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STUDIES ON THE PROTOZOAN PARASITES OF ORISSA

By

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INTRODUCTION

Orissa state lies between 17°48′ and 22°30′ north latitude and 81°24′ and 87°18′ east longitude. The total land area of the state is 37 million acres. The hill ranges stretch from north to south and rise to an elevation of 762.0 to 1066.8 m. above sea level. On the north east region, there lies the Simlipal range in Mayurbhanj district. The central portion consists of dense forest and hills interposed with fertile valleys. The average temperature and annual rainfall in the state ranges from 20-30°c and 228.6-317.5 cm. respectively. The state with its diverse ecological niches affords suitable condition to accomodate various types of animals.

Several surveys were undertaken during 1971-1974 (4 years) covering almost all the districts of Orissa to study the Protozoan parasites of different group of animals. Only a few stray reports like Patnaik (1963), Patnaik and Ray (1965, 1966) Patnaik and Mohanty (1969), Patnaik and Acharjyo (1971, 1972) are available from this part of the country, who mainly studied the coccidian parasites of some domestic animals and zoo animals of Nandan Kanan Zoological garden, Orissa. A special emphasis was given to examine other group of freeliving animals in addition to the captive animals of Nandan Kanan Biological park for Protozoan parasites.

MATERIAL AND METHODS

Two hundred ninety eight examples of mammals belonging to 55 spp., 118 examples of birds belonging to 30 spp., 110 examples of reptiles belonging to 20 spp. and 35 examples of Amphibia consisting of 5 spp., were collected from Orissa and examined both for intestinal and blood parasites. Faecal samples were collected. A portion of it was kept in 2.5% Potassium dichromate solution for examination of

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coccidian parasites and another part of faecal sample was kept in 1% normal saline for examination of other intestinal protozoans. Blood was obtained by puncturing the brachial vein in case of birds and by cutting the tail tips and digits in case of reptiles and amphibians. When the animals were dead or sacrificed, blood was taken directly from the heart by means of syringe or capillary pipette. Blood smears were fixed in 100% methanol and stained with Romanowsky type of stains.

Observations

The protozoan parasites investigated during this survey have been broadly classified into two categories *viz.*, (A) Intestinal and (B) Blood inhabiting protozoans.

(A) Intestinal Protozoans :

A number of intestinal protozoa *viz.*, Coccidians, Ruminant ciliates, Nyctotherus and Opalinids were recorded from different group of animals.

The Barking deer *(Muntiacus muntjak)* was collected from Berbera forest, Puri district, Orissa and found to harbour the following rumen ciliates as endocommensals.

Family Ophryoscolecidae

Entodinium dubardi Buisson, 1923

Material : 1 ex. on slide ; Z. S. I. Reg. No. Pt. 1704 ; locality—Berbera, Orissa ; host—Barking deer ; 23.7.73 ; habitat—stomach ; coll. *Dr. A. K. Mandal.*

Description : Body oval, length 1.5 times the dorso-ventral diameter. The anterior end is truncated, strongly flattened laterally. Cytostome is relatively small in appearance, single contractile vacuole is situated to the left of the anterior end of the macronucleus. Macronucleus large, band or sausage-shaped. Micronucleus elongated situated at or in front of the middle of macronucleus. The dimension is 35-45 μm$\times$ 25-30μm.

Remarks : Banerjee (1955) reported this ciliate from barking deer.

Entodinium ovinum Dogiel, 1927

Material : 2 exs. on slides Z. S. I. Reg. No. Pt. 1719, 1934 ; locality—Berbera, Orissa ; host—Barking deer ; 22.7.73 & 23.7.73 ; habitat—stomach ; coll. *Dr. A. K. Mandal.*

Description : Body is oval with somewhat truncated anterior and rounded posterior end. Ciliary apparatus and endoplasmic sack do not present any characteristic feature. The latter contains numerous small food-particles. A large contractile vacuole is situated to the left of the anterior end of the macronucleus. Macronucleus is sausage-shaped, beginning near the anterior end of the body and extending along the dorsal surface up to the posterior third of the body. Micronucleus lies on the middle of the macronucleus. The body measures 52-65 μm in length and 34-40 μm in breadth.

