ON *PARYPHOSTOMUM HORAI* SP. NOV. (TREMATODA: ECHINOSTOMATIDAE), WITH A NOTE ON THE SYSTEMATIC POSITION OF *PARYPHOSTOMUM NOVUM* VERMA, 1936.

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In 1945, Dr. M. L. Roonwal of the Zoological Survey of India, collected at Allahabad three specimens of an Echinostome parasite from the intestine of a domestic duck, *Anas poecilorhyncha* Forster. On examination, they were found to represent a new species of the genus *Paryphostomum* Dietz, 1910 which is described below.

Paryphostomum horai,[1] sp. nov.

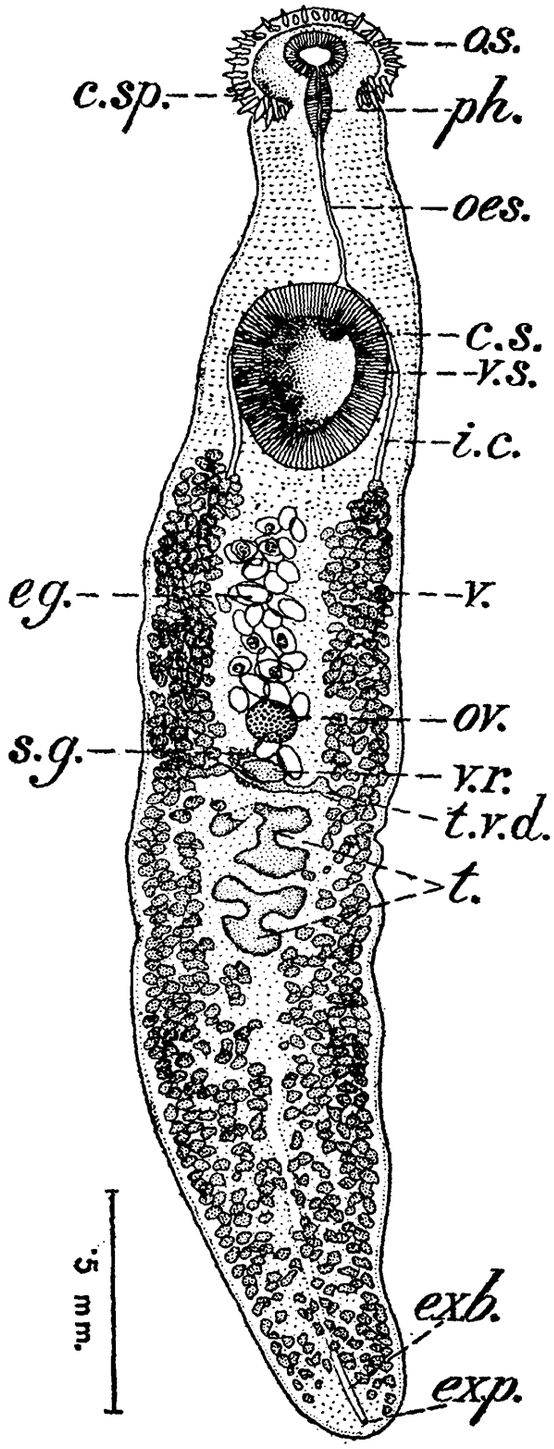
The parasite is elongate with dorso-ventrally flattened body which tapers at both ends. The length of the worm is 3·05 mm. and the maximum width, in the region of ovary, 0·61 mm. Cuticle is studded on the ventral surface with broad scale-like, backwardly directed spines which are present upto the anterior testis. These spines are very closely placed upto the acetabular region but sparsely distributed posterior to it. The pre-acetabular spines are much larger and stouter than those of the post-acetabular region. They gradually decrease in size till they altogether disappear near the posterior end. The marginal spines on the body are comparatively long and blunt. They are present upto the level of acetabulum.

