

VOL. 70, PARTS 1-4 PAGES 1-257

Records of the Zoological Survey of India

A Journal of Indian Zoology

**Issued by The Director
Zoological Survey of India, Calcutta**

**RECORDS
OF THE
ZOOLOGICAL SURVEY OF INDIA**

Vol. 70 (1-4)



सत्यमेव जयते

Edited by the Director, Zoological Survey of India
1976

© Copyright 1976, Government of India

ZSI LXX
400

PRINTED IN INDIA BY EKA PRESS, 204/1, BARRACKPORE TRUNK ROAD,
CALCUTTA 700 035 AND PUBLISHED BY THE MANAGER OF PUBLICATIONS
CIVIL LINES, DELHI, 110 006

RECORDS OF THE ZOOLOGICAL SURVEY OF INDIA

(A journal of Indian Zoology)

Vol. 70, Parts 1-4

Pages 1-257

CONTENTS

	PAGES
HALDER, BADRI PRASAD—Sipuncula from the Andaman and Nicobar Islands	1
TILAK, RAJ—On the fishes of the genus <i>Ctenops</i> McClelland, 1845 (Family: Belontiidae)	11
SINGH, ASKET and PRASAD, MAHABIR—Odonata of Doon Valley-1. Anisoptera	21
MANDAL, A. K.—Coccidia of Indian Vertebrates	39
PRASAD, MAHABIR, and SINGH, ASKET—Odonata of Doon Valley 2. Zygoptera	121
DAVID, B. VASANTHARAJ and SUBRAMANIAM, T. R.—Studies on some Indian Aleyrodidae	133
FISCHER-PIETTE, E.—Les Veneridae Indéterminées des Collec- tions de Calcutta	235

SIPUNCULA FROM THE ANDAMAN AND NICOBAR ISLANDS

By

BADRI PRASAD HALDAR

*Southern Regional Station,
Zoological Survey of India, Madras*

INTRODUCTION

Sipuncula of the Indian ocean have received considerable attention and 135 species and subspecies have been authentically recorded so far (Haldar, 1970).

However, the Sipuncula of the Andaman and Nicobar Islands are not so well known. Fifteen species of Sipuncula have been previously recorded from this area. These belong to 2 species of *Sipunculus* (Prashad, 1936), 3 species of *Siphonosoma* (Haldar,* 1970), 4 species of *Phascolosoma* (Haldar, 1970 and Johnson, 1971), 3 species of *Paraspidosiphon* (Johnson, 1964 and Haldar, 1970) and 1 species each of the genera *Themiste* and *Cloeosiphon* (Haldar, 1970) and *Phascolopsis* (Johnson, 1971).

The present work is based on the collection made by different survey parties of the Zoological Survey of India. The collections contain limited number of examples. The specimens examined are referred to nine species embraced in four genera, out of which six are new records (marked by asterisk) from the Andaman and Nicobar Islands. The list of species is as follows:

Family SIPUNCULIDAE

1. *Sipunculus nudus* Linnaeus
2. *S. robustus* Kefeferstin
- *3. *Siphonosoma* (*Siphonosoma*) *australe* (Keferstein)

Family PHASCOLOSOMATIDAE

4. *Phascolosoma andamanensis* Johnson
- *5. *P. nigrescens* Keferstein
- *6. *P. pacificum* Keferstein
- *7. *P. scolops* (Selenka & de Man)

Family ASPIDOSIPHONIDAE

- *8. *Paraspidosiphon klunzingeri* (Selenka & de Man)
- *9. *P. steenstrupii* (Diesing)

*Haldar, B. P., *Proc. Intern. Symp. Biology of Sipuncula, Kotor, Yugoslavia, 1970*, p. 19 (Abstr.)

SYSTEMATIC ACCOUNT

Family SIPUNCULIDAE

Sipunculus nudus Linnaeus

1767. *Sipunculus nudus* Linnaeus, *Systema Naturae*, 12th. ed., p. 1078.
 1883. *Sipunculus nudus*: Selenka *et al.*, *Semper's Reisen im Archipel der Philippinen*, (2) 4(1): 92-93.
 1889. *Sipunculus nudus*: Shipley, *Proc. zool. Soc. London*: 57.
 1904. *Sipunculus nudus*: Hérubel, *Bull. Mus. Hist. nat.*, 10: 563.
 1936. *Sipunculus nudus*: Prashad, *Rec. Indian Mus.*, 38 (2): 232-233.
 1952. *Sipunculus nudus*: Stephen & Robertson, *Proc. R. Soc. Edinb.*, Sec. B, 64: 432-433.
 1957. *Sipunculus nudus*: Wesenberg-Lund, *Bull. Sea Fish. Res. Stn. No. 14*: 2.

Material.—1 ex., Aberdeen Bay, Port Blair, S. Andaman, *K. K. Tiwari*, 18.3.59; 1 ex., Galathea river entrance, Great Nicobar Islands, "coral sandy beach", *A. Daniel*, 23.3.66.

Description.—Total length 130-150 mm., maximum width 9-11 mm; Skin thick and dull-brown in colour. Longitudinal muscle bands 31-33 and fused anteriorly in introvert region; ventral and dorsal retractors arise from 2-6 and 8-12 longitudinal muscle bands respectively. Intestinal convolutions 19 and fixed to body wall by a number of fixing muscles; rectal diverticulum present. Proximal one-fourth of nephridium attached to body wall by mesenteries.

Distribution.—In the Indian Ocean: Gulf of Aden, Gulf of Aqaba (Eylath & Ghardaqa), Zanzibar (Mbweni, Mtoni & Pwakuu), Andaman & Nicobar Islands, Malacca and Christmas Islands.

In other Oceans.—Kermadec Islands, Loyalty Islands, New Britain, Queensland, Ghina, Japan, East Indies, Philippines, Mediterranean Sea, North Sea, Lusitanian area, Atlantic coast of America, English Channel and West Indies.

Sipunculus robustus Keferstein

1865. *Sipunculus robustus* Keferstein, *Z. wiss. Zool.*, 15: 412.
 1883. *Sipunculus robustus*: Selenka *et al.*, *Semper's Reisen im Archipel der Philippinen*, (2) 4 (1): 97-99.
 1905. *Sipunculus robustus*: Lanchester, *Proc. zool. Soc. London*, 1: 27.
 1936. *Sipunculus robustus*: Prashad. *Rec. Indian Mus.*, 38(2): 233-235.
 1941. *Sipunculus robustus*: Stephen, *Scient. Rep. John Murray Exped.*, 7 (4): 402-404
 1952. *Sipunculus robustus*: Stephen & Robertson: *Proc. R. Soc. Edinb.*, Sec. B. 64: 433.
 1965. *Sipunculus robustus*: Stephen, *Bull. Sea Fish. Res. Stn. Israel*, No. 17: 82.
 1965. *Sipunculus robustus*: Cutler, *Cah. ORSTOM Oceanographie*, 3(4): 56.

Material.—1 ex., Ross Island, East of Aberdeen Bay, S. Andaman, "lying in the sandy beach", *H. C. Ray*, 26.3.52; -1 ex., Corbyn's cove, Port Blair, S. Andaman, *H. C. Ray*, 21.3.52.

Description.—Total length 140-165 mm., maximum width 32-35 mm; introvert one-third of trunk length; skin flesh coloured, bearing triangular scale-like papillae with apices directed downwards in introvert region but shows rectangular areas in trunk region; longitudinal

muscle bands 26-28; ventral and dorsal retractors originating from 2-5 and 9-12 longitudinal muscle bands respectively; intestinal convolution consists of 14-16 spirals and fixed to body wall by many fixing muscles; tuft-like organ and rectal diverticulum present; nephridia short and hang freely into body cavity.

Used as fisherman's bait in the Andamans.

Distribution.—In the Indian Ocean: Timor, Singapore, Mergui Archipelago, Andaman and Nicobar Islands, Madras, Maldive Islands, Gulf of Oman, Red Sea (Melita Bay and Gulf of Zulu), Zanzibar and Madagascar.

In other Oceans.—Japan, Queensland, New South Wales, West Indies, Wallis Islands, Billiton, Amboina, Uwea, Upolu, Nusa-Land, Norway, Spain and Cape of Good Hope.

Siphonosoma (Siphonosoma) australe (Keferstein)

1865. *Phascolosoma australe* Keferstein, *Nachr. Ges. Wiss. Gottingen.*, No. 7: 197.
 1905. *Sipunculus australis*: Lanchester, *Proc. zool. Soc. London*, 1: 30.
 1912. *Siphonosoma australis*: Spengel, *Verh. dt. zool. Ges.*, 22: 263.
 1936. *Siphonosoma australe*: Prashad, *Rec. Indian Mus.*, 38(2): 237-238.
 1952. *Siphonosoma australe*: Stephen & Robertson, *Proc. R. Soc. Edinb.*, Sec. B, 64: 435-436.
 1952. *Siphonosoma (Siphonosoma) australe*: Fisher, *Proc. U.S. natn. Mus.*, 102: 400.
 1963. *Siphonosoma australe*: Wesenberg-Lund, *Vidensk. Meddr. dansk naturh. Foren.*, 125: 103.
 1965. *Siphonosoma australe*: Cutler, *Cah. ORSTOM Oceanographie*, 3(4): 56.
 1970. *Siphonosoma australe*: Ganapati & Subba Rao, *Curr. Sci.*, 39(1): 12-13.

Material.—1 ex., Long Island, M. Andaman, "found crawling below a stone", K. K. Tiwari, 25.1.59.

Description.—Total length 200 mm., maximum width 10 mm; introvert about one-fourth of trunk length, provided with more than 50 rows of hooks; longitudinal muscle bands 18-19; ventral and dorsal retractors widely separated from each other; nephridia open in front of anus and hang freely at posterior end.

Distribution.—In the Indian Ocean: Zanzibar (Ghwaka Bay and Mbweni), Durban, Off Kosi Bay, Madagascar, Gulf of Mannar, Visakhapatnam Harbour and Penang.

In other Oceans.—Fiji Islands, Lifu & Loyalty Islands, Sydney, Philippines, Amboina and Roscoff.

Family PHASCOLOSOMATIDAE

Phascolosoma andamanensis Johnson

1971. *Phascolosoma andamanensis* Johnson, *J. Bombay nat. Hist. Soc.*, 68(3): 601-603.

Material.—5 exs., Little Andaman, "collected by breaking the coral rocks with hammer", B. P. Haldar, 17.3.71.

Description.—Maximum length and width 62 mm. and 12 mm. respectively; fully extended introvert three-fourths as long as trunk;

colour not uniform throughout, dorsal side of introvert with several bands, bands dark brown at anterior region and light brown near base but ventral surface white; anterior half of trunk white and posterior half blue while at posterior most end white. Marked constriction present at junction of introvert and trunk. Proximal part of introvert armed with hooks arranged in rings, number varying from 18 to 22; introvert bearing 18 to 20 finger-shaped tentacles at tip. Longitudinal muscle layer grouped into 18 to 20 rarely anastomosing bundles, muscle bands most prominent and clearly visible like ridges from point of origin of ventral retractors upto end of trunk but more flat and wider and have a tendency to fuse with skin from point of origin of dorsal retractors upto base of introvert. Dorsal and ventral retractors arise from 4th to 6th or 7th and 2nd to 5th longitudinal muscle bands respectively. Intestinal convolution having 22 spirals, coiling round a spindle muscle not attached to tip of posterior extremity but slightly behind it to body wall; polian vessel without villi; rectal diverticulum absent, anal aperture situated on dorsal surface of trunk close to introvert-trunk constriction. Nephridia light brown, proximal halves attached to body wall by mesenteries.

Distribution.—In the Indian Ocean: Port Blair (Andaman Islands).

Phascolosoma nigrescens Keferstein

1865. *Phascolosoma nigrescens* Keferstein, *Z. wiss. Zool.*, **15**: 424.
 1883. *Physcosoma nigrescens*: Selenka *et al.*, *Semper's Reisen im Archipel der Philippinen*, (2) **4** (1): 72-74.
 1895. *Phymosoma nigrescens*: Fischer, *Abh. Geb. Naturw., Hamburg*, **13**: 10-12.
 1903. *Physcosoma nigrescens*: Shipley, In Gardiner, *Fauna and Geography of the Maedive and Laccadive Archipelagoes*, **1**(2): 134.
 1904. *Phymosoma nigrescens*: Hérubel, *Bull. Mus. Hist. nat.*, **10**: 563.
 1905. *Physcosoma nigrescens*: Lanchester, *Proc. zool. Soc. London*, **1**: 30, 36.
 1912. *Physcosoma nigrescens*: Fischer, *Mitt. naturh., Mus. Hamb.*, **30**: 98.
 1913. *Physcosoma nigrescens*: Fischer, *Ibid.*, **31**: 2.
 1915. *Phymosoma nigrescens*: Hammerstein, *Ark. Zool.*, **9**(10): 1
 1921. *Physcosoma nigrescens*: Fischer, *K. svenska Vetensk-Akad. Handl.*, **61**(8): 4.
 1922. *Physcosoma nigrescens*: Fischer, *Ark. Zool.*, **14**(19): 14.
 1926. *Physcosoma nigrescens*: Fischer, In Michaelsen and Hartmeyer, *Die Fauna Südwest-Australiens*, **5**(3): 201-202.
 1941. *Physcosoma nigrescens*: Stephen, *Scient. Rep. John Murray Exped.*, **7**(4): 404.
 1942. *Physcosoma nigrescens*: Stephen, *Ann. Natal Mus.*, **10**(2): 248.
 1952. *Physcosoma nigrescens*: Stephen & Robertson, *Proc. R. Soc. Edinb.*, Sec. B **64**: 436.
 1956. *Phascolosoma nigrescens*: Edmonds, *Aust. J. mar. Freshwat. Res.*, **7**(2): 289.
 1957. *Phascolosoma nigrescens*: Wesenberg-Lund, *Bull. Sea Fish. Res. Stn. Israel*, No. **14**: 7.
 1959. *Phascolosoma nigrescens*: Wesenberg-Lund, *Vidensk. Meddr. dansk naturh. Foren.*, **121**: 62.
 1963. *Phascolosoma nigrescens*: Wesenberg-Lund, *Ibid.*, **125**: 130.
 1965. *Phascolosoma nigrescens*: Stephen, *Bull. Sea Fish. Res. Stn. Israel*, No. **17**: 83.
 1965. *Phascolosoma nigrescens*; Cutler, *Cah. ORSTOM Oceanographie*, **3**(4): 57.

Material.—2 exs., Aberdeen jetty, S. Andaman, *H. C. Ray*, 14.3.52; 2 exs., Neil Island, S. Andaman, "from coral crevices", *B. P. Haldar*, 21.2.71.

Description.—Total length 40-42 mm. Colour pale brown but introvert base and distal end of trunk dark brown due to presence of crowded papillae, introvert provided with 25 rows of single pointed hooks having distinctly expanded clear streak without separate triangular space. 20 longitudinal muscle bands at anterior and posterior ends but 24 in middle of trunk. 2 pairs of retractor muscles, ventral pair stouter than dorsal pair. Nephridia short and anterior two-thirds fixed to body wall.

Distribution.—In the Indian Ocean: Red Sea (Koseir & Gundabilu Island), Gulf of Aqaba, Gulf of Aden, S. E. Coast of Arabia, Mozambique, Zanzibar, Natal, Durban, Cape Province (East London & Mossel Bay), Madagascar (Nosy Be, Tulear & Makamby), Mauritius, Chagos, Maldiv Islands, Sri Lanka, Penang and Australia (Cape Jaubert, Shark Bay, Brown Station & Port Denison).

In other Oceans.—Great Barrier Reef, Queensland, Fiji Islands, Philippines, Japan, West Indies, Cape Verde Islands, Ascension, Tristan da Gunha, Indo-China, Java, Rotuma, Funafuti, Honolulu, California, East coast of S. America, Costa Rica and Gulf of Guinea.

***Phascolosoma pacificum* Keferstein**

1867. *Phascolosoma pacificum* Keferstein, *Z. wiss. Zool.*, **17**: 49-50.
 1883. *Phymosoma pacificum*: Selenka et al., *Semper's Reisen im Archipel der Philippinen*, (2) **4**(1): 63.
 1898. *Physcosoma pacificum*: Shipley, *Proc. zool. Soc. London*, **3**: 470.
 1902. *Physcosoma pacificum*: Sluiter, *Siboga Exped.*, **25**: 11.
 1903. *Physcosoma pacificum*: Augener, *Arch. Naturgesch.*, **69**: 300.
 1903. *Physcosoma pacificum*: Shipley, In Gardiner, *Fauna and Geography of the Maldiv and Laccadive Archipelagoes*, **1**(2): 134.
 1913. *Physcosoma pacificum*: Fischer, *Mitt. naturh. Mus. Hamb.*, **31**: 6.
 1922. *Physcosoma pacificum*: Fischer, *Wiss. Ergebn dt. Tiefsee-Exped. "Valdivia"*, **22**(1): 8.
 1952. *Physcosoma pacificum*: Stephen & Robertson *Proc. R. Soc. Edinb.*, Sec. B, **64**: 436.
 1957. *Phascolosoma pacificum*: Wesenberg-Lund, *Bull. Sea Fish. Res. Stn. Israel*, No. **14**: 6-7.
 1959. *Phascolosoma pacificum*: Wesenberg-Lund, *Vidensk. Meddr. dansk naturh. Foren.*, **121**: 62-63.

Material.—1 ex., Campbell Bay, Great Nicobar, *A. Daniel*, 3.3.66; 3 exs., Eastern side of Rangat Bay, M. Andaman, "from dead coral block", *B. P. Haldar*, 22.10.72.

Description.—Maximum length and width 160 mm. and 25 mm. respectively; introvert partially retracted, about as long as trunk, bearing more than 70 rows of sharp but strongly curved hooks; colour of trunk brown with scattered dark brown mottling but band-like in introvert region; skin thick, opaque and rough; longitudinal muscle bands

28 at introvert base but 34 at posterior part of trunk, anastomosing frequently; 4 retractor muscles, dorsal and ventral ones of each side fused together for most of their length; intestinal spirals 15, last one attached to body wall by a fixing muscle; polian villi poorly developed; nephridia long, reaching upto posterior end of trunk; nephridiopores lie in front of anus.

Distribution.—In the Indian Ocean: Red Sea (Kosier, Eylath, Fanadir & Ghardaqa), Gulf of Auaba, Zanzibar, Madagascar, Mauritius, Ghagos, Laccadive and Maldiv Islands and Waingapu.

In other Oceans.—Formosa, Queensland, Rotuma, Funafuti, Loyalty Islands, Philippines, New Guinea, Fiji Islands, Banda Neira, Yap, Makassar, Amboina, Marquesas, Upolu and Recif Polo Kalapa.

Phascolosoma scolops (Selenka and de Man)

1883. *Physcosoma scolops* Selenka et al., *Sempere's Reisen im Archipel der Philippinen*, (2)4 (1): 75.
1892. *Phymosoma scolops*: Fischer, *Jb. hamb. wiss. Anst.*, 9: 86.
1898. *Physcosoma (Phymosoma) scolops*: Sluiter, *Zool. Jb. Syst. Abth.*, 11: 443-444.
1902. *Physcosoma scolops*: Sluiter, *Siboga Exped.*, 25: 12.
1902. *Physcosoma scolops*: Shipley, In Herdman, *Rep. Govt. Ceylon Pearl Oyster Fish. Gulf Mannar*, suppl. rept., No. 2: 174.
1903. *Physcosoma scolops*: Shipley, In Gardiner, *Fauna and Geography of the Maldiv and Laccadive Archipelagoes*, 1(2): 135.
1903. *Physcosoma scolops*: Augener, *Arch. Naturgesch.*, 69: 300.
1904. *Phymosoma scolops*: Hérubel, *Bull. Mus. Hist. nat.*, 10: 563.
1905. *Physcosoma scolops*: Lanchester, *Proc. zool. Soc. London*, 1: 28, 30, 36.
1912. *Physcosoma scolops*: Fischer, *Mitt. naturh. Mus. Hamb.*, 30: 98.
1915. *Phymosoma scolops*: Hammerstein, *Ark. Zool.*, 9(10): 1-2.
1922. *Physcosoma scolops*: Benham, *Scient. Rep. Australas. Antarct. Exped.*, 100(6): 20.
1942. *Physcosoma scolops*: Stephen, *Ann. Natal Mus.*, 10(2): 248-249.
1952. *Physcosoma scolops*: Stephen & Robertson, *Proc. R. Soc. Edinb.*, Sec. B, 64: 436-437.
1957. *Phascolosoma scolops*: Wesenberg-Lund, *Bull. Sea Fish. Res. Stn. Israel*, No. 14: 5.
1965. *Phascolosoma scolops*: Stephen, *Israel South Red Sea Exped.*, rept. No. 17: 83.
1965. *Phascolosoma scolops*: Cutler, *Cah. ORSTOM Oceanographie*, 3(4): 57-58.
1969. *Phascolosoma scolops*: Stephen & Cutler, *Trans. R. Soc. S. Afr.*, 38: 116.

Material.—2 exs., Aberdeen Bay, S. Andaman, “found under stones”, H. S. Rao, 10.1.24; 3 exs., Galathea river entrance, Great Nicobar Islands, A. Daniel, 25.3.66; 2 exs., Aves Island, N. Andaman, “by breaking the corals”, B. P. Haldar, 16.10.72.

Description.—Length ranges from 25 to 35 mm.; skin, in general, opaque, reddish brown in colour but rough at introvert base and distal end of trunk due to presence of tall, conical papillae; a few dark bands visible on dorsal side of introvert, armed with hooks arranged in circlets varying in number from 15 to 20, having clear narrow streak inside and height slightly greater than breadth at base; papillae elliptical

in shape and consist of densely packed polygonal plates; longitudinal muscle bands separated into 20 to 22 rarely anastomosing bundles; 2 pairs of retractor muscles, not arising from same level, ventral pair stronger than dorsal pair; intestinal spirals 12 to 16, rectal diverticulum absent; nephridia long, anterior one-third fixed to body wall by mesenteries.

Distribution.—In the Indian Ocean: Red Sea (Koseir, Eritrea, Goliath Bay & Enteraia Island), Gulf of Suez, Gulf of Aqaba (Ghardaqa & Eylath), Zanzibar, Tanzania, S. Africa (East London, Durban, Inhaca Island, Delago Bay, Kosi Bay, Port Edward, Port Alfred & Natal), Off Mozambique, Madagascar, Lakshadweep and Maldive Islands, Sri Lanka, Penang, Singapore, Christmas Islands, Sumbawa, Timor and Tasmania.

In other Oceans.—Japan, Philippine, Java, Funafuti, Loyalty Islands, New Zealand, New Britain, Billiton, Germany, France, West Indies, Port Jackson, Sydney, St. Berthelemy, Gold Coast, Sao Thome, Annobon Island, Belgium Congo and Ascension.

Family ASPIDOSIPHONIDAE

Paraspidosiphon klunzingeri (Selenka & de Man)

1883. *Aspidosiphon klunzingeri* Selenka et al., *Semper's Reisen im Archipel der Philippinen*, (2) 4 (1): 115.
 1898. *Aspidosiphon klunzingeri*: Sluiter, *Zool. Jb. Syst. Abth.*, 11: 444.
 1904. *Aspidosiphon klunzingeri*: Hérubel, *Mem. Soc. zool. Fr.*, 20: 564.
 1957. *Aspidosiphon klunzingeri*: Wesenberg-Lund, *Bull. Sea Fish. Res. Stn. Israel*, No. 14: 8.
 1964. *Paraspidosiphon klunzingeri*: Stephen, *Ann. Mag. nat. Hist.*, (13) 7 (80): 459.

Material.—2 exs., North side of east end of Macpherson's Strait near Gheringatapam, Baratang, S. Andaman, "breaking down the rock with hammer", *H. S. Rao*, 20.1.24; 1 ex., Havelock Island, S. Andaman, "from coral rock area", *B. P. Haldar*, 9.10.72.

Description.—Maximum length and width 65 mm. and 5 mm. respectively; slender introvert nearly as long as trunk length bearing more than 40 rows of small hooks and behind that hooked region spines arranged irregularly; hooks single pointed and having clearly differentiated streaks; longitudinal muscle bands divided into 38 anastomosing narrow bundles visible externally and in introvert region these bundles fused to form a continuous sheet; a single retractor muscle arising in front of caudal shield covering about 20 longitudinal muscle; nephridia long, reddish in colour and partly fixed to body wall.

Distribution.—In the Indian Ocean: Red Sea, Djibouti Bay, Gulf of Aden, Gulf of Aqaba and Durban.

In other Oceans.—Great Barrier reef, Rotuma, Funafuti, New Britain, Loyalty Islands, Amboina, Moluccas, Philippines and Cape Verde Islands.

Paraspidosiphon steenstrupii (Diesing)

1859. *Aspidosiphon steenstrupii* Diesing, *Sber. Akad. Wiss. Wien, math. naturwiss.*, **37**: 767.
1883. *Aspidosiphon steenstrupii*: Selenka et al., *Semperis Reisen im Archipel der Philippinen*, (2) **4** (1): 116.
1902. *Aspidosiphon steenstrupii*: Sluiter, *Siboga Exped.*, **25**: 18.
1902. *Aspidosiphon steenstrupii*: Shipley, In Gardiner, *Fauna and Geography of the Maldive and Laccadive Archipelagoes*, **1** (2): 131-132.
1903. *Aspidosiphon steenstrupii*: Shipley, In Herdman, *Rep. Govt. Ceylon Pearl Oyster Fish. Gulf Mannar*, suppl. rept., No. **2**: 171.
1904. *Aspidosiphon steenstrupii*: Hérubel, *Bull. Mus. Hist. nat.*, **10**: 564.
1905. *Aspidosiphon steenstrupii*: Lanchester, *Proc. zool. Soc. London*, **1**: 39.
1914. *Aspidosiphon steenstrupii*: Hammerstein, *Ark. Zool.*, **9**(10): 1.
1922. *Aspidosiphon steenstrupii*: Fischer, *Ark. Zool.*, **14**(19): 1.
1942. *Aspidosiphon steenstrupii*: Stephen, *Ann. Natal Mus.*, **10**(2): 253.
1952. *Aspidosiphon steenstrupii*: Stephen & Robertson, *Proc. R. Soc. Edinb.*, Sec. B, **64**: 441.
1964. *Paraspidosiphon steenstrupii*: Stephen, *Ann. Mag. nat. Hist.*, (13) **7** (80): 459.

Material.—2 exs., Campbell Bay, Nicobar Islands, *A. Daniel*, 6.3.66; 1 ex., Malacca village, Car Nicobar Islands, *K. K. Tiwari*, 23.3.59; 2 exs., Sesostris Bay, near South Point, Port Blair, S. Andaman, "living in holes in coral", *H. C. Ray*, 16.3.52. 2 exs; Ganatikri, N. Andaman, "from coral crevices, associated with polychaete, *Nereis* sp.", *B. P. Haldar*, 14.10.72.

Description.—Length ranges from 30 to 40 mm.; introvert and trunk nearly equally long; general colour yellowish brown but anal and caudal shields dark brown; anal shield flat, granulated and furrowed; body covered with numerous papillae formed by densely aggregated polygonal plates; longitudinal muscle grouped into 20 rarely anastomosing bundles visible from outside; retractor muscle originating from posterior end of trunk by two roots but fused after running for a short distance; rectal diverticulum present but fixing muscle absent; nephridia long, proximal halves attached to body wall but posteriorly reaching to roots of retractor muscle.

Distribution.—In the Indian Ocean: Durban, Madagascar, Zanzibar, Djibouti, Mauritius, Gulf of Mannar, Lakshadweep & Maldive Islands, Penang, South coast of Java and Timor.

In other Oceans.—Japan, Great Barrier reef, Loyalty Islands, New Guinea, Cape Verde Islands, St. Helena, West Indies, Brazil, Bahamas and Eastern North America.

REMARKS ON DISTRIBUTION

The Sipuncula of the Andaman and Nicobar Islands is still far from well known despite the fact that 21 species of Sipuncula has been recorded recently. This constitute only 15.5% of the known species occurring in the Indian Ocean. Material of Johnson is exclusively from Port Blair area and that of Prashad is from either Port Blair and Nancowry Harbour or without any particular locality (Andamans and

Nicobars). But the localities indicated in this paper and earlier paper from various parts of two groups of Islands showing a wide range of distribution. Most of the species occur in the intertidal region and are shallow water forms occurring in sand, inside coral and calcareous rock platform except *Phascolosoma pacificum* Keferstein from deep water dealt elsewhere (Haldar, 1970). Hitherto collections were made from the eastern side of the Islands, thereby showing a trend of close relationship with Indo-Pacific species. All these species belong to warm temperate region but some of them range well into tropics in other oceans. Material at hand expect to add some more species to the list in near future. The western coast of these Islands were not surveyed with regards to this group, thus underlying the need for detail study.

SUMMARY

The present paper is a preliminary report on the collection of *Sipuncula* from the Andaman and Nicobar Islands, collected by different survey parties of the Zoological Survey of India. The material contained four genera and nine species. Six species are new records from the area. Brief description of each species given.

ACKNOWLEDGEMENTS

I take this opportunity of expressing my sincere thanks to Dr. A. P. Kapur, Director, Zoological Survey of India, Calcutta, for his constant encouragement. I am indebted to Dr. J. M. Julka, Zoologist, Zoological Survey of India, Calcutta, for helping in the preparation of this paper. I am also thankful to Dr. A. Daniel, Superintending Zoologist and Officer-in-Charge, Southern Regional Station, Zoological Survey of India, Madras, for going through the manuscript critically and offering valuable suggestions.

ON THE FISHES OF THE GENUS *CTENOPS*

McCLELLAND, 1845

(FAMILY: BELONTIIDAE)

By

RAJ TILAK

Zoological Survey of India, Calcutta.

(With 4 Text-figures)

INTRODUCTION

In the classification of the teleostean fishes, Regan (1909) and Weber & de Beaufort (1922) placed Anabantoidei as a suborder of the order Labyrinthici. Berg (1940) and Greenwood *et al.* (1966) considered that the association of these two groups was unnatural and their resemblance was simply because of convergence; they, therefore, transferred Anabantoidei as a suborder under the order Perciformes. The anabantid fishes of the family Belontiidae have been known for their beauty and many of them have been kept as pets in the aquaria. *Ctenops* McClelland, 1845 is one of the Indian representatives of the family Belontiidae and the only species of this little-known genus, *Ctenops nobilis* McClelland, recorded so far from North-east Bengal, Bihar, Assam, Sikkim and Bangla Desh, is rather rare and has, therefore, not been able to catch the imagination of aquarists to acquire them as pets or of the department of Health to exploit its larvivorous habit. Since the description of this species by McClelland (1845), only little attention seems to have been paid to it. Even the status of this genus has been doubtful for quite some time. In the past many years, collection of this species has been made from many different localities and the material is available in the National Zoological Collections of Zoological Survey of India, Calcutta. In the present paper, therefore, it is proposed to give a detailed description of the species based on that material.

TAXONOMY

McClelland (1845) proposed the genus *Ctenops* for an elegant anabantid fish from the rivers of Sikkim, passing on the northern frontiers of Bengal and described under it a species, *Ctenops nobilis* McClelland. Day (1877) did not recognise the genus *Ctenops* McClelland and referred *nobilis* to the genus *Osphronemus* (Commerson) Lacépède, 1801 (Day changed the spellings to *Osphromenus*). Day (1877) and Regan (1909) considered *Trichopsis* (Kner) Ganestrini, 1860 as a junior homonym of *Ctenops* McClelland, 1845 and the latter author described under the

genus *Ctenops* two species, *nobilis* and *vittatus*. Same has been the opinion of Weber and deBeaufort (1922) and Bertin and Arambourg (1958).

Fowler (1934) and Innes (1935) used the generic name *Trichopsis* distinct from *Ctenops*. However, Myers (in Herre and Myers, 1937) pronounced that the species *nobilis* and *vittatus* have generic differences, and proposed to resurrect the generic name *Trichopsis* (Kner) Ganestrini for the latter species. Holly *et al.* (1932), Arnold (in Ahl, 1937), Smith (1945), Axelrod and Schultz (1955), Forselius (1957) and Sterba (1962) thought it more appropriate to describe the Indian genus, *Ctenops*, as monospecific and the genus *Trichopsis* with three species, *vittatus*, *harrisi* and *pumilus*.

Liem (1965) has referred to the personal communication from Myers, who recognised *Ctenops* and *Trichopsis* as distinct genera, based on the shape of the lacrymal. Liem (*op. cit.*) has, however, added a few more points of their distinction, based on the study of radiographs of *C. nobilis* and three species of the genus *Trichopsis*.

Ctenops was earlier included under the family Osphronemidae. Recently, Liem (1963) has erected a family name, Belontiidae, for all the genera of Osphronemidae of Jordan (1923) except *Osphronemus*. This was necessary according to the International Rules of Zoological Nomenclature because Myers (1923) proposed a new generic name, *Belontia* in place of *Polyacanthus* (Family Polyacanthidae). In Belontiidae, *Ctenops* falls under the subfamily Macropodinae of Liem (1963) and the closest ally of this genus is *Trichopsis*.

Genus **Ctenops** McClelland, 1845

1845. *Ctenops* McClelland, *Calcutta J. nat. Hist.*, 5 : 281.

(Type-species: *C. nobilis* McClelland).

Description: Body oblong, compressed. Head acute. Snout longer than diameter of eye. The cleft of mouth horizontal. The lower free margin of the enlarged lacrymal and the angle and lower margin of the preoperculum rectilinear, finely denticulated. The premaxillaries and the dentaries with bands of conical teeth; the peripheral teeth being enlarged (Text-fig. 3A). No teeth on the prevomer and the palatines. The upper jaw protrusible. The dorsal fin with 4-6 spines and 6-8 rays and inserted against nearly the middle of the soft anal. The anal with 4-5 spines and 23-28 rays. Median fins scaly at the base. The ventral inserted a little in advance of the pectorals, each with a strong spine and 5 rays; the first ray produced into a filament. Scales arranged in regular rows. Transverse scales 17-18. Body scales ciliated (Text-fig. 3B) while those on the head may or not be ciliated (Text-fig. 3C). Lateral line vestigial. The swim-bladder extends into caudal region. Vertebral column sinuous.

This genus is monotypic.

Distribution: North-east Bengal, Assam, Purnea and Champaran districts of Bihar; Dacca and Jessore Jheel in Bangla Desh; Sikkim.

Ctenops nobilis McGlelland

1845. *Ctenops nobilis* McGlelland, *Calcutta J. nat. Hist.*, **5**: 281, pl. 21, fig. 1 (Type-locality: Rivers of Sikkim, passing on northern frontiers of Bengal).
 1849. *Trichopsis nobilis*: Cantor, *J. Asiat. Soc. Bengal*, **18**: 1074.
 1869. *Osphromenus nobilis*: Day, *Proc. zool. Soc. London*: 519.
 1877. *Osphromenus nobilis*: Day, *Fishes of India*: 372, pl. LXXVIII, fig. 5.
 1909. *Ctenops nobilis*: Regan, *Proc. zool. Soc. London*, **2**: 777.
 1922. *Ctenops nobilis*: Weber & de Beaufort, *Fish. Indo- Austr. Archipel.*, **4**: 352.
 1937. *Ctenops nobilis*: Shaw & Shebbeare, *J. Asiat. Soc. Bengal*, **3**: 113. text-fig. 118.
 1965. *Ctenops nobilis*: Liem, *Copeia*, No. **2**: 207.

Material studied: (1) one example (53 mm. standard length), Purnea, Bihar, Dr. Jerdon, Z.S. I. Reg. No. Gat. 333.

(2) One example (57 mm. standard length), Dacca, Mus. Collector, Z.S.I. Reg. No. Gat. 334.

(3) One example (60 mm. standard length), Assam, purchased from Dr. F. Day (Original of Pl. LXXVIII, fig. 5, *Fishes of India*), Z.S.I. Reg. No. 1565.

(4) Three examples (41-66 mm. standard length), Jessore Jheel, Bangla Desh, J. Wood-Mason and Alcock, Z.S.I. Reg. No. 13343-45.

(5) Two examples (42-56 mm. standard length), Dibrugarh, Assam, Dr. S. W. Kemp, Z.S.I. Reg. No. 7866-67/1.

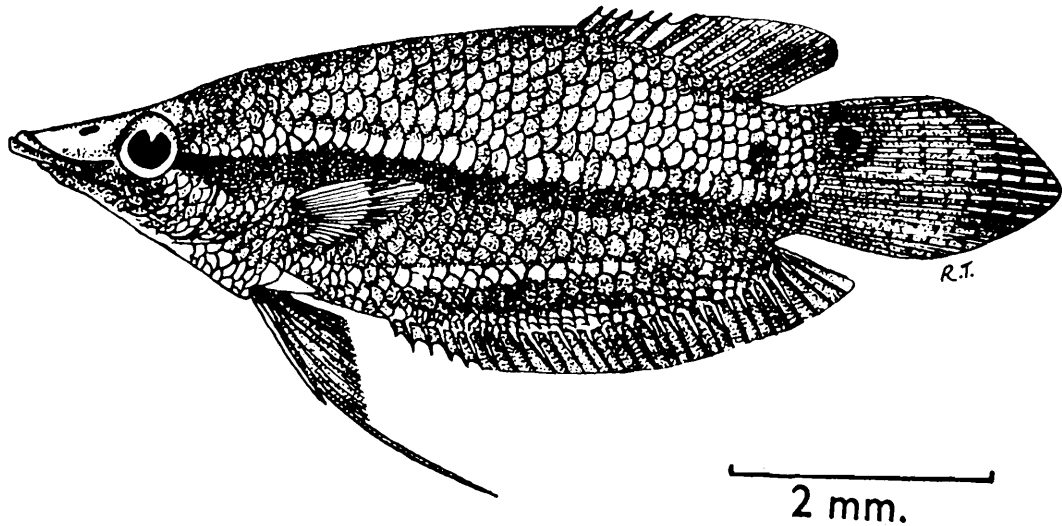
(6) One example (60 mm. standard length), Siliguri, N. Bengal, Messers G. E. Shaw and E. O. Shebbeare, Z.S.I. Reg. No. 11425/1.

(7) One example (57 mm. Total length, 43 mm. standard length), Bettiah, Dist. Champaran, Bihar.

Description: B. VI, D. IV-VI/6-8, P. 13, V I/5, A. IV-V/23-28, G. 16 Lat. 1. 28-34, Lat. tr. 6/12.

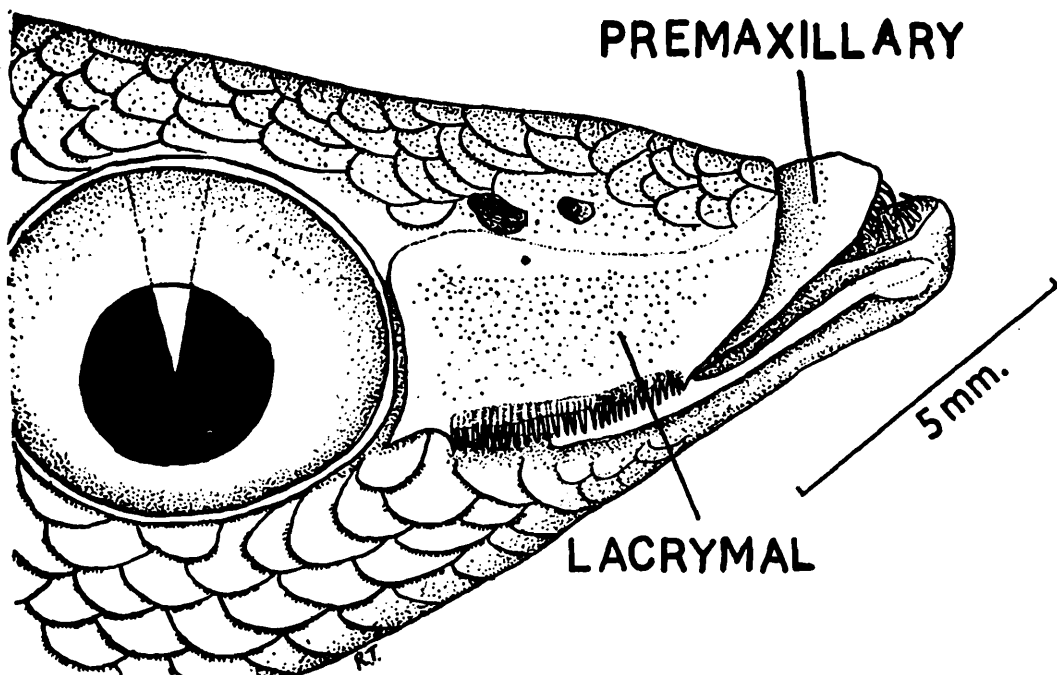
It is a small elegant anabantid with body laterally flattened. The dorsal profile rises immediately behind the nape to the origin of the dorsal after which it descends down to the base of the caudal. The ventral profile likewise descends sharply from the mandibular edge to the origin of the anal fin after which it ascends gradually upto the base of the caudal. The length of the head is contained from 2.62-3.0 in the standard length. The eyes are prominent and situated laterally. The diameter of the eye lies 3.2-3.8 times in the length of the head. Because of the enlarged lacrymal, the snout is longer than the diameter of the eye. The snout is dorsally convex and anteriorly blunt. The diameter of eye is contained 0.75-0.98 times in the snout length. The interorbital space is nearly flat and its width is more than the length of the snout. The nostrils are paired and separated by a flat internarial membrane. They are nearer to the eye than the tip of the snout. The cleft of the mouth is horizontal and wide. The upper and lower jaws

are elongated to form a somewhat pipe-shaped mouth. The lower jaw is longer than the upper jaw which is protrusible.



Text-fig. 1. *Ctenops nobilis* McClelland.

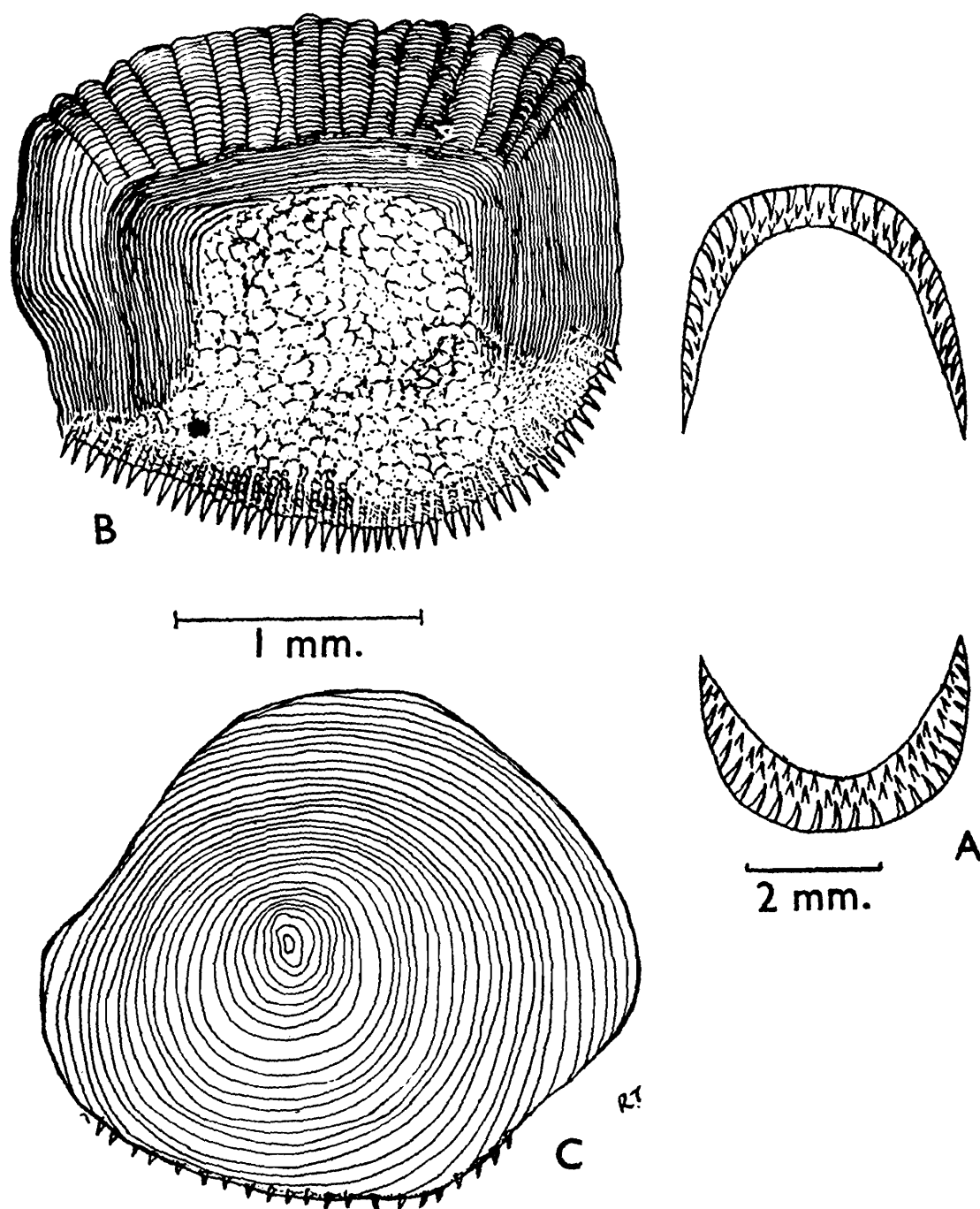
Day (1877), Weber and de Beaufort (1922) and Liem (1965) stated that the end of the premaxillaries extend opposite the front border of the orbit. The premaxillaries do not extend to opposite the front border of the orbit. The premaxillaries form the upper jaw and each is medially broad and distally narrow. The broad medial end is produced backwards into a rod-like bony process; the two processes of either side



Text-fig. 2. Lateral view of the anterior part of the head of *Ctenops nobilis* McClelland.

lie apposed to each other and conjointly form a medio-posterior process of the upper jaw. These processes lie beneath the nasals. The under

side of the premaxillaries bears a wide band of villiform teeth which are enlarged on the periphery (Text-fig. 3A). The maxillaries are toothless. The distal ends of the premaxillaries and the maxillaries lie close to each other, that of the latter being on the outer side. The distal tip of maxillary is flattened. The whole of the maxillary and the distal part of the premaxillary lie in a groove, formed below the enlarged lacrymal (preorbital of Day, 1877; Regan, 1909; Weber & de Beaufort, 1922). The free outer border of the lacrymal is finely toothed (Text-fig. 2). The tooth-band on the mandibles is of a similar nature as that of the upper jaw and has a series of enlarged peripheral teeth (Text-fig. 3A). The groove below the lacrymal extends on the underside of



Text-fig. 3A. The dentition of jaws of *C. nobilis*
 B. A scale from the lateral line of *C. nobilis*
 C. A scale from the head of *C. nobilis*

the mandibles. The lower lip is enlarged on the lateral side where it covers the retracted medial part of the premaxillary.

The angle and the lower border of the preoperculum are denticulated. The dorsal is short and its origin lies above nearly the middle of the soft portion of the anal. The length of the base of the dorsal fin lies 4.4-6.0 times in the standard length whereas that of the anal base lies 1.7-2.1 times. The length of the pectoral fin is equal to half of head length or in some examples even somewhat less. The pelvics are inserted a little in advance of the pectorals (Text-fig. 1). The spine of the ventral fin is strong and the outer most ray is prolonged to varying lengths in all the examples studied here. The length of the pelvic spine is contained from 2.0-2.48 times in the length of the head.

Except the naked part of the upper lip and the ventral side of the lower jaw, the whole body is covered by scales. The scaly sheath extends to the basal part of each of the median fins. The lateral line is but slightly visible and irregularly pierces the scales. The scales of the body are more or less rectangular with the posterior margin convex and beset with ctenii (Text-fig. 3B). The scales on the head may be smooth or minutely ciliated (Text-fig. 3C). There are 28-34 scales on the lateral line and in the transverse series, there are 6 scales above the lateral line and 12 below it.

Colouration: The colour of the spirit-preserved specimens is brownish. A white band extends from behind the posterior border of the orbit and runs uninterrupted below the lateral line upto opposite the end of the spiny portion of the anal fin and thenceafter upto the base of the caudal in the form of white patches. Another uninterrupted white band originates from the area between the bases of the pectoral and the pelvic fins and extends to the middle of the soft portion of the anal. A third similar band extends along the base of the anal fin. At the upper part of the base of the caudal, there is a light-edged dark brown ocellus. The ventral side of the head and abdomen are banded alternately with brown and white.

Remarks: Mr. T. Mackessack sent a specimen of *C. nobilis* from Sarayaman Lake, Bettiah (Dist. Champaran, Bihar) to Zoological Survey of India on the basis of which Menon (1962) extended the range of distribution of this species further westwards to Champaran (Bihar) and gave a photograph of the specimen. A comparison of this specimen, measuring 57 mm. total length, with specimens of similar length from Dibrugarh (Assam) and Jessore Jheel (Bangladesh) shows that the specimen from Bihar (Champaran district) is somewhat different in the following morphological characters:

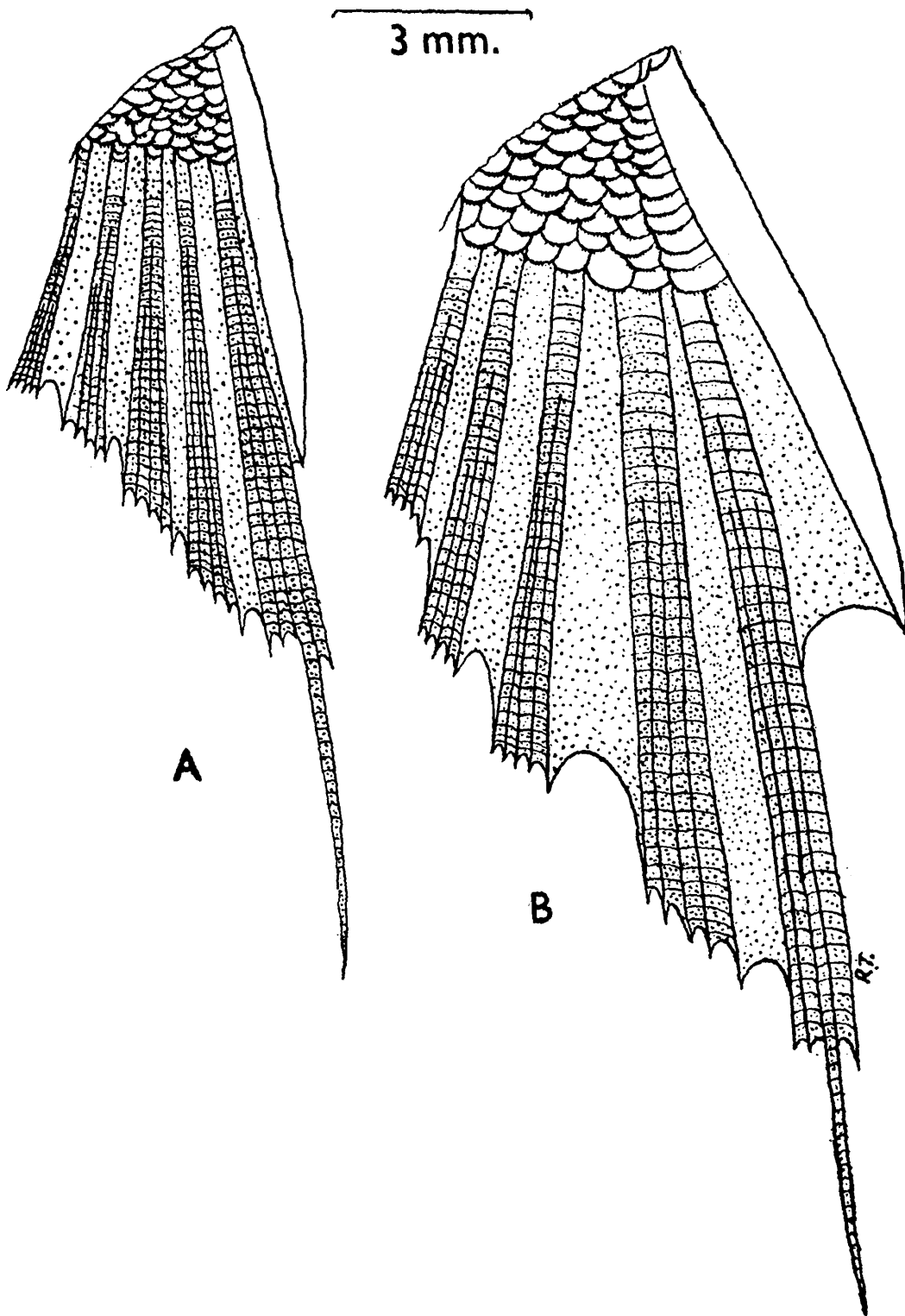
(1) The depth of the body is less than the length of head (being 1.2 times in head length *Versus* 0.88-1.0 times).

(2) The depth of body lies 3.4 times in the standard length (*Versus* 2.6-3.0 times).

(3) The height of the caudal peduncle is contained 1.8 times in the height of the body (*Versus* 2.0-2.6 times).

(4) The height of the head at the occiput is contained 1.1 times in the depth of the body (*Versus* 1.3-1.9 times).

(5) The length of the pelvic spine goes 1.87 times in the length of the head (*Versus* 2.0-2.78 times) (Text-figs. 4A, 4B).



Text-fig. 4. A. Pelvic fin of a specimen of *C. nobilis* from Bettiah, Bihar.
 4. B. Pelvic fin of a specimen of *C. nobilis*.

The morphometric differences shown by the specimen from Bettiah (Dist. Champaran, Bihar) are interesting from taxonomic point of view and could be of subspecific level if they are further confirmed from more examples from the same area. Because of the single specimen, it is kept here as *C. nobilis* and naming it as a new taxon should be kept in abeyance till more material of the same is available from its locality.

ACKNOWLEDGEMENT

The author feels grateful to Dr. A. P. Kapur, Director, Zoological Survey of India, Calcutta for his constant encouragement and advice.

REFERENCES

- AHL, E. 1937. Neue Süßwasserfische aus den Indischen und Maläiischen Gebiet. *Zool. Anz.*, **117**: 113-119.
- AXELROD, H. R. and L. P. SCHULTZ 1955. *Handbook of tropical aquarium fishes*. McGraw Hill Book Co., New York, N. Y.
- BERTIN, L. and G. ARAMBOURG 1958. Superordre des Téléostéens. Grassé *et al.*, *Traité de Zoologie*, **13**, Masson, Paris.
- BERG, L. S. 1940. Classification of fishes, both recent and fossil. *Trav. Inst. Zool. Acad. Sci. U.R.S.S.*, **5**(2): 87-517 (English translation).
- DAY, F. 1877. *The Fishes of India; being a natural history of the fishes known to inhabit the seas and freshwaters of India, Burma, and Ceylon*; Dowson & Sons, London: 371-372.
- FORSELIUS, S. 1957. Studies of Anabantoid fishes I. A qualitative description of the reproductive behaviour in territorial species investigated under laboratory conditions with special regard to genus *Colisa*. An introduction. *Zool. Bidr.*, **32**: 93-302.
- FOWLER, H. W. 1934. Zoological results of the third de Schauensee Siamese expedition, Part V Additional fishes. *Proc. Acad. Nat. Sci. Phila.*, **86**: 335-352.
- GREENWOOD, P. H., ROSEN, D. E., WEITZMAN, S. H. and MYERS, G. S. 1966. Phyletic studies of Teleostean Fishes, with a provisional classification of living forms. *Bull. Amer. Mus. Nat. Hist.*, **131**(4): 341-455.
- HERRE, A. W. G. T and MYERS, G. S. 1937. A contribution to the ichthyology of the Malaya Peninsula. *Bull. Raffles Mus.*, **13**: 5-75, pls. 1-7.
- HOLY, M., MEINKEN, H. and RACHOW, A. 1932. *Die Aquarienfische in Wort und Bild*. Alfred Kern Verlag. Stuttgart: 365-367.
- INNES, W. T 1935. *Exotic aquarium fishes*. Innes Publishing Co., Philadelphia, Pa.
- JORDAN, D. S. 1923. A classification of fishes. Including families and genera as far as known. *Stanford Univ. Publ. Biol. Ser.*, **3**: 79-243.
- LIEM, K. F. 1963. The comparative osteology and phylogeny of the Anabantoidei (Teleostei, Pisces). *Ill. Biol. Monogr.*, **30**: 1-149.
- LIEM, K. F. 1965. The status of the anabantoid fish genera *Ctenops* and *Trichopsis*. *Copeia*, (**2**): 206-213.
- MENON, A. G. K. 1962. *Ctenops nobilis*. *Aq. J.*, **32**(6): 238-240.
- MCGLELLAND, J. 1845. Description of four species of fishes from the rivers at the foot of the Boutan mountains. *Calcutta. J. nat. Hist.*, **5**: 274-282.

