Rec. zool. Surv. India, **70**: 39-120, 1976.

COCCIDIA OF INDIAN VERTEBRATES

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(With 10 Text-figures and 1 Table)

INTRODUCTION

The Coccidian parasites have representatives in all the major realms of the world. Out of 35 genera of the Order Coccidia, 17 are represented in India and they are comprised of nearly 200 species. In this order, the family Eimeriidae with its members infecting vertebrate hosts, constitute the maximum by its 10 genera and nearly 165 species. Amongst these, all the genera except *Lankestrella* require no intermediate animal transmitter for the spread of infection. They constitute the major part of the family. The information on most of the genera and species is scattered and inaccessible. Hence, an attempt has been made in the present paper to redescribe the less known genera and species along with the observations on the type specimens obtained from different institutions and individuals or the topotypes collected by the author. Where either the type series or the specimens are not available the original descriptions are merely cited as such. The paper also includes the descriptions of 13 species and a subspecies from different vertebrate hosts described as new earlier by the author. Keys for identification of species is provided where ever they are not available.

For purpose of covenience, this work is divided into five parts dealing with the parasites of fishes, amphibia, reptiles, birds and mammals.

The materials collected by the author will be deposited in the National Zoological Collection, Zoological Survey of India, in due course.

HISTORICAL ACCOUNT

Hake (1839) described Coccidia for the first time but he considered them as pathological products of the diseased animal. The complete history of coccidia was first described by Kloss (1855). Since then, many contributions have been made to the family Eimeriidae by many workers from India and abroad, of which the following are the important ones from abroad. Rivolta (1869), Schaudinn (1902), Wasielewsky (1904), Phisalix (1923, 1924), Leger (1926), Tyzzer (1928, 1929), Kotlan (1932), Hoare (1933), Yakimoff and Gousseff (1933, 1936), Allen (1934, and 1936), Vincent (1936), Hardcastle (1955), Becker (1956), Livine (1961a, b), Pellerdy (1963 and 1965).

In India, Ross (1898) was the pioneer in reporting Coccidian oocysts from mosquito. Cooper and Gulati (1926), Sen (1932) and

Ware (1936) recorded cases of bovine coccidiosis, Knowles and Das Gupta (1931, 1934) studied the coccidial infection in Carnivores. Ray and Das Gupta (1935 a, b, and 1936) described coccidia from toad and reptiles, the same authors (1937b) reported coccidia also from squirrel. Mitra and Das Gupta (1937) reported coccidia from Indian birds. Setna and Bana (1935 a, b) described *Eimeria harpodoni* from fish and *E. flaviviridis* from lizard. Bhatia (1938) extensively dealt with the Indian Sporozoa of different group of vertebrates and invertebrates. Chakravarty and Kar (1944 a, b, 1947 a, b), (Kar 1944) recorded several species of coccidia from reptiles and birds. Ray (1930) described the genus *Dorisiella* from a polychaete worm at Plymouth. The same author (1945) described *Wenyonella gallinae* from domestic fowl. Ray and Das Gupta (1937), Ray and Raghavachari (1942) described the genera *Pythonella* and *Octosporella* from Indian reptiles. Ray and Sarkar (1967) reported several species from Indian birds. Ray, D. K. (1959) submitted a thesis on Coccidia and coccidiosis in sheep and goats of India for his Doctoral Degree. Ray and Hiregaudar (1959) described several species of avian coccidia. Mandal and Chakravarty (1963, 64) described some species of avian coccidia. Mandal and Chakravarty (1965) described a new coccidium from marine fishes of Bengal. Mandal (1965) reported five species of coccidia from Indian birds along with a subspecies. Gill (1960, 1968) reported several species of Coccidian parasites from Indian pigs and cattle.

General Method and Technique

The topotypes were collected from different parts of India. A large proportion of samples were obtained from different sources. In compliance with the directions issued by the author, they were forwarded in 2.5 percent potassium dichromate solution either in specimen tubes or in test tubes. Particulars of the date of collection, etc. were shown in a consolidated statement that accompanied each consignment of sample, while, in addition each tube had a separate label attached to it to indicate its contents in respect of the same particulars.

For ensuring viability of the oocysts, the classical method of preserving them in a 2. 5 per cent aqueous solution of potassium dichromate was used. The faecal samples being taken either from droppings or directly from the rectum of the hosts. When a floating medium was required a salt solution of 1.2 specific gravity was used, invariably crushing or mixing of faecal samples was done in the dichromate in pestle and mortar, the material being there-after strained though a piece of fine-meshed wire guaze to eliminate debris. Identification of various species was mainly based on the biometry and morphology of the oocysts.

For an examination of oocysts under a microscope a small quantity of the surface material from the fluid was transferred to a slide with flattened end of a glass rod and then a cover glass placed over it.

The oocyst wall being impermeable (Cheissin, 1935) to all known staining reagents, no method exists that might be effectively utilised for a detailed study of their internal structure, such as the developing sporozoites. Nohmi (1927) and Crouch and Becker (1931) have described methods for staining coccidian oocysts, but neither of them has indicated whether these methods would lend themselves for use for the

purpose mentioned above. While the author does not claim to have come any nearer the solution of this universally admitted baffling problem, he found, as a result of a numerous trials, that when oocysts, after they have been concentrated by centrifugation and placed in tap water, for about 10 hours, at a temperature of 38.5°C, and stained with such-stains as Janus green, Delafield's haematoxylin, eosin or Indian ink, the oocyst wall took up the stain in a manner to expose the sporozoites, the residual body and the refractile globules, so as to make these structures suitable for a detailed study. This was, therefore, the routine method used by the writer for his study of the morphology of Coccidian oocysts. It is noteworthy that sporulation of the oocysts was also found to occur at 33·5°38·5° C in most cases, unless otherwise stated, the figures were drawn with the help of a camera lucida.

I. FISH

This is the first part of the series of the review work on the family Eimeriidae (Protozoa: Sporozoa) occurring in Indian fishes. All the species obtained so far from Indian fishes belong to the genus *Eimeria*.

Observation on Coccidian parasites obtained so far from Indian fishes

Genus **Eimeria** Schneider

Synonym: *Gregarina* Eimer, 1870, pro parte; *Cryptospermium* Rivolta, 1878, pro parte; *Psorospermium* Rivolta, 1878, pro parte; *Coccidium* Leuckert, 1879, pro parte; *Orthospora* Schneider, 1881, pro parte; *Karyophagus* Steinhaus, 1889; *Cytophagus* Steinhaus, 1891; *Globidium* Flesch, 1883, pro parte; *Acystis* Labbé, 1894; *Pfeifferia* Labbé, 1894; *Bananella* Labbé, 1895, *Goussia* Labbé; 1896; *Crystallospora* Labbé, 1896; *Pfeifferella* Labbé, 1899; *Pfeifferella* Labbé, 1899; *Paracoccidium* Laveran & Mesniil, 1902; *Jarrina* Leger & Hesse, 1922; "*G. Marotelia*, Ratz, 1905"? (Vide, Marotel: Parasitologie Veterinarie, 1949)

Type species: E. falciformis (Eimer)

Eimeria harpodoni Setna and Bana

(Text-fig. 1 a, b)

1933. *Eimeria* Sp. Setna, *Curr. Sci.* **2**: 97.
1935. *Eimeria harpodoni* Setna and Bana, *J. Roy, Micr. Soc.*, **55**: 166.

Description.—Oocysts spherical measuring 12.3-17.3μ in diameter with a mean of 14.02μ, with two transparent membranes, the outer one is thicker than the inner one. Cytoplasm granular with centrally placed nucleus. Cytoplasmic mass measures 8.5-10.5μ in diameter with a mean of 9.5μ. Four rounded sporoblasts 3.5-4.4μ in diameter are present. No micropyle is seen. Thin granular oocystic residuum clearly visible after the complete development of the oocyst. Sporocyst elliptical in shape with a long protuberance at one end. At the edge of this protuberance or neck there is a broad inverted V-shaped appendage. Sporocysts are 8.5-10.8 μ in length with a mean of 9.7 μ, 3.6-5.7μ in breadth with a mean of 4.8 μ; shape index is 2.02. Sporocystic residual compact mass present at one end of the sporocyst. Elongated

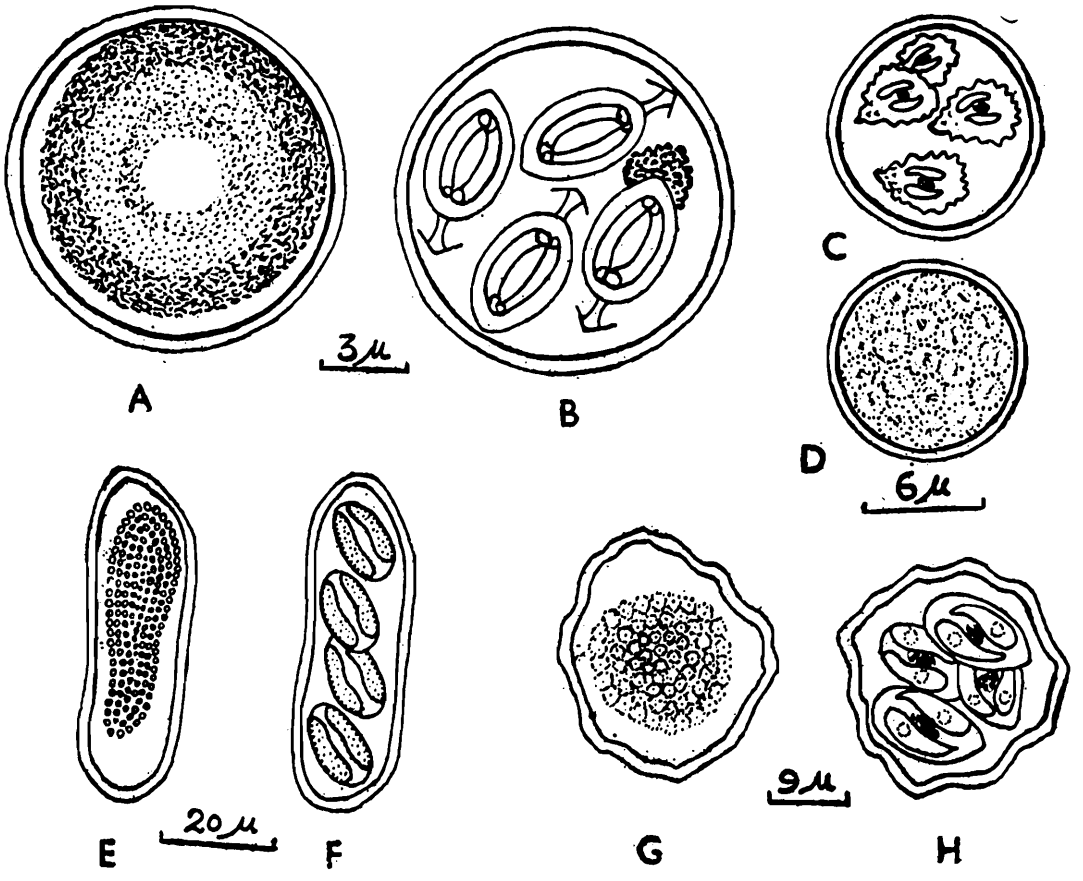
sporozoites are slightly curved at middle region with one pointed end. Sporozoites measure 7.3μ in length. Nucleus situated at broader end of the sporozoite.

Sporulation time—24-36 hours.

Habitat.—Alimentary canal of Bombay Duck, *Harpodon nehereus* (Ham. & Buch).

Locality.—Port Canning, West Bengal.

Remarks.—Setna and Bana (1935) described this species after obtaining the specimen from Bombay duck at Bombay. According to them "the sporocysts measure on an average 9.6μ in length and 4.6μ in width. "In this observation the sporocysts were found to be 8.5-10.8μ in length with a mean of 9.7μ and 3.6-5.7μ in width with a mean of 4.8μ. Moreover, oocysts of anomalous development, containing two instead of four sporocysts were observed by them.



Text-fig. 1.—Oocysts : a, b. *Eimeria harpodoni* Setna and Bana, a, unsporulated b, sporulated; c, d. *Eimeria zygaenae* Mandal and Chakravarty, c, immature d, mature; e, f. *Eimeria southwelli* Halawani, e, immature f, with sporoblast; g, h. *Eimeria notopteri* Chakravarty and Kar, g, immature h, fresh mature

Eimeria notopteri Chakravarty and Kar

(Text-fig. 1 g, h)

1944. *Eimeria notopteri* Chakravarty and Kar, *Curr. Sci.*, **13:** 61.

Description.—Oocysts irregular in shape measuring 23.5-25.2μ in length with a mean of 24.3μ and 21.4-22.5μ in width with a mean of 22.2μ. Double layered Oocystic wall of equal thickness are present.

Centrally placed cytoplasm measures 20.4-21.1 μ in diameter. Sporoblasts four in number measuring 5.8 μ in diameter. Neither a micropyle nor oocystic resudium is seen in the Oocyst. Sporocysts oval with both ends bluntly pointed. They measure 10.5-11.5 μ in length with a mean of 11.00 μ and 5.5-7.3 μ in width with a mean of 6.8 μ. The shape index is 1.5. Sporocystic residuum absent; the sporozoites are elongated in shape with one end pointed and the other end rounded. It measures 5.5 μ in length and the nucleus is situated in the middle.

Sporulation time.—48-50 hours.

Habitat.—Intestine of the fish, *Notopterus notopterus* (Pallas).

Locality.—Calcutta.

Remarks.—The above description is based on the examination of topotype. The same species is also obtained from *Notopterus chitala* Günther of Calcutta and Shillong. According to Chakravarty and Kar (1944), "both the mature and the immature cocysts are irregular in shape and measure 24.2 $\mu \times 22$ μ." In the present observation it was found to be 24.3×22.2 μ with shape index 1.6. The sporocysts measured 11 $\mu \times 6.6$ μ in the original description. In this observation the sporocysts measured 10.5-11.5 μ in length with a mean of 11.00 μ and 5.5-7.3 μ in width with a mean of 6.8 μ. The shape index is 1.6.

Eimeria southwelli Halawani

(Text-fig. 1 e, f)

1930. *Eimeria southwelli* Halawani, *Ann. Trop. Med. Parasit.*, **24**(1), 1.

Description.—Immature oocyst pear-shaped, the mature oocysts cylindrical or sausage-shaped provided with a single outer transparent wall measuring 1-3 μ in thickness. Oocysts measure 30.5-53.4 μ in length with a mean of 39.5 μ and 10.5-15.4 μ in width with a mean of 13.1 μ. The shape index is 3.02. The cytoplasmic mass appears as refractile globules. Sporoblasts four in number, each measure 10.5-13.5 μ in length with a mean of 10.6 μ. The shape index is 1.9. The sporocyst are oval in shape measure 10 μ-12 μ in length and 6.5 μ width. Sporocystic residuum absent but present at immature stage. Sporozoites are sausage-shaped with one pointed end. It measures 10.1 μ in length and arranged irregularly.

Sporulation time.—48 hours.

Habitat.—In the alimentary canal of the shark, *Scoliodon sorrakowah* (Cuvier).

Locality.—Sunderban, West Bengal.

Remarks.—Halawani (1930) obtained this species from a Devil fish, *Aetobatis narinari* in the Indian Ocean. The site of infection is in the liver. No such noticeable differences are found in the oocysts studied at present. Halawani noted a remarkable feature of this parasite regarding the intra cellular occurrence in the embryo of *Aetobatis narinari*,

Eimeria zygaenae Mandal and Chakravarty

(Text-fig. 1 c, d)

1965. *Eimeria zygaenae* Mandal and Chakravarty, *Sci. & Cult.*, **31**: 381.

Description.—Perfectly round oocysts, measuring 12.1-14.3 μ in diameter with a mean of 13.2 μ, two transparent oocystic envelopes present, outer one is thinner than the inner one; highly refractile cytoplasm completely fills up the oocyst. Sporoblasts 4 in number. No oocystic residuum and micropyle seen after complete development of the occyst. Sporocyst pyriform in shape, anterior end bluntly pointed and the posterior end rounded. Wall of the sporocysts warty and yellowish in colour, sporocysts measures 7.7-8.9 μ in length with a mean of 8.8μ and 4.5-6.6 μ in width with a mean of 5.5 μ shape index is 1.6. Sporocystic residuum present as globular mass. Sporozoites elongated in shape, 6.6 μ in length with a centrally placed nucleus.

Sporulation time.—72-80 hours.

Habitat.—Small intestine of the hammer headed shark, *Zygaena blochii* (Cuvier).

Remarks.—This species is obtained afterwards from the Hammer headed shark collected from the Sunderbans, West Bengal and described. No noticeable differences are found except for the size of sporocysts. It was mentioned previously that the sporocysts measured 8.8 × 5.5μ. In the present instance they measure 7.7-8.9 μ in length and 4.5-6.6μ in width.

Key to **Eimeria** *species from Indian fishes*

(A)	Oocyst spherical or rounded	
	(1) Sporocyst elliptical with a long protuberance at one end.	*.E. harpodoni*
	(2) Sporocyst pyriform, wall provided with worts.	*.E. zygaenae*
(B)	Oocyst not spherical	
	(1) Sporocyst oval with sausage-shaped sporozoites of 10.1μ in length.	*.E. southwelli*
	(2) Sporocyst oval with elongated sporozoites of 5.5μ in length.	*.E. notopteri*

II. Amphibia

This part is in continuation of the previous work dealing with Coccidian parasites obtained from Indian fishes. In this part, the occurrence and distribution of Coccidian parasites in Indian Amphibia are dealt with. Uptil now two species of genus *Isospora* and three species of the genus *Eimeria* have been described from Indian Amphibians.

Observation on Coccidian parasites obtained so far from class Amphibia in India

Genus **Isospora** Schneider

Synonym: *Gregarina* Eimer, 1870, pro parte, *Cytosperminm* Rivotta, 1878, pro parte *Psorospermium* Rivotta, 1878, pro parte; *Coccidium* Leuckart, 1879, pro parte; *Diplospora* Labbé, 1893; Klossia, Labbé 1894, *Hyaloklossia* Labbé 1894, pro parte *Lucetina* Henry & Leblois, 1925, 1926.

Type Species: **Isospora rara** Schneider

Isospora stomaticae Chakravarty and Kar

(Text-fig. 2 c, d)

1944. *I. stomaticae* Chakravarty and Kar, *Proc. Indian Sci. Congr.*: 104. (1952, Chakravarty and Kar, *Proc. zool. Soc. Bengal*, **5**(1): 12.)

Description.—Oocysts oval or spherical, double layered, both the walls very thin, without any residuum and micropyle. Oocysts measure 24.5-26.5μ in length with a mean of 25.5μ and 15.5-19.5μ in width with a mean of 17.5μ. The shape index is 1.5. The globular and refractile cytoplasm measures 20.4μ in diameter. The sporocysts are egg-shaped, with a thin sporocystic membrane and a knob-like structure at the anterior end (stieda body). The sporocysts measure 15.5-17.5μ with a mean of 16.5μ and 10.5μ in width with a mean of 10.9μ. The sporocystic residuum present as a granular mass. The shape index is 1.5. Sporozoites elongated measuring 12.5-14.8μ in length and 2.5-4.5μ in width with one end narrower than the other. Nucleus is centrally placed and oval in shape.

Sporulation time.—48-60 hours.

Habitat.—Intestine of *Bufo stomaticus* Schneider, Calcutta.

Remarks.—Topotype was examined and it was found to differ slightly from original measurements. In the present author's description the oocysts measure 24.00-26.30μ in length and 14.50-20.00μ in breadth. Sporocysts measure 15.40-17.00μ in length and 11.0μ in breadth. Sporozoites measure 13.20μ in length and 3.30μ in breadth.

Isospora wenyoni Ray and Das Gupta

(Text-fig. 2 a, b)

1935. *I. wenyoni* Ray and Das Gupta, *Arch. Protistenk.*, **86**: 219. (1952. Chakravarty and Kar, *Proc. zool. Soc. Bengal*, **5**: 13.)

Description.—Oocysts subcylindrical, double layered with a thick inner layer. The oocysts measures 15.3-20.5μ in length with a mean of 17.5μ and 13.5μ-15.5μ in width with a mean of 14.5μ. The shape index is 1.2. Cytoplasm compact and refractile. Oocystic residuum present and micropyle absent. Sporocysts oval in immature stages and become naviculoid later on. It measures 10.0-13.5μ in length with a mean of 11.8μ and 7.5μ-9.5μ in width with a mean of 8.5μ. The shape index is 1.3. Sporocystic residuum present as compact mass. Sporozoites are elongated tapering at one end. The nucleus is situated at the posterior end.

Sporulation time.—60-70 hours.

Habitat.—Small intestine of *Bufo melanostictus* Schneider, Calcutta.

Remarks.—This species was obtained by Chakravarty and Kar (1952) from *Rana tigrina* and *Rana limnocharis* and they emended the description. The topotype from the specific host and other examples

of the species were collected from *Rana tigrina* in Calcutta. The present observation does not correspond to the previous description in some points of measurement. In original description the oocysts measure 16-20μ in length and 11-14μ in breadth and are without any residuum. The sporulation time observed by me is 60-70 hours at room temperature whereas it has been mentioned by the original authors as 3 days at room temperature.

Genus **Eimeria** Schneider

Eimeria cyanophlyctis Chakravarty and Kar

(Text-fig. 2 e, f)

1944. *E. cyanophlyctis* Chakravarty and Kar, *Proc. Indian Sci. Congr.*: 104 (1952. Chakravarty and Kar, *Proc. zool. Soc., Bengal*, **5**: 14).

Description.—Both the immature and mature oocysts are oval or sub-spherical in shape. In some of the former, a clear spherical globule is present. The single layered oocystic membrane is very thin and transparent. An oocystic residuum in the form of an irregular mass containing a globule is present. Micropyle absent. Oocysts measure 15.5-20.2μ in length with a mean of 17.9μ and 15.5-13.3μ in width with a mean of 16.7μ. The shape index is 1.07. Sporocysts spindle-shaped, tapering at one end with scattered residuum; measure 10.5-12.5μ in length with a mean of 11.5μ and 4.5-6.5μ in width with a mean of 5.5μ. The shape index is 2.09. Sporozoites are elongated with pointed anterior end and highly granular cytoplasm having refringent globules. The nucleus is situated at the broader end of the sporozoite.

Sporulation time.—60-75 hours.

Habitat.—In the intestine of *Rana cyanophlyctis* Schneider, Calcutta.

Remarks.—The description of the topotype as stated above differs from that of the original authors. They stated that the oocysts measure 15.40-19.60μ, in length and 15.40-17.60μ in width; sporocysts 11.00μ in length and 4.40-6.60μ in width.

Eimeria himalayanum Ray and Misra

(Text-fig. 2 i, j)

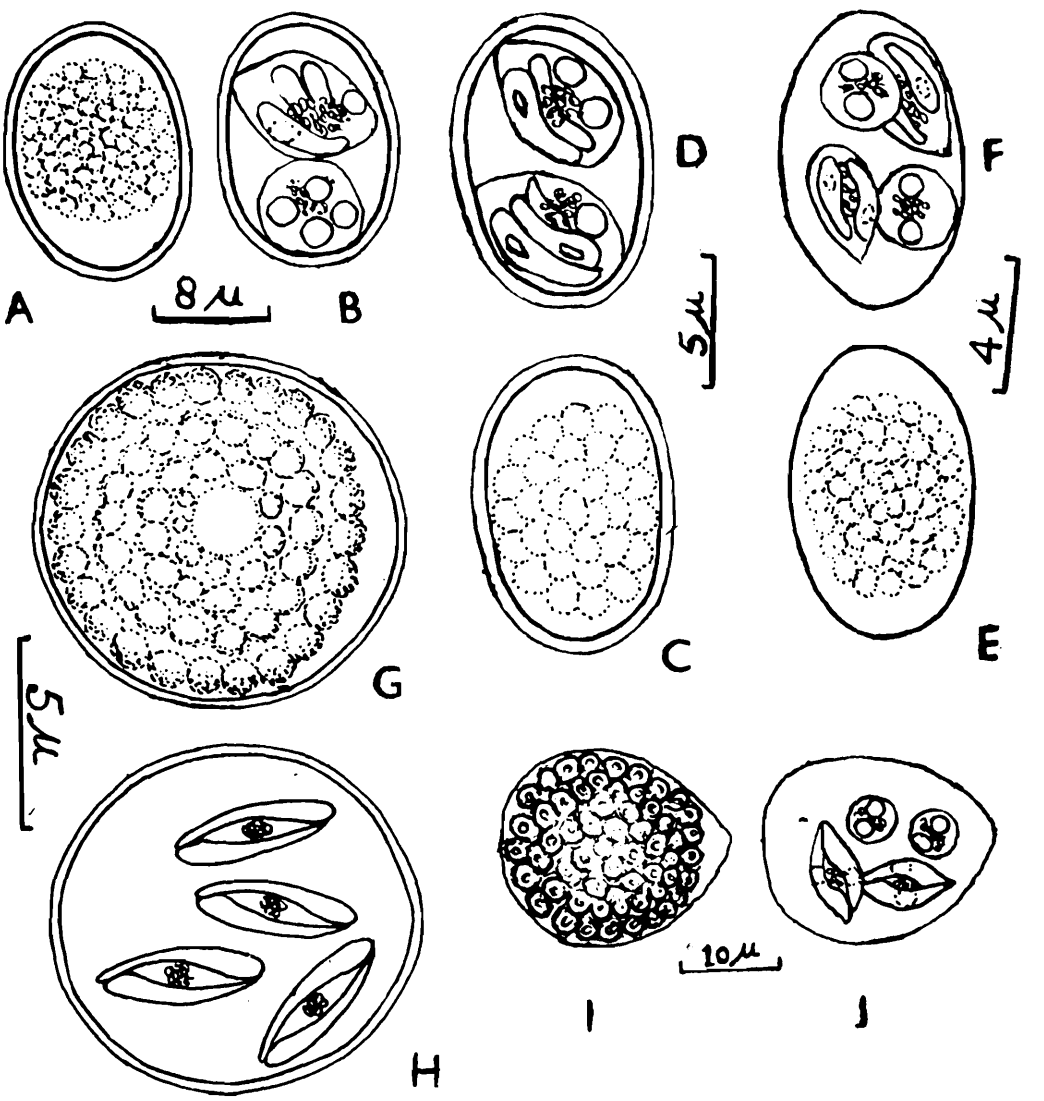
1942. *E. himalayanum* Ray and Misra, *Proc. Indian Sci. Congr.*: 169. (1943. Ray and Misra, *Proc. Nat. Inst. Sci. India*, **9**: 266.)

Description.—Oocysts rounded oval, with two thin oocystic walls without micropyle, residue absent. Oocysts measure 7.5-10.5μ in diameter with a mean of 9.2μ. Sporocysts naviculoid, measure 4.5-6.5μ in length with a mean of 5.5μ and 2.5μ-3.5μ in width with a mean of 2.9μ, with globular residuum. Sporozoites club-shaped with a centrally placed nucleus and siderophilous structure at one of the poles. Sporozoites measure 3.8-4.5μ in length.