The oral collar measures 0·19×0·35 mm. It is incomplete ventrally and carries 39 large and strong spines. The ventro-lateral collar spines (Text-fig. 2*a*) are arranged in a single row but the dorsal ones show a tendency towards a double arrangement. They measure 0·03—0·05× 0·009—0·014 mm. The end-group collar spines are five on the right side and six on the left but they are not arranged in pairs. They greatly vary in size, one of them in each group being slightly stouter and broader than others and measures 0·044—0·049×0·19 mm. Besides this spine, in the type specimen, there is an additional very long spine on each side near the end-group, the right one being of the same length as the left one but much broader and almost cylindrical, and lies so close to the end-group spines that it is included amongst them, while the left one is quite apart. This spine measures 0·058×0·014—0·019 mm. The smallest spine present in the end-groups of both sides measures 0·039×0·014 mm. The end-group of the left side has an extra very small spine measuring 0·029×0·009 mm.

The mouth is terminal and surrounded by a well developed transversely oval oral sucker measuring 0·098×0·137 mm. Prepharynx

[1] Named in honour of Dr. S. L. Hora, Director, Zoological Survey of India.

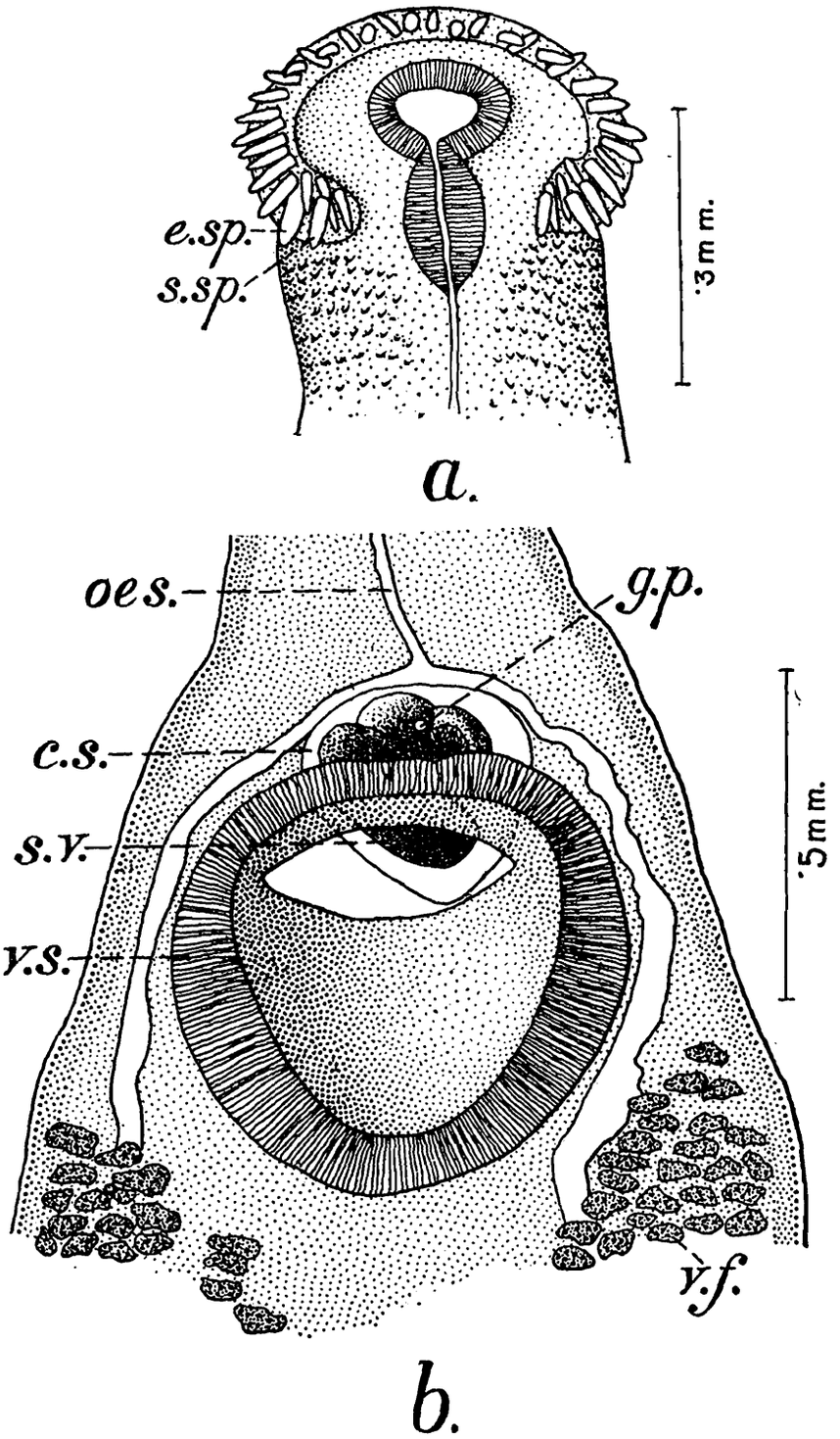
is absent. Pharynx is oval and strongly muscular measuring 0·117 × 0·058 mm. Pharyngeal or oesophageal glands are absent. Oesophagus is 0·27 mm. long and bifurcates at a distance of 0·47 mm. from the anterior end. The intestinal caeca run laterally almost upto the posterior end of the body. Ventral sucker is nearly circular, much larger than