Entodinium ovoideum Kofoid and MacLennan, 1930

Material : 2 exs. on slides ; Z. S. I. Reg. No. Pt. 1710, 1936 ; locality—Berbera, Orissa ; host—Barking deer ; 23.7.73 & 24.7.73 ; habitat—stomach ; *coll. Dr. A. K. Mandal.*

Description : Body ovoidal. Anterior end is truncated, posterior end smoothly rounded, with no indication of a ventral lobe. Endoplasmic sack bounded by a fairly distinct boundary layer. Contractile vacuole is situated to the left of the macronucleus at its anterior end. Macronucleus long, slightly wedge-shaped, wider anteriorly, extending along the anterior two-thirds to three-fourths of the length of the body in the dorsal mid-line. Micronucleus small, ellipsoidal lies on the left ventral side of the anterior third of the macronucleus. The dimension is 35-45 μm in length.

Entodinium simplex Dogiel, 1925

Material : 2 exs. on slides ; Z. S. I. Reg. No. Pt. 1718, 1735 ; locality—Berbera, Orissa ; host—Barking deer ; 23.7.73 & 24.7.73 ; habitat-stomach ; coll. *Dr. A. K. Mandal.*

Description : Body elongated oval, unarmed, with rounded posterior end. Contractile vacuole situated to the left of the anterior end of the macronucleus. Macronucleus band-shaped, closely applied against the surface of the body, and confined to its anterior two-thirds. Micronucleus small, oval, usually close to the middle of the macronucleus. The dimension is 40-50 μm in length and 22-28 μm in breadth.

Diplodinium minor (Dogiel, 1925)

Material : 2 exs. on slides ; Z. S. I. Reg. No. Pt. 1699, 1700 ; locality—Berbera, Orissa ; host—Barking deer ; 23.7.73 ; habitat—stomach ; coll. *Dr. A. K. Mandal.*

Description : Body oval, truncated anteriorly. Dorsal zone of membranellae lies at the same transverse level of the body as the adoral zone. A narrow, longitudinal, cuticular line extends along the right dorsal surface from the base of outer dorsal furrow to dorsal edge of the anal opening. Operculum shallow, projecting a short distance anteriorly. Endoplasmic sack does not form an anterior diverticulum extending into the operculum. Macronucleus relatively stout, somewhat hatchet-shaped, lying under the right surface of the body, slightly dorsal to the lateral midline. Micronucleus small, ovoid, lying in a slight concavity on the antero-dorsal surface of the macronucleus. Contractile vacuoles two, usually subequal, lying along the dorsal mid-line of the body. The body dimension is 55-78 μm in length, dorsoventral diameter is 40-50 μm.

Eudiplodinium maggii Fiorentini, 1889

Material : 3 exs. on slides ; Z. S. I. Reg. No. Pt. 1701, 1702, 1737 ; locality—Berbera, Orissa ; host—Barking deer ; 22.7.73 & 23.7.73 ; habitat—stomach ; coll. *Dr. A. K. Mandal.*

Description : Body roughly triangular in side view, sharply truncated anteriorly and tapering to a smoothly rounded posterior end. Dorsal surface is convex. Dorsal membranellae zone relatively large, operculum relatively small and inconspicuous. Skeletal plate lies beneath the right surface and extends from the oral region dorsally across the middle of the body. Usually two contractile vacuoles lie beneath the dorsal surface near the mid-line. Macronucleus elongate, rod-like with the anterior end hooked dorsally, situated beneath the middle of the right surface adjacent to the dorsal border of the skeletal plate. Micronucleus ovoidal, lying in the concavity of the hook. The body dimension is 105-250 μm in length.

Remarks : Banerjee (1955) reported this ciliate for the first time from barking deer.

Metadinium medium Awerinzew & Mutafowa, 1914

Material : One ex. Z. S. I. Reg. No. Pt. 1703 ; locality—Berbera, Orissa ; host—Barking deer ; 23.7.73 ; habitat—stomach ; coll. *Dr. A. K. Mandal.*

Description : Body large and heavy, flattend laterally. Anterior end blunt, posterior end truncated or slightly rounded. Dorsal membranellae zone also large. Operculum relatively very small. Two skeletal plates extend from the border of the oral area beneath the right surface towards the middle of the body. Endoplasmic sack relatively small,

usually with two distinct projections on the dorsal and ventral sides. Two large contractile vacuoles in the hollow between the lobes of the macronucleus. Macronucleus elongate, adjacent to the dorsal lobes of the skeletal plate. Micronucleus small, ovoid, lying in a slight depression along the anterior border of the middle portion of the macronucleus. The dimension is 110-250 μm in length.