Sporulation time.—48-72 hours.

Habitat.—Small intestine (mucous membrane) of *Bufo himalayanus* Boulenger from Mukteswar, U.P.

Remarks.—The above description is based on the topotype. The measurements of oocysts and sporocysts slightly differs from the original description. According to Ray and Misra (1945) Oocysts measure 7-10μ along its broadest diameter, sporocysts 3.2$\mu \times$2.8μ and sporozoites 4.6$\times$1.4μ.



Text-fig. 2.—Oocysts : a, b. *Isospora wenyoni* Ray and Das Gupta, a, immature b, mature; c, d. *Isospora stomaticae* Chakraborty and Kar, c, unsporulated d, mature; e. f. *Eimeria cyanophlyctis* Chakravarty and Kar, e. immature, f. mature; g, h. *Eimeria laminata* Ray, g, immature h, mature; i, j. *Eimeria himalayanum* Ray and Misra, i, immature j, with sporoblast.

Eimeria laminata Ray

(Text-fig. 2 g, h)

1935. *E. laminata* Ray, *Parasitol.*, **27**(3): 370.

Description.—Oocysts spherical, measure 8.5μ-11.0μ in diameter with a mean of 9.8μ. Oocystic wall double layered, outer one thicker than the inner one, no oocystic residuum; rounded cytoplasm contains

highly refringent, refractile globules. Spindle-shaped sporocysts pointed at both ends and without any knob. Sporocysts measure 5.2-6.5μ in length and 3.0μ width. The shape index is 1.96. Sporocystic residuum present. Sporozoites are elongated bodies with one end bluntly pointed than the other with a nucleus at the middle.

Sporulation time.—60-72 hours.

Habitat.—Small intestine of Indian toad, *Bufo melanostictus* Schneider from Calcutta, West Bengal.

Remarks.—The topotype was collected and observed. The original authors described the oocysts as spherical and measuring 8-11μ in diameter without any residuum. Sporocysts spindle-shaped, measuring 4.5-5.8μ in length with a breadth slightly under 3μ. They found only 2 specimens infected out of 200 examined.

Key to the **Isospora** *species from Indian Amphibia*

A. Oocysts sub-cylindrical
   (*i*) Size of oocyst 15.3—20.5 × 13.5—15.5μ. . *Isospora wenyoni*

B. Oocysts broadly oval
   (*i*) Size of oocyst 24.5—26.5 × 15.5—19.5μ. . *I. stomaticae*

Key to the **Eimeria** *species from Indian Amphibia*

A. Oocyst spherical, measuring 8.5—11.0μ. . *Eimeria laminata*

B. Oocyst not spherical
   (*i*) Oocyst without residium and sporocyst naviculoid. . . *E. himalayanum*
   (*ii*) Oocyst with residuum and sporocyst spindle-shaped. . *E. cyanophlyctis*

III. Reptilia

This is the third part of the series dealing with the Coccidian parasites obtained from Indian reptiles. Twenty two species belonging to 5 genera of the family Eimeriidae have so far been described from Indian reptiles.

Observation on Coccidian parasites obtained so far from class Reptilia in India.

Genus **Caryospora** Leger

Synonym: *Eumonospora* Allen, 1933 (1932, p. 193)

Type Species: C. simplex Leger

Caryospora gekkonis Chakravarty and Kar

(Text-fig. 3 o, p)

1947. *C. gekkonis* Chakravarty and Kar, *J. Roy asiatic Soc., Bengal,* (Sc.) **12**(1): 3.

Description.—Oocysts spherical, measuring 18.5-20.8μ in diameter with a mean of 19.7μ, double walled, outer thin and the inner wall being 1.1μ in thickness; no oocystic residuum, micropyle present. Sporocyst

almost spherical, thin walled and measures 10.5-12.5μ with a mean of 11.5 μ in diameter of which a blunt knob like refractile part is drawn out. Sporocystic residuum scattered as diffuse residual mass. The sporozoites are almost spherical in shape and measure 2.5μ diameter.

Sporulation time.—35-50 hours.

Habitat.—Small intestine of *Gekko geko* (Linn.), Calcutta, West Bengal.

Remarks.—The description of the topotype differs from the original description in respect of measurements, where oocysts and sporocysts measure 19.8μ and 11μ in diameter respectively.

Isospora calotesi Bhatia

(Text-fig. 3 s, t)

1933. *Isospora* sp. Setna, *Cur. Sci.* **2**: 97.,
1938. *I. calotesi* Bhatia, *Fauna of British India*, (Protozoa: Sporozoa): 167.
1948. Chakravarty and Kar, *J. Roy asiatic Soc., Bengal,* **12**: 4).

Description.—Both unsporulated and sporulated oocysts are usually spherical or subspherical. It is provided with a double-layered wall with a micropyle and without any oocystic residuum. It measures 25.0-37μ with a mean 32.5μ. The sporocysts are elliptical in shape, with a small knob at the anterior end (Steida body) and rounded posterior end. In some cases the posterior end abruptly tapers to a blunt point. The sporocystic residual body is aggregated together into an irregular mass. The sporocysts measure 12.5-17.5μ in length with a mean 14.5μ and 9.5-10.5μ in width with a mean 9.8μ. The shape index is 1.5. The sporozoites are elongated and irregularly arranged with one of the ends pointed and other rounded. The spherical nucleus is situated at the centre. It measures 12.00μ in length and 2.5μ in width.

Sporulation time.—48-60 hours.

Habitat.—Intestine of the garden lizard, *Calotes versicolor* (Daudin), Calcutta.

Remarks.—The specimen was collected from the suburbs of Calcutta and described. It differs in measurements. Bhatia (1938) described only the endogenous stages. Its process of sporogony is known from the work of Chakravarty and Kar (1948), where the oocysts measure 25.5μ-38.8μ in diameter and the sporocysts measure 12.3μ-16.5$\mu \times$ 10.3μ.

Isospora knowlesi Ray and Das Gupta

(Text-fig. 3 g, h)

1935. *Isospora* sp. Knowles and Das Gupta, *Indian J. med. Res.*, **22**: 703, 705.
1937. *I. knowlesi* Ray and Das Gupta, *Arch. Protistenk.*, **88**: 270.

Description.—Spherical oocysts with a single layer of 1.5μ thickness, 17.5-23.14μ in diameter with a mean of 21.7μ. The refractile and granular cytoplasm measures 15.5-17.3μ, in diameter. Oocystic residuum

and micropyle absent. Sporocysts ellipsoidal with a mean of 14.3 and 7.3-10.5μ in width with a mean of 8.5μ.

The shape index is 1.7 Sporozoites are elongated tapering towards one end and measure 10.5μ-12.5μ in length.

Sporulation time.—4-5 days.

Habitat.—Small intestine (intracellular) of *Hemidactylus flaviviridis* (Rüppell), Calcutta.

Remarks.—The topotype differs mainly in measurements from its original description, where the oocysts measure 18.00-23.00μ in diameter and the sporocysts measure 12-15μ in length and 8-10μ in width. Moreover the structure of the sporocysts was not mentioned.

Isospora minuta Mitra and Das Gupta

(Text-fig. 3 a, b)

1937. *I. minuta* Mitra and Das Gupta, *Proc. Indian Sci. Congr.*: 291
(1938. Das Gupta, *J. Bombay nat. Hist. Soc.* **40**: 236.)

Description.—Oocysts cylindrical, with a thin single wall. It measures 14.5-16.5μ in length with a mean of 15.5μ and 6.8-8.5μ in width with a mean of 7.7μ. The shape index is 2.01. No oocystic residium or any micropyle is seen. The sporocysts are spherical in shape measuring 6.5-9.9μ in diameter with a mean of 7.7μ. Sporocystic residuum present as a compact mass. The sporozoites are elongated tapering at one end measuring 3.5-4.6μ in length.

Sporulation time.—50-72 hours.

Habitat.—Small intestine of the Cobra, *Naja naja* Linn, from Sundarbans, West Bengal.

Remarks.—The specimen was observed after collecting the host from Sundarban and the same species is also obtained from *Naja hannah* (Linn.) from Shillong, Meghalaya. The original authors described this species imperfectly. But Das Gupta (1938) redescribed this species, where the oocysts measure 15 $\times$ 7.5μ and sporocysts 7.5μ and the sporulation time is 3 days. The shape of the oocysts was not mentioned by him.

Isospora rayi Mandal

1966. *I. rayi* Mandal, *Sci. & Cult.*, **32**: 507.

Description.—Immature oocysts spherical in shape with double envelope, the outer wall thin and membranous while the inner one is thick, yellowish red in day light, measure 1.00-1.50μ in thickness; centrally placed spherical cytoplasm measure 20.0-20.8μ in diameter and appears as beaded, refringent, refractile globules. Mature oocysts measure 25.5μ-27.4μ in diameter with a mean of 26.3μ; oocystic residuum and micropyle absent; sporocysts, naviculoid in shape, tapering at both ends, measuring 14.5μ-16.3μ in length and 9.15-10.5μ in breadh with a mean of 15.4μ $\times$ 8.6μ and shape index 1.5; blackish sporocystic

residuum visible as shiny globular materials and scattered irregularly inside the sporocyst. Bean-shaped sporozoites measure 7.5μ-8.15μ in length with a mean of 7.9μ, nucleus situated at the middle of the sporozoite and appears as a refractile area.

Sporulation time.—50-60 hours.

Habitat.—Rectum of a lizard, *Ptyctolaemus* sp., Shillong.

Remarks.—The topotype was collected and examined and no noticeable differences are found.

Genus **Eimeria** Schneider

Eimeria flaviviridis Setna and Bana

(Text-fig. 3 u, v)

1933. *Eimeria* sp. Setna, *Curr. Sci.*, **2**: 97,
1935. *Eimeria* ("Species B') Knowles and Das Gupta, *Indian J. med. Res.*, **22**: 703, 705.
1935. *E. flaviviridis* Setna and Bana, *J. Roy. micr. Soc.*, London, **55**: 256.

Description.—Oocysts elliptical, colourless, measuring 18.5-35.4μ in length with a mean of 25.5μ and 10.5-15.5μ in width with a mean of 12.5μ. The shape index is 2. Micropyle and oocystic residium absent. The ovoid sporocysts measure 6.5-9.4μ in length with a mean of 8.3μ and 5.3-8.3μ in width with a mean of 6.9μ. The shape index is 1.2. Granular sporocystic residium present in the middle region. Sporozoites are elongated in shape with a bend at mid region. They overlap each other inside the sporocyst at one end. Sporozoites measure 9.5μ in length with a nucleus situated at rounded posterior end.

Sporulation time.—3-4 days.

Habitat.—Gall bladder and intestine of the lizard *Hemidactylus flaviviridis* (Rüppell), Bombay.

Remarks.—The topotype has been examined. The host was also collected from Barasat, West Bengal. This description corresponds with the original description except in measurements. According to Setna and Bana (1935) oocysts vary from 25 to 34μ in length and 11 to 14μ in breadth and sporocysts measure 8μ by 6μ.

Eimeria gupti Bhatia

1936. *E. cylindrica* Ray and Das Gupta, *Proc. Indian Sci. Congr.*: 345, non *E. cylindrica* Wilson, 1931, *Va. Agric. Exp. Sta. Tech. Bull.* **42**: 3.
1936: *Eimeria gupti*, Bhatia, *Curr. Sci.*: **5**: 117.

Description.—Oocysts cylindrical, measuring 36μ by 18μ. Oocystic residuum present.

Habitat.—Rectum of snake, *Natrix piscator* (Schneid.), Calcutta.

Remarks.—This description is based on that of Bhatia (1938). Twenty hosts were collected from subarbs of Calcutta and examined but none of them was found to be infected. The oocysts with such incomplete description as well as the non-availability of any topotype threaten the validity of the species.

Eimeria hemidactyli Knowles and Das Gupta

1935. *E. hemidactyli*, Knowles and Das Gupta, *Indian Jour. Med. Res.*, **22**: 705.

Description.—The Oocysts are lemon-shaped with two layers of equal thickness. It measures 16.5-21.5μ in length with a mean of 18.50μ and 12.5-16.2μ in width with a mean of 14.4μ. The shape index is 1.3. Oocystic residuum and micropyle absent. Granular cytoplasm gives rise to four rounded sporoblasts. Ovoid sporocysts measure 9.5-11.3μ in length with a mean of 10.4μ and 7.5-8.5μ in width with a mean of 8.00μ. The shape index is 1.3. The sporocystic residuum is scattered inside the sporocysts. The elongated sporozoites are pointed at one end. They measure 6.5μ in length. The nucleus is situated at the posterior end.

Sporulation time.—24-36 hours.

Habitat.—Gut contents of *Hemidactylus flaviviridis* (Rüppell) Calcutta.

Remarks.—The topotype was collected and observed as stated above. It differs from original descriptions only in measurements, where the oocysts measure 17-20μ in length and 13.6-17 μ in width.

Eimeria irregularis Kar

(Text-fig. 3 m, n)

1944. *E. irregularis* Kar, *Indian Vet. Jour*, **20**: 231.

Description.—The immature oocysts are spherical in shape and the mature ones irregular and without micropyle or oocystic residuum. The oocysts measure 14.6-16.5μ in diameter with a mean of 15.5μ. Cytoplasm measure 11.5-12.5μ in diameter. Spindle-shaped sporobiasts measure 8.5$\times$4.5μ. The sporocysts are elongately oval in shape having rounded posterior and a bluntly pointed anterior end. At the anterior end of the sporocyst there is a little knob. A sporocyst measures 11.5-13.5μ in length with a mean of 12.5μ and 6.5-7.5μ in width with a mean of 6.9μ. Sporocystic residuum is present. The sporozoites are sausage-shaped having both the ends rounded. Sporozoites measure 8.5μ $\times$2.5μ. They have a spherical nucleus placed at the centre of the body.

Sporulation time.—30-45 hours.

Habitat.—Intestine of Pond Turtle *Lissemys punctata* (Bonnaterre), Calcutta.

Remarks.—The topotype was examined and it differs in the following characters. According to Kar (1944) the oocysts measure 15.4μ is diameter. The sporocysts and sporozoites measure 12$\mu\times$6.6 and 8.8$\mu\times$2.2 respectively.

Eimeria kermoganti (Simond)

1901. *Coccidium kermoganti*, Simond, *Compt. Rend. Soc. Biol.* **53**: 483.
1926. *Eimeria kermonganti*, Wenyon, *Protozoology*,: 860.
1921. *Eimeria kormoganti*, (Simond), Reichenow, *Handbuch der pathogenen Protozoen*: 949.

Description.—Oocysts spherical, measure 20μ-22μ in diameter, Cytoplasm granular, oocysts double walled of equal thickness, oocystic residuum absent. Sporocysts oval, sporocystic residual massesat one end. Sporozoites comma-shaped and transparent.

Sporulation time.—Not known.

Habitat.—Spleen of Gharial, *Gavialis gangeticus* (Gmein) In the river Ganges.

Remarks.—The description is based on that of Bhatia (1938) and Pellerdy (1965).

Eimeria knowlesi Bhatia

1935. *Eimeria* ("Species A") Knowles and Das Gupta *Indian Jour. Med. Res.*, **22**: 701.
1936. *Eimeria knowlesi* Bhatia, *Curr. Sci.*, Bangalore, **5**: 177.
1937. *Eimeria* ("Species A"), Ray and Das Gupta, *Arch. Protistenk.*, **88**: 270.

Description.—The oocysts are spherical or oval, double-walled having granular cytoplasm and without any micropyle and residuum. They measure 16.5-20.5μ in length with a mean of 18.5μ and 14.5-18.5μ in width with a mean of 16.5μ. The sporocysts are ovoid in shape, measure 9.00-11.00μ length with a mean of 10.00μ and 7.5μ-8.5 in width with a mean of 7.9μ. The sporozoites are elongated with nucleus situated at one posterior round end. The sporocystic residual mass is placed in between sporozoites. The sporozoites measure 7.2μ in length.

Sporulation time.—30-40 hours.

Habitat.—Gut contents of *Hemidactylus flaviviridis* (Rüppell), Calcutta.

Remarks.—Topotype was collected and observed. It has been found that this species is closely related to *E hemidactyli* Knowles and Das Gupta. Measurements given in original description of oocysts are 16.20$\mu \times$ 14.18μ. But both of them differ in the shape of the oocysts; *E. knowlesi* is spherical or oval and *E. hemidactyli* is lemon-shaped.

Eimeria innominata Kar

(Text-fig. 3q, r)

1944. *E. innominata* Kar, *Indian vet. J.* **20**: 232.

Description.—Oocysts subspherical; double-walled, the outer is thinner than the inner one. Oocysts measure 16.5-18.8 μ in length with a mean of 17.7 μ and 11.5-14.3 μ in width with a mean of 13.5 μ. The shape index is 1.3. Spherical cytoplasm measures 7.3-8.2μ in diameter and is provided with highly refringent globules. Micropyle and oocystic residuum absent. Sporocysts pyriform with an irregular shaped knob at the pointed end. Sporocysts measure 10.5-12.3μ in length with a mean of 11.3 μ and 5.5-7.5μ in width with a mean of 6.5 μ. The shape index is 1.7. Sporocystic residual mass present. The sporozoites are elongated in shape with one sharply pointed end and measure 6.5-7.5μ in length and 4.1-4.6μ in width with nucleus at the centre.

Sporulation time.—Not known.

Habitat.—Liver of pond turtle, *Lissemys punctata* (Bonnaterre), Calcutta.

Remarks.—Topotype differs from the original description in the following points:

According to Kar (1944) oocysts measure 17.6$\mu \times$13.2μ. The sporocysts and sporozoites are 11$\mu \times$6.6μ and 6.6$\mu \times$4.4μ respectively.

Eimeria koormae Das Gupta

(Text-fig. 3 c, d)

1938. *E. koormae* Das Gupta, *Arch. Protistenk.*, **90**: 414.

Description.—Spherical oocysts with two layers, the inner layer being thicker than the outer. Granular cytoplasm and micropyle present. The oocysts measure 13.5-15.8μ in diameter with a mean of 14.6μ. Oocystic residuum absent. Spindle-shaped sporocysts tapering at both ends, measuring 9.3-11.3μ in length with a mean of 10.3μ and 3.5-5.6μ in width with a mean of 4.6μ. The shape index is 2.24. Sporocystic residual mass is granular and situated between the two sporozoites. The sporozoites are elongated and have one end rounded and thicker than the other.

Sporulation time.—2-3 days.

Habitat.—Small intestine of tortoise (*Lissemys punctata* Bonnaterre), Basirhat, West Bengal.

Remarks.—The type locality of this species is Jessore, Bangladesh. As it was not possible to collect the topotype due to certain difficulty. The species was collected very near to its type locality. The present observation corresponds with original description except in case of measurements. In original description oocysts measure 14μ in diameter and sporocysts 10$\mu \times$4.5μ.

Eimeria legeri (Simond)

1901. *Coccidium legeri* Simond, *Compt. Rend. Soc. Biol.* **53**: 485, non 1920.
1920. *Eimeria legeri* Stankovitch, *Compt. Rend. Soc. Biol.* **83**: 834.
1926. *Eimeria legeri* Wenyon, *Protozoology*: 860.
1921. *Eimeria legeri* Reichenow, *Handbuch der pathogenen Protozoen*: 950
1938. Bhatia, *Fauna of British India*, Protozoa; Sporozoa: 186.

Description.—Oocysts spherical, the cytoplasm dividing to form sporoblasts without leaving any residuum. Oval sporocysts contain two comma-shaped sporozoites, sporocystic residuum is granular in the beginning and after becomes transparent and refringent.

Sporulation time.—Not known.

Habitat.—Gall bladder and bile duct of the tortoise, *Lissemys punctata granosa* (Schoepff) (*Emyda granosa*): India.

Remarks.—This description is based on Bhatia (1938). Fifteen hosts from different localities were examined but none of them was found to be infected.

Eimeria minetti Ray, Raghavachari and Sapre.

1942. *E. minetti* Ray, Raghavachari and Sapre, *Proc. Indian Sci. Congr.*: 170.

Description.—Oocysts oval, double walled, the outer being thinner. Oocysts measure 17.5-21.5μ in length with a mean of 19.5μ and 12.5-14.5μ in width with a mean of 15.5μ. The shape index is 1.2. Cytoplasm appears as globular refractile mass. Micropyle and oocystic residuum absent. Spherical sporocysts measure 7.5-9.5μ in diameter with a mean of 8.5μ. Sporocystic residuum granular. The sporozoites are circular in shape.

Sporulation time.—36 to 48 hours.

Habitat.—Small intestine of *Mabuia* sp. Mukteswar, U.P.

Remarks.—The topotype was collected and described. But according to Ray, Raghavachari and Sapre (1942) oocysts measure 18-21$\mu \times$ 12-14μ and sporocysts 7.9μ in diameter.

Eimeria najae Ray and Das Gupta

(Text-fig. 3 e, f)

1936. *E. najae* Ray and Das Gupta, *Proc. Indian Sci. Congr.*: 345 and 1937. *Arch. Protistenk.*, **88**: 275.

Description.—Oocysts ovoidal, double-walled, outer wall being thinner. Oocysts measure 23-5-27.5μ with a mean of 25.5μ in length and 15.5-18.5μ in width with a mean of 16.9μ. The shape index is 1.5. Micropyle visible in immature oocysts. Oocystic residual mass appears as a compact mass. Sporocysts spindle-shaped, measure 11.5-13.5μ in length with a mean of 12.5μ and 5.9-7.8μ in width with a mean of 6.9μ. The shape index is 1.8. The sporozoites are elongated and tapering at both ends. The nucleus is situated in the middle. Sporozoites measure 10.5-11.5μ in length.

Sporulation time.—4-5 days.

Habitat.—Small intestine of *Naja naja* Linn, from Sundarbans, West Bengal.

Remarks,—Topotype was examined. Some details of this species were given by Ray and Das Gupta (1937), where the oocysts measure 23-27μ16-$\times$ 18μ with residuum. Spindle-shaped sporocysts measure 12.14$\times$6.8μ. A button-like plug is visible at the micropyle of the female gamete. In their previous descriptions there was no other residual body.

Eimeria piscatori Ray and Das Gupta

1936. *E. piscatori* Ray and Das Gupta, *Proc. Indian Sci. Congr.*: 345.

Description—Oocysts oval, oocystic residuum present. Oocysts measure 29-31$\mu \times$22.3-24.5μ; Sporocysts spindle-shaped, measure 24$\mu \times$4-6μ.

Sporulation time.—Not known.

Habitat.—Rectum of the snake, *Natrix piscator* (Schn.), Calcutta.

Remarks.—The description is from Bhatia (1938). Twenty hosts were examined from the suburb of Calcutta but none of them was found to be infected with this parasite.

Eimeria stolatae Ray and Das Gupta

(Text-fig. 3 i, j)

1938. *E. stolatae* Ray and Das Gupta. *Arch. Protistenk.*, **90**: 361.

Description.—Oocysts spherical, provided with double envelope, the outer is thinner than the inner. Oocysts measure 19.5-21.5μ in diameter with a mean of 20.5μ. Neither micropyle nor oocystic residuum present. The cytoplasm is rounded with refractile globules. Cytoplasm gives rise to four spindle-shaped sporoblasts. Spindle-shaped sporocysts with both ends tapering. It measures 11.5-13.4μ in length with a mean of 12.5μ and 5.5-7.5μ in with with a mean of 6.5μ. The shape index is 2.0. Sporocystic residuum present between the elongated sporozoites. Sporozoites lie side by side with their broad nuclear ends facing each other. The sporozoites measure 8.5$\mu \times$2.3μ.

Sporulation time.—60-72 hours.

Habitat.—Small intestine (inter cellular) of grass snake, *Natrix stolata*, Calcutta.

Remarks.—Topotype was collected and examined as stated above, *E. stolatae* Ray and Das Gupta (1938) is closely related to *E. laminata* Ray (1936) in the shape of the oocysts and sporocysts but differs in size. In its original description, the oocysts measure 20.5μ in diameter and the sporosyst measures 12.3μ in length and 6.15μ in width.

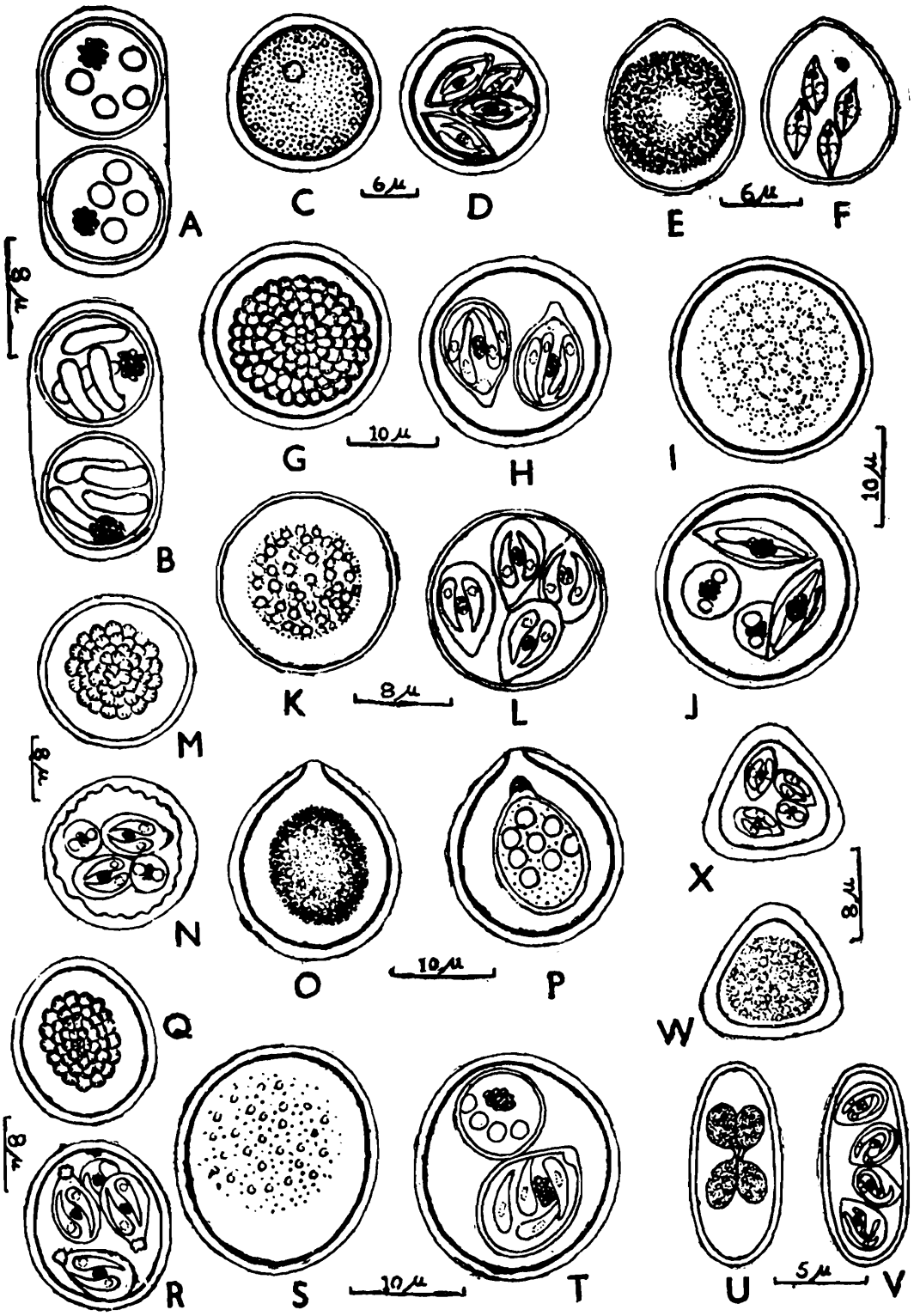
Eimeria triangularis Chakravarty and Kar

(Text-fig. 3 w, x)

1943. *E. triangularis* Chakravarty and Kar, *J. Roy. asiatic Soc. Bengal*, **9**: 49.

