ON SOME DIGENETIC TREMATODES FROM RANA CYANOPHLYCTIS OF KUMAON HILLS.

BY B. P. Pande.

(From the Department of Zoology, University of Allahabad, U.P., India.)

Received May 14, 1937.

(Communicated by Prof. C. R. Narayan Rao, M.A.)

Rana cyanophlyctis.

The common frog found in the streams near Almora and in the lake at Bhimtal, is usually infected with the trematodes belonging to the genera Diplodiscus Diesing, 1836; Pneumonaeae Looss, 1902 and Ganeo Klein, 1905, which are described in this paper. The bladder fluke met with in this frog has been already described in a separate paper.

The author wishes to express his gratitude to Dr. H. R. Mehra for his valuable help and guidance and to Dr. D. R. Bhattacharya for the facilities provided in the Department.

Diplodiscus mehra, n. sp.

The worms, measuring 2.1–3.2 in length and 1–1.3 in maximum breadth which lie in front of the acetabulum, are conical in shape with a slight deflection on their ventral surface and are covered with thick, smooth, cuticle. The body in the living condition is translucent with the excretory vessels visible as black wavy tubes. The terminal oral sucker with a dorsal lip and provided laterally with a pair of diverticula—the oral evaginations, arising from its base, measures 0.36 in length (median line) and 0.2–0.32, in breadth. It is 0.32–0.36 broad in the region of the diverticula, which are 0.2 × 0.18 in size. The oesophagus, 0.38–0.5 in length, arises from the bottom of the oral sucker ventrally to the oral evaginations and has an oesophageal bulb of 0.11–0.14 × 0.07–0.1 size at its end. It bifurcates into wide cæca just in front of the anterior third of body length. The cæca terminate a little in front of the acetabulum. The latter is shallow and situated at the posterior end of body with its opening directed ventrally, measuring 0.56–0.74 × 0.9–1.1 in dimensions. In the centre of the acetabular cavity the wall is raised internally into an additional sucker, with a depression in it, which divides the entire acetabulum into two halves. A few branches of the lymph system project dorsally into this additional sucker. The median genital pore is situated on the ventral surface just behind the oesophageal bulb and leads into a narrow and small genital
atrium. The excretory pore lies dorsally midway between the extreme posterior end of the body and the central sucker inside the acetabulum. It leads into a tubular excretory vesicle which is obliquely situated above the acetabulum between it and the Mehli's gland. Posteriorly the vesicle narrows just behind the centre of the acetabulum into the thick-walled
excretory canal, which is lined with cuticle continuous with that of the body wall. At this point the bladder receives ventrally a duct from the dorsal side of the additional sucker-like structure. The excretory vesicle, just behind its anterior end, receives a pair of large vessels which extend straight outwards to the sides and then backwards immediately behind the hind ends of the cæca and then forwards, describing a loop between the acetabulum and the ends of the cæca. Then they run forwards in a wavy course, dorsally to the cæca, in front of the testis as far as the level of the oral diverticula. Posteriorly the vessels lie internally and ventrally to the cæca. A large number of well-developed, elongated, subcuticular gland cells are present below the musculature both on the dorsal and ventral surfaces. They also surround the œsophagus and the genital pore and have also been observed in the substance of the suckers. The lymph system, as studied from sections, consists of two large vessels with membranous walls lying outside and dorsally to the cæca. These vessels give off branches to all parts of the body between the different organs. A number of these branches also surround closely the suckers.

The single testis, nearly globular, is situated ventrally near the middle of the body, measuring 0.23-0.4 x 0.34-0.45 in size. From its anterolateral border the two vasa efferentia arise, which unite about midway between the anterior margin of the testis and the genital pore to form the sinuous vesicula seminalis externa. The cirrus-sac, 0.18 x 0.16 in size, has membranous walls and contains in greater part of its cavity the coiled vesicula seminalis interna. The latter passes into the thick-walled and nearly straight ejaculatory duct which is surrounded by the unicellular prostatic glands.

The ovary, 0.16-0.18 in diameter, is spherical in shape. It is laterally situated to the left side just behind the testis. The oviduct arises from the middle of its dorsal side and runs caudal to enter the Mehli's gland which lies dorsally to the right side of the ovary with the well-developed yolk-reservoir just behind it and immediately in front of the acetabulum. The Laurer's canal opens dorsally immediately in front of the Mehli's gland. The receptaculum seminis is absent. The uterus, after its origin from the Mehli's gland, travels posteriorly on the right side of the ovary and on reaching near the anterior border of the acetabulum turns forward, lying dorsal to the testis and occupying the entire inter-cæcal space. Ventrally to the vesicula seminalis externa, the uterus passes into the thick-walled and convoluted metraterm. The metraterm is provided with gland cells opening into its ventral wall. The ripe eggs measure 0.14 x 0.09 in size. The follicular vitellaria extend from a little distance behind the oral evaginations to the
anterior border of the acetabulum, meeting mesially in the acetabular part of the body. The large follicles 35–40 in all, lie laterally and ventrally to the cæca except in the hinder region where they pass mesially forming a dorsally placed row.