- MYERS, G. S. 1923. Notes on the nomenclature of certain anabantids and a new generic name proposed. *Copeia*: 62-63.
- REGAN, G. T 1909a. The Asiatic Fishes of the family Anabantidae. *Proc. zool. Soc. London*, **2**: 767-787, 3 pls.
- REGAN, G. T 1909b. The classification of the Teleostean fishes. *Ann. Mag. nat. Hist.* (8) **3**: 75-86.
- SMITH, H. M. 1945. The freshwater fishes of Siam, or Thailand. *Bull. U.S. Nat. Mus.*, **188**: 1-622.
- STERBA, G. 1962. *Freshwater fishes of the world*. Translated and reviewed by D. W. Tucker. Vista Books, London.
- WEBER, M. and DE, BEAUFORT, L. F. 1922. *The Fishes of the Indo-Australian Archipelago*, **4**: 350-352.
-

ODONATA OF DOON VALLEY—1. ANISOPTERA

By

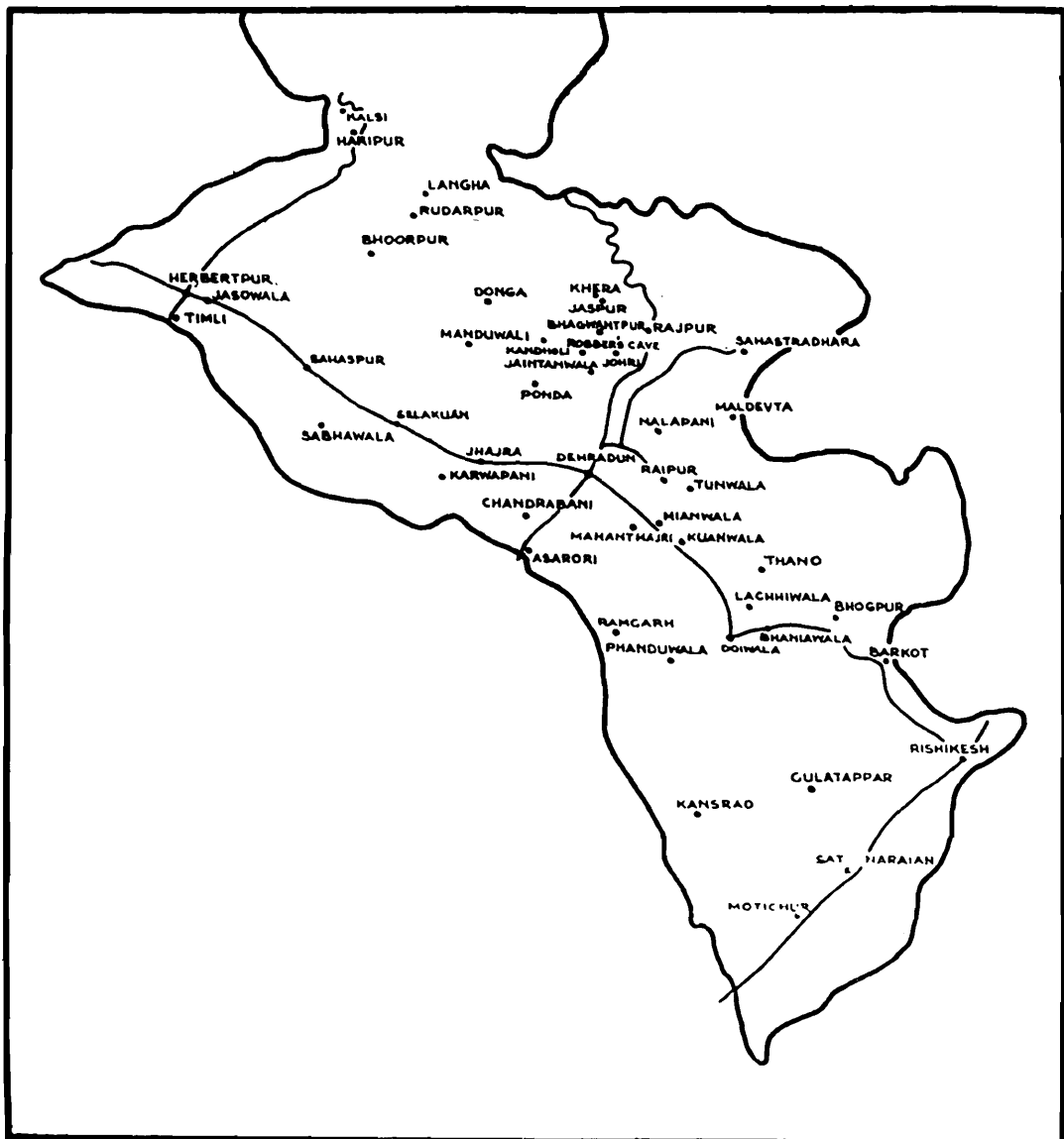
ASKET SINGH and MAHABIR PRASAD

*Northern Regional Station,
Zoological Survey of India, Dehra Dun*

(With 6 Text-figures)

INTRODUCTION

Dragonfly fauna of Doon Valley is very inadequately known. Except for a few scattered references no comprehensive account is available on the Odonata of this Valley. Keeping this in view systematic collection of this group was made from all over the valley (Text-fig. 1) in



Text-fig. 1, Map of Doon Valley showing the collection Sites.

the last few years, as a result of which a larger representative collection of this group has accumulated in the Zoological Survey of India. The results based on this collection are presented in this report.

Most of the species agree fairly well with the descriptions of Fraser (1933, 1934, 1936), but in a few species marked differences were observed and have been recorded.

ACKNOWLEDGEMENTS

We are highly thankful to Dr. A. P. Kapur, Director, Zoological Survey of India, for providing the facilities to carry out this work. The help of Sri S. S. L. Verma and Sri T. S. Farmahan in preparation of the figures is gratefully acknowledged. Thanks are also due to Dr. P. N. Chatterjee, Forest Entomologist, Forest Research Institute, Dehra Dun for permitting us to consult Institute's library and reference collection.

Suborder *ANISOPTERA*

Superfamily *AESHNOIDEA*

Family *GOMPHIDAE*

Subfamily *GOMPHINAE*

***Anormogomphus heteropterus* Selys**

1854. *Anormogomphus heteropterus* Selys, *Bull. Acad. Belg.* **21**(2): 61.

1934. *Anormogomphus heteropterus*, Fraser, *Fauna Brit. Ind. Odon.* **2**: 174-176.

Material: Donga, Gula Tappar, Haripur, Kalsi, Lachhiwala, Mianwala, Ramgarh, Sahastradhara and Timli, one female from each locality.

Measurements: Female—Abdomen, 35 mm. fore wing, 31-33.5 mm. hind wing, 31 mm.

Remarks: No male could be collected. It is the first record of this species from U.P. Previously it is known only from Punjab and Bihar.

***Anormogomphus kiritschenkoi* Bartenev**

1913. *Anormogomphus kiritschenkoi* Bartenev, *Revue Russe d'Ent.*, **13**: 179.

1934. *Anormogomphus kiritschenkoi*, Fraser, *Fauna Brit. Ind. Odon.* **2**: 176-177.

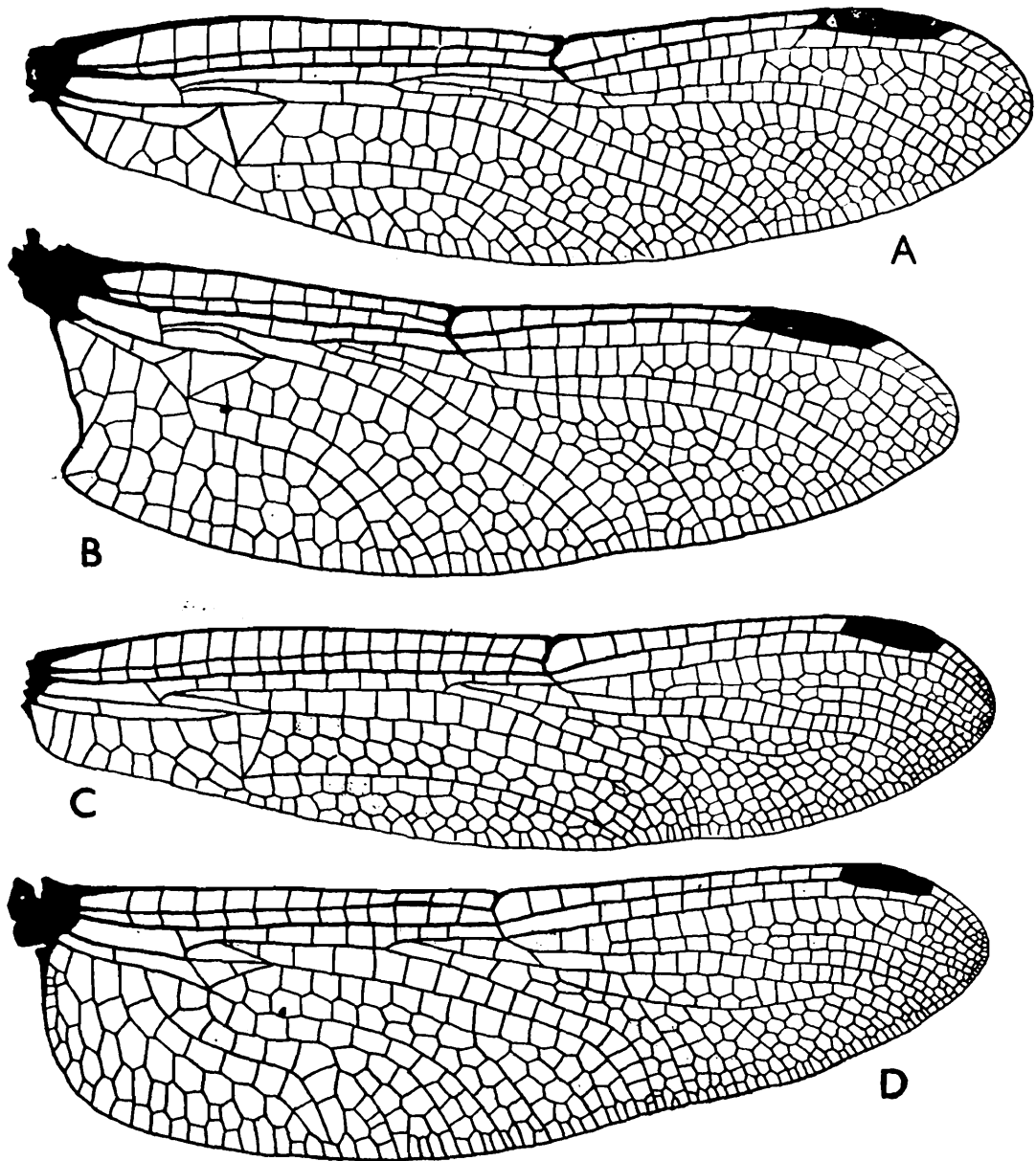
Material: Herbertpur, 1 ♀.

Measurements: Female—Abdomen, 30 mm. fore wing, 27 mm. hind wing, 25.5 mm.

Remarks: A very rare species. It has recently been recorded from India for the first time (Singh and Prasad, 1974).

Mesogomphus lineatus (Selys)

(Text-fig. 2, A & B)

1850. *Gomphus lineatus* Selys, *Rev. Odon.* p. 386.1934. *Mesogomphus lineatus*, Fraser, *Fauna Brit. Ind. Odon.* 2: 230-234.

Text-fig. 2. (A & B) *Mesogomphus lineatus* (Selys) A. fore wing, B. hind wing; (C & D) *Cratilla lineata* (Braner), C. fore wing, D. hind wing.

Material: Bhaniawala, 1 ♂; Asarori, 1 ♂; Donga, 1 ♀; Kaudholi, 1 ♂; Langha, 1 ♂; Motichur, 1 ♂; Rishikesh, 1 ♂; Raipur, 2 ♂♂; and Sahastradhara, 3 ♀♀.

Measurements: Male—Abdomen, 29 mm. fore wing, 25 mm. hind wing, 23 mm. Female—Abdomen, 33 mm. fore wing, 31 mm. hind wing, 29 mm.

Remarks: A very common species.

Onychogomphus M-flavum Selys

1854. *Onychogomphus bistrigatus* Selys, *Mon. Gomph.* p. 22.
 1934. *Onychogomphus M-flavum*, Fraser, *Fauna Brit. Ind. Odon.* 2: 250-254.

Material: Herbertpur, 1 ♂; Robber's Cave, 1 ♂; and Sahastradhara, 4 ♂♂.

Measurements: Male—Abdomen, 34 mm. fore wing, 31 mm. hind wing, 30 mm.

Remarks: This species is known only from Darjeeling and is reported from U.P. for the first time. The material studied consists of males only.

Onychogomphus cerastes (Selys)

1854. *Ophiogomphus cerastes* Selys, *Bull. Acad. Belg.* 21(2): 41.
 1934. *Onychogomphus cerastes*, Fraser, *Fauna Brit. Ind. Odon.* 2: 260-261.

Material: Sahastradhara, 3 ♂♂; and Timli, 1 ♂;

Measurements: Male—Abdomen, 32 mm. fore wing, 30 mm. hind wing, 28 mm.

Remarks: A rare species.

Distribution: It is known from Nepal and north India.

Lamelligomphus risi (Fraser)

1922. *Gomphus risi* Fraser, *Mem. Dept. Agric. India*, 7(7): 73-74.
 1934. *Lamelligomphus risi*, Fraser, *Fauna Brit. Ind. Odon.* 2: 273-275.

Material: Rishikesh, 1 ♂.

Measurements: Male—Abdomen, 38 mm. fore wing, 35 mm. hind wing, 34 mm.

Remarks: A very rare species.

Distribution: It is known from eastern India only.

Nepogomphus modestus (Selys)

1878. *Onychogomphus modestus* Selys, *Bull. Acad. Belg.* 46: 423.
 1934. *Nepogomphus modestus*, Fraser, *Fauna Brit. Ind. Odon.* 2: 285-286.

Material: Donga, 1 ♂; Motichur, 1 ♂; 1 ♀; Rajpur, 1 ♂, 1 ♀; Robber's Cave, 1 ♂; Sahastradhara, 7 ♂♂, 10 ♀♀; and Timli, 2 ♂♂.

Measurements: Male—Abdomen, 23 mm. fore wing, 24 mm. hind wing, 22.5 mm. Female—Abdomen, 24 mm. fore wing, 24 mm. hind wing, 22.5 mm.

Remarks: This species is known from Bengal and Assam, Burma and Sumatra. This is the first record of this species from north-west India.

Subfamily ICTINOGOMPHINAE

Ictinogomphus rapax (Rambur)1842. *Diastatomma rapax* Rambur, *Ins. Neurop.* p. 169.1934. *Ictinus rapax*, Fraser, *Fauna Brit. Ind. Odon.* 2: 373-376.*Material*: Bhaniawala, 1 ♂; and Rishikesh, 1 ♂.*Measurements*: Male—Abdomen, 46 mm. fore wing, 42 mm. hind wing, 41 mm.*Remarks*: A very rare species. Differs from the published account in having dark brown basal markings of both the wings extended up to first antenodal nervure, and in having brown membrane.

Family AESHNIDAE

Subfamily ANACTINAE

Anax immaculifrons Rambur1842. *Anax immaculifrons* Rambur, *Ins. Neurop.* p. 189.1936. *Anax immaculifrons*, Fraser, *Fauna Brit. Ind. Odon.* 3: 145-146.*Material*: Rajpur, 1 ♂; and Sahastradhara, 2 ♂♂;*Measurements*: Male—Abdomen, 51.5 mm. fore wing, 56-58 mm. hind wing, 55 mm.*Remarks*: A very rare species. This is the first record of this species from Doon Valley.**Anax guttatus** (Burmeister)1839. *Aeschna guttata* Burmeister, *Handb. Ent.* 2: 840.1936. *Anax guttatus*, Fraser, *Fauna Brit. Ind. Odon.* 3: 140-142.*Material*: Ballupur (Dehra Dun), 1 ♂.*Measurements*: Male—Abdomen, 54 mm. fore wing, 51 mm. hind wing, 50 mm.*Remarks*: Very rare. According to Fraser (1936) the pterostigma extends over $2\frac{1}{2}$ cells in all the wings. But in this specimen it extends over $3\frac{1}{2}$ cells in the right fore wing. Discoidal cell in hind wings comprises only two cells.

Superfamily LIBELLULOIDEA

Family GORDULIIDAE

Subfamily EPOPTHALMIINAE

Macromia moorei Selys1874. *Macromia moorei* Selys, *Bull. Acad. Belg.* 37: 28.1936. *Macromia moorei*, Fraser, *Fauna Brit. Ind. Odon.* 3: 164-166.*Material*: Kandholi, 4 ♂♂; Dhera Dun, 1 ♂; and Sahastradhara, 1 ♂; 2 ♀♀.

Measurements: Male—Abdomen, 47 mm. fore wing, 46 mm. hind wing, 44 mm. Female—Abdomen, 47 mm. fore wing, 47 mm. hind wing, 46 mm.

Remarks: Very rare species.

Distribution: It is known from N. E. Himalayas, Simla, and Kumaon Hills.

Family LIBELLULIDAE

Subfamily LIBELLULINAE

Cratilla lineata (Brauer)

(Text-fig. 2, C & D)

1878. *Orthemis lineata* Brauer, *Sitzungsber. Akad. Wien.* 77: 9.

1936. *Cratilla lineata*, Fraser, *Fauna Brit. Ind. Odon.* 3: 286-288.

Material: Asarori, 1 ♂; Donga, 1 ♂; Kuanwala, 2 ♂♂; and Timli, 1 ♂.

Measurements: Male—Abdomen, 28 mm. fore wing, 35.5 mm. hind wing, 34 mm.

Remarks: A rare species. It is usually found in thick forest quite far from ponds and streams. This species has recently been reported from north-west India (Singh and Prasad, 1974).

Potamarcha obscura (Rambur)

1842. *Libellula obscura* Rambur, *Ins. Neurop.* p. 64.

1936. *Potamarcha obscura*, Fraser, *Fauna Brit. Ind. Odon.* 3: 289-291.

Material: Jasowala, 1 ♂; Lachhiwala, 2 ♂♂; and Timli, 3 ♂♂, 3 ♀♀.

Measurements: Male—Abdomen, 28.5 mm. fore wing, 34 mm. hind wing, 32.5 mm. Female —Abdomen, 28 mm. fore wing, 34 mm. hind wing, 32 mm.

Remarks: It is commonly found near small, weedy ponds and also from thick forest far away from ponds and streams.

Orthetrum brunneum brunneum (Fonscolombe)

1837. *Libellula brunnea* Fonscolombe, *Ann. Soc. Ent. France*, 6: 141.

1936. *Orthetrum brunneum brunneum*, Fraser, *Fauna Brit. Ind. Odon.* 3: 294-295.

Material: Donga, 2 ♀♀; Kansrao, 1 ♀; Kandholi, 1 ♀; Karwapani, 1 ♀; Phanduwala, 2 ♀♀; Ramgarh, 1 ♀; and Sahastradhara, 6 ♀♀.

Measurements: Female—Abdomen, 29 mm. fore wing, 35 mm. hind wing, 34 mm.

Remarks: Fairly common species.

Orthetrum taeniolatum (Schneider)1845. *Libellula taeniolata* Schneider, *Stett. Ent. Zeit.* 6: 1111936. *Orthetrum taeniolatum*, Fraser, *Fauna Brit. Ind. Odon.* 3: 296-298.

Material: Asarori, 1 ♂, 1 ♀; Barkot, 1 ♀; Bhaniawala, 2 ♂♂; Bhagwant Pur, 1 ♂, 1 ♀; Bhoorpur, 5 ♂♂; Donga, 2 ♂♂, 2 ♀♀; Haripur, 5 ♂♂, 3 ♀♀; Herbertpur, 9 ♂♂, 12 ♀♀; Johari, 1 ♂; Jaintanwala, 1 ♂; Jaspur, 1 ♂; Jhajra, 2 ♂♂; 8 ♀♀; Kandholi, 8 ♂♂, 3 ♀♀; Karwapani, 1 ♂; Kanarao, 3 ♂♂, 7 ♀♀; Kalsi, 2 ♂♂; Kuanwala, 1 ♀; Khera, 1 ♀; Langha, 3 ♂♂; Lachhiwala, 2 ♀♀; Maldevta, 1 ♂, 1 ♀; Motichur, 7 ♂♂, 6 ♀♀; Nalapani, 1 ♂, Pondha, 1 ♂; Phanduwala, 3 ♂♂; Prem Nagar, 1 ♂; Raipur, 10 ♂♂, 4 ♀♀; Rajpur, 3 ♂♂, 2 ♀♀; Robber's Gave, 1 ♂; Satnarain, 1 ♂; Sahaspur, 3 ♂♂, 1 ♀; Sahastradhara, 30 ♂♂, 10 ♀♀; Timli, 6 ♂♂; 2 ♀♀; and Thano, 1 ♂.

Measurements: Male—Abdomen, 24 mm. fore wing, 29 mm. hind wing, 27 mm. Female—Abdomen, 22-23.5 mm. fore wing, 28 mm. hind wing, 27 mm.

Remarks: A very common species found near as well as away from ponds and streams. It is often seen resting on dry or moist sand and is seldom found resting on twigs.

Orthetrum chrysostigma luzonicum (Brauer)1868. *Libella luzonica* Brauer, *Verh. Zool.-bot. Ges. Wien*, 18: 169, 732.1936. *Orthetrum chrysostigma luzonicum*, Fraser, *Fauna Brit. Ind. Odon.* 3: 298-300.

Material: Herbertpur, 1 ♀; Motichur, 1 ♂; Robber's Gave, 1 ♂, 1 ♀; and Rishikesh, 2 ♂♂, 1 ♀.

Measurements: Male—Abdomen, 29 mm. fore wing, 29 mm. hind wing, 27 mm. Female—Abdomen, 28 mm. fore wing, 32 mm. hind wing, 31 mm.

Remarks: It differs from the published description in the following features. Middle portion of labium is black and its sides are pale yellow; face slightly greenish yellow; rows of cells between 1 *Riii* and *Rspl* always 2; reticulation in subcostal, cubital and discoidal areas may be black or yellow.

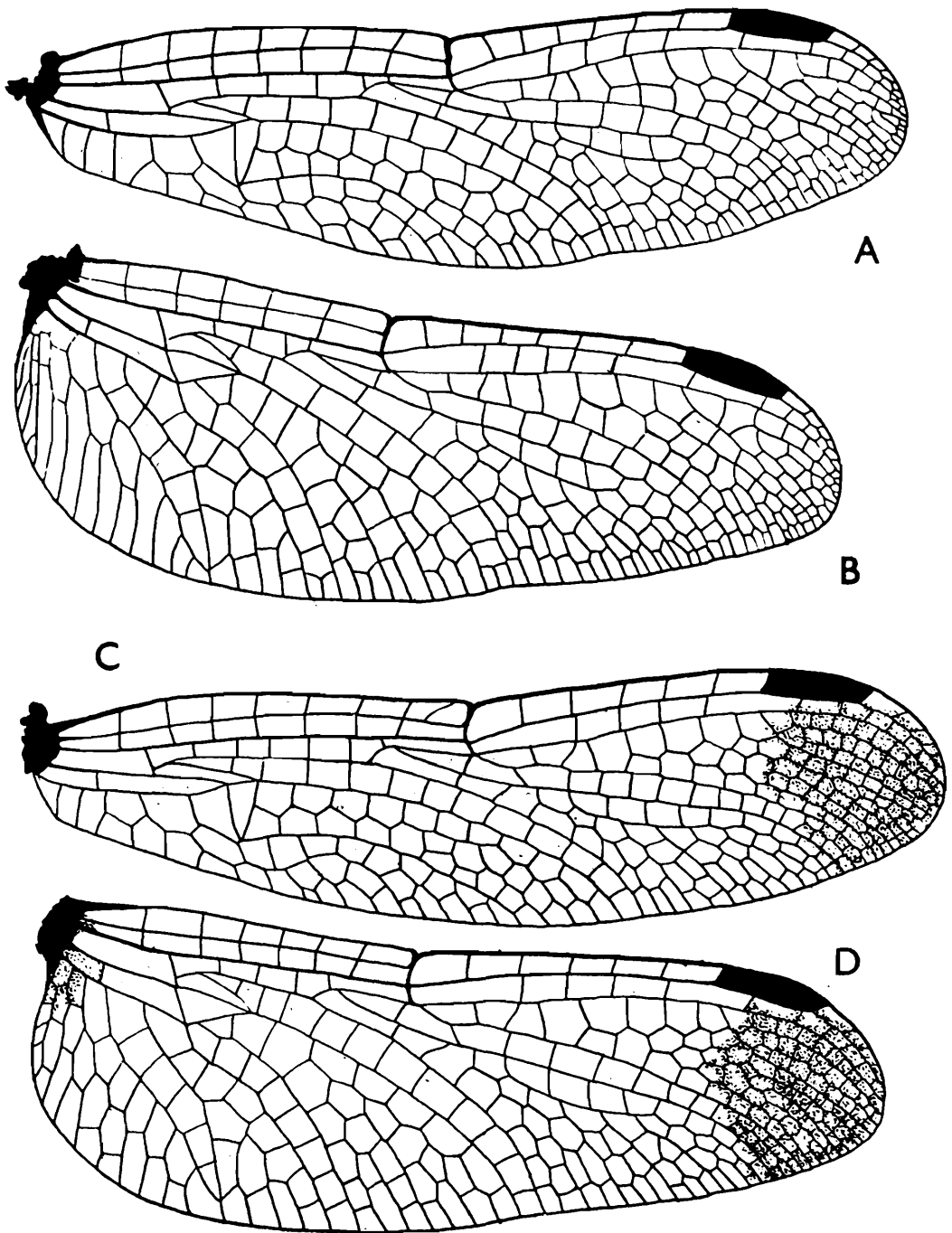
Orthetrum sabina (Drury)

(Text-fig. 3, A & B)

1770. *Libellula sabina* Drury, *Ill. Exot. Ins.* 1: 114, 115.1936. *Orthetrum sabina*, Fraser, *Fauna Brit. Ind. Odon.* 3: 300, 302.

Material: Asarori, 1 ♂, 1 ♀; Bhoorpur, 1 ♂; Gula Tappar, 1 ♂, 1 ♀; Herbertpur, 1 ♂, 10 ♀♀; Jaintanwala, 1 ♀; Jasowala, 1 ♂; Johari, 1 ♂; Kansrao, 5 ♀♀; Mahant Majri, 3 ♂♂, 2 ♀♀; Rishikesh, 1 ♂, 2 ♀♀; Ramgarh, 1 ♀; Sahaspur, 3 ♀♀; Satnarain, 1 ♀; Sahastradhara, 1 ♂; and Timli, 5 ♂♂.

Measurements: Male—Abdomen, 33 mm. fore wing, 30-34 mm. hind wing, 30-33 mm. Female—Abdomen, 31 mm. fore wing, 33 mm. hind wing, 30 mm.



Text-fig. 3. (A & B) *Orthetrum sabina* (Drury), A. fore wing, B. hind wing; (C & D) *Brachydiplax sabina* (Rambur) C. fore wing, D. hind wing.

Remarks: A very common species. It can be seen flying in large numbers in paddy fields and near the streams. Specimens of this species collected from moist habitats have greenish-yellow thorax and abdomen marked with black, while those collected from comparatively drier habitats are creamy yellow with black markings.

***Orthetrum triangulare triangulare* (Selys)**

1878. *Libella triangularis* Selys, *Mitth. Mus. Dresden.* p. 314.

1936. *Orthetrum triangulare triangulare*, Fraser, *Fauna Brit Odon.* 3: 305-307.

Material: Donga, 5 ♂♂, 1 ♀; Kansrao, 1 ♂; Kandholi, 12 ♂♂; Kalsi, 1 ♂; Lachhiwala, 1 ♂; Nalapani, 6 ♂♂; Rajpur, 3 ♂♂; Raipur, 1 ♂; Robber's Gave, 2 ♂♂; and Sahastradhara, 65 ♂♂, 1 ♀.

Measurements: Male—Abdomen, 27-28.5 mm. fore wing, 36-39 mm. hind wing, 35-38 mm. Female—Abdomen, 29 mm. fore wing, 38-40 mm. hind wing, 37-39 mm.

Remarks: It is one of the commonest species. It differs from the published account in having its pterostigma extended over more than two cells—extending over half or a even more of the third cell.

***Orthetrum pruinosum neglectum* (Rambur)**

1842. *Libellula neglecta* Rambur, *Ins. Neurop.* p. 86.

1936. *Orthetrum pruinosum neglectum*, Fraser, *Fauna Brit. Ind. Odon.* 3: 311-313.

Material: Asarori, 5 ♂♂, 2 ♀♀; Bhogpur, 1 ♂, 1 ♀; Barkot, 2 ♂♂; Bhoorpur, 1 ♂, 1 ♀; Bhaniawala, 2 ♂♂; Ballapur, 3 ♂♂; Donga, 8 ♂♂; Dehradun, 1 ♂, 1 ♀; Herbertpur, 9 ♂♂, 5 ♀♀; Jaintanwala, 1 ♂; Kandholi, 18 ♂♂, 2 ♀♀; Kalsi, 1 ♂, 1 ♀; Kansrao, 6 ♂♂, 3 ♀♀; Lachhiwala, 3 ♂♂, 2 ♀♀; Langha, 7 ♂♂, 1 ♀; Motichur, 4 ♂♂; Nalapani, 2 ♂♂, 1 ♀; Rishikesh, 5 ♂♂, 3 ♀♀; Robber's Gave, 6 ♂♂, 2 ♀♀; Raipur, 13 ♂♂, 4 ♀♀; Rajpur, 5 ♂♂, 3 ♀♀; Sahaspur, 5 ♂♂, 1 ♀; Sabhawala, 1 ♂; Sahastradhara, 24 ♂♂, 8 ♀♀; and Timli, 7 ♂♂, 2 ♀♀.

Measurements: Male—Abdomen, 28 mm. fore wing, 35.5 mm. hind wing, 34 mm. Female—Abdomen, 25.5—28 mm. fore wing, 34-37 mm. hind wing, 32-36 mm.

Remarks: A very common species, easily distinguished by its bright red abdomen.

***Orthetrum glaucum* (Brauer)**

1865. *Libellula glauca* Brauer, *Verh. zool.-bot. Ges. Wien*, 15: 1012.

1936. *Orthetrum glaucum*, Fraser, *Fauna Brit. Ind. Odon.* 3: 307-309.

Material: Asarori, 5 ♂♂; Donga, 16 ♂♂; Haripur, 1 ♂; Kandholi, 13 ♂♂; 1 ♀; Kalsi, 1 ♂; Kansrao, 2 ♂♂, 1 ♀; Lachhiwala, 1 ♂; Manduwala, 1 ♂; Motichur, 3 ♂♂; Nalapani, 2 ♂♂; Rajpur, 13 ♂♂; Ramgarh, 1 ♂; Raipur, 8 ♂♂; Robber's Gave, 3 ♂♂; Sahastradhara, 24 ♂♂; and Satnarain, 1 ♂.

Measurements: Male—Abdomen, 28.5-30 mm. fore wing, 36.5-38.5 mm. hind wing, 35-37 mm. Female—Abdomen, 29.30 mm. fore wing, 35-37 mm. hind wing, 34-36 mm.

Remarks: A common species.

***Orthetrum japonicum internum* MacLachlan**

1894. *Orthetrum japonicum internum* MacLachlan, *Ann. Mag. Nat. Hist.* 13: 431.

1936. *Orthetrum japonicum internum*, Fraser, *Fauna Brit. Ind. Odon.* 3: 304-305.

Material: Kansrao, 1 ♀; Rajpur, 1 ♂, 1 ♀; Robber's Gave, 1 ♂; and Sahastradhara, 2 ♂♂, 1 ♀;

Measurements: Male—Abdomen, 27.5 mm. fore wing, 35 mm. hind wing, 33 mm. Female—Abdomen, 27.5 mm. fore wing, 35 mm. hind wing, 33.5 mm.

Remarks: A fairly common species.

Subfamily DIASTAPIDINAE

Palpopleura sexmaculata sexmaculata (Fabr.)

1787. *Libellula sexmaculata* Fabricius, *Mant. Ins.* 1: 338.

1936. *Palpopleura sexmaculata sexmaculata*, Fraser, *Fauna Brit. Ind. Odon.* 3: 318-320.

Material: Barkot, 1 ♀; Bhoorpur, 1 ♂; Donga, 3 ♂♂, 2 ♀♀; Herbertpur, 9 ♂♂, 10 ♀♀; Johari, 1 ♀; Kalsi, 2 ♂♂; Gula Tappar, 3 ♂♂; Kuanwala, 1 ♂; Kandholi, 14 ♂♂, 5 ♀♀; Kansrao, 9 ♂♂, 1 ♀; Lachhiwala, 2 ♂♂; Langha, 8 ♂♂, 8 ♀♀; Motichur, 5 ♂♂, 7 ♀♀; Maldevta, 1 ♀; Rajpur, 33 ♂♂, 11 ♀♀; Rishikesh, 22 ♂♂, 14 ♀♀; Raipur, 1 ♂; Sahastradhara, 26 ♂♂, 35 ♀♀; and Timli, 1 ♂, 2 ♀♀;

Measurements: Male—Abdomen, 13 mm. fore wing, 19 mm. hind wing, 18 mm. Female—Abdomen, 11.5 mm. fore wing, 19 mm. hind wing, 16-18 mm.

Remarks: A very common species. It differs from the published account as follows: Hind wings may be tinted with yellow throughout or only in the basal half. In majority of the specimens black stripe of cubital space in the fore wing covers hypertrigone, subtrigone and discoidal cells. Black stripe of the cubital space in the hind wing also covers discoidal cells and a few cells of the anal area.

Subfamily BRACHYDIPLACTINAE

Brachydiplax sobrina (Rambur)

(Text-fig. 3, G & D)

1842. *Libellula sobrina* Rambur, *Ins. Neurop.* p. 114.

1936. *Brachydiplax sobrina*, Fraser, *Fauna Brit. Ind. Odon.* 3: 325-327.

Material: Bhaniawala, 1 ♂; and Gula Tappar, 1 ♂.

Measurements: Male—Abdomen, 19 mm. fore wing, 27 mm. hind wing, 25.5 mm.

Remarks: A very rare species. It has recently been recorded from north-west India (Singh and Prasad, 1974).

Subfamily SYMPETRINAE

Acisoma panorpoides panorpoides Rambur

(Text-fig. 4, A & B)

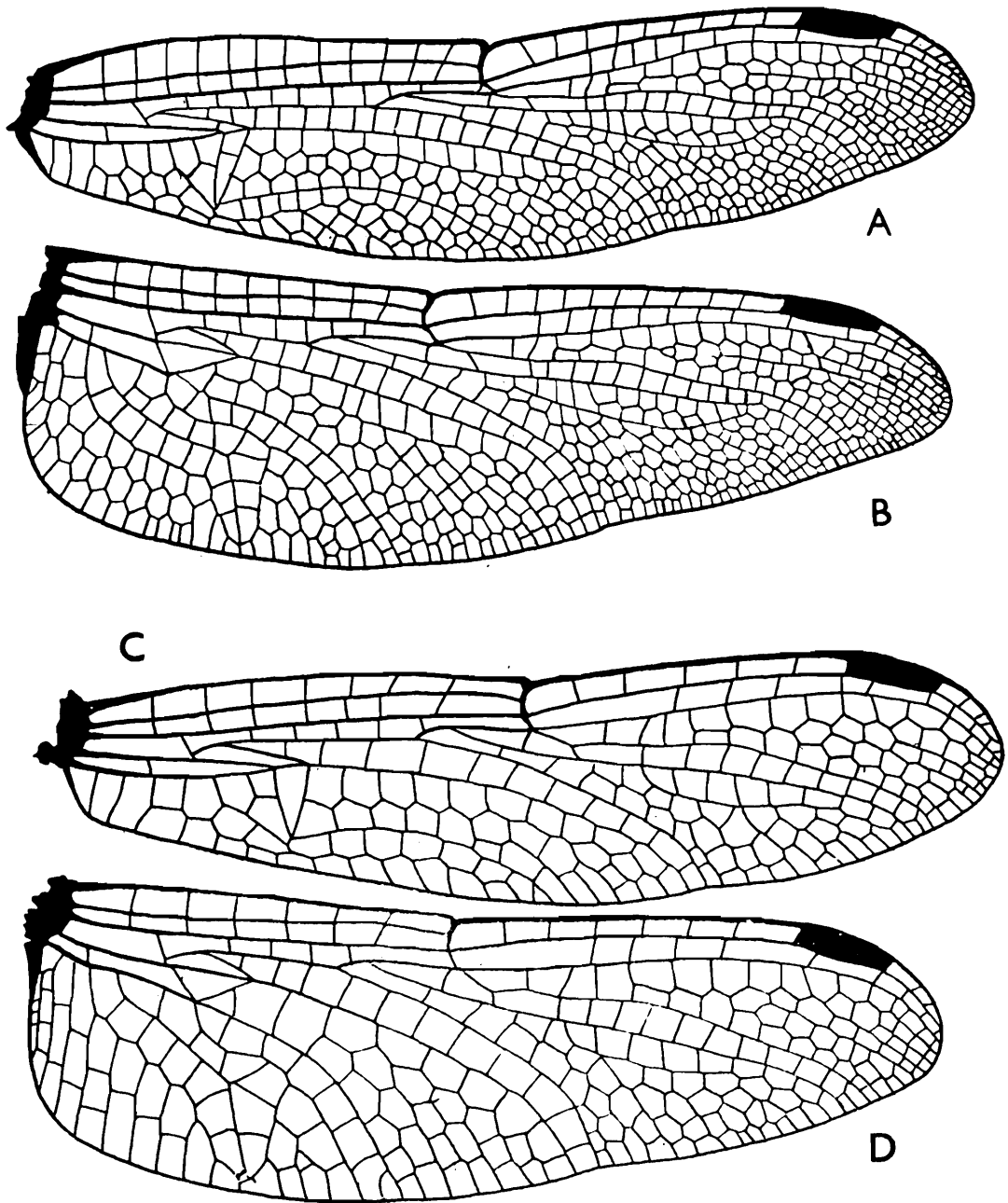
1842. *Acisoma panorpoides* Rambur, *Ins. Neurop.* p. 28.

1936. *Acisoma panorpoides panorpoides.*, Fraser, *Fauna Brit. Ind. Odon.* 3: 330-331.

Material: Bhaniawala, 5 ♂♂, 6 ♀♀; Mianwala, 1 ♂; Rishikesh, 10 ♂♂, 9 ♀♀; Herbertpur, 1 ♂; and Selakuan, 2 ♂♂.

Measurements: Male—Abdomen, 17 mm. fore wing, 22 mm. hind wing, 20 mm. Female—Abdomen, 16.5-17.5 mm. fore wing, 22-23 mm. hind wing, 20-21 mm.

Remarks: It is the first record of this species from north-west India.



Text-fig. 4. (A & B) *Acisoma panorpoides panorpoides* Rambur, A. fore wing, B. hind wing, (C & D) *Diplacodes nebulosa* (Fabricius), C. fore wing, D. hind wing.

***Diplacodes nebulosa* (Fabricius)**

(Text-fig. 4, C & D)

1793. *Libellula nebulosa* Fabricius, *Ent. Syst.* 2: 379.

1936. *Diplacodes nebulosa*, Fraser, *Fauna Brit. Ind. Odon.* 3: 335-336.

Material: Mianwala, 5 ♂♂, 12 ♀♀.

Measurements: Male—Abdomen, 13-14.5 mm. fore wing, 19 mm. hind wing, 17.5 mm. Female—Abdomen, 13 mm. fore wing, 19 mm. hind wing, 17.5 mm.

Remarks: A very rare species.

Distribution: It is known to extend from Western India to Australia.

Diplacodes trivialis (Rambur)

1842. *Libellula trivialis* Rambur, *Ins. Neurop.* p. 115.

1936. *Diplacodes trivialis*, Fraser, *Fauna Brit. Ind. Odon.* 3: 336-338.

Material: Mianwala, 4 ♂♂.

Measurements: Male—Abdomen, 19 mm. fore wing, 20 mm. hind wing, 19 mm.

Remarks: A very rare species.

Distribution: Extends from the Seychelles to the Pacific through India, Sri Lanka, Burma, Philippines to Formosa.

Crocothemis servilia servilia (Drury)

1770. *Libellula servilia* Drury, *Ill. Ex. Ins.* 1: 112, 113.

1936. *Crocothemis servilia servilia*, Fraser, *Fauna Brit. Ind. Odon.* 3: 345-347.

Material: Asarori, 11 ♂♂, 2 ♀♀; Bhoorpur, 2 ♂♂, 2 ♀♀; Barkot, 3 ♂♂, 1 ♀; Bhogpur, 1 ♀; Bhaniawala, 3 ♂♂; Donga, 1 ♂; Dehradun, 3 ♂♂; Doiwala, 2 ♂♂, 1 ♀; Gula Tappar, 2 ♂♂, 2 ♀♀; Herbertpur, 46 ♂♂, 43 ♀♀; Haripur, 3 ♂♂, 2 ♀♀; Jaintanwala, 1 ♂; Johari, 1 ♀; Kansrao, 10 ♂♂, 7 ♀♀; Kuanwala, 2 ♀♀; Karwapani, 3 ♂♂, 4 ♀♀; Jaspur, 1 ♂; Jhajra, 2 ♂♂, 2 ♀♀; Kalsi, 3 ♂♂; Kandholi, 3 ♂♂, 1 ♀; Langha, 7 ♂♂, 8 ♀♀; Lachhiwala, 7 ♂♂, 5 ♀♀; Motichur, 3 ♂♂, 11 ♀♀; Mianwala, 22 ♂♂, 2 ♀♀; Manduwala, 1 ♂, 2 ♀♀; Maldevta, 7 ♂♂, 2 ♀♀; Phanduwala, 2 ♂♂, 6 ♀♀; Pondha, 2 ♂♂, 3 ♀♀; Ramgarh, 3 ♀♀; Rishikesh, 16 ♂♂, 11 ♀♀; Raipur, 34 ♂♂, 9 ♀♀; Rajpur, 1 ♂, 1 ♀; Robber's Cave 34 ♂♂, 9 ♀♀; Sahhawala, 2 ♀♀; Sahastradhara, 28 ♂♂, 14 ♀♀; Satnarain, 9 ♂♂, 8 ♀♀; Sahaspur, 16, ♂♂, 6 ♀♀; Tunwala, 1 ♀; and Timli, 24 ♂♂, 15 ♀♀;

Measurements: Male—Abdomen, 22-25 mm. fore wing, 27.5-31 mm. hind wing, 26-29 mm. Female—Abdomen, 19-21.5 mm. fore wing, 27-28.5 mm. hind wing, 27 mm.

Remarks: A very common species. It differs from the published account in the following features. Labium, labrum and anteclypeus are light yellow while rest of the face is blood red.

Bradinopyga geminata (Rambur)

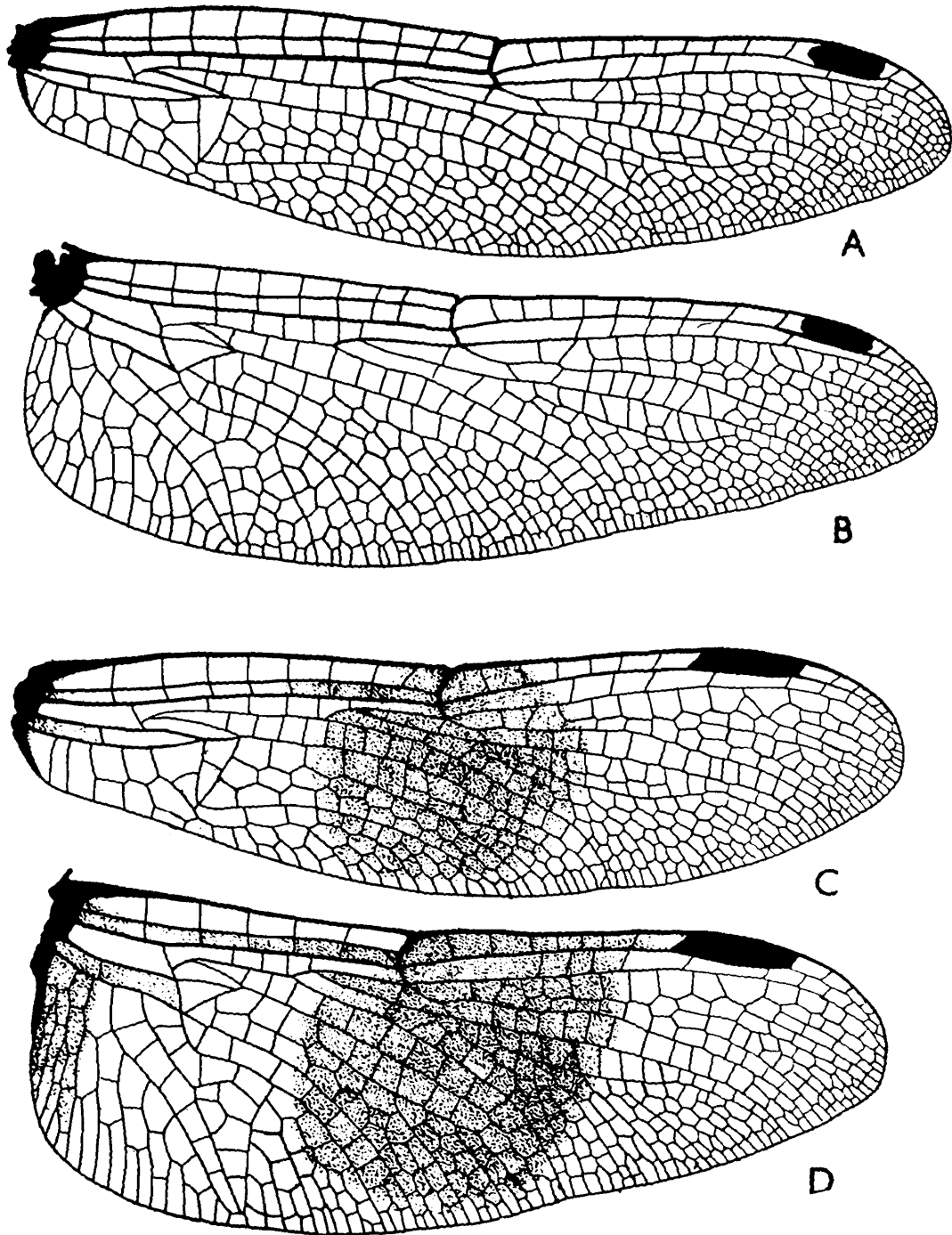
(Text-fig. 5, A & B)

1842. *Libellula geminata* Rambur, *Ins. Neuorp.*, p. 90.

1936. *Bradinopyga geminata*, Fraser, *Fauna Brit. Ind. Odon.* 3: 349-350.

Material: Sahastradhara, 1 ♂, 2 ♀♀; and DehraDun, 5 ♂♂, 2 ♀♀;

Measurements: Male—Abdomen, 25 mm. fore wing, 33 mm. hind wing, 32 mm. Female—Abdomen, 25 mm. fore wing, 33-35 mm. hind wing, 32-34 mm.



Text-fig. 5. (A & B) *Bradinopyga geminata* Rambur, A. fore wing, B. hind wing, (C & D) *Brachythemis contaminata* Fabricius, C. fore wing, D. hind wing.

Remarks: It is not a very common species in Doon Valley. It breeds even in very small bodies of water. One is likely to come across this species on house tops of crowded parts of the city. It is comparatively rare near big streams and ponds.

***Neurothemis fulvia* (Drury)**

1773. *Libellula fulvia* Drury, *Ill. Exot. Ins.* 2: 84-85.

1936. *Neurothemis fulvia*, Fraser, *Fauna Brit. Ind. Odon.* 3: 353-354.

Material: Asarori, 1 ♂; Gula Tappar, 1 ♂; and Timli, 15 ♂♂, 2 ♀♀;

Measurements: Male—Abdomen, 19 mm. fore wing, 25-27 mm. hind wing, 25-27.5 mm. Female—Abdomen, 18 mm. fore wing, 25 mm. hind wing, 25 mm.

Distribution: It is known throughout India, Burma, Thailand and Indochina.

Neurothemis intermedia intermedia (Rambur)

1842. *Libellula intermedia* Rambur, *Ins. Neurop.* p. 91.

1936. *Neurothemis intermedia intermedia*, Fraser, *Fauna Brit. Ind. Odon.* 3: 357-358.

Material: Barkot, 1 ♀; Herbertpur, 2 ♀♀; Haripur, 1 ♀; Jhajra, 6 ♂♂; 1 ♀; Kalsi, 1 ♀; Kuanwala, 1 ♂; Kansrao, 1 ♂, 1 ♀; Motichur, 2 ♂♂, 3 ♀♀; Phanduwala, 1 ♂; Sahastradhara, 1 ♀; and Timli, 1 ♂.

Measurements: Male—Abdomen, 23 mm. fore wing, 30 mm. hind wing, 28.5 mm. Female—Abdomen, 21.5 mm. fore wing, 27 mm. hind wing, 25 mm.

Remarks: It is one of the commonest species.

Neurothemis tullia tullia (Drury)

1773. *Libellula tullia* Drury, *Ill. Exot. Ins.* 2: 85.

1936. *Neurothemis tullia tullia*, Fraser, *Fauna Brit. Ind. Odon.* 3: 360-362.

Material: Sahastradhara, 2 ♂♂; Rishikesh, 1 ♀.

Measurements: Male—Abdomen, 19 mm. fore wing, 24 mm. hind wing, 23 mm. Female—Abdomen, 18 mm. fore wing, 24 mm. hind wing, 23 mm.

Remarks: It differs from the published description in the following features. The labium is yellowish and the membrane is brown. It is the first record of this species from north-west India.

Brachythemis contaminata (Fabricius)

(Text-fig. 5, C & D)

1793. *Libellula contaminata* Fabricius, *Ent. Syst.* 2: 382.

1936. *Brachythemis contaminata*, Fraser, *Fauna Brit. Ind. Odon.* 3: 365-366.

Material: Barkot, 1 ♂; Bhaniawala, 4 ♂♂, 5 ♀♀; Bhoorpur, 1 ♂, Herbertpur, 5 ♂♂; Jasowala, 1 ♂, 1 ♀; Kansrao, 1 ♂; Lachhiwala, 2 ♀♀; Mahant Majri, 5 ♂♂, 5 ♀♀; Rishikesh, 7 ♂♂, 4 ♀♀; Selakuan, 14 ♂♂, 21 ♀♀; Sahastradhara, 3 ♂♂; and Timli, 1 ♂.

Measurements: Male—Abdomen, 17 mm. fore wing, 23 mm. hind wing, 22 mm. Female—Abdomen, 17 mm. fore wing, 23.5 mm. hind wing, 21.5 mm.

Sympetrum commixtum (Selys)1884. *Diplax commixta* Selys, *Ann. Soc. Ent. Belg.* **28**: 38.1936. *Sympetrum commoxitum*, Fraser, *Fauna Brit. Ind. Odon.* **3**: 372-73.*Material*: Sahastradhara, 5 ♂♂, 1 ♀.*Measurements*: Male—Abdomen, 26.5 mm. fore wing, 33 mm. hind wing, 31.5 mm. Female—Abdomen, 25 mm. fore wing, 31 mm. hind wing, 29.5 mm.*Remarks*: A comparatively rare species. It differs from the published description in the following features. The pterostigma is reddish-brown and the membrane is whitish brown.*Distribution*: It is known from north and north-west India.

Subfamily TRITHEMINAE

Trithemis aurora (Burmeister)1839. *Libellula aurora* Burmeister, *Handb. Ent.* **2**: 859.1936. *Trithemis aurora*, Fraser, *Fauna Brit. Ind. Odon.* **3**: 383-385.*Material*: Asarori, 1 ♂; Bhaniawala, 28 ♂♂, 7 ♀♀; Barkot, 3 ♂♂; Chandrabani, 1 ♂; Donga, 1 ♀; Dehra Dun, 1 ♂; Gula Tappar, 5 ♀♀;

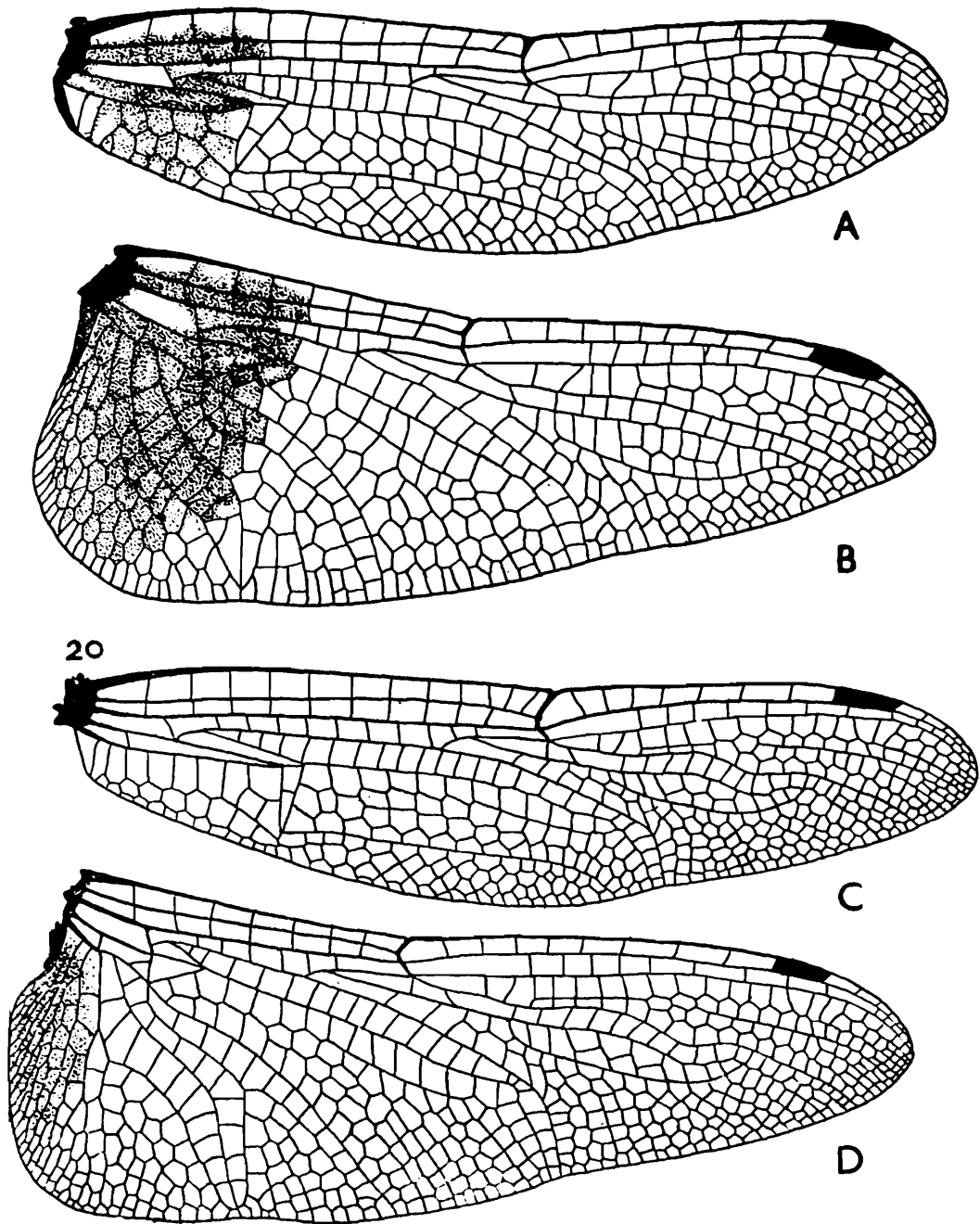
Herbertpur, 4 ♂♂, 8 ♀♀; Jhajra, 1 ♂; Kansrao, 5 ♂♂, 5 ♀♀; Karwapani, 1 ♂; Langha, 1 ♂, 1 ♀; Lachhiwala, 2 ♀♀; Mianwala, 1 ♀; Motichur, 3 ♂♂; Rajpur, 1 ♀; Rishikesh, 31 ♂♂, 6 ♀♀; Sahastradhara, 6 ♂♂, 2 ♀♀; Satnarain, 1 ♂; and Timli, 1 ♂.

Measurements: Male—Abdomen, 20.5 mm. fore wing, 25 mm. hind wing, 24 mm. Female—Abdomen, 21 mm. fore wing, 28 mm, hind wing, 27 mm.*Remarks*: One of the most common species, easily distinguished by its crimson coloured abdomen.***Trithemis kirbyi kirbyi*** Selys

(Text-fig. 6, A & B)

1890. *Trithemis aurora* Kirby, *Proc. zool. Soc. Lond.* p. 327.1936. *Trithemis kirby kirby*, Fraser, *Fauna Brit. Ind. Odon.* **3**: 365-387.*Material*: Maldevta, 4 ♂♂, 1 ♀; Mianwala, 1 ♀; Mahant Majri, 1 ♀; and Pondha, 1 ♂.*Measurements*: Male—Abdomen, 20 mm. fore wing, 26 mm. hind wing, 24.5 mm. Female—Abdomen, 19 mm. fore wing, 27 mm. hind wing, 25 mm.*Remarks*: The males of this species are very swift fliers and difficult to catch. Both the forms of females described by Fraser (1936) are available in the Doon Valley. The female collected from Maldevta

is of the 'rare' type and those collected from Mahant Majri are of the 'common' type.



Text-fig. 6. (A & B) *Trithemis kirbyi kirby* Selys, A. fore wing, B. hind wing. (C & D) *Pantala flavescens* (Fabricius), C. fore wing, D. hind wing.

***Trithemis festiva* (Rambur)**

1842. *Libellula festiva* Rambur, *Ins. Neurop.* p. 92.

1936. *Trithemis festiva*, Fraser, *Fauna Brit. Ind. Odon.* 3: 387-389.

Material: Asarori, 9 ♂♂; Bhaniawala, 12 ♂♂; Barkot, 1 ♂; Dehra Dun, 1 ♂, 1 ♀; Donga, 21 ♂♂, 6 ♀♀; Doiwala, 2 ♂♂; Gula Tappar, 1 ♂, Herbertpur, 7 ♂♂, 1 ♀; Haripur, 3 ♂♂; Johari, 1 ♂, 1 ♀; Jhajra, 4 ♀♀; Jaintanwala, 12 ♂♂, 1 ♀; Kandholi, 47 ♂♂, 6 ♀♀; Kansrao, 18 ♂♂, 9 ♀♀; Khera, 2 ♂♂; Kerwapani, 1 ♂; Kalsi, 2 ♂♂; Lachhiwala, 3 ♂♂; Langha, 18 ♂♂; Mianwala, 2 ♂♂, 1 ♀;

Motichur, 16 ♂♂, 2 ♀♀; Pondha, 3 ♂♂; Raipur, 14 ♂♂; Rishikesh, 4 ♂♂, 2 ♀♀; Robber's Cave, 5 ♂♂, 1 ♀; Ramgarh, 1 ♂, 1 ♀; Rajpur, 27 ♂♂, 3 ♀♀; Sahastradhara, 73 ♂♂, 11 ♀♀; Satnarain, 1 ♂; Sahaspur, 5 ♂♂; and Timli, 1 ♂.

Measurements: Male—Abdomen, 20-22 mm. fore wing, 28-31 mm. hind wing, 26-30 mm. Female—Abdomen, 20-22 mm. fore wing, 28-30 mm. hind wing, 27-29 mm.

Remarks: It is one of the most common species.

***Trithemis pallidinervis* (Kirby)**

1889. *Sympetrum pallidinervis* Kirby, *Trans. zool. Soc. Lond.* **12**: 327.

1936. *Trithemis pallidinervis*, Fraser, *Fauna Brit. Ind. Odon.* **3**: 389-391.

Material: Herbertpur, 1 ♀; Lachhiwala, 4 ♂♂; Raipur, 1 ♂, 1 ♀; and Sahastradhara, 1 ♂.

Measurements: Male—Abdomen, 24 mm. fore wing, 31 mm. hind wing, 30 mm. Female—Abdomen, 23 mm. fore wing, 30 mm. hind wing, 28 mm.