TEXT-FIG. 1.— *Paryphostomum hoari sp. nov.*; Ventral view.

c. s. cirrus sac ; *c. sp.* collar spine ; *e. sp.* extra long spine ; *eg.* egg ; *ex. b.* excretory bladder ; *ex. p.* excretory pore ; *g. p.* genital pore ; *i. c.* intestinal caeca ; *oes.* oesophagus ; *o. s.* oral sucker ; *ov.* ovary ; *ph.* pharynx ; *s. g.* shell gland ; *s. sp.* stout spine ; *s. v.* seminal vesicle ; *t.* testes ; *t. v. d.* transverse vitelline duct ; *v.* vitellaria ; *v. f.* vitelline follicle ; *v. r.* vitellin reservoir ; *v. s.* ventral sucker.

the oral sucker, the ratio of the two being approximately 1 : 3·8. It is situated at the anterior third of the body, at a distance of 0·49 mm. from the anterior end. It measures 0·37×0·33 mm.



Text-fig. 2.—*Paryphostomum horai* sp. nov ; Ventral view.
a. collar region ; *b.* acetabular region (paratype) showing position of cirrus sac.
For explanations, see Text-fig. 1.

Testes are post-equatorial, trilobed and tandem in position. The lobes are simple and broad. The posterior testis is usually slightly larger than the anterior testis. The anterior testis measures 0·15× 0·19 mm. while the posterior one 0·190×0·21 mm. The cirrus—sac is strongly muscular, pear-shaped and lies dorsal to the acetabulum, parallel

to the longitudinal axis of the body. Its anterior end abuts against the oesophageal arch (Text-fig. 2*b*) while its posterior end extends posteriorly over the anterior third of the acetabulum. Vesicula seminalis is well developed, occupying the major portion of the cirrus—sac and is bent on itself, thereby giving a bipartite appearance. Its proximal part is much larger and covers up a portion of the distal part. Pars prostatica is short and opens into the cirrus.

Ovary is equatorial, almost round and medially placed. It measures 0·098×0·137 mm. Vitellaria are extra-caecal and partly inter-caecal, extending along the sides of the body from the level of the posterior border of the acetabulum upto the posterior end of the body. They merge into each other behind the posterior testis. The transverse vitelline ducts arise, on either side, at a level slightly in front of the anterior testis and open into a prominent pear-shaped yolk-reservoir lying in the mid-longitudinal line of the body. The apex of the reservoir is directed obliquely forward. The yolk-reservoir is a very characteristic feature of all these specimens. It measures 0·117×0·058 mm. The shell-gland is situated medially just posterior to the ovary. It is almost spherical and measures 0·078×0·101 mm. Laurer's canal is present. Receptaculum seminis is absent. The uterus is confined to the inter-caecal field in front of the testes. The uterine coils are few, containing only 30 eggs. The posterior end of the uterus passes dorsal to the acetabulum as the metraterm and opens into the genital pore. The eggs are oval, non-operculate and measure 0·058—0·098×0·039—0·058 mm. The development of the embryo seems to precede the egg laying as there are eggs in the uterus containing multinucleated bodies. Genital pore is single, lying in the mid-longitudinal line in front of the acetabulum.

