alae in male begin near anterior end of body.

—**P. tectipenis**, Gedoelst, 1919.

β Lateral alae of male confined to posterior region of body.

—**P. laevicauda**, Seurat, 1914.

γ Lateral alae reduced or absent.

—**P. tarentolae**, Spaul, 1926.

B. *Caudal alae of male reduced or absent.*

(a) *Lateral alae widen out posteriorly.*

Tail of male short.

1. Lateral alae present in female.

Tail of female short.

—**P. mabuyae**, Sandground, 1936.

2. Lateral alae absent in female.

Tail of female long.

—**P. mabuiensis** n. sp.

(b) *Lateral alae do not widen out posteriorly.*

Tail of male very long.

—**P. megalocerca**, Skrjabin, 1916.

The two species of *Pharyngodon* (female specimens only) recorded from amphibian hosts, namely *P. batrachiensis* Walton, 1929, and *P. armatus* Walton, 1933, are distinguishable from each other in that in *P. armatus* the pharynx seems to be protected by chitinous plates for a short distance back from the mouth (Walton 1933).

Genus THELANDROS, Wedl, 1862.

Definition:—*Oxyurinae*: Mouth bounded by six small (three bilobed) lips, with six sessile papillae, one to each lobe; vestibule short, oesophagus with a posterior bulb; lateral flanges absent or present. Excretory pore usually post bulbular.

Male: Posterior extremity truncate, caudal alae usually absent; caudal papillae consisting of one pair preanal; a second pair which varies in position from pre-anal to post-anal; and a pair of post-anals inserted in the ventral surface of the caudal point; anterior margin of cloaca may be deeply 'tassellated' in some species; posterior margin may be produced into a conical projection, at base of which the single spicule protrudes. Spicule short acicular, gubernaculum absent.

Female: Lateral areas usually formed by a row of about 15 large cells; vulva usually near the middle of the body with slightly projecting lips; uteri convergent, ovaries club-shaped, coiled in anterior region of the intestine and in some even in front of the oesophageal bulb; eggs ovoid, not containing embryos when laid.

Parasites of Lizards and Tortoises.

Type species: *T. alatus*, Wedl, 1862 (after Seurat, 1917 and Yorke and Maplestone, 1926).

Thelandros rotundus n. sp.

The material consisted of a large number of females and about 15 males, found chiefly in the caecal portion of the rectum of *Agama atra* and *Pseudocordylus microlepidotus*. The worm is evidently a fairly common parasite of the former lizard, 67 out of 74 mature lizards examined being infected. Out of 31 immature ones, 15 were infected and the infection in these forms was on the whole not such a heavy one as in the mature forms.

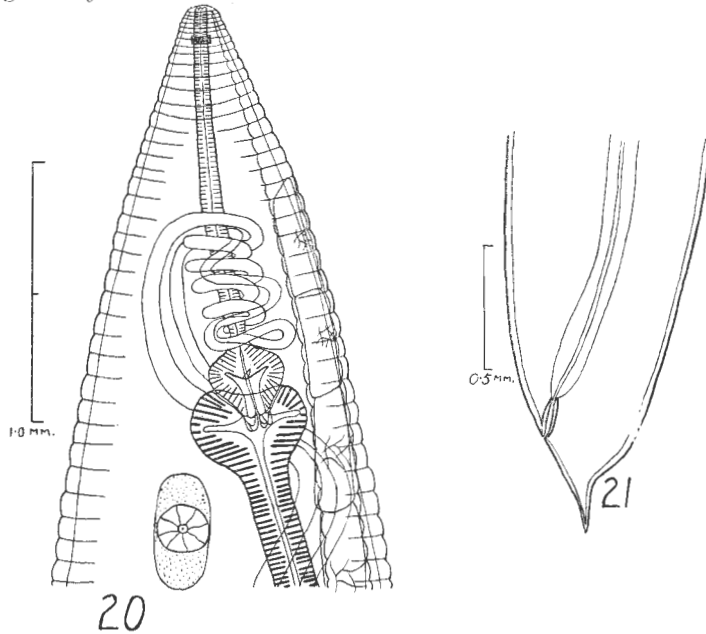
The body is stout, of medium size, and the males are usually much smaller and more slender than the females. The cuticle is thick with coarse transverse striations, and has a furry appearance, which appears to peel off in the elder worms. It is apparently not due to a definite ciliation, but may be homologous with the 'spines' described by Seurat, 1917, in young *T. echinatus*, and the hairy covering seen by Thapar, 1925, in *Oryziris* sp. (see page 62). The 'furry' covering is, however, not quite such a definite structure as that mentioned for these two species. The lateral areas are well marked, usually enclosed by two cuticular ridges, which are not always equally pronounced. In the male between each set of these ridges there is a lateral ala, whereas in the female (Fig. 20) the ridges enclose 13 to 15 large cells, extending anteriorly from the oesophageal bulb to near the anus. In *T. micipsae*, Seurat, 1917, describes definite star-shaped nuclei to these cells, but in this form the structures observed at about the centre of the cells have more the appearance of a protoplasmic attachment of the cell to the cuticle. Further, they did not take the stain in stained specimens.