The other intestinal forms which were recorded from different group of vertebrates already reported earlier are represented as follows :

Family BALANTIDIIDAE

Balantidium gracile Bezzenberger, 1904

Material : 2 exs., on slide ; Z. S. I. Reg. Nos. Pt 1643, 1644 ; locality —Konark, Puri district, Orissa ; host—*Rana* sp. ; 28.7.73 ; habitat—Rectum ; coll. *Dr. A. K. Mandal.*

Description : Body cylindrical, tapering and rounded at both ends ; peristom excavate, extending up to about one - seventh the length of the body ; two contractile vacuoles ; macronucleus oval ; micronucleus rounded.

Family OPALINIDAE

Opalina coracoidea Bezzenberger, 1904

Material : 1 ex. on slide ; Z. S. I. Reg. No. Pt. 1648 ; locality—Konark, Puri dist., Orissa ; host—*Rana cyanophlyctis* ; 30.7.73 ; habitat—intestine and rectum ; coll. *Dr. A. K. Mandal.*

Description : Body oval, anterior end narrower, posterior end broadly rounded ; nuclei numerous.

Protoopalina malabarica Uttangi, 1961

Material : 4 exs. on slides ; Z. S. I. Reg. Nos. Pt. 1683-1686 ; locality—Badrama, Sambalpur and Deogarh, Orissa ; host *Rana* sp. ; 23.12.72 & 31.12.72 ; habitat—Intestine and rectum ; coll. *Dr. A. K. Mandal.*

Description : Body elongated ; two pear shaped nuclei with a nuclear thread connecting the nuclei.

Family NYCTOTHERIDAE

Nyctotherus cordiformis (Ehrenberg, 1838)

Material : 1 ex. on slide ; Z. S. I. Reg. No. Pt. 1660 ; lacality—Badrama, Sambalpur, Orissa ; host—*Rana* sp. ; 24.12.72 ; habitat—Intestine and rectum coll. *Dr. A. K. Mandal.*

Description : Body bean or kidney-shaped, somewhat pointed anteriorly ; cytopharynx reaching beyond the middle of the body ; contractile vacuole single, posteroterminal, with cytopyge close to it. Macronucleus kidney-shaped, with a minute centrally attached micronucleus.

Nyctotherus magnus Bezzenberger, 1904

Material : 1 ex. on slide ; Z. S. I. Reg. No. Pt. 1661 ; locality—Badrama, Sambalpur, Orissa ; host—*Bufo* sp. ; 24.12.72 ; habitat-intestine and rectum ; coll. *Dr. A. K. Mandal.*

Description : Body flattened, kidney-shaped, with the posterior end slightly thicker than the anterior ; cytopharynx funnel-shaped ; contractile vacuole single, situated on the posterior part of the body ; macronucleus strongly flattened ; micronucleus lies infront of macronucleus.

Nyctotherus ovalis Leidy, 1849

Material : 9 exs. on slide ; Z. S. I. Reg. No. Pt. 1615-1623 ; locality—Badrama, Sambalpur, Orissa ; host—*Blata* sp. ; 26.12.72 ; habitat—hind gut ; coll. *Dr. A. K. Mandal.*

Description : Body broadly egg-shaped ; the anterior extremity rounded ; cytopharynx not reaching beyond the middle of the body, transverse in direction ; contractile vacuole single, subterminal ; macronucleus egg-shaped.

Plagiotoma dichogasteri Mandal and Nair, 1975

Material : 4 exs. on slides ; Z. S. I. Reg. Nos. Pt. 1745 (Holotype) and Pt. 1746-1748 (Paratype) ; locality—Khajuripada, Orissa ; host—Earthworm, *Dichogaster bolaui* ; 17.7.73 ; habitat—Coelom (posterior half) ; coll. *Dr. A. K. Mandal.*

Description : Body elongated, oval, anterior end bluntly pointed, posterior end rounded ; posterior portion below the cytopharynx vacuolated ; contractile vacuole single and located below the cytopharynx ; cytopharynx continues as a curved conical tube ; macronucleus an irregular fragmented mass ; micronuclei two, subspherical.

Remarks : This species was reported by Mandal and Nair (1975) for the first time in India.

Plagiotoma pellogasteri Mandal and Nair, 1976

Material : 5 exs. on slides ; Z. S. I. Reg. No. Pt. 1825 (Holotype) and Pt. 1826 to 1829 (Paratypes) ; locality—Biswanathpur, Koraput Dist.