The excretory vessel is cylindrical and is seen extending upto the level of the posterior testis. The excretory pore is sub-terminal in position.

TABLE

Important measurements of Paratype specimens, in millimetres.

——	Specimen 1.	Specimen 2.
Length	6·97	6·66
Breadth . .	1·56	1·76
No. of collar spines	38	?
Collar	0·274×0·509	0·294×0·627
Oral sucker	0·196×0·196	0·137×0·215
Pharynx	0·215×0·137	0·235×0·137
Oesophagus	0·646	0·548
Ventral sucker	0·705×0·646	0·686×0·725
Ovary .	0·196×0·313	0·196×0·509
Anterior testis	0·47×0·50	0·41×0·66
Posterior testis	0·56×0·58	0·50×0·62
Cirrus sac	0·254×0·352	0·333×0·352
Shell gland	0·235×0·49	0·235×0·45
Yolk reservoir	0·215×0·078	0·235×0·137
Eggs	0·078—0·098 ×0·058	0·078—0·098 ×0·058
Distance of intestinal bifurcation from anterior end	1·078	0·94
Distance of ventral sucker from anterior end.	1·176	1·117
Distance between intestinal bifurcation and ventral sucker.	0·137	0·098

Variations.—The marked differences shown by the paratype specimens, as regards the size of the body and of various other organs, have been given in the above table. Besides this, the paratypes show some random variations in their morphological characters. The collar spines in one specimen are 38 and are arranged in a double alternate row ; in the other, the dorsal spines have fallen out but the ventro-lateral spines are in a single row. In both, the number of end-group spines is 4 on each side, of which one is more prominent than others, and they are arranged in pairs. The oral sucker is round in one whereas it is transversely oval in the other. In one of the specimens, two lobes of the anterior testis are very faintly indented. In both paratype specimens, ovary is oval, just post-equatorial and dextral in position. The shell-gland is also oval. The uterus is densely coiled and packed with numerous eggs.

Discussion.—The parasite has branched testes, confluent vitellaria in the post-testicular region, and therefore belongs to the genus *Paryphostomum* Dietz[1], 1910. Bhalerao,[2] 1927 created the genus *Testisaculus* with *T indicum* as the genotype which he recorded from *Uromastix hardwickii*. Later, however, when the full account was published, he[3] (Bhalerao, 1931) placed this species under the genus *Paryphostomum*. Evidently his new genus is a synonym of *Paryphostomum* and in this, Bhalerao also agrees. So far only eight species (excluding *P. novum* Verma, 1936) have been assigned to this genus, *viz.*, *P. radiatum*[4] (Dujardin, 1845) Dietz, 1910 ; Edward,[5] 1927 ; *P. segregatum* Dietz, 1910 ; *P. sufrartyfex* (Lane,[6] 1915) Bhalerao,[7] 1931 ; *P. tenuicollis* (Johnston,[8] 1917) Price,[9] 1931 ; *P. indicum* Bhalerao, 1931 ; *P. testitrifolium* Gogate,[10] 1934 ; *P. pentalobum* Verma, 1936 and *P. phalacrocoracis* Goss,[11] 1940. The absence of a prepharynx in the author's species distinguishes it from all others excepting *sufrartyfex* which, according to Faust[12], also lacks a prepharynx. It differs from others in the number of collar spines but comes close to *sufrartyfex*, in which the collar spines are 32 according to Lane, but 39-42 according to Bhalerao. The presence of a stout and prominent spine in the end-groups readily distinguishes the present species from all others but

[1] Dietz, E., *Zool Anz.*, Leipzig, XXXIV, pp. 180-190 (1909) ; *Zool. Jahrb., Jena*, Suppl. XII, pp. 368-376 (1910).

[2] Bhalerao, G. D., *Proc. Indian Sci. Congr.* Cal. XIV, p. 191 (1927).

[3] Bhalerao, G. D., *Parasitology* XXIII, pp. 99-102 (1931).