The excretory pore is post-oesophageal, 1.18 to 1.29 mm. (female) and 0.44 to 0.52 mm. (male) from the anterior end. The small excretory opening is in the centre of a circular area of varying size showing radiating folds. The whole apparatus opens on an oval pigmented area. This is similar to that seen in *T. seclabiata*. Ortlepp, 1933, but the cuticular hairs present in this latter species were not observed. The excretory canals appear to come together in the form of an X:—2 anterior and 2 posterior canals.

SOME HELMINTHS OF SOUTH AFRICAN LIZARDS.

The head is not distinct, the mouth is surrounded by three fairly deep bilobed lips, giving the appearance of 6 separate lips. There is a small papilla to each lobe. Depending as to whether oesophagus is withdrawn or protruded a small 'buccal cavity' may or may not be present.

The oesophagus is long and separated by a slight constriction from a large spherical bulb (Fig. 20). The bulb is armed with chitinous plates, it has a diameter of 0.173-0.252 mm. in the female, and 0.096-0.12 mm. in the male. The oesophagus including the posterior bulb attains a length of 1.2-1.5 mm. in the female, and 0.51-0.85 mm. in the male. The oesophago-intestinal valves are six in number and project into the enlarged anterior portion of the intestine. The Nerve Ring surrounds the oesophagus 0.23 mm. (female) and 0.092-0.115 mm. (male) from the anterior end. This measurement, however, varies according to the amount of contraction undergone by the anterior end.



Thelandros rotundus n. sp.

Fig. 20.—Female anterior extremity, ventral view.

Fig. 21.—Young female tail, lateral view.

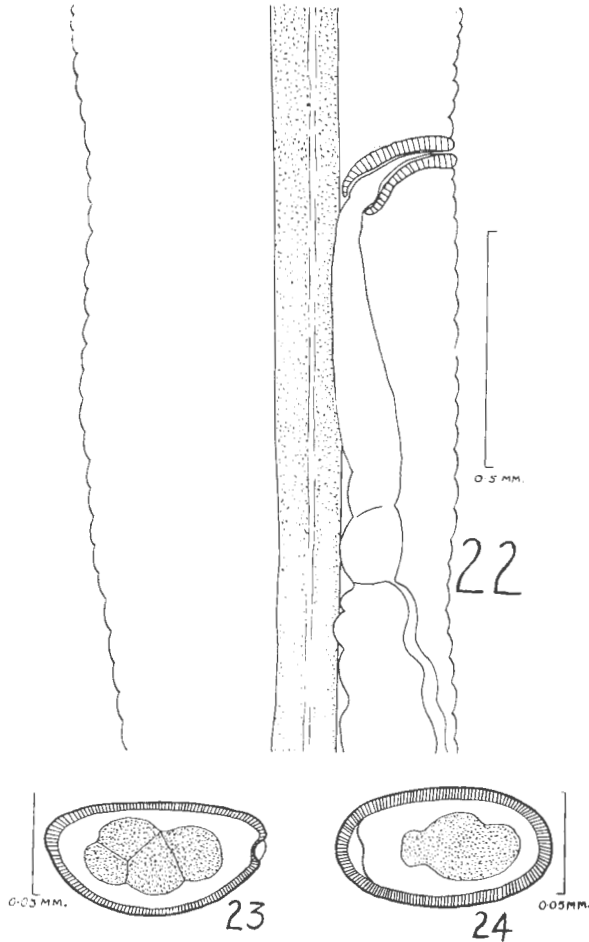
The *female* body is stout, and in the living state has a decided maggot-like appearance. This is especially so in the mature females, where the eggs seem to fill the entire body, with the apparent degeneration of the other organs. It measures 4.9-8.5 mm. in length with a maximum diameter of 0.55-1.24 mm.; tail (Fig. 21) is 0.43-0.53 mm. long and ends in a sudden point behind the anus. The caudal pores are situated laterally, on a level with the commencement of the tail.

The vulva (Fig. 22) with slightly projecting lips lies near the middle of the body. Vagina consists of a stout and horizontal portion, 0.136-0.165 mm. long, and a posteriorly running portion

0.77-0.84 mm. long. Uteri are convergent. The coils of the ovarian tubes encircle the oesophagus 5-6 times, anterior to the oesophageal bulb (Fig. 20).

Note: The coils do not always extend as far forward as indicated in the figure.

The eggs, $52-56 \mu \times 84-108 \mu$, appear oval (Fig. 24) when viewed from the dorsal aspect, but slightly more convex along the dorsal than the ventral side, when viewed from the lateral aspect (Fig. 23). The eggs are smooth, thick-shelled, and the single plug situated on the dorsal face is not quite terminal.



T. rotundus n. sp.

Fig. 22.—Female genitalia, lateral view.

Fig. 23.—Ovum, lateral view.

Fig. 24.—Ovum, dorsal view.