Distribution: It is known throughout India, Sri Lanka, Burma, Philippines and Formosa.

Subfamily ZYGONICTINAE

***Zygonyx torrida isis* Fraser**

1924. *Zygonyx isis* Fraser, *Rec. Ind. Mus.* **26**: 426, 440, 441.

1936. *Zygonyx torrida isis*, Fraser, *Fauna Brit. Ind. Odon.* **3**: 401-402.

Material: Johari, 1 ♀.

Measurements: Female—Abdomen, 39 mm. fore wing, 50 mm. hind wing, 48 mm.

Remarks: A very rare species. It has been recorded for the first time from Uttar Pradesh.

Distribution: It is known from South India, Punjab, and Eastern India.

Subfamily ZYXOMMATINAE

***Zyxomma petiolatum* Rambur**

1842. *Zyxomma petiolatum* Rambur, *Ins. Neurop.* p. 30.

1936. *Zyxomma petiolatum*, Fraser, *Fauna Brit. Ind. Odon.* **3**: 409-410.

Material: Dehra Dun, 1 ♀.

Measurements: Female—Abdomen, 37 mm. fore wing, 34 mm. hind wing, 33 mm.

Remarks: A very rare species.

Distribution: It is known throughout India, Burma, and Sri Lanka,

Subfamily PANTALIINAE

***Pantala flavescens* (Fabricius)**

(Text-fig. 6, C & D)

1798. *Libellula flavescens* Fabricius, *Ent. Syst. Suppl.* p. 285.1936. *Pantala flavescens*, Fraser, *Fauna Brit. Ind. Odon.* 3: 414-416.

Material: Asarori, 2 ♂♂; Bhaniawala, 2 ♂♂, 1 ♀; Donga, 3 ♂♂, 1 ♀; Johari, 4 ♀♀; Kandholi, 1 ♀; Langha, 2 ♀♀; Mianwala, 1 ♂, 5 ♀♀; Dehra Dun, 1 ♂, 1 ♀; Motichur, 1 ♂, 1 ♀; Phanduwala, 1 ♀; Rajpur, 1 ♂, 5 ♀♀; Sahastradhara, 11 ♂♂, 8 ♀♀; Thano, 1 ♂; and Jaintanwala, 1 ♂.

Measurements: Male—Abdomen, 29 mm. fore wing, 40.5 mm. hind wing, 38.5 mm. Female—Abdomen, 27 mm. fore wing, 39 mm. hind wing, 37 mm.

Remarks: A very common species. Swarms of this species are a common sight from July to September. They are often seen resting in large numbers on the bushes.

***Tramea basilaris burmeisteri* Kirby**1839. *Libellula chinensis* Burmeister, *Handb. Ent.* 2: 852.1936. *Tramea basilaris burmeisteri*, Fraser, *Fauna Brit. Ind. Odon.* 3: 432-434.

Material: Mianwala, 1 ♂.

Measurements: Male—Abdomen, 29 mm. fore wing, 39.5 mm. hind wing, 35 mm.

Remarks: A very rare species.

Distribution: It is known from India, Burma, Malaysia and Sri Lanka.

***Tramea virginia* (Rambur)**1773. *Libellula chinensis* De Geer, *Mem. Ins.* 3: 556.1936. *Tramea virginia*, Fraser, *Fauna Brit. Ind. Odon.* 3: 435-436.

Material: Mianwala, 9 ♂♂.

Measurements: Male—Abdomen, 28 mm. fore wing, 40 mm. hind wing, 38-39.5 mm.

Remarks: A rare species. It differs from the published account in being slightly smaller in size. The membrane and pterostigma are brownish.

Distribution: Burma, Thailand, Indo-China, and Formosa.

COCCIDIA OF INDIAN VERTEBRATES

By

A. K. MANDAL

Zoological Survey of India, Calcutta

(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 convenience, 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), Pellcrdy (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 through a piece of fine-meshed wire gauze 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 (Gheissin, 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 & Mesnil, 1902; *Jarrina* Leger & Hesse, 1922; "*G. Marotelia*, Ratz, 1905"? (Vide, Marotel: Parasitologie Veterinaire, 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 12.3-17.3 μ in diameter with a mean of 14.02 μ , with two transparent membranes, the outer one is thicker than the inner one. Cytoplasm granular with centrally placed nucleus. Cytoplasmic mass measures 8.5-10.5 μ in diameter with a mean of 9.5 μ . Four rounded sporoblasts 3.5-4.4 μ 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 , 3.6-5.7 μ 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

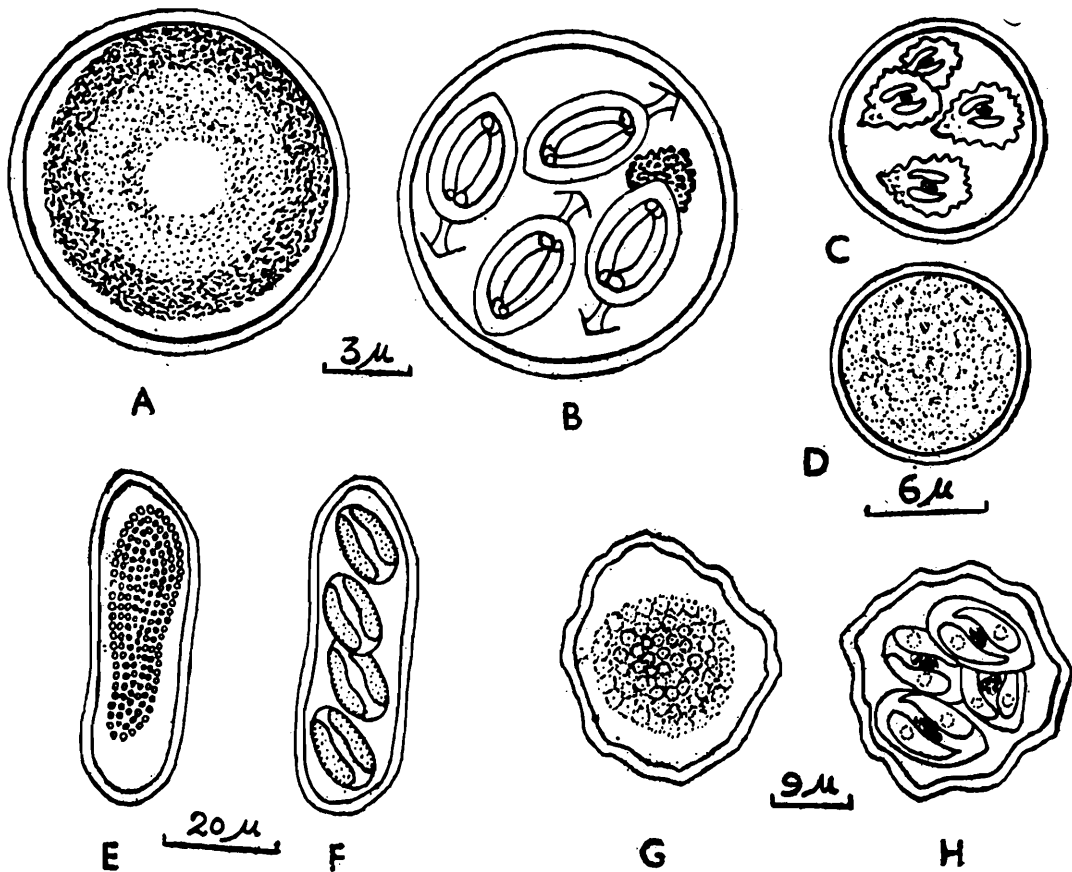
sporozoites are slightly curved at middle region with one pointed end. Sporozoites measure 7.3μ in length. Nucleus situated at broader end of the sporozoite.

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 $8.5-10.8\mu$ in length with a mean of 9.7μ and $3.6-5.7\mu$ 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 $23.5-25.2\mu$ in length with a mean of 24.3μ and $21.4-22.5\mu$ 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 residuum 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 $\mu \times 22 \mu$." In the present observation it was found to be 24.3 \times 22.2 μ with shape index 1.6. The sporocysts measured 11 $\mu \times 6.6 \mu$ 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 oocyst. 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 8.8 μ 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 \times 5.5 μ . In the present instance they measure 7.7-8.9 μ in length and 4.5-6.6 μ 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 warts. *E. zygaenae*
- (B) Oocyst not spherical
 (1) Sporocyst oval with sausage-shaped sporozoites of 10.1 μ in length. *E. southwelli*
 (2) Sporocyst oval with elongated sporozoites of 5.5 μ 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* Rivolta, 1878, pro parte, *Psorospermiun* Rivolta, 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 24.5-26.5 μ in length with a mean of 25.5 μ and 15.5-19.5 μ in width with a mean of 17.5 μ . The shape index is 1.5. The globular and refractile cytoplasm measures 20.4 μ 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 15.5-17.5 μ with a mean of 16.5 μ and 10.5 μ in width with a mean of 10.9 μ . The sporocystic residuum present as a granular mass. The shape index is 1.5. Sporozoites elongated measuring 12.5-14.8 μ in length and 2.5-4.5 μ 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 24.00-26.30 μ in length and 14.50-20.00 μ in breadth. Sporocysts measure 15.40-17.00 μ in length and 11.0 μ in breadth. Sporozoites measure 13.20 μ in length and 3.30 μ 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 15.3-20.5 μ in length with a mean of 17.5 μ and 13.5 μ -15.5 μ in width with a mean of 14.5 μ . 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 10.0-13.5 μ in length with a mean of 11.8 μ and 7.5 μ -9.5 μ in width with a mean of 8.5 μ . 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 16-20 μ in length and 11-14 μ 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 15.5-20.2 μ in length with a mean of 17.9 μ and 15.5-13.3 μ in width with a mean of 16.7 μ . The shape index is 1.07. Sporocysts spindle-shaped, tapering at one end with scattered residuum; measure 10.5-12.5 μ in length with a mean of 11.5 μ and 4.5-6.5 μ in width with a mean of 5.5 μ . 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 15.40-19.60 μ , in length and 15.40-17.60 μ in width; sporocysts 11.00 μ in length and 4.40-6.60 μ in width.

Eimeria himalayanum Ray and Misra

(Text-fig. 2 i, j)

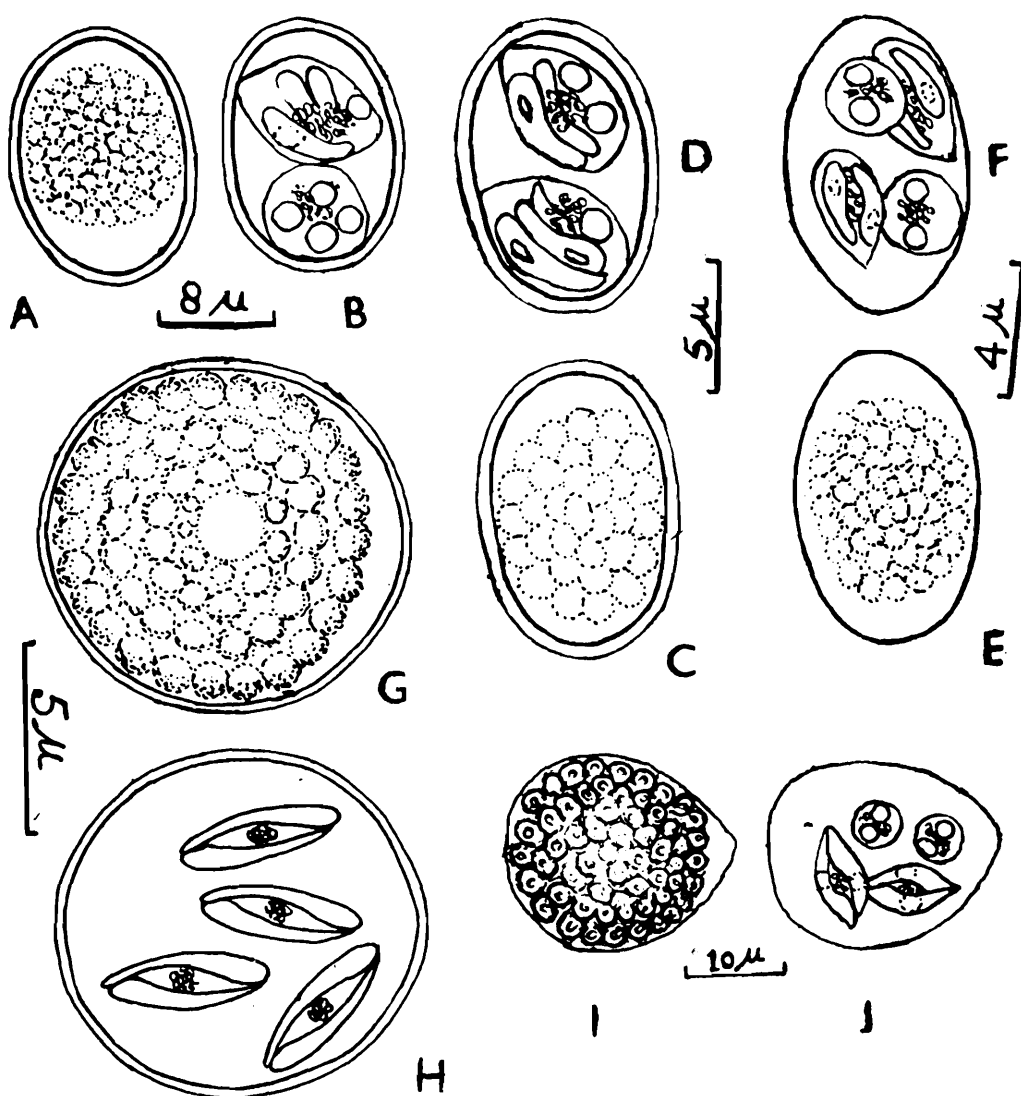
1942. *E. himalayanum* Ray and Misra, *Proc. Indian Sci. Congr.*: 169.
(1943. Ray and Misra, *Proc. Nat. Inst. Sci. India*, 9: 266.)

Description.—Oocysts rounded oval, with two thin oocystic walls without micropyle, residue absent. Oocysts measure 7.5-10.5 μ in diameter with a mean of 9.2 μ . Sporocysts naviculoid, measure 4.5-6.5 μ in length with a mean of 5.5 μ and 2.5 μ -3.5 μ in width with a mean of 2.9 μ , with globular residuum. Sporozoites club-shaped with a centrally placed nucleus and siderophilous structure at one of the poles. Sporozoites measure 3.8-4.5 μ 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 $7-10\mu$ along its broadest diameter, sporocysts $3.2\mu \times 2.8\mu$ and sporozoites $4.6 \times 1.4\mu$.



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 $8.5\mu-11.0\mu$ 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 $5.2-6.5\mu$ 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 $8-11\mu$ in diameter without any residuum. Sporocysts spindle-shaped, measuring $4.5-5.8\mu$ 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 $15.3-20.5 \times 13.5-15.5\mu$. . *Isospora wenyoni*
- B. Oocysts broadly oval
 (i) Size of oocyst $24.5-26.5 \times 15.5-19.5\mu$. . *I. stomaticae*

Key to the *Eimeria* species from Indian Amphibia

- A. Oocyst spherical, measuring $8.5-11.0\mu$. . *Eimeria laminata*
- B. Oocyst not spherical
 (i) Oocyst without residium and sporocyst naviculoid. . . *E. himalayanum*
 (ii) Oocyst with residium 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 $18.5-20.8\mu$ 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 $10.5-12.5\mu$ with a mean of 11.5μ 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 $25.0-37\mu$ 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 $12.5-17.5\mu$ in length with a mean 14.5μ and $9.5-10.5\mu$ 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 $25.5\mu-38.8\mu$ in diameter and the sporocyst, measure $12.3\mu-16.5\mu \times 10.3\mu$.

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, $17.5-23.14\mu$ in diameter with a mean of 21.7μ . The refractile and granular cytoplasm measures $15.5-17.3\mu$, in diameter. Oocystic residuum

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

The shape index is 1.7 Sporozoites are elongated tapering towards one end and measure 10.5 μ -12.5 μ 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 18.00-23.00 μ in diameter and the sporocysts measure 12-15 μ in length and 8-10 μ 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 14.5-16.5 μ in length with a mean of 15.5 μ and 6.8-8.5 μ in width with a mean of 7.7 μ . The shape index is 2.01. No oocystic residuum or any micropyle is seen. The sporocysts are spherical in shape measuring 6.5-9.9 μ in diameter with a mean of 7.7 μ . Sporocystic residuum present as a compact mass. The sporozoites are elongated tapering at one end measuring 3.5-4.6 μ 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 7.5 μ and sporocysts 7.5 μ 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 1.00-1.50 μ in thickness; centrally placed spherical cytoplasm measure 20.0-20.8 μ in diameter and appears as beaded, refringent, refractile globules. Mature oocysts measure 25.5 μ -27.4 μ in diameter with a mean of 26.3 μ ; oocystic residuum and micropyle absent; sporocysts, naviculoid in shape, tapering at both ends, measuring 14.5 μ -16.3 μ in length and 9.15-10.5 μ in breadth with a mean of 15.4 μ \times 8.6 μ 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 residuum 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 residuum 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 suburbs 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 $16.5-21.5\mu$ in length with a mean of 18.50μ and $12.5-16.2\mu$ 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 $9.5-11.3\mu$ in length with a mean of 10.4μ and $7.5-8.5\mu$ 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 $17-20\mu$ in length and $13.6-17\mu$ 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 $14.6-16.5\mu$ in diameter with a mean of 15.5μ . Cytoplasm measure $11.5-12.5\mu$ in diameter. Spindle-shaped sporoblasts measure $3.5 \times 4.5\mu$. 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 $11.5-13.5\mu$ in length with a mean of 12.5μ and $6.5-7.5\mu$ in width with a mean of 6.9μ . Sporocystic residuum is present. The sporozoites are sausage-shaped having both the ends rounded. Sporozoites measure $8.5\mu \times 2.5\mu$. 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 kermoganti*, 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 masses at 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 $16.20\mu \times 14.18\mu$. 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 - 18.8μ in length with a mean of 17.7μ and 11.5 - 14.3μ in width with a mean of 13.5μ . 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 11.3μ and 5.5 - 7.5μ in width with a mean of 6.5μ . 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 $17.6\mu \times 13.2\mu$. The sporocysts and sporozoites are $11\mu \times 6.6\mu$ and $6.6\mu \times 4.4\mu$ 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 $13.5-15.8\mu$ in diameter with a mean of 14.6μ . Oocystic residuum absent. Spindle-shaped sporocysts tapering at both ends, measuring $9.3-11.3\mu$ in length with a mean of 10.3μ and $3.5-5.6\mu$ 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 $10\mu \times 4.5\mu$.

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 17.5-21.5 μ in length with a mean of 19.5 μ and 12.5-14.5 μ in width with a mean of 15.5 μ . The shape index is 1.2. Cytoplasm appears as globular refractile mass. Micropyle and oocystic residuum absent. Spherical sporocysts measure 7.5-9.5 μ in diameter with a mean of 8.5 μ . 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 μ \times 12-14 μ and sporocysts 7.9 μ 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 23.5-27.5 μ with a mean of 25.5 μ in length and 15.5-18.5 μ in width with a mean of 16.9 μ . The shape index is 1.5. Micropyle visible in immature oocysts. Oocystic residual mass appears as a compact mass. Sporocysts spindle-shaped, measure 11.5-13.5 μ in length with a mean of 12.5 μ and 5.9-7.8 μ in width with a mean of 6.9 μ . The shape index is 1.8. The sporozoites are elongated and tapering at both ends. The nucleus is situated in the middle. Sporozoites measure 10.5-11.5 μ 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 23-27 μ \times 16-18 μ with residuum. Spindle-shaped sporocysts measure 12.14 \times 6.8 μ . 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 $29-31\mu \times 22.3-24.5\mu$; Sporocysts spindle-shaped, measure $24\mu \times 4-6\mu$.

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 $19.5-21.5\mu$ 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 $11.5-13.4\mu$ in length with a mean of 12.5μ and $5.5-7.5\mu$ in width 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 $8.5\mu \times 2.3\mu$.

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 sporocyst measures 12.3μ in length and 6.15μ in width.

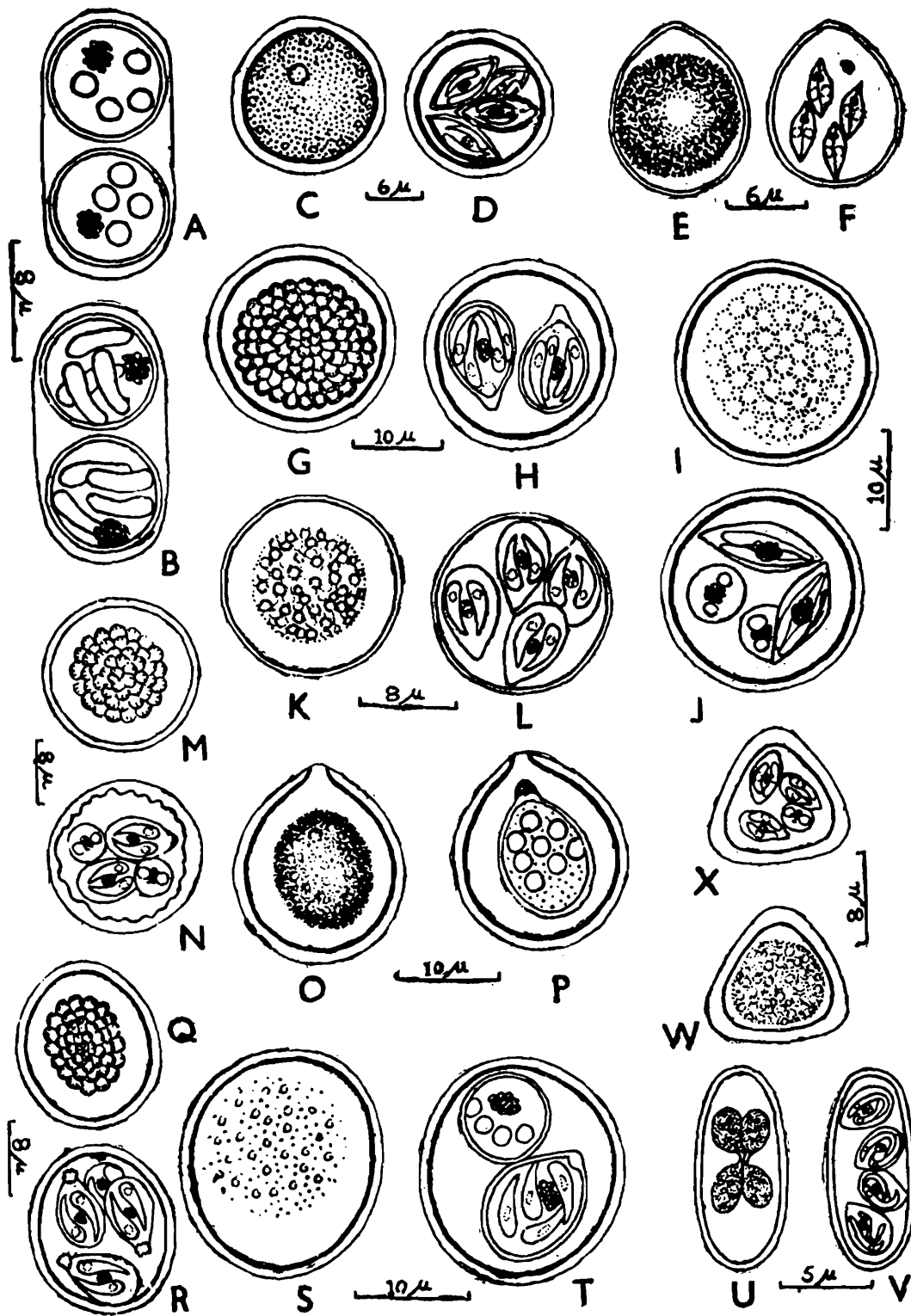
Eimeria triangularis Chakravarty and Kar

(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 $9.5-14.5\mu$ in length with a mean of 12.5μ . The cytoplasm is rounded measuring $9.12-11.50\mu$ 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 $9.5-11.5\mu$ in length with a mean of 10.5μ and $3.14-5.14\mu$ in width with a mean of

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



Text-fig. 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 knuclesi* 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 in-nominata* 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 10.3-14.4 μ in longest diameter and sporocysts measure 10.3 μ \times 4.12 μ .

Eimeria trionyxae Chakravarty and Kar

(Text-fig. 3 k, 1)

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

Description.—Oocysts spherical, double layered, the outer being thinner. Oocysts measure 14.45-19.5 μ in diameter with an average of 16.5 μ . The cytoplasm is spherical and is placed centrally containing large number of refringent globules. No micropyle, cocystic 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 11.5-13.48 μ in length with a mean of 12.5 μ and 5.7-7.9 μ in width with a mean of 6.3 μ . 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 9.5-10.5 μ in length.

Sporulation 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 4.12 μ with one end tapering and other rounded. The spherical nucleus is placed near the middle region of the trophozoite. The schizonts measuring 8.24-14.42 μ 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 4.12-6.18 μ in length and about 1 μ 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. mabuiaae* Ray and Raghavachari

Octosporella mabuiaae Ray and Raghavachari

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

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

shaped, measure $8.4 \times 4.2 \mu$. 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 $25-30 \mu$ in diameter, sporocysts contain four sporozoites and a central residuum sporocysts measure $8-10 \mu \times 6.7 \mu$.

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. | . <i>Caryospora</i> |
| 2. Oocyst disporocystid, sporocysts tetrozoic. .. | . <i>Isospora</i> |
| 3. Oocyst tetrasporocystid, sporocyst dizoic. | . <i>Eimeria</i> |
| 4. Oocyst polysporocystid | |
| A. Sporocyst dizoic. | . <i>Octosporella</i> |
| B. Sporocyst tetrazoic. .. | . <i>Pythonella</i> |

Key to the Isospora species

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

Key to the *Eimeria* species

- A. Oocyst spherical
1. Sporocyst oval
 - (a) Size of oocyst, 16.00–18.00 μ . . . *E. legeri*
 - (b) Size of oocyst 20.00–22.00 μ . . . *E. kermoganthi*
 2. Sporocyst pyriform or spindle-shaped
 - (a) Oocyst without residuum. . . *E. koormae*
 - (b) Oocyst with residuum
 - (i) Size of oocyst 20 μ or above. . . *E. stolatae*
 - (ii) Size of oocyst below 20 μ . . . *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 36 μ \times 18 μ . . . *E. gupti*
 - (ii) Size of oocyst 29.00–31.00 μ \times 22.5–24.5 μ . . . *E. piscatori*
 - (iii) Size of oocyst 23–27 μ \times 16–18 μ . . . *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 14.48–17.3 μ in length with a mean of 16.5 and 9.63–11.5 μ 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 $5.35-6.48\mu$ 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 $20.4-27.6\mu$ in length and $14.6-20.4\mu$ in diameter, (average $24.84 \times 16.8\mu$). 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 $18.7-23.3\mu$ 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 $14.4-16.4\mu$ in length with a mean of 15.4 and $6.7-8.7\mu$ 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 $8.8\mu \times 3.3\mu$ 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 18.75-24.5 μ in length with a mean of 22.5 μ and 18.75-22.5 μ in width with a mean of 21.5 μ . 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 9.5-15.0 μ in length and 7.5-9.5 μ 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 15.0-23.0 μ in length with a mean of 20.0 μ and 14.0-21.5 μ in width with a mean of 17.7 μ . 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 7.5-12.5 μ with a mean of 10.8 μ and 6.25-8.75 μ width with a mean of 7.75 μ . The shape index is 1.3. Sporocyst residuum present as compact mass. Elongated sporozoites with pointed anterior end measuring 7.9-9.9 μ in length with a mean of 8.9 μ and 2.2-4.2 μ in width with a mean of 3.2 μ . The shape index is 2.7.

Sporulation time.—36-48 hours.

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

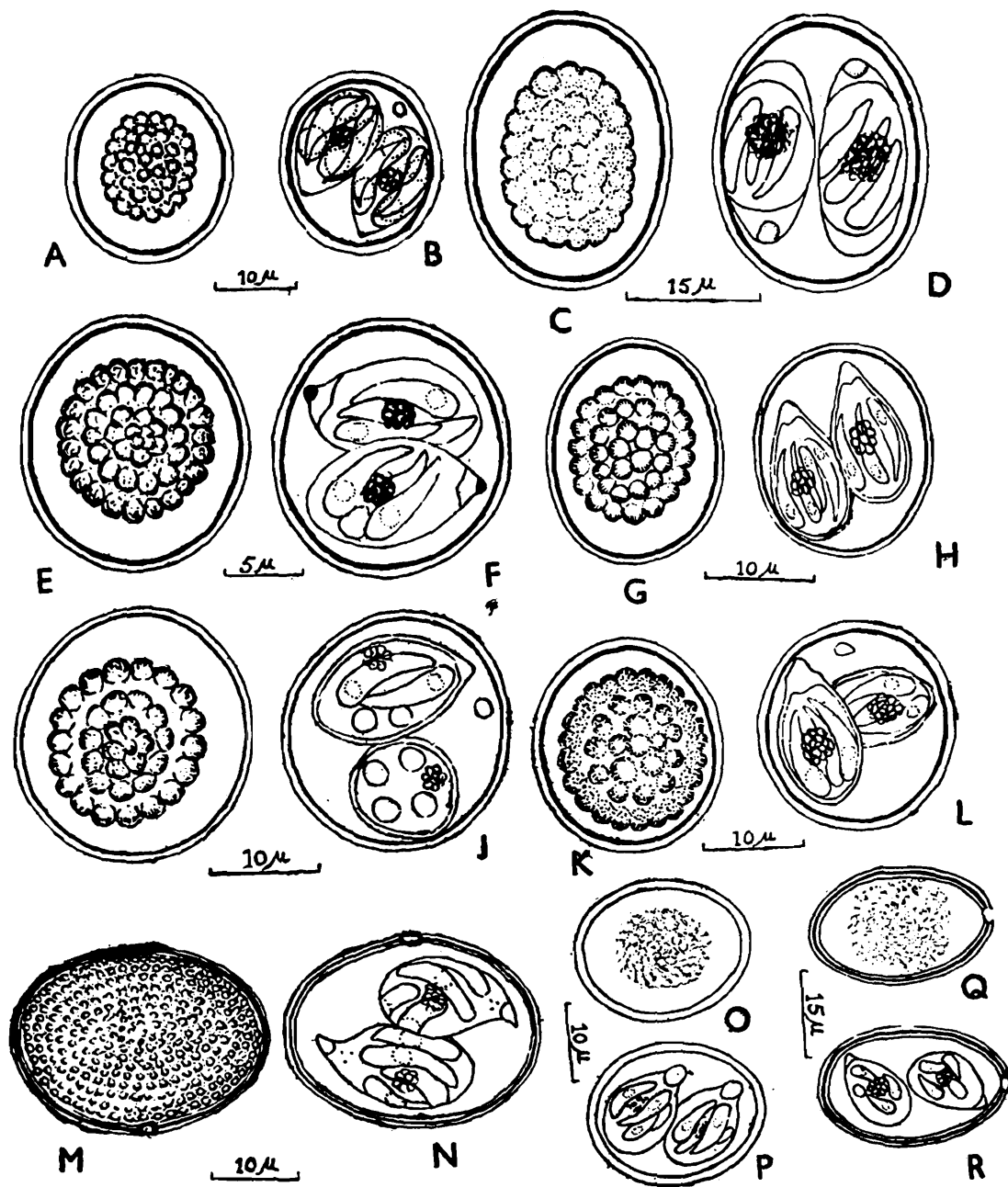
Remarks.—Topotype as well as the same species were observed at Shillong, Meghalaya from *Corvus macrorhynchus intermedius*. The differences lie in the measurements of the oocysts and sporocysts.

***Isospora emberizae* Mandal and Chakravarty**

(Text-fig. 4 m, n)

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

Description.—Oocysts oval with three envelopes. The middle layer is thicker than the other two layers. Oocysts measure 22.2-24.2 μ in length with a mean of 23.2 μ and 18.8-20.8 μ in width with a mean of 19.8 μ . 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. ginguiana 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 18.8-20.8 μ in length with a mean of 19.8 μ and 14.4-16.4 μ in width with a mean of 15.4 μ . The shape index is 1.2. Sporocystic residuum present as scattered mass. Sporozoites are elongated in shape with tapering anterior end and they measure 13.5-15.3 μ in length with a mean of 14.5 μ and 2.5-3.5 μ in width with a mean of 3.00 μ . 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 \times 19.8 μ and 19.8 \times 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 glandarius, bispecularis*, 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. garrulusae* (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 20.0-22.5 μ in length with a mean of 21.25 μ and 17.5-21.25 μ in width with a mean of 19.75 μ . 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 13.40 μ and 7.5-12.5 μ in width with a mean of 8.5 μ . 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 μ \times 2.6 μ . The shape index is 3.9.

Sporulation time.—24-36 hours.

Habitat.—Small intestine of *Garrulus 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 24.00-28.00 μ in length with a mean of 26.00 μ and 19.5-24.5 μ in width with a mean of 21.9 μ . 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 15.5-17.5 μ in length with a mean of 16.5 μ and 8.5-11.5 μ in width with a mean of 10.5 μ . The shape index is 1.5. Sporocystic residuum present as a compact mass. Sporozoites are elongated in shape measuring 15.4 μ in length and 2.2 μ 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 17.00 μ -23.5 μ (mean 20.4 μ) in length and 14.5 μ -19.5 μ (mean 17.5 μ) 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 8.5μ) 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 $10.5\mu \times 4.2\mu$ 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 - 31.5μ in length with a mean of 28.3μ and 15.5 - 19.5μ in width with a mean of 17.5μ . The shape index is 1.6. Oocysts with double envelope of 1.5μ thickness. The cytoplasm is granular with several refringent globules, 15.6μ 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 - 16.5μ in length with a mean of 15.5μ and 10.2 - 11.2μ in width with a mean of 10.7μ . 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 $6.5\mu \times 2.00\mu$. 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 $17.6 \times 9.9\mu$. The sporocystic residual mass scattered irregularly. Sporozoites elongated measuring 7.7μ 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 22.5 μ -27.5 μ in length with a mean of 24.16 μ and 20-22.5 μ in width with a mean of 20.83 μ . The shape 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 2.5 μ 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 psittaculæ* Chakravarty and Kar**

(Text-fig. 4 c, d)

1947. *Isospora psittaculæ* 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 μ 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 2.2μ in length. Sporocysts measure $22.0-26.4 \mu$ with a mean of 24.5μ and $12.5-14.5 \mu$ in width with a mean of 13.5μ . 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 $11.5-15.5 \mu$ in length with a mean of 13.5μ and $4.4-6.4 \mu$ at broadest point with a mean of 5.4μ . 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 $23.2-25.2 \mu$ in length with a mean of 24.2μ and $18.8-20.8 \mu$ 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 $18.8-20.8 \mu$ in length with a mean of 19.8μ and $7.8-9.8 \mu$ 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 $11.1-13.1 \mu$ in length with a mean of 12.1μ and $2.1-3.4 \mu$ 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 $24.2 \mu \times 19.8 \mu$ and $19.8 \mu \times 8.6 \mu$ respectively. Moreover, the sporulation time was not known.

***Isospora scircusae* 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 scircusae* 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 $22.5-28.0\mu$ in length with a mean of 24.8 and $20.25\mu-26.25\mu$ 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 $10.0-17.5\mu$ in length with a mean of 14.21μ and $8.75-11.25\mu$ 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 $8.5-9.7\mu$ in length with a mean of 8.8μ and $2.2-4.3\mu$ 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, 1)

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

Description.—Oocysts spherical or subspherical with double oocystic membrane. Oocysts measure $22.5-28.5\mu$ 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 $17.7-19.7\mu$ length with a mean of 18.7μ and $11.4-13.4\mu$ 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 $11.2-13.2\mu$ in length with a mean of 12.2μ and $2.2-3.2\mu$ 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 $22.0-28.6\mu$ in diameter, the sporocysts $17.6-19.8\mu \times 11.0-13.2\mu$, the sporozoites $11.0-13.2\mu \times 2.2-3.3\mu$.

***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 22.5-24.5 μ in length with a mean of 23.5 μ and 19.5-21.5 μ in width with a mean of 20.5 μ . The shape index is 1.14. Oocyst wall 2 μ thick and double layered. Micropyle present in some cases, oocyst residuum absent. Unsegmented zygote highly granular, contains several refringent globules, measures about 15.5 μ . Sporocysts elongately oval in shape with the anterior end somewhat bluntly pointed with a well developed knob. Sporocysts possess single layer and measure 15.5-17 μ in length with a mean of 16.5 μ and 10.2-11.5 μ in width with a mean of 10.6 μ . 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 μ \times 3.3 μ .

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 μ \times 19.8-22.0 μ , 8.8 μ \times 3.3 μ 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 24.4-28.4 μ in diameter with a mean of 26.4 μ . 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 15.4-19.4 μ in length with a mean of 17.4 μ and 11.3-13.5 μ in width with a mean of 12.4 μ . The shape index is 1.4. Sporocystic residuum present as a compact irregular mass. Sporozoites are sickle-shaped measuring 16.00-18.00 μ in length with a mean of 17.00 μ and 2.00-3.00 μ in width with a mean of 2.4 μ . 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 macrocereus* Vieillot, from Gaya, Bihar.

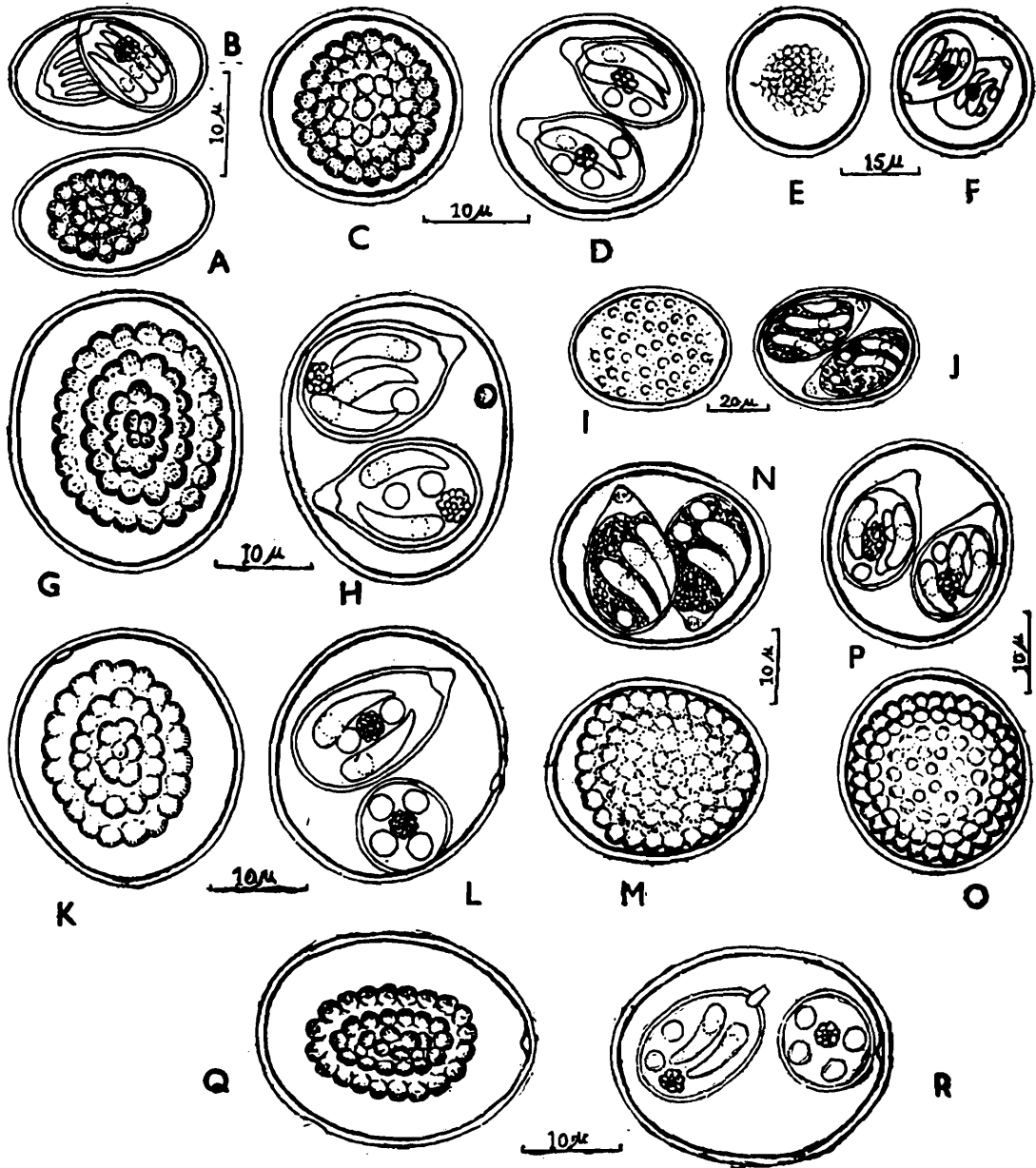
Remarks.—Topotype and paratypes were examined. According to Chakravarty and Kar (1947) oocysts, sporocysts and sporozoites measure 24.2-28.6 μ in diameter, 15.4-19.8 μ \times 13.3 μ and 17.6 μ \times 2.2 μ respectively. The specific name should be spelt as *I. upupai*.

***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 $24.3-26.4\mu$ in length with a mean of 25.8μ and $20.9-23.1\mu$ 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 scircercusae* Ray, Shivnani, Oommen and Bhaskaran, k, immature l, mature; m, n. *Isospora lonchiuræ* Mandal and Chakraborty, m, immature n, mature; o, p. *Isospora megalaimæ* Mandal and Chakraborty, o, immature p, mature; q, r. *Isospora parusæ* 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 9.2-10.4 μ in length with a mean of 9.6 μ and 2.5-3.5 μ in width with a mean of 2.6 μ . 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. μ \times 20.9-23.1 μ . 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 24.0-32.0 μ in length with a mean of 26.8 μ and 20.0-30.0 μ in width with a mean of 27.4 μ . 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 14-22 μ in length with a mean of 17.2 μ and 10.0-11.0 μ in width with a mean of 10.3 μ . The shape index is 1.56. Sporocystic residuum finely granular and present as scattered mass. Sporozoites are almost bean-shaped measuring 8.5 μ in length and 2.3 μ 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**: 25^o.

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

13.5-19.5 μ in width with a mean of 16.5 μ . 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 10.5-11.5 μ in width with a mean of 11.1 μ . The shape index is 1.4. Sporocystic residuum present as a compact mass. Sporozoites are club-shaped with the nucleus at central position measuring 14.5-16.5 μ in length with a mean of 15.5 μ and 2.1-3.5 μ in width with a mean of 2.5 μ . 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 μ \times 13.2-19.8 μ , sporocysts 15.4-17.6 μ \times 11.0 μ and the sporozoites 15.4 μ \times 2.2 μ .

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 28.5 μ -30.5 μ in length with a mean of 29.5 μ and 24.4-25.4 μ in width with a mean of 25.4 μ . The shape index is 1.16. Oval form measures 33.5-38.5 μ in length with a mean of 35.8 μ and 24.4-26.4 μ in width with a mean of 25.4 μ . 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 19.5-22.5 μ in length with a mean of 20.9 μ and 11.2-13.2 μ in width with a mean of 12.2 μ . 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 12.2-14.2 μ in length with a mean of 13.2 μ and 1.5-2.5 μ in width with a mean of 2.1 μ . 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 μ \times 24.2-26.4 μ and oval 33.0-38.8 μ \times 24.2-26.4 μ ; Sporocysts 19.8-22.0 μ \times 11.0-13.2 μ and the sporozoites 13.2 μ \times 2.2 μ .

Dorisiella chakravartyi Ray and Sarkar

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

Description.—Oocysts spherical, measuring 27.5-30.00 μ with a mean of 28.45 μ . Double layered, the outer being transparent and the inner one dark black in transmitted light. Oocystic residuum and micropyle absent. Sporocyst ellipsoidal measuring 22.5 μ in length and 15.0-17.5 μ 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 13.2 μ 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 18.5-22.5 μ with a mean of 20.5 μ with double envelope, the outer being thinner than inner one. The cytoplasm globular measuring 18.2 μ ., 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 14.5-18.5 μ in length with a mean of 16.5 μ and 9.5-10.5 μ width a mean of 9.9 μ . The shape index is 1.5. Residuum present. Sporozoites club-shaped with bluntly pointed anterior end. Sporozoites measure 8.2 μ \times 2.5 μ . Nucleus situated at rounded posterior end.

Sporulation time.—72-96 hours.

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

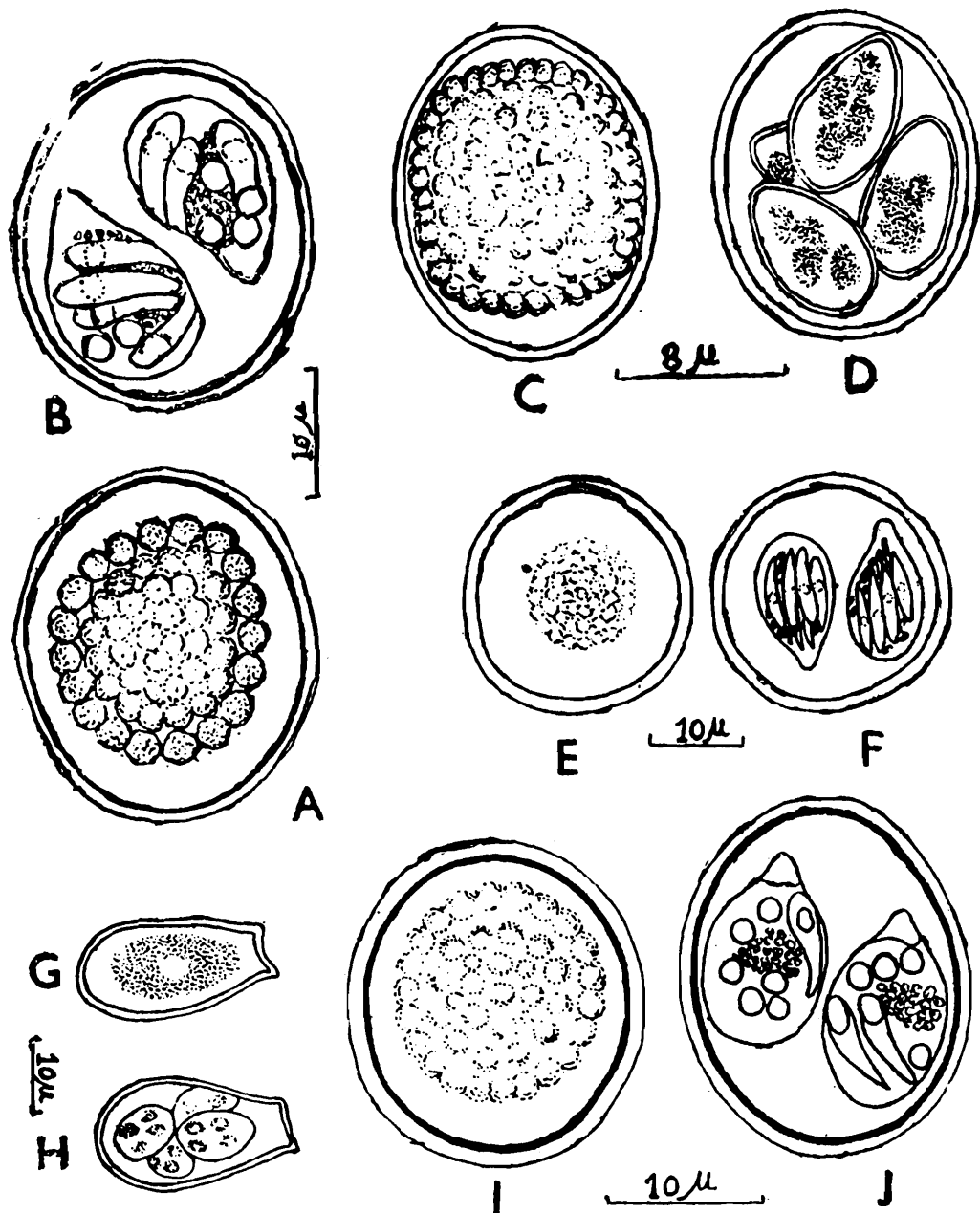
Remarks.—Topotype and paratypes were observed. According to Chakravarty and Kar (1944), Oocysts measure 18.5-22.5 μ with an average 20.6 μ , sporocysts 14.2-18.5 μ \times 9.3-10.3 μ and sporozoites 8.2 μ \times 2.2 μ .

Dorisiella mandali Ray and Sarkar

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

Description.—Oocysts oval in shape measuring 27.5-33.7 μ in length and 25.0-30.0 μ in breadth (average 30.73 \times 26.7 μ). Oocystic wall 1.87-2.00 μ 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 $12.25 \times 4.5 \mu$ 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, 30-32.5 μ in diameter average (31.17 μ), wall 1.8 to 2 μ 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 20.25 μ in length and 14-16.0 μ in breadth (avg. 22.5 μ \times 15.2 μ). Sporocystic residuum centrally situated as a compact granular mass. Sporozoites are curved, sausage like in appearance and measure 9.75 \times 3.0 μ in dimensions, 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 μ \times 22.0 μ . Fully developed sporocysts with anterior pointed end, rounded posterior end, anterior end develops a less prominent knob. Sporocysts measure 17.6 μ -19.8 μ \times 12.1 μ . 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. *Sivatoshella lonchurae* Ray and Sarkar, *J. Protozool.*, 15(4): 640.

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

in thickness. Oocystic residuum and micropyle absent. Sporocysts pear-shaped measuring $28.00-29.00\mu$ 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 $23.6 \pm 2.4\mu$ in length and $15.6 \pm 1.5\mu$ in width and the shape index is 1.43. Oocysts from another bird of the same species measure $26.2 \pm 2.5\mu$ in length and $17.4 \pm 1.9\mu$ in width and the shape index is 1.50. Refractile granules present in cytoplasm. Sporocysts are pear-shaped measure $8-9.5\mu \times 5-5.6\mu$, 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 $16.5-29.8\mu$ in length and $13.5\mu-24.5\mu$ in width (mean $24.5\mu \times 18.5\mu$). 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 $8.5\mu-13.5\mu \times 5.5\mu-8.5\mu$ with a mean of $12.5 \times 7.5\mu$. 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 19-24 μ in length with a mean of 21 μ and 16 μ -21 μ in width with a mean of 18 μ . The shape index is 1.16. Cytoplasm centrally placed coarsely granular with small refractile globules. Micropyle and oocystic residuum absent. The sporocysts are elongately ovoid, measuring 11-13 μ in length with a mean of 12 μ and 6-8 μ in width a mean of 7 μ . 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 9-11 μ in length with a mean of 10 μ and 2 μ 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 barbata Kar

(Text-fig. 7 l, m)

1944. *Eimeria barbata* 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 22.2-24.2 μ in length with a mean of 23.2 μ and 17.5-19.5 μ in width with a mean of 18.5 μ . 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 14.5-16.5 μ in length with a mean of 15.5 μ and 7.5-9.5 μ in width with a mean of 8.5 μ . The shape index is 1.8. Sporocystic residuum present as compact mass. Sporozoites are sickle-shaped, measuring 10.5-12.5 μ in length and 2.2 μ 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 15.5-16.8 μ in length and 14.6-16.6 μ in width. Sporocysts are bean-shaped, with a steida body at one end with scanty residual matter. Sporocysts measure 6-7 \times 3-4 μ . 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 14.3-17.6 μ in length with a mean of 15.8 μ and 11.0-12.0 μ in width with a mean of 11.5 μ . 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 7.8-9.8 μ in length with a mean of 8.8 μ . and 5.5-7.6 μ in width with a mean of 6.6 μ . 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 4.4 μ \times 2.2 μ . 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.

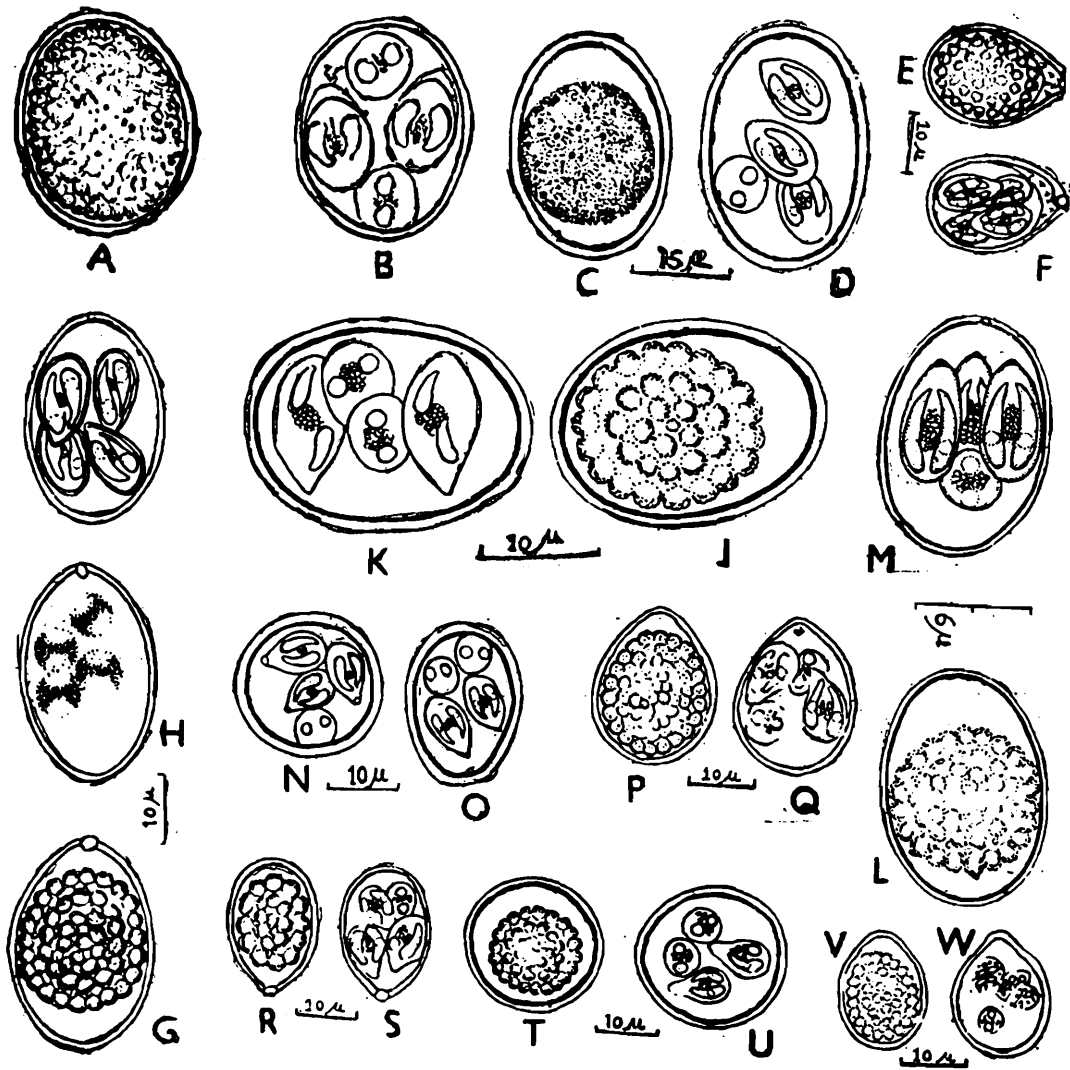
Remarks.—Type specimen and Topotype were examined. No remarkable differences are found.

***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 malaccaae* 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* Chakravarty and Kar, j, immature k, mature; l, m. *Eimeria barbelta* Kar l, immature m, mature; n, o. *Eimeria labbeana* (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 23.5-25.5 μ in length with a mean of 24.5 μ and 19.5-21.5 μ in width with a mean of 20.5 μ . The shape index is 1.2. Micropyle absent, oocystic residuum present. Sporocysts ellipsoidal, without any knob. Sporocysts measure 12.2-14.2 μ in length with a mean of 13.2 and 8.3-10.3 μ in width with a mean of 9.3 μ . 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 μ \times 14.25 μ and the sporocysts measure 16.4 μ \times 14.25 μ and the sporozoites measure 7.2 \times 4.8 μ 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 17.8 μ and 11-13 μ in width with a mean of 12.5 μ . The shape index is 1.4. Oocystic residuum absent. Sporocyst elongated with narrow anterior end. It measures 10.5 μ -12.5 μ in length with a mean 10.5 μ and 5.5-7.8 μ in width with a mean 5.8 μ . Steida body prominent plug-like, sporocystic residuum present as dark granules. Sporozoites elongated, measuring 8.5 μ , in length and 2.5 μ 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 $19.8-20.9\mu$ in length with a mean of 20.2μ and $13.2-14.3\mu$ 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 $6.7-8.7\mu$ in length with a mean of 7.7μ and $4.5-6.5\mu$ 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 gennaescusae* Ray and Hiregaudar**

1959. *Eimeria gennaescusae* 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 $21.2\pm 1.5\mu$ in length and $18.3\pm 2.0\mu$ in width and the shape index is 1.16. Sporocysts pear-shaped with a small steida body and residuum. Sporocysts measure $7-8\mu \times 4-5\mu$. 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 $26.1 \times 23.5\mu$ contain one or two refractile globules; two layered, inner one being thicker; micropyle present as a depression at the anterior pole; sporocyst ovoid measures $8.5-9.5\mu$, 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. Chaktavarty 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. Sporocysts 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 $6.5 \times 2.3\mu$. 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 - $24.5\mu \times 17.4$ - 18.8μ in size. Sporocysts ovoid and devoid of any thickening at either pole. It measures $8.5\mu \times 6.0\mu$. 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 $8.5\mu \times 2.3\mu$. 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 Ray1964. *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 5.6-7.6 μ in length with a mean of 6.6 μ and 4.5-6.5 μ in width with a mean of 5.5 μ . 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 5.9 μ in length and 2.5 μ 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 19.8-25.4 μ in length and 16.5-18.5 μ 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 12.1-15.6 μ in length with a mean of 14.5 μ and 5.6-7.6 μ in width with a mean of 6.6 μ . 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 11.5-13.5 μ in length with a mean of 12.5 μ and 2.3-3.8 μ in width with a mean of 2.6 μ . 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 17.7-19.7 μ in length with a mean of 18.7 μ and 13.3-15.3 μ in width with a mean of 14.3 μ . 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 11.1-13.1 μ in length with a mean of 12.1 and 5.6-7.6 μ in width with a mean of 6.6 μ . 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 μ \times 2.5 μ . The shape index is 3.5.