Description.—Oocysts are triangular with the sides arched. Oocysts measure 9.5-14.5μ in length with a mean of 12.5μ. The cytoplasm is rounded measuring 9.12-11.50μ in diameter and provided with some refringent globules. Oocystic residuum and micropyle absent. The sporocysts are oval or spindle-shaped with both the ends bluntly rounded. Sporocyst wall is very thin. Sporocysts measure 9.5-11.5μ in length with a mean of 10.5μ and 3.14-5.14μ in width with a mean of

3.14μ. The shape index is 3.02. The sporozoites are elongated in shape with tapering ends. It measures 9.5μ in length.



Text-fiig. 3.—Oocysts: a, b *Isospora minuta* Mitra and Das Gupta, a, immature b, Sporulated; c, d. *Eimeria koormae* Das Gupta, c. unsporulated d. maturee, e, f. *Eimeria najae* Ray and Das Gupta, e, immature f, Sporulated; g, h. *Isospora knowlesi* Ray and Das Gupta, g, unsporulated h, with sporoblast; i, j. *Eimeria stolatae* Ray and Das Gupta, i, immature j, with sporoblast; k, l, *Eimeria trionyxae* Chakraborty and Kar, k, immature l, with sporoblast; m, n. *Eimeria irregularis* Kar, m, immature n, with sporoblast; o, p. *Caryospora gekkonis* Chakraborty and Kar, o, immature p, mature; w, x. *Eimeria triangularis* Chakraborty and Kar, w, immature x, mature; q, r. *Eimeria innominata* Kar, q, immature r, with sporoblast; s, t. *Isospora calotesi* Bhatia, s, immature t, with sporoblast; u, v. *Eimeria flaviviridis* Setna and Bana, u, immature v, mature.

Sporulation time.—24-36 hours.

Habitat.—Intestine of *Trionyx gangeticus* Cuv., Calcutta.

Remarks.—The present description is based on the Topotype which differs slightly from the original description. In the original description oocysts measure 10.3-14.4μ in longest diameter and sporocysts measure 10.3$\mu \times$4.12μ.

Eimeria trionyxae Chakravarty and Kar

(Text-fig. 3 k, l)

1943. *E. trionyxae* Chakravarty and Kar, *J. Roy. asiatic Soc., Bengal,* **9**: 50.

Description.—Oocysts spherical, double layered, the outer being thinner. Oocysts measure 14.45-19.5μ in diameter with an average of 16.5μ. The cytoplasm is spherical and is placed centrally containing large number of refringent globules. No micropyle, oocystic residuum present. The cytoplasm gives rise to four oval shaped sporoblasts which are ultimately converted into pyriform sporocysts with one end pointed and the other end rounded. The sporocysts measure 11.5-13.48μ in length with a mean of 12.5μ and 5.7-7.9μ in width with a mean of 6.3μ. The shape index is 2.00. Sporocystic residuum is present in between the two sporozoites as a centrally placed compact mass. The sporozoites are narrow and elongated with a centrally placed nucleus. Sporozoites measure 9.5-10.5μ in length.

Sporolation time.—48-60 hours.

Habitat.—Intestine of *Trionyx gangeticus* Cuv., Calcutta.

Remarks.—The typotype was collected and examined. The endogenous stages were also observed and measurements are as follows: The trophozoites are ovoid bodies measuring 7.42$\times$4.12μ with one end tapering and other rounded. The spherical nucleus is placed near the middle region of the trophozoite. The schizonts measuring 8.24-14.42μ in largest diameter, are spherical or oval in shape and contain a large number of nuclei of uniform size. The merozoites have elongate, club-shaped bodies measuring 4.12-6.18μ in length and about 1μ in breadth. The merozoites are arranged in the form of a rosette. The microgametes are small rod like bodies with a long flagellum attached to one end. The macrogametes are spherical in shape with a circular nucleus. The nucleus has a nuclear membrane and small karyosome placed centrally within it. The oocysts and sporocysts slightly differ in measurements from original descriptions.

Genus **Octosporella** Ray and Raghavachari

Type species: *O. mabuiae* Ray and Raghavachari

Octosporella mabuiae Ray and Raghavachari

1942. *O. mabúiae* Ray and Raghavachari, *Proc. Indian Sci. Congr.*,: 170.

Description.—Oocysts octosporocystid and dizoic. Spherical oocysts measure 14-16μ in diameter. No oocystic residuum. Sporocysts spindle-

shaped, measure 8.4×4.2μ. Each sporocyst contains two sickle-shaped sporozoites and a central residual mass.

Sporulation time.—48 hours.

Habitat.—*Mabuia* sp. Calcutta.

Remarks.—This description is based on Ray and Raghavachari (1942). According to Pellerdy (1963), "This genus is placed provisionally in the family Eimeriidae, although the method of formation of male gametes is still unknown" Moreover, nearly thirty specimens of *Mabuia* sp. from different localities were observed but none of them was found to be infected with this parasite.

Genus **Pythonella** Ray and Das Gupta

Type Species: Pythonella bengalensis Ray and Das Gupta

Pythonella bengalensis Ray and Das Gupta

1937. *P. bengalensis* Ray and Das Gupta, *Proc. Indian Sci. Congr.:* 292.

Description.—Oocysts develop sixteen sporocysts, each containing four sporozoites. Oocysts spherical. Oocysts develop eight primary sporoblasts, and these divide to form sixteen. Oocysts measure 25-30μ in diameter, sporocysts contain four sporozoites and a central residuum sporocysts measure 8-10μ×6.7μ.

Sporulation time.—7 to 10 days.

Habitat.—Intestine of *Python* sp., Calcutta.

Remarks.—So far as is known, the full description of this species has not yet been published. Moreover, seventeen specimens of *Python* were examined from different localities of India but none of them was found to be infected with this parasite.

Key to genera of family **Eimeriidae** *from Indian Reptiles*

1. Oocyst monosporocystid, Sporocysts Octozoic. ..... *Caryospora*
2. Oocyst disporocystid, sporocysts tetrozoic. .. .. *Isospora*
3. Oocyst tetrasporocystid, sporocyst dizoic. ..... *Eimeria*
4. Oocyst polysporocystid
   - A. Sporocyst dizoic. ..... *Octosporella*
   - B. Sporocyst tetrazoic. .. .. *Pythonella*

Key to the **Isospora** *species*

- A. Oocyst cylindrical. ..... *I. minuta*
- B. Oocyst spherical or subspherical
  - (*i*) Sporocyst naviculoid. ..... *I. rayi*
  - (*ii*) Sporocyst elliptical or ellipsoidal
    - (*a*) Oocyst 17.5–23.14 in diameter. ..... *I. knowlesi*
    - (*b*) Oocyst 25.00–37.00 in diameter.. . . .. *I. calotesi*

Key to the **Eimeria** *species*

A. Oocyst spherical

1. Sporocyst oval
   (*a*) Size of oocyst, 16.00–18.00μ. ..*E. legeri*
   (*b*) Size of oocyst 20.00–22.00μ. .*E. kermoganthi*

2. Sporocyst pyriform or spindle-shaped
   (*a*) Oocyst without residuum. .*E. koormae*
   (*b*) Oocyst with residuum
      (*i*) Size of oocyst 20μ or above. .*E. stolatae*
      (*ii*) Size of oocyst below 20μ. .*E. trionyxae*

B. Oocyst not spherical

1. Oocyst triangular. ...*E. triangularis*
2. Oocyst lemon-shaped. .*E. hemidactyli*
3. Oocyst ellephical. .*E. flaviviridis*
4. Oocyst irregular. .. .*E. irregularis*
5. Oocyst oval, cylindrical or subspherical
   (*a*) Oocyst with residuum
      (*i*) Size of oocyst 36μ × 18μ... .*E. gupti*
      (*ii*) Size of oocyst 29.00–31.00 μ × 22.5–24.5μ. .*E. piscatori*
      (*iii*) Size of oocyst 23—27μ × 16—18μ. .*E. najae*
   (*b*) Oocyst without residuum
      (*i*) Sporocyst ovoid. .*E. knowlesi*
      (*ii*) Sporocyst spherical. .*E. minetti*
      (*iii*) Sporocyst pyriform. .*E. innominata*

IV Aves

The present part is the fourth chapter dealing with the occurrence and distribution of Coccidian parasites available in Indian birds. Uptil now nearly 60 species belonging to 6 genera of the Eimeriidae have been described from Indian birds.

Observation on Coccidian parasites obtained so far from Indian birds.

Genus **Tyzzeria** Allen

Synonym: *Koidzumiella* Matsubayashi, 1936.

Type species: T perniciosa Allen

Tyzzeria alleni Chakravarty and Basu

1946. *Tyzzeria alleni* Chakravarty and Basu, *Sci. & Cult.*, **12**: 106.

Description.—Oocysts oval, immature ones are completely filled up with the zygotic mass consisting of a large number of refractile granules. Micropyle present, oocystic residuum absent. Oocysts measure 14.48-17.3μ in length with a mean of 16.5 and 9.63-11.5μ in width a

mean of 10.5μ. The shape index is 1.56. The residual mass is 6.42μ in diameter. Sporozoites are spherical in shape in early stages and later become elongated having rounded posterior and pointed anterior ends. It measures 5.35-6.48μ centrally placed spherical nucleus measures about 2.14μ in diameter.

Sporulation time.—24-36 hours.

Habitat.—Large intestine of Cotton teal, *Chenicus*=(*Nettapus*) *coromandelianus* Gmelin, from Bidyadhari spill area fisheries near Calcutta.

Remarks.—The species is collected from Mahis Batham, Salt Lake, 24-Parganas, West Bengal very near to its Type locality and examined. No noticeable differences are found from the original description.

Tyzzeria chenicusae Ray and Sarkar

1967. *Tyzzeria chenicusae* Ray and Sarkar, *J. Protozool.*, **14**: 27 (Suppl.).

Description.—Oocysts broadly cylindrical, measure 20.4-27.6μ in length and 14.6-20.4μ in diameter, (average 24.84 × 16.8μ). The shape index 1.5 Micropyle absent, outer wall thicker, inner wall thinner. The sporozoites are club-shaped, 13.2μ in length and 4.2μ in width. They are usually arranged in a circular fashion around a granular mass of residual body placed at the broader pole of the sporozoites.

Sporulation time.—3-5 days.

Habitat.—Small intestine of *Chenicus* = (*Nettapus*) *coromandelianus:* Basirhat, 24-Parganas, West Bengal.

Remarks.—The type specimen has been examined by me and it differs from *T alleni* in the size of the oocysts. The differences in sporulation time, viz., *T chenicusae* 3-5 days and *T alleni* 24-36 hours, are probably due to temperature. However, the larger size of oocysts and absence of micropyle in the present species distinguish it from *T alleni*. At present this species can be treated as a distinct one.

Genus **Isospora** Schneider

Isospora bengalensis Mandal and Chakravarty

(Text-fig. 4a, b)

1964. *Isospora bengalensis* Mandal and Chakravarty, *Proc. zool. Soc., Calcutta*, **17**: 36.

Description.—Oocysts spherical, double walled, the outerwall being thinner than the inner, measuring 1.1μ in thickness. Oocysts measure 18.7-23.3μ in diameter with a mean of 20.5μ. Cytoplasm with highly refractile granules measures about 16.5μ in diameter. Micropyle present, oocystic residuum absent. Sporocysts pyriform in shape with pointed anterior end with a knob and a rounded posterior end. Sporocysts measure 14.4-16.4μ in length with a mean of 15.4 and 6.7-8.7μ in width with a mean of 7.7μ. The shape index is 2.0. Sporocystic residuum present as a compact mass. Sporozoites are elongated in shape with an anterior pointed end. It measures 8.8μ × 3.3μ with shape index 2.6. The sporozoites lie parallel to the long axis of the

sporocyst, but the anterior ends of two of them are directed towards the posterior ends of the other two.

Sporulation time.—48-60 hours.

Habitat.—Small intestine of *Corvus splendens* Vieillet, Calcutta.

Remarks.—Description is based on the topotype, the sporulation time was noted in addition to the minor differences in size of the sporocyst.

Isospora bellericae Banik and Ray

1962. *Isospora bellericae* Banik and Ray, *Bull. Calcutta Sch. trop. Med.*, **10**: 16.

Description.—Oocyst round or slightly oval, measuring 18.75-24.5μ in length with a mean of 22.5μ and 18.75-22.5μ in width with a mean of 21.5μ. Double walled. At one of the broader poles, the wall showed a bulbous thickening. The oocystic residuum and micropyle absent. Sporocyst pear-shaped with a prominent steida body. It measures 9.5-15.0μ in length and 7.5-9.5μ in width. The sporocyst residuum is centrally placed. The sporozoites are elongated and the nucleus is centrally placed.

Sporulation time.—24-48 hours.

Habitat.—Intestine of *Bellerica regulorum*, Zoological garden, Calcutta.

Remarks.—Type specimen was observed and no major differences are found from its original description.

Isospora corvae Ray, Shivnani, Oommen and Bhaskaran

(Text-fig. 4 i, j)

1952. *Isospora corvae* Ray, Shivnani, Oommen and Bhaskaran, *Proc. zool. Soc., Bengal*, **5**: 142.

Description.—Oocysts sub-spherical to spherical with double envelope, grayish pink in colour. Oocysts measure 15.0-23.0μ in length with a mean of 20.0μ and 14.0-21.5μ in width with a mean of 17.7μ. The shape index is 1.1. Cytoplasm present as a concentrated mass with refractile globules. Micropyle absent, oocyst residuum present. Sporocysts pyriform in shape, with a knob at the tapering anterior end, posterior end being rounded. Sporocysts measure 7.5-12.5μ with a mean of 10.8μ and 6.25-8.75μ width with a mean of 7.75μ. The shape index is 1.3. Sporocyst residuum present as compact mass. Elongated sporozoites with pointed anterior end measuring 7.9-9.9μ in length with a mean of 8.9μ and 2.2-4.2μ in width with a mean of 3.2μ. The shape index is 2.7.

Sporulation time.—36-48 hours.

Habitat.—Small intestine of *Corvus macrorhynchus intermedius*, Mukteswar, U.P.

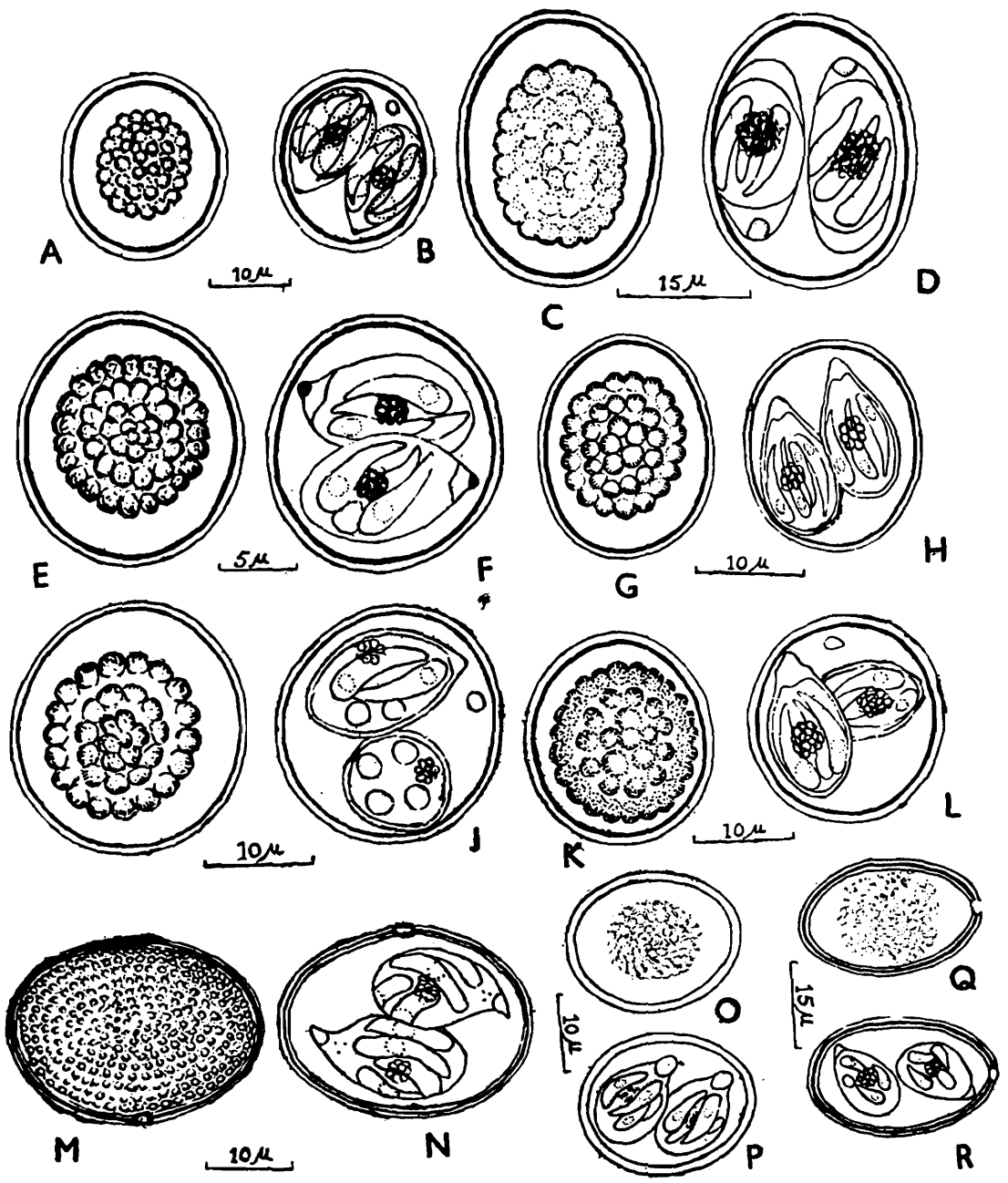
Remarks.—Topotype as well as the same species were observed at Shillong, Meghalaya from *Corvus macrorhynchus intermedius*. The differences lie in the measurements of the oocysts and sporocysts.

Isospora emberizae Mandal and Chakravarty

(Text-fig. 4 m, n)

1964. *Isospora emberizae* Mandal and Chakravarty, *Proc. zool. Soc., Calcutta*, **17**: 43.

Description.—Oocysts oval with three envelopes. The middle layer is thicker than the other two layers. Oocysts measure 22.2-24.2μ in length with a mean of 23.2μ and 18.8-20.8μ in width with a mean of 19.8μ. The shape index is 1.1. Coarsely granular cytoplasm present within the oocysts. Micropyle and oocystic residuum present.



Text-fig. 4.—Oocysts : a, b. *Isospora bengalensis* Mandal and Chakravarty, a, immature b, mature ; c, d. *I. psittaculae* Chakravarty and Kar, c, immature d, mature ; e, f. *I. garrulae* Ray, *et al.*, e, immature, f, mature ; g, h. *I. ginginiana tristis* Chakravarty and Kar, g, immature, h, mature ; i, j. *I. corvae* Ray *et al.*, i, immature, j, mature ; k, l. *I. sturniae* Chakravarty and Kar, k, immature, l, sporulated ; m, n. *I. emberizae* Mandal and Chakravarty, m, immature, n, sporulated ; O, p. *I. temenuchii* Chakravarty and Kar, o, immature, p, sporulated ; q, r. *I. muniae* Chakravarty and Kar, q, immature, r, sporulated.

Sporocysts pyriform in shape with slightly curved anterior end and posterior end with a small knob. Sporocysts measure 18.8-20.8μ in length with a mean of 19.8μ and 14.4-16.4μ in width with a mean of 15.4μ. The shape index is 1.2. Sporocystic residuum present as scattered mass. Sporozoites are elongated in shape with tapering anterior end and they measure 13.5-15.3μ in length with a mean of 14.5μ and 2.5-3.5μ in width with a mean of 3.00μ. The shape index is 4.8.

Sporulation time.—24-36 hours.

Habitat.—Small intestine of *Emberiza bruniceps* Brandt, Sundarban, West Bengal.

Remarks.—Topotype was observed. The specific name should be spelt as *I. emberiza* as the specific name was given after the generic name of the host. The differences lie on the measurements of oocysts and sporocysts. It was mentioned as 23.2 × 19.8 μ and 19.8 × 15.4 μ respectively.

Isospora garrulusae Ray, Shivnani, Oommen and Bhaskaran

(Text-fig. 5 g, h)

1952. *Isospora garrulusae* Ray, Shivnani, Oommen and Bhaskaran, *Proc. zool. Soc. Bengal*, **5**: 143.

Description.—Oocyst oval to subspherical provided with double wall. General colour is greyish. It measures 25.0-27.5 μ in length with a mean of 25.20 μ and 20.0 μ-25.0 μ in width with a mean of 21.20 μ. The shape index is 1.1. The cytoplasm is globular and appears as a compact mass. Micropyle and oocystic residuum present. The sporocyst is pear-shaped with pointed anterior and rounded posterior ends. It measures 12.5 μ-17.5 μ in length with a mean of 16.07 μ and 7.5 μ-10.0 μ in width with a mean of 9.60 μ. The shape index is 1.6. The sporocystic residuum is present as a compact mass. The sporozoites are elongated bodies pointed at the anterior end and rounded posterior end. It measures 8.3 μ in length and 2. 7 μ width. The shape index is 3.07. The nucleus is situated at the middle.

Sporulation time.—48-72 hours.

Habitat.—Small intestine of *Garrulus glandarieus*, *bispeculaeris*, Mukteswar, U.P.

Remarks,—Topotype as well as the specimen from the same species of birds were collected from Shillong, Assam and observed. The differences found are only on the size of oocysts and sporocysts. This species is almost similar as regards to the size of oocyst and sporocyst of *I. seicercusae*. But it differs in the size of sporozoite and sporulation time. Moreover, the name and should be spelt as *I. garrulusi* instead of *I. garulusae* (vide Pellerdy, 1965).

Isospora garrulae Ray, Shivnani, Oommen and Bhaskaran

(Text-fig. 4 e, f)

1952. *Isospora garrulae* Ray, Shivnani, Oommen and Bhaskaran, *Proc. zool, Soc. Bengal*, **5**: 143.

Description.—Oocysts spherical to sub-spherical in shape, with double contour of brownish colour. The outerwall being thinner than the inner one. The Oocysts measure 20.0-22.5μ in length with a mean of 21.25μ and 17.5-21.25μ in width with a mean of 19.75μ. The shape index is 1.05. Globular cytoplasm present. Micropyle absent, oocystic residuum present as a small granule. Sporocysts, pyriform in shape, with a knob at the tapering anterior end and rounded posterior end. Sporocysts measure 10.0-15.5 μ in length with a mean of 13.40μ and 7.5-12.5μ in width with a mean of 8.5μ. The shape index is 1.5. Sporocystic residuum is in the form of globular mass. Sporozoites are elongated, with bluntly pointed anterior end and a rounded posterior end. Sporozoites measure 9.3$\mu \times$2.6μ. The shape index is 3.9.

Sporulation time.—24-36 hours.

Habitat.—Small intestine of *Garrulas lineatus lineatus*, Mukteswar, U.P.

Remarks.—Topotype and the same species was collected from the same host from Shillong, Meghalaya. The size of oocysts and sporocysts slightly varies with those of its original descriptions. The name should be spelt as *I. garruli* instead of *I. garrulae* (Pellerdy, 1965).

Isospora ginginiana tristis Chakravarty and Kar

(Text-fig. 4 g, h)

1947. *Isospora ginginiana tristis* Chakravarty and Kar, *Proc. Roy. Soc., Edinburgh*, Sec. B, **62**(3): 226.

Description.—Oocysts sub-spherical or slightly oval with double envelope. Oocysts measure 24.00-28.00μ in length with a mean of 26.00μ and 19.5-24.5μ in width with a mean of 21.9μ. The shape index is 1.18. Globular cytoplasm, oocystic residuum present, micropyle absent. Sporocysts pyriform in shape with a small knob at the anterior pointed end. Sporocysts measure 15.5-17.5μ in length with a mean of 16.5μ and 8.5-11.5μ in width with a mean of 10.5μ. The shape index is 1.5. Sporocystic residuum present as a compact mass. Sporozoites are elongated in shape measuring 15.4μ in length and 2.2μ in width. The shape index is 7.00.

Sporulation time.—60-70 hours.

Habitat.—Small intestine of *Acridotheres tristis tristis* (Linn.) Calcutta.

Remarks.—Topotype was examined. Chakravarty and Kar (1947) described the present one as a variety of *Isospora ginginiana* Chakravarty and Kar (1944). They found micropyle in the oocystic wall which was not observed in the present case.

Isospora gypsi Patnaik and Mohanty

1969. *Isospora gypsi* Patnaik and Mohanty, *Curr. Sci.*, **38**: 316.

Description.—Oocysts sub-spherical, double walled in equal thickness and smooth. It measures 17.00μ-23.5μ (mean 20.4μ) in length and 14.5μ-19.5μ (mean 17.5μ) in width with shape index 1.5. The

cytoplasm completely fills up the inner space, residuum and micropyle absent. Sporocysts pyriform, measures 11.5μ-16.5μ (mean 13.2μ) in length and 8.2μ-8.5μ (mean 8.5 μ) in maximum width with a refractile stieda body at the narrow anterior end. Sporocystic residuum granular, sporozoites sausage-shaped with pointed anterior end. It measures 6.00μ in length and has a maximum width of 1.6μ

Sporulation time.—20 to 24 hours.

Habitat.—Small intestine of *Gyps bengalensis*, from Calcutta.

Remarks.—Topotype was collected, similarly the faecal sample of *Gyps bengalensis* was collected from a slaughter house at Beleaghata, Calcutta and examined. This species has a close resemblance with *I. bengalensis* Mandal and Chakravarty, 1964. The difference mainly lies on the sporulation time. In *I. bengalensis* it is 48-60 hours and for this species it is 20-24 hours at room temperature.

Isospora ginginiana. Chakravarty and Kar

(Text-fig. 5 e, f)

1944. *Isospora ginginiana* Chakravarty and Kar, *Proc. Indian Acad. Sci.*, **20**(3), Sec. B: 104.