[4] According to Johnston (*Trans. Roy. Soc. S. Australia* LXVI, pp. 226-242, 1943) *P. tenuicollis*, *P. testitrifolium* and *P. phalacrocoracis* are synonyms of *P. radiatum* Yamashita (*Volumen Jubilare pro Prof. Yashida*, Osaka II, pp. 173-186, 1939) regards *P. radiatum* and *P. segregatum* to be synonymous. These two publications were not accessible to the writer.

[5] Edward, E. E., *Parasitology* XIX, pp. 245-259 (1927).

[6] Lane, C., *Indian J. Med. Res.* II, pp. 977-983 (1915).

[7] Bhalerao, G. D., *Rec. Ind. Mus.* XXXIII, pp. 475-479 (1931).

[8] Johnston, S. J., *J. Roy. Soc. Sydney*, N. S. W. L, p. 206 (1917).

[9] Price, E. W., *Proc. U. S. Nat. Mus.* LXXIX, pp. 1-13 (1931).

[10] Gogate, B. S., *Rec. Ind. Mus.* XXXVI, pp. 139-141 (1934).

[11] Goss, O. M., *J. Roy. Soc. West. Australia* XXVI, pp. 1-6 (1940).

[12] Faust, E. C., *Human Helminthology, Philadelphia*, pp. 181-183.

sufrartyfex. In the trilobed nature of the testis, it resembles *testitrifolium* but differs from it in other respects. The extent, size and position of the cirrus—sac further distinguish this species from *sufrartyfex, radiatum, testitrifolium* and *phalacrocaracis.* In the absence of a definite receptaculum seminis, it differs from *testitrifolium* and *indicum,* and in the equatorial position of ovary, from *radiatum, segregatum, testitrifolium* and *phalacrocoracis.* It further differs from *tenuicollis* in the extent of the cirrus sac and vitellaria, and also in the distinct lobation of testes. The presence of a prominent yolk-reservoir is also very characteristic of the new species.

Type-specimen.—No. W3755/1 ; *Paratypes.*—Nos. W3756 & 3757/1, Zoological Survey of India, Calcutta.

Echinostomum novum (Verma).

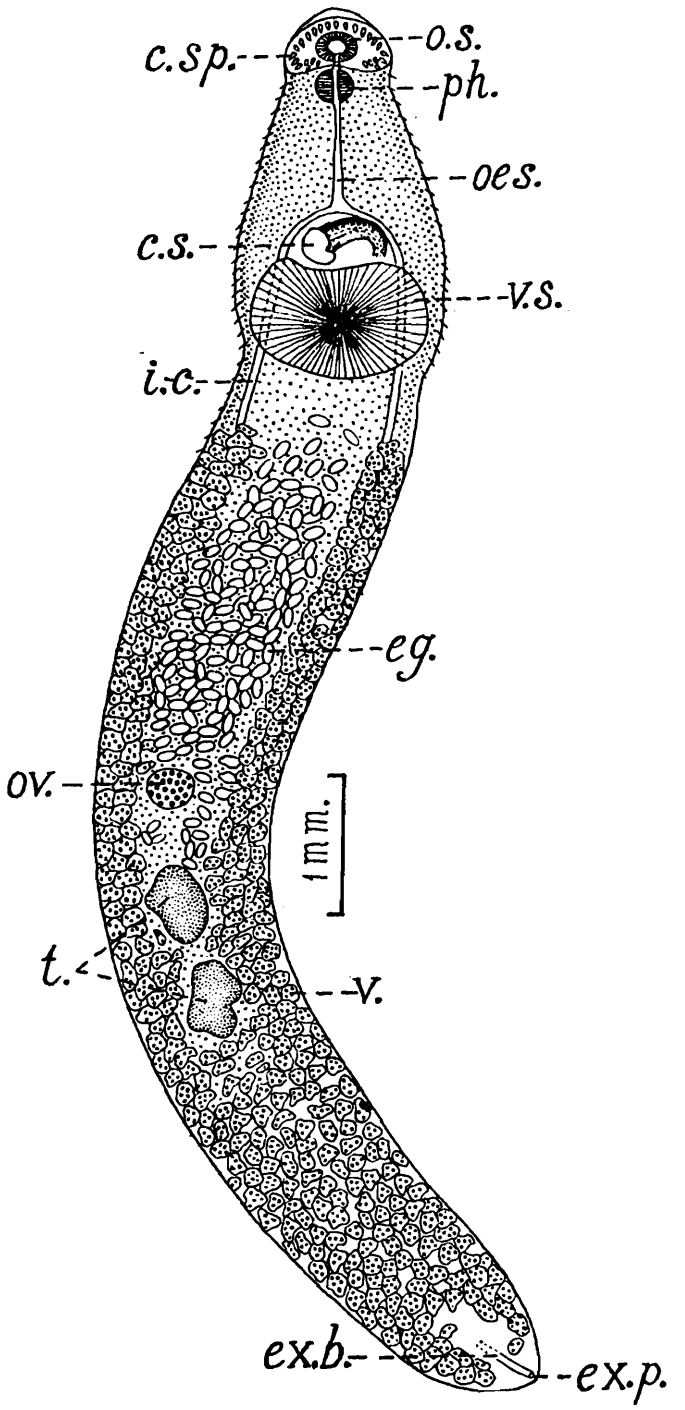
Verma,[1] 1936, described this species under the genus *Paryphostomum* Dietz, 1909. By the courtesy of Mr. S. C. Verma, the writer had an opportunity to examine the type specimen. Since the original account of the species by Verma does not contain any figure of his new species, a figure of the type-specimen is being provided in this paper, and as he published only a brief diagnosis, his description is supplemented as below :