**Habitat**—Rectum.

**Locality**—Almora.

**Remarks.**—The only Diplodiscus species from frog known hitherto from India is Diplodiscus amphichrus Tubangui, 1933—variety magnum Srivastava, 1934, reported from Rana cyanophlyctis of Sitapur (Oudh). The seven species listed under Diplodiscus by Travassos (1934) are: *D. subclavatus* Goez, 1782—the type species: *D. megalochrus* Johnstone, 1912; *D. microchrus* Johnstone, 1912; *D. doyeri* Ortlepp, 1926; *D. pygmaeus* Lütz, 1928; *D. amphichrus* Tubangui, 1933; and *D. cornu* (Diesing, 1836). About the systematic position of the last species Travassos feels doubtful.

Comparing all the above-mentioned species recorded up to the present time, I find that reliable specific differences can be based on the position of the genital pore, the excretory pore and the excretory vesicle; the arrangement of the collecting tubes of the excretory bladder; the anterior extent of the vitellaria and the size of the eggs. In *D. doyeri* the genital pore is much anteriorly placed, i.e., just behind the level of the hinder border of oral pouches, the excretory pore lies immediately in front of the acetabulum and the elongate bladder passes ventrally to the anterior margin of the latter. In *D. amphichrus* the genital pore and the cirrus-sac lie some distance behind the intestinal bifurcation while the excretory bladder and the pore lie immediately or a short distance in front of the acetabulum. *D. subclavatus* and *D. megalochrus* agree in the position of the genital pore but differ in the position of the excretory pore which lies near the centre of the acetabulum in the former and at the extreme posterior end of the body in the latter. The new species, which differs from the last two species in the slightly more anterior position of its genital pore, is characterised by the position of the excretory pore midway between the centre of the acetabulum and the posterior end of the body. In *D. subclavatus*, according to Fukui (1929), the bladder receives, besides the main canals, a pair of canals from the acetabulum. In my species I did not come across such an arrangement but from the centre of the acetabulum there runs postero-dorsally a median vessel to join the bladder at the point where it narrows down into the excretory canal. Besides this difference the size of the body and the anterior extent of the vitelline follicles also differ in the two species. The Australian species, *D. megalochrus*, has however, smaller eggs.
Recently, Yamaguti (1936) described a new sub-species of *D. amphichrus*—*D. amphichrus japonicus*. This form should not be assigned to Tubangui’s species on account of the more anterior position of its genital pore in which feature as well as in the extent of the vitellaria it agrees with *D. subclavatus* but differs from it in the size of the body, position of the excretory pore which lies in front of the acetabulum, in the arrangement of the excretory branches in the acetabulum and in the size of eggs. These differences, in my opinion, are important enough to necessitate the creation of a new species for the Japanese form for which I propose the name *Diplodiscus japonicus*.

*Pneumonacées almorai*, n. sp.

The worms are fairly large, flattened and elongated, with a narrower and somewhat pointed anterior portion and a rounded posterior end. The longest specimen measures 7 in length and 1.6 in maximum breadth which lies in the testicular zone of the hinder body. The thick cuticle is devoid of spines. The subcuticular cells form a compact thick layer throughout the body. The subterminal oral sucker, 0.29–0.32 in diameter, is double the size of the acetabulum. The globular pharynx is 0.13–0.16 in diameter. The oesophagus measures 0.18–0.4 in length. The wide and sinuous intestinal cæca which extend posteriorly to the middle of the post-vitelline region are seen red in the living worm on account of the contained blood. The genital pore lies median between the pharynx and the intestinal bifurcation nearer the former in the fully extended worm. The main stem of the Y-shaped excretory bladder divides into the cornua near the posterior end of the receptaculum seminis.