Description.—Oocysts round with double envelope, measure 22.3-24.5μ in diameter with a mean of 23.4μ. Micropyle and oocystic residuum absent. Spherical cytoplasm is 15.5μ in diameter. Sporocysts are pyriform with one anterior pointed end with knob and other round end. Sporocysts measure 15.5-17.5 in length with a mean of 16.5μ and 10.5-11.5μ in width with a mean of 11μ. The shape index is 1.5. Sporocysts with granular residuum and a thick wall. The sporozoites are elongated with pointed anterior end, measure 10.5$\mu \times$4.2μ with a nucleus situated at the middle region.

Sporulation time.—72 hours.

Habitat.—Small intestine of *Acridotheres ginginianus* (Lath.), Calcutta.

Remarks.—The topotype was examined. The oocystic wall is provided with two layers, though it was not mentioned. The sporocystic wall is provided with single layer.

Isospora mayuri Patnaik

1965. *I. Pellerdyi* Patnaik, *Indian J. Microbiol*, **5**: 67.
1966. *Isospora mayuri* Patnaik, *Indian J. Microbiol.*, **6**(4): 53.

Description.—The oocysts are sub-spherical to spherical in shape, yellowish brown in colour and double walled. Oocysts measure 20-27.48μ in length with a mean of 23.37μ and 18-24.18μ in width with a mean of 21.36μ. The shape index varies from 1.0 to 1.18 with a mean of 1.09. Oocystic wall smooth and 1.5μ thick, residuum absent and micropyle present. Sporocysts pyriform in shape measure 14.5-16.13μ in length with a mean of 15.9μ and 9.6-11.29μ in width with a mean of 10.17μ. Sporocysts with distinct wall and button like refractile stieda body at the pointed end. Sporozoites banana-shaped, 6 to 7μ in length and 1.5 to 2μ in width.

Sporulation time.—72 hours.

Habitat.—Small intestine of *Pavo cristatus* Linn., Calcutta Market.

Remarks.—The specimen is collected from a host obtained from Calcutta market and examined. No noticeable differences are found from its original description.

Isospora muniae Chakravarty and Kar

(Text-fig. 4 q, r)

1944. *Isospora muniae* Chakravarty and Kar, *Proc. Indian Acad. Sci.*, **20**(3), Sec. B: 103.

Description.—Oocysts broadly or elongately oval, measuring 24.5μ-31.5 μ in length with a mean of 28.3μ and 15.5-19.5μ in width with a mean of 17.5 μ. The shape index is 1.6. Oocysts with double envelope of 1.5 μ thickness. The cytoplasm is granular with several refringent globules, 15.6 μ in diameter and placed centrally. Micropyle present, oocystic residuum absent. The sporocysts are pyriform with the anterior end pointed and the posterior end rounded measuring 14.5-16.5 μ in length with a mean of 15.5 μ and 10.2-11.2 μ in width with a mean of 10.7 μ. The shape index is 1.4. Sporocysts are double layered and each of them provided with a refractile knob at the pointed anterior end. Sporocystic residual mass is granular and scattered irregularly. Sporozoites are sickle-shaped, measuring 6.5$\mu \times$2.00 μ. The anterior end is pointed and the posterior end rounded where the nucleus is situated.

Sporulation time.—48-60 hours.

Habitat.—Small intestine of *Munia malacca malacca* Linn., Calcutta.

Remarks.—While examining the topotype and type specimens the description of the oocysts does not correlate in some points. In the text, it is mentioned that oocysts possess double envelope but in the figure it is shown that it contains three layers, however double layer is closely visible. The wall of the sporocysts is thick. The specific name should be spelt as *I. muniai* as the name was given after the generic name of the host.

Isospora magalaimae Mandal and Chakravarty

(Text-fig. 5, o, p)

1964. *Isospora magalaimae* Mandal and Chakravarty, *Proc. zool. Soc., Calcutta*, **17**: 42.

Description:.—Oocysts round measure 23.2-25.4 in diameter. They possess double envelope without any micropyle. Oocystic residuum absent. The sporocysts pyriform in shape and have broader posterior and bluntly pointed anterior ends. It measures 17.6 $\times$ 9.9μ. The sporocystic residual mass scattered irregularly. Sporozoites elongated measuring 7.7 μ in length and arranged irregularly.

Sporulation time.—24-36 hours.

Habitat.—Small intestine of *Magalaima haemocephala* (P.L.S. Meiller). Suburb of Calcutta.

Remarks.—Topotype was collected and examined, only the sporulation time was not known previously. The same is noted. The specific name should be spelt as *I. megalaima* as the name was given after the generic name of the host.

Isospora parusae Ray, Shivnani, Oommen and Bhaskaran

(Text-fig. 5 q, r)

1952. *Isospora lophopheriae* Ray, Shivnani, Oommen and Bhaskaran, *Proc. Indian Sci. Congr.*: 314.

1952. *Isospora parusae* Ray, Shivnani, Oommen and Bhaskaran, *Proc. zool. Soc., Bengal*, **5**: 144.

Description.—Oocysts oval to subspherical in shape, double walled of greyish white colour with a yellowish tinge. Oocysts measure 22.5μ-27.5 μ in length with a mean of 24.16 μ and 20-22.5μ in which with a mean of 20.83 μ. The shaped index is 1.1. Sub-spherical cytoplasm. Oocystic residuum is in the form of one or two granules and micropyle present in the form of a slight depression in the endocystic wall. Sporocysts pyriform in shape having tapering anterior end. With a steida body in the form of plug-like knob. Sporocysts measure 10.0-17.5 μ in length with a mean of 15.0 μ and 10.0 μ in width. The shape index is 1.5. Sporocystic residuum present in the form of a globular mass. Sporozoites are elongated bodies having nucleus at the posterior rounded end and it is tapering at anterior end. Sporozoites measure 9.5 μ in length and 2.5μ in width. The shape index is 3. 8.

Sporulation time.—36-48 hours.

Habitat.—Small intestine of *Parus dichrurus* from Mukteswar, U.P.

Remarks.—Topotype was examined. This species was also obtained at Shillong, Meghalaya from *Parus dicrurus* and observed. The specific name should be spelt as *I. parusi* as the name was given after the generic name of the host. No noticeable differences are found.

Isospora psittaculae Chakravarty and Kar

(Text-fig. 4 c, d)

1947. *Isospora psittaculae* Chakravarty and Kar, *Proc. Roy. Soc. Edinburgh*, Sec. B, **62**: 230.

Description.—Oocysts are broadly oval and provided with double envelope, the outer being thinner than the inner one. Oocysts measure 28.5-32.6 μ in length with a mean of 30.5 μ and 24.4-28.4 in width with a mean of 26.4 μ. The shape index is 1.16. Cytoplasm with refringent globules almost fills up the oocyst. Oocystic residuum present, micropyle absent. Sporocysts are somewhat oval with narrow anterior end being

provided with a well developed knob measuring 2.2 μ in length. Sporocysts measure 22.0-26.4 μ with a mean of 24.5 μ and 12.5-14.5 μ in width with a mean of 13.5 μ. The shape index is 1.8. Sporocystic residuum present as compact mass. Sporozoites are elongated in shape with pointed anterior end and rounded posterior ends. Sporocysts measure 11.5-15.5 μ in length with a mean of 13.5 μ and 4.4-6.4 μ at broadest point with a mean of 5.4 μ. The shape index is 2.5. Posterior end of the sporozoites provided with a vacuole.

Sporulation time.—48-60 hours.

Habitat.—Small intestine of *Psittacula eupatria nepalensis* (Hodges) and *Elathes jocosa emeria* (Linn.) Calcutta, Bengal.

Remarks.—On examination of the topotype slight differences are found in the measurements of oocysts and sporocyst. The specific name should be spelt as *I. psittaculi* as the name was given after the generic name of the host.

Isospora pycnonotae Mandal and Chakravarty

(Text-fig. 5 i, j)

1964. *Isospora pycnonotae* Mandal and Chakravarty, *Proc. zool. Soc., Calcutta*, **17**:38.

Description.—Oocysts oval, provided with double wall, the outer being thinner than the inner one. Oocysts measure 23.2-25.2μ in length with a mean of 24.2μ and 18.8-20.8μ in width with a mean of 19.8μ. The shape index is 1.2. Cytoplasm spherical, highly granular containing refractile refringent globules. Micropyle present, oocystic residuum absent. The sporocysts are pyriform with pointed anterior end and rounded posterior end. The pointed end is provided with a small knob and just behind the knob a transparent refractile area is observed. Sporocysts measure 18.8-20.8μ in length with a mean of 19.8μ and 7.8-9.8μ in width with a mean of 8.8μ. The shape index is 2.1. Sporocyst residuum present as scattered granules. Sporozoites are elongated in shape with both ends bluntly pointed with the nucleus located the middle position. Sporozoites measure 11.1-13.1μ in length with a mean of 12.1μ and 2.1-3.4μ in width with a mean of 2.8μ. The shape index is 4.3.

Sporulation time.—48-62 hours.

Habitat.—Small intestine of *Pycnonotus jocosus* (Linnaeus) and *Turdoides straitus* (Dumont.), Calcutta.

Remarks.—The specific name should be spelt as *I. pycnonoti* as the name was given after the generic name of the host. The differences lie in the measurements of oocysts and sporocysts, previously they were mentioned as 24.2$\mu \times$19.8μ and 19.8$\mu \times$8.6μ respectively. Moreover, the sporulation time was not known.

Isospora scicercusae Ray, Shivnani, Oommen and Bhaskaran

(Text-fig. 5 k, l)

1952. *Isospora cryptolophae* Ray, Shivnani, Oommen and Bhaskaran, *Proc. Indian Sci. Congr.*: 314.

1952. *Isospora scicercusae* Ray, Shivnani, Oommen and Bhaskaran, *Proc. zool. Soc., Bengal*, **5**: 144.

Description.—Oocysts spherical to sub-spherical in shape and provided with double wall of pink colour. Oocysts measure 22.5-28.0μ in length with a mean of 24.8 and 20.25μ-26.25μ in width with a mean of 23.28μ. The shape index is 1.06. Micropyle and oocystic residuum present. Sporocysts are pear-shaped with a prominent knob at the tapering anterior end. It measures 10.0-17.5μ in length with a mean of 14.21μ and 8.75-11.25μ in width with a mean of 10.31μ. The shape index is 1.3. Sporocystic residuum present as compact mass. Sporozoites are elongated, with bluntly pointed anterior end. Sporozoites measure 8.5-9.7μ in length with a mean of 8.8μ and 2.2-4.3μ in width with a mean of 3.3μ. The shape index is 2.7. Nucleus is situated at the rounded posterior end.

Sporulation time.—48 hours.

Habitat.—Small intestine of *Seicercus xanthoschistos*, from Mukteswar, U.P.

Remarks.—Topotype was collected and observed as mentioned above. The sizes of oocyst and sporocyst come closely to that of *I. garrulosae* but differ in the size of sporozoites and in sporulation time. The specific name should be spelt as *I. seicercusi* as the name was given after the generic name of the host.

Isospora sturniae Chakravarty and Kar

(Text-fig. 4 k, l)

1947. *Isospora sturniae* Chakravarty and Kar, *Proc. Roy. Soc., Edinburgh*, **62**: 245.

Description.—Oocysts spherical or subspherical with double oocystic membrane. Oocysts measure 22.5-28.5μ in diameter with a mean of 25.5μ. Unsporulated oocysts filled up with cytoplasm. Micropyle present, oocystic residuum absent. Sporocysts pyriform in shape with narrow anterior and broad posterior ends, the former being provided with a well developed knob. Sporocysts measure 17.7-19.7μ length with a mean of 18.7μ and 11.4-13.4μ in width with a mean of 12.4μ. The shape index is 1.5 Sporocystic residuum present as a compact mass. Sporozoites are elongated with a centrally placed nucleus. The sporozoites measure 11.2-13.2μ in length with a mean of 12.2μ and 2.2-3.2μ in width with a mean of 2.8μ. The shape index is 4.3.

Sporulation time.—30-43 hours.

Habitat.—Small intestine of *Sturnia malabarica malabarica* (Gmel.), Gaya, Bihar.

Remarks.—Paratypes and topotype were examined. According to Chakravarty and Kar (1947) the oocysts measure 22.0-28.6μ in diameter, the sporocysts 17.6-19.8$\mu \times$11.0-13.2μ., the sporozoites 11.0-13.2$\mu \times$2.2-3.3μ.

Isospora temenuchii Chakravarty and Kar

(Text-fig. 4 o, p)

1944. *Isospora temenuchii* Chakravarty and Kar, *Proc. Indian Acad. Sci.*, **20**(3): 108.

Description.—Oocysts subspherical or slightly ovoid, measuring 22.5-24.5μ in length with a mean of 23.5μ and 19.5-21.5μ in width with a mean of 20.5μ. The shape index is 1.14. Oocyst wall 2μ thick and double layered. Micropyle present in some cases, oocyst residuum absent. Unsegmented zygote highly granular, contains several refringent globules, measures about 15.5μ. Sporocysts elongately oval in shape with the anterior end somewhat bluntly pointed with a well developed knob. Sporocysts possess single layer and measure 15.5-17μ in length with a mean of 16.5μ and 10.2-11.5μ in width with a mean of 10.6μ. Sporocystic residuum compact and appears as refractile area. Sporozoites elongated in shape with the anterior end narrowing down to a blunt point while the posterior end remains round. Nucleus is placed near the centre of the body or slightly towards the rounded end of the sporozoites. Sporozoites measure 8.5$\mu \times 3.3\mu$.

Sporulation time.—36-48 hours.

Habitat.—Small intestine of *Temenuchus pagodarum* (Gmel.), Calcutta.

Remarks.—The topotype and paratypes were examined. In original description the measurement of oocysts and sporozoites are 22.0-24.2$\mu \times 19.8$-22.0μ, 8.8$\mu \times 3.3\mu$ respectively.

Isospora upupae Chakravarty and Kar

(Text-fig. 5 c, d)

1947. *Isospora upupae* Chakravarty and Kar, *Proc. Roy. Soc., Edinburgh*, **62**: 250.

Description.—Oocysts spherical provided with double envelope. Oocysts measure 24.4-28.4μ in diameter with a mean of 26.4μ. Cytoplasm is rounded and contains refringent globules. Micropyle and oocystic residuum absent. Sporocysts are oval and provided with a knob at the pointed anterior end. Sporocysts measure 15.4-19.4μ in length with a mean of 17.4μ and 11.3-13.5μ in width with a mean of 12.4μ. The shape index is 1.4. Sporocystic residuum present as a compact irregular mass. Sporozoites are sickle-shaped measuring 16.00-18.00μ in length with a mean of 17.00μ and 2.00-3.00μ in width with a mean of 2.4μ. The shape index is 7.08. Nucleus is situated towards the rounded posterior end of sporozoite.

Sporulation time.—48-62 hours.

Habitat.—Small intestine of *Upupa epops orientalis* Baker, and *Dicrurus macrocerecus* Vieillot, from Gaya, Bihar.

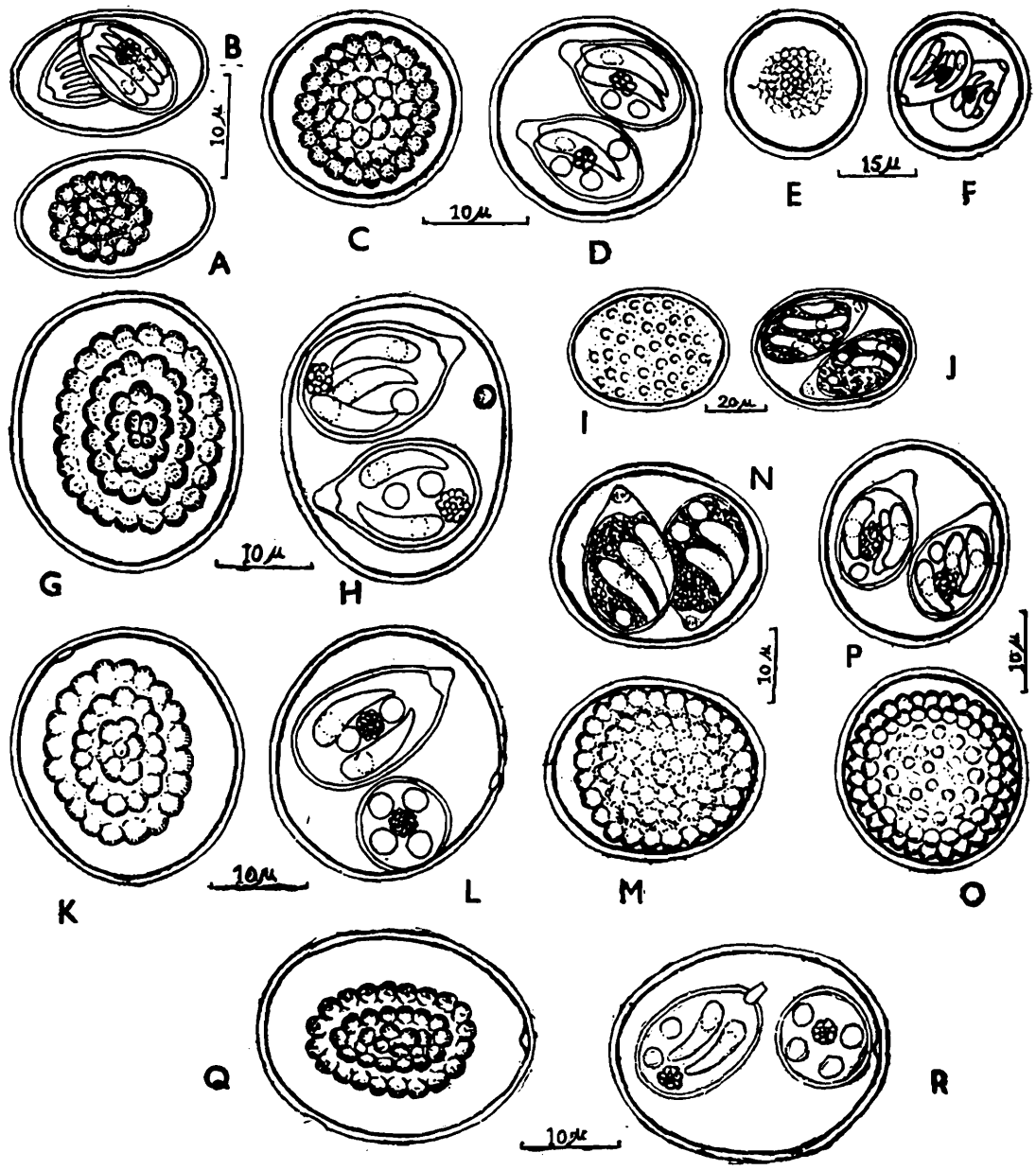
Remarks.—Topotype and paratypes were examined. According to Chakravarty and Kar (1947) oocysts, sporocysts and sporozoites measure 24.2-28.6μ in diameter, 15.4–19.8$\mu \times 13.3\mu$ and 17.6$\mu \times 2.2\mu$ respectively. The specific name should be spelt as *I. upupai.*

Isospora lonchiurae Mandal and Chakravarty

(Text-fig. 5 m, n)

1964. *Isospora lonchiurae* Mandal and Chakravarty, *Proc. zool. Soc., Calcutta*, **17**: 40.

Description.—Oocysts oval and provided with double envelope, the outer being thinner than the inner one. Oocysts measure 24.3-26.4μ in length with a mean of 25.8μ and 20.9-23.1μ in width with a mean of



Text-fig. 5.—Oocysts : a, b. *Isospora zosteropis* Chakraborty and Kar, a, immature b, mature; c, d. *Isospora upupae* Chakraborty and Kar, c, immature d, mature; e, f. *Isospora ginginiana* Chakraborty and Kar, e, immature f, mature; g, h. *Isospora garrulusae* Ray, Shivnani, Oommen and Bhaskaran, g, immature h, mature; i, j. *Isospora pycnonotae* Mandal and Chakraborty, i, immature j, mature; k, l. *Isospora scicercusae* Ray, Shivnani, Oommen and Bhaskaran, k, immature l, mature; m, n. *Isospora lonchiurae* Mandal and Chakraborty m, immature n, mature; o, p. *Isospora megalaimae* Mandal and Chakraborty, o, immature p, mature; q, r. *Isospora parusae* Ray, Shivnani, Oommen and Bhaskaran, q, immature r, mature

21.8μ. The shape index is 1.1. Cytoplasm spherical with highly refractile globules, micropyle absent and oocystic residuum present. The sporocysts are pyriform in shape, the anterior end is bluntly pointed with a small knob while the posterior end is rounded. Sporocysts measure 18.7μ in width with a mean of 12.1μ. The shape index is

1.6. **Sporocystic residuum is present as scattered mass. The sporozoites are elongated and bluntly pointed at both ends.** Sporozoites measure 9.2-10.4μ in length with a mean of 9.6μ and 2.5-3.5μ in width with a mean of 2.6μ. The shape index is 3.4. The nucleus is centrally placed. A vacuolated area is seen at one end of the sporozoite.

Sporulation time.—60-72 hours.

Habitat.—Small intestine of *Lonchura punctulata* (Linn.) and *Sturnus contra* Linnaeus, Suburb of Calcutta.

Remarks.—Topotype was observed and the differences are found in the size of the oocyst. Previously it was mentioned as 23.3-26.$\mu \times$ 20.9-23.1μ. The sporulation time was also not known. The specific name should be spelt as *I. lonchiuri* as the name is given after the generic name of the host.

Isospora lacazei (Labbé, 1893)

1893. *Diplospora rivoltae* Labbé, *Comp. Rend. Acad. Sci.*, **116**: 1300.
1893. *Diplospora lacazii* Labbé, *Comp. Rend. Acad. Sci.* **117**: 407.
1897. *Isospora communis passerum* Sjobring, *Zbl. Bakt. I. Abt. Orig.* **22**: 675.
1897. *Isospora passerum* Sjobring, *Zbl. Bakt. I. Abt. Orig.* **22**: 676.
1944. Chakravarty and Kar, *J. Dept. Sci. C.U.* 1: **78.**
1960. Levine and Mohan, *J. Parasit.* **46**: 733.
1965. Mandal, *J. Assam Sci.*, **8**: 1.

Description.—Oocysts spherical or sub-spherical double walled, inner thick and outer thin membrane. Oocysts measure 24.0-32.0μ in length with a mean of 26.8μ and 20.0-30.0μ in width with a mean of 27.4μ. The shape index is 1.09. Cytoplasm is granular with several refractile granules. Micropyle and oocystic residuum absent. Sporocysts ovoid to pyriform with a button-shaped plug at the narrow anterior end. Sporocysts measure 14-22μ in length with a mean of 17.2μ and 10.0-11.0μ in width with a mean of 10.3μ. The shape index is 1.56. Sporocystic residuum finely granular and present as scattered mass. Sporozoites are almost bean-shaped measuring 8.5μ in length and 2.3μ in width. The shape index is 3.7. Nucleus is situated at the middle.

Sporulation time.—48-60 hours.

Habitat.—Small intestine of (*i*) *Passer domesticus* (Linn.) (*ii*) *Ploceus philippinus* (Linn.) (*iii*) *Copsichus saularis* (Linn.) (*iv*) *Pycnonotus cafer* (Linn.) from Calcutta.

Remarks.—A considerable amount of work has been done on *I. lacazei* by many workers in different parts of the world, as well as in India. However, the present description is mainly based on the oocysts obtained from *Passer domesticus* (Linn.).

Isospora zosteropis Chakravarty and Kar

(Text-fig. 5 a, b)

1947. *Isospora zosteropis* Chakravarty and Kar, *Proc. Roy. Soc., Edinburgh*, **62**: 250.

Description.—Oocysts oval, double layered, the outer being thinner. Oocysts measure 17.5-22.5μ in length with a mean of 19.8μ and

13.5-19.5μ in width with a mean of 16.5μ. The shape index is 1.2. Cytoplasm circular and provided with refringent globules. Micropyle and oocystic residuum absent. Sporocysts are oval and the anterior pointed end is provided with a knob. Sporocysts measure 15.5-17.5 in length and 10.5-11.5μ in width with a mean of 11.1μ. The shape index is 1.4. Sporocystic residuum present as a compact mass. Sporozoites are club-shaped with the nucleus at central position measuring 14.5-16.5μ in length with a mean of 15.5μ and 2.1-3.5μ in width with a mean of 2.5μ. The shape index is 6.2.

Sporulation time.—30-48 hours.

Habitat.—Small intestine of *Zosterops palpebrosa palpebrosa* (Temm. and Schlegel) and *Thereiceryx zeylanicus caniceps* (Frankl), from Calcutta.

Remarks.—Topotype and paratype were examined. In original description the measurements are given as oocysts 17.6-22.2$\mu \times$ 13.219.8μ, sporocysts 15.4-17.6$\mu \times$ 11.0μ and the sporozoites 15.4$\mu \times$ 2.2μ.

Genus **Dorisiella** Ray

Type species: D. scololepidis Ray

Dorisiella aethiopsaris Chakravarty and Kar

(Text-fig. 6 i, j)

1947. *Dorisiella aethiopsaris* Chakravarty and Kar, *Proc. Roy. Soc., Edinburgh*, **62**: 225.

Description.—Oocysts subspherical or oval, double walled; walls of equal thickness. The spherical form measures 28.5μ-30.5μ in length with a mean of 29.5μ and 24.4-25.4μ in width with a mean of 25.4μ. The shape index is 1.16. Oval form measures 33.5-38.5μ in length with a mean of 35.8μ and 24.4-26.4μ in width with a mean of 25.4μ. The shape index is 1.4. Cytoplasm spherical and centrally placed with numerous refractile globules. Micropyle and oocystic residuum absent. Sporocysts are oval, with a well developed knob at the pointed anterior end. It measures 19.5-22.5μ in length with a mean of 20.9μ and 11.2-13.2μ in width with a mean of 12.2μ. The shape index is 1.5. Sporocystic residuum present as a compact mass. Sporozoites are elongated in shape with pointed anterior end and rounded posterior end. Nucleus centrally placed, sporozoites measure 12.2-14.2μ in length with a mean of 13.2μ and 1.5-2.5μ in width with a mean of 2.1μ. The shape index is 6.2.

Sporulation time.—48-62 hours.

Habitat.—Small intestine of *Acridotheres* (*Aethiopsar*) *fuscus fuscus* (Wagler) from Calcutta.

Remarks.—Topotype and paratype were examined. In original description the sub-spherical oocysts measure 28.6-30.8$\mu \times$ 24.2-26.4μ and oval 33.0-38.8$\mu \times$ 24.2-26.4μ; Sporocysts 19.8-22.0$\mu \times$ 11.0-13.2μ and the sporozoites 13.2$\mu \times$ 2.2μ.

Dorisiella chakravartyi Ray and Sarkar

1967. *Dorisiella chakravartyi* Ray and Sarkar, *Proc. Indian Sci. Congr.*: 448.