The *males* are rather smaller and more slender worms than the females, being from 2.6-2.9 mm. in length, with a maximum diameter of 0.42-0.55 mm. The posterior end of the body is truncate with a somewhat short slender tail, extending from the dorsal

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region and curved ventrally (Fig. 25). Lateral alae varying in length from 1.09-1.14 mm. on the one side and 1.32 to 1.42 on the other side extend from approximately the middle of the body to a little anterior to the anus. In some specimens they were found to originate at the level of the oesophageal bulb.

Ventrally on the truncate portion of the body there is, (Figs. 25-27, No. 1) one pair of capitate or 'mamillate' pre-anal papillae; (in Figs. 25-27 No. 2) one capitate pair on a level with the anus; (in Figs. 25-27 No. 4) a capitate impar post-anal papilla; (in Figs. 25-27 No. 5) a pair capitate post-anals on the curved tail and (in Figs. 25-27 No. 3) also a pair of cuticular prominences on the level with the anus, axial to the papillae; they are, however, not equally prominent in all the specimens examined.

The spicule, (Fig. 25) is 0.096-0.14 mm. long. It is relatively heavy with ridges. Accessory piece absent.

Besides the males mentioned above, two somewhat smaller and apparently not fully grown males, measuring 2.2 and 2.3 mm. in length, with oesophagus plus posterior bulb 0.42 and 0.46 mm. long, diameter of bulb 0.09 and 0.10 mm. and spicule 0.084 and 0.088 mm. long were also found

Affinities: Karve 1938 redescribed *Thelandros (Parapharyngodon) maplestoni*, Chatterji 1933, from new and also some of Chatterji's material. He mentions some characters apparently overlooked by Chatterji.

Further Karve also examined *T. hemidactylus* and finds in Patwardhan's material amongst others, lateral alae for the male, 5 pairs caudal papillae, and the absence of the "swollen knob-like process" on posterior lip of cloacal opening.

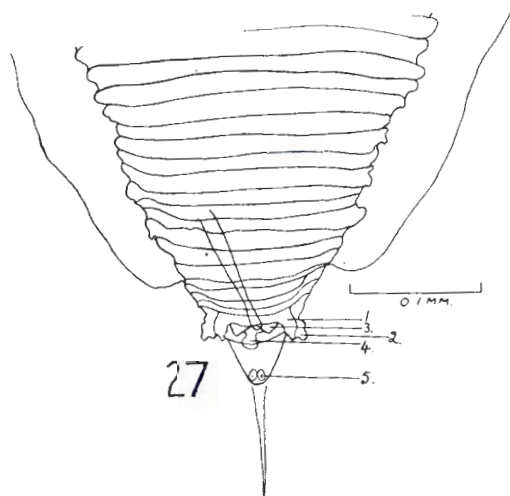
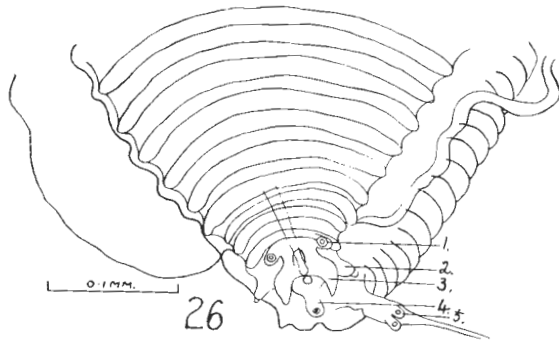
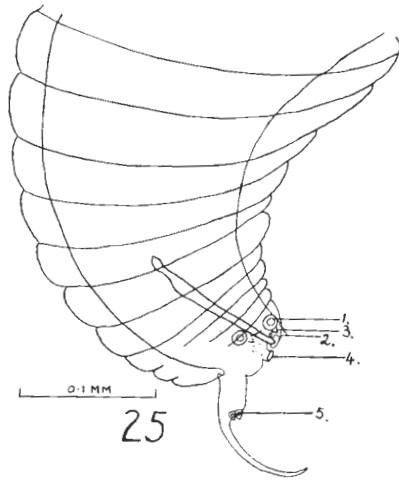
He concludes that *T. hemidactylus* Patwardhan 1935 is identical with *T. maplestoni*, Chatterji 1933.

The species described above due to the presence of the ovarian tubes round the oesophagus, is allied with:

- T. micipsae*, Seurat 1917,
- T. maplestoni*, Chatterji 1933, and
- T. seurati*, Sandground 1936.

It differs from Seurati's species, however, in that the latter has 2 small papillae, which is also seen in *T. maplestoni* (after Karve), in place of the post-cloacal conical projection and in having the anterior margin of cloaca "tasselated".

T. maplestoni apart from its smaller size, differs further in having lateral areas in female apparently absent, and its small adanal pair of papillae (Karve) if analogous with the cuticular prominences (non capitate papillae?) of *T. rotundus* certainly has not the same arrangement.



T. rotundus n. sp.—male caudal extremity.

Fig. 25.—Lateral view.

Fig. 26.—Postero-ventral view.

Fig. 27.—Ventral view.