The elongated ovary, 0.66 × 0.32 in size, is situated to the left side of the median line in the middle of the body. On its outer wall, internal to the left intestinal cæcum, there is an indentation which divides it into spherical anterior and elongated posterior halves. The posterior half, in all the specimens, has the convex outer and concave inner sides. The voluminous receptaculum seminis, 0.5 × 0.29 in size, lies just behind the acetabulum in level with, and ventrally and mesially to, the ovary. The Mehli’s gland is situated just in front of the receptaculum seminis in the acetabular field. After its origin from the Mehli’s gland, the uterus which is literally packed with countless eggs passes to the posterior end of the body and just in front it runs external to the cæcum of the ovarian side forming the characteristic longitudinal extracæcal fold. After pursuing a similar course outside the cæcum on the other side of the body, the uterus forms the ascending limb which closely resembles the descending loop as far as the acetabulum. In front of the latter, the uterus, in a number of
transverse coils which never extend beyond the outer borders of the cæca, proceeds forwards to the genital pore where it opens through a metraterm of about 0.41 length. The ripe eggs are operculate, elongate oval and light brown in colour, measuring 0.17 × 0.07 in size. The vitellaria, in approximately 21 grape-like bunches, extend from near the beginning of the second quarter of the body to about one-eighth of body length from the posterior extremity. The groups are arranged in 2 patches of equal number. The anterior one lies in front of the acetabulum and the posterior in the testicular zone along the lateral sides of the testes and between the posterior testis and the hinder ends of the intestinal cæa. Between these two, there is a solitary group external to the ovary. Mostly the follicles are arranged along the ceca but some of the anterior and posterior groups are intercæcally placed.

The testes are large, elongated, with smooth or slightly irregular outline. The anterior testis lies just behind the ovary and the receptaculum seminis on the side opposite to that of the ovary and measures 0.72 × 0.4 in size. The posterior testis, 0.95 × 0.47 in size, is more elongated than the anterior one and lies obliquely to it with its anterior part on the same side as the ovary. The long cirrus-sac, 1.5-1.7 in length and 0.11 in maximum breadth, is narrow and tubular extending posteriorly to one-fourth of the body length from the anterior extremity with its posterior end below the dorsal row of the intracæal vitelline follicles. It contains a vesicula seminalis of about 0.99 length, which is nearly straight posteriorly but much coiled anteriorly. The pars prostatica is indistinguishable, the seminal vesicle continuing into an ejaculatory duct which terminates in a cirrus.

**Habitat**—Lungs.

**Locality**—Almora.

**Remarks.**—The illustrated resumé of the lung flukes from the Amphibia Anura have been given by Travassos and Darriba (1930) and Caballero and Sokoloff (1934) respectively. After a comparison with all the species of the genus *Pneumocovera*, to which the present form evidently belongs, it is found that it does not fit in any one of the already known species. The new species, however, shows closer affinities to *P. variegatus* Rudolphi, 1819, than to any other species on account of its aspinose cuticle, the position of the acetabulum which is smaller than the oral sucker, configuration of the uterus, and the arrangement of the vitellaria, but differs from it in the sucker ratio, in the slightly more posterior position of the genital pore, the character and extent of the cirrus-sac, shape and position of the ovary and testes, and the size of its eggs. The South Indian species, *P. campyristis* Klein, 1905,
agrees with *P. almorai* in its smooth skin, in the ratio of the oral sucker to the acetabulum, position and shape of the testes, and arrangement of the uterine coils but is separated from it by the position of its genital pore in the region of the intestinal bifurcation, the extent and shape of its cirrus-sac, the oval shape of its ovary, the smaller number of the vitelline groups, and the larger size of the eggs.

*Ganeo Kumaonensis* n. sp.

The body, nearly elliptical and covered with spines, measures 3.56–3.93 in length and 1.34 in maximum breadth in the vitelline zone. The sub-terminal oral sucker, 0.11–0.14 long and 0.15–0.16 broad, leads into a small thin-walled prepharynx of 0.08 × 0.043 size. The pharynx measures 0.07 in length and 0.1 in width. The narrow oesophagus, 0.36 long bifurcates at about one sixth of the body length from the anterior extremity. The intestinal caeca extend beyond the vitellaria, terminating a little in front of three-fourth length of the body from the anterior end. The acetabulum is distinctly larger than the oral sucker and measures 0.18–0.2 in diameter. It lies a little behind the anterior one-third of the body. The genital pore, which leads into a fairly deep spinous atrium, is situated ventrally on the left body margin between the pharynx and the intestinal bifurcation, nearer the latter. The excretory pore is ventral just in front of the posterior end of the body and leads into a very small thick-walled median stem which communicates with the U-shaped bladder. The arms of the bladder extend forwards intracaecally as far as the posterior boundary of the ovary. The subcuticular gland cells are present in the body parenchyma and conspicuously surround the oesophagus, the median stem of the excretory bladder, terminal part of the metraterm and the genital atrium.