Description.—Oocysts spherical, measuring 27.5-30.00μ with a mean of 28.45μ. Double layered, the outer being transparent and the inner one dark black in transmitted light. Oocystic residuum and micropyle absent. Sporocyst ellipsoidal measuring 22.5μ in length and 15.0-17.5μ in width. The narrow end is provided with steida and sub-steidal body. Sporocystic residuum is present as scattered mass. Sporozoites elongated, club-shaped measuring 13.2μ in length and 3.6 μ in width. Each sporozoites has a large vacuole at its broader pole and small one at the narrower pole. while the nucleus is placed just below the large vacuole.

Sporulation time.—3-4 days.

Habitat,—Duodenum and small intestine of *Lonchura malabarica* and *L. punctulata* Calcutta, West Bengal.

Remarks.—Type specimen was examined and subsequently described. No noticeable differences are found.

Dorisiella hareni Chakravarty and Kar

(Text-fig. 6 e, f)

1944. *Dorisiella hareni* Chakravarty and Kar, *Proc. Indian Acad. Sci.*, Sec. B. **20**: 104

Description.—Oocysts spherical measuring 18.5-22.5μ with a mean of 20.5μ with double envelope, the outer being thinner than inner one. The cytoplasm globular measuring 18.2μ., Micropyle and oocystic residuum absent. Sporocysts single layered and pyriform in shape with anterior pointed and posterior rounded ends the anterior end being provided with small ill differentiated knob. Sporocysts measure 14.5-18.5μ in length with a mean of 16.5μ and 9.5-10.5μ width a mean of 9.9μ. The shape index is 1.5. Residuum present. Sporozoites club-shaped with bluntly pointed anterior end. Sporozoites measure 8.2$\mu \times$2.5μ. Nucleus situated at rounded posterior end.

Sporulation time.—72-96 hours.

Habitat.—Intestine of *Munia malacca malacca* Linn., Calcutta.

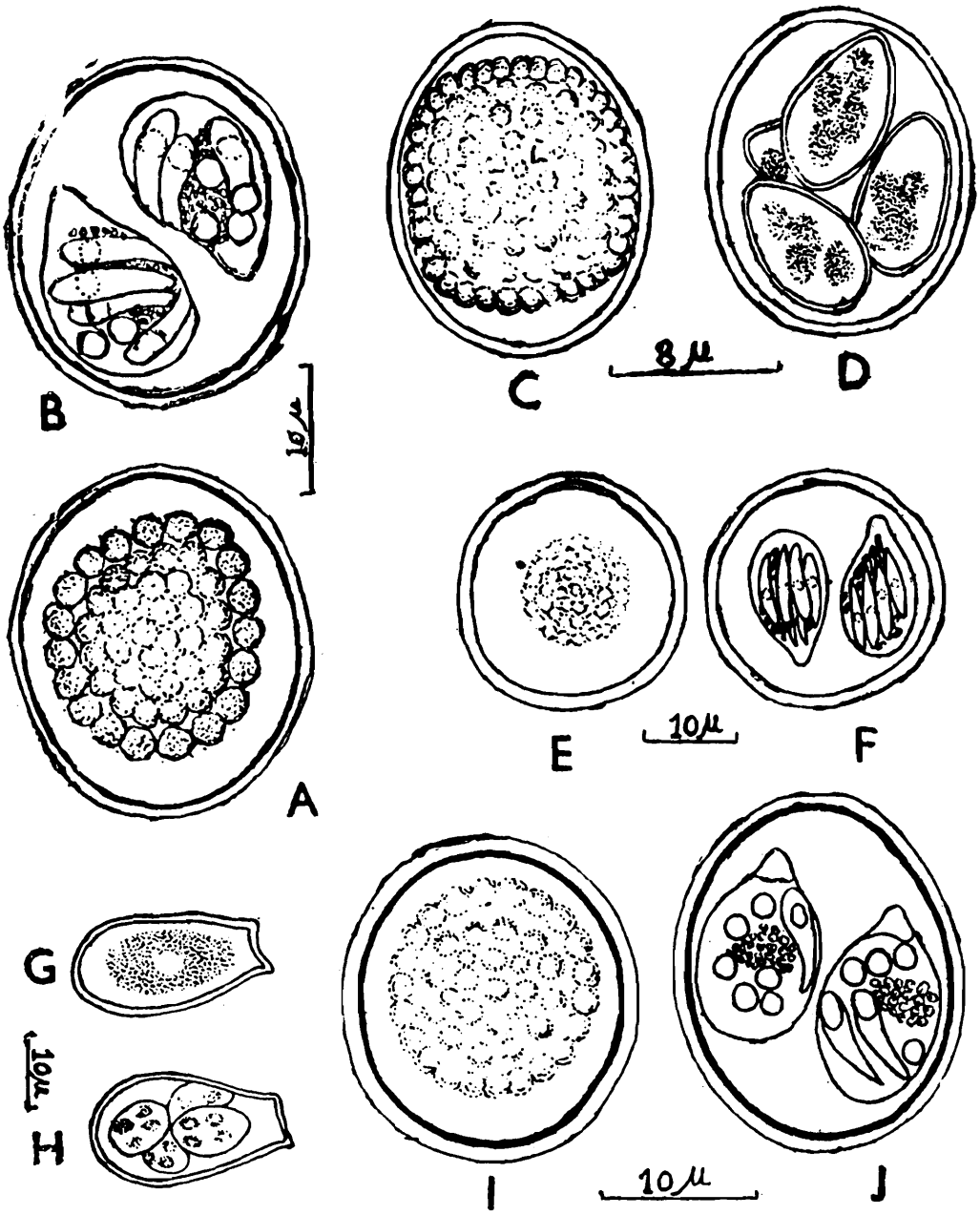
Remarks.—Topotype and paratypes were observed. According to Chakravarty and Kar (1944), Oocysts measure 18.5-22.5μ with an average 20.6μ, sporocysts 14.2-18.5$\mu \times$9.3-10.3μ and sporozoites 8.2$\mu \times$2.2μ.

Dorisiella mandali Ray and Sarkar

1967. *Dorisiella mandali* Ray and Sarkar, *Proc. Indian Sci. Congr.*: 448.

Description.—Oocysts oval in shape measuring 27.5-33.7μ in length and 25.0-30.0μ in breadth (average 30.73$\times$26.7μ). Oocystic wall 1.87-2.00μ thick, outer wall transparent greenish yellow in colour with a thin yellow inner membrane. Oocystic residuum present as a few scattered minute refractile granules; no micropyle. Two vial-shaped

sporocysts with prominent plug-like "steida body" at the pointed anterior end. Sporocystic residuum comprised of compact refractile granules. Sporozoites measure 12.25 ×4.5μ with a vacuole at one end and the nucleus is placed just below the vacuole.



Text-fig. 6.—Oocysts : a, b. *Dorisiella vagabundae* Mandai and Chakraborty a. immature b, with sporoblast ; c, d, *Wenyonella bhali* Misra, c, immature d, mature ; e, f. *Dorisiella hareni* Chakraborty and Kar e, immature f, sporulated ; g, h. *Wenyonella anatis* Panda, Bhatia and Srivastava, g, immature h, mature; i, j. *Dorisiella aethiopsaris* Chakraborty and Kar, i, immature j, mature

Sporulation time.—4-5 days at 31. 0 c.

Habitat.—Duodenum and small intestine of *Zosterops palpebrosa* (Temm.) from Calcutta.

Remarks.—Type specimen was examined, no noticeable differences are found.

Dorisiella passeris Ray and Sarkar

1967. *Dorisiella passeris* Ray and Sarkar, *Proc. Indian Sci. Congr.*: 448.

Description.—Oocysts spherical, 30-32.5μ in diameter average 31.17μ), wall 1.8 to 2μ thick, colour of the outer transparent wall is pale yellowish green, while the inner one is dark-black in transmitted light. Oocystic residuum present in the form of a few scattered granules, micropyle absent; two vial-shaped sporocysts with a rounded projection carrying a domelike "steida" body; sporocysts measure 20.25μ in length and 14-16.0μ in breadth (avg. 22.5$\mu \times$15.2μ). Sporocystic residuum centrally situated as a compact granular mass. Sporozoites are curved, sausage like in appearance and measure 9.75$\times$3.0μ in diamensions, at both the blunt ends there is a vacuole with the nucleus placed in the centre of the body.

Sporulation time.—6-8 days.

Habitat.—In Duodenum and small intestine of *Passer domesticus* (Linn.) from Calcutta.

Remarks.—Type specimen was examined and no noticeable differences are found.

Dorisiella vagabundae Mandal and Chakravarty

(Text-fig. 6 a, b)

1963. *Dorisiella vagabundae* Mandal and Chakravarty, *Proc. zool. Soc., Calcutta*, **16**: 147.

Description.—Oocysts oval, double walled, outer thinner, micropyle seen in early stage, cytoplasm globular and refractile, oocystic residuum present. Fully developed oocysts measure 24.0-26.4$\mu \times$22.0μ. Fully developed sporocysts with anterior pointed end, rounded posterior end, anterior end develops a less prominent knob. Sporocysts measure 17.6μ-19.8$\mu \times$12.1μ. Sporozoites club-shaped, pointed at one end, nucleus at the rounded posterior end, cytoplasmic striations found in the sporozoites, arrangement irregular.

Sporulation time.—60-72 hours.

Habitat.—Small intestine of *Crypsirina vagabunda* (Latham).

Remarks.—Topotype and Type specimen were examined. No noticeable differences are found.

Genus **Sivatoshella** Ray and Sarkar

Type species: S. lonchurae Ray and Sarkar

Sivatoshella lonchurae Ray and Sarkar

1968. *Sivatosella lonchurae* Ray and Sarkar, *J. Protozool.*; **15**(4): 640.

Description.—Oocysts spherical in shape measure 36.0-38.0μ in diameter with a mean of 37.62. Oocystic wall consists of 4 layers of 3.6μ

in thickness. Oocystic residuum and micropyle absent. Sporocysts pear-shaped measuring 28.00-29.00μ in length and 18.0μ in width. A steida body along with a substeidal body are present at the narrow pole. Sporozoites are broad comma-shaped with large vacuole at the broader end. Sporocystic residuum present as small refractile globules. Sixteen sporozoites are invariably arranged at the periphery of this individual mass.

Sporulation time.—24-48 hours.

Habitat.—Duodenum and small intestine of *Lonchura punctulata* (Linn.) and *L. malabarica* (Linn.) Calcutta, West Bengal.

Remarks.—The Type material has been examined and subsequently described. No noticeable differences are found from its original description.

Genus **Eimeria** Schneider

Eimeria alectoriae Ray and Hiregaudar

1959. *Eimeria alectoriae* Ray and Hiregaudar, *Bull. Calcutta Sch. trop. Med.*, **7**: 111.

Description.—Oocysts ellipsoidal in shape with few ovoidal forms and very few spherical forms. Oocystic wall pale Yellowish-brown with fine granules near the micropyle. Micropyle conspicuous as a minute opening in the wall. Oocysts measure 23.6$\pm$2.4μ in length and 15.6$\pm$1.5μ in width and the shape index is 1.43. Oocysts from another bird of the same species measure 26.2$\pm$2.5μ in length and 17.4$\pm$1.9μ in width and the shape index is 1.50. Refractile granules present in cytoplasm. Sporocysts are pear-shaped measure 8-9.5$\mu\times$5-5.6μ, with steida body at the pointed end. Sporozoites are banana-shaped and the sporocystic residuum present.

Sporulation time.—24-48 hours.

Host.—*Alectoris graeca* "Chukar Partridge" at Zoological Garden, Calcutta.

Remarks.—Type specimen was examined and described. No noticeable differences are found.

Eimeria bateri Bhatia, Pandey and Pande

1965. *Eimeria bateri* Bhatia, Pandey and Pande, *Indian J. Microbiol.*, **5**(4):-61.

Description.—Oocysts ovoid measuring 16.5-29.8μ in length and 13.5μ-24.5μ in width (mean 24.5$\mu\times$18.5μ). The shape index is 1.25. The outer wall yellowish inner one dark bluish. Micropyle and oocystic residuum absent. Polar granules present, sporocyst ovoidal or pyriform with prominent steida body at narrow anterior end. It measures 8.5μ-13.5$\mu\times$5.5μ-8.5μ with a mean of 12.5$\times$7.5μ. The shape index is 1.8. Sporocystic residuum is present as scattered granules. Sporozoites are elongated in shape with nucleus at posterior blunt end.

Sporulation time.—24-30 hours.

Habitat.—Small intestine of *Coturnix coturnix*, Indian Common grey quail.

Remarks.—The parasite was examined, after obtaining a host procured from Calcutta market. Except minor differences in measurements of oocyst, no other differences are found from its original descriptions.

Eimeria battakhi Dubey and Pande

1963. *Eimeria battakhi* Dubey and Pande, *Curr. Sci.*, **32**: 330.

Description.—Oocysts subspherical to ovoid, double walled the outer being thinner than the inner one. It measures 19-24μ in length with a mean of 21μ and 16μ-21μ in width with a mean of 18μ. The shape index is 1.16. Cytoplasm centrally placed coursely granular with small refractile globules. Micropyle and oocystic residuum absent. The sporocysts are elongately ovoid, measuring 11-13μ in length with a mean of 12μ and 6-8μ in width a mean of 7μ. The shape index is 1.7. The narrower end is provided with a small knob (steida body). Sporocystic residuum present as a compact mass. The sporozoites are elongated with one broader and other narrower end. It measures 9-11μ in length with a mean of 10μ and 2μ in width. A clear vacuolated area is seen on the posterior rounded end in addition to the centrally placed nucleus.

Sporulation time.—24-32 hours.

Habitat.—Small intestine of *Anas platyrhynchos domesticus*. Mathura, U.P.

Remarks.—Topotype and the same species were obtained from domestic duck at Shillong, Meghalaya. No differences are found from its original description.

Eimeria barbeta Kar

(Text-fig. 7 l, m)

1944. *Eimeria barbeta* Kar, *Proc. Indian Sci. Congr.*: 104.
1947. Chakravarty and Kar, *Proc. Roy. Soc.*, Edinburgh, **62**: 226.

Description.—Oocysts oval, double walled, the outer being thinner. Oocysts measure 22.2-24.2μ in length with a mean of 23.2μ and 17.5-19.5μ in width with a mean of 18.5μ. The shape index is 1.2. Micropyle present and oocystic residuum absent. Sporocysts are oval, with anterior portion narrower than the posterior. The anterior end is provided with a ill developed knob. Sporocysts measure 14.5-16.5μ in length with a mean of 15.5μ and 7.5-9.5μ in width with a mean of 8.5μ. The shape index is 1.8. Sporocystic residuum present as compact mass. Sporozoites are sickle-shaped, measuring 10.5-12.5μ in length and 2.2μ. in width. The shape index is 5.2. Nucleus is placed towards the rounded posterior end.

Sporulation time.—48-62 hours.

Habitat.—Small intestine of *Cyanops asiatica asiatica* (Lath.) from Calcutta.

Remarks.—The topotype was examined and the sporulation time was noted, slight differences in measurements of oocysts were also noticed.

Eimeria bhutanensis Ray and Hiregaudar

1959. *Eimeria bhutanensis* Ray and Hiregaudar, *Bull. Calcutta Sch. Trop. Med.*, **7**: 111.

Description.—Oocysts spherical to subspherical in shape. Endocystic wall thicker than the ectocystic wall and slightly yellowish in colour. Refractile granules present. Oocysts measure 15.5-16.8μ in length and 14.6-16.6μ in width. Sporocysts are bean-shaped, with a steida body at one end with scanty residual matter. Sporocysts measure 6-7 $\times$ 3-4μ. Sporozoites are sickle-shaped.

Sporulation time.—24-36 hours.

Habitat.—Intestine of *Polyplectron bicoloratus* "Bhutan Peacock pheasant" at Zoological Gardens, Calcutta.

Remarks.—Type specimen was examined and described. No differences are found from its original description.

Eimeria charadrii Mandal

(Text-fig. 7 v, w)

1965. *Eimeria charadrii* Mandal, *Proc. zool. Soc., Calcutta*, **18**: 53.

Description.—Oocysts oval in shape with double wall, the outer wall is thinner than the inner one. Anterior end of the oocyst is drawn out as a small neck. Oocysts measure 14.3-17.6μ in length with a mean of 15.8μ and 11.0-12.0μ in width with a mean of 11.5μ. The shape index is 1.3. Highly refractile cytoplasm completely fills up the oocyst. Micropyle present at the anterior end, oocystic residuum absent. Sporocysts are pyriform in shape measuring 7.8-9.8μ in length with a mean of 8.8μ. and 5.5-7.6μ in width with a mean of 6.6μ. The shape index is 1.3. The anterior end of the sporocyst is narrow and the posterior end round. Sporocystic mass present as scattered mass. Sporozoites are elongated in shape with both ends bluntly pointed. Sporozoites measures 4.4μ $\times$ 2.2μ. The shape index is 2.0. Nucleus is situated at the middle.

Sporulation time.—80-90 hours.

Habitat.—Small intestine of *Charadrius asiaticus* Pallas, Naryantala, 24-Parganas, West Bengal.

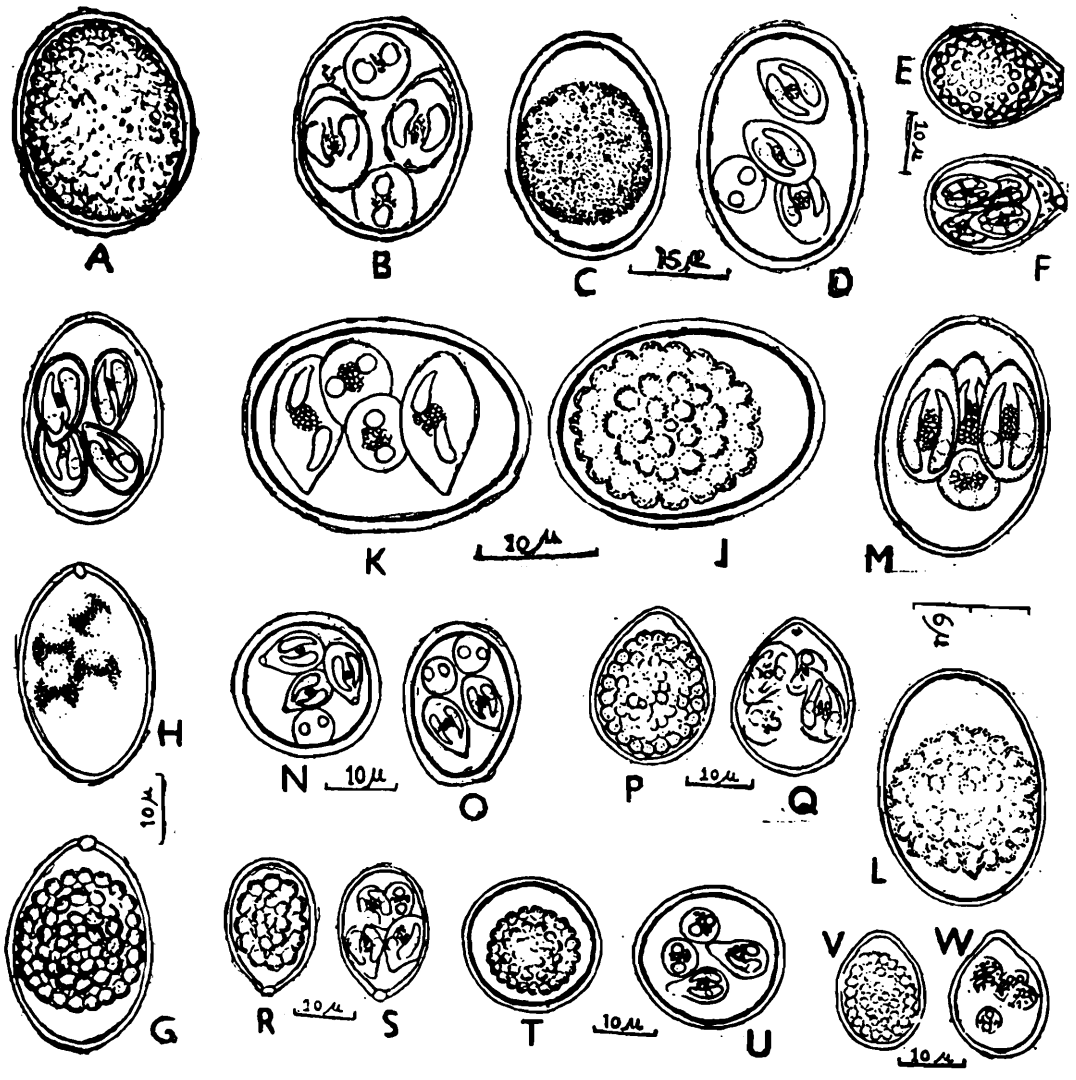
Remarks.—Type specimen and Topotype were examined. No remarkable differences are found.

Eimeria coturnicis Chakravarty and Kar

(Text-fig. 7 j, k)

1947. *Eimeria coturnicis* Chakravarty and Kar, *Proc. Roy Soc. Edinburgh*, **62**: 230.

Description.—Oocyst oval, provided with double envelope. It measures 26.5μ-34 5μ in length with a mean of 31.5μ and 19.4μ-26.4μ in width with a mean of 22.8μ. The shape index is 1.3. The cytoplasm, spherical and completely filled up the oocyst. It is provided with refractile globules. Micropyle and oocystic residuum absent. The sporocysts are pyriform and the anterior pointed end is provided with knob. It



Text-fig. 7.—Oocysts : a, b. *Eimeria columbae* Mitra and Das Gupta a, immature b, mature; c, d, *Eimeria malaccae* Chakraborty and Kar, c, immature d, mature; e, f. *Eimeria vanelli* Mandal e, immature f, mature; g, h, i. *Eimeria pavonis* Mandal g, immature h, with spront; i, mature; j, k. *Eimeria coturnicis* Chakrabarty and Kar, j, immature k, mature; l, m. *Eimeria barbelta* Kar l, immature m, mature; n, o. *Eimeria Iabbeana* (Labbe) n, immature o, mature; p, q. *Eimeria roscoviensis pluvialina* Mandal p, immature q, mature; r, s. *Eimeria gallinagoi* Mandal r, immature s, mature; t, u. *Eimeria numanii* Mandal t, immature u, mature; v, w. *Eimeria charadrii* Mandal, v. immature w, mature

measures 13.4-17.4 in length with a mean of 15.4 and 8.5-11.5 in width with a mean of 9.5μ. The shape index is 1.6. The sporocystic

residuum is present as a compact mass. The sporozoites are spherical or slightly oval in shape.

Sporulation time.—60-72 hours.

Habitat.—Small intestine of *Coturnix coturnix* Calcutta, Bengal.

Remarks.—Topotype was collected and examined. The sporulation time was not mentioned earlier, no other differences are found.

Eimeria columbae Mitra and Das Gupta

(Text-fig. 7 a, b)

1937. *Eimeria columbae* Mitra and Das Gupta, *Proc. Indian Sci. Congr:* 291.
1938. Das Gupta, *Arch. Protistenk*, **91**: 108.

Description.—Oocysts subspherical, thick-walled, the outer being thinner and membranous. Oocysts measure 23.5-25.5μ in length with a mean of 24.5μ and 19.5-21.5μ in width with a mean of 20.5μ. The shape index is 1.2. Micropyle absent, oocystic residuum present. Sporocysts ellipsoidal, without any knob. Sporocysts measure 12.2-14.2μ in length with a mean of 13.2 and 8.3-10.3μ in width with a mean of 9.3μ. The shape index is 1.4. Sporocystic residuum present as scattered mass. Sporozoites are curved with one pointed end and the other rounded end.

Sporulation time.—3-4 days.

Habitat.—Small intestine and caeca of *Columba intermedia* from Calcutta.

Remarks.—Topotype was collected and observed. The same species has also been collected from Shillong, Meghalaya. According to the original descriptions, the oocysts measure 16.4$\mu \times$14.25μ and the sporocysts measure 16.4$\mu \times$14.25μ and the sporozoites measure 7.2$\times$4.8μ and the sporulation time was 4 to 5 days.

Eimeria dauki Bhatia and Pande

1965. *Eimeria dauki* Bhatia and Pande, *Indian J. Microbiol.* 5(4): 65.

Description.—Oocysts ovoidal, knobbed at narrow micropylar end and provided with double wall. It measures 14-20 in length with a mean 17.8μ and 11-13μ in width with a mean of 12.5μ. The shape index is 1.4. Oocystic residuum absent. Sporocyst elongated with narrow anterior end. It measures 10.5μ-12.5μ in length with a mean 10.5μ and 5.5-7.8μ in width with a mean 5.8μ. Steida body prominent plug-like, sporocystic residuum present as dark granules. Sporozoites elongated, measuring 8.5μ, in length and 2.5μ in width. Nucleus is situated at the middle.

Sporulation time.—24-30 hours.

Habitat.—Small intestine of *Amaurornis phoenicurus* (Pennant) from Mathura, U.P.

Remarks.—Out of 20 specimens examined from Barasat, 24-Parganas, West Bengal, only 5 were infected with this parasite. No pathogenicity was noticed while rearing the White Breasted Moorhen in the

laboratory. The present description is more or less similar with that of its original description.

Eimeria gallinagoi Mandal

(Text-fig. 7 r, s)

1965. *Eimeria gallinagoi* Mandal, *Proc. zool. Soc., Calcutta*, **18**: 48.

Description.—Oocysts pyriform, double walled with uniform thickness and yellowish in colour. Oocysts measure 19.8-20.9μ in length with a mean of 20.2μ and 13.2-14.3μ in width with a mean of 13.8μ. The shape index is 1.4. Cytoplasm is completely packed up within oocysts and provided with refractile globules. Micropyle present and oocystic residuum absent. Sporocysts are pyriform in shape, anterior narrower end is provided with a small knob. Sporocysts measure 6.7-8.7μ in length with a mean of 7.7μ and 4.5-6.5μ in width with a mean of 5.5μ. The shape index is 1.4. Sporocystic residuum present as a concentrated mass. Sporozoites measure 5.5μ in length and 2.5μ in width. The shape index is 2.2.

Sporulation time.—24-36 hours.

Habitat.—Small intestine of *Gallinago gallinago* (Linnaeus) from Basanti, 24-Parganas, West Bengal.

Remarks.—Type specimen and topotype were examined. The sporulation time was noted. Found no noticeable differences.

Eimeria gennaeuscusae Ray and Hiregaudar

1959. *Eimeria gennaeuscusae* Ray and Hiregaudar, *Bull. Calcutta Sch. trop. Med.*, **7**: 112.

Description.—Oocysts subspherical in shape, oocystic wall thin, pale yellowish brown in colour. Endocystic wall thicker than the outer wall. Oocysts measure 21.2$\pm$1.5μ in length and 18.3$\pm$2.0μ in width and the shape index is 1.16. Sporocysts pear-shaped with a small steida body and residuum. Sporocysts measure 7-8$\mu \times$4-5μ. Sporozoites are sickle-shaped.

Sporulation time.—24-36 hours.

Habitat.—*Cennaecus horsfieldi* G. R. Gray, at Zoological gardens, Calcutta.