Orissa ; host—Earthworm, *Pellogaster bengalensis* ; 10.7.74 ; habitat—Coelom ; coll. *Dr. A. K. Mandal.*

Description : Body elongated, flat, anterior end bluntly pointed, posterior end attenuated. Body ciliation uniform ; cytopharynx continuous as a conical tube ; peristome and cytostome provided with membranellae. Macronucleus consists of two unequal fragments ; micronucleus single, rounded.

Remarks : The species was reported by Mandal and Nair (1976) for the first time from India.

Family HYSTEROCINETIDAE

Ptychostomum drawidi Mandal and Nair, 1976

Material : 6 exs. on slides ; Z. S. I. Reg. No. Pt. 1819 (Holotype) and Pt. 1820-1824 (Paratypes) ; locality—Biswanathpur, Koraput Dist., Orissa ; host—Earthworm, *Drawida willsi* ; 10.7.74 ; habitat—Intestine ; coll. *Dr. A. K. Mandal.*

Description : Body elongated, flat anterior half-narrow ending in a blunt cone, posterior half broad truncated. Prominent sucker with 6-7 kinetics ; cytopharynx is a small tapering tube 6-7 μm in length ; single contractile vacuole is prominent and located at posterior third ; numerous food vacuoles on the posterior part ; macronucleus palm-shaped ; micronucleus not observed.

Remarks : The species was reported by Mandal and Nair (1976) for the first time from Orissa.

Family EIMERIIDAE

Eimeria polita Péllerdy, 1949

Material : 2 exs. on slide ; Z. S. I. Reg. Nos. Pt. 1641, 1642 ; locality —Nandan Kanan Zoo, Orissa ; host—wild boar (*Sus* sp.) ; 3.8.73 ; habitat—Intestine ; coll. *Dr. A. K. Mandal.*

Description : Oocyst ellipsoidal or broadly oval ; oocyst residuum absent ; sporocyst ellipsoid sporocyst residuum present ; sporozoites long. The cyst wall yellowish or colourless and thick.

Remarks : The species has been recorded for the first time from wild boar in India.

Isospora felis weynon, 1923

Material : 1 ex. on slide ; Z. S. I. Reg. No. Pt. 1639 ; locality—Nandan Kanan Zoo, Orissa, host—Tiger Cub (*Panthera tigris*) ; 3.8.73 ; habitat—Intestine coll. *Dr. A. .K Mandal.*

Description : Oocyst egg-shaped, with one pole somewhat narrowed : sporocyst pyriform ; each sporocyst contains four club-shaped sporozoites ; and a large rounded, granular residual mass ; oocyst residuum absent.

Remarks : This species has been recorded by a number of workers in domestic cats, *Felis domesticus*. But this report is for the first time from tiger cub from Orissa.

Family TRICHOMONADIDAE

Trichomonas gallinae (Rivolta, 1878)

Material : 3 exs. on slides ; Z. S. I. Reg. Nos. 1694, 1695 & 1696 ; locality—Berbera, Puri Dist., Orissa ; host—*Streptopelia chinensis* ; 21.7.73 ; habitat—Buccal cavity ; coll. *Dr. A. K. Mandal.*

Description : Body is roughly pyriform ; 4 anterior long flagella arise from the blepharoplast ; axostyle narrow and protrudes a short distance from the body ; no chromatic ring ; parabasal body sausage shaped ; undulating membrane does not reach the posterior end of the body ; an accessory filament present ; cytostome absent.

Remarks : This species has been recorded from a new host *Streptopelia chinensis* from Orissa.

(B) Blood protozoans :

A number of blood inhabiting protozoans belonging to the genera *Trypanosoma*, *Haemogregarina*, *Haemoproteus* and *Plasmodium* were recorded from different group of vertebrates. These are represented as follows :

Family TRYPANOSOMATIDAE

Trypanosoma rotatorium (Mayer, 1843)

Material : 15 exs. on slides ; Z. S. I. Reg. Nos. Pt. 1586-1591, 1595-1600, 1755-1757 ; locality—Lathore, Bolangir, Orissa and Biswanathpur, Orissa ; 13.12.72 ; host—*Bufo* sp. ; habitat—Blood ; coll. *Dr. A. K. Mandal.*

Description : These are pleomorphic haemoflagellate having 4 distinct forms *viz.* juvenile, slender, flal-leaf like and large compact form. Amongst which the flat leaf-like forms are most predominant. Cytoplasm densely granular in the posterior two-third of the body, stains deep blue and has striated myonemes ; nucleus rounded ; kinetoplast very small, surrounded by a halo and situated at the extreme posterior end of the body. Free flagellum is very prominent ; undulating membrane very very conspicuous with many folds.