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The number and arrangement of the papillae also distinguish this species from *T. seurati*, in which we find the cushion-like prominence and minute bosses or blunt spines on the cloacal projection. Both exhibit the phenomenon of "endotokie matricide", Seurat 1914, in the accumulation of the eggs in the mature females in such numbers that the other organs seem to degenerate.

The name *Thelandros rotundus* is proposed for this new species, on account of its stout and maggot-like appearance.

Host: *Agama atra* and *Pseudocordylus microlepidotus*.

Habitat: Rectum, chiefly caecum.

Locality: Wellington, C.P.

Types in Onderstepoort Helminthological Collection.

Other species:

T. alatus, Wedl 1862, in *Uromastix* spp.

T. baylisi, Chatterji 1935 in *Uromastix hardwicki*.

T. bulbosus, Linstow, 1899, in *Chalcides* sp. and *Scinus* sp.

T. cinctus, Linstow, 1897, in *Agama stellio* and *Agama* sp.

T. echinatus, Rudolphi, 1819, in Gecko.

T. hemidactylus, Patwardhan 1935, synonymous to *T. malplestoni*.

T. kasauli, Chatterji, 1935, in *Uromastix hardwicki*.

T. maplestoni, Chatterji, 1933, in *Calotes versicolor*.

T. micropsae, Seurat 1917, in *Chalcides micropsae*.

T. micruris, Rauther 1918, in *Uromastix hardwicki*.

T. nimidicus, Seurat 1918, in Tortoises.

T. oswaldocruzi, Travassos 1925.

T. sahariensis, Baylis, 1930.

T. scleratus, Travassos 1923, in *Tropidurus* spp.

T. seurati, Sandground 1936, in *Acontias percivali*.

T. seclabiata, Ortlepp 1933, in *Testudo verreauxi*.

T. taylori, Chatterji 1935, in *Uromastix hardwicki*.

T. (Oxyuris) megaloon, (Linstow 1906), Baylis 1936 in *Hemidactylus leschenaulti*. This species, from female specimens only, might, according to Baylis, be identical with *T. hemidactylus* i.e. *T. maplestoni*.

Thelandros sp. (Thapar 1925) nom. nov.

Thapar 1925, page 130, worm number 18, gives a description of female worms which had been obtained from the intestine of *Trachysaurus rugosus*. He suspected that the worm was related in part to the genus *Pharyngodon* and also in part to *Thelandros*. Owing to absence of males he could not definitely locate its position, and therefore described it under the common genus *Oxyuris*.

This worm is evidently a *Thelandros* and from description and drawings has closest affinities with those species having the ovarian coils round the oesophagus, but is apparently different in specific characters from the known species.

SUPERFAMILY SPIRURIODEA.

FAMILY PHYSALOPTERIDAE.

SUBFAMILY PHYSALOPTERINAE.

Genus: *THUBUNAEA*, Seurat, 1914.

Definition:— *Physalopterinae*: Mouth with two lateral rounded simple lips, the internal surfaces of which are armed with three small teeth, and which bear a pair of submedian papillae; lateral flanges absent; cervical papillae immediately behind the nerve ring; vestibule short, compressed laterally, with delicate walls; oesophagus short with an anterior muscular and a posterior glandular portion.

Male: Posterior extremity rounded, terminating in a small conical process; caudal alae well developed exhibiting a verrucose appearance; four pairs of pedunculated preanal papillae and four or five pairs of pedunculated postanal papillae and, in addition, about a dozen sessile papillae round the anus; spicules subequal.

Female: Posterior extremity short, terminating in a small conical point; vulva in the anterior fifth of the body; ovejector long; uteri parallel. Oviparous, eggs with a thick shell, containing larvae when deposited.

Parasites of Reptiles (after Yorke and Maplestone).

Type species: *T. pudica*, Seurat, 1914.

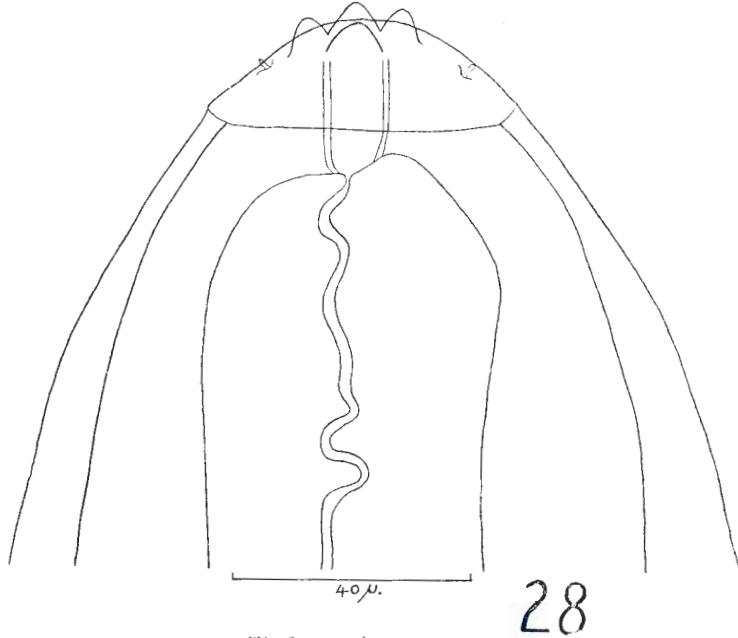
Thubunaea impar n. sp.