Remarks.—The type specimen was examined and described. Found without any noticeable differences from its original description.

Eimeria kapotei Chatterjee and Ray

1969. *Eimeria kapotei* Chatterjee and Ray, *Proc. Indian Sci. Congr.*: 512.

Description.—Oocyst oval, measures 26.1$\times$23.5μ contain one or two refractile globules; two layered, inner one being thicker; micropyle present as a depression at the anterior pole; sporocyst ovoid measures 8.5-9.5μ, sporocystic residuum present in the form of scattered granules; 'Steida' body present; Sporozoite bean-shaped measures 5.6μ in length.

Sporulation time.—3-4 days.

Habitat.—*Columba livia intermedia* Strickl from Calcutta.

Remarks.—Type specimen was examined and no differences are found from its original description.

Eimeria labbeana (Labbé)

(Text-fig. 7 n, o)

1896. *Coccidian pfeifferi* Labbé, *Arch. Zool. Exper. et. Gen.* **4**: 520.
1896. *E. pfeifferi* (Labbé), *Arch. Zool. Exper. et. Gen.* **4**: 521.
1944. Chakravarty and Kar, *Proc. Indian Acad. Sci.* **20**: 103.

Description.—Oocysts are of two forms, oval or spherical, oval form measures 19.5μ-21.2μ in length with a mean of 20.1μ and 16.5-17.5μ in width with a mean of 16.9μ. The shape index is 1.1. The spherical form measures 17.5-18.5 with a mean of 17.9. It possesses double envelope, the outer being thinner. The cytoplasm is refractile with refringent globules. Micropyle present oocystic residuum absent. Sporosysts oval measuring 11.00-13.5μ in length with a mean of 12.4 and 5.5-6.8μ in width with a mean of 6.4μ. The shape index is 1.4. The sporocystic residuum appears as a compact mass. The sporozoites are elongated measuring 6.5 $\times$ 2.3μ. The nucleus is situated in the middle.

Sporulation time.—24-30 hours.

Habitat.—Intestine of *Columba livia intermedia* Strickl, Calcutta.

Remarks.—A total of 50 birds were examined of which 10 were infected with this parasite. The differences are in the measurements of oocyst and sporocyst.

Eimeria lucknowensis Misra

1947. *Eimeria lucknowensis* Misra, *Proc. Indian Acad. Sci.*, **25**: 78.

Description.—Oocysts ovoid in shape and limited in unsegmented condition in the faeces. Cyst wall colourless and double layered. Both ends of the oocysts are similar and rounded and there is no indication of a flattening and prolongation at either end. Oocystic residuum absent. Oocysts measure 21.4-24.5μ $\times$ 17.4-18.8μ in size. Sporocysts ovoid and devoid of any thickening at either pole. It measures 8.5μ $\times$ 6.0μ. Sporozoites are curved and club-shaped. They measure 7.6μ in length and are arranged with their concavities facing the sporocystic residuum between them.

Sporulation time.—3 to 4 days.

Habitat.—Small intestine of *Motacilla alba* Linn. from Lucknow.

Remarks.—This specimen was examined at Shillong, Meghalaya after obtaining a parasite from *Motacilla elba* Linn. and described. No noticeable differences are found.

Eimeria malaccae Chakravarty and Kar

(Text-fig. 7 c, d)

1944. *Eimeria malaccae* Chakravarty and Kar, *Proc. Indian Acad. Sci.*, **20**: 106.

Description.—Oocysts broadly oval, measuring 26.5μ-30.5μ in length with a mean of 28.5μ and 16.5-18.5μ in width with a mean 17.5μ. The shape index is 1.6. Oocysts possess double wall, the outer being thinner. Cytoplasm is rounded and appears like refractile globules. Micropyle present, oocystic residuum absent. Sporocysts are oval, anterior end pointed and provided with a small knob. Sporocysts measure 11.5-13.5μ in length with a mean of 12.5μ and 9.5-11.5μ in width with a mean of 10.5μ. The shape index is 1.1. Sporocystic residuum with tapering anterior end. Sporozoites measure 8.5$\mu \times$2.3μ. Nucleus is situated near the posterior end.

Sporulation time.—48-70 hours.

Habitat.—Intestine of *Munia malacca malacca* Linn., Calcutta.

Remarks.—Type specimen and Topotype were examined. The sporulation time was noted. The differences are found in the measurements of oocysts.

Eimeria mandali Banik and Ray

1964. *Eimeria mandali* Banik and Ray, *Bull. Calcutta. Sch. trop. Med.* **12**(1): 27.

Description.—Oocysts round, possess double envelope. It measures 14.5μ-20.60μ in length and 14.2μ-18.8μ in width with a mean of 17.6μ and 16.5μ respectively. The shape index is 1:1. Cytoplasm centrally placed, granular. Micropyle present with a refractile granule below it. Oocystic residuum present. Sporocysts pyriform measure 6.5-12.00μ in length and 4.5μ-8.5μ in width. The sporocystic residuum is present in the centre. Sporozoites banana-shaped, measuring 6.5μ in length and 2.5μ at broadest region.

Sporulation time.—24-72 hours.

Habitat.—Small intestine of *Pavo cristatus* Linnaeus, Calcutta Zoo.

Remarks.—Type specimen was examined and found no differences The shape and size of sporozoites are recorded here.

Eimeria numenii Mandal

(Text-fig. 7 t, u)

1965. *Eimeria numenii* Mandal, *Proc. zool. Soc., Calcutta.*, **18**: 50.

Description.—Oocysts spherical, possess double envelope, the outer being thinner. Oocysts measure 20.9-23.1μ in diameter with a mean of 22.2μ. Cytoplasm is centrally placed and round in shape, highly globular and refractile, measures 15.4μ in diameter. Micropyle and oocystic residuum absent. Sporocysts are pyriform in shape with

bluntly pointed anterior end and rounded posterior end. Sporocysts measure 5.6-7.6μ in length with a mean of 6.6μ and 4.5-6.5μ in width with a mean of 5.5μ. The shape index is 1.2, the wall of sporocyst is very thin. Sporocystic residuum present as scattered mass. Sporozoites are elongated in shape with tapering anterior end. It measures 5.9μ in length and 2.5μ in width. The shape index is 2.3. The nucleus is situated in the middle.

Sporulation time.—60-70 hours.

Habitat.—Small intestine of *Numenius arquata* (Linnaeus) from Namkhana, 24-Parganas, West Bengal.

Remarks.—Type specimen and Topotype were examined. No noticeable differences are found.

Eimeria pavonis Mandal

(Text-fig. 7 g, h)

1965. *E. cristata* Patnaik, *Indian J. Vet.*, **5**: 46.
1965. *Eimeria pavonis* Mandal, *Proc. zool. Soc., Calcutta*, **18**: 49.

Description.—Oocysts ovoidal in shape double walled, the inner being thinner than the outer. Oocysts measure 19.8-25.4μ in length and 16.5-18.5μ in width, the shape index is 1.2, the cytoplasm completely fills up the oocysts and appears as a refractile globular mass. Micropyle present, oocystic residuum absent. Sporocysts are more or less elliptical in shape with double wall of uniform thickness and with a knob at the anterior narrower end. Sporocysts measure 12.1-15.6μ in length with a mean of 14.5μ and 5.6-7.6μ in width with a mean of 6.6μ. The shape index is 2.1. Sporocystic residuum present as scattered mass. Sporozoites are elongated in shape with pointed anterior end and nucleus situated at the posterior end. Sporozoites measure 11.5-13.5μ in length with a mean of 12.5μ and 2.3-3.8μ in width with a mean of 2.6μ. The shape index is 4.8. The sporozoites lie along the longitudinal axis of the sporocysts with their anterior end directed to opposite poles.

Sporulation time.—65-70 hours.

Habitat.—Small intestine of *Pavo cristatus* Linnaeus from Mau, U.P.

Remarks.—Type specimens and topotype were examined. The sporulation time was noted. No other differences are found.

Eimeria rescoviensis pluvialina Mandal

(Text-fig. 7 p, q)

1965. *Eimeria rescoviensis pluvialina* Mandal, *Proc. zool. Soc., Calcutta*, **18**: 55.

Description.—Oocysts pyriform or ovoidal in shape with double envelope. They measure 17.7-19.7μ in length with a mean of 18.7μ and 13.3-15.3μ in width with a mean of 14.3μ. The shape index is 1.3. Cytoplasm with globular refractile mass. Micropyle absent,

Oocystic residuum present. Sporocysts are pyriform with pointed anterior end and rounded posterior end. Sporocysts measure 11.1-13.1μ in length with a mean of 12.1 and 5.6-7.6μ in width with a mean of 6.6μ. The shape index is 1.7. Sporocystic residuum present as scattered mass. Sporozoites are elongated in shapes with nucleus in the central position and anterior end narrower than the posterior one. Sporozoites measure 8.8$\mu \times$2.5μ. The shape index is 3.5.

Sporulation time.—72-80 hours.

Habitat.—Small intestine of *Pluvialis appricaria* (Linnaeus) from Namkhana, 24-Parganas, West Bengal.

Remarks.—Observations were recorded from type specimen.

Eimeria pavonina Banik and Ray

1961. *Eimeria pavonina* Banik and Ray, *Bull. Calcutta, Sch. trop. Med.*, **19**(2): 61.

Description.—Oocyst egg-shaped, double layered, the outer being thicker. Cytoplasmic mass granular and does not entirely fill up the oocyst. The Oocyst measures 20μ-28μ in length with a mean of 26.5μ and 16-20μ in width with a mean of 18.5μ. A small micropyle present with a refractile granule usually lying just underneath. Oocystic residuum present. Sporocysts boat-shaped measuring 6-16μ in length and 4-8μ in width, with one end being sharply pointed than the other. A steida body is present at the pointed end. Sporocystic residuum present as a scattered granules. The sporozoites are elongated measuring 10-12μ in length.

Sporulation time.—24-72 hours.

Habitat.—Intestine of *Pavo cristatus* Linneaus in Calcutta Zoo.

Remarks.—The Type specimen was studied and described. No noticeable differences are found.

Eimeria patnaiki Ray

1965. *E. pavonis* Patnaik, *Indian Vet. J.* **5**: 46.
1966. *Eimeria patnaiki* Ray, *Indian J. Microbiol.* **6**(4): 51.

Description.—Oocysts smooth walled, spherical to subspherical in shape and colourless. Oocysts measure 17.5-19.35μ in length and 13-17μ in width with a mean of 18.5$\mu \times$15.5μ. The shape index is 1.2. Micropyle absent. Polar granule and oocystic residuum present. Sporocysts lemon-shaped, measure 6.45-8.5μ in length and 3.2-4.83μ in width with a mean of 7.5μ and 4.0μ respectively. Steida body visible as a small thickening at the narrower end. Sporocystic residuum present in the early stages. Sporozoites are comma-shaped with a large globular hyaline body at the broader blunt end.

Sporulation time.—4 to 6 days.

Habitat.—Intestine of Peacock, *Pavo cristaus* Linn. from Bhubaneswar, Orissa.

Remarks.—The type specimen was examined and no differences were found. Moreover the description was also based on Ray, 1966.

Eimeria sphenocercae Ray

1952. *Eimeria sphenocercae* Ray, *J. Parasit.*, **38**: 546.

Description.—Oocysts kidney-shaped with a slight bend on one side, having a double contour. It is surrounded by an exomembrane which is tight fitting all over the body except at either pole where it broadens considerably in the form of an irregular cap. In most specimens on one of the broader sides of the oocyst the endocystic wall is depressed considerably giving it the appearance of kidney and in some the oocysts have got an appearance of dum-bell. Perfectly cylindrical specimens are seen very rarely. Micropyle is asymmetrical in position and appears as a portuberance. In some cases a plug like structure closes the opening of the micropyle. The size of the oocyst varies from 17.525.0-μ in length and 12.5-15.0μ in width the average being 18-19μ $\times$12.61μ. Sporocysts are broadly oval in outline ranging from 18.75μ to 17.5μ in length and 12.5 13.75μ in width, the average being 19.18μ $\times$ 12.61μ. Sporocystic residuum present.

Sporulation time.—5-6 days.

Habitat.—Intestine of *Sphencercus sphenura*, Mukteswar, U.P.

Remarks.—The description is mainly based upon its original description.

Eimeria tropicalis Malhotra and Ray

1961. *Eimeria tropicalis* Malhotra and Ray, *Proc. Indian Sci. Congr.*: 412.

Description.—Oocysts spherical or sub-spherical measuring 19-24μ in length and 18-23μ in width with a mean of 20.5μ. The wall of the oocyst is thick. Small oocystic residuum is seen after the development. Sporocyst ellipsoidal, 10μ in length and 6μ in width with a prominent steida body. The sporocystic residuum is present as scattered mass. Sporozoites globular in shape.

Sporulation time.—40-48 hours.

Habitat.—Duodenum and anterior small intestine of *Columba livia*, Calcutta.

Remarks.—Type specimen was examined and described. No differences are found.

Eimeria vanelli Mandal

(Text-fig. 7 e, f)

1965. *Eimeria vanelli* Mandal, *Proc. zool. Soc., Calcutta*, **18**: 51.

Description.—Oocysts oval or pyriform in shape with double envelope, the outer being thinner and provided with warts. Oocysts measure 19.9-21.9μ in length with a mean of 20.9μ and 13.3-15.3μ in width with a mean of 14.3μ. The shape index is 1.4. The Cytoplasm with granules and refractile material completely fills up the oocysts. Micropyle present, oocystic residuum absent. Sporocysts

pyriform in shape with bluntly pointed anterior and rounded posterior ends. Sporocysts measure 11.1-13μ in length with a mean of 12.1μ and 5.6-7.6μ in width with a mean of 6.6μ. The shape index is 1.8. Sporocystic residuum present as scattered mass. Sporozoites are elongated in shape with tapering at both ends. Cytoplasm of sporozoites shows banded appearance. Sporozoites measure 6.7-8.7μ in length with a mean of 7.7μ and 2.3-4.3μ in width with a mean of 3.3μ. The shape index is 2.3.

Sporulation time.—72-80 hours.

Habitat.—Small intestine of *Vanellus malabaricus* (Boddaart). Basanti, 24-Parganas, West Bengal.

Remarks.—Type specimen and Topotype were observed. No noticeable differences are found.

Genus **Wenyonella** Hoare

Type species: *W. africana* Hoare

Wenyonella anatis Pande, Bhatia and Srivastava

(Text-fig. 6 g, h)

1965. *Wenyonella anatis* Pande, Bhatia and Srivastava, *Sci. Cult.*, **31**: 383.

Description.—Oocysts oval with double wall of equal thickness oocysts measure 11.5-17.5μ in length with a mean of 14.5μ and 7.5-10.5μ in width with a mean of 8.8μ. The shape index is 1.6. Cytoplasm coarsely grannular and occupies the whole of the oocyst. Micropyle and oocystic residuum present. Sporocysts ovoid in shape, measure 5.7-7.2μ in length with a mean of 6.4 and 4.3-5.3μ in width with a mean of 4.8μ. The shape index is 1.3. Sporocystic residuum present as coarsely grannular mass of dark appearance. Sporozoites are ovoid with nucleus in middle position, having narrow anterior and broad posterior ends; Sporozoites measure 2.8$\mu \times 2\mu$. The shape index is 1.4.

Sporulation time.—48-62 hours.

Habirat.—Small intestine of *Anas platyrhynchus domesticus*. Mathura, U.P.

Remarks.—Topotype and the sames pecies were obtained from domestic duck at Shillong. In the original description the oocysts were punctate, oval and measurement was recorded as 14$\mu \times 8.5\mu$. Oocystic wall was recorded as ·5-1μ thick and micropyle 4.5-6μ in width. Sporulation time was found to be completed in 48 hours. Sporocysts measured 6.3$\mu \times 4.7\mu$ and sporozoites 2.8$\mu \times 2\mu$.

Wenyonella bahli Misra

(Text-fig. 6 o, d)

1944. *Wenyonella bahli* Misra, *Proc. nat. Inst. Sci. India*, **10**: 203.

Description.—Oocysts subspherical or ovoid with double envelope of equal thickness and measure 15.5-17.5μ in length with a mean of 16.5μ and 14.5-15.5μ in width with a mean of 14.0μ. The shape index is 1.1. Cytoplasm compact, rounded in shape with several refractile globules. Oocystic residuum and micropyle absent. Sporocysts egg-shaped without any knob, measure 5.7-7.8μ in length with a mean of 6.5μ and 3.5-4.8μ in width with a mean of 4.3μ. The shape index is 1.3. Sporocystic residuum absent. Sporozoites ovoid and measure 2.6-3.00μ in length.

Sporulation time.—36-48 hours.

Habitat.—Small intestine of *Coturnix communis* from Lucknow.

Remarks.—Topotype and the same species were collected and observed from the same host at Shillong. Except slight differences in measurements of oocyst and sporocyst no other differences are found.

Wenyonella gallinae Ray

1945. *Wenyonella gallinae* Ray, *Curr. Sci.*, **14**: 275.

Description.—Oocysts oval or egg-shaped with double envelope, the outer being thick than the inner one. Oocysts measure 28.5-34.5μ in length with a mean of 31.5μ and 19.5-21.5μ in width with a mean of 20.5μ. The shape index is 1.5. Micropyle present, oocystic residuum absent. Cytoplasm granular and fills up the oocyst. Sporocysts pyriform in shape, measuring 17.5-19.5μ in length with a mean of 18.5μ and 7.5-9.2μ in width with a mean of 8.3μ. The shape index is 2.2. Sporocystic residuum present as granular mass. Sporozoites club-shaped.

Sporulation time.—4-5 days.

Habitat.—Terminal part of the intestine of *Gallus gallus domesticus* from Mukteswar, U.P.

Remarks.—Topotype was collected and examined. The same species was obtained from domestic fowl at Calcutta. Except the differences in measurements of oocyst and sporocyst no other differences are found from its original description.

Wenyonella mackinnoni Misra

1947. *Wenyonella mackinnoni* Misra, *Proc. Indian Acad. Sci.*, **25**: 76.

Description.—Oocysts are spherical or ovoid in shape. In spherical forms they measure 19μ-23μ and in ovoid forms they measure 23.8-26.2$\mu \times$18.0-21.5μ. The cyst wall consists of two layers, an outer layer thin and colourless and an inner layer comparatively thick and brownish in colour. Protoplasm of the freshly discharged oocysts is filled with refractile granules of reserve materials but later on it becomes condensed and has a more or less spherical contour and measures, on an average, 15.5μ in diameter. Micropyle and the polar inclusions absent in the oocysts. No oocystic residuum seen after the formation

of the sporocysts. Sporocysts are ovoid in form, measure 10.2μ × 7.4μ, with a lens shaped knob at one end. Sporocystic residuum absent. Sporozoites are 8.2μ long, club shaped and irregularly arranged.

Sporulation time.—4-6 days at room temperature.

Habitat.—Small intestine of *Motacilla alba* Linn. from Lucknow.

Remarks.—Topotype as well as the same species were collected from Shillong but no noticeable differences are found.

Wenyonella gagari Sarkar and Ray

1966. *W. gagari* Sarkar and Ray, *Proc. Indian Sci. Congr.*: 499.

Description.—Oocysts pitcher-shaped having three layers of 1.8μ thickness. The outer being yellow, middle greenish and the inner yellowish pink. At narrow pole there is a prominent micropyle of 4.8μ in diameter with fluted 4-6 ridges at its outer border. Oocysts measure 22.8-26.4μ in length and 16.8-19.2μ in width with a mean 24.0μ in length and 18.5μ in width. Oocystic residue absent. Four sporocysts are vial-shaped measuring 13.2-15.6μ in length and 7.2-9.6μ in width with a mean 13.8μ in length and 8.4μ in width. Sporocystic residue present as a small cluster of minute refractile granules. 'Steida' body present. Sporozoites club-shaped measuring 9.6μ in length and 3.6μ in width at broader end. It possesses a large vecuole at the broader pole.

Sporulation time.—24-48 hours.

Habitat.—Gut of a duckling, *Anas boschus* Linnaeus, Basirhat, West Bengal.

Remarks.—Type specimen was examined and no noticeable differences are found from the original description.

Key to genera obtained from Indian Birds

1. Oocyst asporocystid.. *Tyzzeria*
2. Oocyst disporocystid. ..
   - (*a*) Sporocyst Tetrozaic. ..*Isospora*
   - (*b*) ,, Octozoic. ..*Dorisiella*
   - (*c*) ,, Heccaidecazoic.... .*Sivatoshella*
3. Oocyst tetrasporocystid
   - (*a*) Sporocyst dizoic.... ...*Eimeria*
   - (*b*) ,, tetrazoic.... *Wenyonella*

Key to the species of Avian **Tyzzeria**

1. Oocyst oval size of oocyst 14μ—18μ × 9μ—12μ. .. ... *T alleni*
2. Oocyst broadly cylindrical size of oocyst 29μ—28μ × 20μ. *T chenicusae*

Key to the species of Avian **Isospora**

1. Sporocyst pear-shaped
   - (A) Wall of the oocyst showed a bulbous thickening. .*I. bellericae*
   - (B) Wall of the oocyst not having bulbous thickening

2. Sporocyst oval
   - (A) Oocyst sub-spherical. — *.I. temenuchi*
   - (B) Oocyst spherical. — *...I. upupae*
   - (C) Oocyst oval.
     - (*i*) Size of oocyst over 25μ. — *.I. psittaculae*
     - (*ii*) Size of oocyst below 25μ. — *.I. zosteropis*

3. Sporocyst pyriform or spindle-shaped
   - (A) Oocyst with residuum
     - (*i*) Oocyst spherical or subspherical
       - (*a*) size of oocyst 22μ—28μ. — *.I. perusae*
       - (*b*) size of oocyst 15μ–22μ...
         - (*x*) Length of sporocyst above 12.00μ (average). — *...I. garrulae*
         - (*y*) Length of sporocyst below 12.00μ (average). — *.I. corvae*
     - (*ii*) Oocyst oval or ovoid
       - (*a*) Size of oocyst above 23.00μ × 20.00μ (average)
         - (*x*) Size of sporozoites above 10μ. — *.I. lonchurae*
         - (*y*) Size of sporozoites below 10μ
           - (*i*) width 2.7μ. — *.I. garrulusae*
           - (*ii*) width 3.3μ. — *.I. scicerousae*
       - (*b*) Size of oocyst below 23.00μ × 20.00μ (average). — *.I. emberizae*
   - (B) Oocyst without residuum
     - (*i*) Oocyst oval
       - (*a*) Length of oocyst above 24μ. — *...I. muniae*
       - (*b*) Length of oocyst below 24μ. — *.I. pyononotae*
     - (*ii*) Oocyst spherical or sub-spherical
       - (*a*) Micropyle present
         - (*i*) Sporozoite elongated.
           - (*x*) size above 10.5μ. — *...I. sturnae*
           - (*y*) size below 10.00μ. — *.I. bengalensis*
     - (*iii*) Sporozoite banana-shaped size 6-7μ. — *.I. mayuri*
       - (*b*) Micropyle absent
         - (*i*) Sporozoites elongated
           - (*x*) size above 10.00μ. — *.I. ginginiana*
           - (*y*) size below 7.00μ. — *.I. megalaimae*
         - (*ii*) Sporozoites bean-shaped.. — *.I. lacazei*
         - (*iii*) Sporozoites sausage-shaped. — *.I. gypsi*

Key to the species of Avian **Dorisiella**

1. Oocyst spherical
   - (A) Oocystic residuum present. — *.D. passeris*
   - (B) Oocystic residuum absent.
     - (*a*) Sporocyst ellipsoidal. — *....D. chakravartyi*
     - (*b*) Sporocyst pyriform. — *.D. hareni*

2. Oocyst oval
   - (A) Oocystic residuum present
     - (*a*) Sporocyst oval. — *.D. vagabundae*
     - (*b*) Sporocyst vial-shaped. — *.D. mandali*
   - (B) Oocystic residuum absent. — *.D. aethiopsaris*

Key to the species of Avian **Eimeria**

1. Oocyst kidney-shaped. ..... *E. sphenocercae*
2. Oocyst elliptical. ..... *E. alectoriae*
3. Oocyst pyriform.. ..... *E. gallinagoi*
4. Oocyst Egg-shaped. ..... *E. pavonina*
5. Oocyst oval

(A) Oocystic residuum present

(x) Sporocyst pyriform

(a) Sporocyst large above 10.00μ in length. ..... *E. roscoviensis*

(b) Sporocyst small below 10.00μ in length.

(i) Size of oocyst above 17.00$\mu \times$ 13.00μ. ..... *E. patnaiki*

(ii) Size of oocyst below 17.00$\mu \times$ 13.00μ. ..... *E. charidric*

(y) Sporocyst ovoid or eillipsoidal

(a) size of oocyst large above 25μ. ..... *E. columbae*

(b) size of oocyst small below 25μ. ..... *E. kapotei*

5. Oocyst spherical or subspherical

(A) Oocystic residuum present

(i) Sporocyst ellipsoidal. ..... *E. tropicalis*

(ii) Sporocyst pyriform

(a) size of oocyst above 20μ. ..... *E. numenii*

(b) size of oocyst below 20μ.

(i) Sporocyst pyriform. ..... *E. mandali*

(ii) Sporocyst bean-shaped. ..... *E. bhutanensis*

(B) Oocystic residuum absent

(i) Sporocyst oval, ovoidal or elliptical

(a) Length of sporocyst below 10μ. ..... *E. lucknowensis*

(b) Length of sporocyst ranging from 10μ–13μ.

(i) Length of oocyst above 25μ. ..... *E. malaccae*

(ii) Length of oocyst below 25μ.

(x) Length of sporozoite 6.5μ. ..... *E. labbeana*

(y) Length of sporozoite 9-11μ... ..... *E. battakhi*

(a) Length of sporocyst above 13.00μ

(i) Width of sporocyst above 7μ (average) ..... *E. barbeta*

(ii) Width of sporocyst below 7μ (average). ..... *E. pavonis*

(B) (i) Sporocyst pyriform

(a) Size of oocyst large above 27μ. ..... *E. coturnicis*

(b) Size of oocyst below 27μ.

(i) Size of sporocyst below 8μ. ..... *E. gennaeuscusae*

(ii) Size of sporocyst above 8μ.

(λ) Wall of oocyst provided with warts. ..... *E. vanelli*

(y) wall of oocyst smooth

(i) Oocyst with a knob at the micropylar end. ..... *E. dauki*

(ii) Oocyst without any knob at the micropylar end.

(x) Sporocyst with prominent steida body. ..... *E. bateri*

Key to the species of Avian **Wenyonella**

1. Oocyst pitcher-shaped. ..... *W. gagari*
2. Oocyst not pitcher-shaped.

(A) Sporocyst vial-shaped. ..... *W. gallinae*

(B) Sporocyst oval.

(i) Sporocyst with residuum. ..... *W. anatis*

(ii) Sporocyst without residuum.