Sporulation time.—72-80 hours.

Habitat.—Small intestine of *Pluvialis apricaria* (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 20 μ -28 μ in length with a mean of 26.5 μ and 16-20 μ in width with a mean of 18.5 μ . A small micropyle present with a refractile granule usually lying just underneath. Oocystic residuum present. Sporocysts boat-shaped measuring 6-16 μ in length and 4-8 μ 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 10-12 μ in length.

Sporulation time.—24-72 hours.

Habitat.—Intestine of *Pavo cristatus* Linnaeus 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 17.5-19.35 μ in length and 13-17 μ in width with a mean of 18.5 μ \times 15.5 μ . The shape index is 1.2. Micropyle absent. Polar granule and oocystic residuum present. Sporocysts lemon-shaped, measure 6.45-8.5 μ in length and 3.2-4.83 μ in width with a mean of 7.5 μ and 4.0 μ 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 cristatus* 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 protuberance. In some cases a plug like structure closes the opening of the micropyle. The size of the oocyst varies from 17.5-25.0- μ in length and 12.5-15.0 μ in width the average being 18-19 μ \times 12.61 μ . Sporocysts are broadly oval in outline ranging from 18.75 μ to 17.5 μ in length and 12.5-13.75 μ in width, the average being 19.18 μ \times 12.61 μ . 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 19-24 μ in length and 18-23 μ in width with a mean of 20.5 μ . The wall of the oocyst is thick. Small oocystic residuum is seen after the development. Sporocyst ellipsoidal, 10 μ in length and 6 μ 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 19.9-21.9 μ in length with a mean of 20.9 μ and 13.3-15.3 μ in width with a mean of 14.3 μ . 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 $11.1-13\mu$ in length with a mean of 12.1μ and $5.6-7.6\mu$ 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 $6.7-8.7\mu$ in length with a mean of 7.7μ and $2.3-4.3\mu$ 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 $11.5-17.5\mu$ in length with a mean of 14.5μ and $7.5-10.5\mu$ in width with a mean of 8.8μ . The shape index is 1.6. Cytoplasm coarsely granular and occupies the whole of the oocyst. Micropyle and oocystic residuum present. Sporocysts ovoid in shape; measure $5.7-7.2\mu$ in length with a mean of 6.4 and $4.3-5.3\mu$ in width with a mean of 4.8μ . The shape index is 1.3. Sporocystic residuum present as coarsely granular 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.

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

Remarks.—Topotype and the same species 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 $0.5-1\mu$ thick and micropyle $4.5-6\mu$ 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 $15.5-17.5\mu$ in length with a mean of 16.5μ and $14.5-15.5\mu$ 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 $5.7-7.8\mu$ in length with a mean of 6.5μ and $3.5-4.8\mu$ in width with a mean of 4.3μ . The shape index is 1.3. Sporocystic residuum absent. Sporozoites ovoid and measure $2.6-3.00\mu$ 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 $28.5-34.5\mu$ in length with a mean of 31.5μ and $19.5-21.5\mu$ 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 $17.5-19.5\mu$ in length with a mean of 18.5μ and $7.5-9.2\mu$ 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 $19\mu-23\mu$ and in ovoid forms they measure $23.8-26.2\mu \times 18.0-21.5\mu$. 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 $10.2\mu \times 7.4\mu$, 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 $22.8-26.4\mu$ in length and $16.8-19.2\mu$ in width with a mean 24.0μ in length and 18.5μ in width. Oocystic residue absent. Four sporocysts are vial-shaped measuring $13.2-15.6\mu$ in length and $7.2-9.6\mu$ 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 vacuole 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.. | <i>Tyzzeria</i> |
| 2. Oocyst disporocystid. | .. |
| (a) Sporocyst Tetrozoic. | .. <i>Isospora</i> |
| (b) ,, Octozoic. | .. <i>Dorisiella</i> |
| (c) ,, Heccaidecazoic.... | .. <i>Sivatoshella</i> |
| 3. Oocyst tetrasporocystid | |
| (a) Sporocyst dizoic.... | ... <i>Eimeria</i> |
| (b) ,, tetrazoic.... | <i>Wenyonella</i> |

Key to the species of Avian Tyzzeria

- | | |
|---|---------------------|
| 1. Oocyst oval size of oocyst $14\mu-18\mu \times 9\mu-12\mu$. | ... <i>T alleni</i> |
| 2. Oocyst broadly cylindrical size of oocyst $29\mu-28\mu \times 20\mu$. | <i>T chenicusae</i> |

Key to the species of Avian Isospora

- | | |
|--|-------------------------|
| 1. Sporocyst pear-shaped | |
| (A) Wall of the oocyst showed a bulbous thickening. | .. <i>I. bellericae</i> |
| (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 25 μ . *.I. psittaculae*
 (ii) Size of oocyst below 25 μ . *.I. zosteropsis*
3. Sporocyst pyriform or spindle-shaped
- (A) Oocyst with residuum
- (i) Oocyst spherical or subspherical
- (a) size of oocyst 22 μ —28 μ . .. *.I. perusae*
 (b) size of oocyst 15 μ —22 μ *...I. garrulae*
 (x) Length of sporocyst above 12.00 μ (average). *.I. corvae*
 (y) Length of sporocyst below 12.00 μ (average).
- (ii) Oocyst oval or ovoid
- (a) Size of oocyst above 23.00 μ × 20.00 μ (average)
 (x) Size of sporozoites above 10 μ . *.I. lonchurae*
 (y) Size of sporozoites below 10 μ
 (i) width 2.7 μ *.I. garrulusae*
 (ii) width 3.3 μ . *.I. scicerousae*
 (b) Size of oocyst below 23.00 μ × 20.00 μ (average). *.I. emberizae*
- (B) Oocyst without residuum
- (i) Oocyst oval
- (a) Length of oocyst above 24 μ . *...I. muniae*
 (b) Length of oocyst below 24 μ . *.I. pyonotae*
- (ii) Oocyst spherical or sub-spherical
- (a) Micropyle present
- (i) Sporozoite elongated. ..
 (x) size above 10.5 μ . .. *...I. sturnae*
 (y) size below 10.00 μ . *.I. bengalensis*
- (iii) Sporozoite banana-shaped size 6-7 μ . .. *.I. mayuri*
- (b) Micropyle absent
- (i) Sporozoites elongated
 (x) size above 10.00 μ . *.I. ginginiana*
 (y) size below 7.00 μ . *.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. alectoricae*
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 $17.00\mu \times 13.00\mu$. *E. patnaiki*
 - (ii) Size of oocyst below $17.00\mu \times 13.00\mu$ *E. charidric*
 - (y) Sporocyst ovoid or ellipsoidal
 - (a) size of oocyst large above 25μ . *E. columbae*
 - (b) size of oocyst small below 25μ . *E. kapotei*
- (B) Oocystic residuum absent
 - (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 $10\mu-13\mu$
 - (i) Length of oocyst above 25μ . *E. malaccaae*
 - (ii) Length of oocyst below 25μ
 - (x) Length of sporozoite 6.5μ *E. labbeana*
 - (y) Length of sporozoite $9-11\mu$... *E. battakhi*
 - (a) Length of sporocyst above 13.00μ
 - (i) Width of sporocyst above 7μ (average) *E. barbata*
 - (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
 - (a) 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 $19 \times 26\mu$. *W. mackinoni*
 - (b) Size of oocyst small below $19 \times 18\mu$ *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 redescrptions 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 Allatorvosok Lapja*. **14**: 91.

Description.—Oocysts subspherical measuring 36-40 μ in length with a mean of 38 μ and 32 μ in width. The wall of the oocyst is thick. Micropyle and oocystic residuum absent. Sporocyst spherical in shape measuring 20 μ in length and 16 μ in width. Steida body absent, sporocystic residuum present as a large granular mass. Sporozoites are bean-shaped measuring 11.5 μ 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 30-32 μ in length with a mean of 31.8 μ and 28.00-31 μ in width with a mean of 28.2 μ . Micropyle and oocystic residuum absent. Sporocyst spherical, measuring 16-20 μ in length and 13.5-15 μ in width. Sporocystic residual mass coarsely granular. Sporozoites sausage shaped measuring 9.5 μ 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 $15.5-16\mu$ in length and $10.00-10.5\mu$ in width. The sporocystic residuum presents as a granular mass. The sporozoites are banana-shaped measuring $8-10\mu \times 3.2-4\mu$.

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 bandipurensis* Ray, Banik and Mukherjea, *J. Protozool.*, **12**: 473.

Description.—Oocyst spherical or egg-shaped the former measuring $16\mu-18\mu$ with a mean of 17μ and the later $16\mu-20\mu \times 14-18\mu$ with a mean of $18 \times 16\mu$. Double wall of uniform thickness. Micropyle and oocystic residuum absent. Sporocysts broadly pear-shaped with a stieda body at the narrow end. It measure $6-10\mu$ in length with a mean of 8μ and $6-8\mu$ 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)

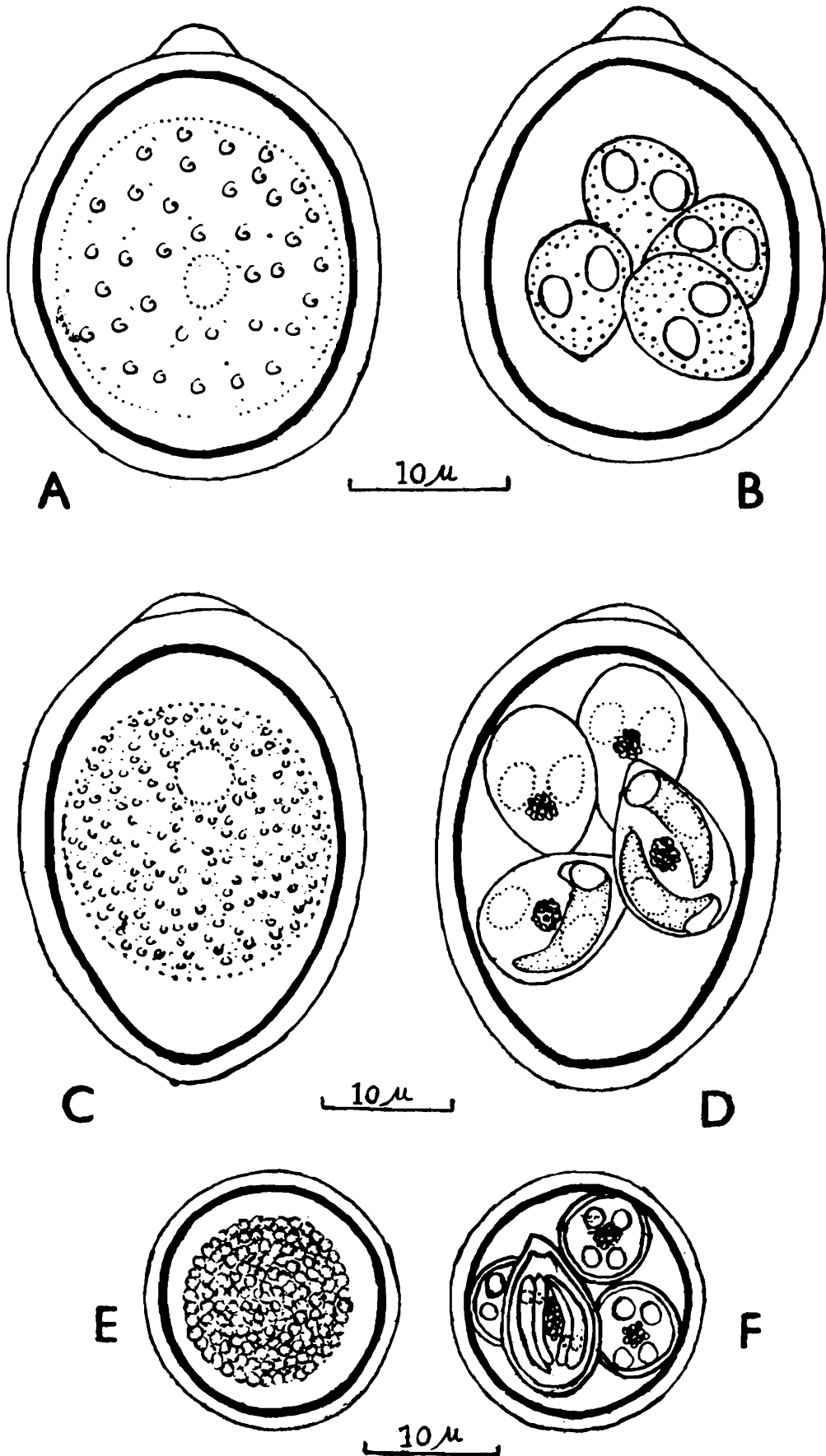
1932. *Eimeria cameli* Noller, *Sitz. Ber. ges. Naturf. Freunde.*: 417, pro parte;

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 26-28 μ in length with a mean of 27 μ and 21-23 μ in width with a mean of 21 μ .



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 $10-11\mu$ 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 $34-39\mu$ in length with a mean of 36.00μ and $25-27\mu$ 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 $14-15\mu$ in length with a mean of 15μ and $8-11\mu$ in width with a mean of 11.00μ . Sporocystic residuum present. Sporozoites elongated measuring $10\mu-14\mu$ in length and $3-4\mu$ 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 $32.00-40.00\mu$ in length with a mean of 35.5μ and $20-28\mu$ in width with a mean of 23.8μ . Micropyle present. Oocystic residuum absent. Sporocyst oval measuring $14\mu-16\mu$ in length and $8-9\mu$ in width. Sporocystic residual mass coarsely granular. Steida body present at the narrow end. Sporozoites ovoidal measuring $8\mu-9\mu$ in length and $4-6\mu$ 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 $28.5-46.8\mu$ in length with a mean of 38.7μ and $12.5-28.5\mu$ 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 - 8.5μ in width with a mean of 6.00μ . 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 $22.96 \times 18.60\mu$. 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* (Geoffery).

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 $29-33\mu$ in length and $22-25\mu$ in width. Oocystic residuum absent. Sporocyst ellipsoidal, measuring $19-21\mu$ in length and $11-12\mu$ 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 $27-30\mu$ in length and $20-25\mu$ in width. Oocystic residuum absent. Sporocyst ellipsoidal, measuring $17-19\mu$ in length and $12-14\mu$ 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 $35-45\mu$ in length and $25-35\mu$ in width. Oocyst residuum absent. Sporocyst pyriform, measuring $18.4\mu-11.4\mu$ with a sporocystic residual mass.

Sporulation time.—3 days

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

***Isospora garnhami* Bray**

Description.—Oocyst ellipsoidal to ovoidal, measuring $22.6\mu-25.8\mu$ in length and $17.8-22.5\mu$ in width. Oocystic residuum absent. Sporocyst ellipsoidal, measuring $12-16\mu$ in length and $11-12.5\mu$ 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 $19.13-20.9\mu$ in length and 16.32μ in width. Oocyst residuum absent. Sporocyst ellipsoidal measuring $10-12\mu$ in length and $8-9.7\mu$ 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 23-29 μ in length and 23-26 μ in width. Oocyst residuum absent. Sporocyst ellipsoidal, measuring 16-18 μ in length and 11-14 μ 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 10-25 μ in length and 15-22 μ in width. Oocystic residuum absent. Sporocyst elongated, measuring 16 μ in length and 10 μ 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 13.2-15.8 μ in length and 11.5-12.6 μ in width. Oocystic residuum absent. Sporocyst elongated measuring 16-18 μ in length and 12-13 μ 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 20 μ -45 μ . Oocystic residuum absent. Sporocyst oval, measuring 13 μ in length and 6 μ in width, with no sporocystic mass.

Sporulation time.—2-3 days.

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

Eimeria auburnensis Christensen and Porter

Synonym: *E. bombayensis* Rao and Hiregauder.

Description.—Oocyst elongated or ovoidal, measuring 31-45 μ in length and 19-28 μ in width. Oocystic residuum absent. Sporocyst oval or elongated measuring 18.5 μ in length and 7.4 μ 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 $15-19\mu$ in length and $18-24\mu$ in width. Oocystic residuum absent. Sporocyst ovoid, measuring $9.5-14.5\mu$ in length and $4.9-7.5\mu$ 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 Bhatwadekar.

Description.—Oocyst ellipsoidal, measuring $34-41\mu$ in length and $23-28\mu$ 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 $36-48\mu$ in length and $24-34\mu$ 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 $26-38\mu$ in length and $21-28\mu$ 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 $19-25\mu$ in length and $19-22\mu$ in width. Oocystic residuum absent. Sporocyst

ellipsoidal, measuring $10-11\mu$ 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 $16-32.5\mu$ in length and $15-25\mu$ in width. Oocystic residuum absent. Sporocyst spindle-shaped, measuring $8.3-11.2\mu$ in length and $5.4-8\mu$ 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 $27.5-33\mu$ in length and $14-19.5\mu$ 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 $27-29\mu$ in length and $21-23\mu$ in width. Oocystic residuum absent. Sporocyst elongate, measuring $16-17\mu$ in length and $7-9\mu$ 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 $32-43\mu$ in length and $24-30\mu$ in width. Oocystic residuum absent. Sporocyst ovoidal, measuring $14-18\mu$ in length and $8-11\mu$ 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 $21-31\mu$ in length and in width. Oocystic residuum absent. Sporocyst oval and round measuring $8.5-10.5\mu$ in length and $6.5-8.4\mu$ in width with a sporocystic residual mass.

Sporulation time.—36-48 hrs.

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

Eimeria debliccki Douwes

Description.—Oocyst ellipsoidal to ovoid, measuring 20-29 μ in length and 14-20 μ in width. Oocystic residuum absent. Sporocyst elongated ovoid, measuring 13-16 μ in length and 6-7 μ 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 18.5-28 μ in length and 14.9-20.5 μ in width. Oocystic residuum absent. Sporocyst ellipsoidal, measuring 5 μ in length and 3 μ 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 25-33 μ in length and 20-24 μ in width. Oocystic residuum absent. Sporocyst ovoid measuring 14-16 μ in length and 8.9 μ 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 15-19 μ in length and 11-17 μ in width. Oocystic residuum absent. Sporocyst nearly ovoid, measuring 8-10 μ in length and 6-8 μ 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 24-29 μ in length and 14-22 μ in width. Oocystic residuum absent. Sporocyst broadly ovoid, measuring 11-14 μ in length and 8-10 μ 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 33-35 μ in length and 25-35 μ in width. Oocystic residuum absent. Sporocyst oval, measuring 19-26 μ with a sporocystic residual mass.

Sporulation time.—9-12 days.

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

Eimeria intestinalis Cheissin

Description.—Oocyst pyriform, measuring 25-30 μ in length and 17.5-20 μ 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 Jankiewicz

Description.—Oocyst ovoidal, measuring 25-37.5 μ in length and 17.5-24.75 μ in width. Oocystic residuum absent. Sporocyst anterior and moderately pointed measuring 18 μ in length and 9 μ 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 22-28 μ in length and 15-26 μ in width. Oocystic residuum present. Sporocyst ovoidal or oval measuring 12-13 μ in length and 9.5 μ 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 24-29 μ in length and 14-22 μ in width. Oocystic residuum absent. Sporocyst ovoid measuring 11-14 μ in length and 8-10 μ 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 20.25-31.5 μ in length and 18-25.5 μ in width. Oocystic residuum present. Sporocyst ovoidal measuring 15.25-18 μ in length and 7-8.75 μ 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 23.5-29.5 μ in length and 14.5-19.25 μ in width. Oocystic residuum present. Sporocyst ovoidal measuring 7 μ in length and 6 μ 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 20-28 μ in length and 16-20 μ in width. Oocystic residuum absent. Sporocyst broadly ovoid, measuring 11-13 μ in length and 7-9 μ 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 25-37 μ in length and 16-20 μ in width. Oocystic residuum present. Sporocyst ovoidal measuring 14-15 μ in length and 9-10 μ 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 10-15.5 μ in length and 9-15 μ in width. Oocystic residuum absent. Sporocyst ovoidal, measuring 5 μ in length and 2.8 μ 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 36-38 μ in length and 25-28 μ in width. Oocystic residuum absent. Sporocyst oval, measuring 14.3 μ in length and 9.1 μ 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 20.25-26.3 μ in length and 10-15 μ in width. Oocystic residuum absent. Sporocyst oat-shaped measuring 15 μ in length and 5 μ 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 17-26 μ in length and 14-19 μ in width. Oocystic residuum absent. Sporocyst broad ovoid, measuring 19-13 μ in length and 6-8 μ 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 $30-54\mu$ in length and $16-22\mu$ 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 $16.10-19.35\mu$ in length and $12.88-15.98\mu$ 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 $20-28\mu$ in length and $15-22\mu$ in width. Oocystic residuum absent. Sporocyst oval, measuring $5-6.5\mu$ in length and $3-4.5\mu$ 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 $80-100\mu$ in length and $65-80\mu$ in width. Oocystic residuum absent. Sporocyst elongated, measuring $12.5-13\mu$ in length and $10-11\mu$ 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 $12-20\mu$ in length and $8-15\mu$ in width. Oocystic residuum absent. Sporocyst ovoid, measuring $12.5-14.5\mu$ in length and $9.5-10.5\mu$ 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 $12.5-20\mu$ in length and $10-17\mu$ in width. Oocystic residuum absent. Sporocyst oval measuring $13-15\mu$ in length and $10-12\mu$ 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 $35-48\mu$ in length and $23-31\mu$ 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 $11.2-16\mu$ in length and $9.6-12.8\mu$ in width. Oocystic residuum absent. Sporocyst elongated, measuring $9.5-10.5\mu$ in length and $4.5-8\mu$ 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 $46.24-52.5\mu$ in length and $35-40.4\mu$ in width. Oocystic residuum present. Sporocyst naviculate, measuring $27.5-31.25\mu$ in length and $10-18.75\mu$ 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 $17-32\mu$ in length and $12.5-19.5\mu$ in width. Oocystic residuum present. Sporocyst ovoid, measuring 7.75μ in length and 3.75μ in width with a sporocystic residual mass.

Sporulation time.—48 hrs.

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

***Eimeria polita* Pellérdy**

Description.—Oocyst ellipsoidal or oval, measuring $23-27\mu$ in length and 10 to 21μ in width. Oocystic residuum absent. Sporocyst ellipsoidal, measuring $16-17\mu$ 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 $20-23.7\mu$ in length and $9.5-22.5\mu$ 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 $20-27\mu$ in length and $14-18\mu$ in width. Oocystic residuum absent. Sporocyst broadly ovoid, measuring $9-11\mu$ 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 $33-44.5\mu$ in length and $21-32.5\mu$ 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 $28-38\mu$ in length and $12-15\mu$ in width. Oocystic residuum present. Sporocyst ovoidal, measuring $13.5-15.5\mu$ in length and $8.5-10.5\mu$ 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 $22.4-35.6\mu$ in length and $16-25.6\mu$ in width. Oocystic residuum present. Sporocyst oval measuring $16-19.2\mu$ 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 $16-22.4\mu$ in length and $12.8-16\mu$ in width. Oocystic residuum absent. Sporocyst ellipsoidal, measuring $9.1-11.7\mu$ in length and $5.2-6.5\mu$ 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 21-39 μ in length and 16.24 μ in width. Oocystic residuum absent. Sporocyst ellipsoidal to oval; measuring 16 μ in length and 7 μ 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 subspherical measuring 20.8 μ in length and 12.18 μ in width. Oocystic residuum absent. Sporocyst spindle-shaped measuring 5 μ in length and 3 μ 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 26-40 μ in length and 16-24 μ in width. Oocystic residuum absent. Sporocyst ovoidal to oval, measuring 17 μ in length and 9 μ 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 24-44 μ in length and 24-29 μ in width. Oocystic residuum absent. Sporocyst pear-shaped, measuring 18 μ in length and 8 μ 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 21-25 μ . Oocystic residuum absent. Sporocyst ovoid, measuring 9.9-11 μ in length and 5.3-5.7 μ in width with a sporocystic residual mass.

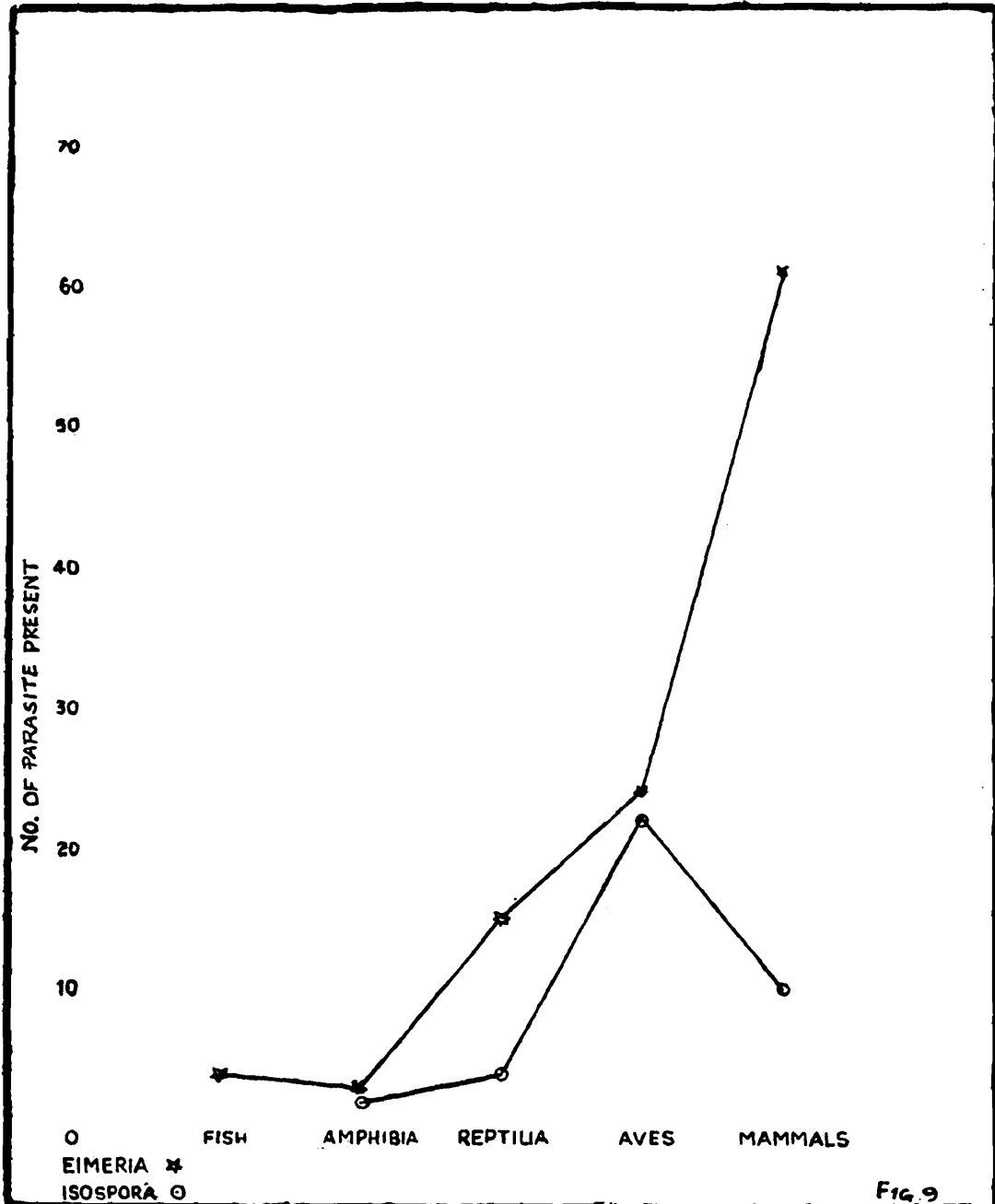
Sporulation time.—48-72 hrs.

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. <i>Tyzzeria</i>	-	-	-	2	-
2. <i>Caryospora</i>	-	-	1	-	-
3. <i>Isospora</i>	-	2	4	22	10
4. <i>Dorisiella</i>	-	-	-	6	-
5. <i>Eimeria</i>	4	3	15	24	61
6. <i>Wenyonella</i>	-	-	-	5	1
7. <i>Octosporella</i>	-	-	1	-	-
8. <i>Pythonella</i>	-	-	1	-	-
9. <i>Sivatoshella</i>	-	-	-	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.

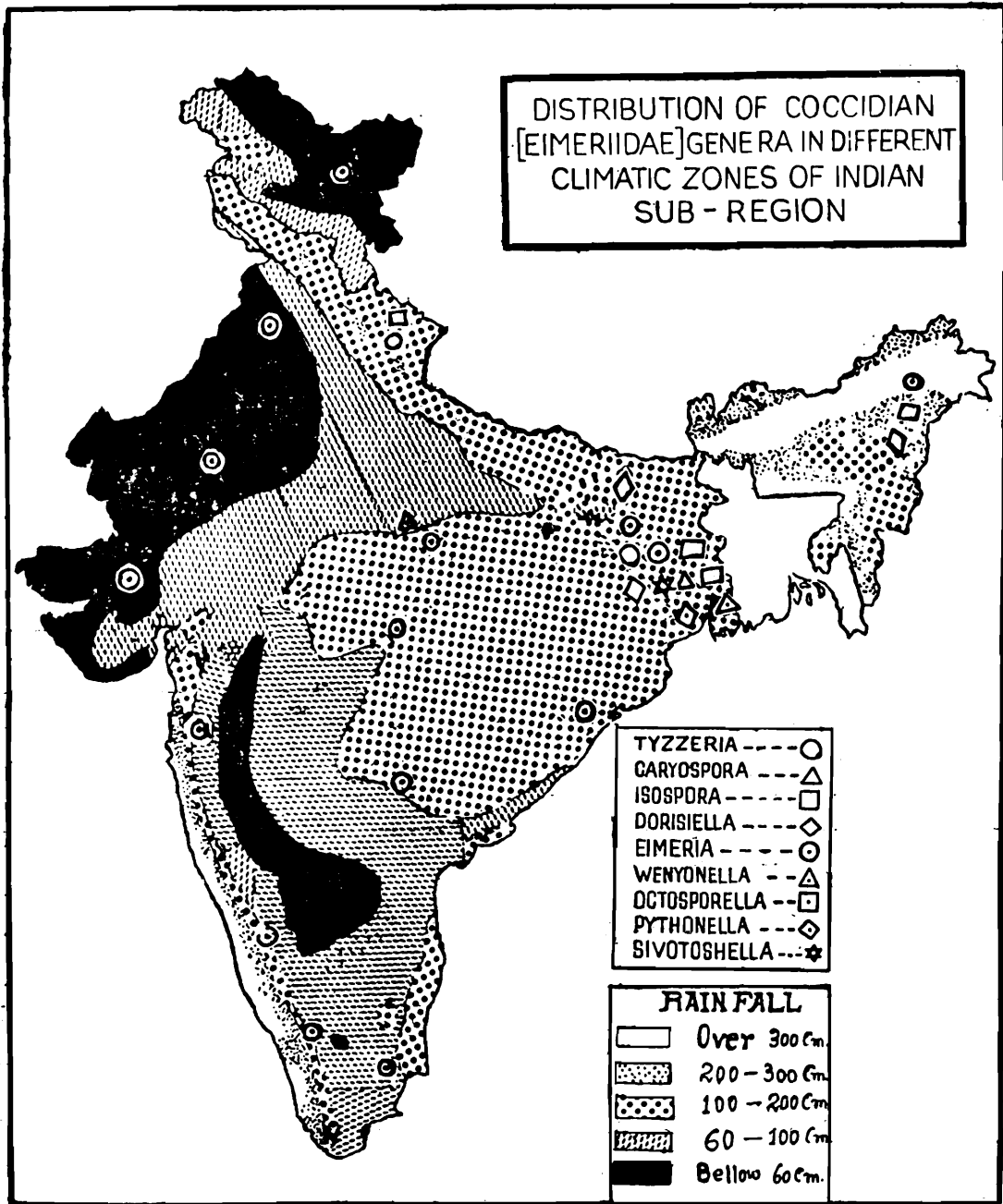
Geographical distribution

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 Christensen'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 occurring 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 overlapping 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 Hygiene, 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.

REFERENCES

- ALLEN, E. A. 1932. *Eumonospora tremula* gen. et. sp. nov., a coccidium from the intestine of the turkey buzzard, *Cathartes aura septentrionalis* Wied. *Trans. Amer. micr. Soc.*, **52**: 192-194.

- ALLEN, E. A. 1934. *Eimeria angusta* sp. nov. and *Eimeria bonasae* sp. nov. from grouse, with a key to the species of *Eimeria* in birds, *Trans. Amer. micr. Soc.*, **52**: 1-5.
- ALLEN, E. A. 1936. *Tyzzeria pernicioso* gen. et. sp. nov., a coccidium from the small intestine of the Pekin Duck, *Anas domesticus* L. *Arch. Protistenk.*, **87**: 262-267.
- BANIK, D. C. and RAY, H. N. 1961. New Coccidium *Eimeria pavonina* n. sp. from peacock, *Pavo cristatus* Linn. *Bull. Calcutta Sch. trop. Med.*, **9**(2): 61-62.
- BANIK, D. C. and RAY, H. N. 1962. On a new coccidium, *Isospora bellericae* n. sp. from Cape ground Crane, *Bellerica regulorum*. *Bull. Calcutta Sch. trop. Med.*, **10**: 16.
- BANIK, D. C. and RAY, H. N. 1964. On a new coccidium, *Eimeria mandali* n.sp. from the Indian peacock. *Bull. Calcutta Sch. trop. Med.*, **12**(1): 27.
- BHATIA, B. L. 1938. *Fauna of British India* (Protozoa: Sporozoa). pp. 497 (Taylor and Francis Ltd.), London.
- BHATIA, B. B. and PANDE, B. P. 1965a. *Eimeria bateri* n.sp. from Indian common grey Quail (*Coturnix communis*.) *Indian J. Microbiol.*, **5**(4): 61-64.
- BHATIA, B. B. and PANDE, B. P. 1965b. *Eimeria dauki* n.sp. from white breasted water hen, *Amaurornis phoenicurus* (Pennant) *Indian J. Microbiol.*, **5**(4): 65-66.
- CHAKRAVARTY, M. M. and KAR, A. B. 1943. Observation on two Coccidia, *Eimeria trionyxae* n. sp. and *Eimeria triangularis* n. sp. from the intestine of the Turtle *Trionyx gangeticus* Cuv. *J. Roy. asiat. Soc., Bengal*, **9**: 49-54.
- CHAKRAVARTY, M. M. and KAR, A. B. 1944a. Studies on Coccidia of Indian birds. I. On the life history of *Isospora lacazei* (Labbé). *Jour. Dept. Sci. C.U.*, **1**: 76-80.
- CHAKRAVARTY, M. M. and KAR, A. B. 1944b. A study on the Coccidia of Indian birds. II. Observation on several species of Coccidia of the subfamilies Cyclosporinae and Eimeriinae. *Proc. Ind. Acad. Sci.*, **20**(B): 102-114.
- *CHAKRAVARTY, M. M. and KAR, A. B. 1946. Effect of temperature on the sporulation and mortality of Coccidion oocysts. *Proc. Nat. Inst. Sci. India*. **12**: 1-6.
- CHAKRAVARTY, M. M. and KAR, A. B. 1947a. A study on the Coccidia of Indian birds. *Proc. Roy. Soc.*, **62**(B): 225-233.
- CHAKRAVARTY, M. M. and KAR, A. B. 1947b. Observations on two reptilian coccidia. *J. Roy. asiat. Soc., Bengal*, **12**: 3-5.
- CHAKRAVARTY, M. M. and KAR, A. B. 1952. The life history and affinities of two salientian coccidia, *Isospora stomaticae* and *Eimeria cyanophiyctis* with a note on *Isospora wenyoni*. *Proc. zool. Soc., Bengal*, **5**: 11-18.
- CHATTERJEE, D. K. and RAY, H. N. 1969. On *Eimeria kapotei* n.sp. from the domestic pigeon, *Columba livia intermedia*. *Proc. Indian Sci. Congr.*, p. 512,

- **CHHABRA, M. B. 1968. Effect of temperature on sporulation of oocysts of *Coccidia*. *Indian Vet. J.* **45**: 31-34.
- COOPER, H. and GULATI, A. N. 1926. On the occurrence of *Isospora* and *Balantidium* in cattle. *Mem. Dep. Agric. Ind., Vet. Ser.*, **3**: 191-193.
- CROUCH, H. B. and BECKER, E. R. 1931. Some effect of temperature upon development of the oocysts of *Coccidia*. *Proc. Exp. Biol. Med.*, **28**: 529-530.
- DAS GUPTA, M. 1938a. On a new *Coccidium*, *Eimeria koormai* n.sp. from an Indian tortoise, *Lissemys punctata* Smith. *Proc. Indian Sci. Congr.*, p. 155.
- DUBEY, J. P. and PANDE, B. P. 1963a. A preliminary note on *Eimeria battakhi* n.sp. (Protozoa: Eimeriidae) domestic duck (*Anas platyrhynchos platyrhynchos domesticus*). *Curr. Sci.*, **32**: 329-331.
- GILL, B. S. 1960a. The Coccidian oocysts of Indian cattle. *Proc. Indian Sci. Congr.*, p. 430.
- GILL, B. S. 1960a. The Coccidian oocysts of Indian pigs. *Proc. Indian Sci. Congr.*, p. 430.
- GILL, B. S. 1968. The Coccidian oocysts (Protozoa: Sporozoa) of Indian Cattle. *Proc. zool. Soc., Calcutta*, **21**: 101-121.
- HAKE, T. G. 1839. A Treatise on varicose capillaries, as constituting the structure of carcinoma of the hepatic duct, and developing the law and treatment of morbid growths, with an account of a new form of pus globule. London.
- HALAWANI, A. 1930a. On a new species of *Eimeria* (*E. southwelli*) from *Aetobatis narinari*. *Ann. trop. Med. Parasit.*, **24**: 1-3.
- HOARE, C. A. 1933. Studies on some new ophidian and avian coccidia from Uganda with a revision of the classification of the Eimeriidae. *Parasitol.*, **25**: 359-388.
- KAR, A. B. 1944b. Two new *Coccidia* from pond turtles. *Lissemys punctata* (Bonnaterree) *Indian vet. J.*, **20**(5): 231-235.
- KAR, A. B. 1944b. Observation on *Eimeria barbata* n.sp. from the blue throated barbet *Cyanops asiatics* (Lath.) *Proc. Indian Sci. Congr.*, pp. 104-105.
- KLOSE, H. 1855. Uber Parasiten in der Niere von Relix. *Abh. Seckenb. naturf. Ges.*, **1**: 189.
- KOTLAN, A. 1932. Adatok a vizimadarak (kacsa, Liba) coccidiasisanak ismeretehez. *Allat. Lapok.*, **55**: 63-107.
- KNOWLES, R. and DAS GUPTA, B. M. 1931. A note on two intestinal Protozoa of the Indian mangoose. *Indian. med. Res. men.*, **19**: 175-176.
- KNOWLES, R. and DAS GUPTA, B. M. 1934. *Isospora* infection in Indian cats. *Indian med. Res. Men.*, **691**: 387-390.
- LEGER, A. 1926. Un cas de coccidiose humaine a *Isospora belli* a Hue (Annam) *Bull. Soc. Path. exct.*, **19**: 95-96.
- LEVINE, N. D. and BECKER, E. R. 1933. A catalogue and host index of the species of the coccidian genus *Eimeria*. *Iowa State Coll. J. Sci.*, **8**: 85-106,

- LEVINE, N. D. 1961a. Problems in the systematics of the "Sporozoa"
J. Protozool., **8**: 422-451.
- MANDAL, A. K. 1966. A new Coccidium *Isospora rayi* n.sp. from a lizard
Ptyctolaemus sp. from Shillong. *Sci. & Cult.*, **32**: 507-508.
- MANDAL, A. K. and CHAKRAVARTY, M. M. 1963. Studies on some
aspects of avian coccidia (Protozoa: Sporozoa). 1. On a new
species of *Dorisiella* from the Indian tree-pie, *Crypsirina vagabunda*
(Latham). *Proc. zool. Soc., Calcutta*, **16**: 147-150.
- MANDAL, A. K. and CHAKRAVARTY, M. M. 1964. Studies on some
aspects of avian Coccidia (Protozoa: Sporozoa). 2. Some new
species of the genus *Isospora* Schneider (1881). *Proc. zool. Soc.,
Calcutta*, **17**: 35-45.
- MANDAL, A. K. 1965. Studies on some aspects of avian Coccidia
(Protozoa: Sporozoa). 3. Some new species of the genus *Eimeria*
Schneider (1875) with a sub-species of *E. roscoviensis* (Labbé.). *Proc.
zool. Soc., Calcutta* **18**: 47-57.
- MANDAL, A. K. and CHAKRAVARTY, M. M. 1965. A new Coccidium
Eimeria zygaenae from Hammer headed shark, *Zygaena blochii*. *Sci.
& Cult.*, **31**: 381-382.
- MANDAL, A. K. 1965. Studies on some aspects of avian coccidia
(Protozoa; sporozoa). 5. the effects of Physical and Chemical
agents on the oocysts of *Doriciella vagabundae*. *Proc. zool. Soc.
Calcutta*. **19**: 23-29.
- MANDAL, L. N. and RAY, H. N. 1960. A new Coccidium, *Isospora
leonina* n.sp. from a lion cub. *Bull. Calcutta Sch. trop. Med.*,
8: 107-108.
- MALHOTRA, M. N. and RAY, H. N. 1961. On a new Coccidian, *Eime-
ria tropicalis* n.sp. from the domestic pigeon, *Columba livia inter-
media*. *Proc. Indian Sci. Congr.*, p. 412.
- MISRA, P. L. 1944. On a coccidium *Wenyonella bahli* n.sp. from the
common grey quail. *Proc. natu. Inst. Sci., India*, **10**: 203-204.
- MISRA, P. L., 1947. On three Coccidian parasites *Wenyonella mackinnoni*
n.sp., *Eimeria lucknowensis* n.sp. and *Isospora* sp. from the intestine
of the Wagtail, *Motacilla alba* Linn. (Passeriformes, Motacillidae).
Proc. Ind. Acad. Sci., **25**(B): 75-85.
- MITRA, A. N. and DAS GUPTA, M. 1937a. On a species of *Isospora*
from the intestine of *Naja naja* Linn. *Proc. Indian Sci., Congr.*
p. 291.
- MITRA, A. N. and DAS GUPTA, M. 1937b. On a species of *Eimeria*
from the intestine of a pigeon *Columba intermedia*. *Proc. Indian. Sci.
Congr.*, p. 291.
- MUKHERJEA, A. K. and KRASSNER, S. M. 1965. A new species of Cocci-
dia (Protozoa: Sporozoa) of the genus *Isospora* Schneider, 1881
from the Jackal *Canis aureus* Linnaeus. *Proc. zool. Soc., Calcutta*,
18: 35-40, figs.
- NOHMI, A. 1927. A staining method of goat Coccidium and Coccidian
oocysts. *Jap. Soc. vet. Sci.*, **6**: 360-363,

- PANDE, B. P., BHATIA, B. B. and SRIVASTAVA, K. M. N. 1965. *Wenyonella anatis* n.sp. (Protozoa : Eimeriidae) from Indian domestic duck. *Sci. & Cult.*, **31** : 383-384.
- PATNAIK, M. M. and RAY, S. K. 1965. Coccidia of Indian Mongoose (*Herpestis edwardsi*), *Indian J. Anim. Hlth.*, **4** : 33-36.
- PATNAIK, M. M. and MOHANTY, D. N. 1969. *Isospora gypsi* n.sp. from the Indian vulture (*Gyps bengalensis*). *Curr. Sci.*, **38**(13): 316.
- PELLERDY, L. 1949. Studies on Coccidia occurring in the domestic pig, with the description of new Eimeria species (*Eimeria polita* n.sp.) of that host. *Acta. Vet. Hung.*, **1** : 105-109.
- PELLERDY, L. P. 1963. *Catalogue of Eimeridea* (Protozoa : Sporozoa), pp. 1-160.
- PELLERDY, L. P. 1965. *Coccidia and coccidiosis*, pp. 657. Hungarian academy of Sciences.
- PHISALIX, M. 1923. Coccidiose intestinale de la vipère aspicoa *Cyclospora vipereen.* sp. *Bull. Soc. Path. Exot.*, **16**: 637-642.
- PHISALIX, M. 1924a. Note complementaire sur *Cyclospora viperae*, coccidie parasite de l'intestin de la vipère aspic. *Bull. Soc. Path. exot.*, **16** : 559-562.
- RAY, H. N. 1930. Studies on some Sporozoa in Polychaete worms, *Dorisiella scololepidis* n.gen., n.sp. *Parasitology.*, **22**: 471-480.
- RAY, H. N. and DAS GUPTA, M. 1935a. *Wenyonella* (Coccidia) from an Indian squirrel. *Sci. & Cult.*, **1**: 121-113.
- RAY, H. N. 1935a. On a new coccidium *Eimeria laminata* n.sp. from the intestine of an Indian toad, *Bufo melenostictus* Schneid. *Parasitology.*, **27**: 369-373.
- RAY, H. N. and DAS GUPTA, M. 1935b. On a new Coccidium, *Isospora wenyoni* n.sp. from the intestine of Indian toad, *Bufo melanostictus*. *Arch. Protistenk.*, **86**: 219-224.
- RAY, H. N. and DAS GUPTA, M. 1936. *Eimeria* from *Natrix piscator* (Schneid.) *Proc. Indian Sci. Congr.*: 345.
- RAY, H. N. and DAS GUPTA, M. 1937a. On a new Coccidium from the intestine of *Python* sp. *Proc. Indian Sci. Congr.*: 292.
- RAY, H. N. and DAS GUPTA, M. 1937b. A new Coccidium, *Wenyonella hoarei* n.sp. from an Indian squirrel. *Parasitology.*, **29**: 117-120.
- RAY, H. N. and DAS GUPTA, M. 1938. On a new Coccidium *Eimeria stolatae* n.sp. from the intestine of common grass snake, *Natrix stolata* (Linn.). *Arch. Protistenk.*, **90**: 361-364.
- RAY, H. N. and RAGHAVACHARI, K. 1942. Observation on a new Coccidium *Octosporella mabuiae* n.gen. n.sp from the intestine of *Mabuia* sp. *Proc. Indian Sci. Congr.* 170.
- RAY, H. N. and RAGHAVACHARI, K, SPARE, S. N. 1942. On a new Coccidium, *Eimeria minitti* n.sp. from the lizard., *Mabuia* sp. *Proc. Indian Sci, Congr.* 170.
- RAY, H. N. 1945. On a new Coccidium *Wenyonella gallinae* n.sp. from the gut of the domestic fowl, *Gallus gallus domesticus* Linn. *Curr, Sci.*, **14**: 275,

- RAY, H. N. and MISRA, P. L. 1942. Observation on a new Coccidian, *Eimeria himalayanum* n.sp. from the intestine of a Himalayan toad, *Bufo* sp. *Proc. Indian Sci. Congr.* : 169.
- RAY, H. N. and HIREGAUDAR, L. S. 1959. Coccidia from some birds at Calcutta Zoo. *Bull. Calcutta. Sch. trop. Med.*, **7** : 111-112.
- RAY, H. N. and MANDAL, L. N. 1961. On a new Coccidium, *Eimeria ovoidalis* n.sp. from a buffalo calf and its experimental transmission to cow-cal. *Proc. Indian Sci. Congr.* : 411.
- RAY, H. N. and BANIK, D. C. 1965. On a new Coccidium, *Eimeria oryotelagi* n.sp. from the domestic rabbit, *Oryctolagus (Lepus) cuniculis*. *Proc. Indian Sci. Congr.* : 465.
- RAY, H. N. and SARKAR A. C. 1967. On some new Coccidia from the Indian Passerine birds *Zosterops palpebrosa* (Temk.), *Lonchura malabarica* (Linn.), *L. punctulata* (Linn.) and *Passer domestica* (Linn.) *Proc. Indian Sci. Congr.* : 448-449.
- RAY, H. N. and SARKAR, A. C. 1967b. On a new coccidium, *Tyzzeria chenicusae* from Cotton Teal (*Chenicus coromandelianus*, Aves: Anseriforms). *J. Protozool.*, **24** : 27 (Suppl.).
- RAY, H. N. and SARKAR, A. C. 1968. A new Coccidium, *Sivatoshella lonchurae* n.gen. n.sp. from *Lonchura malabarica* and *L. ponatulata*. *J. Protozool.*, **15**(4) : 640-643.
- RAY, D. K. 1952a. On a new Coccidium, *Eimeria sphenocercae* n.sp. from *Sphenoceros sphenurus* (Kokla green Pigeon). *J. Parasit.*, **38** : 546-547.
- RAY, D. K., SHIVANANI, G. A., OOMMEN, M. and BHASKARAN, R. 1952b. A study on the coccidia of some Himalayan birds. *Proc. zool. Soc., Bengal.*, **5** : 141-147.
- RAY, D. K. 1959. *Coccidia and Coccidiosis in the sheep and goats of India*. Doctoral Thesis., Calcutta University.
- RIVOLTA, S. 1869. Psorospormioe psorospermosi negli animali domestici. *Medico. veter.*, **4**.
- ROSS, R. 1898. Report on a preliminary investigation into malaria in the Sihur Ghat, Ootacamund. *Trans. S. Indian Brit med. Ass.* **8** : 143.
- SCHAUDINN, F. 1902. Studien uber krankheitserregende protozoen-I. *Cyclospora caryolitoca* Scahud., der Erregerder perniciosen Entritis des Maulwurfs. *Arb. Genundh Amt. Berlin*, **18** : 378-416.
- SARKAR, A. C. and RAY, H. N. 1966. On a new Coccidium *Wenyonella gageri* n.sp. from the domestic duck, *Anas boschus*. *Proc. Indian Sci. Congr.* : 499-500.
- SEN, S. K. 1932. Coccidiosis. In *Rep. Imp. Inst. vet. Res., Mukteswar*, for 1932 : 34.
- SETNA, S. B. and BANA, R. H. 1935a. *Eimeria harpodoni* n.sp. new Coccidium from *Harpodon neherus* (Ham. & Buch.) *J. Roy. micr. Soc.*, **55** : 165-169.
- SETNA, S. B. and BANA, R. H. 1935b. *Eimeria flaviviridis* n.sp. from the gall bladder of *Hemidactylus flaviviridis*. *J. Roy. micr. Soc.*, **55** : 256.

- TYZZER, E. E. 1928. Methods of isolating and differentiating species of *Eimeria* occurring in Gallinaceous birds. *J. Parasitol.*, **15** : 148-149.
- TYZZER, E. E. 1929. Coccidiosis in gallinaceous birds. *Amer. J. Hyg.*, **10** : 269-283.
- VINCENT, M. 1936. Un nouveau type de coccidie des peripates. *C. R. Soc. Biol., Paris*, **122** : 260-262.
- WARE, F. 1936. Coccidiosis. In. *Rep. Inst. Bet. Res. Mukteswar*, for 1936b : 35.
- YAKIMOFF, W. L. and GOUSEOFF, W. F. 1935. Une Coccidie de Serpent. *Ann. de Paras.*, **13** : 28-31.
- YAKIMOFF, W. L. and GOUSEOFF W. F. 1936. A propos des coccidies oisieux sauvages. *Ann. de Paras.*, **14** : 449-456.
-

ODONATA OF DOON VALLEY 2. ZYGOPTERA

By

MAHABIR PRASAD and ASKET SINGH

Northern Regional Station,
Zoological Survey of India, Dehra Dun.

(With 3 Text-figures)

Suborder *ZYGOPTERA*
Superfamily GOENAGRIOIDEA
Family PLATYSTICTIDAE
Subfamily PLATYSTICTINAE

Drepanosticta carmichaeli Laidlaw

1915. *Prosticta carmichaell* Laidlaw, *Rec. Ind. Mus.*, **11**: 390.

1933. *Drepanosticta carmichaeli*, Fraser, *Fauna Brit. Ind. Odon.* **1** : 142-144

Material: Doiwala, 2 ♂♂; Lachhiwala, 2 ♂♂; Kansrao, 1 ♀.

Measurements: Male—Abdomen, 31-32 mm. fore wing, 21-22 mm. hind wing, 20.5-21 mm. Female—Abdomen, 28-29 mm. fore wing, 21-22 mm. hind wing, 20-21 mm.

Remarks: The males collected from Dehra Dun differ slightly from the published description. They are smaller in body-length as well as in wing expanse. Postnodal nervures in the forewing vary from 14-15, and in the hind wing from 12-13. Riv+v arises from the same point or proximal to the oblique nervure. The females are also smaller in body-length and in wing expanse. Postnodal nervures vary from 13-15 in the fore wing, and 12-14 in the hind wing. In some specimens the oblique nervures descend from the subnode.

Family PROTONEURIDAE
Subfamily CACONEURINAE

Caconeura autumnalis Fraser

1922. *Caconeura autumnalis* Fraser, *Mem. Dept. Agric. India (Ent.)* **7**: 43.

1933. *Caconeura autumnalis*. Fraser, *Fauna Brit. Ind. Odon.* **1**: 223-225.

Material: Herbertpur, 4 ♂♂, 1 ♀; Rishikesh, 1 ♂, 1 ♀.

Measurements: Male—Abdomen, 27 mm. fore wing, 18 mm. hind wing, 17.5 mm. Female—Abdomen, 29 mm, fore wing, 21 mm. hind wing, 20 mm.

Remarks: The labium is brown but its basal portion is creamywhite. Pterostigma is black and covers only one cell. Postnodal nervures vary from 13-14 in the fore wing and from 11-12 in the hind wing.

Family PLATYCNEMIDIDAE

Subfamily PLATYCNEMININAE

Copera marginipes (Rambur)1842. *Platycnemis marginipes* Rambur, *Ins. Neuropt.* : 240.1933. *Copera marginipes*, Fraser, *Fauna Brit. Ind. Odon.* 1: 192-197.

Material: Asarori, 1 ♂; Herbertpur, 11 ♂♂, 2 ♀♀; Kansrao, 4 ♀♀, 1 ♀; Kalsi, 1 ♂; Rishikesh, 4 ♂♂, 4 ♀♀.

Measurements: Male—Abdomen, 30 mm; fore wing, 18.5 mm; hind wing, 17 mm. Female—Abdomen, 30 mm; fore wing, 20 mm; hind wing, 20 mm.

Remarks: Common species.

Copera vittata (Selys)1863. *Psilocnemis vittata* Selys, *Bull. Acad. Belg.* 16(2): 170.1933. *Copera vittata*, Fraser, *Fauna Brit. Ind. Odon.* 1: 198-201.

Material: Herbertpur, 1 ♀.

Measurements: Female—Abdomen, 30 mm; fore wing, 19 mm; hind wing, 19 mm.

Remarks: Very rare species.

Distribution: It is known from Southern and Eastern India, Burma, and Sri Lanka.

Subfamily CALICNEMINAE

Calicnemia miles Laidlaw

(Text-fig. 1 A, B)

1886. *Calicnemia eximia* Selys, *Mem. Cour.* 28: 131, 132.1933. *Calicnemia miles*, Fraser, *Fauna Brit. Ind. Odon.* 1: 178-181.

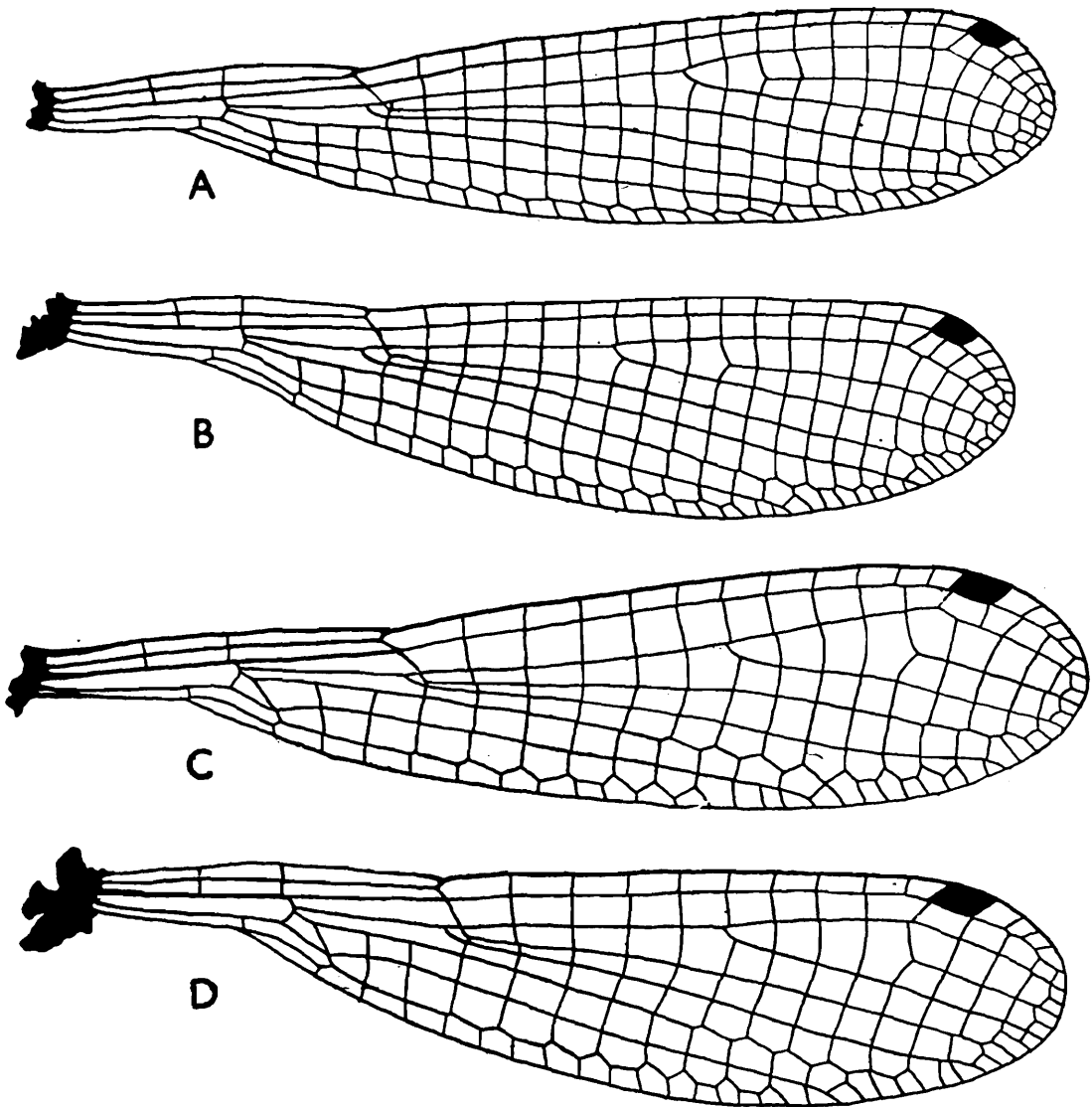
Material: Donga, 1 ♂, 1 ♀; Kandholi, 6 ♂♂, 3 ♀♀; Raipur, 4 ♂♂; Selakuan, 1 ♀; Sahastradhara, 21 ♂♂, 14 ♀♀; Timli, 1 ♀.