The end-group spines are five on each side, the gap near the end-group spines on right side seems to indicate that a spine has fallen out. The flat scale-like spines are visible on the ventral surface only upto the acelabular region. The sharp marginal body spines are seen upto the level of ovary. The oesophagus shows a few diverticula at its posterior end (Text-fig. 4*b*). The testes are post-equatorial, almost equal in size ; the anterior one is roughly oval with an extero-lateral protuberance on the right side, the posterior one is rather irregular with a lateral depression on the left side. They are, however, not branched. The cirrus sac (Text-fig. 4*b*) is a prominent structure lying transversely in the space between the intestinal arch and acetabulum. The vesicula seminalis is a voluminous structure and is full of sperms. It leads into a long and club-shaped pars prostatica into which open the prostatic cells, it is followed by the cirrus. The ovary is post-equatorial in position and oval in shape. Receptaculum seminis and Laurer's canal are present. The shell gland is seen as a diffused structure. The genital pore is, however, not clearly seen, but seems to be situated on the left side. The excretory pore is sub-terminal.

The principal character which Dietz used to distinguish the genus *Paryphostomum* from *Echinostomum* is, the strongly branched testes in the former. Besides this, the cirrus—sac is always in front of the acetabulum in the genus *Echinostomum* whereas in the genus *Paryphostomum* it extends posteriorly over the acetabulum. The testes in Verma's species are not branched, the faintly crenated appearance of the testes is, in the opinion of the writer, due to fixation. There are, however, species assigned to the genus *Echinostomum* in which the testes are faintly lobed. Since the diagnosis of the genus *Echinostomum* admits the inclusion of such species in which the testes are either entire