(a) Size of oocyst large above 19$\times$26μ. ..... *W. mackinoni*

(b) Size of oocyst small below 19$\times$18μ. ..... *W. bahli*

V Mammalia

This is the fifth chapter of the series dealing with the Coccidian parasites of Indian mammals. This group has received tremendous attention because of their relative importance in the Veterinary science and Animal Husbandry. Thus, recent works of Ray (1959), Gill and Ray (1960), Dubey and Pande (1963 and 1964), Patnaik (1964), Gill (1958) and Srivastava and Shah (1968) deal in detail, the description of various species. Moreover, they have also succeeded in providing a very useful key to species available in Indian Sub-region. Therefore it appears to be unnecessary to give the redescription of all those species in details but the description of the species has been summarised indicating the specific characteristics of each species along with their hosts and locality which may facilitate the future works. However, I had an opportunity to examine some of the species from mammals, whose redescriptions have been incorporated here. Up till now 3 genera comprising of 72 species have been described from, Indian mammals.

Observations on Coccidian parasites obtained from Indian mammals.

Genus **Isospora** Schneider

Isospora canis Nemeseri

1965. *Isospora canis* Ray and Banik, *Proc. Indian Sci.* Cong.: 446.
1959. *Isospora canis* Nemeseri, 1959. *Nagyar Allatoryosok Lapja*. **14**: 91.

Description.—Oocysts subspherical measuring 36-40μ in length with a mean of 38μ and 32μ in width. The wall of the oocyst is thick. Micropyle and oocystic residuum absent. Sporocyst spherical in shape measuring 20μ in length and 16μ in width. Steida body absent, sporocystic residuum present as a large granular mass. Sporozoites are bean-shaped measuring 11.5μ in length.

Sporulation time.—15-20 hours.

Habitat.—Gut of domestic dog, *Canis familiaris*, Calcutta, West Bengal.

Remarks.—The specimen was also examined by me. Ray and Banik (1965) described it as new species which was already described from Hungary. The differences between the two are negligible to mention. Therefore, *I. canis* Ray and Banik (1965) should be treated as a synonym of *I. canis* Nemeseri, 1959.

Isospora leonina Mandal and Ray

1960. *Isospora leonina* Mandal and Ray, *Bull. Calcutta Sch. trop. Med.*, **8**: 107.

Description.—Oocyst rhomboidal in shape measuring 30-32μ in length with a mean of 31.8μ and 28.00-31μ in width with a mean of 28.2μ. Micropyle and oocystic residuum absent. Sporocyst spherical, measuring 16-20μ in length and 13.5-15μ in width. Sporocystic residual mass coarsely granular. Sporozoites sausage shaped-measuring 9.5μ in length,

Sporulation time.—24-48 hours.

Habitat.—Intestine of *Panthera leo* (Linn.) Zoological Garden, Calcutta.

Remarks.—Type specimen was examined and described and found no noticeable differences which can be mentioned.

Isospora tropicalis Mukherjea and Krasaner

1965. *Isospora tropicalis* Mukherjea and Krasaner, *Proc. zool. Soc., Calcutta,* **18**: 38.

Description.—Oocysts spherical measuring 16μ in diameter. The wall is thin and tightly stretched over the sporocysts. Micropyle and oocystic residuum absent. Sporocyst oval measuring 15.5-16μ in length and 10.00-10.5μ in width. The sporocystic residuum presents as a granular mass. The sporozoites are banana-shaped measuring 8-10$\mu \times$ 3.2-4μ.

Sporulation time.—Not known.

Habitat.—The intestine of Jackal, *Canis aurius,* Bandipore Hooghly, West Bengal.

Remarks.—Type specimen was examined and described. No noticeable differences are found.

Genus **Eimeria** Schneider

Eimeria bandipurensis Ray, Banik and Mukherjea

1965. *Eimeria bandipureusis* Ray, Banik and Mukherjea, *J. Protool.*, **12**: 473.

Description.—Oocyst spherical or egg-shaped the former measuring 16μ-18μ with a mean of 17μ and the later 16μ-20$\mu \times$14-18μ with a mean of 18$\times$16μ. Double wall of uniform thickness. Micropyle and occystic residuum absent. Sporocysts broadly pear-shaped with a stieda body at the narrow end. It measure 6-10μ in length with a mean of 8μ and 6-8μ in width with a mean of 6.5μ. The sporocystic residuum present as refractile globules lying in between the two sporozoites. Sporozoites banana-shaped with one end rounded and other pointed and contains a clear globule at each end.

Sporulation time.—48-120 hours.

Habitat.—Small intestine of *Funumbulus palmarum* (Linnaeus) Bandipur, West Bengal.

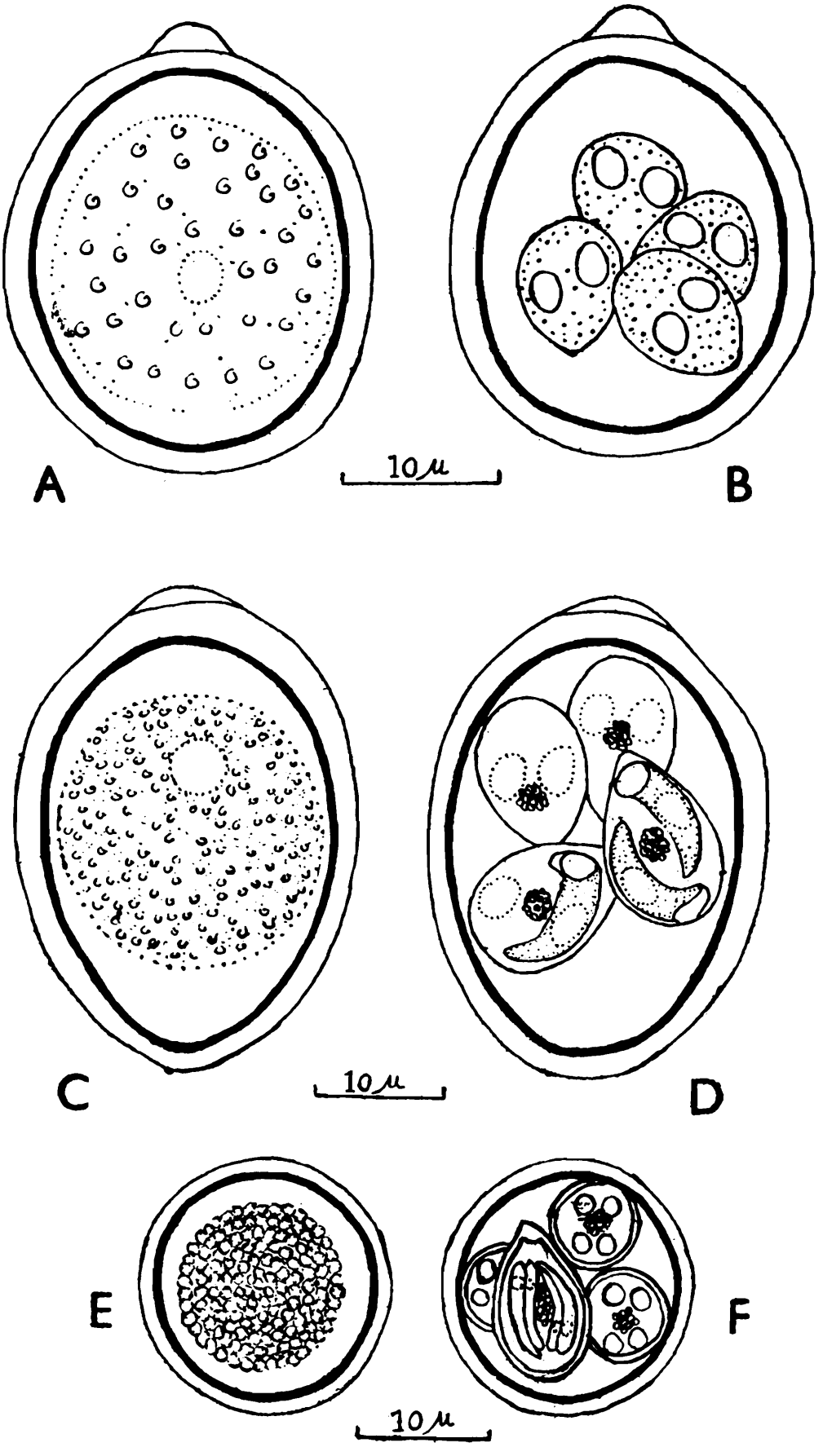
Remarks.—Type specimen was examined and described. No noticeable differences are found.

Eimeria dromedarii Yakimoff and Matschoulsky

(Text-fig. 8 a, b)

1932. *Eimeria cameli* Noller, *Sitz. Ber. ges. Naturf. Freunde.*: 417, proparte;
1934. *Eimeria cameli* Iwanoff-Gobzem, *Ztschr. Infkrankh.* **46**: 1, pro parte.
1939. *Eimeria dromedarii* Yakimoff and Matschoulsky, *J. Roy. Micr. Soc.*, **59**: 28.
1964. Dubey and Pande, *Indian J. Vet. Sci.*, **34**(1): 30.

Description.—Oocysts subspherical to spherical measuring 26-28μ in length with a mean of 27μ and 21-23μ in width with a mean of 21μ.



Text-fig. 8.—Oocysts : a, b. *Eimeria dromedarii* : a, immature b, mature; c, d. *Eimeria rajasthani* : c, immature d, mature; e, f. *Wenyonella hoarei* : e, immature f, mature.

The shape index is 1.19-1.33. Double layered. Micropyle and oocystic residuum absent. Sporocyst ovoid measuring 10-11μ in length with a mean of 10μ and 8.5μ in width. Each sporozoite contained two or more prominent globules.

Sporulation time.—Not known.

Habitat.—Intestine of *Camelus dromedarius* Linn. Bikaner, Rajasthan.

Remarks.—The specimen reached me in a very bad condition, so it was not possible to note all the relevant data except which mentioned above.

Eimeria rajasthani Dubey and Pande

(Text-fig. 8 c, d)

1963. *Eimeria rajasthani* Dubey and Pande, *Curr. Sci.*, **32**: 273.

Description.—Oocyst ellipsoidal measuring 34-39μ in length with a mean of 36.00μ and 25-27μ in width with a mean of 26μ. The shape-index varies from 1.30-1.44. Double layered, micropyle not visible provided with a well defined cap. Oocystic residuum absent. Sporocysts almost ovoid with prominent stieda body. It measures 14-15μ in length with a mean of 15μ and 8-11μ in width with a mean of 11.00μ. Sporocystic residuum present. Sporozoites elongated measuring 10μ-14μ in length and 3-4μ in width with two or more prominent globules.

Sporulation time.—About 7 days.

Habitat.—Intestine of *Camelus dromedarius* Linn., Bikaner, Rajasthan.

Remarks.—Topotype was collected and examined. No noticeable differences are found from the original description.

Eimeria ovoidalis Ray and Mandal

1961. *Eimeria ovoidalis* Ray and Mandal, *Proc. Indian Sci. Congr.*: 411.

Description.—Oocyst ovoidal, measuring 32.00-40.00μ in length with a mean of 35.5μ and 20-28μ in width with a mean of 23.8μ. Micropyle present. Oocystic residuum absent. Sporocyst oval measuring 14μ-16μ in length and 8-9μ in width. Sporocystic residual mass coarsely granular. Steida body present at the narrow end. Sporozoites ovoidal measuring 8μ-9μ in length and 4-6μ in width.

Sporulation time.—90-120 hours.

Habitat.—Intestine of Buffalo calf (Domestic buffalo), *Bubalis bubalis*, Dairy farm in Calcutta.

Remarks.—Type specimen was examined and described. No noticeable differences are found.

Eimeria oryctolagi Ray and Banik

1965. *Eimeria oryctolagi* Ray and Banik, *Proc. Indian Sci., Congr.* **9**: 465.

Description.—Oocyst ellipsoidal, measuring 28.5-46.8μ in length with a mean of 38.7μ and 12.5-28.5μ in width with a mean of 10.1μ.

The shape index 1:2. It is provided with a double wall. Micropyle and oocystic residuum present. Sporocyst pyriform, measuring 8.5μ-14.5μ in length with a mean of 10.00μ and 4.5μ-8.5μi n width with a mean of 6.00 μ. Steida body present at the narrow end. Granular sporocystic residuum present. Sporozoites elongated, tapering at one end and measuring 10.5μ in length.

Sporulation time.—32-48 hours.

Habitat.—Intestine of domestic rabbit, *Oryctolagus cuniculis*, Calcutta, India.

Remarks.—Type specimen was examined and described. No major differences are found which can be noted.

Eimeria pandei Patnaik and Ray

1965. *Eimeria pandei* Patnaik and Ray, *Indian J. Anim. Hel.*, **4**(2): 35.

Description.—Oocysts ovoidal with a thick wall. It measures 22.58-24.18$\mu \times$16.61-19.35μ with a mean of 22.96$\times$18.60μ. The shape index 1.27. Sporocyst pyriform measuring 11.25μ in length and 6μ in width with granular sporocystic residuum. The sporozoites are elongated measuring 9.5μ in length.

Sporulation time.—30-48 hours.

Habitat.—Intestine of *Herpestis edwardsi* (Geoffory).

Remarks.—This species was collected from *H. edwardsi* (Geoffery) available at Calcutta market and described, and found no differences at all.

Genus **Wenyonella** Hoare

Wenyonella hoarei Ray and Dasgupta

(Text-fig. 8 e, f)

1935. *Wenyonella hoarei* Ray and Das Gupta, *Sci. & Cult.*, **1**: 2 and 1937. *Parasitol.* **29**: 118.

Description.—Oocysts spherical, double layered, the outer thinner than the inner thick one. The cytoplasm is highly granular. It measures 14.5-18.5μ in diameter with a mean of 16.8μ. Oocystic residuum absent, micropyle present. The sporocysts ovoid, with a lens-shaped knob at the pointed anterior end. It measures 9.5-11.5μ in length with a mean of 10.5μ and 7.4-9.3μ in width with a mean of 8.4μ. The shape index is 1.2. The sporocystic residuum is present as a compact mass. The sporozoites elongated with bluntly pointed anterior end. It measures 7.4μ in length and 1.5μ in width. The shape index is 4.8. They lie in pairs on each side of the sporocystic mass with a head to tail arrangement.

Sporulation time.—7 days.

Habitat.—Small intestine of a Indian squirrel, *Sciurus* sp. Botanical Garden, Shibpur, West Bengal.

Remarks.—Topotype was collected and examined, and no noticeable differences are found from the original description.

Although the following Coccidian parasites of mammals have not been examined by me but the same have been represented here with their diagnostic characters on the basis of their original description.

Isospora buriatica Dubey

Description.—Oocyst ovoid, measuring 29-33μ in length and 22-25μ in width. Oocystic residuum absent. Sporocyst ellipsoidal, measuring 19-21μ in length and 11-12μ in width, with a sporocystic residual mass.

Sporulation time.—2 days.

Habitat.—Intestine of *Vulpes bengalensis*, Mathura, U.P.

Isospora dubeyi Patnaik and Ray

Description.—Oocyst ovoid, measuring 27-30μ in length and 20-25μ in width. Oocystic residuum absent. Sporocyst ellipsoidal, measuring 17-19μ in length and 12-14μ in width with a sporocystic residual mass.

Sporulation time.—24-48 hrs.

Habitat.—Gut of *Herpestis mungo*, Mathura, U.P.

Isospora felis Wenyon

Description.—Oocyst egg shaped, measuring 35-45μ in length and 25-35μ in width. Oocyst residuum absent. Sporocyst pyriform, measuring 18.4μ-11.4μ with a sporocystic residual mass.

Sporulation time.—3 days

Habitat.—Intestine of *Felis domestica*, Calcutta.

Isospora garnhami Bray

Description.—Oocyst ellipsoidal to ovoidal, measuring 22.6μ-25.8μ in length and 17.8-22.5μ in width. Oocystic residuum absent. Sporocyst ellipsoidal, measuring 12-16μ in length and 11-12.5μ in width with a sporocystic residual mass.

Sporulation time.—1-2 days.

Habitat.—Intestine of *Herpestis edwardsi*, Mathura, U.P.

Isospora hoarei Bray

Description.—Oocyst spherical to subspherical, measuring 1913-20.9μ in length and 16.32μ in width. Oocyst residuum absent. Sporocyst ellipsoidal measuring 10-12μ in length and 8-9.7μ in width with a sporocystic residual mass.

Sporulation time.—2-3 days.

Habitat.—Intestine of *Herpestis edwardsii*, Mathura, U.P.

Isospora levinei Dubey

Description.—Oocyst ovoid, measuring 23-29μ in length and 23-26μ in width. Oocyst residuum absent. Sporocyst ellipsoidal, measuring 16-18μ in length and 11-14μ in width with a sporocystic residual mass.

Sporulation time.—24 hrs.

Habitat.—Intestine of *Hyaena striata*, Mathura, U.P.

Isospora rivolta Grassi

Description.—Oocyst ovoid, measuring 10-25μ in length and 15-22μ in width. Oocystic residuum absent. Sporocyst elongated, measuring 16μ in length and 10μ in width with a sporocystic residual mass.

Sporulation time.—2-3 days.

Habitat.—Intestine of *Felis domestica* and *F. chaus*, Mathura, U.P.

Eimeria albamensis Christensen

Description.—Oocyst pyriform or sub-spherical, measuring 13.2-15.8μ in length and 11.5-12.6μ in width. Oocystic residuum absent. Sporocyst elongated measuring 16-18μ in length and 12-13μ in width with no sporocystic residual mass.

Sporulation time.—80-96 hrs.

Habitat.—Intestine of *Indian Cattle*, Izatnagar, U.P.

Eimeria arloingi Marotel

Synonym: *E. hawkinei*, Ray

Description.—Oocyst ellipsoidal, measuring 20μ-45μ. Oocystic residuum absent. Sporocyst oval, measuring 13μ in length and 6μ in width, with no sporocystic masss.

Sporulation time.—2-3 days.

Habitat.—Intestine of sheep and goats, Izatnagar, U.P.

Eimeria auburnensis Christensen and Porter

Synonym: *E. bombayansis* Rao and Hiregauder.

Description.—Oocyst elongated or ovoidal, measuring 31-45μ in length and 19-28μ in width. Oocystic residuum absent. Sporocyst oval or elongated measuring 18.5μ in length and 7.4μ in width with a sporocystic residual mass.

Sporulation time.—48-72 hrs.

Habitat.—Intestine of Indian Cattle, Izatnagar, Agra, U.P.

Eimeria bareillyi Gill, Chhabra and Lall

Description.—Oocyst pyriform, measuring 30.8μ in length and 21.6μ in width. Oocystic residuum absent. Sporocyst lemon shaped, measuring 18μ in length and 8μ in width with a sporocystic residual mass.

Sporulation time.—3 days.

Habitat.—Gut of Indian Cattle, Bareilly, U.P. Agra, Mukteswar, U.P.

Eimeria bovis Zublin

Synonym: *Eimeria Smithi* Yakimoff and Galerego.

Description.—Oocyst ovoidal, measuring 15-19μ in length and 18-24μ in width. Oocystic residuum absent. Sporocyst ovoid, measuring 9.5-14.5μ in length and 4.9-7.5μ in width with a sporocystic residual mass.

Sporulation time.—48-72 hrs.

Habitat.—Gut of Indian Cattle, Agra, Mukteswar, U.P.

Eimeria brasiliensis Jorres and Ramos

Synonym: *E. gokaki* Rao and Bhatawadekar.

Description.—Oocyst ellipsoidal, measuring 34-41μ in length and 23-28μ in width. Oocystic residuum absent. Sporocyst elongate, measuring 16μ in length and 9μ in width with a sporocystic residual mass.

Sporulation time.—144-168 hrs.

Habitat.—Gut of Indian Cattle, Agra, Mukteswar, U.P.

Eimeria bukidonensis Tubangui

Description.—Oocyst pyriform, measuring 36-48μ in length and 24-34μ in width. Oocystic residuum absent. Sporocyst elliptical, measuring 14.4μ in length and 6.5μ in width with no sporocystic residual mass.

Sporulation time.—120-186 hrs.

Habitat.—Gut of Indian Cattle, Mukteswar, U.P.

Eimeria canadensis Bruce

Description.—Oocyst oval or ellipsoidal, measuring 26-38μ in length and 21-28μ in width. Oocystic residuum is present. Sporocyst spindle shaped measuring 14.9μ in length and 7.5μ in width with a sporocystic residual mass.

Sporulation time.—66-96 hrs.

Habitat.—Gut of sheep and goats, Indian Cattle, Agra, Mukteswar, U.P.

Eimeria cati Yakimoff

Description.—Oocyst subspherical to spherical, measuring 19-25μ in length and 19-22μ in width. Oocystic residuum absent. Sporocyst

ellipsoidal, measuring 10-11μ in length and 7μ in width with a sporocystic residual mass.

Sporulation time.—8 days.

Habitat.—Gut of *Felis chaus*, Mathura, U.P.

Eimeria crandallis Honess

Description.—Oocyst ellipsoidal, measuring 16-32.5μ in length and 15-25μ in width. Oocystic residuum absent. Sporocyst spindle-shaped, measuring 8.3-11.2μ in length and 5.4-8μ in width with a sporocystic residual mass.

Sporulation time.—2-3 days.

Habitat.—Gut of Domestic goat, *Capra hircus*, Izatnagar, U.P.

Eimeria coecicola Cheissin

Description.—Oocyst oval, measuring 27.5-33μ in length and 14-19.5μ in width. Oocystic residuum present. Sporocyst oval, measuring 12μ in length and 5.5μ in width with a sporocystic residual mass.

Sporulation time.—3 days.

Habitat.—Intestine of Domestic Rabbit, Ludhiana, Panjab.

Eimeria cerdonis Vetterling

Description.—Oocyst ovoid, measuring 27-29μ in length and 21-23μ in width. Oocystic residuum absent. Sporocyst elongate, measuring 16-17μ in length and 7-9μ in width with a sporocystic residual mass.

Sporulation time.—2-3 days.

Habitat.—Gut of *Sus scrofa*, Mhow, Jabalpur, M.P.

Eimeria christensei Levine

Description.—Oocyst nearly spherical, measuring 32-43μ in length and 24-30μ in width. Oocystic residuum absent. Sporocyst ovoidal, measuring 14-18μ in length and 8-11μ in width with a sporocystic residual mass.

Sporulation time.—2-3 days.

Habitat.—Gut of Domestic goat, *Capra hircus*, Izatnagar, U.P.

Eimeria cylindrica Wilson

Description.—Oocyst cylindrical, measuring 21-31μ in length and in width. Oocystic residuum absent. Sporocyst oval and round measuring 8.5-10.5μ in length and 6.5-8.4μ in width with a sporocystic residual mass.

Sporulation time.—36-48 hrs.

Habitat.—Gut of Indian Cattle, Agra, Mukteswar, U.P.

Eimeria debliecki Douwes

Description.—Oocyst ellipsoidal to ovoid, measuring 20-29μ in length and 14-20μ in width. Oocystic residuum absent. Sporocyst elongated ovoid, measuring 13-16μ in length and 6-7μ in width with a sporocystic residual mass.

Sporulation time.—5-9 days.

Habitat.—Intestine of *Sus scrofa*, Mhow, Jabalpur, M.P.

Eimeria ellipsoidalis Beaker and Frye

Description.—Oocyst ellipsoidal, measuring 18.5-28μ in length and 14.9-20.5μ in width. Oocystic residuum absent. Sporocyst ellipsoidal, measuring 5μ in length and 3μ in width with a sporocystic residual mass.

Sporulation time.—48-72 hrs.

Habitat.—Intestine of Indian Cattle, Agra, Mukteswar, U.P.

Eimeria faurii Moussu and Marotel

Description.—Oocyst egg shaped, measuring 25-33μ in length and 20-24μ in width. Oocystic residuum absent. Sporocyst ovoid measuring 14-16μ in length and 8.9μ in width with a sporocystic residual mass.

Sporulation time.—2-3 days.

Habitat.—Intestine of sheep and goats, Izatnagar, U.P.

Eimeria felina Nicschulz

Description—.Oocyst ovoidal to ellipsoidal measuring 15-19μ in length and 11-17μ in width. Oocystic residuum absent. Sporocyst nearly ovoid, measuring 8-10μ in length and 6-8μ in width with a sporocystic residual mass.

Sporulation time.—24 hrs.

Habitat.—Intestine of *Felis chaus*, Mathura, U.P.

Eimeria hammondi Dubey and Pande

Description.—Oocyst ellipsoidal, measuring 24-29μ in length and 14-22μ in width. Oocystic residuum absent. Sporocyst broadly ovoid, measuring 11-14μ in length and 8-10μ in width with a sporocystic residual mass.

Sporulation time.—6 days.

Habitat.—Intestine of *Felis chaus* Mathura, U.P.

Eimeria intricata Spiegl

Description—Oocyst ellipsoidal, measuring 33-35μ in length and 25-35μ in width. Oocystic residuum absent. Sporocyst oval, measuring 19-26μ with a sporocystic residual mass.

Sporulation time.—9-12 days.

Habitat.—Intestine of Sheep, Izatnagar, U.P.

Eimeria intestinalis Cheissin

Description.—Oocyst pyriform, measuring 25-30μ in length and 17.5-20μ in width. Oocystic residuum present. Sporocyst ovoid with a sporocystic residual mass.

Sporulation time.—2-3 days.

Habitat.—Intestine of *Lepus* sp; Kashipur, U.P.

Eimeria irresidua Kassel and Jankiewiez

Description.—Oocyst ovoidal, measuring 25-37.5μ in length and 17.5-24.75 μ in width. Oocystic residuum absent. Sporocyst anterior and moderately pointed measuring 18μ in length and 9μ in width with a sporocystic residual mass.

Sporulation time.—72 hrs.

Habitat.—Intestine of *Lepus* sp. Ludhiana, Punjab.

Eimeria leporis Nieschulz

Description—.Oocyst cylindrical or slightly oval, measuring 22-28μ in length and 15-26μ in width. Oocystic residuum present. Sporocyst ovoidal or oval measuring 12-13μ in length and 9.5μ in width with a sporocystic residual mass.

Sporulation time.—3 days.

Habitat.—Intestine of *Lepus* sp. Kashipur, U.P.

Eimeria lomarii Dubey

Description.—Oocyst ellipsoidal, measuring 24-29μ in length and 14-22μ in width. Oocystic residuum absent. Sporocyst ovoid measuring 11-14μ in length and 8-10μ in width with a sporocystic residual mass.

Sporulation time.—4 days.

Habitat.—Intestine of *Vulpes bengalensis*, Mathura (U.P.).

Eimeria magna Perard

Description.—Oocyst ellipsoidal to ovoidal, measuring 20.25-31.5μ in length and 18-25.5μ in width. Oocystic residuum present. Sporocyst ovoidal measuring 15.25-18μ in length and 7-8.75μ in width with a sporocystic residual mass.

Sporulation time.—2-3 days.

Habitat.—Intestine of *Lepus ruficaudatus*, Ludhiana, Punjab.