The material consisted of 24 females and 11 males, obtained from the oesophagus and the stomach of *Zonurus cordylus*. The proper habitat is doubtless the stomach, since the worms frequented this habitat more than the oesophagus. Two immature females were also found in the stomach of an *Agama atra*.

In both sexes the body tapers gradually towards the extremities, being only slightly thicker near the middle. The males vary in length from 7·9–8·5 mm., with a minimum diameter of 0·28–0·34 mm.; in the females these measurements are 11·0–14·1 mm. and 0·37–0·53 mm. respectively.

The lips are asymmetrical, the left lip being smaller than the right one, and bears on its inner surface three small forwardly directed teeth. The central one is somewhat larger than the lateral ones. In the right lip these teeth are larger and the right lip bears in addition a strong tooth, which appears to back up the larger

central tooth and forms the most characteristic feature. (Fig. 28.) In dorso-ventral view (Fig. 29) the small teeth of the left lip hardly show up at all, the teeth on the right lip being very conspicuous. A cuticular groove encircles the body at the base of the lips. There are four submedian papillae and two laterals, which are, however, not always conspicuous. The lozenge-shaped mouth leads into the laterally compressed vestibule, whose walls are lined with a somewhat thickened cuticula, being $20.7-25.3 \mu$ in the male and $23.0-27.6 \mu$ in the female in length.

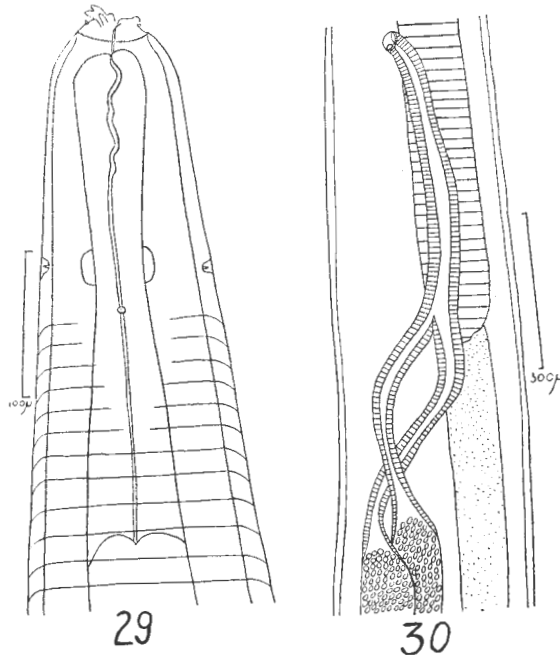


Thubunea impar, n. sp.
Fig. 28.—Right lip, lateral view.

The oesophagus (Fig. 29) is slender and increases very slightly in diameter posteriorly. It is composed of a short, muscular portion and a much longer and slightly thicker posterior portion. The total organ measures $1.65-1.82$ mm. in the male, and $1.6-2.4$ mm. in the female. The anterior muscular portion measures $0.24-0.26$ mm. and $0.228-0.391$ mm. respectively. The Nerve Ring is situated in front of the junction of the muscular and glandular oesophagus portions, being $0.20-0.216$ mm. (male) and $0.184-0.207$ mm. (female) from the anterior end. The laterally placed cervical papillae are situated on a level with the Nerve Ring in both sexes. The excretory pore is situated somewhat posteriorly to the Nerve Ring being $0.276-0.299$ mm. (male), and $0.248-0.253$ mm. (female) from the anterior end. There are no lateral alae.

The tail of the *Male* (Fig. 31) bears conspicuous caudal alae, the latter varying in length from $0.391-0.546$ mm. The maximum breadth across the alae varies from $0.20-0.25$ mm. The alae are covered with numerous papilliform cuticular elevations on the ventral surface. Among these the terminations of the caudal

papillae may be distinguished by their greater size and well defined shape. The papillae comprise three pairs long pedunculated preanal papillae (on the left side, in one specimen the first and second pedunculated papillae were found to be absent); one pair sessile preanals, which were found to be situated either between the middle and last pedunculated preanals, or just posterior to the last pair; two pairs with short peduncles just posterior to the anus; another pair of long pedunculated ones, and, lastly, two pairs situated further posteriorly and which are practically sessile. The papillae were on the whole found to be arranged regularly and symmetrically. A pair of small subequal spicules are present, they are only feebly chitinised and thus not quite distinct structures. The left one measures 0.095 mm. and the right 0.10-0.11 mm. in length.



T. impar n. sp.

Fig. 29.—Cephalic extremity, ventral view.