Measurements: Male—Abdomen, 28-30 mm; fore wing, 21-23 mm; hind wing, 20-22 mm. Female—Abdomen, 27-30 mm; fore wing, 23-26 mm; hind wing, 21.5-24 mm.

Remarks: The males are smaller in body-length as well as wing expanse. Legs are reddish yellow, Femora are not marked with black posteriorly, but in some specimens their dorsal area is marked with black. Bases of antennae brick red upto third segment. Postnodal nervures vary from 14-16 in the fore wing and from 13-15 in the hind wing. The females are also smaller. Postnodal nervures vary from 14-16 in the fore wing and from 12-14 in the hind wing.

Family GOENAGRIIDAE

Subfamily PSEUDAGRIINAE

***Pseudagrion decorum* (Rambur)**1842. *Agrion decorum* Rambur, *Ins. Neurop.* : 258.1933. *Pseudagrion decorum*, Fraser, *Fauna Brit. Ind. Odon.* 1: 286-289.*Material*: Bhaniawala, 1 ♂; Rishikesh, 1 ♂; Herbertpur, 1 ♂*Measurements*: Male—Abdomen, 29 mm; fore wing, 20.5 mm; hind wing, 19 mm.*Remarks*: Rare species.

Text-fig. 1.—(A & B) *Calicnemis miles* Laidlaw, A. Fore wing, B. Hind wing ;
 (C & D) *Ceriagrion cerinorubellum* (Brauer), C. Fore wing, D.
 Hind wing.

***Pseudagrion laidlawi* Fraser**1922. *Pseudagrion laidlawi* Fraser, *Mem. Dept. Agric. India (Ent.)*, 7(7): 48-50.1933. *Pseudagrion laidlawi*, Fraser, *Fauna Brit. Ind. Odon.* 1: 294-296,*Material*: Herbertpur, 1 ♂, 1 ♀.

Measurements: Male—Abdomen, 23.5 mm; fore wing, 17 mm; hind wing, 16 mm. Female—Abdomen, 22.5 mm; fore wing, 17 mm; hind wing, 16 mm.

Remarks: Very rare species. It differs from the published description in the following characters. Labrum is reddish yellow; post nodal nervures vary from 8-9 in the fore wing.

Distribution: It is known from Sind (Pakistan) and also from Dehra Dun.

Pseudagrion rubriceps Selys

1876. *Pseudagrion rubriceps* Selys, *Bull. Acad. Belg.* **42**: 510.

1933. *Pseudagrion rubriceps*, Fraser, *Fauna Brit. Ind. Odon.* **1**: 296-299.

Material: Bhaniawala, 6 ♂♂, 1 ♀; Bhoorpur, 1 ♂; Herbertpur, 11 ♂♂, 7 ♀♀; Haripur, 3 ♂♂, 1 ♀♀; Kalsi, 5 ♂♂, 5 ♀♀; Kansrao, 5 ♂♂; Langha, 2 ♂♂, 5 ♀♀; Mahantmajri, 1 ♂; Rishikesh, 4 ♂♂, 1 ♀; Sahstradhara 2 ♂♂, 1 ♀; Selakuan, 6 ♂♂, 1 ♀.

Measurements: Male—Abdomen, 29 mm; fore wing, 19 mm; hind wing, 19 mm; Female—Abdomen, 28 mm; fore wing, 21 mm; hind wing, 21 mm.

Remarks: A very common species. It has only 9 postnodal nervures in the fore wing and 8 in the hind wing.

Ceriagrion coromandelianum (Fabricius)

1798. *Agrion coromandelianum* Fabricius, *Ent. Syst. Suppl.*: 287.

1933. *Ceriagrion coromandelianum*, Fraser, *Fauna Brit. Ind. Odon.* **1**: 315-316.

Material: Bhaniwala, 5 ♂♂, 2 ♀♀; Bhogpur, 1 ♂; Ghandrabani, 1 ♂; Gulatappar, 3 ♂♂, 1 ♀♀; Herbertpur, 19 ♂♂, 5 ♀♀; Haripur, 1 ♂, 1 ♀; Jasowala, 5 ♂♂, 2 ♀♀; Kansrao, 10 ♂♂, 3 ♀♀; Langha, 1 ♂, 1 ♀; Lachhiwala, 6 ♂♂, 1 ♀; Mianwala, 18 ♂♂, 5 ♀♀; Rishikesh, 12 ♂♂, 5 ♀♀; Raipur, 4 ♀♀; Sabhawala, 1 ♂; Selakuan, 1 ♂; Timli, 10 ♂♂, 1 ♀.

Measurements: Male—Abdomen, 30 mm; fore wing, 20 mm; hind wing, 19 mm. Female—Abdomen, 28 mm; fore wing, 20.5 mm; hind wing, 19 mm.

Remarks: A very common species from July to October.

Ceriagrion cerinorubellum (Brauer)

(Text-fig. 1 C, D)

1865. *Pyrrhosoma cerinorubellum* Brauer, *Verh. Zool. bot. Ges. Wien.* **15**: 511.

1933. *Ceriagrion cerinorubellum*, Fraser, *Fauna Brit. Ind. Odon.* **1**: 326-328.

Material: Herbertpur, 2 ♂♂

Measurements: Male—Abdomen, 30 mm; fore wing, 19 mm; hind wing, 18 mm.

Remarks: A very rare species. It can be easily identified by its bright brick-red basal region of the abdomen,

Distribution: Throughout India and South East Asia.

Subfamily ISCHNURINAE

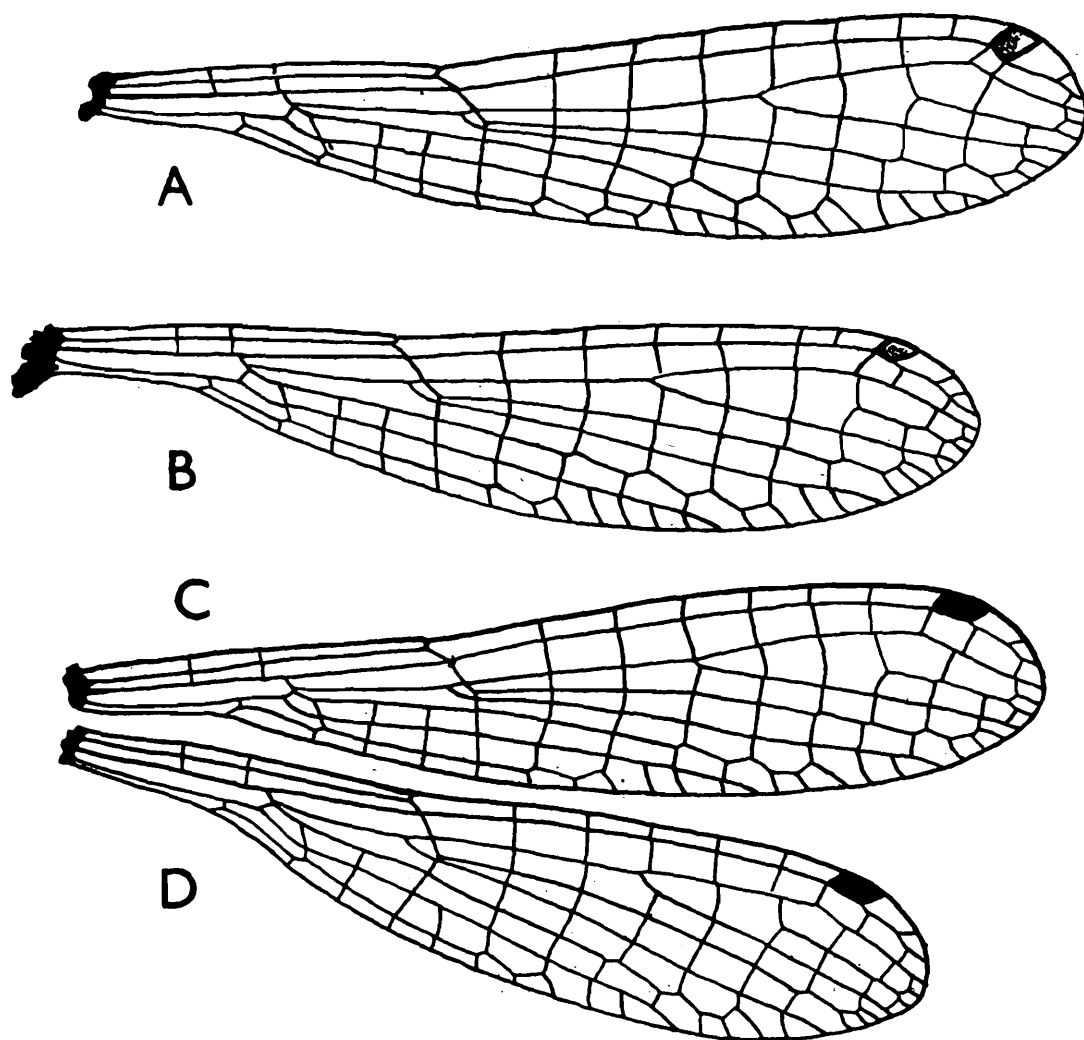
***Ischnura forcipata* Morton**

1907. *Ischnura forcipata* Morton, *Trans. ent. Soc. Lond.* p. 306.

1933. *Ischnura forcipata*, Fraser, *Fauna, Brit. Ind. Odon.* 1: 354-357.

Material: Asarori, 1 ♀; Bhaniawala, 2 ♂♂, 2 ♀♀; Bhoorpur, 1 ♂; Donga, 1 ♀; Gulatappar, 1 ♂, 3 ♀♀; Herbertpur, 20 ♂♂, 16 ♀♀; Haripur, 11 ♂♂, 9 ♀♀; Jasowala, 3 ♀♀; Kansrao, 2 ♂♂, 1 ♀; Kalsi, 19 ♂♂, 20 ♀♀; Kandholi, 2 ♂♂, 1 ♀; Karwapani, 1 ♂, 1 ♀; Langha, 3 ♂♂, 2 ♀♀; Lachhiwala, 1 ♂, 2 ♀♀; Motichur, 1 ♂; Nalapani, 1 ♂; Rishikesh, 2 ♀♀; Robber's Cave, 4 ♂♂, 4 ♀♀; Raipur, 19 ♂♂, 8 ♀♀; Selakuan, 10 ♂♂, 1 ♂, 13 ♀♀; Sahastradhara, 40 ♂♂, 15 ♀♀; Satnarain, 1 ♀; Timli, 1 ♀.

Measurements: Male—Abdomen, 23 mm; fore wing, 17 mm; hind wing, 15.5 mm. Female—Abdomen, 21 mm; fore wing, 17 mm; hind wing, 15 mm.



Text-fig. 2.—(A & B) *Ischnura delicata* (Hagen), A. Fore wing, B. Hind wing; (C & D) *Agriocnemis pygmaea* (Rambur), C. Fore wing, D. Hind wing.

Remarks: This is one of the most common species and is found throughout the year. It differs from the published description in having only 7 postnodal nervures in the hind wing.

Ischnura delicata (Hagen)

(Text-fig. 2 A, B)

1858. *Agrion delicatum* Hagen, *Verh. Zool.-bot. Ges. Wien.* **8**: 479.

1933. *Ischnura delirata*, Fraser, *Fauna Brit. Indi. Odon.* **1**: 360-362.

Material: Asarori, 1 ♂, 2 ♀♀; Bhaniawala, 7 ♂♂, 9 ♀♀; Bhogpur, 1 ♂, 2 ♀♀; Barkot, 2 ♀♀; Ghandrabani, 3 ♂♂; Gulatappar, 1 ♀, 3 ♀♀; Haripur, 1 ♂; Herbertpur, 19 ♂♂, 10 ♀♀; Jhajra, 1 ♂, 3 ♀♀; Jasowala, 26 ♂♂, 10 ♀♀; Kansrao, 2 ♂♂; Kalsi, 5 ♂♂, 3 ♀♀; Kuanwala, 1 ♂; Lachhi, wala, 7 ♂♂, 4 ♀♀; Langha, 2 ♂♂; Mahant-majri, 4 ♂♂; Mianwala, 23 ♂♂, 4 ♀♀; Motichur, 1 ♂; Maldevta, 1 ♀; Rishikesh, 3 ♂♂, 6 ♀♀; Robber's Gave, 3 ♀♀; Sahastradhara, 3 ♂♂, 3 ♀♀; Satnarain, 2, ♂♂ 4 ♀♀; Selakuan, 1 ♂, 1 ♀; Sahaspur, 26 ♂♂, 6 ♀♀; Timli, 2 ♂♂, 3 ♀♀.

Measurements: Male—Abdomen, 16-20 mm; fore wing, 11 mm; hind wing, 10.5-12 mm. Female—Abdomen, 17 mm; fore wing, 13 mm; hind wing, 12.5 mm.

Remarks: Differs slightly from the published description. In a few specimens the anterior border of the pterostigma in the fore wing is yellow and not white; *acis* situated nearer to the antenodal nervure.

Distribution: Throughout India and South East Asia.

Enallagma parvum Selys

1876. *Enallagma parvum* Selys, *Bull. Acad. Belg.* **41**: 537.

1933. *Enallagma parvum*, Fraser, *Fauna Brit. Ind. Odon.* **1**: 376-378.

Material: Raipur, 1 ♂; Haripur, 1 ♂; Herbertpur, 3 ♂♂; Kalsi, 1 ♂; Kansrao, 1 ♂; Mianwala, 3 ♂♂; Sahastradhara, 1 ♂; Bhaniawala, 2 ♂♂, 1 ♀; Timli, 1 ♂

Measurements: Male—Abdomen, 17 mm; fore wing, 11 mm; hind wing, 11 mm. Female—Abdomen, 17.5 mm; fore wing, 12 mm; hind wing, 11 mm.

Remarks: It is a fairly common species.

Subfamily AGRIOCNEMINAE

Agriocnemis clauseni Fraser

1922. *Agriocnemis clauseni* Fraser, *Mem. Dept. Agric. India, (Ent.)*, **7**(7): 53.

1933. *Agriocnemis clauseni*, Fraser, *Fauna Brit. Ind. Odon.* **1**: 390-392.

Material: Herbertpur, 16 ♂♂, 3 ♀♀.

Measurements: Male—Abdomen, 19 mm; fore wing, 12.5 mm; hind wing, 12 mm.

Female—Abdomen, 19 mm; fore wing, 13 mm; hind wing, 12.5.

Remarks: It is rather a rare species.

Distribution: Assam and West Bengal, Burma and Thailand.

Agriocnemis pygmaea (Rambur)

(Text-fig. 2 C, D)

1842. *Agrion pygmaeum* Rambur, *Ins. Neurop.*: 278.

1933. *Agriocnemis pygmaea*, Fraser, *Fauna Brit. Ind. Odon.* 1: 398-401.

Material: Bhogpur, 1 ♂; Bhianawala, 1 ♂, 3 ♀♀; Haripur, 1 ♂; Herbertpur, 5 ♂♂, 1 ♀; Jasowala, 5 ♂♂, 1 ♀; Kansrao, 1 ♂, 1 ♀; Lachhiwala, 1 ♀; Mianwala, 3 ♂♂, 1 ♀; Maldevta, 1 ♂; Motichur, 1 ♀; Raipur, 4 ♂♂; Rishikesh, 1 ♂, 1 ♀; Sahastradhara, 1 ♂, 1 ♀; Satnarain, 1 ♂; Selakuan, 2 ♂, Sabhawala, 1 ♀.

Measurements: Male—Abdomen, 19 mm; fore wing, 11.5 mm; hind wing, 10 mm. Female—Abdomen, 15 mm; fore wing, 11 mm; hind wing, 10 mm.

Remarks: It is one of the commonest species in the Valley and is represented by both type of females (Fraser, 1933).

Superfamily LESTINOIDEA

Family LESTIDAE

Subfamily LESTINAE

Lestes praemorsa praemorsa Selys

1862. *Lestes praemorsa* Selys, *Bull. Acad. Belg.* 13: 320.

1933. *Lestes praemorsa praemorsa*, Fraser, *Fauna Brit. Ind. Odon.* 1: 30-34.

Material: Asarori, 1 ♂; Bhaniawala, 1 ♂; Jaintanwala, 1 ♀; Kanddholi, 2 ♂♂; Mahantmajri, 5 ♀♀, 1 ♀; Mianwala, 19 ♂♂, 9 ♀♀; Sahastradhara, 1 ♂, 2 ♀♀; Timil, 14 ♂♂, 2 ♀♀.

Measurements: Male—Abdomen, 35 mm; fore wing, 24 mm; hind wing, 24 mm.

Female—Abdomen, 32.5 mm; fore wing, 26.5 mm; hind wing, 26 mm.

Remarks: In the males postnodal nervures of the hind wing vary from 10-13; *ac* of the hind wing is situated slightly proximal to the first antenodal nervure. Some of the females have 13 nervures; *ac* situated nearer to the first antenodal nervure; and their anal appendages are blackish brown and not creamy white.

Distribution: It is known to extend from Western India to Burma and to southern Asia.

Lestes viridula Rambur

(Text-fig. 3 A, B)

1842. *Lestes viridula*, Rambur, *Hist. Nat. Ins. Neurop.* p. 252.

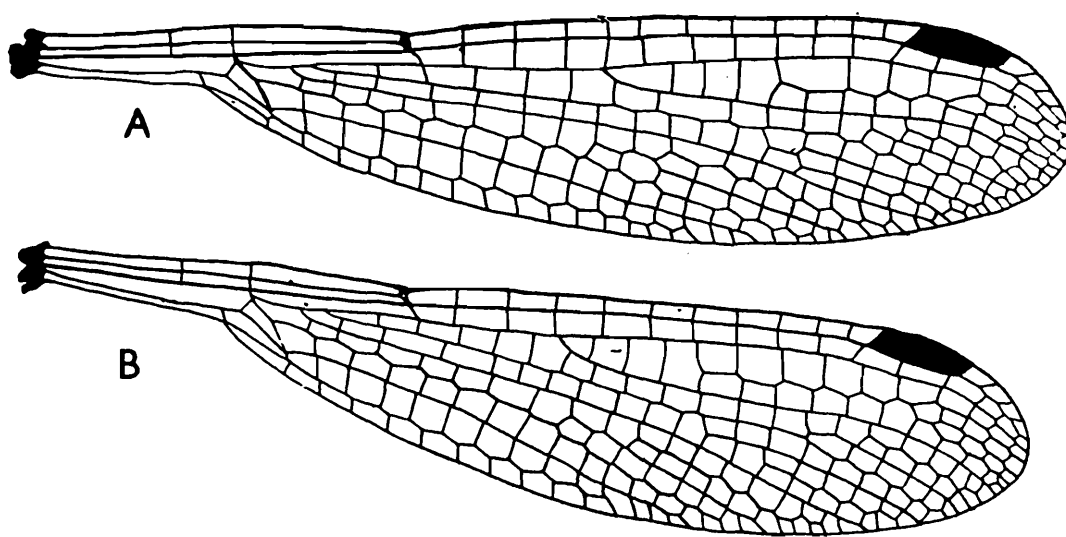
1933. *Lestes viridula*, Fraser, *Fauna Brit. Ind. Odon.* 1: 45-46.

Material: Asaroir, 3 ♂♂; Barkot, 2 ♂♂, 1 ♀; Lachhiwala, 1 ♂, 1 ♀; Mianwala, 2 ♂♂, 1 ♀; Phanduwala, 1 ♂; Rudarpur, 1 ♂; Timli, 1 ♂, 2 ♀♀.

Measurements: Male—Abdomen, 33 mm; fore wing, 24.5 mm; hind wing, 24 mm. Female—Abdomen, 34 mm; fore wing, 25 mm; hind wing, 24 mm.

Remarks: It is rather a rare species. It is usually found in the long, dry grasses and has a weak and short flight.

Distribution: It is confined to peninsular India.



Text-fig. 3.—*Lestes viridula* Rambur, A. Fore wing, B. Hind wing.

***Lestes thoracica* Laidlaw**

1920. *Lestes thoracica* Laidlaw, *Rec. Indian Mus.* **19**: 152.

1933. *Lestes thoracica*, Fraser, *Fauna Brit. Ind. Odon.* **1**: 56-57.

Material: Mianwala, 5 ♂♂, 1 ♀.

Measurements: Male—Abdomen, 29 mm; fore wing, 20 mm; hind wing, 19 mm. Female—Abdomen, 28 mm; fore wing, 21 mm; hind wing, 20 mm.

Remarks: It is a very rare species. It differs from the published description as follows. Occiput and post genae in the males are blackish brown and not creamy white. In the females facial region, dorsal to the clypeus has numerous densely placed, blackish spots.

Distribution: It is known from U.P., Bihar, West Bengal and Orissa.

Superfamily AGRIOIDEA

Family CHLOROCYPHIDAE

***Rhinocypha quadrimaculata* Selys**

1853. *Rhinocypha quadrimaculata* Selys, *Syn. Cal.*: 60.

1934. *Rhinocypha quadrimaculata*, Fraser, *Fauna Brit. Ind. Odon.* **2**: 14-17.

Material: Barkot, 1 ♂, 1 ♀; Donga, 6 ♂, 3 ♀♀; Kandholi, 1 ♂♂, 6 ♀♀; Kalsi, 12 ♂♂, 2 ♀♀; Motichur, 5 ♂♂, 3 ♀♀; Raipur 5 ♂♂, 2 ♀♀; Ramgarh, 2 ♂♂, 2 ♀♀; Sahastradhara, 6 ♂♂, 3 ♀♀.

Measurements: Male—Abdomen, 19 mm; fore wing, 24 mm; hind wing, 22.5 mm. Female—Abdomen, 19 mm; fore wing, 26 mm; hind wing, 24 mm.

Remarks: This is a fairly common species. It is usually found perched on stones and small twigs in the streams. In one specimen opaque area in the fore wing extends upto 5 cells proximal to the node. Discoidal cell traversed 3-5 times. Antenodal nervures vary from 16-20.

Rhinocypha unimaculata Selys

1853. *Rhinocypha unimaculata* Selys, *Syn. Cal.*: 61.

1934. *Rhinocypha unimaculata*, Fraser, *Fauna Brit. Ind. Odon.* 2: 27-29.

Material: Khera, 1 ♂, 1 ♀; Sahastradhara, 2 ♂♂.

Measurements: Male—Abdomen, 22 mm; fore wing, 29 mm; hind wing, 28 mm. Female—Abdomen, 22 mm; fore wing, 32 mm; hind wing, 30 mm.

Remarks: This is a very rare species.

Distribution: It is known from north east India and Dehra Dun.

Rhinocypha trifasciata Selys

1853. *Rhinocypha trifasciata* Selys, *Syn. Cal.*: 61.

1936. *Rhinocypha trifasciata*, Fraser, *Fauna Brit. Ind. Odon.* 2: 31-33.

Material: Donga, 5 ♂♂, 3 ♀♀; Kandholi, 3 ♂♂; Sahastradhara, 13 ♂♂, 8 ♀♀;

Measurements: Male—Abdomen, 20 mm; fore wing, 25.5 mm; hind wing, 24 mm. Female—Abdomen, 20 mm; fore wing, 28 mm; hind wing, 28 mm.

Remarks: This is a rare species.

Distribution: It is known from U.P. and Himachal Pradesh.

Rhinocypha biforata beelsoni Fraser

1922. *Rhinocypha beelsoni* Fraser, *Mem. Dept. Agric. India (Ent.)*, 7: 61.

1934. *Rhinocypha biforata beelsoni*, Fraser, *Fauna Brit. Ind. Odon.* 2: 48-49.

Material: Karwapani, 1 ♂; Kansrao, 1 ♂.

Measurements: Male—Abdomen, 18 mm; fore wing, 24 mm; hind wing, 24 mm.

Remarks: This is a very rare species.

Distribution: It is known from Dehra Dun and Burma.

Libellago lineata lineata (Burmeister)

1839. *Calopteryx lineata* Burmeister, *Handb. Ent.* 2: 826.

1934. *Libellago lineata lineata*, Fraser, *Fauna Brit. Ind. Odon.*, 2: 60-63.

Material: Herbertpur, 6 ♂♂, 9 ♀♀; Kansrao, 2 ♂♂.

Measurements: Male—Abdomen, 13 mm; fore wing, 18 mm; hind wing, 17 mm. Female—Abdomen, 12 mm; fore wing, 20 mm; hind wing, 20 mm.

Remarks: This is a rare species. The nodal index of the males is higher in number. The antenodal nervures are 6, postnodal nervures 11.

Family EPALAGIDAE

Bayadera indica (Selys)

1853. *Epallage indica* Selys, *Syn. Cal.*: 49

1934. *Bayadera indica*, Fraser, *Fauna Brit. Ind. Odon.* 2: 79-81.

Material: Haripur, 2 ♂♂; Khera, 5 ♂♂; Sahastradhara, 19 ♂♂, 8 ♀♀.

Measurements: Male—Abdomen, 36 mm; fore wing, 33.5 mm; hind wing, 32 mm. Female—Abdomen, 32-36 mm; fore wing, 36 mm; hind wing, 32-36 mm.

Remarks: A yellowish green, rounded spot is present near each of the lateral ocelli. Pterostigma covers $7\frac{1}{2}$ cells. First and second abdominal segments are heavily pruinosed. Postnodal nervures of the females vary from 22-23 in the fore wing and from 18-19 in the hind wing.

Anisopleura lestoides Selys

1853. *Anisopleura lestoides* Selys, *Syn. Cal.*: 48.

1934. *Anisopleura lestoides*, Fraser, *Fauna Brit. Ind. Odon.* 2: 86-87.

Material: Jhajra, 3 ♂♂; Sahastradhara, 2 ♂♂.

Measurements: Male—Abdomen, 36 mm; fore wing, 29 mm; hind wing, 27 mm.

Remarks: This is a very rare species.

Distribution: It is known from Nainital, West Bengal, Assam and Sikkim.

Anisopleura comes Selys

1880. *Anisopleura comes* Selys, *C.R. Soc. Ent. Belg.* 23: 63.

1934. *Anisopleura comes*, Fraser, *Fauna Brit. Ind. Odon.* 2: 87-89.

Material: Sahastradhara, 1 ♂.

Measurements: Male—Abdomen, 37 mm; fore wing, 33 mm; hind wing, 31 mm.

Remarks: This is a very rare species.

Distribution: It is known from Dehra Dun, Punjab, Assam and Sikkim.

Family AGRIIDAE

Subfamily AGRIINAE

***Neurobasis chinensis chinensis* (Linnaeus)**

1758. *Libellula chinensis* Linnaeus, *Syst. Nat.* 1: 545.

1934. *Neurobasis chinensis chinensis*, Fraser, *Fauna Brit. Ind. Odon.* 2: 121-124.

Material: Barkot, 1 ♂; Gulatappar, 1 ♂, 1 ♀; Haripur, 3 ♂♂, 4 ♀♀; Herbertpur, 2 ♂♂; Kansrao, 2 ♂♂, 4 ♀♀; Kalsi, 1 ♂, 1 ♀; Maldevta, 2 ♂♂; Raipur, 3 ♀♀; Rajpur, 1 ♂; Ramgarh, 2 ♂♂, 2 ♀♀; Sahastradhara, 42 ♂♂, 14 ♀♀; Timli, 1 ♂.

Measurements: Male—Abdomen, 46 mm; fore wing, 34 mm; hind wing, 32 mm. Female—Abdomen, 39 mm; fore wing, 36 mm; hind wing, 34 mm.

Remarks: This is a very common species. In the males the Labium is yellowish white, with metallic green sides. Discoidal cell is traversed 7-10 times. In the females the labium is yellow.

SUMMARY

Forty two species of Anisoptera and 27 species of Zygoptera have been recorded from Doon Valley. Twenty one of these have been recorded from this valley for the first time. Differences wherever noted from the published description have been recorded.

REFERENCES

- FRASER, F. C. 1933. *The Fauna of British India, Odonata*, 1. xiii-423 pp.—London (Taylor and Francies).
- FRASER, F. C. 1934. *The Fauna of British India, Odonata*, 2. xxiii-398 pp.—London (Taylor and Francis).
- FRASER, F. C. 1936. *The Fauna of British India, Odonata*, 3. xi-461 pp.—London (Taylor and Francis).
- SINGH, A. and M. PRASAD 1974. New Records of Odonata from North West India, *J. Bombay nat. Hist. Soc.* Bombay 70(2) : 403-405.

STUDIES ON SOME INDIAN ALEYRODIDAE*

By

B. VASANTHARAJ DAVID¹

and

T R. SUBRAMANIAM²

INTRODUCTION

Aleyrodids or whiteflies are small, inconspicuous phytophagous insects often overlooked in spite of their abundance. This is evident from lack of substantial work on this group in this country for the past quarter of a century or more. Several species are known to be economically important and particular mention may be made of species such as the greenhouse whitefly *Trialeurodes vaporariorum* (Westwood), the sugarcane whiteflies *Neomaskellia bergii* (Signoret) and *Aleurolobus barodensis* (Maskell), the jasmine aleyrodid *Dialeurodes kirkaldyi* (Kotinsky), the citrus whiteflies *Aleurocanthus woglumi* Ashby, *Dialeuroloonga elongate* (Dozier) and *Dialeurodes citri* Ashmead and the cotton whitefly *Bemisia tabaci* (Gennadius). The last named species has also been known to be the vector of a number of virus diseases of crop plants. The aleyrodids inhabit the leaves of plants, generally the undersurface, and a few species are found on petioles and stem. They are typically pests of angiosperms, most species infesting dicotyledonous plants; a few have been reported to infest ferns. Aleyrodids are mostly restricted to the tropics and subtropics though they have also been reported to occur in the cooler regions of the world.

The adult aleyrodids are small forms, with 7-segmented antennae, two ocelli, a pair of compound eyes and both sexes with two equal pairs of opaque, whitish, clouded or mottled or banded wings; the rostrum is 3-segmented and tarsi 2-segmented. Four larval instars are characteristic, the last, the 'pupal instar', being of considerable value in the determination of species in view of the possession of many striking characteristics in the 'pupal case' or the last larval exuvium.

The economic importance of this group of insects has been well realised in other countries particularly in North America and Europe and much headway has been made on the studies of this group both on systematics and bionomics. There are many species of aleyrodids in India causing substantial damage to cultivated crops but, however, very little work has been done on this group as a whole. The high economic status of these insects and lack of sufficient information of

*Being part of the thesis submitted by the first author to the Tamil Nadu Agricultural University, Coimbatore for the degree of Ph.D.

¹ Department of Entomology, Tamil Nadu Agricultural University, Coimbatore.

² Professor and Head of the Department of Entomology, Tamil Nadu Agricultural University, Coimbatore 641003,

this group necessitates taking up intensive studies on these interesting insects, with particular reference to taxonomy, and the present study is a further contribution to the knowledge of Indian Aleyrodidae.

REVIEW OF LITERATURE

Though Cestone was the first to notice an aleyrodid in the 17th century, it was left to Reaumur (1734) to describe it and place it among the moths, and for which Linnaeus (1758) gave the name *Phalaena* (*Tinea*) *proletella*. Later it was placed under Hemiptera by Latreille in 1796, who christened it as *Aleyrodes* referred to as *Aleurodes* by Burmeister (1835). It was only in the year 1840 the family Aleyrodidae was established by Westwood and the first world monograph on the family was published by Signoret (1868) which included twentythree species, and a further addition of fortythree species was made by Maskell (1895) making the total sixtysix.

Reviewing the essential world literature pertaining to aleyrodids it may be found that the North American species were listed by Quaintance (1900), Cockerell (1902) and Bemis (1904). Kirkaldy (1907) published a systematic and bibliographic catalogue of the species of the world and in 1909 Quaintance listed 141 species. A comprehensive revision of the family was made by Quaintance and Baker (1913, 1914 and 1917) and these contributions formed the basis for modern classification of the family. Hempel (1922 and 1923) and Bondar (1923) erected several genera from South America. Since then a number of workers contributed to the study of the Nearctic species of aleyrodids and mention may be made of the papers of Dozier (1927) on aleyrodids of Porto Rico, and of Baker (1937), Sampson (1944 and 1945), Sampson and Drews (1940, 1941 and 1944), Russell (1947 and 1948), and Drews and Sampson (1956 and 1958) on North American species, and of Russell (1943) on West Indies species.

The Japanese aleyrodids were studied by Kuwana (1911 and 1927) and Takahashi (1934b, 1935b & c, 1938a, 1946, 1949a, 1952c, 1954, 1955b, 1957, 1960 and 1963). Dozier (1928) and Dumbleton (1961a) reported on aleyrodids of South Pacific. The aleyrodids of New Caledonia were investigated by Cohic (1959a, b and c) and Dumbleton (1956b and 1961a) and those of Formosa, Island of ReUnion, Micronesia and Mauritius by Takahashi (1932, 1933, 1934a, 1935a, 1936, 1938b, 1939 and 1956). The aleyrodids of Australia and New Zealand were published by Takahashi (1937 and 1950) and Dumbleton (1956a and 1957).

The aleyrodids of Palaearctic region were studied by a number of workers and the contributions of Silvestri (1914 and 1915) on Italian species, of Goux (1949) on French species, of Gomez-Menor (1943, 1945 and 1954) on Spanish aleyrodids, of Ossiannilsson (1944 and 1955) on Swedish species, of Takahashi (1949b) on aleyrodids of Riouw Islands, of Chou (1949) on Chinese aleyrodids, of Danzig (1964) on Russian species, of Zahradnik (1956, 1957, 1961 and 1963) on Czechoslovakian aleyrodids, of Dobreanu and Manolache (1956) on Rumanian aleyrodids and of Klimaszewski and Szelegiewicz (1962) on aleyrodids of Poland form some important publications. Though the British whiteflies were investigated by Harrison (1920) and Trehan (1938 and 1940),

a revision of them was recently done by Mound (1962a, 1966 and 1967).

In the study of Ethiopian aleyrodid fauna, though Newstead (1911 and 1921), Dozier (1934), Corbett (1935), Gomez-Menor (1954) and Russell (1960 and 1962) made some contributions to the study of African species, it was Mound (1961 and 1965a) and Cohic (1966 a and b) who made some substantial contribution adding eight new genera and a number of new species. The aleyrodids of Canary Islands were studied by Gomez-Menor (1954). The Egyptian species were dealt with by Priesner and Hosny (1932 and 1934a and b). Takahashi (1951a, 1952b, 1955a, 1961 and 1962) and Takahashi and Mamet (1952) described a large number of new species and erected ten new genera from Madagascar.

In the Oriental region the study of aleyrodids first received attention in India and the Indian species were studied by Maskell (1895), Buckton (1903), Peal (1903), Quaintance and Baker (1917), Misra (1923), Dozier (1928), Corbett (1935 and 1939), Singh (1931, 1938, 1940 and 1944), Takahashi (1950) and Rao (1958). Singh (1932, 1933, 1938 and 1944) reported on aleyrodids of Burma. The Ceylonese and Malayan species of aleyrodids were published by Corbett (1926, 1927 and 1935) and Takahashi (1951b and 1952a). Takahashi (1942a and b, 1943 and 1950) contributed to the study of aleyrodids of Thailand, French Indo-China and Borneo.

The biology, ecology and control of a few economically important species have been investigated by several workers. Morrill (1903) first observed parthenogenesis and later in collaboration with Back (1911) reported that unfertilised eggs gave rise to males. In *Trialeurodes vaporariorum* (Westwood) unusual parthenogenetic behaviour was noticed in that the American race gave rise to males when reproduced parthenogenetically and the English race to females (Morrill 1903; Hargreaves 1915; Williams 1917; Stoll and Schull, 1919; Schrader, 1920 and 1926, and Thomsen, 1925 and 1927). The seasonal colour variations in the British whitefly *Aleyrodes fragariae* Walker (= *A. loniceræ* Walker) were studied by Trehan (1939). The contributions on the bionomics, ecology and control of the Greenhouse whitefly *Trialeurodes vaporariorum* (Westwood) (Morrill 1903, Hargreaves 1915 and Lloyd 1922), the British cabbage whitefly *Aleyrodes proletella* (Linnaeus) = *A. brassicae* Walker) (Butler 1938a and b and Elkhidir 1967) and the cotton whitefly, *Bemisia tabaci* (Gennadius) on tobacco in Israel (Avidov 1956) are important. Mound (1962b) studied olfaction and colour sensitivity in *Bemisia tabaci* (Gennadius). Mound (1965b) working on the effect of *Bemisia tabaci* (Gennadius) on cotton in the Sudan Gezira reported serious reduction in cotton yield and lowering of the seed weight and the lint weight per boll. In the recent years the importance of host-correlated variations in aleyrodids was brought out by Russell (1948) and Mound (1963). In the field of biological control of pests, biological control of the citrus black fly *Aleurocanthus woglumi* Ashby by the introduction of its natural enemies received greater attention (Woglum 1913, Gowdey and Ashby 1921, Edwards 1932, Smith *et al.* 1964, Bennett and Whervin 1965 and Whervin 1968).

The rôle of the whitefly *Bemisia tabaci* (Gennadius) as an important vector of virus diseases of crops in the field of economic entomology

needs no emphasis. 'Leaf crinkle' or 'leaf curl' of cotton in Nigeria and Sudan 'Cassava mosaic' in Africa are known to be transmitted by the whitefly (Golding 1930 and 1936, Kirkpatrick 1930 and 1931).

While reviewing in particular the taxonomic work done so far in India, it may be seen that Maskell (1895) was the first to study Indian aleyrodids who described five new species. Peal (1903) added seven new species and Buckton (1903) one more new species. Quaintance and Baker (1917) described a number of new species from the material collected by R. S. Woglum from the Orient in 1910 and this is the second occasion on which Indian material was handled. Misra (1923) added a new species from castor, and Dozier (1928) added one more new species *Dialeurodes (Dialeurolonga) elongata*. It was Singh (1931) who made a somewhat detailed study of the family in India recording 44 species of which 25 were new. Subsequently, Corbett (1935 and 1939) added three new species and Singh (1938, 1940 and 1944) included five more species to his original list. Takahashi (1950) added one new species in the genus *Tetraleurodes*. Though Singh's paper (1931) formed a significant contribution to the study of Indian aleyrodids, he dealt with only three species from southern parts of India. His few subsequent papers were also on species from north India. Though Ayyar in 1923 made mention of eight species (without giving their scientific names) as occurring in South India only in 1940 he furnished some notes on aleyrodids of sugarcane, citrus, jasmine, Eugenia, castor, and pomegranate. Usman and Puttarudraiah (1955) listed eight species from Mysore State and Rao (1958) twentytwo species from Hyderabad (Andhra Pradesh). It may be inferred from the above that a large gap exists in our knowledge of aleyrodid fauna of India.

Analysing the work done on different aspects of the group in this country, it must be said that studies on morphology, biology, population dynamics, ecology, control and economic importance have received fairly appreciable attention. Roonwal (1936) detailed sexual dimorphism and post-embryonic growth in *Dialeurodes dissimilis* Quaintance and Baker. Rakshpal (1940a and b, and 1941) reported on the morphology and mode of working of genitalia, mechanism of respiration, and post-embryonic development of male genitalia and respiratory system. Singh (1936, 1943, 1948 and 1955) reported on antennae, external genitalia and vasiform orifice of adult aleyrodids and vasiform orifice of larval aleyrodid. The morphology of the adults of *Aleurolobus barodensis* (Maskell) and *Trialeurodes rara* (Singh) were studied by Mahmood (1955) and Kurian (1962) respectively. Singh (1931), while working on Indian aleyrodids, added brief notes on the biology of a number of species. Husain (1930), Husain and Trehan (1933, 1940 and 1942), and Husain *et al.* (1936) made detailed studies of *Bemisia tabaci* (Gennadius) on cotton, and Pruthi and Samuel (1942), and Samuel (1950) on the study of biology and natural enemies of the insect on tobacco. The life-cycle of citrus aleyrodids and their control in the Punjab were reported by Husain and Khan (1945). Investigations were also carried out from time to time on various aspects of the two aleyrodid pests of sugarcane *Neomaskellia bergii* (Signoret) and *Aleurolobus barodensis* (Maskell) by a number of workers (Misra 1921, Mathur 1941, Gupta 1938, 1939 and 1953; Prasad, 1954, Mahmood, 1955, Basheer, 1956, Khan and Krishnamurthy Rao, 1956, Giridhari Lal, 1958, Leela

David *et al.* 1962, and Agarwal and Siddiqui 1964. Khanna *et al.* (1948) and Gupta and Avasthy (1955) reported on sampling the incidence of whitefly on sugarcane. A loss of 30-40 per cent in sucrose and 20-25 per cent in total solids due to whitefly attack in sugarcane and 1.21, 2.71 and 2.81 unit loss of sugar recovery in light, medium and heavy attacks, respectively, have been estimated by various workers (Agarwal and Siddiqui 1964). David (1961, 1963) investigated the effects of weather factors on the occurrence of the aleyrodids *Aleurocanthus spiniferus* Quaintance on rose and *Siphoninus phillyreae* Haliday on pomegranate and also the host-predator relationship in the latter. The biology and control of the castor whitefly *Trialeurodes rara* Singh were also studied by Kurian (1962), David and Radha (1964), Radha (1971) and Sundara Babu (1971). In India 'leaf crinkle' or 'leaf curl' of cotton, 'leaf curl' of tobacco, tomato and *Zinnia elegans*, 'yellow vein mosaic' of *Abelmoschus esculentus* (lady's finger), pumpkin and *Althaea rosea* (hollyhock), Dolichos yellow mosaic, double bean yellow mosaic, leaf curl and enation mosaic of *Hibiscus rosasinensis*, papaya leaf curl, potato necrosis and sunnhemp phyllody are known to be transmitted by the well known whitefly vector *Bemisia tabaci* (Gennadius) (Mathur, 1933; Uppal *et al.* 1940; Pruthi and Samuel 1937, 1939, 1941 and 1942; Cooper and Varma 1948 and 1950; Cooper 1950 and John 1957).

A perusal of the above review of literature reveals the neglect in the taxonomic studies of this important group of insects in this country, particularly in South India.

CLASSIFICATION OF ALEYRODIDAE

(Keys to subfamilies and tribes)

Phalaena (Tinea) proletella described by Linnaeus in 1758 and placed by him among moths formed the first valid species of the family. Its hemipterous nature was recognised in 1796 by Latreille who erected the genus *Aleyrodes*. However, only in 1810 *proletella* was made the type of the genus *Aleyrodes*. The family name Aleyrodidae was established by Westwood in 1840. In 1909 Enderlein recognised two subfamilies Udamoselinae and Aleyrodinae and one more new subfamily Uraleyrodinae was erected by Sampson and Drews (1941).

Although aleyrodids were known since 1758 it was only in 1943 tribes under this family were recognised by Sampson for the first time who proposed five tribes and named them as Neomaskellini, Aleurochitonini, Siphonini, Dialeurodini and Aleyrodini. A sixth tribal division was proposed by Russell (1947) and two more new tribes, Aleurocanthini and Aleurolobini were recognised by Takahashi (1954).

At present the classification of the major groupings higher than tribes and genera are based primarily on wing venation and secondarily on characters of pupal case. The tribes and genera are now principally recognised from pupal cases (Sampson, 1943). Russell (1947) pointed out that "accurate definition of tribes in the Aleyrodidae is a perplexing problem, owing to the paucity of morphological characteristics indicative of tribal limits" and scarcity of positively associated stages as majority of species are known only by pupal cases.

The contributions of Quaintance and Baker (1913, 1914 and 1917) formed the basis for modern classification of the family. Sampson (1943) attempted a new generic classification based on a reshuffling of characters of pupal cases and proposed new tribal divisions too. In 1947 he proposed additions and corrections to his earlier work. Russell (1947 and 1948) brought out the taxonomic importance of the structural details of the ventral surface of pupal case and also the possibility of recognising the male case by the presence of the bifid sac or male organ. Sampson and Drews (1956) published an upto date key to genera of the subfamily Aleyrodinae which served as an excellent basis for determination of seventyfive genera known at that time. Since then 24 new genera have been added to the list making the total genera 99 known till date. A brief account of the system of classification of Aleyrodidae upto tribes is detailed hereunder.

Superfamily: ALEYRODOIDEA Handlirsch, 1903

Family : ALEYRODIDAE Westwood, 1840

Subfamily: 1. URALEYRODINAE Sampson and Drews, 1941

Subfamily: 2. UDAMOSSELINAE Enderlein, 1909

Subfamily: 3. ALEYRODINAE Enderlein, 1909.

Tribes of subfamily Aleyrodinae :

1. Neomaskellini Sampson, 1943
2. Aleurochitonini Sampson, 1943
3. Siphonini Sampson, 1943
4. Dialeurodini Sampson, 1943
5. Aleyrodini Sampson, 1943
6. Trialeurodini Russell, 1947
7. Aleurocanthini Takahashi, 1954
8. Aleurolobini Takahashi, 1954.

Key to Subfamilies of the family Aleyrodidae

(Sampson, 1943, *Ent. Amer. (N.S.)*, 23(3): 183)

a. PUPAL CASES

1. Vasiform orifice invisible, hidden by caudal horn... .. *Uraleyrodinae*
Vasiform orifice visible. .2
2. Case with compound or agglomerate pores; if with simple pores, case thin and flat, operculum transversely rectangular, lingula conical and included; tracheal folds rarely present; margin smooth or with one row of teeth. .. *Udamoselinae*
Case without compound or agglomerate pores; tracheal folds often present; margin often with two rows of teeth. *Aleyrodinae*

b. ADULTS

1. Paronychium spine-like; forewing may have costal, subcostal, radial, cubital, medial, and anal veins. ... *Udamoselinae*
Paronychium blade-like; forewing may have radial, and cubital veins. .. *Aleyrodinae*

Key to Tribes of the subfamily Aleyrodinae

- | | | | |
|---|------|-----|--------------------------|
| 1. Vasiform orifice transversely elliptical, wider than long; lingula extremely short, hardly longer than wide. | | | . <i>Neomaskellini</i> |
| Vasiform orifice not transversely elliptical, at least as long as wide. | | | .2 |
| 2. Dorsum completely covered with simple pores. | | | . <i>Aleurochitonini</i> |
| Dorsum with relatively few simple pores. | | | ..3 |
| 3. Dorsum with elongate, siphon-like wax tubes. | ... | ... | . <i>Siphonini</i> |
| Dorsum without siphon-like wax tubes. | | | .4 |
| 4. Tracheal pores or clefts usually present; if absent vasiform orifice definitely notched at hind end and caudal furrow distinctly defined, or lateral ridges (rhachis) developed on the abdomen and dorsum with many short spine-like setae, many of which are capitate. Lingula usually small, wanting long setae. Tracheal combs and eye spots lacking. | | | . <i>Dialeurodini</i> |
| Tracheal pores or clefts absent, tracheal combs sometimes developed; vasiform orifice not notched at the hind end. Lingula sometimes large, exposed and with a pair of long setae. Eye spots present in some species. | .. | | .5 |
| 5. Submargin with a row of disc pores and porettes with variously associated conspicuous papillae. | | | . <i>Trialeurodini</i> |
| Submargin without a row of disc pores and porettes. | | ... | .6 |
| 6. Seventh abdominal segment nearly as long as or a little shorter than the sixth; vasiform orifice rounded, not elongate, sometimes elevated; lingula concealed; caudal furrow absent. | .. | ... | . <i>Aleurocanthini</i> |
| Seventh abdominal segment much shortened at the median area in many genera; vasiform orifice subcordate, triangular or truncated at the hind end, elongated in some species; lingula exposed, knobbed; caudal furrow sometimes developed. | | | .7 |
| 7. Knobbed part of lingula elongate, much longer than wide. | ... | .. | . <i>Aleurolobini</i> |
| Knobbed part of lingula globular, not distinctly longer than wide.... | ... | | . <i>Aleyrodini</i> |

STUDIES ON SOME INDIAN ALEYRODIDS

There has been a considerable neglect in the taxonomic studies on this group and the available information on the occurrence of species is thoroughly inadequate. This study, therefore, aims at providing a means of recognising the genera and species on the basis of examination of pupal cases and involves:

- (a) Description of new genera and species from this country.
- (b) Revision and redescription of poorly known species.
- (c) Recording of species new to this geographical region.

- (d) Aleyrodid—aleyrodid, and aleyrodid—other insects association on the same host plant.
- (e) Host correlated variations in a few species of aleyrodids studied.

In the present work sixty species in twentyfour genera are discussed, of which thirty are new to science. Further, one new genus has been erected in addition to three new combinations suggested and six known genera recorded for the first time in this country. A few already known Indian species have been assigned to three genera hitherto not recorded from India. Four species known outside the country have been reported for the first time to occur in India. In addition, seven species so far known to occur only in northern part of the country have also been observed to be prevalent in South India. The various species studied are listed below.

LIST OF SPECIES OF ALEYRODIDS STUDIED

- I. Genus *Acaudaleyrodes* Takahashi
 1. *A. rhachipora* (Singh)
- II. Genus *Aleurocanthus* Quaintance and Baker
 2. *A. davidi* sp. n.
 3. *A. loyolae* sp. n.
 4. *A. mangiferae* Quaintance and Baker
 5. *A. marudamalaiensis* sp. n.
 6. *A. rugosa* Singh
 7. *A. seshadrii* sp. n.
 8. *A. spiniferus* Quaintance
 9. *A. splendens* sp. n.
 10. *A. valparaiensis* sp. n.
 11. *A. woglumi* Ashby
- III. Genus *Aleurocybotus* Quaintance and Baker
 12. *A. indicus* sp. n.
- IV. Genus *Aleurolobus* Quaintance and Baker
 13. *A. barodensis* (Maskell)
 14. *A. confusus* sp. n.
 15. *A. marlatti* (Quaintance)
 16. *A. moundi* sp. n.
- V. Genus *Aleuromarginatus* Corbett
 17. *A. kallarensis* sp. n.
 18. *A. tephrosiae* sp. n.
- VI. Genus *Aleuroplatus* Quaintance and Baker
 19. *A. alcocki* (Peal)
 20. *A. mysorensis* sp. n.
- VII. Genus *Aleurotrachelus* Quaintance and Baker
 21. *A. caeruleascens* Singh
 22. *A. coimbatorensis* sp. n.
 23. *A. multipapillus* Singh

- VIII. Genus *Aleurotuberculatus* Takahashi
24. *A. cardamomi* sp. n.
25. *A. psidii* (Singh)
26. *A. russellae* sp. n.
27. *A. takahashii* sp. n.
- IX. Genus *Asterobemisia* Tehan
28. *A. moringae* sp. n.
- X. Genus *Asterochiton* Maskell
29. *A. cordiae* sp. n.
- XI. Genus *Bemisia* Quaintance and Baker
30. *B. haneocki* Corbett
31. *B. jasminum* sp. n.
32. *B. tabaci* (Gennadius)
- XII. Genus *Dialeurodes* Cockerell
33. *D. armatus* sp. n.
34. *D. bassiae* sp. n.
35. *D. cardamomi* sp. n.
36. *D. dissimilis* Quaintance and Baker
37. *D. distinctus* sp. n.
38. *D. eugeniae* (Maskell)
39. *D. indicus* sp. n.
40. *D. ixorae* Singh
41. *D. kirkaldyi* (Kotinsky)
- XIII. Genus *Dialeurolonga* Dozier
42. *D. elongata* (Dozier)
43. *D. fici* sp. n.
- XIV. Genus *Dialeuropora* Quaintance and Baker
44. *D. decempuncta* Quaintance and Baker
45. *D. pterolobiae* sp. n.
- XV. Genus *Indoaleyrodes* g. n.
46. *I. pustulatus* g. et sp. n.
- XVI. Genus *Lipaleyrodes* Takahashi
47. *L. crossandrae* sp. n.
48. *L. euphorbiae* sp. n.
- XVII. Genus *Neomaskellia* Quaintance and Baker
49. *N. bergii* (Signoret)
- XVIII. Genus *Neopealius* Takahashi
50. *N. nilgiriensis* sp. n.
- XIX. Genus *Pealius* Quaintance and Baker
51. *P. indicus* sp. n.
52. *P. schimae* Takahashi
53. *P. spina* (Singh) comb. n.
- XX. Genus *Rhachisphora* Quaintance and Baker
54. *R. trilobitoides* (Quaintance and Baker)

- XXI. Genus *Siphoninus* Silvestri
55. *S. phillyreae* (Haliday)
- XXII. Genus *Taiwanaleyrodes* Takahashi
56. *T. indicus* (Singh) comb. n.
- XXIII. Genus *Trialeurodes* Cockerell
57. *T. rara* Singh
58. *T. ricini* (Misra)
59. *T. vaporariorum* (Westwood)
- XXIV Genus *Zaphanera* Corbett
60. *Z. publicus* (Singh) comb. n.

MATERIALS AND METHODS

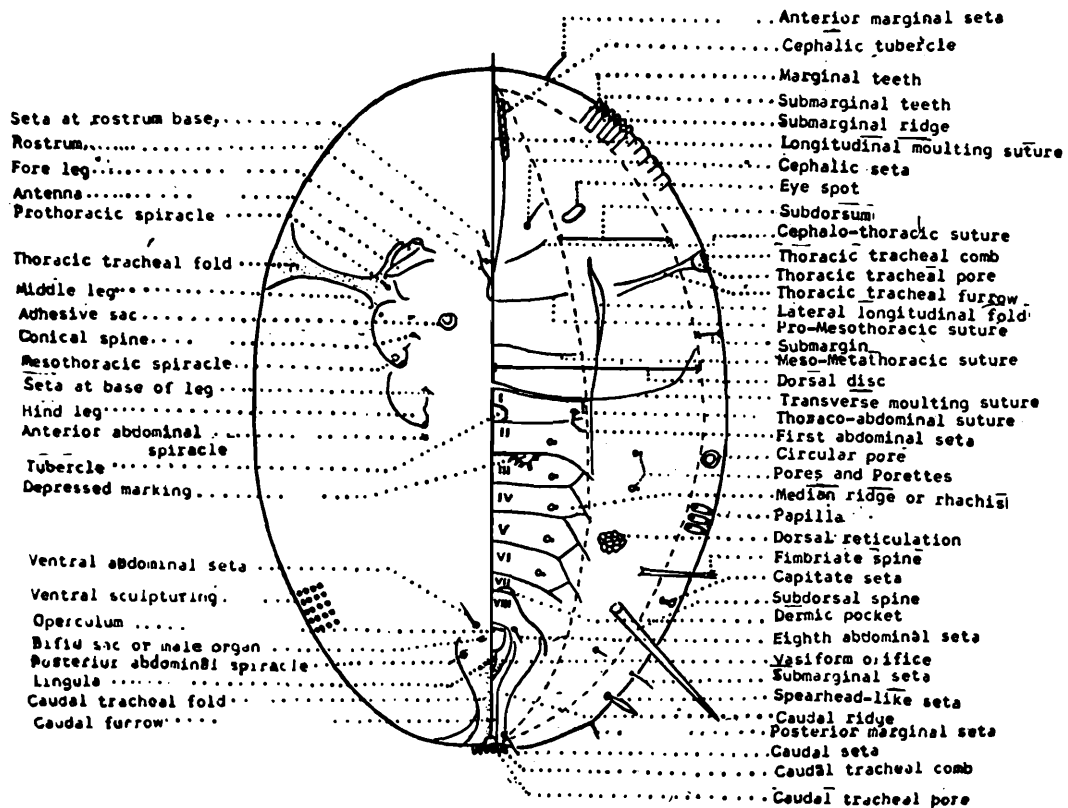
The material for the present study was collected from leaves bearing pupal cases mainly from different parts of three States viz., Tamil Nadu, Kerala and Karnataka in South India.

In the preparation of permanent mounts for critical studies, the pupal cases, from which adults have emerged, were carefully removed from the leaf surface with a very fine needle. Dry specimens were moistened prior to removal. The specimens were treated with 10 percent sodium hydroxide solution and heated gently for 10-15 minutes, depending on age and size of specimen. In the case of black specimens they were allowed to remain in 10 percent sodium hydroxide solution for 12 to 36 hours till they got decolourised to the desired extent. In a few cases specimens, which were very dark, required to be bleached in hydrogen peroxide. The specimens were then transferred to glacial acetic acid to neutralise the action of sodium hydroxide and also to remove wax. When necessary the specimens were cleared by gently pressing them with a fine needle bent slightly at its tip. The colourless specimens were stained with acid fuchsin and again transferred to glacial acetic acid for dehydration and removal of excess stain. Decolourised specimens were generally not stained. They were then cleared in carbonyl (a mixture of carbolic acid and Xylol at 1:3) for 10-15 minutes, then taken to clove oil and after about 5 minutes mounted in Canada balsam. All the specimens were generally mounted keeping the dorsal side above, while a few with the ventral side above. Measurements were made with an ocular micrometer and drawings with the aid of a camera lucida.

TAXONOMIC CHARACTERS OF ALEYRODIDS

The most important characteristic features that are taken into consideration in the taxonomy of aleyrodid are: presence or absence of thoracic and/or caudal tracheal folds, pores or combs; nature of combs; whether dorsal disc separated from submargin by a suture-like line or fold; shape of vasiform orifice and operculum, elevated or not; whether lingula knobbed, spatulate or otherwise, setose or not, exposed or concealed, included or extruded; whether seventh abdominal segment shorter than sixth; presence or absence of papillae, pores and porettes

on submargin and dorsal disc. The other characters of value are: marginal, submarginal and dorsal setae or spines; ventral abdominal setae; antennae and visibility of spiracles; presence or absence of setae or conical spines at base of legs and rostrum. In view of the availability



Text-fig. 1. Structural features of a generalised Aleyrodid pupal case.

of several striking characters relating to the pupal cases, which serve for determination of genera and species, it would appear unnecessary to mention in detail the essential structural features of an aleyrodid pupal case in general. The accompanying diagram (Text-fig. 1) giving the structural features of a generalised aleyrodid appears self-explanatory.