Eimeria matsubavashii Tsunoda

Description.—Oocyst ovoidal or ellipsoidal, measuring 23.5-29.5μ in length and 14.5-19.25μ in width. Oocystic residuum present. Sporocyst ovoidal measuring 7μ in length and 6μ in width with a sporocystic residual mass.

Sporulation time.—2-3 days.

Habitat.—Intestine of *Lepus* sp. Kashipur, U.P

Eimeria mathurai Dubey and Pande

Description.—Oocyst ellipsoidal or spindle shaped measuring 20-28μ in length and 16-20μ in width. Oocystic residuum absent. Sporocyst broadly ovoid, measuring 11-13μ in length and 7-9μ in width with a sporocystic residual mass.

Sporulation time.—6 days.

Habitat.—Intestine of *Felis chaus*, Mathura (U.P.).

Eimeria media Kassel

Description.—Oocyst ovoidal, measuring 25-37μ in length and 16-20μ in width. Oocystic residuum present. Sporocyst ovoidal measuring 14-15μ in length and 9-10μ in width with a sporocystic residual mass.

Sporulation time.—44 hrs.

Habitat.—Intestine of *Lepus* sp. Ludhiana, Punjab.

Eimeria minima Carvalho

Description.—Oocyst sub-spherical, measuring 10-15.5μ in length and 9-15μ in width. Oocystic residuum absent. Sporocyst ovoidal, measuring 5μ in length and 2.8μ in width with a sporocystic residual mass.

Sporulation time.—2-3 days.

Habitat.—Intestine of *Lepus ruficaudatus* Kashipur, Punjab.

Eimeria mundaragi Hiragauder

Description.—Oocyst oval, measuring 36-38μ in length and 25-28μ in width. Oocystic residuum absent. Sporocyst oval, measuring 14.3μ in length and 9.1μ in width with a sporocystic residual mass.

Sporulation time.—24-48 hrs.

Habitat.—Intestine of Cow Calf, Mandaragi, Dharwar.

Eimeria nagpurensis Gill and Ray

Description.—Oocyst barrel shaped, measuring 20.25-26.3μ in length and 10-15μ in width. Oocystic residuum absent. Sporocyst oat-shaped measuring 15μ in length and 5μ in width with a sporocystic residual mass.

Sporulation time.—2-3 days.

Habitat.—Intestine of *Lepus* sp., Nagpur, Maharashtra.

Eimeria neodebliecki Vetterling

Description.—Oocyst ovoid, measuring 17-26μ in length and 14-19μ in width. Oocystic residuum absent. Sporocyst broad ovoid, measuring 19-13μ in length and 6-8μ in width with a sporocystic residual mass.

Sporulation time.—4-5 days.

Habitat.—Intestine of *Sus scrofa*, Mhow, Jabalpur, M.P.

Eimeria neoleporis Carvalho

Description.—Oocyst ellipsoidal, measuring 30-54μ in length and 16-22μ in width. Oocystic residuum absent. Sporocyst oval, measuring 16.5μ in length and 8μ in width with a sporocystic residual mass.

Sporulation time.—3-4 days.

Habitat.—Intestine of *Lepus* sp. Ludhiana, Punjab.

Eimeria nawalai Dubey and Pande

Description.—Oocyst ellipsoidal, measuring 16.10-19.35μ in length and 12.88-15.98μ in width. Oocystic residuum absent. Sporocyst ovoid, measuring 5.92μ in length and 4.93μ in width with a sporocystic residual mass.

Sporulation time.—3 days.

Habitat.—Intestine of *Herpestis edwardsii*, Mathura, U.P.

Eimeria ninakholyakimovi Yakimoff & Rastegaieff

Description.—Oocyst ellipsoidal, measuring 20-28μ in length and 15-22μ in width. Oocystic residuum absent. Sporocyst oval, measuring 5-6.5μ in length and 3-4.5μ in width with a sporocystic residual mass.

Sporulation time.—3 days.

Habitat.—Intestine of Sheep and Goats, Izatnagar, U.P.

Eimeria nolleri Raichenow

Description.—Oocyst oval, measuring 80-100μ in length and 65-80μ in width. Oocystic residuum absent. Sporocyst elongated, measuring 12.5-13μ in length and 10-11μ in width with a sporocystic residual mass.

Sporulation time.—2-3 days.

Habitat.—Intestine of *Camelus dromedarius*, Bikaner, Rajasthan.

Eimeria pallida Christensen

Description—.Oocyst ellipsoidal, measuring 12-20μ in length and 8-15μ in width. Oocystic residuum absent. Sporocyst ovoid, measuring 12.5-14.5μ in length and 9.5-10.5μ in width with a sporocystic residual mass.

Sporulation time.—2-3 days.

Habitat.—Intestine of Sheep and Goats, Izatnagar, U.P.

Eimeria parva Kotlan Mócsy & Vajda

Description.—Oocyst ellipsoidal or sub-spherical, measuring 12.5-20μ in length and 10-17μ in width. Oocystic residuum absent. Sporocyst oval measuring 13-15μ in length and 10-12μ in width with a sporocystic residual mass.

Sporulation time.—2-3 days.

Habitat.—Intestine of Sheep and Goats, Izatnagar, U.P.

Eimeria pellita Supperer

Description.—Oocyst oval to ovoidal, measuring 35-48μ in length and 23-31μ in width. Oocystic residuum absent. Sporocyst oval, measuring 21μ in length and 10μ in width with a sporocystic residual mass.

Sporulation time.—96-120 hrs.

Habitat.—Intestine of Indian Cattle, Mukteswar, U.P.

Eimeria perminuta Henry

Description.—Oocyst oval, measuring 11.2-16μ in length and 9.6-12.8μ in width. Oocystic residuum absent. Sporocyst elongated, measuring 9.5-10.5μ in length and 4.5-8μ in width with a sporocystic residual mass.

Sporulation time.—4-5 days.

Habitat.—Intestine of *Sus scrofa*, Mhow, M.P.

Eimeria peturistae Ray and Singh

Description.—Oocyst flask shaped, measuring 46.24-52.5μ in length and 35-40.4μ in width. Oocystic residuum present. Sporocyst naviculoid, measuring 27.5-31.25μ in length and 10-18.75μ in width with a sporocystic residual mass.

Sporulation time.—10-12 days.

Habitat.—Intestine of *Peturista inornatus*, Mukteswar, U.P.

Eimeria perforans Leuckart

Description.—Oocyst ovoid to ellipsoidal, measuring 17-32μ in length and 12.5-19.5μ in width. Oocystic residuum present. Sporocyst ovoid, measuring 7.75μ in length and 3.75μ in width with a sporo cystic residual mass.

Sporulation time.— 48 hrs.

Habitat.—Intestine of *Lepus ruficaudatus*, Kashipur, U.P.

Eimeria polita Pellérdy

Description.—Oocyst ellipsoidal or oval, measuring 23-27μ in length and 10 to 21μ in width. Oocystic residuum absent. Sporocyst ellipsoidal, measuring 16-17μ in length and 6μ in width with a sporocystic residual mass.

Sporulation time.—8-9 days.

Habitat.—Intestine of *Sus scrofa*, Kashipur, U.P.

Eimeria punjabinensis Gill and Ray

Description.—Oocyst spherical, measuring 20-23.7μ in length and 9.5-22.5μ in width. Oocystic residuum present. Sporocyst ovoidal

measuring 12.5μ in length and 3.5μ in width without, sporocystic residual mass.

Sporulation time.—3-4 days.

Habitat.—Intestine of *Lepus ruficaudatus*, Ludhiana, Punjab.

Eimeria porci Vetterling

Description.—Oocyst pear-shaped, measuring 20-27μ in length and 14-18μ in width. Oocystic residuum absent. Sporocyst broadly ovoid, measuring 9-11μ in length and 7.8μ in width, with a sporocystic residual mass.

Sporulation time.—3-4 days.

Habitat.—Intestine of *Sus scrofa*, Mhow, M.P.

Eimeria robertsoni Madsen

Description.—Oocyst ovoid to ellipsoidal, measuring 33-44.5μ in length and 21-32.5μ in width. Oocystic residuum present. Sporocyst oval, measuring 18.5μ in length and 6.2μ in width, without sporocystic residual mass.

Sporulation time.—4-5 days.

Habitat.—Intestine of *Lepus ruficaudatus*, Kashipur, U.P.

Eimeria ruficaudati Gill and Ray

Description.—Oocyst cylindrical, measuring 28-38μ in length and 12-15μ in width. Oocystic residuum present. Sporocyst ovoidal, measuring 13.5-15.5μ in length and 8.5-10.5μ in width with a sporocystic residual mass.

Sporulation time.—66 hrs.

Habitat.—Intestine of *Lepus ruficaudatus*, Kashipur, U.P.

Eimeria scabra Henry

Description.—Oocyst ellipsoidal, measuring 22.4-35.6μ in length and 16-25.6μ in width. Oocystic residuum present. Sporocyst oval measuring 16-19.2μ in length and 6.4μ in width with a sporocystic residual mass.

Sporulation time.—2-3 days.

Habitat.—Intestine of *Sus scrofa*, Mhow M.P.

Eimeria spinosa Henry

Description.—Oocyst ellipsoidal, measuring 16-22.4μ in length and 12.8-16μ in width. Oocystic residuum absent. Sporocyst ellipsoidal, measuring 9.1-11.7μ in length and 5.2-6.5μ in width with a sporocystic residual mass.

Sporulation time.—5 days.

Habitat.—Intestine of *Sus scrofa*, Izatnagar, U.P.

Eimeria sylvilagi Carini

Description.—Oocyst ovoid, measuring 21-39μ in length and 16.24μ in width. Oocystic residuum absent. Sporocyst ellipsoidal to oval, measuring 16μ in length and 7μ in width with a sporocystic residual mass.

Sporulation time.—2-3 days.

Habitat: Intestine of *Lepus ruficaudatus*, Kashipur, U.P.

Eimeria subspherica Gill

Description.—Oocyst spherical or subspheical measuring 20.8μ in length and 12.18μ in width. Oocystic residuum absent. Sporocyst spindle-shaped measuring 5μ in length and 3μ in width without sporocystic residual mass.

Sporulation time.—80-120 hrs.

Habitat.—Intestine of Indian Cattle, Bombay; Agra, U.P.

Eimeria stiedae Lindeman

Description.—Oocyst ovoidal to elliptical, measuring 26-40μ in length and 16-24μ in width. Oocystic residuum absent. Sporocyst ovoidal to oval, measuring 17μ in length and 9μ in width with a sporocystic residual mass.

Sporulation time.—72 hrs.

Habitat.—Intestine of *Lepus* sp. Kashipur, U.P.

Eimeria wyomingensis Huizinga and Winger

Description.—Oocyst ovoidal, measuring 24-44μ in length and 24-29μ in width. Oocystic residuum absent. Sporocyst pear-shaped, measuring 18μ in length and 8μ in width with a sporocystic residual mass.

Sporulation time.—72-95 hrs.

Habitat.—Intestine of Indian Cattle, Izatnagar, U.P.

Eimeria zurni Rivolta

Description.—Oocyst spherical, measuring 21-25μ. Oocystic residuum absent. Sporocyst ovoid, measuring 9.9-11μ in length and 5.3-5.7μ in width with a sporocystic residual mass.

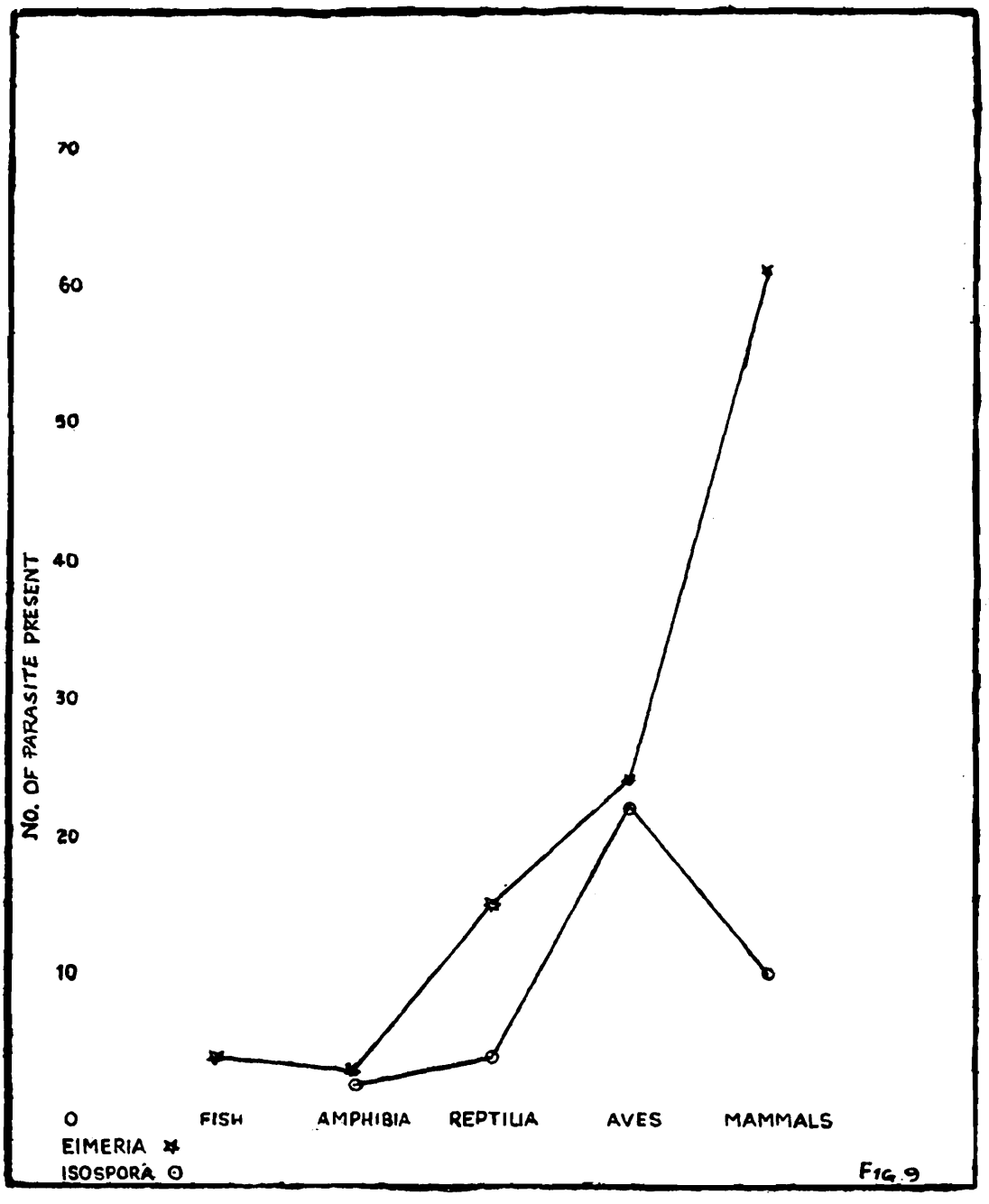
Sporulation time.—48-72 hrs.

Habitat.—Intestine of Indian Cattle, Coorg.

DISTRIBUTION

India is glorified by its various types of vertebrate fauna and the coccidian parasites occurring in them are equally varied. Amongst

these, those which belong to the family Eimeriidae do not require intermediate animal transmitter, are represented by 9 genera and 163 species (Table 1) in our country. All the species reported so far from fishes of India and other parts of the world (Pellerdy, 1965) belong to



Text-fig. 9.—Graph showing the number of Isosporan and Eimerian species in different group of vertebrates in India.

the genus *Eimeria*. From Amphibia only 2 genera comprising of 5 species, from Reptilia 5 genera comprising of 22 species and from Birds, 6 genera comprising of 62 species have been recorded so far. Mammals though harbouring the maximum number of parasite species (72) but they belong to only 3 genera. Table 1 also reveals that the percentage infection in cold-blooded animals is nearly 1/5th of the total, and the rest are in warm-blooded animals. Amongst all, the genera *Eimeria* and *Isospora* are available practically in all the groups of vertebrates.

Table 1. Showing the total number of Coccidian parasites (Eimeriidae) recorded from vertebrate hosts in India and their percentage of infection.

TABLE 1

Name of genera	Group of Vertebrates				
	Fish	Amphibia	Reptiles	Birds	Mammals
1. *Tyzzeria*	–	–	–	2	–
2. *Caryospora*	–	–	1	–	–
3. *Isospora*	–	2	4	22	10
4. *Dorisiella*	–	–	–	6	–
5. *Eimeria*	4	3	15	24	61
6. *Wenyonella*	–	–	–	5	1
7. *Octosporella*	–	–	1	–	–
8. *Pythonella*	–	–	1	–	–
9. *Sivatoshella*	–	–	–	1	–
Total:	4	5	22	60	72
Percentage of the total infection in different groups of vertebrate	2.5%	3%	13.5%	37%	44%

The relative occurrence of the two latter genera is graphically represented in Text-fig. 9. It shows that the infection of the Eimerian species is higher than that of *Isospora*. Though there is no appreciable difference in the frequency of occurrence of both the genera in Amphibia and Birds but in Reptiles and specially in Mammals the Eimerian species have dominated over the Isosporan species.

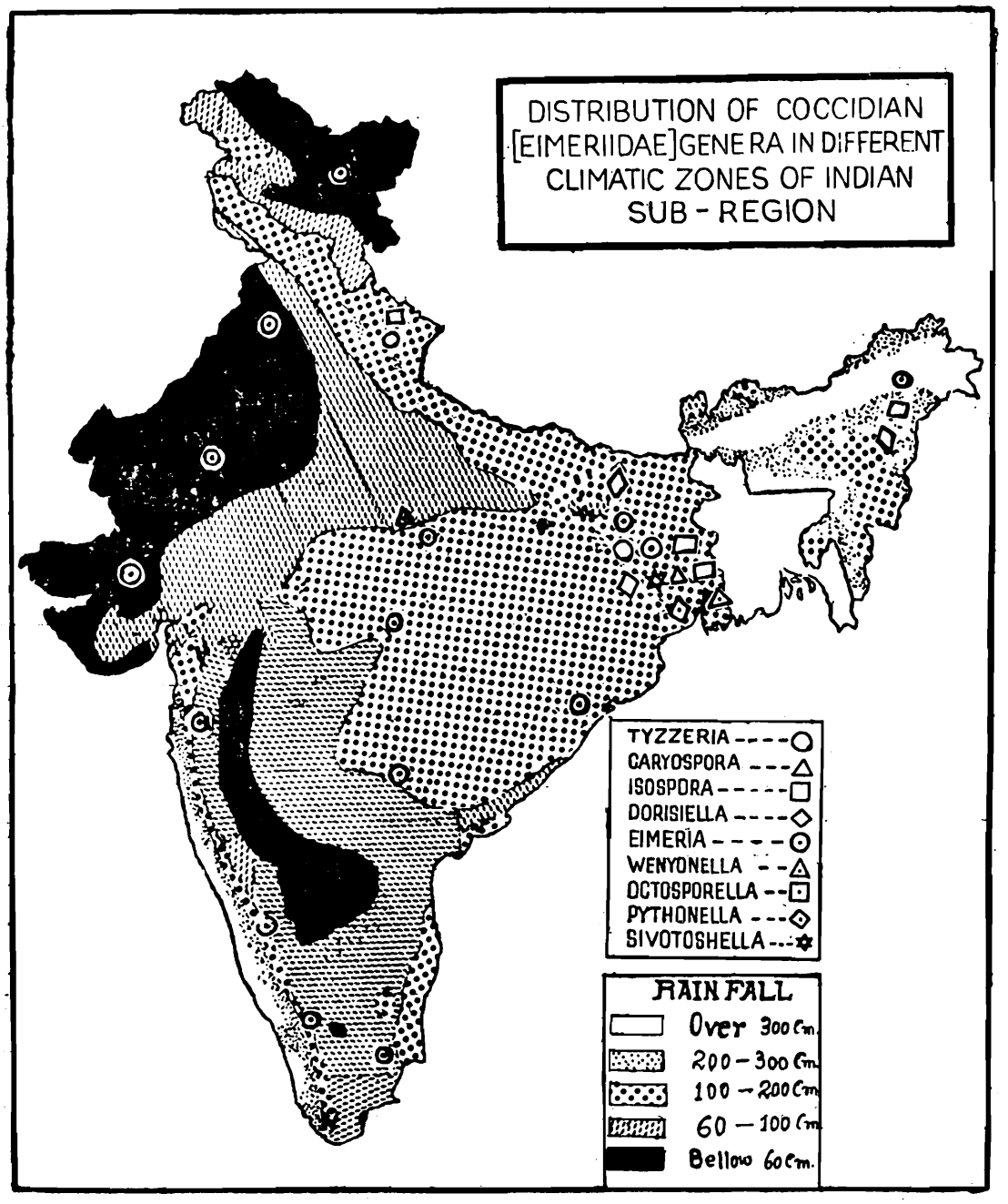
Geographical distribution

To tide over the unfavourable environment, the parasites have developed various mechanisms for survival. For perpetuation of the species they require particular temperature, humidity (Chakravarty and Kar 1946, Mandal 1965, Chhabra 1968) and other ecological conditions. Therefore, different climatic conditions may exercise some influence on the exogenous development of the coccidian oocyst which play a dominant role in the distribution of those parasites.

On the basis of climatic diversities, the Indian subregion can broadly be divided into five climatic zones (Text-fig. 10) based on rainfall and temperature as follows:

1. Rainfall over 300 cm. (Max. temp. 28°C Min. temp. 10°C)
2. Rainfall 200-300 cm. (Max. temp. 33°C Min. temp. 15°C)
3. Rainfall 100-200 cm. (Max. temp. 37°C Min. temp. 7°C)
4. Rainfall 60-100 cm. (Max. temp. 35°C Min. temp. 7°C)
5. Rainfall below 60 cm. (Max. temp. 43°C Min. temp. 15°C)

However, the localization (Text-fig. 10) of maximum number of genera in the wet Eastern Region and the country wide distribution of the genus *Eimeria* do not significantly focus much light on the distribution pattern, as no thorough work has been done in other zones of the country. Anyway, a proper survey of different climatic zones may perhaps throw more light on their distribution pattern and the role played by these climatic zones.



Text-fig. 10.—Map of India showing the distribution of Coccidian (Eimeriidae) genera in different climatic zones.

Discussion

The oocyst is the only exogenous stage of this family, based on which most of the species have been described. It is charged with the task of spreading the infection and perpetuation of the species. It passes

out in the faeces, develop for a short time and then infect the new host when it is ingested. In majority of cases only the oocystic stage is known. Uptil now, it is the general practice to identify a species based on the characters of the oocyst only. The differentiation of species will remain difficult so long as our knowledge regarding the differences in their histozoic phases of the life cycles are not clear to us.

The criteria for speciation was first promulgated by Tyzzer (1928). For this purpose he considered characters like prepatent period, sporulation time, host specificity, characteristic habitat, cross-immunity tests, pathogenicity under both experimental and natural infestations, morphology of developing tissue phases including shape and size of the oocyst, and relation of the parasite to the host cell together with reactions of the host. He further stressed that without considering all the above characters any one of them will not be sufficient for morphological differentiation of the oocysts.

While authors like Yakimoff and Galouzo (1927), Becker and Eyre (1929) differentiated the bovine species on the size, shape and thickness of oocystic wall, sporocystic size and presence or absence of sporocystic residual body, Tubangui (1931) supporting the same applied also some biometric constant and Yakimoff (1933) relied in addition to such factors as host species. Christensen (1938) alone did not attach any taxonomic importance to these. On the other hand he held that sporulation time and a study of not less than 50 oocysts from 5 hosts were essential for speciation just to avoid various strains of the known species preferably those of the unsporulated ones. Morgan and Hawkins (1952) also working on bovine species supported Christenson's basis for differentiation.

Levine (1938 and 1942) rejected the differentiation of species on the basis of biometry of oocysts as unreliable. Instead, he advocated the use of immunological and pathological criteria similar to those used for *Leishmania.* Christensen, Lee and Armour (1959) laid stress on oxygen supply and constant temperature at 27°C to be essential for maintaining valid comparison of morphological and biological performances of the oocysts. Marquardt (1957) also in his experiment with *E. zurnii* at 37°C concluded that the rate of sporulation varies with different grades of temperature. Therefore, there seems to be no need for attaching any importance to these conditions regarding sporulation time. However, they might have some value in case of intergrading or overlapping of species for differentiation under identical conditions, and understanding their biology at a particular place. Pellerdy (1965) in his '*Coccidia and Coccidiosis*' framed the key for the identification of the species on the basis of the characters of the oocysts. In the present study, the Key to the species occuring in different hosts have been prepared on the basis of the following characters of oocysts.

(*i*) Biometry and morphology of the sporulated and unsporulated oocysts.

(*ii*) Presence or absence of oocystic and sporocystic residuum.

(*iii*) Biometry and morphology of the sporocyst and sporozoite.

This may help the future investigator to make routine identification of different genera and species of the family Eimeriidae without going through other details of the different phases of their life-cycle.

While collecting the topotypes regular data were maintained to ascertain the incidence of infection. In the present study the identification of the species is mainly based on the morphological characters of the oocysts. Though in some cases the morphological overlaping of one species with another is noted, it is however, immature at this stage to adjudge the actual relationship unless a few cross-infection experiments are carefully conducted.

Acknowledgements

I offer my deep sense of gratitude to my teachers, late Dr. M. M. Chakravarty and late Dr. H. N. Ray for their help and advice during the course of this study.

My sincere thanks are due to Dr. A. P. Kapur, the then Director, Zoological Survey of India, Calcutta, and Dr. J. L. Bhaduri, the then Head of the Department of Zoology, Calcutta University, for providing me the laboratory facilities.

I owe my indebtedness to Dr. B. P. Pande, Veterinary College, Mathura, U.P.; Dr. M. N. Patnaik, State Veterinary Laboratory, Bhubaneswar; Dr. D. K. Ray and Dr. A. C. Sarkar from Calcutta for providing me the type materials in their custody.

I wish to express my thanks to my colleagues Dr. V C. Agrawal, Dr. A. Bhattacharjee, Sarvasri S. Biswas, R. K. Ghose, S. Chakravarty, A. K. Das, S. S. Saha, D. K. Ghosal, A. K. Podder, R. N. Mukherjee, T P. Bhattacharjee and S. R. Dey Sarkar for their untiring efforts in collecting the materials from different parts of India. Few materials are also kindly supplied by several State Veterinary Officers from different places, to those the authors sincere thanks are due.

Lastly, I am also grateful to Dr. N. D. Levine, Professor, Department of Veterinary Pathology and Hygine, University of Illinois and late Dr. L. Pellerdy, Veterinary Medical Research Institute, Hungarian Academy of Science, Budapest, for their valuable suggestions and constructive criticisms.

Summary

The Eimeriid genera restricted to vertebrate hosts, which do not require an intermediate animal transmitter are cosmopolitan in distribution. In India, they are represented by 9 genera and 163 species. In the present study, however, 13 species have been added and elaborate descriptions of some other species have been given. A key to the species has also been provided. Further, the distribution pattern of this parasite in different climatic zones of India has been dealt with.

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