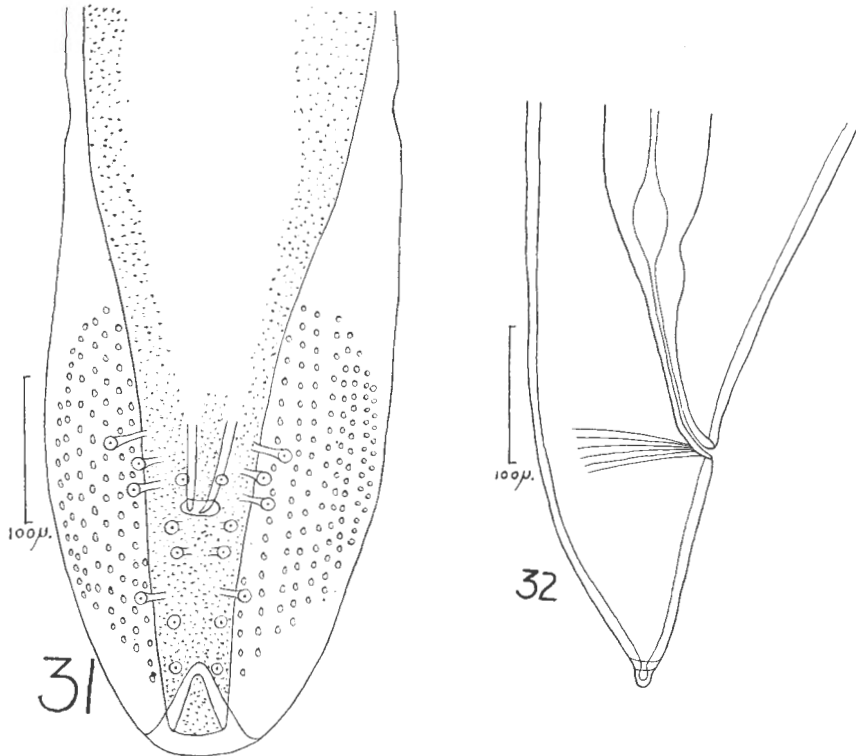
Fig. 30.—Female genital organs, latero-ventral view.

In the *Female* the anus (Fig. 32) is 0.145-0.166 mm. from the posterior extremity, which ends in a short, somewhat conical point. The vulva (Fig. 30) is situated in the oesophageal region, 1.07-1.12 mm. from the anterior end. The posteriorly running vagina attains a length of 0.456-0.485 mm. The two ovejectors, which measures 0.340-0.533 mm. in length, merge into the vagina at the level of the posterior extremity of the oesophagus. The two uteri pass down the length of the posterior extremity of the oesophagus. The two uteri pass down the length of the body more or less parallel with each other. The ovaries are long, thin and coiled tubes. The eggs are numerous, oval, thick-shelled and smooth. They measure $34.5-39 \mu \times 20.7-24.2 \mu$.

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Affinities: The asymmetrical structure of the lips in this species allies it to *T. asymmetrica*, Baylis, 1930, and *T. grayiacola* and *T. agamæ* Sandground, 1933, and *T. dactyluris* Karve 1938; the lips in other species are equal in size and each bears three teeth.

The lips of *T. impar*, n. sp. differ, however, from the allied species in that the right lip has an extra toothlike projection on the outer surface, as opposed to the unarmed state in *T. asymmetrica* and *T. dactyluris* and the presence of only the 3 teeth in *T. grayiacola* and *T. agamæ*.



T. impar, n. sp.

Fig. 31.—Male caudal extremity, ventral view.

Fig. 32.—Female caudal extremity, lateral view.

The caudal papillae of these five species agree as regards the number and the kind of the preanal ones, but differ in the postanal ones. A certain amount of symmetry in the arrangement of the papillae is obtained in *T. impar*, *T. grayiacola* and *T. dactyluris* but the first differs from the second in that the postanals include definite pedunculated ones, and further, in that the worm on the whole is a much smaller one. *T. dactyluris* also differs in the number of pedunculated postanals.

Host: *Zonurus cordylus* var. *flavus* and *Agama atra*.

Habitat: Oesophagus and stomach.

Locality: Du Toit's Kloof, Wellington, C. P.

Types in Helminthological Collection, Onderstepoort.

Discussion on the Genus Thubunaea.—The genus *Thubunaea* was created by Seurat, 1914, for the reception of a nematode parasite—*T. pudica*—which he obtained from lizards and snakes in North Africa. Since then the following species have been described:

- T. parkeri*, Baylis, 1926.
- T. asymmetrica*, Baylis 1930.
- T. fitzsimonsi*, Ortlepp, 1931.
- T. leiolopismae*, Harwood, 1932.
- T. grayiacola*, Sandground, 1933.
- T. agamae*, Sandground, 1933.
- T. dactyluris*, Karve, 1938.
- T. impar*, n. sp.

If the data given in the attached table be compared with Seurat's generic diagnosis it is evident that the other described species do not meet his generic requirements, especially as regards the male tails and the lips.