Key to genera of the Aleyrodinae of India

- | | |
|---|--|
| 1. Vasiform orifice transversely elliptical, elevated, lingula extremely short, submargin with a row of long setae; dorsum without papillae or pores. | <i>Neomaskellia</i> Quaintance and Baker, 1913 |
| Vasiform orifice not transversely elliptical, dorsum with relatively few simple pores. | .2 |
| 2. Dorsum with elongate siphon-like wax tubes. | <i>Siphoninus</i> Silvestri, 1915 |
| Dorsum without siphon-like wax tubes. | .3 |
| 3. Possessing at least one of the following characters: Thoracic tracheal folds, combs or pores; caudal tracheal folds, combs or pores. | .4 |
| Not possessing any of the above characters. | .. .21 |
| 4. Possessing only caudal fold or pore. | .5 |
| Possessing thoracic and caudal tracheal folds, pores or combs. . . | .8 |

5. Submarginal area separated from dorsal disc by a line and with wax plates in clusters arranged in a row. *Lipaleyrodes* Takahashi, 1962
 Submarginal area not separated from dorsal disc; wax plates in clusters not present. 9
6. Dorsum with two pairs of long 2-segmented setae on cephalic and first abdominal regions..
 Dorsum without 2-segmented setae. *Taiwanaleyrodes* Takahashi, 1932 7
7. Dorsum with circular raised papillae-like pores and submargin with a row of spines. *Singhiella* Sampson, 1943
 Dorsum with round patches of suture-like markings. *Aleuroclava* Singh, 1931
8. Possessing thoracic and caudal folds and/or pores 9
 Possessing thoracic and caudal folds and/or combs of teeth. 15
9. Submargin with a ring of large circular pores. *Dialeuropora* Quaintance and Baker 1917
 Submargin without a ring of large circular pores 10
10. Dorsum with furrows and reticulations; submargin with a series of spines and a row of pores. *Rhachisphora* Quaintance and Baker, 1917
 Dorsum lacking furrows and reticulations 11
11. Seventh abdominal segment not shorter than sixth. 12
 Seventh abdominal segment shorter than sixth; lingula exposed and included; vasiform orifice not surrounded by a trilobed figure. 13
12. Dorsum with fine granules and tubercles and a row of papilla-like structures... *Aleurotuberculatus* Takahashi, 1932
 Submargin without a series of papillae; vasiform orifice usually small, lingula usually concealed *Dialeurodes* Cockerell, 1902
13. Vasiform orifice subcordate, usually large; lingula knobbed; submargin with a series of pores or papillae.. . . . *Dialeurolonga* Dozier, 1928
 Vasiform orifice subtriangular or elongately triangular in shape.. 14
14. Vasiform orifice elongately triangular, operculum subcordate to transversely elliptical; lingula spatulate with a pair of terminal setae. *Bemisia* Quaintance and Baker, 1914
 Vasiform orifice subtriangular but rounded apically; floor with subparallel transverse ridges; operculum semicircular; lingula with lateral knob at base on each side without terminal paired setae. *Indoaleyrodes* n.g.
15. Submargin separated from dorsal disc by a suture-like line or fold... .. 16
 Submargin not separated from dorsal disc.. .. 17
16. Vasiform orifice surrounded by a trilobed figure; lingula hidden..... *Aleurolobus* Quaintance and Baker, 1914
 Vasiform orifice not surrounded by a trilobed figure; lingula exposed, included.. . . . *Asterochiton* Maskell, 1878

17. Vasiform orifice situated in a ribbed pyriform pit; submargin with a series of setae; lingula knobbed and exposed... .. *Pealius* Quaintance and Baker, 1914
 Vasiform orifice not situated in a ribbed pyriform pit; sub margin without a series of setae.. : . 18
18. Lingula hidden by rounded operculum.....*Aleuroplatus* Quaintance and Baker, 1914
 Lingula exposed and included.. ... : . 19
19. Submargin with a row of large papilla-like pores..*Trialeurodes* Cockerell, 1902
 Submargin lacking row of papillae like pores..20
20. Vasi-form orifice elongately triangular; operculum semi circular; lingula spatulate with a terminal pair of setae.. .. *Asterobemisia* Trehan, 1940
 Vasiform orifice triangular with caudal end rounded; lingula knobbed bearing a pair of terminal setae.. . *Neopealius* Takahashi, 1954.
21. Margin with two rows of teeth.22
 Margin smooth or with one row of teeth. .23
22. Dorsum with a prominent central ridge; vasiform orifice not elevated.....*Aleurotrachelus* Quaintance and Baker, 1914
 Dorsum with small circular pores; vasi-form orifice elevated.*Zaphanera* Corbett, 1926
23. Submarginal area separated from dorsal disc by a line; vasiform orifice elevated; lingula hidden. *Tetraleurodes* Cockerell, 1902
 Submarginal area not separated from dorsal disc; vasiform orifice may or may not be elevated; lingula hidden orexposed.24
24. Operculum extremely short; vasiform orifice elevated and elongately elliptical. .. *Acaudaleyrodes* Takahashi, 1951
 Operculum not extremely short; vasiform orifice elevated or not elevated and variably shaped. .. : .25
25. Vasiform orifice elevated, small, rounded or subcordate; lingula hidden; dorsum with many prominent spines. *Aleurocanthus* Quaintance and Baker, 1914.
 Vasiform orifice not elevated; vasiform subcordate or cordate; dorsum without many prominent spines. .. .26
26. Margin irregularly toothed; vasiform orifice subcordate; operculum roundly trapezoidal; lingula knobbed, setose and exposed *Aleyrodes* Latreille, 1795
 Margin regularly toothed; operculum subcordate or trapezoidal.27
27. Operculum subcordate; lingula knobbed, exposed and usuall excluded.:*Aleurotulus* Quaintance and Baker, 1914
 Operculum otherwise shaped; lingula exposed but included.28
28. Vasiform orifice cordate; operculum roundly trapezoidal; dorsal setae small, in conspicuous... .. *Aleuromarginatus* Corbett, 1935
 Vaisform orifice subcordate; operculum trapezoidal; median abdominal area with a series of pit-like structures. *Aleurocybotus* Quaintance and Bakrc, 1914

SYSTEMATIC ACCOUNT

I. Genus **Acaudaleyrodes** Takahashi, 1951

Type species.—*Acaudaleyrodes pauliani* Takahashi, 1951. *Mem. Inst. scient. Madagascar*, **6A**: 382.

The striking features of this genus are: absence of thoracic and caudal tracheal folds, combs and pores; dorsum with a pair of longitudinal folds without papillae; vasiform orifice elongately elliptic with extremely short transversely rectangular operculum; lingula slightly exposed and truncate apically.

1. **Acaudaleyrodes rhachipora** (Singh, 1931)

(Text-fig. 2)

1931. *Aleurotrachelus rachioora* Singh, 1931, *Mem. Dept. Agric. India, Ent. Ser.* **12(1)**: 57.

1962. *Acaudaleyrodes rachipora* (Singh) Russell, Comb. n., *Bull. Brooklyn Ent. Soc.* **57**: 63-65.

1965. *Acaudaleyrodes rhachipora* (Singh) Mound, *Bull. Br. Mus. nat. Hist., Ent.* **17(3)**: 113-160.

The following additional descriptive notes are added to the original description of the species by Singh.

Pupal case black or brown with white waxy fringe; 0.71-0.81 mm long and 0.50-0.60 mm wide. Marginal teeth 10 in 0.1 mm. Cephalic setae minute, 8-11* long; cephalic tubercles well developed. Transverse moulting suture anterior to thoraco-abdominal suture curves deeply to posterior and then recurves to anterior. Variation noticeable in the shape of median rhachis and in the median tubercles on abdominal segments 1 to 6; median tubercles in 1-3 rows. Vasiform orifice 43-50 long and 33-36 wide. Operculum 8 long and 18 wide. Lingula setose and slightly expanded at apex. Eighth abdominal setae 22 long; caudal setae 26-66 long. Ventral abdominal setae 14 long, 25-28 apart. A small conical seta 5 long at base of each leg.

Hosts.—*Bauhinia* sp., *Cassia fistula*, *Dalbergia sissoo*, *Euphorbia pilulifera* (Singh, 1931), *Cassia auriculata*, *Tamarindus indicus* (Rao, 1958), *Abrus precatorius*, *Delonix elata*, *Inga dulce* and *Prosopis juliflora* (new host records).

Distribution.—Bihar, Baroda (Singh 1931), Hyderabad (Andhra Pradesh) (Rao, 1958), Tamil Nadu and Karnataka States (new distribution records).

Materials examined.—42 pupal cases on *Prosopis juliflora*, Coimbatore, 9-3-1967, B. V. David; 2 pupal cases, on *Inga dulce*, Coimbatore, 11-4-1967 (B. V. David); 62 pupal cases, on *Delonix elata*, Coimbatore, June 1968, B. V. David; 12 pupal cases, on *Cassia auriculata*, Kunigal (Karnataka State), 28-3-1969, B. V. David; 26 pupal cases, on *Tamarindus indicus*, Thanjavur, 1-6-1969, B. V. David; and 14 pupal cases, on *Abrus precatorius*, Vellore, 25-8-1971, B. V. David.

* All measurements in microns unless otherwise specified.

The specimens from *Prosopis juliflora* were examined by Cohic in 1968 who remarked as follows: "In my opinion there is only one species, the yellow one are immature, they are flat, the rachis is not developed. The same thing occurs in Africa with *Acaudaleyrodes africana*. I cannot find any differences between your *Acaudaleyrodes* and *Acaudaleyrodes citri* which is common in Africa, and probably this one is the same as *A. rachipora* (Singh) but I had never seen type material of this species. Your specimens has the lingula expanded apically as in *A. citri*" Similarly, Mound (1965) reported that material from India and Pakistan in the British Museum collection cannot be distinguished from *A. citri*, and *A. rhachipora* should be easily recognized as its lingula is not expanded apically as per Singh's original description. Specimens collected from *Tamarindus indicus* were determined by Russell as *A. rhachipora*.

A detailed examination of pupal cases from the different hosts mentioned did not show any difference among them. The lingula was visible only in a few cases and was found to be setaceous and slightly expanded at tip. Singh in his description has remarked that the lingula is 'cylindric setose' In the figure also he has not clearly indicated the details. It is quite likely that he might have encountered similar difficulties in getting a perfect mount showing appreciably the lingula. The type of this species was not available to the writer for arriving at definite conclusions. In view of the above, the present series of specimens examined are retained under *Acaudaleyrodes rhachipora* (Singh). It is likely that *A. citri* may prove to be a synonym of *A. rhachipora*.

II. Genus **Aleurocanthus** Quaintance and Baker, 1914

Type species.—*Aleyrodes spiniferus* Quaintance, 1903, *Canad. Ent.* 35: 61-64.

The species included in this genus are characterised by the pupal cases possessing many prominent spines on the dorsum and the elevated vasiform orifice. The operculum is rounded or subcordate and the lingula hidden.

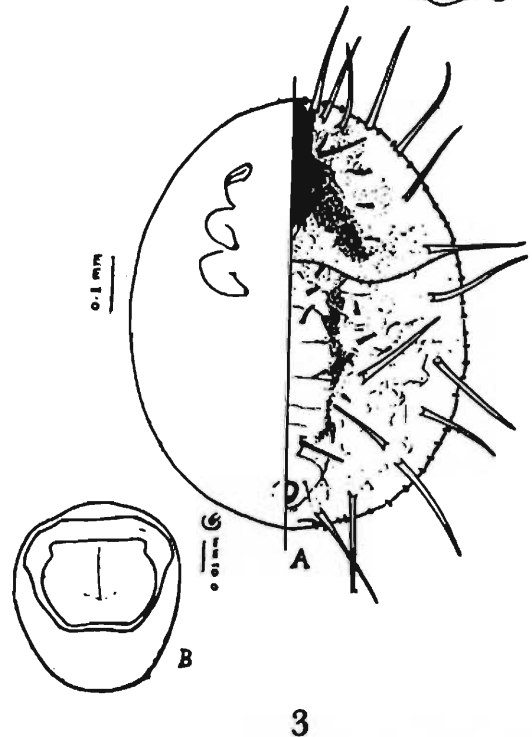
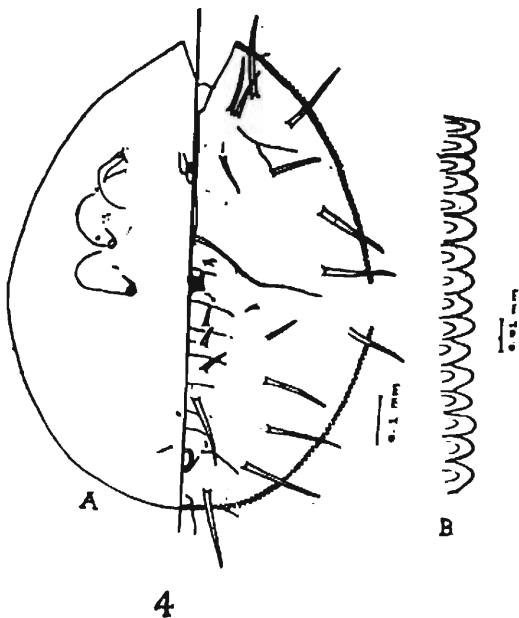
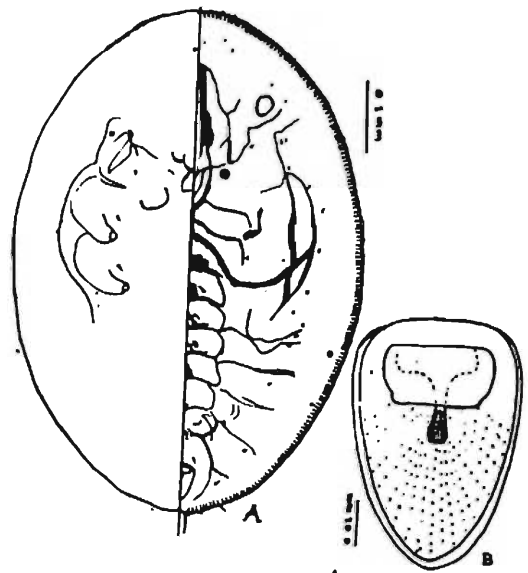
2. **Aleurocanthus davidi** sp. n.

(Text-fig. 4)

Pupal case.—Transparent, oval, slightly narrowed anteriorly; 0.88-1.00 mm long and 0.63-0.78 mm wide.

Margin.—Margin with a row of rounded teeth, 12 teeth in 0.1 mm. Thoracic and caudal tracheal pores or combs absent. Anterior marginal setae 11 long; posterior marginal setae 36 long.

Dorsal surface.—Dorsum with three pairs of thin setae—a pair of cephalic setae, 39 long; a pair of setae on the eighth abdominal segment cephalic setae, 39 long; a pair of setae on the eighth abdominal segment laterad of base of vasiform orifice, 92 long; and a pair of submarginal caudal setae, 116 long. Dorsal surface with a series of spines—nine pairs on cephalothorax and thirteen pairs on abdomen (six pairs medially on abdominal segments 1 to 6); 23-168 long. The transverse moulting suture reaches the margin.



Text-figs. 2-4. (2) (left to right) Infestation of *Acaudaleyrodes rachipora* on *Prosopis juliflora* and *Abrus Precatorius*; A. Pupal case, B. Vasiform Orifice, (4) *Aleurocanthus davidi*, sp. n. A. Pupal case, B. Margin of pupal case; (3) *Aleurocanthus loyolae*, sp. n. A. Pupal case, B. Vasiform orifice.

Vasiform orifice elevated, longer than wide, 61×36 . Operculum slightly longer than wide, 30×25 . Lingula hidden.

Ventral surface.—Ventral abdominal setae 17 long, 47 apart. All the four pairs of spiracles visible. Antennae not extending beyond the base of fore legs; mesothoracic legs at base with four small conical spines.

Host.—*Ipomoea* sp.

Holotype.—One case on slide, on *Ipomoea* sp., Coimbatore, 3-5-1957, S. K. David.

Paratypes.—Fourteen cases on slides bearing the same details. Nine pupal cases on slides, on *Ipomoea* sp., 12-6-1957, S. K. David. [Paratypes deposited in the collections of the Zoological Survey of India, Calcutta, British Museum (Natural History), London and Department of Entomology, U.S.D.A., Washington.

This species closely resemble *Aleurocanthus strychnosicola* Cohic, but differs in having only eight submarginal spines and in not possessing short submarginal spines and ventral sub-marginal sculpturing.

This species is named after Dr. S. K. David, Aphidologist, who collected this species.

3. *Aleurocanthus loyolae* sp. n.

(Text-fig. 3)

Pupal case.—Jet black with a fringe of white wax; exuviae of previous instars found sticking to spines on dorsum; globules of exudation sticking to distal end of spines. Oval in shape with the dorsum elevated medially; 0.90-0.93 mm long and 0.68-0.70 mm wide. Found in groups on the undersurface of leaves.

Margin.—Margin with a single row of pointed teeth, 12-13 teeth in 0.1 mm. Thoracic and caudal tracheal pores or combs absent. Paired anterior and posterior marginal setae 22 long.

Dorsal surface.—Cleared case brown, with darker shades on cephalo-thorax and submedially on rhachis. Dorsum with three pairs of setae—cephalic setae, 55 long; setae on the eighth abdominal segment laterad of base of vasiform orifice, 83 long; caudal setae 83-146 long. Thirteen pairs of long submarginal spines—seven pairs on cephalo-thorax and six pairs on abdomen seen. A pair of moderately long spines just below the cephalic setae; three pairs of smaller spines on the subdorsal region of cephalo-thorax; rhachis with three pairs of short spines on abdominal segments 1 to 3 and a pair of slightly longer spines on segment 7; five pairs of smaller spines and two pairs of longer spines laterad of rhachis; length of various spines ranging from 40-211. In addition a row of minute knobbed setae present in the submarginal area. Transverse moulting suture runs to the posterior for a short distance and bends to the anterior reaching the margin.

Vasiform orifice elevated, subcordate, 52×44 . Operculum somewhat broadly rectangular. Lingula concealed.

Ventral surface.—Ventral abdominal setae 41 long, 33 apart. Antenna not extending beyond base of fore leg. All the spiracles visible. A minute seta at base of each of meso- and meta-thoracic legs. A pair of minute setae at base of rostrum evident.

Host.—*Streblus asper* and an unidentified shrub.

Holotype.—One pupal case on a slide, on *Streblus* sp., Burliar (Nilgiris), 13-8-71, B. V. David.

Paratypes.—Twentyseven pupal cases on slides on *Streblus* sp., Burliar, 13-8-71, B. V David; seventeen pupal cases on slides, on unidentified shrub, Madras (Loyola College), 28-7-71, B. V David; eight pupal cases on slide, on *Streblus asper*, Madras, 14-2-1971 and numerous specimens on dry leaves in collection. [Paratypes deposited in the collections of the Zoological Survey of India, Calcutta and the British Museum (Natural History), London].

This species comes close to *Aleurocanthus spiniferus* (Quaintance) but differs in having distinct brown patches on dorsum, in the arrangement and length of dorsal spines and in the structural details of vasiform orifice.

4. *Aleurocanthus mangiferae* Quaintance and Baker

1917. *Aleurocanthus mangiferae* Quaintance and Baker, *Proc. U.S. natn. Mus.*, **51**:345.
 1931. *A. mangiferae* Quaintance and Baker, Singh, *Mem. Dept. Agric. India, Ent. Ser.* **12**(1): 69.

This is a well known species found infesting mango leaves throughout the plains of India. The description provided by Quaintance and Baker, and Singh are adequate.

Host.—*Mangifera indica* (Mango).

Material examined.—Sixteen pupal cases mounted on slides, on mango leaves, Neyveli, 23-1-1967, B. V David; numerous pupal cases on dry leaves in the collections of the writer.

Pupal cases on dry leaves of Mango, Cuddalore, 23-1-1967, B. V David.

5. *Aleurocanthus marudamalaiensis* sp. n.

(Text-fig. 5)

Pupal case.—Black with a fringe of wax and with exuviae of previous instars sticking to spines on dorsum; globules of exudation found sticking to distal end of spines. Oval in shape; 0.95-0.96 mm long and 0.71-0.75 mm wide. Found on the undersurface of leaves singly and very much scattered.

Margin.—Margin with rounded teeth, 11 teeth in 0.1 mm. Paired anterior and posterior marginal setae 22 long. Thoracic and caudal tracheal pores or combs wanting.

Dorsal surface.—Dorsum with prominent spines. Eleven pairs of spines on cephalo-thorax and sixteen pairs on abdomen (six pairs on submargin, three pairs on subdorsum and seven pairs on abdominal segments 1-7). Length of spines 16 to 138 long. A pair of thin setae, 55 long laterad at base of vasiform orifice and a pair of caudal setae, 89 long evident. Transverse moulting suture reaches margin. Thoracic and caudal tracheal furrows wanting.

Vasiform orifice elevated, subcircular, 55 long and 47 wide, lateral walls and caudal end ridged; operculum wider than long (36×30) nearly filling the orifice and concealing the lingula.

Ventral surface.—Ventral abdominal setae 29-39 long, 36-43 apart. Adhesive sac visible. No setae at base of legs and rostrum.

Host.—*Ficus bengalensis* (Banyan tree).

Holotype.—One pupal case on slide, on *Ficus bengalensis*, Coimbatore, 22-10-1966, B. V David.

Paratypes.—Seven cases on slides, on *Ficus bengalensis*, Coimbatore, 22-10-1966, B. V David; two pupal cases on slide, on *Ficus bengalensis*, Coimbatore, 10-4-1967, B. V David.

This species appears to resemble *Aleurocanthus multispinosus* Dumbleton, but differs considerably in the length and arrangement of spines on rhachis, in the number of spines on cephalo-thorax and in the structural details of vasiform orifice.

6. *Aleurocanthus rugosa* Singh

(Text-fig. 6)

1931. *Aleurocanthus rugosa* Singh, *Mem. Dept. Agric. India, Ent. Ser.* 12(1): 71.

The following additional description is provided.

Pupal case.—Length 0.896-0.913 mm, width 0.664-0.681 mm.

Margin.—Anterior marginal setae 17 long; posterior marginal setae 20 long.

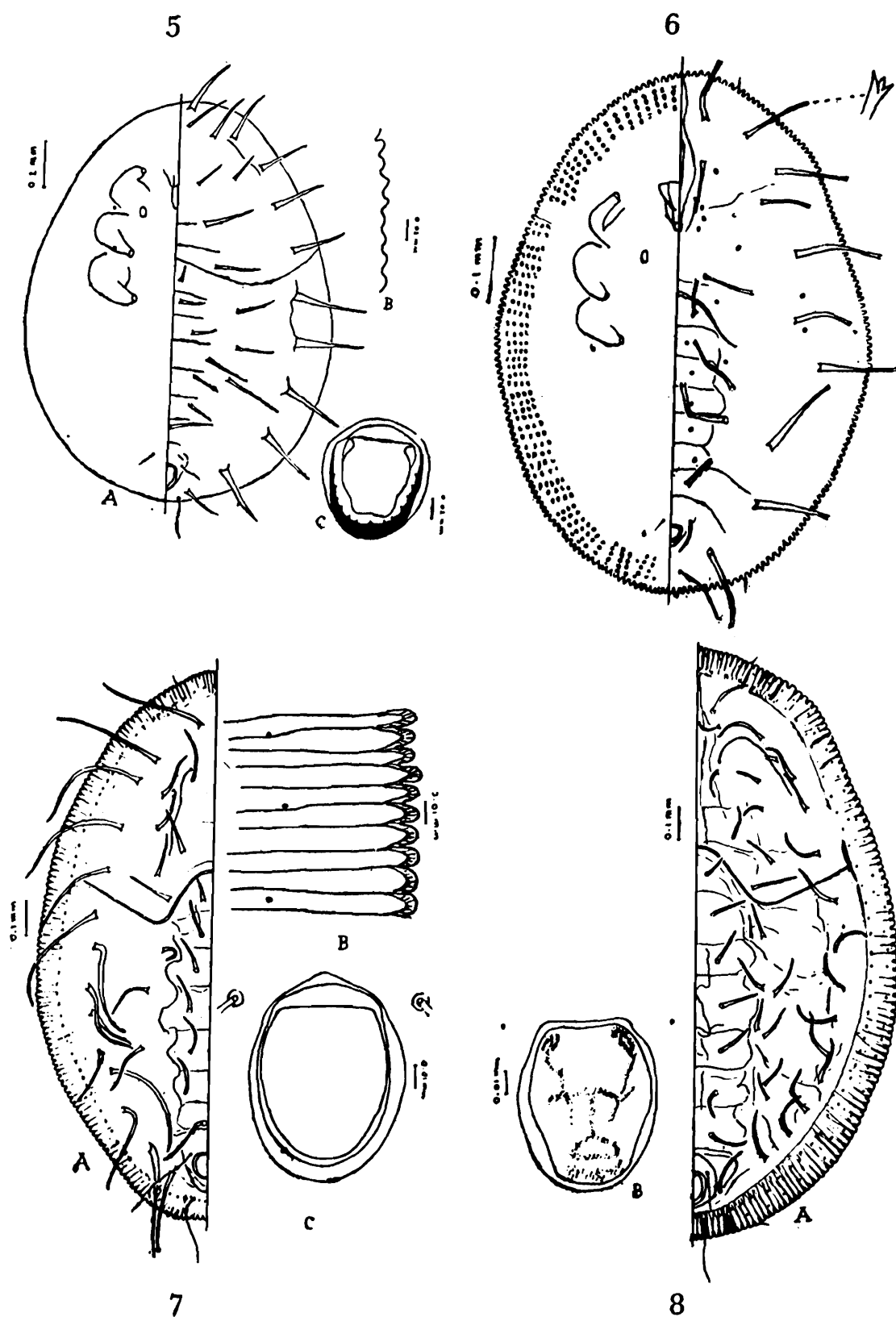
Dorsal surface.—Length of spines on dorsum 63 to 135. Cephalic setae 50 long; eighth abdominal setae 59 long. Vasiform orifice length 36-40, width 50; operculum length 23-26, width 23-26, caudal setae 132 long.

Ventral surface.—Ventral abdominal setae 20 long, 40 apart. Anterior and posterior abdominal spiracles distinct. Antennae not extending beyond fore leg. Submargin with about four or five rows of rectangular markings, absent only at tracheal fold area. No setae at base of legs and rostrum.

Host.—*Syzigium jambolanum*, *Piper betel*, *Psidium quajava*, *Michelia chamoaca* (Singh, 1931) and *Anona* sp., *Polyalthia longifolia* and *Polyalthia pendula* (new host records).

Distribution.—Pusa (Bihar) (Singh, 1931); Coimbatore and Madras (Tamil Nadu) (new distribution record).

Material examined.—Two pupal cases on slides, on *Polyalthia pendula*, Coimbatore, 16-11-1966, B. V David; eleven pupal cases mounted, on an unidentified shrub, Madras, 9-7-1971, B. V David; twentyfive pupal cases mounted, on *Anona* sp., Madras, 3-8-1971, B. V David; five pupal cases mounted, on *Polyalthia longifolia*, Madras, 13-9-1971, B. V David.



Text-figs. 5-8. (5) *Aleurocanthus marudamalaiensis*, sp. n. A. Pupal case, B. Margin, C. Vasiform Orifice, (6) *Aleurocanthus rugosa* Pupal case; (7) *Aleurocanthus seshadrii* sp. n. A. Pupal case, B. Margin, C. Vasiform orifice; (8) *Aleurocanthus splendens* sp. n. A. Pupal case, B. Vasiform orifice.

7. *Aleurocanthus seshadrii* sp. n.

(Text-fig. 7)

Pupal case.—Jet black with marginal fringe of wax; Elliptic 1.56-1.59 mm long, 0.99-1.00 mm. wide. Found scattered on the under-surface of leaves.

Margin.—Margin with a row of rounded teeth, 10-11 in 0.1 mm. Anterior and posterior marginal setae 36-50 long. Thoracic and caudal tracheal pores or combs absent.

Dorsal surface.—The paired thin cephalic setae about 99 long; the eighth abdominal setae thin, laterad of base of vasiform orifice, 122 long; a pair of long caudal setae, sub-marginal in position, 165 long. The transverse moulting suture runs posteriorly to the level of the suture between the abdominal segments 1 and 2 and then bends sharply to anterior, extending upto submargin. Dorsum with eleven pairs of spines on cephalo-thorax, seven pairs submedially on abdominal segments 1 to 7, three pairs laterad of indistinct rhachis and nine pairs on subdorsum; 130-356 long. Submargin distinct with ridges running mesad of marginal teeth; each tooth with a pore at base; minute pores scattered on submarginal area.

Vasiform orifice elevated, oval, longer than wide (86×66). Operculum similarly shaped (69×59), filling the orifice and concealing the lingula.

Ventral surface.—Ventral abdominal setae 40 long, 66 apart. Setae at base of legs wanting.

Host.—Bamboo.

Holotype.—One pupal case on a slide, on bamboo, Mallisery Estate near Kongode (Kerala State), 27-9-1968, B. V David.

Paratypes.—Two cases on a slide bearing the same details in the collection of the British Museum (Natural History), London. One case on a slide in the collection of the author.

This species is quite distinct from *Aleurocanthus bambusae* (Peal), differing very much in the arrangement of spines, size, course of transverse moulting suture on pupal case, etc.

This species is named after Dr. A. B. Seshadri, the then Professor of Entomology, Agricultural College and Research Institute, Coimbatore, now Head of the Division of Nematology, Indian Agricultural Research Institute, New Delhi, under whom the study of aleyrodids was initiated by the senior author.

8. *Aleurocanthus spiniferus* (Quaintance)

(Plate I)

1903. *Aleurodes spinifera* Quaintance, *Canad. Ent.* **35**: 63.

1914. *Aleurocanthus spiniferus* (Quaintance), Quaintance and Baker, *U.S. Dept. Agric., Bur. Ent., Techn. Ser.*, **27(2)**: 102.

1931. *Aleurocanthus rosae* Singh, *Mem. Dept. Agric. India, Ent. Ser.* **12**: 70.

This is a widespread species in India. It is occasionally serious on rose.

Hosts.—Citrus (Usman and Puttarudraiah 1955), Rose (*Rosa* sp.) (Singh 1931) and *Vitis vinifera* (grapevine) (new host record).

Material examined.—Five pupal cases mounted, on Rose, Coimbatore, 14-4-1967, B. V David; three pupal cases mounted, on *Vitis vinifera*, Coimbatore, 5-8-1967, B. V David; numerous pupal cases on dry leaf of *Vitis vinifera*, Coimbatore, 18-9-1971, M. Mohanasundaram.

9. **Aleurocanthus splendens** sp. n.

(Text-fig. 8)

Pupal case.—Jet black with dense white fleecy waxy filaments covering the dorsum to which the exuviae of previous instars stick. Shape elliptical, broadest caudad. Length 1.33-1.78 mm, width 0.83-1.21 mm. Found on the undersurface of leaf.

Margin.—Margin with a row of broad teeth each tooth with a pore at base; 7 teeth in 0.1 mm, broad at base and rounded at tip. Paired anterior and posterior marginal setae 26-33 long. Thoracic and caudal tracheal pores or combs absent.

Dorsal surface.—A pair of thin cephalic setae, about 297 long; a pair of thin setae on the eighth abdominal segment laterad of base of vasiform orifice, 55 long; and a pair of submarginal thin long caudal setae, 201 long. Dorsum with thirtyeight pairs of spines distributed as follows: 13 pairs on cephalothorax; 7 pairs submedially on abdominal segments 1-7, 8 pairs in four groups on either side laterad of rhachis and 10 pairs in a line on subdorsum. Transverse moulting suture runs posteriorly and turns sharply to anterior at the level of suture between abdominal segments 1 and 2, reaching the submargin. Submargin with broad ridges running mesad of marginal teeth and with minute pores scattered on submarginal area.

Vasiform orifice elevated oval, longer than wide (89×69). Operculum similarly shaped (83×66) covering the orifice and obscuring the lingula.

Ventral surface.—Ventral abdominal setae 17 long, 55 apart. No setae at base of legs.

Host.—*Phoenix humilis*.

Holotype.—One pupal case on slide, on *Phoenix humilis*, 24-4-1969, Perammur (Tiruchirapalli district, Tamil Nadu), B. V. David.

Paratypes.—One pupal case on slide in the collection of the Zoological Survey of India, Calcutta; one pupal case on slide in the collection of the British Museum (Nat. History), London; seven pupal cases on slide bearing the same details. Pupal cases on dry leaves in the collections of the writer.

This species closely resembles *Aleurocanthus bambusae* (Peal) from which it differs in size, in the number of marginal teeth in 0.1 mm length and in having distinctly four pairs of spines on either side of rhachis.

10. **Aleurocanthus valparaiensis** sp. n.

(Text-fig. 9)

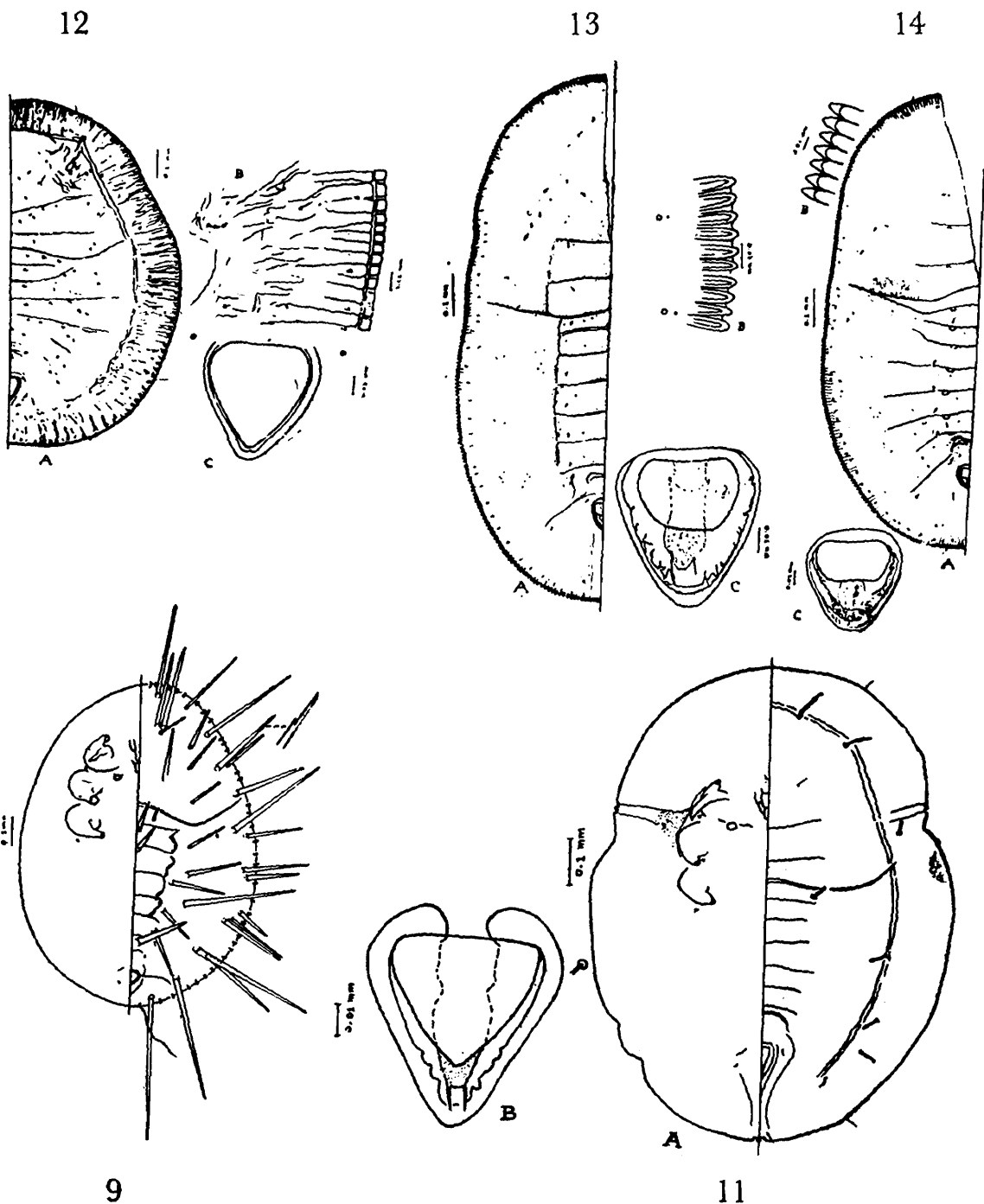
Pupal case.—Jet black with fringes of wax; oval 1.11-1.15 mm long and 0.83-0.85 mm wide. Found on the undersurface of leaves in colonies.

Margin.—Margin with a row of pointed teeth, 10 in 0.1 mm. Anterior and posterior marginal setae 13-16 long. Thoracic and caudal tracheal pores or combs wanting.

Dorsal surface.—A pair of thin setae laterad of vasiform orifice 99 long and a pair of submarginal thin long caudal setae 231 long. Dorsal surface with long pale spines varying in length from 55-400. Thirteen pairs of spines on cephalothorax and twentyone pairs on abdominal segments distributed as illustrated. Submargin with a row of small stout knobbed setae.

Vasiform orifice elevated, subcircular (55×55). Operculum similarly shaped filling the orifice and obscuring the lingua.

Ventral surface.—Ventral abdominal setae 28 long, 25 apart. Antenna normal, does not extend beyond fore leg. All the four pairs



Text-figs. 9, 11-14. (9) Pupal case of *Aleurocanthus valparaiensis* (11) *Aleurolobus confusus*, sp. n. A. pupal case, B. Vasiform Orifice; (12) *Aleurolobus moundi* sp. n. A. Pupal case, B. Margin C. vasiform orifice, (13) *Aleuromarginatus kallerensis*, sp. n. A. Pupal case, B. Margin, C. Vasiform orifice; (14) *Aleuromarginatus tephrosiae* A. Pupal case, B. Margin, C. vasiform orifice.

of spiracles and adhesive sac visible. A minute seta at base of each of meso- and metathoracic legs evident. Setae at base of rostrum lacking.

Host.—*Piper nigrum*.

Holotype.—One pupal case on slide, on *Piper nigrum* (pepper), Valparai (6,000 feet), 16-4-1967, B. V David.

Paratypes.—Thirtyeight pupal cases on slides bearing the same details. Pupal cases on leaves in the collections of the writer. Material is also in the collections of the British Museum (Natural History), London and of the Systematic Entomology Laboratory, United States Department of Agriculture, Washington. Nine pupal cases on a slide, on wild *Piper* sp., Burliar, 13-8-1971, B. V David.

This species in general appearance resembles *Aleurocanthus citriperdus* Quaintance and Baker but differs in the number and arrangement of dorsal spines.

11. *Aleurocanthus woglumi* Ashby

(Plate I)

1917. *Aleurocanthus woglumi* (Ashby). Quaintance and Baker, *Proc. U.S. natn. Mus.* 51: 336, 355.

This is commonly known as the Citrus Blackfly and is a well-known serious pest of citrus in many parts of the world. In India this is widely distributed found infesting citrus in serious proportions.

Hosts.—Orange (*Citrus* sp.) (Husain and Khan, 1945); sapota (*Achras zapota*) (Rao and Rao, 1962); Pommello (*Citrus* sp.), *Morinda tinctoria* and *Murraya koenigii* (new host records).

Material examined.—On Pommello, Coimbatore, 11-7-1966, B. V David; Fourteen pupal cases mounted, on orange, Yercaud, 20-1-1967, B. V David; on *Morinda tinctoria*, Coimbatore, 9-3-1967, B. V David and five pupal cases mounted, on *Murraya koenigii*, Coimbatore, 15-8-1969, B. V David.

Key to Indian Species of Aleurocanthus

- | | |
|---|---|
| 1. Pupal case not jet black in colour. | .2 |
| Pupal case jet black in colour. | .4 |
| 2. Dorsal spines fimbriate, 19 pairs of spines and 6 pairs of papillae evident on dorsal surface. | <i>rugosa</i> Singh |
| Dorsal spines non-fimbriate, papillae absent. | 3 |
| 3. 22 pairs of spines evident on dorsal surface; lingula hidden. | <i>dauidi</i> sp. n. |
| 18 pairs of spines evident on dorsal surface; lingula tip seen. | <i>simolex</i> Singh* |
| 4. Submargin with about 55 pairs of spines; operculum with markings. | <i>longispinus</i>
Quaintance and Baker* |
| Submargin without or with less number of spines; operculum without markings. | 5 |
| 5. Submarginal area with linear ridges. | .116 |
| Submarginal area without linear ridges. | 8 |

* Species known in India that are not studied here.

6. Dorsum with 30 pairs of spines (11 pairs on cephalo-thorax and 19 pairs on abdomen). *..seshadrii* sp. n.
Dorsum with 38 pairs of spines. 7
7. Pupal case 1.44 mm × 0.96 mm; 4 pairs of spines in a row on either side of rhachis *..splendens* sp. n.
Pupal case 2.1 mm × 1.4 mm; arrangement of spines on either side of rhachis differs considerably. *..bambusae* (Peal)*
8. Possessing 29 pairs of spines on dorsal surface. 9
Not possessing 29 pairs of spines on dorsal surface. 12
9. Dorsum with brown patches on cephalothorax and abdomen; 11 pairs of spines on cephalo-thorax. *..loyolae* sp. n.
Dorsum lacking shades of brown patch; 13 pairs of spines on cephalo-thorax. 10
10. An irregular row of capitate setae just above the submarginal row of spines.
A regular row of capitate setae evident. : 11
. *..spiniferus* (Quaintance)
11. Vasiform orifice subcordate. *..husaini* Corbett*
Vasiform orifice circular. *..woglumi* Ashby
12. Marginal teeth knobbed; 37 pairs of spines on dorsal surface. *..mangiferae*
Marginal teeth not knobbed; possessing 27, 33 or 34 pairs of spines on dorsal surface. Quaintance and Baker
13
13. Dorsal surface with 27 pairs of spines margin with rounded teeth. *..marudamalaiensis*
Dorsal surface with 33 or 34 pairs of spines; margin with pointed teeth. sp. n.
14
14. Possessing 18 pairs of spines on submargin and 15 pairs on dorsal disc; marginal teeth 14 in 0.1 mm. *..citriperdus* Quaintance and Baker*
Possessing 16 pairs of spines on submargin and 18 pairs on dorsal disc; marginal teeth 11 in 0.1 mm. *..valparaiensis* sp. n.

III. Genus *Aleurocybotus* Quaintance and Baker

Type species.—*Aleurodes graminicolus* Quaintance, 1899, *Can. Ent.* **31**: 89.

Pupal case narrowly elongate with toothed margin; submargin not separated from dorsal disc; median area of abdomen with pit-like structures; tracheal folds not discernible; vasiform orifice subcordate, operculum trapezoidal, lingula exposed and usually included, but apex sometimes exerted.

12. *Aleurocybotus indicus* sp. n.

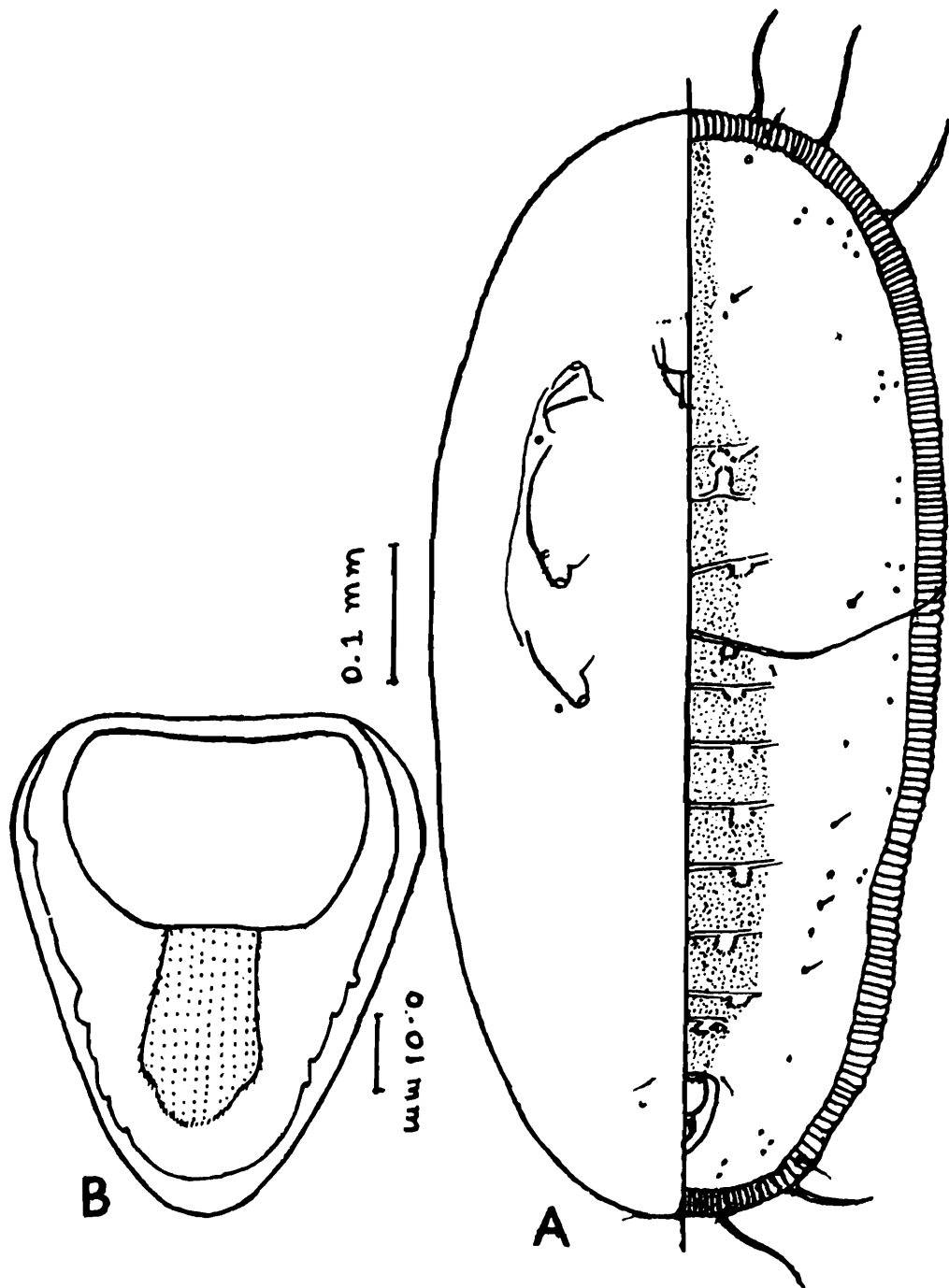
(Text-fig. 10)

Pupal case.—White with the median area from cephalic region to vasiform orifice light brownish; wax tubes poorly developed and a short rim of waxy secretion raises the case from leaf surface. Elongate and narrow, 0.88-0.92 mm long and 0.40-0.41 mm wide. Found infesting both surfaces of leaf blades and leaf sheath of grass.

Margin.—Margin crenulate, with 10-11 rounded irregular crenulations in 0.1 mm, deflexed under case when mounted. Usual anterior and posterior marginal setae minute, 13, long, Ventral in position.

Dorsal surface.—The usual dorsal setae minute—the cephalic setae 6 long, the first abdominal setae 8 long and the setae laterad of vasiform orifice 8 long. The transverse moulting suture bends to anterior reaching the margin. Pit-like structures evident medially on the thoracic

and abdominal segments. Tracheal furrows absent. Minute pores found scattered on dorsum. Submargin with three pairs of long setae anteriorly, 83-99 long, two pairs of setae posteriorly 86-106 long; in addition a pair of minute setae present on each of metathorax and abdominal segments 1, 4, 5 and 6. A series of pores and porettes in a line in the submargin.



Text-fig. 10. *Aleurocybotus indicus* sp. n. A pupal case, B. vasiform orifice.

Vasiform orifice subcordate, 59 long and 50 wide; lateral walls slightly ridged. Operculum trapezoidal, wider than long (36×26). lingula setose, exposed, included.

Ventral surface.—Ventral abdominal setae 8-11 long, 50 apart. All the four pairs of spiracles visible. Antenna not extending beyond fore leg. Setae at base of legs and rostrum, and tracheal folds absent.

Hosts.—*Chloris barbata* and *Dactyloctenium aegyptiacum*.

Holotype.—Pupal case on slide, on *Chloris barbata*, Coimbatore, 20.5.1966, B. V David.

Paratypes.—Five pupal cases mounted, on *Chloris barbata*, Coimbatore, 20-5-1966, B. V David; two pupal cases on slide, on *Chloris barbata*, Coimbatore, 23-2-1967, B. V David; 3 cases on slide, on *Dactyloctenium aegyptiacum*, Madras, 18-9-1971, B. V David. Pupal cases on leaves of *Chloris barbata*, Coimbatore, 15-3-1969, B. V David in the collections of the senior author, and also of the Systematic Entomology Laboratory, United States Department of Agriculture, Washington and the British Museum. (Natural History), London.

This species is quite distinct from the other two known species, viz., *A. graminicolus* (Quaintance) and *A. setiferus* Quaintance and Baker in possessing five pairs of longer submarginal setae.

This genus is being reported from India for the first time.

IV Genus **Aleurolobus** Quaintance and Baker

Type species.—*Aleurolobus marlatti* (Quaintance), 1903, *Can. Ent.*, **34**: 61.

Pupal case usually dark brown to blackish; margin toothed, with moderately developed wax tubes; submarginal area separated from dorsal disc by suture-like lines; minute pores present on dorsum; tracheal folds in most cases obscure or wanting but in some evident, terminating on margin in few specialised teeth, vasiform orifice subcordate, operculum similarly shaped almost filling the orifice and obscuring the lingula. A trilobed figure surrounding the orifice quite characteristic.

13. **Aleurolobus barodensis** (Maskell)

(Plate I, part)

1896. *Aleurodes barodensis* Maskell, *Trans. N. Zealand Inst.*, **28**: 424.

1902. *Aleyrodes barodensis* Cockerell, *Proc. Acad. nat. Sci. Phila.* 281.

1897. *Aleurodes longicornis* Zehntner, *Archief Java Suikerind*, **5**: 381.

1917. *Aleurolobus barodensis* (Maskell), Quaintance and Baker, *Proc. U.S. natn. Mus.* **51**: 359.

This is a well known pest of sugarcane in many parts of the world and in India it has a very wide distribution, and the description of the species by Quaintance and Baker (1917) appears to be complete.

Hosts.—*Saccharum officinarum* (sugarcane) (Singh, 1931); *Erianthus arundinaceum* and *E. ciliaris* (Rao, 1958).

Distribution.—Throughout India.

Material examined.—Twentythree pupal cases, on sugarcane, Cuddalore, 23-1-1967. B. V David. Numerous pupal cases on leaves in collections—on sugarcane, Cuddalore, 12-9-1967, G. Varadarajan; on sugarcane, Kayarambedu (Madras), 5-1-1971, B. V David.

14. *Aleurolobus confusus* sp. n.

(Text-fig. 11)

Pupal case.—White with sparse marginal waxy secretion, oval in shape. Female case: Length 1.04-1.10 mm long and 0.78-0.85 mm wide; Male case: 0.83-0.85 mm long and 0.59-0.61 mm wide. Found on the undersurface of leaflets.

Margin.—Finely crenulate. Paired anterior and posterior marginal setae, 16 and 33 long, respectively. Thoracic and caudal tracheal ends each with a tooth-like projection. Margin variously indented depending upon development between or along the sides of hairs on the undersurface of leaflets.

Dorsal surface.—Three pairs of usual dorsal setae evident—a pair on cephalic region 41 long, a pair of blunt setae 25-39 long on first abdominal segment, and a pair of pointed setae on eighth abdominal segment, minute, 8 long, laterad of base of vasiform orifice. A pair of caudal submarginal setae, 76 long, submargin separated from dorsal disc by a distinct fold; transverse moulting suture, bending slightly to anterior, extending upto the fold. Abdominal segments distinct, seventh segment medially shortened. Seven pairs of blunt setae along the submarginal fold, two pairs on cephalic region, a single pair on thoracic region and four pairs on the abdomen, 36-76 long. Thoracic and caudal tracheal folds evident.

Vasiform orifice subcordate, surrounded by a trilobed figure, 79 long, 63 wide lateral walls of orifice slightly ridged. Operculum similarly shaped, length 43 and width 50. Lingula setose, club-shaped, exposed and included, bearing subapically a pair of setae.

Ventral surface.—Ventral abdominal setae 27-30 long, 50-56 apart. Antenna in male reaching middle of mesothoracic leg and in female extending to the base of mesothoracic leg. All the four pairs of spiracles visible. Thoracic tracheal folds distinct, with half the length towards its base dotted. Caudal tracheal folds evident but not dotted. Setae at base of legs absent. A pair of minute setae at base of rostrum visible.

Host.—*Murraya koenigii*.

Holotype.—One pupal case on slide; on *Murraya koenigii*, Madras, 25-7-1971, B. V. David.

Paratypes.—Six pupal cases on slides bearing the same data. Pupal cases on leaves in the collections of the senior author and in the collections of the Systematic Entomology Laboratory, United States Department of Agriculture, Washington D. C., the British Museum (Natural History), London, and the Zoological Survey of India, Calcutta.

This species resembles *Aleurolobus simulus* (Peal) but differs from it in size and in possessing a tooth-like projection at thoracic and caudal tracheal ends.

15. *Aleurolobus marlatti* (Quaintance)

1903. *Aleurodes marlatti* Quaintance, *Can. Ent.*, **34** : 61.

1917. *Aleurolobus marlatti* (Quaintance), Quaintance and Baker, *Proc. U. S. natn. Mus.*, **51** : 361.

The description of the species by Quaintance and Baker appears to be complete.

Host.—Acid lime (*Citrus* sp.) (Husain and Khan, 1945) and *Murraya koenigii* (new host record).

Material examined.—Two cases mounted, on *Murraya koenigii*, Coimbatore, 17-3-1967, B. V. David; two cases mounted, on *Citrus* sp. (acid lime), Madras, 25-7-1971, B. V. David.

Numerous pupal cases on dry leaves of *Murraya koenigii* and acid lime in the collections of the senior author.

16. *Aleurolobus moundi* sp. n.

(Plate I, & Text-fig. 12)

Pupal case.—Black with a marginal fringe of wax and white powdery meal on dorsum; oval, 1.59-1.68 mm long and 1.36-1.40 mm wide.

Margin.—Crenulate; 7-8 crenulations in 0.1 mm. Paired anterior and posterior marginal setae 20-26 long. Thoracic tracheal pore areas not differentiated from margin; caudal tracheal pore not indicated.

Dorsal surface.—Dorsum separated from submargin by a distinct suture-like line. The usual dorsal setae are small—a pair of cephalic setae 11 long, a pair of first abdominal setae 11 long and a pair of setae laterad of base of vasiform orifice, 17 long. A pair of submarginal minute caudal setae on either side of caudal furrow. Transverse moulting suture reaches the submarginal fold. Abdominal segments with distinct sutures; second abdominal suture bends sharply to anterior and meets the first suture; eighth abdominal segment not distinctly trilobed, being typical of the genus. Seventh abdominal segment short, one-third of sixth segment; eighth almost twice the length of sixth. Paired submedian depressions evident on each abdominal segment. Sublaterally four pairs of minute setae evident on abdominal segments 3 to 6. Eye spots prominent. Submargin broad, one-quarter of overall width and with about ten pairs of minute setae, four pairs on cephalothorax and six pairs on abdomen. Marginal teeth broadly rounded, with suture-like markings extending mesad across the submargin. Submargin with a series of about 70 pores and porettes on each side. Both the submarginal area and dorsal disc are sparsely covered with pores and porettes.

Vasiform orifice subcordate with transverse posterior margin; operculum thin, pointed posteriorly, filling the orifice and obscuring the lingula. Caudal furrow rather narrow, 195 long.

Ventral surface.—All the four pairs of spiracles visible. Antenna extending upto prothoracic spiracle. Adhesive sac visible. Setae at base of legs and rostrum wanting.

Holotype.—One pupal case mounted, on *Bassia* sp., Madras, 21-7-1971, B. V. David.

Paratypes.—Seven pupal cases on slides bearing the same details. [Paratypes deposited in the collection of the British Museum (Natural History), London and the Zoological Survey of India, Calcutta].

Numerous pupal cases on dry leaves of *Bassia latifolia*, Coimbatore, 7-11-1966, B. V David; on *Bassia longifolia*, Kovilpatti, 31-1-1967, B. V David.

This species resembles *Aleurolobus taonabae* Q. & B. but differs from it in being bigger in size and in other details.

This distinct species is named after Mr. L. A. Mound of the British Museum (Natural History), Commonwealth Institute of Entomology, London.

Key to Indian Species of *Aleurolobus*

1. Pupal case white; submarginal area with prominent setae. *confusus* sp. n.
Pupal case black; submarginal area without prominent setae. 2
2. Thoracic tracheal folds terminate in three rounded teeth. 3
Thoracic tracheal folds not discernible. 4
3. Pupal case 1.35 × 1.1 mm; margin with a short fringe of wax and whiter tufts of wax from pores of tracheal folds; a pear-shaped wax figure on dorsum of abdomen, from which run lines of wax along sutures to submarginal rim. *marlatti* (Quaintance)
Pupal case 1.29 × 1.01 mm; margin with a broad filamentous colourless fringe of wax and white waxy powder; submarginal fold indicated by waxy powder; cephalo-thorax and abdomen again defined in wax; six radial lines of wax in abdomen extend upto submarginal fold. *bidentatus* Singh*
4. Pupal case very elongate elliptical; 2.25 × 1.15 mm dense black; margin with a fringe of long snowy white wax rods; dorsum sometimes dusted with white powdery meal. *barodensis* (Maskell)
Pupal case oval; 1.64 × 1.40 mm; marginal fringe of wax and white powdery meal on dorsum evident. *moundi* sp. n.

V. Genus *Aleuromarginatus* Corbett, 1935.

Type species.—*Aleuromarginatus tephrosiae* Corbett, 1935, *Ann. Mag. nat., Hist.*, **16** (10): 246

The species included in this genus are characterised by the following: Pupal case with a row of teeth with large marginal pores; submarginal area not separated from dorsal disc; thoracic and caudal pores or combs absent though caudal fold may merely be indicated. Vasiform orifice cordate; operculum roundly trapezoidal filling about half the orifice; lingula knobbed, exposed, included.

17. *Aleuromarginatus kallarensis* sp. n.