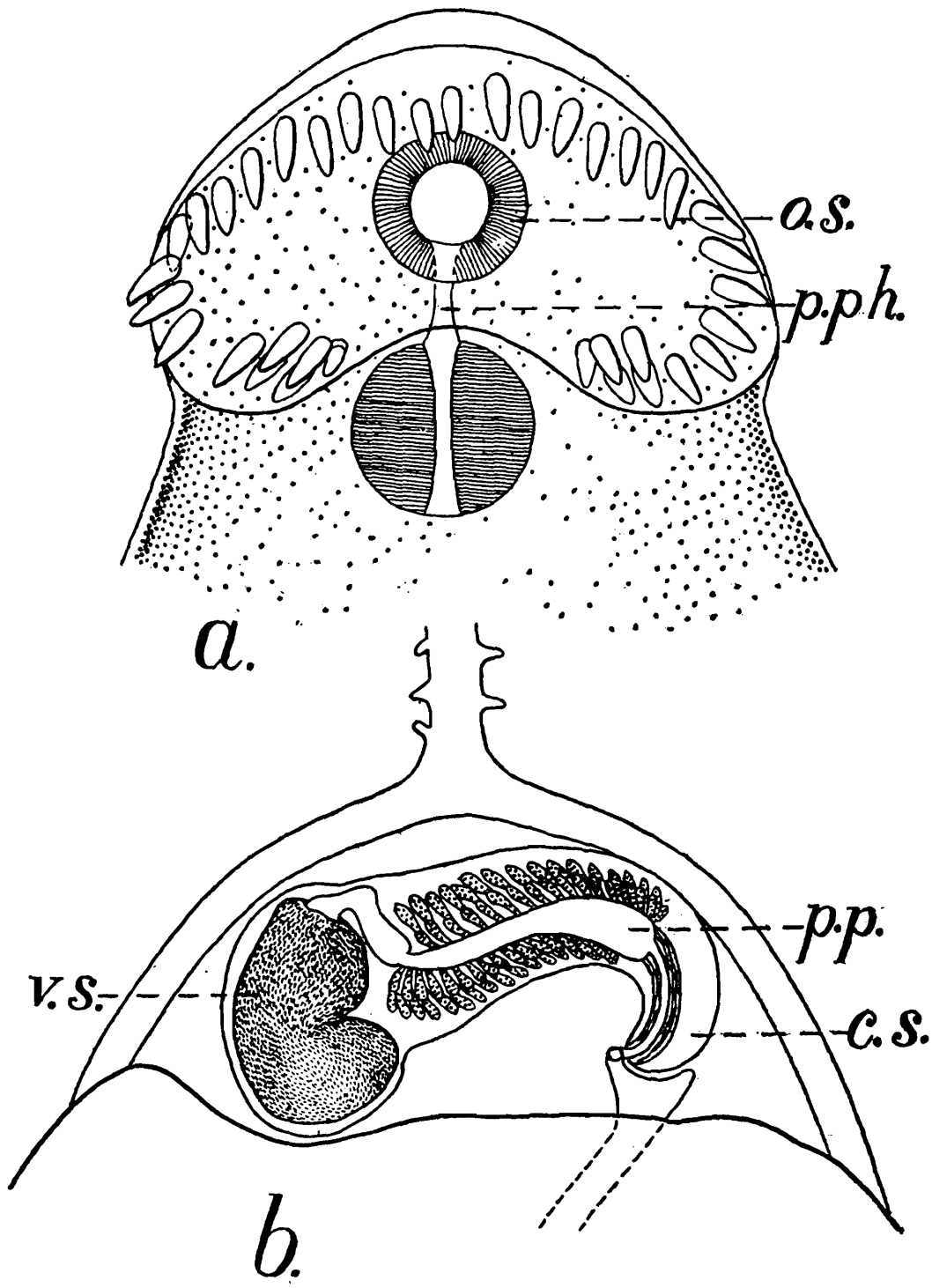
[1] Verma, S. C., *Allahabad Uni. Studies* XII, pp. 158-159 (1936).

or faintly lobed and the cirrus—sac lies in front of the acetabulum, the writer is of the opinion that the species *novum* Verma, 1936 should be transferred to the genus *Echinostomum*.



TEXT-FIG. 3.—*Echinostomum novum* (Verma); Ventral view.

c. s. cirrus sac; *c. sp.* collar spines; *eg.* egg; *ex. b.* excretory bladder; *ex. p.* excretory pore; *i. c.* intestinal caeca; *oes.* oesophagus; *o. s.* oral sucker; *ov.* ovary; *ph.* pharynx; *t.* testes; *v.* vitellaria; *v. s.* ventral sucker.



TEXT-FIG. 4.—*Echinostomum novum* (Verma); ventral view.

a. Anterior end showing collar spines; *b*. Acetabular region showing cirrus sac.

c. s. cirrus sac; *o. s.* oral sucker; *p.p.* pars prostatica; *p.ph.* prepharynx; *v. s.* vesicula seminalis.

ACKNOWLEDGMENTS.

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