Remarks : *T. rotatorium* has been described by the junior author (Ray, 1979) from a number of anuran hosts in India.

Trypanosoma sp.

Material : 2 exs. on slides ; locality—Berbera, Puri district, Orissa ; 21.7.73 host—Stone lizard ; habitat—blood ; coll. *Dr. A. K. Mandal.*

Description : Flat leaf-like, sometimes slender ; cytoplasm densely granular ; nucleus median ; kinetoplast dot-like ; undulating membrane conspicuous with many folds ; free flagellum long.

Remarks : This haemoflagellate has been recorded for the first time from stone lizard. But due to insufficient materials it is not possible to name the parasite.

Family HAEMOGREGARINIDAE

Haemogregarina triedri Robertson, 1908

Material : 3 exs. on slides ; Z. S. I. Reg. Nos. 1604—1606 ; locality—Deogarh, Orissa ; 30.12.72 ; host—*Hemidactylus* sp. ; habitat—blood ; coll. *Dr. A. K. Mandal.*

Description : Two gametocytic forms present (1) Broad bean-shaped and (2) long, slightly recurved forms ; having double capsule—a delicate inner and a loose outer one ; nucleus fragmented.

Haemogregarina mirabilis Castellani & Willey, 1904

Material : 4 exs. on slides ; locality—Pulicot lake, Orissa, 28.7.73 ; host—*Xenochrophis piscator* ; habitat—blood ; coll. *Dr. A. K. Mandal.*

Description : Forms elongate, thick, gregarine-like, capsulated gametocyte ; cytoplasm stains uniform blue ; nucleus stains reddish-blue and is near the anterior pole.

Remarks : The species has been reported by a number of workers from India (Bhatia, 1938).

Haemogregarina sp.

Material : 2 exs. on slides, locality—Berbera, Puri district, Orissa ; 27.7.73 ; host—*Calotes versicolor* ; habitat—blood ; coll. *Dr. A. K. Mandal.*

Description : Body of the gametocyte kidney-bean shaped, capsulated ; nucleus oval or rounded ; some forms have compact nucleus and some have vesicular nucleus.

Remarks : Due to the paucity of material it is not possible to designate any name of this parasite.

Haemogregarina sp.

Material : 3 exs. on slides ; locality—Berbera, Puri district, Orissa 27.7.73 ; host—stone lizard ; habitat—blood ; coll. *Dr. A. K. Mandal.*

Description : Body of the gametocyte elongated with one end tapering ; capsule absent ; free forms also present ; ronnded nucleus situated at the broader end.

Family HAEMOPROTEIDAE

Haemoproteus columbae Kruse, 1890

Material : Many exs. on slide ; Z. S. I. Reg. No. Pt. 1798 ; locality—Kalinga, Orissa ; host—*Streptopelia chinensis* ; 10.6.74 ; habitat—blood ; coll. *Dr. A. K. Mandal.*

Description : The young gametocytes are elongated having granules of black pigments in cytoplasm. The fully developed gametocytes are distinguishable as macro- and microgametocytes. Male or microgametocyte possesses a hyaline cytoplasm staining pale blue and nucleus with fine chromatin granules. Female or macrogametocyte possesses dense cytoplasm which stains deep blue. The nucleus is more compact than the microgametocytes,

Remarks ; Nandi nnd Mandal (1977) reported this parasite from Orissa for the first time.

Haemoproteus dicruri de Mello, 1935

Material : Many exs. on slides ; Z. S. I. Reg. No. Pt. 1743, 1744 ; locality—Kalinga, Orissa ; host—*Dicrurus adsimilis* ; 4.9.74 ; habitat—blood ; coll. *Dr. A. K. Mandal.*

Description : Gametocytes can be differentiated into macro or female and micro or male gametocyte. The female gametocyte stains deep blue with Leishman's stain but the poles and the borders remain unstained ; nucleus small, subcentral, stains pale rose. Male gametocytes are oval ; either light stained or not stained ; nucleus rod-like, subcentral, stained pale rose ; pigments in the form of large granules.