The paired lips in *T. pudica*, *T. fitzsimonsi* and *T. leiolopismae* are equal in size and each carries three forwardly directed teeth. In the other six species the lips are symmetrical, the left one being smaller, and further the number of teeth is variable. Thus in *T. grayiacola* and *T. agamae* both lips have 3 teeth, but the larger right lips have teeth reduced, whereas in *T. asymmetrica* and *T. dactyluris* the right lip is unarmed and lastly in *T. impar* the teeth of the right lip are larger than those of the left, with an additional tooth to the right lip.

Cephalic papillae are not recorded for *T. parkeri* and *T. fitzsimonsi*, but in the other species each lip bears a pair of submedian papillae.

The lips in the genus may thus be equal or unequal in size, usually carrying three teeth on internal surface, and also a pair of submedian papillae.

Lateral flanges are absent in all the species, cervical papillae as seen from table may be anterior to, on level with, or posterior to Nerve Ring i.e. Cervical papillae are usually situated in neighbourhood of Nerve Ring.

The vestibule is short and laterally compressed, in *T. pudica* and *T. asymmetrica* it has delicate walls, whereas in *T. fitzsimonsi* and *T. impar* the walls are somewhat chitinised. (Structure not mentioned for the other species.) The oesophagus is short to medium-sized, consisting of a short anterior muscular portion and a longer posterior glandular portion.

Male: The posterior extremity is usually rounded, curved dorsally and bears conspicuous caudal alae. The number, kind and arrangement of the caudal papillae are, however, an extremely variable quantity, tending on the whole to be arranged irregularly and asymmetrically. Pedunculated as well as sessile papillae are usually present. In *T. fitzsimonsi*, however, all the papillae are

slightly pedunculated and in the two males at Ortlepp's disposal the number and arrangement varied. The cuticular elevations on the inside of the caudal alae are well marked in all the species and tend to camouflage the papillae to such an extent that in *T. parkeri*, Baylis was unable to decide upon the exact number of sessile papillae. However, as seen from the table, there appears to be a tendency for the preanal papillae to be composed of 3 pairs pedunculated and one pair sessile papillae, in that 6 out of the 9 species have this arrangement, but there is no similar corresponding number of postanals.

The number and kind of the caudal papillae are thus rather variable quantities, usually composed of pedunculated ones, 3 to 5 pairs preanal and 3 to 6 pairs postanals, with sessile papillae numbering from one to as many as 4 pairs, pre- and 5 pairs postanally. The arrangement may, however, be asymmetric and not necessarily paired. In one species all the papillae are slightly pedunculated.

Spicules are present as two feebly chitinised unequal structures, or may be completely absent.

Female: The posterior extremity is usually very short terminating in a small conical point. The vulva is situated in the anterior half of the body; ovejectors medium-sized to long; uteri parallel, running caudad, eggs numerous, roundish oval, thick-shelled, smooth and contain an embryo *in utero*. (No mature eggs were found for *T. asymmetrica*).

This genus thus tends on the whole to be rather cosmopolitan and it might be advisable to separate out the species into a new or a sub-genus in the future.

SUMMARY.

The following new species are described and figured:—

TREMATODA.

Paradistomum zonuri

CESTODA.

Oochoristica africana

Oochoristica africana var. *ookiepensis*

NEMATODA.

Pharyngodon mabuicensis

Thelandros rotundus

Thubunaca impar

The genera have been considered in detail and in most cases it has been found necessary to somewhat amend the existing generic diagnosis, so as to include variations which have been described since the formation of the genera.

Notes on host-specificity, infection percentage of hosts by the parasites found and possible life-histories of parasites are recorded.

TABLE FOR GENUS THUBUNAEA.
(All measurements in mm.)

	<i>T. pudica.</i>	<i>T. parkeri.</i>	<i>T. asymmetrical.</i>	<i>T. fleissimonosi.</i>	<i>T. vingar.</i>
Length..... ♂	8	Up to 10.5	6.0-7.5	8.5-9.0	7.9-8.5
♀	9-19	14.5-18.0	10.8-14.8	Up to 18.5	11.0-14.1
Maximum diameter ♂	—	0.3-0.34	0.19-0.25	0.29-0.33	0.28-0.34
♀	0.4	0.4-0.44	0.26-0.38	0.44	0.37-0.53
Lips.....	Equal in size.	Equal in size.	Left one smaller.	Equal in size.	Left one smaller.
Number of teeth.....	3 to each lip.	3 to each lip.	3 on left lip, right one unpaired.	3 to each lip.	3 to left lip, 4 to right lip.
Oesophagus (total length)	♂ $\frac{1}{3}$ total length. ♀ $\frac{1}{3}$ total length.	1.1-1.75	1.45-2.4	♂ 1.0 ♀ 1.7	1.65-1.82 1.6-2.4
Oesophagus (anterior portion)	—	0.22-0.38	0.2-0.35	♂ 0.14 ♀ 0.19	0.24-0.26 0.23-0.39
Length of pharynx.....	Short.	0.05-0.08	0.035-0.05	♂ 0.036 ♀ 0.038	0.023-0.028 0.021-0.025
Nerve ring from anterior end	In posterior $\frac{1}{3}$ of Muscular oesophagus.	0.19-0.24	In post. half of ant. portion of oesophagus.	Just ant. to junction of oesophageal parts.	0.20-0.216 0.184-0.207
Excretory pore from anterior end	Behind cervical papillae	0.30-0.35	In post. half of ant. portion of oesophagus.	Slightly post. to Nerve Ring.	♂ 0.276-0.299 ♀ 0.248-0.253

SOME HELMINTHS OF SOUTH AFRICAN LIZARDS.