(Text-fig. 13)

Pupal case.—Light brown with a marginal fringe of wax and deeper brown shades mid-dorsally; elliptic but slightly constricted at thorax and slightly emarginate posteriorly; 1.33-1.46 mm long and 0.75-0.85 mm wide. Found on both surfaces of leaf.

Margin.—Margin strongly toothed with a pore at base of each tooth; 13-14 teeth in 0.1 mm. Thoracic and caudal tracheal pores or combs absent.

Dorsal surface.—Dorsum with deep brown shades medially along longitudinal moulting suture and on rhachis, along thoracic sutures

and laterad of rhachis. Dorsum sculptured with dotted markings. Dorsal setae 21 pairs, minute, blunt and apparently hooked, 11 pairs on cephalo-thorax, about 17 long; five pairs submedially on abdominal segments 1,3-6, about 11 long; a pair laterad of base of vasiform orifice, 14 long; a pair subdorsally at a level of second abdominal segment; two pairs subdorsally caudal of vasiform orifice and a pair submarginally on either side of caudal furrow. Transverse moulting suture reaches submargin; rhachis discernible. Dorsal disc sparsely scattered with pores and porettes. A series of submarginal pores and porettes, about 44 pairs, very characteristic. Thoracic tracheal furrows absent; caudal tracheal furrow slightly indicated. Abdominal segment seven shorter; pockets distinct.

Vasiform orifice cordate, longer than wide (69×56), lateral walls ridged; operculum broadly trapezoidal filling half the orifice (43×30); lingula setose, knobbed, bearing subapically a pair of setae, exposed, included.

Ventral surface.—Ventral abdominal setae 19-25 long, 59 apart. Antenna slender, long, extending slightly beyond the prothoracic spiracle but not reaching base of mesothoracic leg. All the four pairs of spiracles visible. A minute seta at base of each of meso-and meta-thoracic legs evident. Marginal setae arise ventrally.

Hosts.—*Pongamia glabra* and *Pterolobium indicum*.

Holotype.—One pupal case mounted, on *Pterolobium indicum*, Kallar (Nilgiris), 4-9-1966, B. V David.

Paratypes.—Twelve pupal cases mounted bearing the same details; numerous pupal cases on leaves in the collections of the senior author, Sixteen pupal cases mounted, on *Pongamia glabra*, Coimbatore, 31-10-1966, B. V David; numerous cases on dry leaves in collection. Thirty pupal cases mounted, on an unidentified Papilionaceous shrub, Tambaram (Madras), 4-1-1970, B. V David; numerous pupal cases on leaves in collection. [Paratypes deposited in the collection of the British Museum (Natural History), London and the Zoological Survey of India, Calcutta].

This species is quite distinct from *Aleuromarginatus tephrosiae* Corbett in having a rhachis and a submarginal series of pores and porettes and in the structural details of marginal teeth and vasiform orifice.

18. *Aleuromarginatus tephrosiae* Corbett, 1935

(Text-fig. 14)

1935. *Aleuromarginatus tephrosiae* Corbett, 1935, *Ann. Mag. nat. Hist.*, **16**(10): 247.
1940. *Aleuromarginatus indica* Singh, *Rec. Indian Mus.*, **42**: 453-456, *Syn. n.*

The following additional description is provided to the original description of the species by Corbett.

Pupal case.—Length 1.26-1.30 mm. Width 0.78-0.85 mm. Found on both upper and lower surface of leaflets of *Tephrosia* causing pits on them.

Margin.—Margin strongly toothed with a pore at the base of each tooth. The large marginal pores have been erroneously referred to as a second row of teeth by Corbett.

Dorsal surface.—Dorsal setae 21 pairs—11 pairs on cephalo-thorax about 14 long; 10 pairs on abdominal region, 11-14 long (five pairs submedially on abdominal segments 1, 3-6; a pair laterad of base of base of vasiform orifice, 20 long; a pair subdorsally at a level of second abdominal segment, two pairs sublaterally caudal of vasiform orifice and a pair submarginally on either side of caudal furrow. Transverse moulting suture almost reaches the margin. Abdominal rhachis absent.

Vasiform orifice cordate, 73×66 ; operculum wider than long (50×28); lingula setose and blunt bearing terminally a pair of small setae, exposed, included.

Ventral surface.—Ventral abdominal setae 36 long, 83 apart. Marginal setae arise ventrally on small tubercles. All the four pairs of spiracles visible. Antenna slender, long, extending slightly beyond base of fore leg. A minuteseta at base of each of meso- and metathoracic legs evident.

Host.—*Tephrosia purpurea* (Rao, 1958).

Distribution.—Hyderabad (Andhra Pradesh) (Rao, 1958); Badnera (Maharashtra), Marudamalai (Coimbatore), Sawyerpuram, Neyveli, Madras (Tamil Nadu) (new distribution records).

Material examined.—Three pupal cases mounted, on *Tephrosia purpurea*, Marudamalai, 22-10-1966, B. V. David; three pupal cases mounted, on *Tephrosia purpurea*, Madras, 15.9.1971, B. V. David. Numerous pupal cases on leaves of *Tephrosia purpurea*, Sawyerpuram, 29.7.1969, B. V. David.

Mound (1965) has remarked that 'the characters given by Singh (1940) in his description of *A. indica* do not separate this species from the type-species' An examination of the type of *A. indicus* Singh available with the Zoological Survey of India, Calcutta, confirmed that the species is a synonym of *A. tephrosiae* Corbett.

Key to Indian Species of *Aleuromarginatus*

1. Rhachis discernible; a series of submarginal pores and porettes evident.
kallarensis sp. n.
- Rhachis not discernible, a series of submarginal pores only evident.
tephrosiae Corbett

VI. Genus *Aleuroplatus* Quaintance and Baker, 1917

Type species.—*Aleurodes guercusagaticae* Quaintance, 1900, *Bull. U.S. Bur. Ent.*, **8**: 1-43

Though this genus is not well defined at present, the species included in it are characterised by the absence of submarginal wax glands and first abdominal setae, margin with a single row of teeth, thoracic tracheal folds ending in a comb of teeth, and vasiform orifice being

transversely elliptical, rounded or roundly quadrangular, operculum filling one-third of orifice and obscuring the lingula.

19. *Aleuroplatus alcocki* (Peal, 1903)

(Text-fig. 15)

1903. *Aleurodes alcocki* Peal, *J. Asiat. Soc. Bengal*, **72**(2): 61-98.

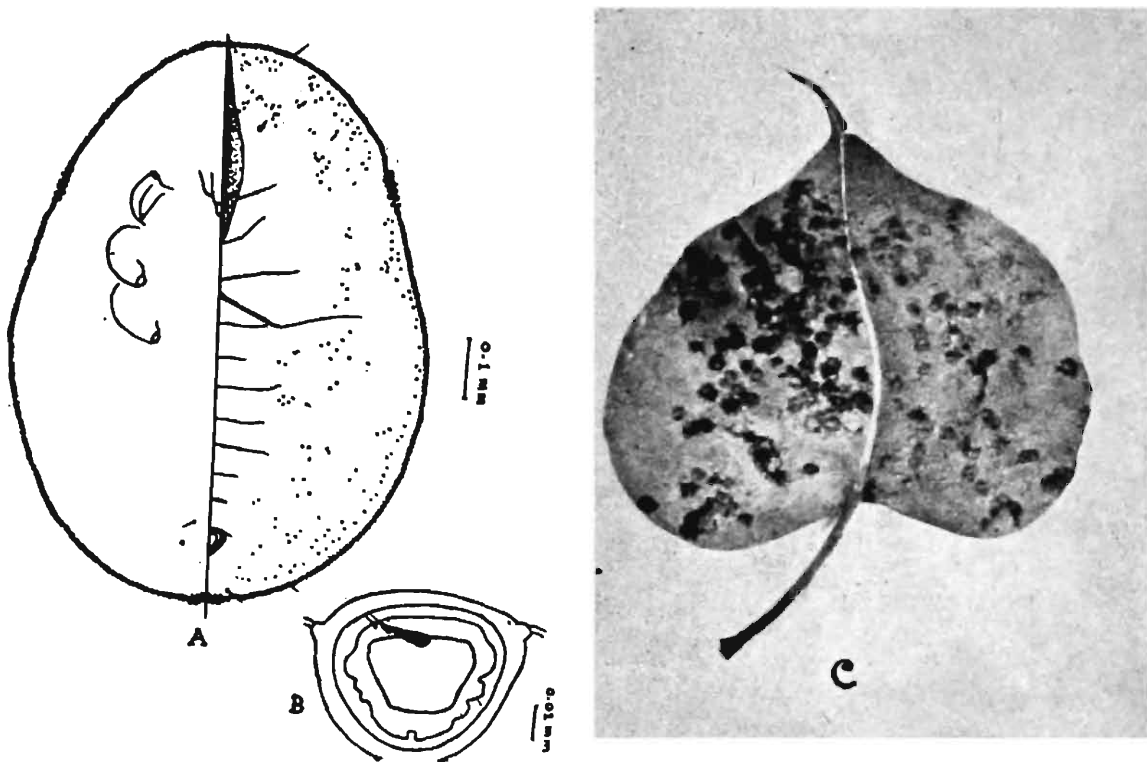
1931. *Aleuroplatus alcocki* (Peal), Singh, *Mem. Dept. Agric., India, Ent. Ser.* **12**(1): 19.

The following additional notes are provided.

Pupal case.—Length 0.80-0.95 mm. Width 0.58-0.72 mm.

Margin.—Margin distinctly toothed with about 19 teeth in 0.1 mm. Paired anterior and posterior marginal setae about 19 long. Thoracic tracheal combs ending in 6-8 teeth, distinct from marginal teeth; caudal tracheal comb distinct with 7-8 teeth.

Dorsal surface.—Cephalic setae minute; setae on first abdominal segment wanting; setae on eighth abdominal segment on a tubercle laterad of vasiform orifice, 17-19 long. Caudal setae 33 long. Vasiform orifice 41 long, 52 wide; operculum 22 long, 25 wide; lingula concealed.



Text-fig. 15. *Aleuroplatus alcocki*, A. Pupal case, B. Vasiform orifice, C. pupal cases on the undersurface of *Ficus religiosa* leaf.

Ventral surface.—Ventral abdominal setae 25 long, 39 apart, placed cephalad of vasiform orifice. A small seta at the base of each of meso- and metathoracic legs. Antenna not extending beyond the base of fore leg. A pair of minute setae at the base of rostrum evident. All the four pairs of spiracles visible.

Hosts.—*Ficus bengalensis* (Peal, 1903), *Ficus religiosa* (Singh, 1931), *Polyalthia longifolia* and *P. pendula* (new host record).

Distribution.—Calcutta (Peal, 1903); Pusa (Bihar) (Singh, 1931); Coimbatore and Madras (Tamil Nadu) (new distribution records).

Material examined.—Twelve pupal cases mounted, on *Polyalthia longifolia*, Coimbatore, 11-11-1966, B. V David; one pupal case mounted, on *Polyalthia pendula*, Coimbatore, 5-4-1967, B. V David; fortyfour pupal cases mounted, on *Ficus religiosa*, Madras, 31-7-1971, B. V David.

20. *Aleuroplatus mysorensis* sp. n.

(Text-fig. 16)

Pupal case.—Black, embedded in a transparent resinous substance; subelliptic; 0.78-1.08 mm long, 0.53-0.78 mm wide. Found on both surfaces of leaf.

Margin.—Marginal row of rounded teeth with a pore at base; 18-19 teeth in 0.1 mm. Paired anterior and posterior marginal setae minute. Thoracic and caudal tracheal combs ending in a tooth; tooth narrower at base and wider at rounded apex; indented at caudal tracheal comb area.

Dorsal surface.—Cleared pupal case brown. A pair of cephalic setae and a pair of eighth abdominal setae laterad of base of vasiform orifice minute; setae on first abdominal segment wanting. Transverse moulting suture runs posteriorly to the level of first abdominal suture and then bends sharply to anterior extending upto submargin. Abdominal segments 1-7 with submedian depressions. Eye spot faintly indicated. Minute pores and porettes found scattered on dorsal disc. Minute setae are found scattered on subdorsum and submarginal area. Submargin with many short sutural lines running mesad from margin.

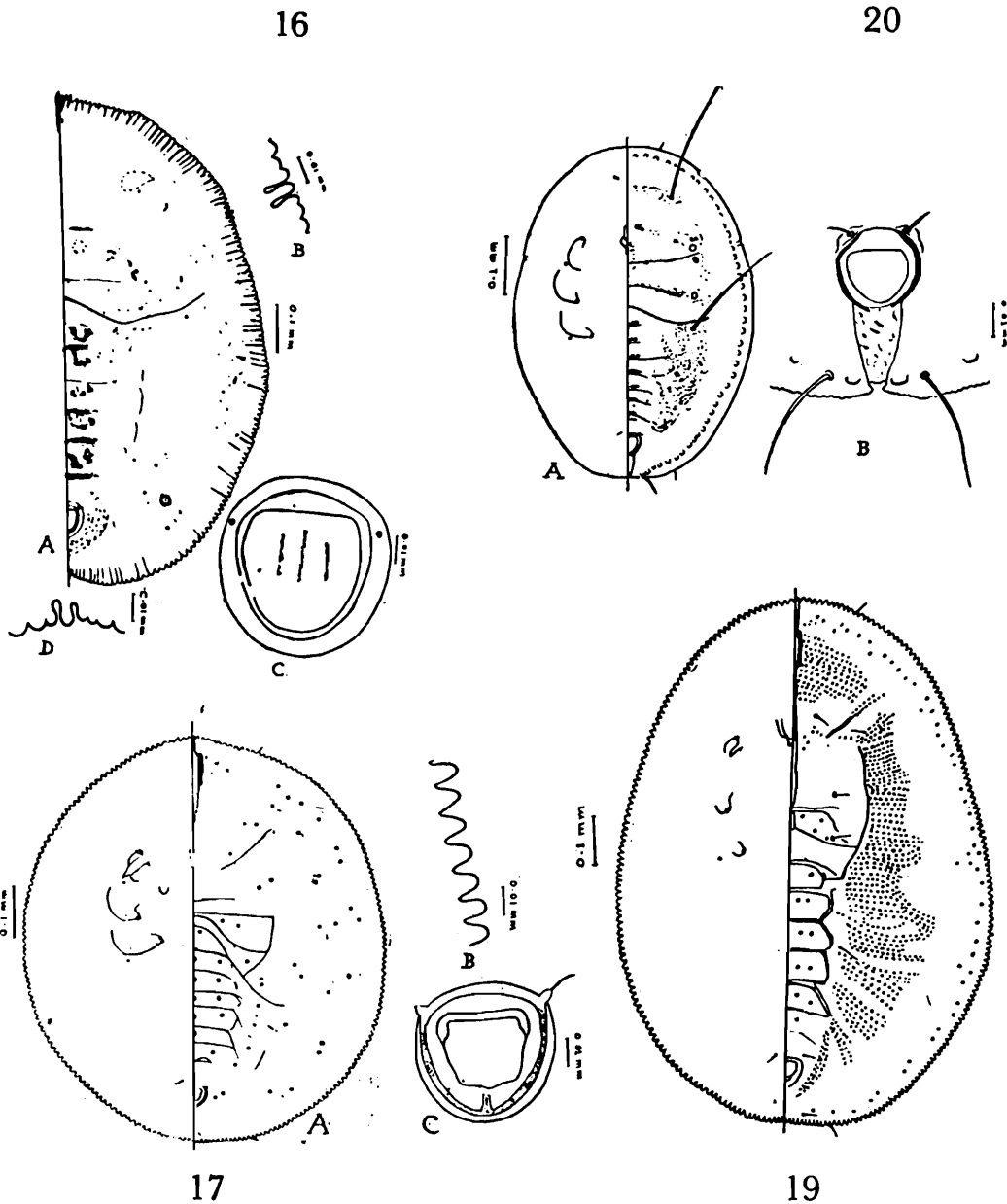
Vasiform orifice rounded with a thickly chitinised rim bearing laterad of the base of orifice a pair of minute setae. Vasiform orifice surrounded by broken dark spots laterad and caudad arranged in circles. Operculum subcircular filling the orifice and obscuring the lingula.

Ventral surface.—Antenna short not extending beyond the base of foreleg; all the four pairs of spiracles visible.

Holotype.—One pupal case mounted, on an unidentified tree, Babboor village (Karnataka State), 15-9-1969, B. V David.

Paratypes.—Ten pupal cases mounted bearing the same details. [Deposited in the collections of the British Museum (Natural History), London and the Zoological Survey of India, Calcutta.]

This species in general appearance resembles *Aleuroplatus incisus* Quaintance and Baker in the tracheal folds armed with an elongate tooth, but differs in the tooth being not situated in a distinct sinus, in not possessing a long caudo-lateral setae and in the shape of operculum.



Text-figs. 16, 17, 19, 20. (16) *Aleuroplatus mysorensis* sp. n. A. pupal case, B. Thoracic tracheal pore, C. Vasiform orifice; (17) *Aleurotrachelus caerulescens*, A. Pupal case, B. Margin, C. Vasiform orifice; (19) Pupal case of *Aleurotrachelus multipapillus*; (20) *Aleurotuberculatus cardomomi* sp. n. A. Pupal case, B. Vasi-form orifice and caudal tracheal pore.

Key to Indian Species of Aleuroplatus

1. Pupal case black, embedded in a transparent resinous substance. 2
 Pupal case brown, embedded in a transparent resinous substance; thoracic and caudal tracheal combs provided with 4-9 teeth. *alcocki* (Peal)
2. Eye spots absent; thoracic and caudal tracheal combs with about seven long widely separated teeth with minute serrations along their lateral margin. *pectenserratus* Singh*
- Eye spots indicated; thoracic and tracheal combs with a distinct tooth.
 *mysorensis* sp. n.

VII. Genus **Aleurotrachelus** Quaintance and Baker, 1914

Type species.—*Aleurodes tracheifer* Quaintance, 1900, *U. S. Dept. Agr. Div. Ent. Bull. Tech. Ser.*, 8 : 1-64.

The important characteristic features of this genus are as follows: Margin of pupal case with two rows of teeth; dorsal disc not separated from submargin; a prominent central ridge on dorsum terminating cephalad in a more or less arrow-shaped figure. Vasiform orifice cordate; operculum subcordate nearly filling orifice; lingula usually hidden, when visible, slightly expanded at tip.

21. *Aleurotrachelus caerulescens* Singh

(Text-fig. 17)

1931. *Aleurotrachelus caerulescens* Singh, *Mem. Dept. Agric. India, Ent. Ser.*, 12(1): 59.

The following notes are provided to Singh's original description of the species.

Pupal case.—0.85-0.86 mm long, 0.68-0.69 mm wide.

Margin.—Thoracic and caudal tracheal pores or combs wanting. Margin with a double row of teeth, rounded, about 15 teeth in 0.1 mm. Paired anterior and posterior marginal setae, about 17 long.

Dorsal surface.—The anterior part of mid-dorsal suture tuberculate. A pair of cephalic setae, 5-8 long; a pair of setae on the eighth abdominal segment cephalad of the orifice on tubercles, 8 long and a pair of caudal setae, 8 long. Papillae-like pores medially on abdominal segments 1-6; submedially on segments 2-5; pores also found scattered on subdorsum and along submargin.

Ventral surface.—Ventral abdominal setae 19 long, 39 apart. All the four pairs of spiracles discernible. Antenna extending to prothoracic spiracle; a minute seta at base of meso- and metathoracic légs.

Hosts.—*Artocarpus heterophyllus* (= *A. integrifolia*) (Singh, 1931) and *Rosa* sp. (Rao, 1958).

Distribution.—Pusa, Bihar (Singh, 1931); Hyderabad (Andhra Pradesh) (Rao, 1958) and Madurai, Coimbatore and Madras (Tamil Nadu) (new distribution record).

Material examined.—Seven pupal cases mounted, on rose (*Rosa* sp.), Coimbatore, 11-11-1966, B. V David; six pupal cases mounted, on rose, Madurai, 5-2-1969, B. V David. Numerous pupal cases on dry leaves in collection.

22. *Aleurotrachelus coimbatorensis* sp. n.

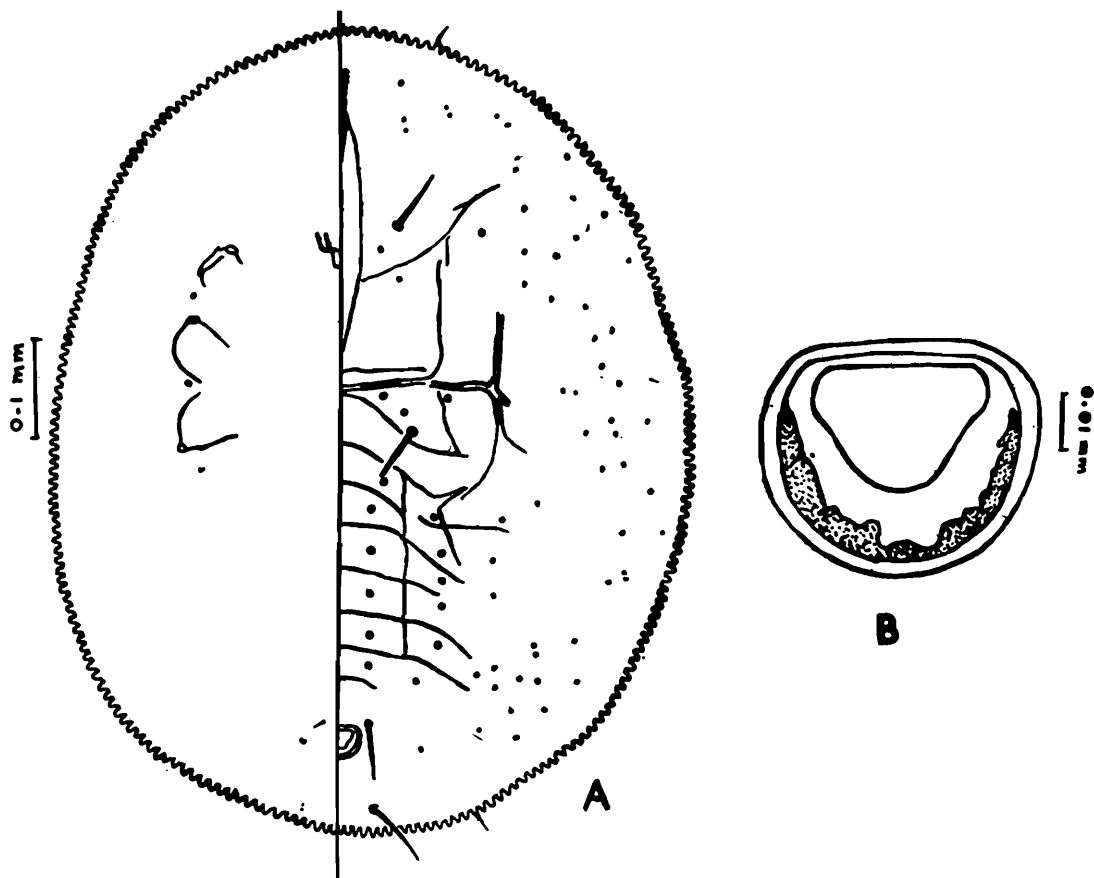
(Text-fig. 18)

Pupal case.—Oval; 0.91-0.95 mm long, 0.71-0.78 mm wide.

Margin.—Margin with a double row of teeth, rounded, about 20 teeth in 0.1 mm. Paired anterior and posterior marginal setae,

16-19 long. A pair of submarginal caudal setae, 61 long. Thoracic and caudal tracheal pores or combs or folds not indicated.

Dorsal surface.—Three pairs of dorsal setae evident—the cephalic setae 61 long, a pair submedially on metathorax, 52 long and the eighth abdominal setae laterad of vasiform orifice, 52 long. The anterior part of mid-dorsal suture with tuberculate markings. Cephalothorax with a longitudinal ridge on each side and the median abdominal rhachis with lateral folds characteristic. Minute papillae-like pores are found scattered on the dorsal disc and a few on submargin.



Text-fig. 18. *Aleurotrachelus coimbatorensis* sp. n. A. Pupal case, B. Vasiform orifice.

Vasiform orifice subcircular with a sclerotized rim, the lateral sides ridged, floor of orifice with minute tubercles; 33 long and 39 wide. Operculum wider than long with the caudal end narrow and rounded; length 17 and width 22. Lingula hidden.

Ventral surface.—Ventral abdominal setae 22 long, 36 apart. Pro- and mesothoracic spiracles and anterior and posterior abdominal spiracles evident. Antenna not extending beyond fore leg. Setae at base of legs and rostrum wanting.

Host.—*Jasminum auriculatum*.

Holotype.—One pupal cases on slide, Coimbatore, *Jasminum auriculatum*, 21-3-1957, S. K. David.

Paratypes.—Seventeen pupal cases mounted bearing the same details. [Deposited in the collections of the British Museum (Natural History), London and the Zoological Survey of India, Calcutta.]

This species closely resembles *Aleurotrachelus caeruleus* Singh, but differs in having a pair of dorsal setae submedially on metathorax and in the distribution of papillae-like pores on dorsum.

23. *Aleurotrachelus multipapillus* Singh, 1932

(Text-fig. 19)

1932. *Aleurotrachelus multipapillus* Singh, *Rec. Indian Mus.*, **34**: 81-88.

Pupal case.—Light translucent yellow without any fluff, oval, female case 1.34 mm long and 0.91 mm wide, male case 0.98 mm long and 0.63 mm wide. Found on the undersurface of leaves.

Margin.—Toothed with closely set rounded teeth, about 12-13 in 0.1 mm. Paired anterior marginal setae 16 long, posterior marginal setae 21 long. Caudal setae submarginal, 16 long. Thoracic and caudal tracheal pores and folds not indicated.

Dorsal surface.—Four pairs of dorsal setae evident—the first pair being longest, 60 long, disposed laterad of mouth parts; a pair of small setae of 18 long on each of meso- and metathorax; a pair of setae at base of vasiform orifice, 31 long. The anterior part of mid-dorsal suture tuberculate. A median rhachis with folds characteristic of the genus evident. Minute papillae on subdorsum and cephalic region distributed in a definite characteristic pattern as illustrated. One or two minute pores medially on rhachis and two or three pores on thoracic region seen. Submargin with a row of minute pores numbering about 39 on one side.

Vasiform orifice almost subcordate with a sclerotized rim, 73 long, 60 wide; caudal membrane and edge tuberculate. Operculum more or less similarly shaped filling two-third of orifice. Swollen and setose part of lingula exposed; tip with two fine setae.

Ventral surface.—Ventral abdominal setae 31 long, 62 apart. A seta, 3 long, at base of metathoracic legs.

Host plant.—Bamboo.

Material examined.—Four female pupal cases and one male pupal case, on bamboo, Mallisery Estate near Kongode (Kerala State), 27-9-1968, B. V. David.

This species was first described by Singh from specimens collected from *Bambusa nana* in Syriam (Burma). This is a new addition to Indian Aleyrodidae.

Key to the Indian Species of Aleurotrachelus

1. A pair of small dorsal setae on each of meso- and metathorax submedially present.

.. .. .	<i>.multipapillus</i> Singh
Dorsal setae on mesothorax wanting but on metathorax may be present or absent.	2
2. A pair of setae submedially on metathorax evident.

Dorsal setae on metathorax absent.	<i>.coimbatorensis</i> sp. n.
	<i>.caeruleus</i> Singh

VIII. Genus **Aleurotuberculatus** Takahashi, 1932

Type species.—*Aleurotuberculatus gordoniae* Takahashi, 1932, *Rep. Dept. Agric.*, Formosa, **59** : 20.

The species included in this genus are characterised by the pupal case with crenulate margin, a row of submarginal papillae, fine granules or papillae on dorsum, faintly discernible thoracic tracheal folds, distinct or indistinct thoracic tracheal pores and distinct caudal tracheal fold and pore. Vasiform orifice subcordate, notched at posterior margin.

24. **Aleurotuberculatus cardamomi** sp. n.

(Text-fig. 20)

Pupal case.—White without any marginal wax; elliptic; 0.78 mm long, 0.55 mm wide. Found on the under surface of leaves at 1-3 cases per leaf.

Margin.—Smoothly crenulate, 38-40 crenulations in 0.1 mm, rounded. Paired anterior and posterior marginal setae 5 long; Tracheal pore regions distinct and notched internally.

Dorsal surface.—Four pairs of setae evident—cephalic setae 189 long, first abdominal setae 208 long, setae on eighth abdominal segment laterad of base of vasiform orifice minute, 5 long and caudal setae submarginal 66 long. Dorsum with numerous minute tubercles and a row of minute tubercles on each of the first seven abdominal segments. Abdominal segment seven is not shortened medially. Submargin with about forty three pairs of broad papillae of variable sizes (10-13 × 8-13) and distinctly isolated from each other. Transverse suture not reaching margin, ends posterior to its mid-point. Subdorsal region without papillae. Vasiform orifice as long as wide (39 × 39), surrounded except on posterior end by a sclerotized ring. Posterior border of orifice transverse, notched internally. Operculum about 29 wide and occupies about two-thirds of orifice; lingula concealed with expanded round tip. Caudal furrow and folds distinct, 44 long and 26 wide at anterior, tapering to 13 at posterior.

Ventral surface.—Smooth, Ventral abdominal setae at base of vasiform orifice, 11 long, 30 apart. Setae at base of legs absent. Anterior thoracic and anterior and posterior abdominal spiracles clearly visible.

Host plant.—*Elettaria cardamomum* (Cardamom).

Holotype.—One pupal case mounted, on cardamom, Valparai (6000 feet), 16-4-1967, B. V David.

Paratypes.—Two pupal cases mounted bearing the same details. [Deposited in the collections of the British Museum (Natural History), London and the Zoological Survey of India, Calcutta].

Related to *Aleurotuberculatus lithocarpi* Takahashi, but differs in the presence of shallow emarginated tracheal pores, in the distribution of

tubercles on dorsum, and in the number and arrangement of submarginal papillae. Also resembles *A. melastomae* Takahashi but differs considerably in the presence of a row of submarginal large papillae.

25. ***Aleurotuberculatus psidii*** (Singh), 1931
(Text-fig. 21)

1931. *Aleurotrachelus psidii* Singh, *Mem. Dept. Agric. India, Ent. Ser.*, **12**(1): 61-62.
1958. *Aleurotuberculatus psidii* (Singh), Rao, *Proc. 10th. int. Congr. Ent.* (1956) **1**: 331.

Pupal case.—Pale white with little waxy secretion, suboval, broader cephalad, being widest at junction of thorax and abdomen, narrowing caudad. Vasiform orifice appears brownish. Length 0.75 mm, width 0.43 mm. Found scattered singly on the under surface of leaves.

Margin.—Finely crenulate and with paired anterior and posterior marginal setae, 13 long. Tracheal pores smooth, shallow emarginations; posterior pore set in a deep cleft. Margin reflexed and visible intad of the arched line on subdorsum.

Dorsal surface.—Paired setae evident—cephalic setae 65 long, first abdominal setae 75 long, small setae cephalad of vasiform orifice 18 long and submarginal caudal setae on tubercles 44 long. The dorsal granulations are crescent and arrow-head shaped. A median abdominal ridge of 8-9 with brown pigmented tubercles with suture-like markings. Similar tubercles on cephalothorax form an anchor-shaped figure. Colourless tubercles evident at 2, 1 and 2 on the pro-, meso- and meta- thoracic legs respectively. Small contiguous arches incompletely separates the submargin from the dorsal disc.

Vasiform orifice sub-circular, rim chitinised, emarginate at posterior, 44 long and 42 wide. Operculum similarly shaped, entirely covering the orifice and concealing the lingula. Caudal furrow 55 long, terminates in a semicircular pore.

Ventral surface.—Ventral abdominal setae 8, 34 apart. Anterior and posterior abdominal spiracles visible distinctly. No setae at base of legs.

Host plant.—*Psidium guajava* (Guava).

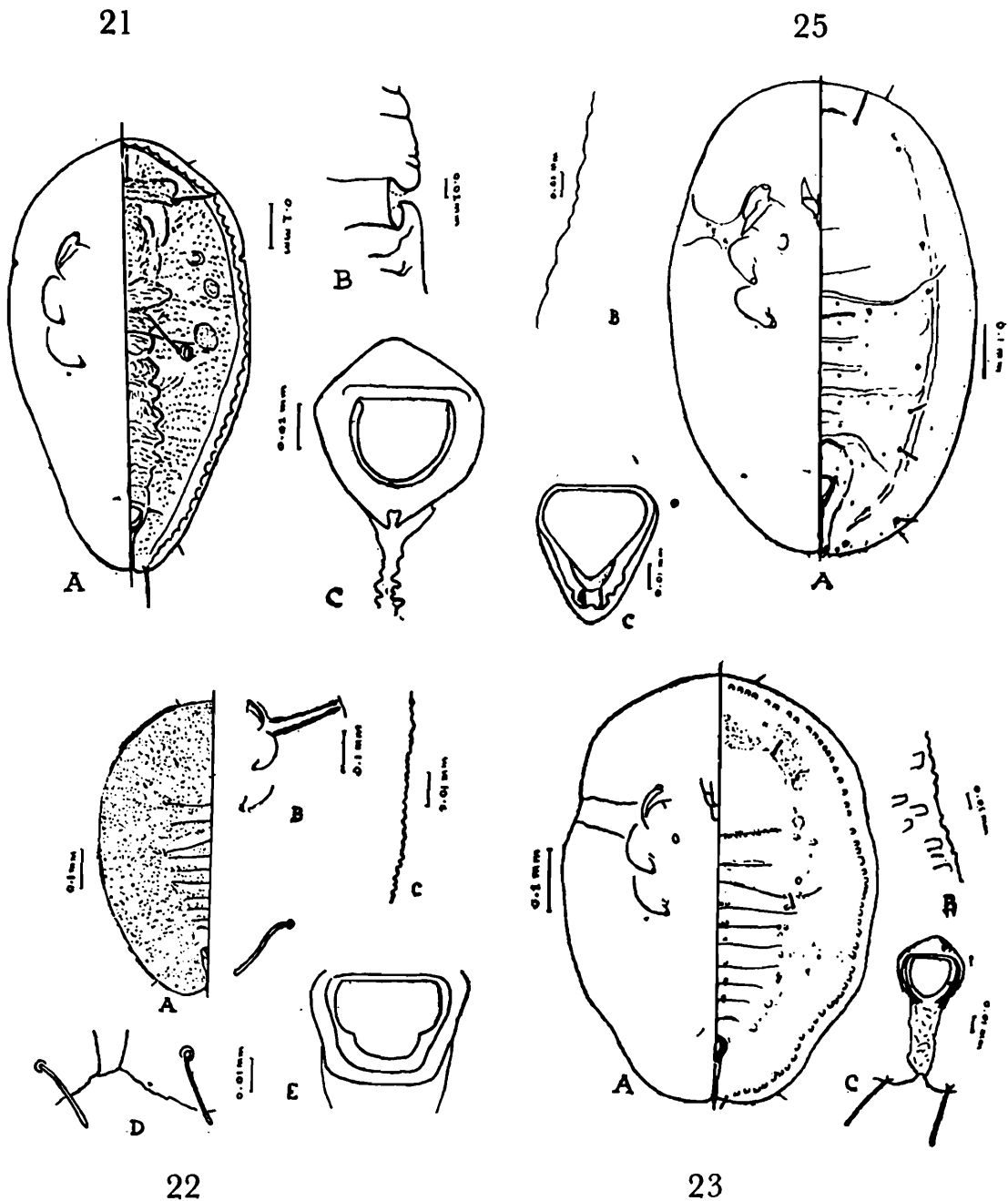
Distribution.—Pusa (Bihar) (Singh, 1931); Himayatnagar, Begumpet (Andhra Pradesh) (Rao, 1958); throughout Tamil Nadu (new distribution record).

Material examined.—11 mounted specimens, on *Psidium guajava* (Guava), Coimbatore, 9-3-1967, B. V. David.

26. ***Aleurotuberculatus russellae*** sp. n.
(Text-fig. 22)

Pupal case.—White, with no secretion evident, elliptic, 1.01 to 1.06 mm long and 0.76 to 0.81 mm wide. Found on the undersurface of leaflets.

Margin.—Finally crenulate, 25 crenulations in 0.1 mm; anterior marginal setae pointed, 18 long; posterior marginal setae pointed, 13 long. Thoracic pores, combs or teeth not indicated; caudal margin with a deep cleft or indented.



Text-figs. 21-23, 25, (21) *Aleurotuberculatus psidii* A. Pupal case, B. Thoracic tracheal pore, C. Vasiform orifice; (22) *Aleurotuberculatus russellae* sp. n. A. Pupal case dorsal surface, B. Ventral surface of thoracic, C. margin, D. Caudal tracheal pore, E. Vasiform orifice; (23) *Aleurotuberculatus takahashii* sp. n. A. Pupal case, B. Thoracic pore, C. Vasiform orifice and caudal tracheal pore, (25) *Asterolichon cordiae* sp. n., A. Pupal case, B. Thoracic tracheal pore, C. Vasiform orifice.

Dorsal surface.—Dorsal surface completely granulated and with four pairs of capitate setae—cephalic setae 16 long, first abdominal setae 16 long, eighth abdominal setae cephalad of vasiform orifice 13 long and submarginal caudal setae 16 long. Thoracic transverse suture not reaching the margin, abdominal segments distinct, pockets well indicated, not contiguous. A row of minute pores on submargin and on sub-dorsum evident.

Vasiform orifice is quite characteristic appearing more or less rectangular, length 34 and width 47. Operculum wider than long (31×26) towards caudal end, constricted at half its length and somewhat rounded; nearly fills the orifice concealing the lingula. Caudal furrow distinct and ends in a deep cleft in the caudal margin; pore, teeth or comb absent. Length 96, width (42) at caudal end of orifice and narrow (8) at caudal margin.

Ventral surface.—Smooth with a pair of ventral abdominal pointed setae 13 long, 42 apart. Thoracic tracheal folds slightly discernible; caudal fold tuberculate throughout its length. Setae at base of legs absent. Anterior and posterior abdominal spiracles evident.

Host plant.—An unidentified tree.

Holotype.—One mounted specimen, on an unidentified tree, Valparai (6000 ft), 16-4-1967, B. V. David.

Paratypes.—Eight pupal cases mounted, bearing the same details. Deposited in the collections of the Systematic Entomology Laboratory, Entomology Research Division, United States Department of Agriculture, Washington, the British Museum (Natural History), London and the Zoological Survey of India, Calcutta.

This species is very distinct and unique in having capitate setae, in the granulation of dorsal surface and in the shape of the operculum. It resembles *Aleurotuberculatus latus* Takahashi in the possession of capitate setae.

This species is named after Dr. Louise M. Russell of the Systematic Entomology Laboratory, Entomology Research Division, United States Department of Agriculture, Washington D. C.

27. *Aleurotuberculatus takahashii* sp. n.

(Text-fig. 23)

Pupal case.—White without any waxy secretion, vasiform orifice light brown; suboval, broader cephalad, being widest at junction of thorax and abdomen, narrowing caudad, indented posteriorly. Female case length 0.78 mm, width 0.56 mm. male case length 0.63 mm, width 0.43 mm. Found on the undersurface of leaves.

Margin.—Finely crenulate, about 26 crenulations in 0.1 mm; margin at thoracic pore area straight without any crenulations. Paired anterior and posterior marginal setae, 13-21 long.

Dorsal surface.—Four pairs of setae—cephalic capitate setae 39 long, first abdominal capitate setae 18 long, pointed setae on eighth abdominal segment laterad of base of vasiform orifice minute, and submarginal caudal setae 26 long on small tubercles. Transverse moulting suture bends to anterior extending to submargin. Dorsum with tubercles and numerous granules. Tubercles evident on median part of first six abdominal segments and larger tubercles on sublateral part of abdomen and cephalo-thorax. A row of papillae numbering about 50 on

submargin. Thoracic tracheal furrows not evident but caudal furrow wider at base and narrower at caudal end.

Vasiform orifice as long as wide, lateral margins sclerotized, widely notched on hind margin. Operculum sub-circular, transverse cephalad, covering most of orifice and concealing the lingula.

Ventral surface.—Ventral abdominal setae 13 long, 36 apart. Anterior and posterior abdominal spiracles seen. Thoracic tracheal folds broad and indicated faintly. Caudal tracheal fold with irregular markings. A minute seta at base of each leg present.

Host.—*Cordia myxa*.

Holotype.—One pupal case mounted, on *Cordia myxa*, Madras, 19-7-1971, B. V. David.

Paratypes.—Eight pupal cases mounted, bearing the same details. Pupal cases on dry leaves in collection. [Deposited in the collection of the British Museum (Natural History), London and the Zoological Survey of India, Calcutta.]

This species resembles *Aleurotuberculatus lithocarpi* Takahashi, but differs in the capitate nature of anterior two pairs of dorsal setae and caudal setae and in the number of submarginal papillae.

This species is named after late Dr. R. Takahashi.

Key to Indian Species of *Aleurotuberculatus*

- | | | |
|--|--------------------------|---------------------------|
| 1. Pupal case jet black; submargin with radial striations. | <i>.murrayae</i> (Singh) | 2 |
| Pupal case white; submargin without radial striations. | | 2 |
| 2. Submargin with a row of papillae. | .. | 3 |
| Submargin without a row of papillae. | . | 4 |
| 3. Thoracic tracheal pore distinct and notched; cephalic and first abdominal setae long and pointed. | | <i>.cardamomi</i> sp. n. |
| Thoracic tracheal pore area straight without any crenulations; cephalic and first abdominal setae short and capitate... | | <i>.takahashii</i> sp. n. |
| 4. Thoracic tracheal pore indicated by shallow emarginations. | | 5 |
| Thoracic tracheal pore area not indicated, but tracheal fold evident; dorsal setae capitate. | | <i>.russellae</i> sp. n. |
| 5. Dorsum granulated; basal abdominal setae present. | | 6 |
| Dorsum with a marked tassellation all over; first abdominal setae absent | | <i>minutus</i> (Singh) |
| 6. Dorsum with crescent and arrowhead shaped granulations; cephalothorax with distinct anchor-shaped tubercles; abdominal segments medially pigmented and tuberculate. | | <i>.psidii</i> (Singh) |
| Dorsum with sparse granules sublaterally; cephalo-thorax with 2 pairs of rounded tubercles; on abdominal segments 1 and 2 and rarely on 3 medially a tubercle evident. | | <i>.hexcantha</i> (Singh) |

IX. Genus *Asterobemisia* Trehan 1940.

Type species.—*Aleyrodos avellanae* Signoret, 1868 after Zahradnik, 1961, *Sb. ent. Odd. n'ar. M'ns. Praze*, 34(593): 433-438.

Pupal case elliptic, with margin finely crenulated; thoracic tracheal folds and combs indicated; caudal fold and comb present; seventh abdominal segment shorter than sixth and eighth; vasiform orifice elongately

triangular; operculum semicircular; lingula stout, spatulate with a pair of long setae at tip, exposed and included.

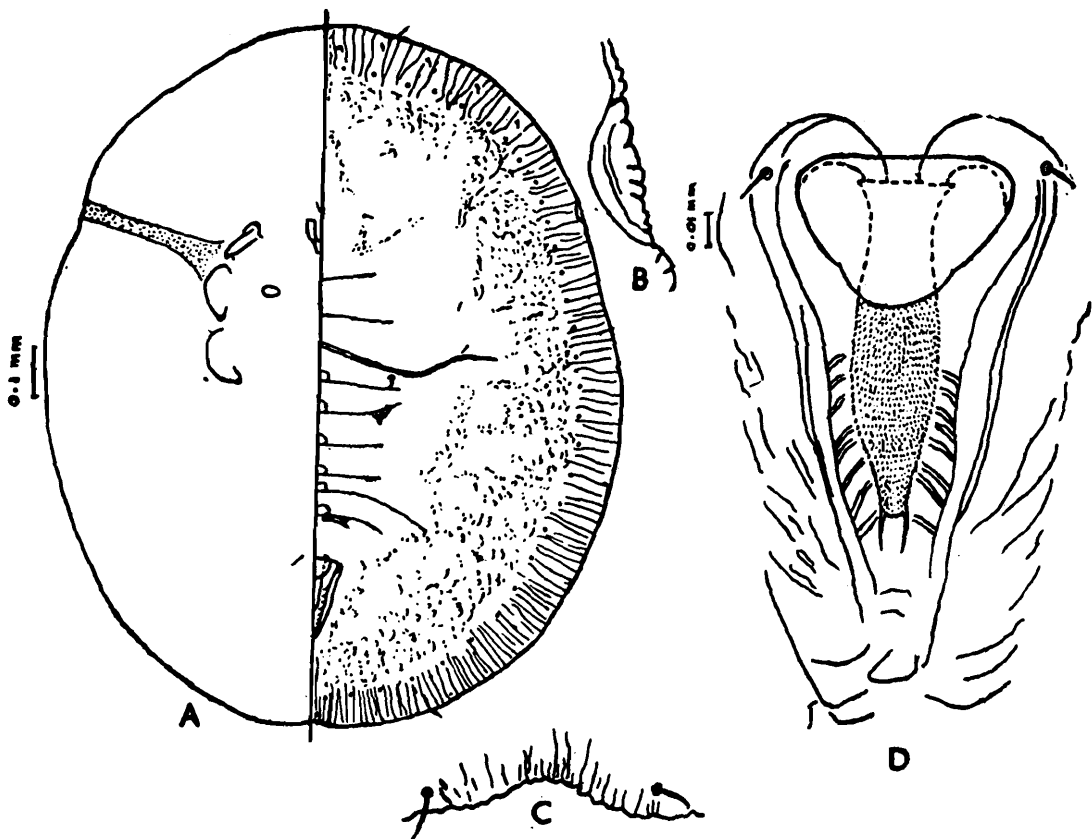
28. **Asterobemisia moringae** sp. n.

(Text-fig. 24)

Pupal case.—White without any waxy secretion, broadly oval, 1.46 mm long and 1.16 mm wide. Found on the lower surface of leaflets.

Margin.—Margin irregularly crenulate slightly emarginate at thoracic and caudal tracheal pore areas; tracheal comb slightly sclerotized and distinct than the marginal teeth. Paired anterior and posterior marginal setae, 16 and 31 long respectively.

Dorsal surface.—Four pairs of setae on dorsal surface evident—cephalic setae 17 long, first abdominal setae 21 long, eighth abdominal setae laterad of based of vasiform orifice 13 long and caudal setae 16 long. Transverse moulting suture bends to anterior extending to submargin. Abdominal segments fairly distinct, segment seven very short at the median part. Submargin with long furrows running mesad from margin. Dorsum and lateral part of abdominal segments granulated. A distinct rounded tubercle present on the median part of each of the first six abdominal segments. Eight pairs of minute setae at five pairs on the submargin of cephalic region and three pairs on the subdorsum of thoracic region and six pairs of minute setae on the subdorsum of abdomen evident; 13-21 long. Minute submarginal pores evident



Text-fig. 24. *Asterobemisia moringae* sp. n. A. Pupal case, B. Thoracic tracheal pore, C. Caudal tracheal pore, D. Vasiform orifice.

in a row. Thoracic tracheal furrows indistinct; caudal tracheal furrow slender, a little longer than orifice, 208 long from caudal margin to apex of vasiform orifice

Vasiform orifice elongate, triangular and pointed apically; 165 long, 99 wide at base; slightly sinuated at the lateral margin with about eight lateral ridges. Operculum wider than long, 66×46 , occupies one-third orifice. Lingula spatulate; stout, pointed at apex, with a pair of long setae, length 153, width at middle 26 and 8 at apex; exposed and included.

Ventral surface.—Ventral abdominal setae 47 long, 76 apart, located ventral to the lateral aspect of base of operculum. Thoracic tracheal fold long, narrow and faintly indiated with minute dots. Anterior and posterior abdominal spiracles distinctly visible. A pair of small setae (11 long) at base of rostrum seen. Setae at base of legs wanting.

Host.—*Moringa oleifera*.

Holotype.—One pupal case on slide, on *Moringa oleifera*, Coimbatore, 17-4-1967, B. V. David.

Paratype.—Two pupal cases on a slide bearing the same details deposited in the collection of the British Museum (Natural History), London.

Key to Indian Species of Asterobemisia

1. Case broadly oval; six rounded tubercles on each of first six abdominal segments medially; minute setae 8 pairs on cephalo-thorax and 6 pairs sublaterally on abdomen in addition to usual 3 pairs of dorsal setae. *moringae* sp. n.
Case elliptic; dorsum with 5 pairs of setae, 1 pair on thorax and 4 pairs sublaterally on abdomen in addition to usual 3 pairs of dorsal setae. *leakii* (Peal)*

X. Genus **Asterochiton** Maskell 1878

Typespecies.—*Asterochiton aureus* Maskell, 1878, *Trans. New Zealand Inst.*, **11**: 214.

Dumbleton (1957) amended the generic description as follows: Pupal case medium sized, subelliptical to subcircular; margin with a row of teeth, dorsal disc may be separated from submargin; thoracic tracheal folds and combs and caudal tracheal comb present, caudal fold indicated; vasiform orifice subcordate, operculum transversely semicircular, subcordate or subtrapezoidal filling about half the orifice; lingula exposed and included.

29. **Asterochiton cordiae** sp. n.

(Text-fig. 25)

Pupal case.—White, with about sixty transparent waxy filaments radiating from margin and some wax middorsally on cephalo-thorax and abdomen and on subdorsum; vasiform orifice brown. Female pupal case 0.98 mm long, 0.63 mm wide; male pupal case 0.86 mm

long and 0.52 mm wide; found on the lower surface of leaves along veins and midrib, rare.

Margin.—Crenulate; crenulations shortened at tracheal pore areas, slightly indented at caudal end. Paired anterior and posterior marginal setae 22-33 long.

Dorsal surface.—Usual paired setae on dorsal surface evident—cephalic setae (broken), first abdominal setae (broken), eighth abdominal setae laterad of base of orifice 14-22 long and submarginal caudal setae 36 long. In addition a row of thick long pointed setae on subdorsum at three pairs on cephalo-thorax and four pairs on abdominal segments 1, 4, 5 and 6, and two pairs submarginal towards caudal end evident, length varies from 25-55. Dorsal disc separated from submargin by a faint fold. Transverse moulting suture bends to anterior extending to submargin. Abdominal segments distinct, seventh being medially shortened than the sixth. Pockets well developed and contiguous. Minute pores and porettes submedially a pair on each of the abdominal segments and scattered on dorsum. Submargin with a row of about 40 pairs of minute setae. Thoracic and caudal tracheal furrows indicated.

Vasiform orifice subcordate with caudal end pointed, 53-63 long, 46-53 wide. Operculum similarly shaped (33-40 long, 40-46 wide) filling half the orifice. Lingula with a pair of terminal setae, exposed, included.

Ventral surface.—Ventral abdominal setae 25 long, 39 apart. Thoracic tracheal folds distinct, half the length dotted from base of legs. Antenna of female 69 long extending to base of mesothoracic leg; in male 138 long extending to middle of mesothoracic leg. All the four pairs of spiracles and adhesive sac visible. A minute seta at base of each of meso- and metathoracic legs, a pair of minute setae at base of rostrum seen.

Host.—*Cordia myxa*.

Holotype.—One pupal case mounted, on *Cordia myxa* Madras, 19-7-1971, B. V. David.

Paratypes.—Mounted specimens in the collections of the Systematic Entomology Laboratory, United States Department of Agriculture, Washington and the British Museum (Natural History), London.

This species in general appearance resembles *Asterochiton simplex* (Maskell), but differs considerably in the number and arrangement of long thick setae on dorsal surface, in the presence of submarginal minute setae and pores and porettes on dorsal disc and in lingula possessing a pair of terminal setae.

XI. Genus **Bemisia** Quaintance and Baker, 1914

Type species.—*Aleyrodes inconspicua* Quaintance, 1900, *U.S. Dept. Agr. Div. Ent. Bull.* 8, Tech. ser : 1-64.

This genus is characteristic in including species having an elongate triangular vasiform orifice, usually with an exposed triangular lingula tip. A series of subdorsal setae are present which may be often overlooked when small, but are occasionally long and stout.

30. ***Bemisia hancocki*** Corbett

(Text-fig. 26)

1936. *Bemisia hancocki* Corbett, *Proc. R. ent. Soc. London* (B), 5: 18-22.

1965. *Bemisia hancocki* Corbett, Mound, *Bull. Br. Mus. nat. Hist. Ent.*, 17(3): 140-142.

Pupal case.—White without any waxy secretion, elliptic with hind end slightly indented, 0.95-1.00 mm long and 0.66 mm wide. Found on both surfaces of leaflets of host plant.

Margin.—Margin finely crenulate, slightly emarginate at thoracic and caudal tracheal pore areas which are not discernible in some specimens. The teeth in the tracheal comb are slightly sclerotized and distinct than the other marginal teeth. Paired anterior and posterior marginal setae, 13-16 long.

Dorsal surface.—Paired setae on dorsal surface as follows: Cephalic setae 26 long, first abdominal setae 13 long, eighth abdominal setae 11 long situated laterad of base of vasiform orifice and caudal setae 16 long. Transverse moulting suture short. Abdominal segments fairly distinct, segment seven very short at the median part. Submargin with furrows running mesad from margin. Dorsum with numerous granules and lateral part of abdominal segments also granulated. Distinct rounded tubercles larger than dorsal granules numbering about six pairs present laterad of abdominal segments and medially one on each of the first six abdominal segments. About eight pairs of rounded tubercles seen on the cephalo-thorax. Subdorsum with three pairs of minute setae on cephalo-thorax and five pairs of minute setae in a row on each side of posterior part of abdomen; 13-21 long. Thoracic tracheal furrows not indicated; caudal furrow slender and as long as orifice, 74-77 long. Pockets well developed and not contiguous.

Vasiform orifice elongated, triangular and pointed caudad; slightly sinuated at the lateral margin with five lateral ridges. Length 122, width 91 at base and 21 at apex. Operculum sub-circular, wider than long, 65×43, narrowed and rounded apically; occupies one third orifice. Lingula stout, 104 long, spatulate, pointed apically (28 wide at middle and 5 at apex) with a pair of long setae, exposed and included.

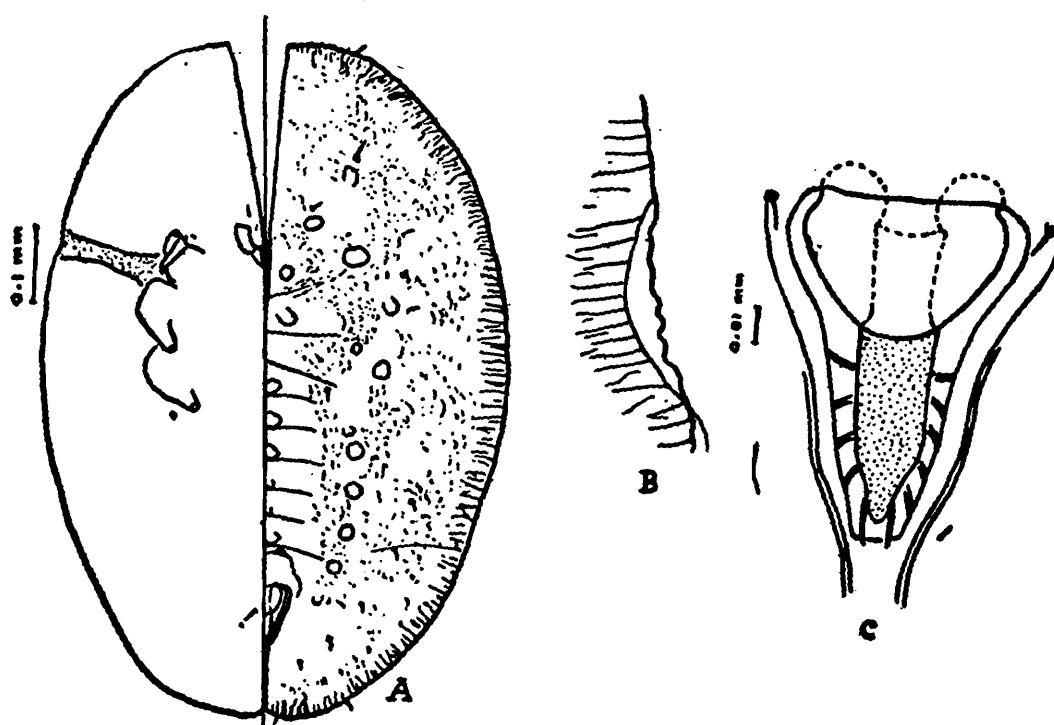
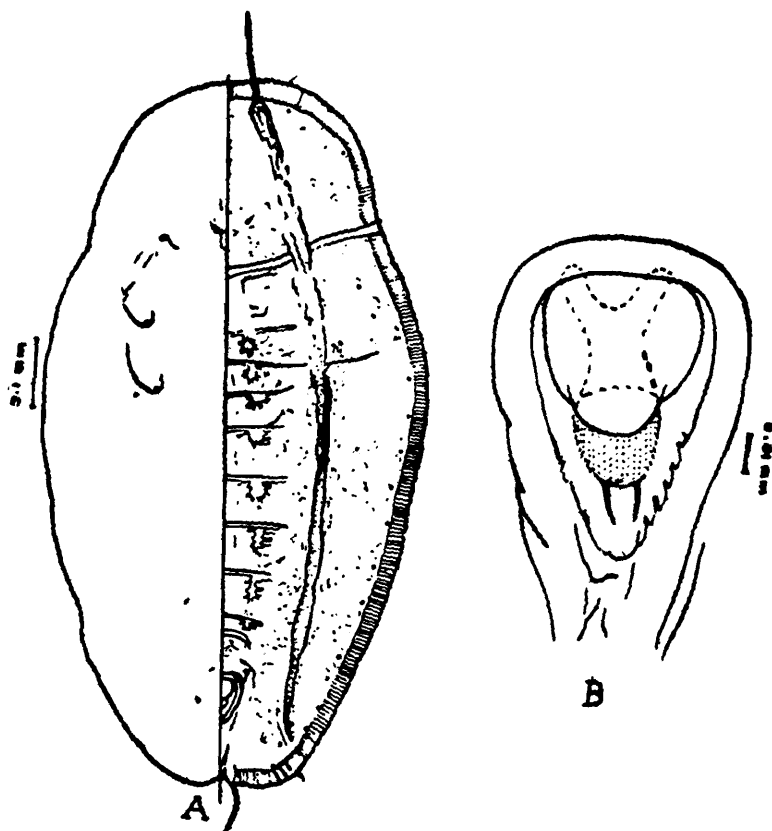
Ventral surface.—Ventral abdominal setae 26 long, 60 apart; situated ventrally just anterior to the caudal end of operculum. Thoracic tracheal fold long and faintly indicated with minute dots. A pair of minute setae present at base of rostrum. Anterior and posterior abdominal spiracles evident. Setae at base of legs absent.