Haemoproteus fallisi Bennett & Campbell, 1972

Material : Many exs. on slide ; Z. S. I. Reg. No. Pt. 1796 ; locality—Kalinga, Orissa ; 4.7.74 ; host—*Copsychus saularis* ; habitat—blood : coll. *Dr. A. K. Mandal.*

Description : Macrogametocyte-small slightly halteridial, not extending upto the poles of the host cell ; cytoplasm coarsely granular,

vacuolated and staining blue ; nucleus compact, rounded sometimes lodged in a vesicle. Microgametocyte—the cytoplasm finely granular staining light blue ; nucleus median, large, staining light pink.

Haemoproteus (Parahaemoproteus) fringillae Labbé 1894

Material : Many exs. on slides ; Z. S. I. Reg. Nos. Pt. 1741, 1742 ; locality—Kalinga, Orissa ; 2.9.74 ; host—*Copsychus saularis* ; habitat—blood ; coll. *Dr. A. K. Mandal.*

Description : Macrogametocyte-halteridial with a marked constriction at the middle of the convex margin ; cytoplasm somewhat coarse with small scattered vacuoles, staining blue. Microgametocyte-cytoplasm granular staining light blue peripherally ; nucleus large central.

Remarks : While reviewing the haemoproteids of the family Turdidae, Bennett and Campbell (1972) synonymised *Haemoproteus moruony* de Mello and Brazdesa, 1916 with *H. fringillae.*

Haemoproteus lanii de Mello, 1937

Material : Many exs. on slides ; Z. S. I. Reg. Nos. Pt. 1789 1790, locality—Kalinga, Orissa ; 3.4.77 ; host ; *Lanius schach* habitat—blood ; coll. *Dr. A. K. Mandal.*

Description : Macrogametocyte halter-shaped, staining blue ; nucleus small, oval or triangular, generally subcentral ; pigment granules large scattered irregularly. Microgametocyte-irregularly halter-shaped, almost quadrangular, not stained or very light blue ; nucleus large, central, without definite outline ; pigment granules very minute, located at the poles.

Haemoproteus meropi Zargar, 1945

Material : Many exs. on slides ; Z. S. I. Reg. Nos. Pt. 1774, 1775, 1776 ; locality—Berbera, Orissa ; 28.7.73 ; host—*Merops orientalis*, habitat—blood ; coll. *Dr. A. K. Mandal.*

Description : Macrogametocyte-sausage-shapsd, encircling the host-cell nucleus ; cytoplasm finely granular, vacuolated, staining light blue ; nucleus compact, rounded or triangular, central or subcentral, staining light rose. Microgametocyte—cytoplasm finely granular, unstained or stained faint blue, vacuolated ; nucleus long, central.

Haemoproteus oryzivorae Anschutz, 1909

Material : Many exs. on slides ; Z. S. I. Reg. No. Pt. 1875 ; locality—Kalinga, Orissa ; 2.7.74 & 3.7.74 ; host—*Terpsiphone paradisi* and *Turdoides striatus* ; habitat—blood ; coll. *Dr. A. K. Mandal.*

Description : Macrogametocyte—broadly sausage-shaped to halteridial ; margin entire ; cytoplasm somewhat coarse, vacuolated, staining blue ; nucleus round to triangular, median to subcentral. Microgametocyte—same size and shape ; cytoplasm granular, faintly staining blue ; nucleus large, central, staining rose.

Haemoproteus passeris Kruse, 1890

Material : Many exs. on slide ; Z. S. I. Reg. No. Pt. 1640 ; locality—Deogarh, Orissa ; 30.12.72 ; host—*Passer domesticus* ; habitat—blood ; coll. *Dr. A. K. Mandal.*

Description : Macrogametocyte—small, slender, vacuolated ; cytoplasm finely granular, staining light blue ; nucleus oval or triangular. Microgametocyte—cytoplasm unstained or faintly stained ; nucleus large, central, staining rose.

Haemoproteus sacharovi Novy and MacNeal, 1904

Material : Many exs. on slide, Z. S. I. Reg. No. Pt. 1798 (mixed infection with *H. columbae*) ; locality—Kalinga, Orissa ; host—*Streptopelia chinensis* ; 10.6.74 ; habitat—blood ; coll. *Dr. A. K. Mandal.*

Description : Macrogametocyte—broadly sausage-shaped to slightly halteridial, not amoeboid ; cytoplasm coarsely granulated with numerous vacuoles, staining blue ; pigments yellow black, rod-like, scattered. The cytoplasm of microgametocyte stained faint blue ; nucleus large, central.