TABLE FOR GENUS THUBUNAEA—(continued).

	<i>T. pudica.</i>	<i>T. parkeri.</i>	<i>T. asymmetrica.</i>	<i>T. fitzsimonsi.</i>	<i>T. imp r.</i>
Position of cervical papillae	Immed. behind Nerve Ring	0.23-0.30 fr. ant. end.	Somewhat in front of Nerve Ring.	Just behind Nerve Ring.	On level with Nerve Ring.
Length of caudal alae..	—	0.4 (approx.).	0.37 (approx.).	0.6-0.69 (approx.).	0.39-0.55
Caudal papillae	Pre. { ped. } { ses. }	5 ; 5	3 ; 3	5-8 ; 7	3 ; 3
		3 ; 4	1 ; 1		1 ; 1
Spicules.....	Post. { ped. } { ses. }	3 ; 5	5 ; 5	6-7 ; 10	3 ; 3
		2 ; 4	2 ; 3		2 ; 2
	Subequal. 150 μ .	Unchitinised ?	Unequal Lt. 0.08-0.1 Rt. 0.065-0.08	Absent Unchitinised ?	Subequal Lt. 0.095 Rt. 0.10-0.11
Vulva from ant. end..	In ant. $\frac{1}{2}$ of body.	3.0-3.5	1.0-1.7	2.45	1.07-1.12
Egg (in μ).....	52 \times 42	575-625 \times 475-525	No fully formed eggs found.	45 \times 38	34.5-39 \times 20.7-24.2
Habitat.....	Stomach.	Mouth and oesophagus (stomach).	Mouth and oesophagus (stomach).	Stomach.	Oesophagus and Stomach.
Host.....	Chameleon. <i>Cerastes vipera.</i> <i>Scincus officinalis.</i>	<i>Tropidurus occipitalis.</i> <i>Dicrodon calliscelis.</i>	<i>Mabuia maculabris.</i>	<i>Ichneotropis squamulosa.</i>	<i>Zonurus cordylus</i> and <i>Agama atra.</i>

TABLE FOR GENUS THURUNAEA—(continued).

	<i>T. leiopismae.</i>	<i>T. grayiacola.</i>	<i>T. agamae.</i>	<i>T. dactyluris.</i>
Length.....♂♀	8.7-9.9 13.4-14.8	14-15.1 21-28	8.1-9.1 14-19	6 - 8.7 11.5-19.4
Maximum Diameter.....♂♀	0.21-0.30 0.31-0.34	0.26-0.30 0.41	0.2 0.37	0.19 0.31
Lips.....	Equal in size.	Left smaller.	Left smaller.	Left smaller.
Number of teeth.....	3 to each lip.	3 to each lip, reduced on right.	3 to each lip, reduced on right.	3 on left, rt. one unarmed.
Oesophagus (total).....♂♀	1.76-2.02 2.67-2.79	2.2-2.31 2.93-3.03	1.61 2.58-3.10	2.33-3.90
Oesophagus (anterior portion).....♂♀	0.21-0.27 0.31-0.34	0.29 0.44	0.18 0.32	0.26-0.35
Pharynx.....♂♀	0.042 0.2-0.24	0.036 0.045	0.029 0.04	0.024-0.034
Nerve Ring from anterior end.....♂♀	0.21 0.285	— —	— —	0.195-0.233
Exer. pore from anterior end.....♂♀	0.25-0.265 0.31-0.34	— —	— —	0.255-0.30
Position of cervical papillae.....	About same level as nerve ring.	0.255 from ant. end.	0.162 from ant. end.	0.203-0.24 from ant. end.
Length of caudal alae.....	—	0.62-0.82	0.37	—
Caudal papillae.....	Pre. { Ped. 3 ; 3 Ses. 1 ; 1	3 ; 3 1 ; 1	3 ; 3 1 ; 1	3 ; 3 1 ; 1
Spicules.....LeftRight	0.05-0.072 0.084-0.093	0.072 } approx. 0.055 }	0.09 } approx. 0.095 }	0.07-0.105 0.045-0.075
Vulva from anterior end.....	1.4-1.6	3.56-3.8 (behind end of oes).	2.58-2.7 (ant. to or on level with end of oes).	2.4-3.26
Egg in μ	23 \times 28	32-36 \times 23-25	26-29 \times 21-24	72-95 \times 38-42
Habitat.....	Stomach.	—	—	Stomach.
Host.....	<i>Leiopisma laterale.</i>	<i>Grayia tholloni, Bitis arietans.</i>	<i>Agama hispida distanti.</i>	<i>Hemidactylus flavivittis.</i> <i>Crotalus versicolor.</i>

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