The anterior testis, 0.25 × 0.27 in dimensions, lies median and just behind the intestinal bifurcation, nearer the ventral body wall. The posterior testis is situated obliquely behind the anterior testis immediately in front of the ovary internally to the caecum of that side. It measures 0.27 in length and 0.29 in breadth. The vesicula seminalis, coiled characteristically in a S-shaped manner, is transversally placed to the left side of the posterior testis between the anterior testis and the acetabulum with its proximal part just behind the former. Distally it narrows into a short tube leading into the pars prostatica which is large, elongated and swollen at the base. Both these parts of the male end apparatus are densely surrounded by the prostate gland cells lying freely in the parenchyma. The pars prostatica, after crossing the caecum of the left side, passes into the short-armed ejaculatory duct. The latter opens into the genital atrium near its posterior end.
The ovary, nearly rounded and $0.22 \times 0.25$ in size, is situated to the right side of the acetabulum. The receptaculum seminis, nearly spherical, is $0.18$ in diameter and lies close behind the ovary slightly to the right side of the median line. The Mehli's gland lies inside the posterior margin of the ovary between the hinder end of the acetabulum and inner margin of the receptaculum seminis. The uterus, in closely packed transverse coils, occupies mostly the intercæcal space between the ovary and the hinder part of the U-shaped excretory bladder, with a few coils overlapping the cæca. The descending convolutions are dorsal to the ascending ones. The outgoing part of the uterus passes forwards between the acetabulum and the left cæcum and on reaching the posterior end of the vesicula seminalis continues into the metraterm. The metraterm lies ventrally to the vesicula seminalis and laterally to the pars prostatica. In the region of the ductus ejaculatorius, the metraterm gives off a spacious, muscular spherical chamber which empties into the genital atrium dorsally to the ejaculatory duct. The terminal part of this chamber is lined with chitinous spines in continuation with those of the atrium. The vitellaria lie laterally beneath and outside the intestinal cæca, extending from the posterior border of the acetabulum to near the middle of the post acetabular region. The ripe eggs are operculate, light yellow in colour, with fully-developed miracidia and measure $0.026 \times 0.012$ in size.

**Habitat**—Small intestine.

**Locality**—Bhimtal.

**Remarks.**—In the absence of a pseudo-cirrus-sac this form differs from the type species *G. glottodides* Klein, 1905, and its varieties but resembles *G. tigrinum* Mehra and Negi, 1928, *G. gastricus* Srivastava, 1933 and *G. attenuatum* Srivastava, 1933. *G. gastricus*, which is parasitic in the same host (*Rana cyanophlyctis*) in Sitapur, is separated from the new species on account of the terminal oral sucker, position of the testes, location of the genital pore on a conical prominence at the level of intestinal bifurcation, excretory bladder without a main stem, absence of the metraterm and size of the ova. The other species from *Rana cyanophlyctis*, viz., *G. attenuatum*, differs from the present form in the equal size of its suckers, position of the ovary and shell-glands, position and extent of the vitellaria, less intricately coiled uterus, uniform width of its metraterm and size of the eggs. Though Srivastava mentions that metraterm is present in *G. attenuatum* but it is not clear whether the genital atrium and the ejaculatory duct are lined with spines. The important features in which the new species differs from *G. tigrinum*, the third North Indian species described from *Rana tigrina,*
the common frog of Allahabad and Benares, are the more anterior position of the ovary in relation to the acetabulum, shape of the vesicula seminalis, smaller size of eggs, more anterior extent of the vitellaria and much smaller size of their follicles. The presence of a metraterm has not been recorded in G. tigrinum.

Note.—All measurements are in millimetres.

EXPLANATION OF THE FIGURES.

Fig. 1. Diplodiscus mehraí, n. sp., dorsal view.

Fig. 2. Sagittal section through region of the acetabulum of D. mehraí.

Fig. 3. Pneumonacés almorai, n. sp., ventral view.

Fig. 4. Cirrus-sac and metraterm with the genital pore in P. almorai.

Fig. 5. Ganeo Kumaonensis, n. sp., ventral view.

KEY TO ABBREVIATIONS USED.

Act., acetabulum; Ads., additional sucker; C.s., cirrus-sac; D.ej., ductus ejaculatorius; E.bl., excretory bladder; Eg., Egg; G.a., genital atrium; G.p., genital pore; I.c., intestinal eæcum; M.d., median excretory duct from acetabulum; M.g., Mehli’s gland; Mtm., metraterm; O.v., ovary; O.e., oral evaginations; Oes., oesophagus; Oes.b., oesophageal bulb; O.s., oral sucker; Ph., pharynx; P.p., pars prostatica; Pr.gl., prostate glands; R.sm., receptaculum seminis; T., testis; U.r., uterus; V.sm., vesicula seminalis; V.s.m. e.r., vesicula seminalis externa; V.s.m.in., vesicula seminalis interna; Vit., vitellaria; Y.r., Yolk reservoir.

REFERENCES.


. "Studies on the structure and life-history of Ostiolum oxyorchis (Ingles) from the California red-legged frog
B. P. Pande


* This paper was not accessible to me.