Haemoproteus sp.

Material : 1 ex. on slide ; locality—Kalinga, Orissa ; 3.4.74 ; host—*Turdoides striatus* ; habitat—blood, coll. *Dr. A. K. Mandal.*

Description : Gametocyte sausage-shaped or halteridial ; cytoplasm coarsely granular ; nucleus central or subcentral staining rose.

Remarks : Due to insufficient material no name could be proposed.

Family PLASMODIIDAE

Plasmodium (Novyella) vaughani Novy & MacNeal, 1904

Material : Many exs. on slide ; Z. S. I. Reg. No. Pt. 1868 ; locality—Berbera, Orissa ; 21.7.73 ; host—*Ploceus philippinus* ; habitat—blood ; coll. *Dr. A. K. Mandal.*

Description : Trophozoite irregularly ring shaped ; schizonts many with 10-20 merozoites ; chramatin relatively large, prominent ; pigments yellowish brown.

Remarks : Nandi and Mandal (1977) reported this species for the first time in India. The same authors also recorded a *Plasmodium* sp. in *Terpsiphone paradisi* (Lin.) from Kalinga, Orissa.

DISCUSSION

A review of the literature on rumen ciliates revealed that Banerjee (1955) reported for the first time, 5 species of ruminant ciliates viz. *Entodinium dubardi, E. muntiacum Diplodinium monacanthium, Eremoplastron asiaticus* and *Eudiplodinium maggii* from Barking deer of Darjeeling district, West Bengal. Roychoudhury and Choudhury (1981) reported six entodinial species from spotted deer (*Axis axis*) of Andaman Islands. The present survey reveals 7 species of Ophryoscolecid ciliate comprising 4 genera from Barking deer (*Muntiacus muntjak*). Of which *Entodinium ovinum, E. ovoideum, E. simplex, Diplodinium minor* and *Metadinium medium* have been recorded for the first time from Orissa, India.

Other intestinal protozoans communicated in the present paper include 1 species of *Balantidium* from frogs, 3 species of *Nyctotherus* from frogs and cockroaches, 2 species of *Opalina* and 1 species of *Protoopalina* from frogs from different parts of Orissa. In addition, one species of *Eimeria* from wild boar and one species of *Isospora* from a tiger cub from Nandan Kanan Biological Park have also been recorded. Three species of coelomic protozoa *viz., Plagiotoma dichogasteri, P. pellogasteri* and *Ptychostomum drawidi* have been reported by Mandal and Nair (1975, 1976) from earthworms *Dichogaster bolaui, Pellogaster bengalensis* and *Drawida willai* of Orissa respectively. *Trichomonas gallinae* has been found to infect a bird, *Streptopelia chinensis* which constitutes a new host record.

One haemoflagellate, *Trypanosoma rotatorium* has been detected from *Bufo melanostictus. Haemogregarina triedri* and *H. mirabilis* were found to infect a lizard and a snake respectively. In addition, 2 undetermined haemogregarine species were detected from lizards and snakes. Ten species of *Haemoproteus* and one species of *Plasmodium* have been recorded from the birds of Orissa state (Nandi and Mandal, 1977), of which *Haemoproteus passeris, H. sacharovi, H. fallisi* and one species of *Plasmodium viz., P.* (*Novyella*) *vaughani* are claimed to be reported for the first time from India. Infection with *Haemoproteus* spp. were common, occurring in 80% of the birds examined. The absence of infection with blood protozoa other than *Haemoproteus* and *Plasmodium* from these birds might possibly be attributed to the birds harbouring infections subpatent which went undetected in the blood smears or might

be due to the absence of specific vectors essential for spreading the infection.

It is evident from the present survey that the incidence of blood parasites in general is higher in comparison to intestinal prozoans. The endocommensal forms recorded from the Barking deer deserves worth mentioning.

Summary

The present paper includes 36 protozoan parasites recorded from the Orissa survey during the period 1971-1974. Of which 5 species of rumen ciliates have been reported for the first time in Barking deer from this part of Indian subcontinent. This survey reveals a higher incidence of blood parasites in comparison to intestinal protozoans.

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