Host plant.—*Tephrosia purpurea*.

Material examined.—Eleven pupal cases mounted, on *Tephrosia purpurea*, Badnera (Maharashtra), 30-8-1969, B. V David. Two pupal cases, on *Tephrosia purpurea*, Madras, 15-9-1971, B. V David.

This species known so far from Western Africa and is reported for the first time from India.

27



26

Text-figs. 26-27. (26) *Bemisia hancocki* A pupal case, B. Thoracic tracheal pore, C. Vasiform orifice, (27) *Bemisia jasmineum* sp. n. A. Pupal case, B. Vasiform orifice.

31. ***Bemisia jasminum*** sp. n.

(Text-fig. 27)

Pupal case.—White, flat, elongate oval, operculum brownish, slightly narrowed across thoracic folds, widest about mid-length, indented caudally. Waxy secretion scanty but case elevated slightly due to a narrow palisade all round the margin. Length 1.10 mm, width 0.56 mm. Found along midrib and veins on the lower surface of leaves.

Margin.—Crenulate; paired anterior and posterior marginal setae 14 long and caudal setae arising on tubercles at the end of caudal ridges, 83 long. Thoracic tracheal pore ending slightly emarginate and distinct.

Dorsal surface.—Dorsal setae minute—a pair of cephalic setae 8 long, a pair of first abdominal setae 5 long and a pair of eighth abdominal setae laterad of base of vasiform orifice 5 long. A narrow raised tuberculate line defines the dorsal area running from cephalic region to a point level with the posterior end of vasiform orifice; length about 0.80 mm. A pair of long setae of 112 long arising at the cephalic terminal end of tuberculate line. The dorsal area between the tuberculate lines slightly concave in the cephalic region continuing upto mesothoracic suture and in the abdominal region. The subdorsal area with minute rounded sculpturing and similar sculpturing in between the tuberculate line and the lateral part of abdominal segments. Transverse moulting suture slightly bends to anterior but does not reach margin. A tuberculate or toothed line anteriorly on mesothorax. A pair of paramedian lobed depressed markings on metathorax and the abdominal segments 1 to 7; seventh abdominal segment shorter than sixth. Submargin radially striate and internally bound by a faint submarginal line; along this line a row of about 18 pairs of minute pores evident. Pockets well developed and contiguous.

Vasiform orifice triangular; 83 long, 60 wide with slight folds laterally. Operculum subcordate covering about half the length of orifice. Lingula setose, exposed, included, club-shaped, bears a pair of setae subapically. Two demarcated lines enclosing the orifice laterally continue to the caudal end forming tuberculate ridges enclosing a grooved area in between and bearing terminally the caudal setae; length of caudal ridge 76. The anal furrow is contained by the ridges.

Ventral surface.—Ventral abdominal setae 20 long, 36 apart. A pair of minute setae present at base of rostrum. Setae at base of legs absent. Anterior and posterior abdominal spiracles evident.

Host.—Jasmine (*Jasminum* sp.)

Holotype.—One case on a slide, Neyveli (Tamilnadu), on Jasmine, 22-1-67, B. V. David.

Paratypes.—Two mounted slides bearing the same details deposited in the collections of the Entomology Research Division, U.S.D.A., Washington and the British Museum (Natural History), London. Four pupal cases on slides in the collections of the senior author.

This species resembles *Bemisia helvi* (Dumbleton) but differs considerably in size, usual dorsal setae being minute, lateral tuberculate line reaching a point just to the level of caudal end of vasiform orifice, depressed markings on abdominal segments 1-7 and in the lingula being club-shaped and setose.

32. ***Bemisia tabaci*** (Gennadius, 1889)
(Text-fig. 27a)

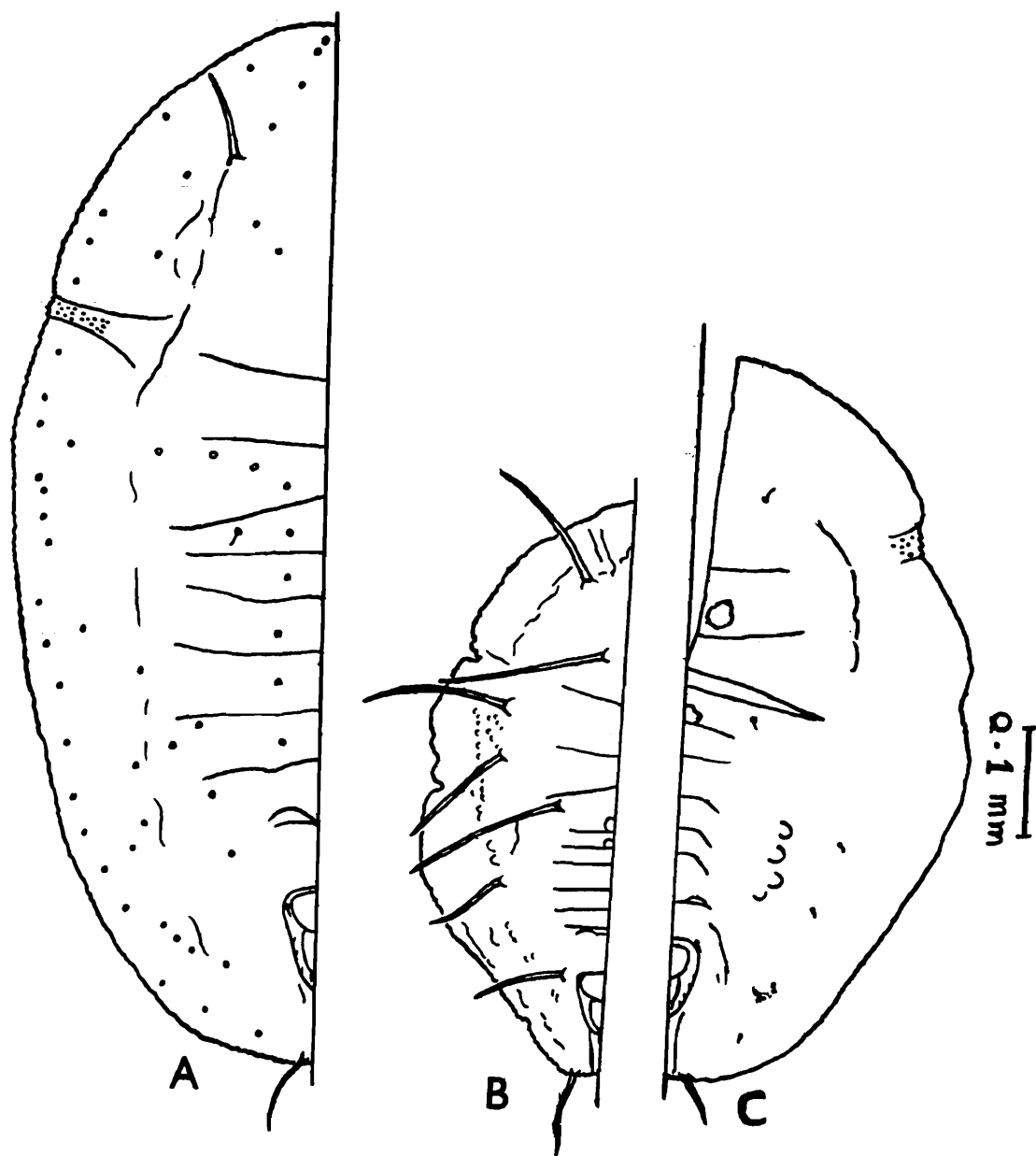
1889. *Aleyrodes tabaci* Gennadius, *Ellenike Georgia (Greek Agriculture) (Athens)*: (1)-3.
 1900. *Aleyrodes inconspicua* Quaintance, *U.S. Dept. Agr., Div. Ent., Tech. Ser. 8*: 28-29.
 1914. *Bemisia inconspicua* (Quaintance) Quaintance and Baker, *U.S. Dept. Agr., Bur. Ent., Tech. Ser. 27*: 99-100.
 1928. *Bemisia costa-limai* Bondar, *Aleyrodideos do Brasil (2nd Contrib.)*: 27-29.
 1928. *Bemisia signata* Bondar, *Aleyrodideos do Brasil (2nd contrib.)*: 29-30.
 1928. *Bemisia bahiana* Bondar, 1928. *Aleyrodideos do Brasil (2nd contrib.)* 30-31.
 1929. *Bemisia gossypiperda* Misra and Lamba, *Agr. Res. Inst. Pusa, Bull. No. 196*: 7.
 1933. *Bemisia hibisci* Takahashi, *Dept. Agro Gov. Res. Inst. Formosa Rpt. 60*: 17-18.
 1934. *Bemisia gossypiperda* Misra and Lamba var. *mosaicivectura* Ghesquiere, *Ann. de Gembloux (Bruxelles)*,: 30-31.
 1934. *Bemisia longispina* Priesner and Hosny, *Egypt. Min. Agr., Tech. and Scien. Service (Ent. sec.) Bul. 139*: 6.
 1935. *Bemisia goldingi* Corbett, *Ann. Mag. nat. Hist. (ser 10)*. **16**: 249-250.
 1935. *Bemisia nigeriensis* Corbett, *Ann. Mag. nat. Hist. (ser. 10)* **16**: 250-252.
 1936. *Bemisia rhodesiaensis* Corbett, *Proc. R. ent. Soc. London (B)* **5**: 22.
 1936. *Bemisia tabaci* (Gennadius), Takahashi, *Tenthredo*, **1(2)**: 110-111.

Bemisia tabaci (Gennadius) is well-known as a pest of cotton, tobacco and cassava, and also as a vector of virus diseases of crops. It was established by a few workers (*loc. cit.*) that in some aleyrodids considerable variations could occur in the structural details of setae, papillae, vasiform orifice, etc., in relation to hairy or glabrous nature of leaves of hosts, and as a result of detailed study a number of species of *Bemisia* were synonymised by Russell (1957).

Hosts.—*Abelmoschus esculentus*, *Achyranthes aspera*, *Brassica campestris* (Mustard), *B. campestris* var. *rapa* (turnip), *Brassica cleracea* (cabbage and cauliflower), *Citrullus colocynthis*, *Cleome viscosa*, *Clerodendron infortunatum*, *Corchorus trilocularis*, *Cucumis melo*, *Euphorbia pilulifera*, *Gossypium* sp. (cotton), *Lannia asplenifolia*, *Lippia geminata*, *Nyctanthes arbortristis*, *Physalis peruviana*, *Solanum melongena*, *S. tuberosum*, *S. xanthocarpum*, *Trewia nudiflora*, *Trichosanthes dioica* (Misra and Singh, 1929); *Saccharum officinarum* (Usman and Puttarudraiah 1955); *Acalypha indica*, *Aristolochia labiosa*, *Datura fastuosa*, *Gauzuma tomentosa*, *Ipomoea batatas*, *I. cairica*, *Lantana camara*, *Macuna cochinchinensis*, *Morinda tinctoria*, *Ocimum sanctum*, *Oryza sativa*, *Phyllanthus niruri*, *Rhynchosia minima* (new records), *Dolichos lab-lab*, *Gossypium arboreum* and *G. hirsutum*.

Material examined.—Nineteen pupal cases mounted, on *Cossypium hirsutum*, Rajapalayam, 8-6-1966, D. S. Aaron; five pupal cases mounted, on *Physalis peruviana*, Coimbatore, 25-10-1966; I. P. Janaki; two pupal cases mounted, on *Achyranthes aspera*, Coimbatore, 18-11-1966, B. V. David; two pupal cases mounted, on *Acalypha indica*, Coimbatore, B. V. David; seven pupal cases mounted, on *Rhynchosia minima* Coimbatore, 22-11-1966, B. V. David; eight pupal cases mounted, on *Ocimum sanctum*, Coimbatore, 13-3-1967, B. V. David; two pupal cases mounted,

on *Datura fastuosa*, Coimbatore, 25-3-1967, B. V David, three pupal cases mounted, on *Ipomoea cairica*, Coimbatore, 30-3-1967, B. V. David; eighteen pupal cases mounted, on *Aristolochia labiosa*, Coimbatore, 3-4-1967, B. V David; four pupal cases mounted, on *Lantana camara*, Coimbatore, 5-4-1967, B. V David; six pupal cases mounted, on *Phyllanthus niruri*, Coimbatore, 5-4-1967, B. V David; six pupal cases mounted, on *Gossypium arboreum*, Coimbatore, 25-4-1967, B. V David; three pupal cases mounted, on *Macuna cochinchinensis*, Coimbatore, 25-7-1967, B. V David; two pupal cases mounted, on *Ipomoea batatas*, 1-9-1967, B. V David; twenty-seven pupal cases mounted, on *Dolichos lab-lab*, Vellore, 5-10-1969, B. V David; twelve pupal cases mounted, on *Oryza sativa*, Kayarambedu (Madras), 21-8-1970, B. V David; fifteen pupal cases mounted, on *Gauzuma tomentosa*, Madras, 19-7-1971, B. V David; fourteen pupal cases mounted, on *Morinda tinctoria*, Madras, 21-9-1971, B. V David; five pupal cases mounted, on *Solanum melongena*, Madras, 4-10-1971, B. V David.



27a

Text-fig. 27a. Host related variation in the pupal case of *Bemisia tabaci* from A. *Oryza sativa*, B. *Gauzuma tomentosa*, C. *Aristolochia labiosa*.

On *Achyranthes aspera* the aleyroidid has been found to cause beautiful scarlet red irregular patch-like galls on the undersurface of leaves and the aleyroidid larva remains in a clear area inside the pitted surface.

Key to Indian Species of Bemisia

1. Case elongately elliptic with scanty waxy secretion, dorsum with a pair of sublateral longitudinal tuberculate lines running all along the length of body bearing long setae..3
Case not elongately elliptic, without any waxy secretion, sublateral longitudinal tuberculate lines absent. ..
2. Elongate dorsal setae vary in number (including usual 13 pairs dorsal setae) from none to seven pairs depending upon the hairy or glabrous nature of leaf of host plant..*tabaci* (Gennadius)
Dorsum with 8 pairs of setae—3 pairs on cephalothorax and 5 pairs sublaterally on abdomen in addition to usual 3 pairs of dorsal setae. .*hancocki* Corbett
3. Sublateral tuberculate line with four pairs of setae... .*giffardi* (Kotinsky)*
Sublateral tuberculate line terminating in a pair of long setae at cephalic end.. .*jasminum* sp. n.

XII. Genus **Dialeurodes** Cockerell, 1902

Type species.—*Aleyrodes citri* Ashmead, 1885, *Florida Dispatch. ns.*, 11 (ex Quaintance and Baker, 1917).

The species included in this genus are characterised by their pupal cases possessing well developed tracheal pores usually with internal teeth and tracheal folds with many fine tubercles. Vasiform orifice small, often with a row of teeth within its caudal margin; lingula concealed. Seventh abdominal segment equal in length to sixth; submarginal papillae wanting.

33. **Dialeurodes armatus** sp. n.

(Text-fig. 28)

Pupal case.—Pale brownish, oval, slightly constricted at thoracic pores without any waxy secretion; 1.58 mm long, 1.21 mm wide. Found on the lower as well as upper surface of leaflets of *Azadirachta indica*.

Margin.—Irregularly crenulate with paired anterior and posterior marginal setae of 13-21 long. Thoracic and caudal pores distinct and invaginated without any comb or teeth.

Dorsal surface.—Dorsum with three pairs of setae—cephalic setae, 8 long; first abdominal setae, 18 long and eighth abdominal setae cephalad of vasiform orifice, 13 long. A pair of minute submarginal caudal setae on either side of caudal pore. Subdorsum with a series of minute setae, 5 long—four pairs of setae anterior to thoracic tracheal furrows, two pairs of setae in between thoracic tracheal furrows and thoraco-abdominal suture, and eight pairs on either side in the abdominal region. Transverse moulting suture not reaching margin, bends to anterior; abdominal segments distinct; submargin with radial striations.

Vasiform orifice subcordate; 91 long, 88 wide; its posterior lateral inner margin with a row of ridges. Operculum similarly shaped, broad

cephalad and slightly constricted at half of its length; caudal end setose; 78 long and 65 wide at base; fills almost the orifice obscuring the lingula. Caudal furrow narrow and distinct, length from caudal end of orifice to pore 232.

Ventral surface.—A pair of ventral abdominal setae cephalad of vasiform orifice, 16 long, 73 apart. Thoracic and caudal folds distinct with small tubercles, caudal fold broader, dotted; thoracic fold with tubercles from pore to base of pro- and mesothoracic legs; antennal tips reaching a little behind the base of mesothoracic legs. Mesothoracic, first abdominal and posterior abdominal spiracles are distinctly visible. Towards the inner aspect of each of the legs a stout spine, 13 long, present which is a distinctive feature. A seta, 8 long, present at the base of each of meso- and metathoracic legs. In the mesothorax cephalad of the basal seta another smaller seta, 3 long, present.

Host plant.—*Azadirachta indica* (Neem).

Holotype.—One specimen mounted, on *Azadirachta indica* (Neem), Coimbatore, 5-11-1966, B. V David.

Paratypes.—Seven specimens mounted bearing the same details. [Deposited in the collections of the Zoological Survey of India, Calcutta.]

Pupal cases on leaflets in writer's collections, on *Azadirachta indica*, Coimbatore, 28-10-1966 and 4-12-1966, B. V David. Material of the latter in the collections of the British Museum (Natural History), London.

This species in general resembles *Dialeurodes bassiae* sp. n., but differs in the arrangement of fourteen pairs of minute subdorsal setae, in having the thoracic tracheal folds dotted and in the absence of waxy markings on dorsum. Further, this species is easily separated from the other known Indian species by the presence of a stout spine on the inner aspect of each of the legs.

34. *Dialeurodes bassiae* sp. n.

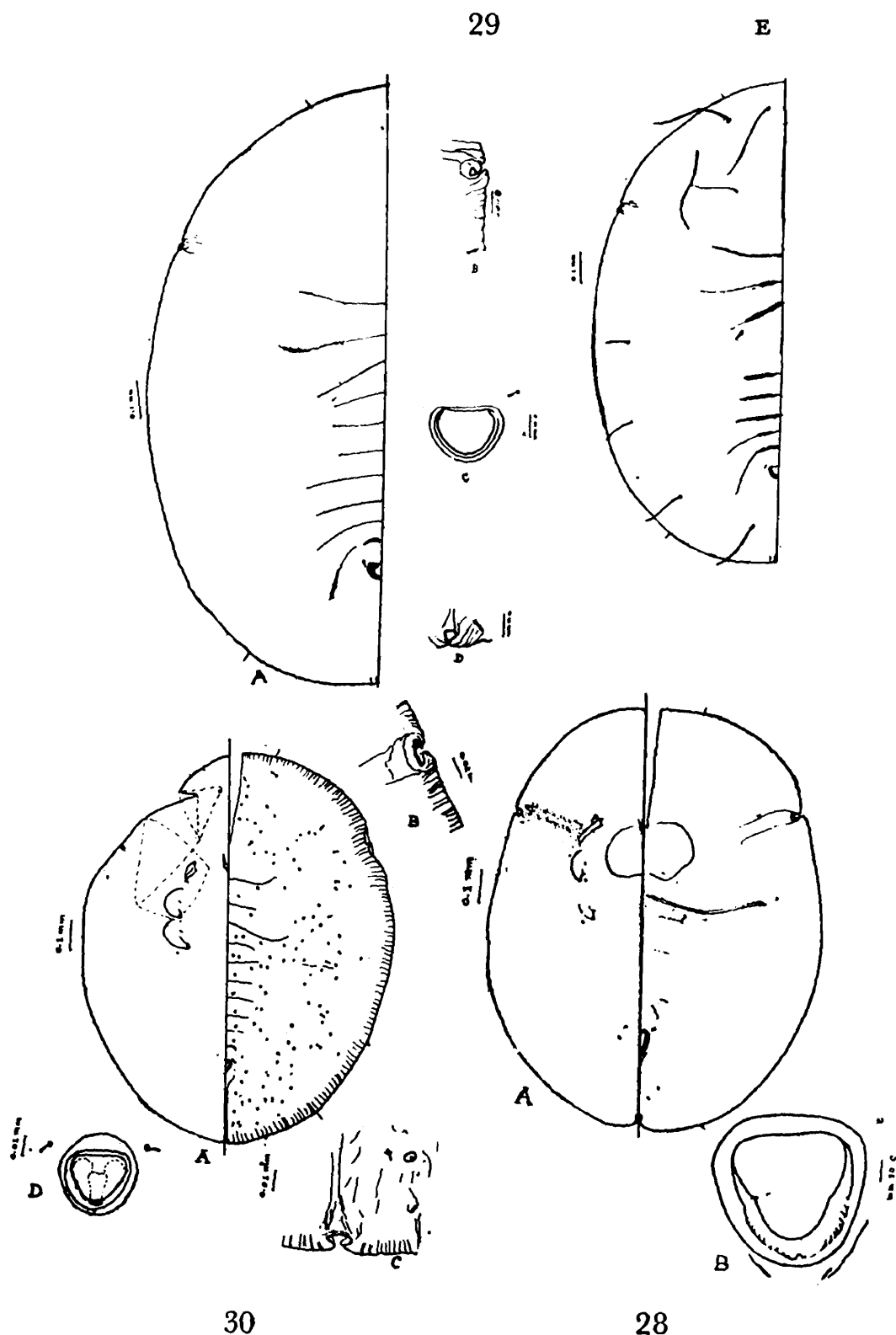
(Plate II; Text-fig. 29)

Pupal case.—Light brownish, roundly elliptic, devoid of any waxy secretion, 1.56-1.63 long, 1.25-1.30 mm wide. Infects both surfaces of leaves but predominant on the under-surface.

Margin.—Crenulate, 17 crenulations in 0.1 mm; thoracic and caudal tracheal pores small, smooth with a distinct chitinised rim. Paired anterior and posterior marginal setae 19-25 long.

Dorsal surface.—Three pairs of dorsal capitate setae—cephalic setae 8 long, first abdominal setae 11 long and eighth abdominal setae laterad of base of vasiform orifice 8 long; a pair of caudal submarginal capitate setae 8 long; fourteen pairs of subdorsal capitate setae 5-8 long—four pairs on cephalic region, four pairs on thorax and six pairs on abdomen; some pupal cases from the undersurface of leaf with a few

subdorsal normal short capitate setae elongated into pointed slender hair-like setae of 25.83 long. Dorsal disc with wavy markings and clear dot-like pores sparsely distributed all over. Thoracic tracheal furrows indicated; caudal tracheal furrow fairly distinct.



Text-figs. 28-30. (28) *Dialeurodes armatus* sp. n. A. Pupal case, B. Vasiform orifice; (29) *Dialeurodes bassiae* sp. n. A. Pupal case, B. Thoracic tracheal pore, C. Vasiform orifice, D. Caudal tracheal pore, E. Pupal case with elongated setae from undersurface of leaf; (30) *Dialeurodes cardamomi* sp. n. A Pupal case, B. Thoracic tracheal pore, C. Caudal tracheal pore. D. Vasiform orifice.

Vasiform orifice subcircular with cephalic margin straight; wider than long, 47×33 . Operculum similarly shaped, wider than long, 33×25 , covering the orifice obscuring the lingula.

Ventral surface.—Ventral abdominal setae pointed, 19 long, 36 apart. All four pairs of spiracles visible. Thoracic and caudal tracheal folds not dotted or tuberculate. A minute seta of 8 long at base of meso- and metathoracic legs; setae at base of rostrum wanting.

Host.—*Bassia latifolia* and *B. longifolia*.

Hololybe.—One pupal case mounted, on *Bassia longifolia*, Madras, 31-7-1971, B. V David.

Paratybes.—Sixteen pupal cases mounted bearing the same details. Numerous pupal cases on leaves in collections—on *Bassia latifolia*, Coimbatore, 7-11-1966, B. V David; on *Bassia longifolia*, Kovilpatti, 31-1-1967, B. V David. [Deposited in the collections of the British Museum (Natural History), London and the Zoological Survey of India, Calcutta].

This species in general appearance resembles *Dialeurodes hexouncta* Singh, but differs considerably in size, number and arrangement of setae on dorsal surface.

35. *Dialeurodes cardamomi* sp. n.

(Text-fig. 30)

Pupal case.—Pale white, without any secretion of wax; elliptic, thin and flattened; 1.58 mm long, 1.22 mm wide. Found on the under-surface of leaf.

Margin.—Not toothed but slightly crenulate, 18 crenulations in 0.1 mm. Paired pointed anterior and posterior marginal setae, 21-23 long. Thoracic and caudal pores distinct and invaginated without any comb or teeth; pore not closed.

Dorsal surface.—A pair of cephalic capitate setae, 10 long and a pair of eighth abdominal capitate setae, 8 long, caudad of vasiform orifice. Setae on first abdominal segment absent. Dorsal disc with numerous very short rounded papillae. Fourteen pairs of capitate setae, 10-13 long, arranged in a row on subdorsum. Submargin with radial striations extending from marginal crenulations. Thoracic transverse suture not reaching margin but bends to anterior; abdominal segments distinct.

Vasiform orifice small, subcordate, as long as wide (52×52), rounded on the hind margin. Operculum wider than long; 36×29 , narrower at the distal part, 13 wide, covers over half the orifice exposing a little of setose lingula tip. Caudal furrow distinct and narrow; length from caudal end of orifice to caudal pore 265.

Ventral surface.—A pair of ventral abdominal pointed setae, 21 long, 49 apart. Thoracic tracheal folds faintly discernible. First abdominal

and posterior spiracles evident. Tip of antennae reaching base of prothoracic legs; a minute seta 16 long, at base of each of meso- and metathoracic legs; Cephalad a little above of the metathoracic leg seta another minute seta is present.

Host plant.—*Elettaria cardamomum* (Cardamom).

Holotype. One pupal case mounted, on cardamom, Valparai, 16-4-1967, B. V David.

This species resembles *Dialeurodes tetrastigmae* Takahashi in possessing dorsal papillae, capitate setae on dorsal disc and pointed marginal setae but differs in the absence of chitinised irregular sculptures in the caudal fold and closed thoracic tracheal pores with four rounded chitinised teeth.

36. *Dialeurodes dissimilis* Quaintance and Baker, 1917.

1917. *Dialeurodes (Dialeuronomada) dissimilis* Quaintance and Baker, *Proc. U.S. natn. Mus.*, 51: 424.

The following additional description is provided to the description of the species by Quaintance and Baker.

Pupal case.—0.771-0.772 mm long; 0.612-0.613 mm wide.

Margin.—Marginal setae 14-28 long.

Dorsal surface.—Cephalic setae 5-8 long; first abdominal setae 14 long; eighth abdominal setae 11 long. Pockets contiguous. Vasi-form orifice longer than wide (39×36); operculum wider than long (22×19).

Ventral surface.—Ventral abdominal setae 17 long, 33 apart. Venter of case with circular markings. All the four pairs of spiracles visible. A seta of 8 long at base of each of meso- and metathoracic legs.

Host.—*Ixora* sp. (Singh, 1931); *Pavetta* sp. (new host record).

Distribution.—Pusa (Bihar) (Singh, 1931); Madras (Tamil Nadu) (new distribution record).

Material examined.—Five pupal cases mounted, on *Pavetta* sp., Madras, 31-7-1971, B. V David.

37. *Dialeurodes distinctus* sp. n.

(Text-fig. 31)

Pupal case.—Pale brown without any waxy secretion; oval; 2.08-2.12 mm long, 1.69-1.89 mm wide; found on the undersurface of leaves.

Margin.—Margin with a row of rounded teeth, 10 teeth in 0.1 mm. Paired anterior and posterior marginal setae are small, 14-17 long. Thoracic and caudal tracheal pores distinct and slightly invaginated, more or less closed. Caudal setae not discernible.

Dorsal surface.—Usual three pairs of dorsal setae evident but very minute; eighth abdominal setae laterad of base of vasiform orifice. Dorsum with very small pores and porettes distributed all over. Thoracic and caudal tracheal furrows visible. A distinct narrow transparent patch on cephalothorax demarcates subdorsum and dorsum. The transverse moulting suture runs to posterior and then bends to anterior extending upto subdorsum. Abdominal segments distinct, pockets well developed but not contiguous.

Vasiform orifice small, subcircular, 22 long and 30 wide; caudal edge and lateral walls ridged or tuberculate. Operculum trapezoidal, transverse cephalad, 17 long, 25 broad, nearly filling the orifice and obscuring the lingula.

Ventral surface.—Ventral abdominal setae 28 long, 56 apart. Mesothoracic, anterior abdominal and posterior abdominal spiracles visible. Antennae slender and long extending upto base of mesothoracic legs. Thoracic and caudal tracheal folds distinct with minute tubercles. A small seta at base of each of meso- and metathoracic legs. Setae at base of rostrum absent.

Host.—*Elaeodendron glaucum*.

Holotype.—One pupal case mounted, on *Elaeodendron glaucum*, Coimbatore, 7-4-1969, B. V. David.

Paratypes.—Ten pupal cases mounted bearing the same details. Pupal cases on dry leaves in the collections of the senior author.

This species in general appearance resembles *Dialeurodes radiilinealis* but distinct in the margin being toothed, in the structural details of vasiform orifice and in the pattern of the transparent area demarcating dorsum from subdorsum in the cephalic region.

38. *Dialeurodes eugeniae* (Maskell)

1896. *Aleurodes eugeniae* Maskell, *Trans. N. Zealand Inst.*, **27**: 430.

1917. *Dialeurodes (Rusostigma) eugeniae* (Maskell), Quaintance and Baker, *Proc. U.S. Nat. Mus.*, **51**: 421.

1931. *Dialeurodes eugeniae* (Maskell), Singh, *Mem. Dept. Agric. India, Ent. Ser.*, **12**(1): 24.

The following notes are added to the description of the species provided by Singh (1931).

Pupal case.—1.86-1.96 mm long, 1.56-1.69 mm wide. The dorsal disc area of the specimens mounted somewhat darker.

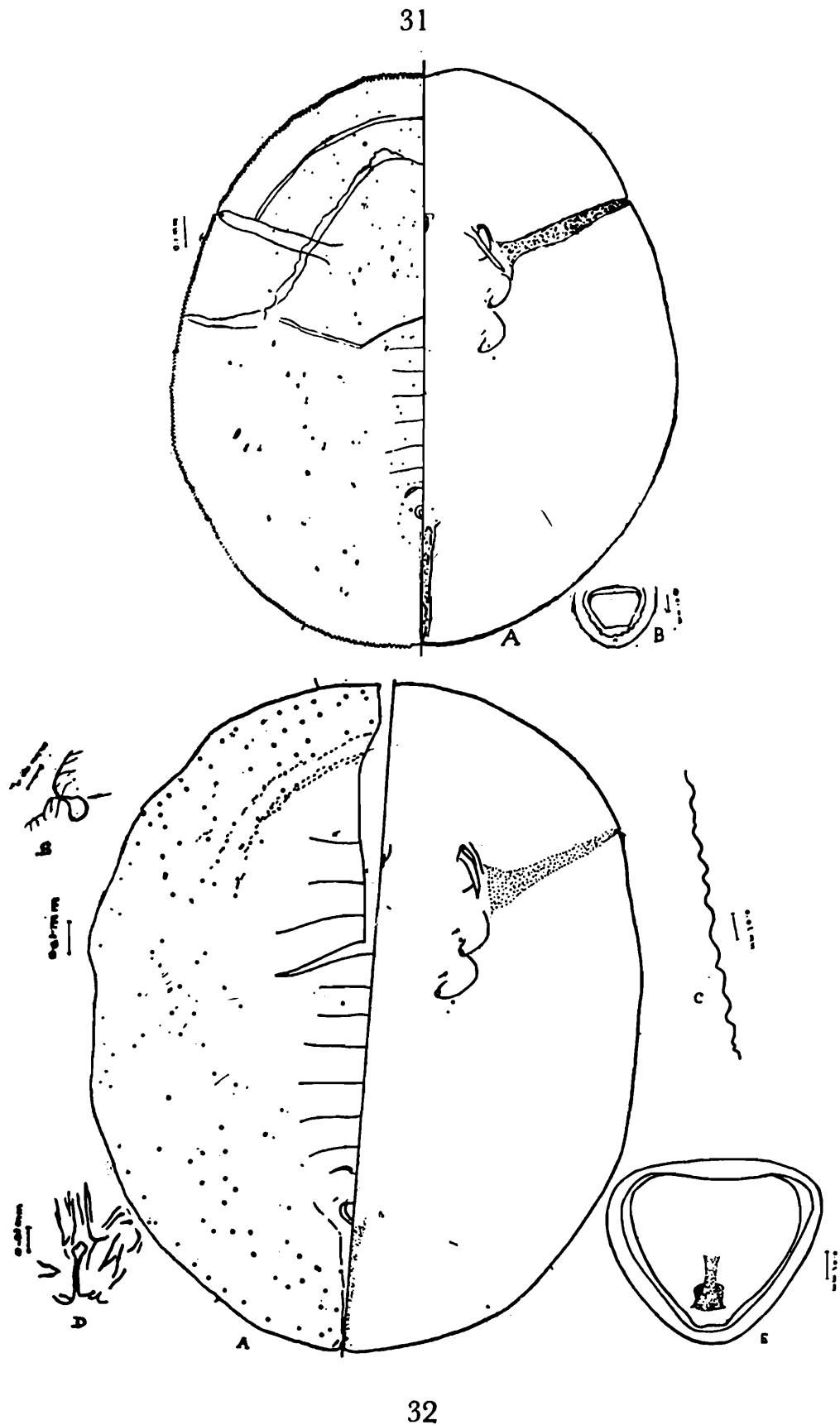
Margin.—Anterior and posterior marginal setae 14-17 long.

Dorsal surface.—Paired cephalic, first abdominal and eighth abdominal setae 11 long. Setae on dorsal disc and submargin 8 long. Vasiform orifice 63 long, 55 wide; operculum 36 long, 44 wide.

Ventral surface.—Ventral abdominal setae 22-25 long, 58-61 apart. A seta of 22 long at base of meso- and meta-thoracic legs evident,

Host.—*Syzigium jambolanum* (Singh, 1931); *Eugenia* sp.

Material examined.—Eleven pupal cases mounted, on *Eugenia* sp., Saklaspur (Karnataka), 31-3-1969, B. V David.



Text-figs. 31-32. (31) *Dialeurodes distinctus* sp. n. A Pupal case, B. Vasisform orifice
 (32) *Dialeurodes indicus* sp. n. A. Pupal case, B. Thoracic tracheal pore,
 C. Margin, D. Caudal tracheal pore, E. Vasisform Orifice.

39. **Dialeurodes indicus** sp. n.

(Text-fig. 32)

Pupal case.—Pale white, oval; 2.02-2.09 mm long, 1.59-1.76 mm wide. Found on the lower surface of leaves.

Margin.—Broadly crenulate with rounded teeth, 13-14 in 0.1 mm. Paired anterior and posterior marginal setae 19 long on tubercles. Thoracic and caudal tracheal pores quite distinct, invaginated, more or less closed, without any teeth-like projections.

Dorsal surface.—Paired setae on cephalic region and on the eighth abdominal segment cephalad of base of vasiform orifice very minute; setae on the first abdominal segment absent; caudal setae minute on either side of caudal pore. Thoracic tracheal furrow not discernible; caudal furrow with reticulate markings. Dorsum and submarginal area with papillae like pores and porettes found scattered all over excepting the submedial part of cephalothorax and abdomen; a pair of pores on the median area of abdominal segments 1-6. A narrow transparent area demarcating submarginal area and dorsum in cephalothorax. Transverse moulting suture short. Abdominal segments distinct. Pockets well developed but not contiguous.

Vasiform orifice small, subcordate, wider than long, 63×55 ; lateral walls of orifice lacking ridges or tubercles. Operculum similar shaped but caudad narrowed and transverse; wider than long, 52×41 ; filling the orifice and obscuring the lingula.

Ventral surface.—Ventral abdominal setae 25 long, 55 apart; cephalad of base of orifice. All four pairs of spiracles visible. Antenna extends to base of mesothoracic leg. A seta at base of each of meso- and metathoracic legs distinct. Thoracic and caudal tracheal folds with minute tubercles.

Host.—*Syzigium jambolanum*.

Holotype.—One pupal case mounted, on *Syzigium jambolanum*, Coimbatore, 8-10-1967, B. V. David.

Paratypes.—Pupal cases on leaves in collection; mounted specimens deposited in the collections of the Systematic Entomology Laboratory, Entomology Research Division, United States Department of Agriculture, Washington, the British Museum (Natural History), London and the Zoological Survey of India, Calcutta.

This species in general appearance resembles *Dialeurodes pallida* Singh, but differs in size, in both thoracic and caudal tracheal folds being tuberculate and in the absence of subdorsal spines.

40. **Dialeurodes ixorae** Singh, 1931.

(Plate III; Text-fig. 33)

Dialeurodes ixorae Singh, 1931, *Mem. Dept. Agric. India, Ent. Ser.*, 12(1): 38.

The following notes are added to the description of the species by Singh.

Pupal case.—Oval, anterior part slightly narrowing with constrictions at thoracic and caudal tracheal pores. Length 1.05 mm; width 0.87 mm at the broadest point at the level of the third abdominal segment.

Margin.—Paired anterior and posterior marginal setae 18-26 long; 12 pairs of marginal setae 23-26 long-five pairs cephalad of thoracic tracheal pores and seven pairs caudad of it.-

Dorsal surface.—Three pairs of dorsal setae—cephalic setae 31 long, first abdominal setae 42 long and eighth abdominal setae laterad of vasiform orifice 26 long. A row of minute papillae-like wax pores evident on periphery of dorsal disc on each side which is very characteristic of the species. Caudal setae submarginal, 26 long.

Vasiform orifice oval, 41 long, 39 wide; operculum 25 wide and 22 long with cephalic margin transverse.

Ventral surface.—Ventral abdominal setae laterad of base of vasiform orifice, 10 long, 42 apart. All the four pairs of spiracles visible. Antenna with its finger-like terminal and slightly protruding beyond base of fore leg. Thoracic and anal tracheal folds distinct, dotted and terminating in small invaginated pores on margin. Meso- and meta-thoracic legs each with a small seta at base of leg. Venter reticulated.

Host.—*Ixora coccinea* (Singh, 1931) and *Mimusops hexandra* (Rao, 1958).

Distribution.—Madras (Tamil Nadu) (Singh, 1931); Hyderabad (Andhra Pradesh) (Rao, 1958).

Material examined.—Fortyfour specimens mounted, on an unidentified shrub, Kayarambedu (Madras), 6-3-1971, B. V David. Numerous cases on leaves of *Ixora* sp., Thanjavur, 1-6-1969, B. V David; on *Ixora coccinea*, Madras, 4-1-1970, B. V David.

The upper surface of leaves of the unidentified shrub with *D. ixorae* are invariably infested with *Rhachhispora trilobitoidea* (Quaintance and Baker) along the midrib and veins in rows.

41. **Dialeurodes kirkaldyi** (Kotinsky), 1907

(Plate II)

1907. *Aleyrodes kirkaldyi* Kotinsky, *Bd. Comm. Agric. and Forestry, Div. Ent., Hawaii, Bull.*, 2: 95.

1914. *Dialeurodes kirkaldyi* (Kotinsky), Quaintance and Baker, *U. S. Dept. Agric., Bur. Ent., Tech. Ser.* 27(2): 98; 1917, *Proc. U.S. natn. Mus.* 5 1: 416.

1934. *Dialeurodes kirkaldyi* (Kotinsky), Priesner and Hosny, *Ministry of Agric., Egypt. Tech. and Sci. Service, Ent. Sect., Bull. No.* 139: 2.

This species, well known as a serious pest of jasmine the world over, is also found in South India causing serious damage to this flowering shrub.

The following additional notes are provided to the description of the species by Quaintance and Baker.

Dorsal surface.—A few minute pores scattered on dorsal disc.

Ventral surface.—Ventral abdominal setae 14 long, 28 apart. Antenna slender, finger-like tip extending slightly beyond base of foreleg; a minute seta at base of meso- and metathoracic legs. All the four pairs of spiracles visible.

Host.—*Jasminum auriculatum* (David, 1958).

Distribution.—Coimbatore (David, 1958) and throughout Tamil Nadu.

Material examined.—Fourteen pupal cases mounted, on jasmine, Coimbatore, 11-11-1966, B. V David; three pupal cases mounted, on jasmine, Neyveli, 22-1-1967, B. V David. Numerous pupal cases on leaves in collection.

Key to Indian Species of Dialeurodes

1. Pupal case bluish black or jet black.. 2
 Pupal case not bluish black or jet black.. 3
2. Pupal case bluish black; dorsum with clear transparent dots, subdorsum with 9 pairs of spines; tracheal pore with 14-16 rounded teeth; thoracic and caudal tracheal folds spinulose. *eugeniae* (Maskell)
 Pupal case jet black; dorsum reticulately sculptured; thoracic tracheal pores minute, circular, rimmed.. *rotunda* Singh*
3. Margin of pupal case toothed. 4
 Margin of pupal case crenulate or entire.. 5
4. Pupal case pale white; thoracic folds terminating on margin in shallow concavities; operculum roundly sub-cordate with its distal end setose projecting a short distance beyond the edge of orifice; anal tracheal fold tuberculate ending in an indentation. *fletcheri* Singh*
 Pupal case pale brown; thoracic and caudal tracheal pores distinct; slightly invaginated, more or less closed; a distinct narrow transparent patch on cephalothorax demarcating subdorsum and dorsum; operculum trapezoidal obscuring lingula. *distinctus* sp. n.
5. Margin with 12 pairs of setae (excluding usual 2 pairs). 6
 Margin with only 2 pairs of usual setae. 7
6. Pupal case with thick bands of white waxy fluff; dorsum with a single row of minute papillae-like pores. *ixorae* Singh
 Pupal case free from waxy exudation except a short filament from each of tracheal pores; dorsum with a group of closely set papillae like structures. *dissimilis* Quaintance & Baker
7. Tracheal folds tuberculate or dotted or with semicircular markings.. 10
 Tracheal folds not showing the above. 8
8. Dorsal disc without rounded papillae. 9*
 Dorsal disc with rounded papillae; 14 pairs of subdorsal capitate setae of which 7 pairs on abdominal region.. *cardamomi* sp. n.
9. Dorsal disc with wavy markings; 14 pairs of subdorsal setae of which 6 pairs on abdomen. *bassiae* sp. n.
 Dorsal disc with somewhat crescentic suture-like chitinous markings; setae on subdorsum, cephalic region and first abdominal segment wanting. *vulgaris* Singh*
10. Either thoracic tracheal folds only dotted or caudal tracheal fold only with semicircular markings.. 11
 Thoracic and caudal tracheal folds dotted.. 12
11. Thoracic tracheal folds only dotted; dorsal disc without circular pores; subdorsal setae 14 pairs; inner aspect of each leg with a thick pointed spine. *armatus* sp. n.

- Caudal tracheal fold only with semicircular markings; dorsal disc with a series of circular pores; subdorsal setae 6 pairs; inner aspect of legs without thick spines.....
*pallida* Singh*
12. Operculum filling the orifice obscuring the lingula.. 13
 Operculum filling three-fourth orifice leaving swollen tip of lingula exposed; 8 pairs of sublateral short spines and a pair of submedial aggregations of small wax pores on dorsum.*glomerata* Singh*
13. Dorsal disc without prominent papillae-like pores; caudal margin of orifice with well-defined fimbriae or teeth. .. 14
 Dorsal disc with prominent papillae like pores; first abdominal setae absent; caudal end of orifice lacking fimbriae or teeth.*indicus* sp. n.
14. Vasiform orifice cordate, somewhat rounded; operculum similarly shaped but indented on lateral margins; caudal margin of orifice with 16-18 well-defined fimbriae or teeth.*kirkaldyi* (Kotinsky)
 Vasiform orifice almost circular; operculum semicircular; caudal margin of orifice with short acute irregular teeth.*citri* (Ashmead)*

XIII. Genus *Dialeurolonga* Dozier

Type species.—*Dialeurodes (Dialeurolonga) elongata* Dozier, 1928, *J. agric. Res.* **36**: 1001-1005.

Takahashi (1951) redefined the genus although not all the species included are closely related. The important characters by which it is separated from *Dialeurodes* are; seventh abdominal segment shorter than the sixth; vasiform orifice subcordate, usually large; lingula knobbed; submargin with a series of pores or papillae.

42. *Dialeurolonga elongata* Dozier, 1928

1928. *Dialeurodes (Dialeurolonga) elongata* Dozier, *J. agric. Res.* **36**: 1001-1005.

1931. *Dialeurodes elongata* Dozier, Singh, *Mem. Dept. Agric. India, Ent. Ser.* **12**(1): 36.

1952. *Dialeurolonga elongata* (Dozier), Takahashi and Mamet, *Mem. Inst. scient, Madagascar*, **6A**(2): 354.

The redescription of the species provided by Singh (1931) appears to be adequate.

Host.—*Citrus* sp., *Ixora coccinea*, *I. parviflora* and *Litchi chinensis* (Singh 1931), *Murraya exotica* (new host record)

Material examined.—Three pupal cases mounted, on *Ixora coccinea*, Madras, 22-7-1971, B. V David; two pupal cases mounted, on *Murraya exotica*, Madras, 22-7-1971, B. V David.

43. *Dialeurolonga fici* sp. n.

(Plate III; Text-fig. 34)

Pupal case.—Pale white without any waxy secretion; oval; 1.31-1.43 mm long, 1.11-1.25 mm wide; found in groups on the undersurface of leaves.

Margin.—Margin finely crenulate, 27-28 crenulations in 0.1 mm. Anterior and posterior marginal setae 22-25 long. Caudal setae small,

5 long, on either side of caudal end. Slightly indented at caudal tracheal end; thoracic and caudal tracheal pores wanting but represented by about six minute teeth.

Dorsal surface.—The paired dorsal setae are minute, the cephalic setae 14 long, the first abdominal setae 8-11 long, and the eighth abdominal setae laterad of base of vasiform orifice 8 long. Thoracic tracheal furrow not discernible; caudal tracheal furrow evident, narrow and long. Transverse moulting suture runs posteriorly and bends to anterior extending upto the submargin. Abdominal segments distinct, seventh abdominal segment shorter than the sixth; pockets not developed well. Submargin with striations running mesad from margin and with a row of minute pores.

Vasiform orifice more or less subcircular, 25 long and 30 wide. Operculum trapezoidal with lateral sides rounded, 14 long and 25 wide. Lingula setose with tip expanded and rounded caudad, long terminal setae wanting, exposed and included or slightly protruded beyond posterior margin of orifice.

Ventral surface.—Ventral abdominal setae laterad of base of vasiform orifice, 17 long, 39 apart. All the four pairs of spiracles visible. Antenna does not extend beyond foreleg. A seta at base of each of meso- and metathoracic legs and a pair of setae at base of rostrum present. Thoracic tracheal folds and caudal tracheal fold minutely tuberculate, the latter 223 long from posterior end of orifice to caudal end.

Host.—*Ficus religiosa*.

Holotype.—One pupal case on slide, Madras, on *Ficus religiosa*, 3-8-1971, B. V. David.

Paratypes.—Twenty four pupal cases on slides bearing same details and pupal cases on leaves in collection. [Deposited in the collections of the B.M., London and the Z.S.I., Calcutta.]

This species in general appearance resembles *Dialeurolonga ambilaensis* Takahashi but differs in having a row of minute pores on submargin and in the structural details of vasiform orifice.

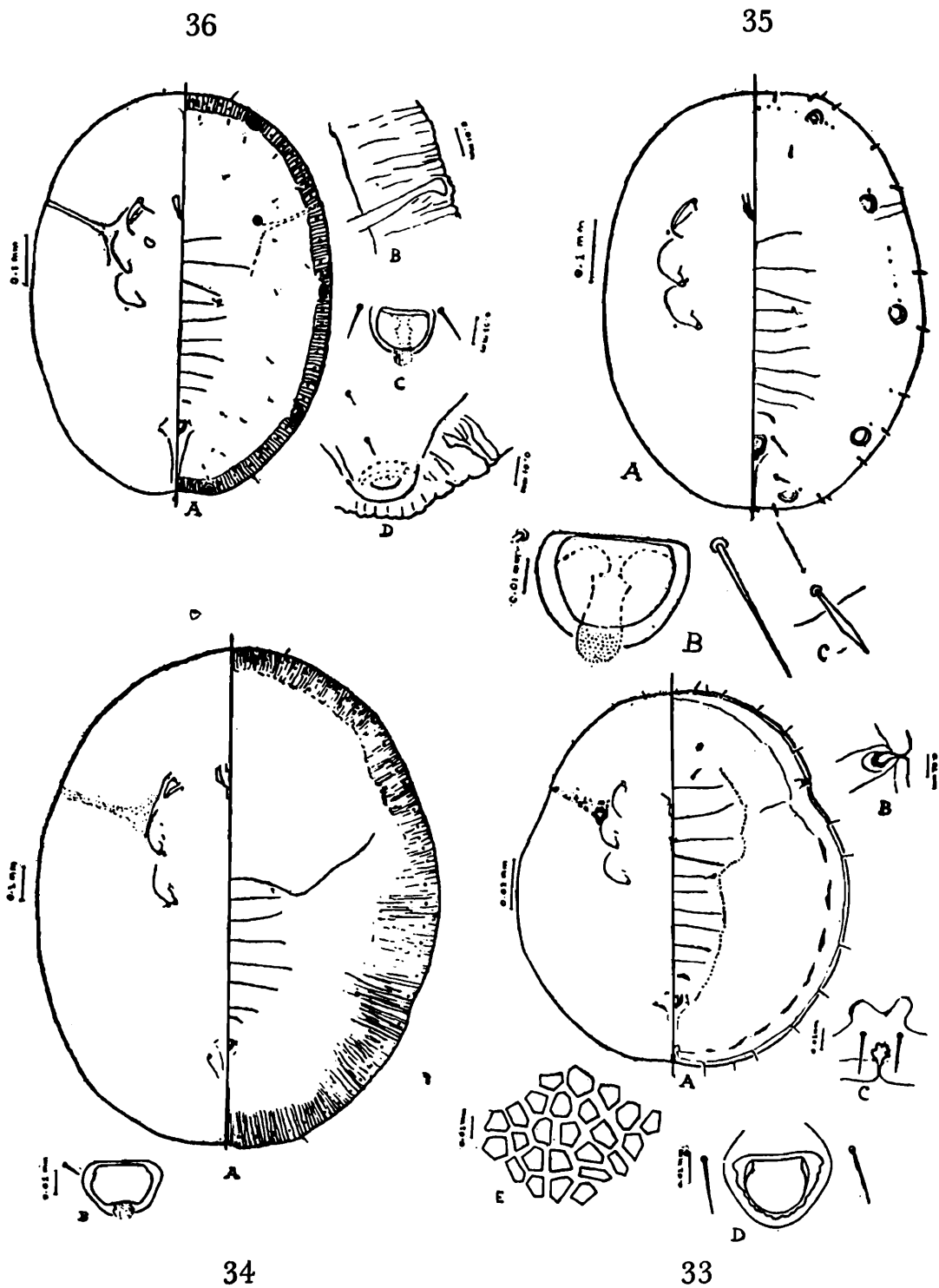
Key to Indian Species of *Dialeurolonga*

1. Pupal case elongately subelliptical; submargin with a row of conical papillae; cephalad of orifice a median large pore with a thickly chitinised rim evident *elongata* (Dozier)
Pupal case oval; submargin with a row of pores; median posts cephalad of orifice wanting. . . *fici* sp. n.

XIV Genus *Dialeuropora* Quaintance and Baker, 1917

Type species: *Dialeurodes* (*Dialeurobora*) *decempuncta* Quaintance and Baker, 1917. *Proc. U. S. natn. Mus.*, 51: 434.

Pupal case elliptic and medium-sized; margin crenulate; submargin with a ring of large simple pores. Thoracic tracheal folds and pores, and anal fold and pore evident. Vasiform orifice subcordate. Operculum subcordate nearly filling orifice. Lingula setose, concealed or exposed.



Text-figs. 33-36. (33) *Dialeurodes ixorae* A. Pupal case, B. Thoracic tracheal pore, C. caudal tracheal pore, D. Vasiform orifice, E. Reticulated ventral surface; (34) *Dialeurolonga fici* sp.n. A Pupal case B. Vasiform orifice. (35) *Dialeuropora decempuncta* A. Pupal case B. Vasiform orifice, C. Spearhead seta; (36) *Dialeuropora pterolobiae* sp. n. A. Pupal case, B. Thoracic tracheal pore, C. Vasiform orifice, D. Circular pore.

44. ***Dialeuropora decempuncta*** (Quaintance and Baker), 1917
(Text-fig. 35)

1917. *Dialeurodes* (*Dialeuropora*) *decempuncta* Quaintance and Baker, *Proc. U.S. Nat. Mus.*, **51**: 434 (subgenus).
1934. *Dialeuropora decempuncta* (Quaintance and Baker) Takahashi, *Rept. Dept. Agric., Formosa* **63**: 46.

Pupal case.—Lemon yellow, lying in a fluffy mass of iridescent blue glassy waxen filaments; empty case transparent, oval; 0.93 mm long, 0.68 mm wide; found on the undersurface of leaves.

Margin.—Irregularly crenulate. Paired anterior and posterior marginal setae 21-23 long. Thoracic tracheal pores indistinct.

Dorsal surface.—Four pairs of pointed setae evident; cephalic setae 21 long, first abdominal setae 13 long, eighth abdominal setae laterad base of vasiform orifice 44 long, and caudal setae cephalad of the caudal submarginal circular pores 23 long. Transverse moulting suture not reaching margin of dorsal disc; abdominal segments fairly distinct. Submargin with 12 pairs of spearhead-like setae—five anterior to thoracic fold and seven posterior to it on each side, 29 long, and with five pairs of large circular pores—the first anterior pair just below the second and third submarginal spines, the second pair immediately anterior to thoracic tracheal folds, the third pair opposite the transverse suture, the fourth pair opposite the eighth abdominal segment, and the fifth pair cephalad of the last submarginal spine. A row of minute pores in between the large circular pores in the dorsum evident.

Vasiform orifice subsemi-elliptical with the cephalic margin practically straight, 39 long and 50 wide. Operculum similarly shaped, 29 long and 42 wide, nearly fills the orifice. Lingula subcylindrical, constricted near base, 23 long, caudal end setose, protruding a short distance caudad of orifice.

Ventral surface.—Smooth. Spiracles not evident. Ventral abdominal setae 21 long, 44 apart. Setae at base of legs absent.

Host plants.—*Anona squamosa*, *Dalbergia sissoo*, *Ficus religiosa*, *Morus* sp. (Mulberry), *Prunus* sp., *Streblus asper* (Singh, 1931); *Anona cherinoya*, *Avocado*, *Cordia myxa*, *Euphorbia pilulifera*, pear, *Rosa* sp. (Rao, 1958); *Anona reticulata*, *Polyalthia longifolia* and *P. pendula* (new host records).

Distribution.—Pusa (Bihar), Lucknow (Singh, 1931); Hyderabad (Andhra Pradesh) (Rao, 1958); throughout Tamil Nadu.

Material examined.—Five pupal cases, on *Anona reticulata*, Coimbatore, 27-4-1967, B. V. David; three pupal cases, on *Polyalthia pendula*, Coimbatore, 5-4-1967, B. V. David; one pupal case, on *Polyalthia longifolia*, Coimbatore, 12-11-1966, B. V. David; and two pupal cases, on *Rosa* sp. (Rose), Madurai, 27-5-1969, B. V. David; five pupal cases, on *Streblus asper*, Madras, 19-7-1971, B. V. David; seven pupal cases, on *Cordia myxa*, Madras, 19-7-1971, B. V. David; two pupal cases on *Avocado*, Coimbatore, 14-8-1971, B. V. David.

45. *Dialeuropora pterolobiae* sp. n.

(Text-fig. 36)

Pupal case.—Lemon yellow but empty case transparent, oval, 1.15 mm long and 0.86 mm wide; lying in a fluffy mass of iridescent blue glassy waxen filaments, found on the undersurface of leaflets of the host plant.

Margin.—Margin with minute irregular crenulations; paired anterior and posterior marginal setae 18-39 long. Thoracic tracheal pores indistinct but margin indicated by about four teeth-like prolongations.

Dorsal surface.—Dorsum with three pairs of setae—a pair of cephalic setae, 13 long; a pair of first abdominal setae, 16 long; and a pair of setae on eighth abdominal segment cephalad of vasiform orifice, 13 long. Sixteen pairs of setae, 5-8 long, on subdorsum—six anterior to thoracic fold and the remaining posterior to it (including the one cephalad of caudal submarginal pores, 10 long. Transverse suture not reaching margin of dorsal disc. Segmentation and dermic pockets distinct. A small circular pore (18 diameter) in the subdorsum on prothorax distinct. Four more larger circular pores evident on submarginal area—a pair of anterior cephalic circular pores (31×36), a pair (31×31) opposite the transverse suture, a pair (31×34) opposite the eighth abdominal segment and a pair (28×31) near the caudal end. Submarginal ridges well defined, dense corresponding to each tooth. A submarginal series of pores present.

Vasiform orifice subcordate or subcircular and transverse cephalad; length 36, breadth 42. Operculum similarly shaped, nearly fills the orifice and 29×34. The setose lingula exposed and protrudes beyond the orifice. Caudal furrow indistinct.

Host plant.—*Pterolobium indicum*.

Holotype.—One pupal case mounted, Kallar (The Nilgiris), on *Pterolobium indicum*, 4-9-1966, B. V David.

Paratypes.—Four pupal cases mounted bearing the same details. [Deposited in the collections of the Systematic Entomology Laboratory, Entomology Research Division, United States Department of Agriculture, Washington, B.M., London and the Z.S.I., Calcutta.]

Some pupal cases on leaves of *Pterolobium indicum*. Marudamalai (Coimbatore), 22-10-1966, B. V David.

This species is quite distinct in possessing four sub-marginal circular pores and is easily recognised from the only other known species in India *Dialeuropora decempuncta* (Quaintance and Baker) which has five sub-marginal circular pores and submarginal spearhead-like setae. This species closely resembles *Dialeuropora cogniauxiae* Cohic in the arrangement of the five circular pores but differs considerably in the structural details of the vasiform orifice and in not possessing the minute setae on the subdorsum.

Key to Indian Species of *Dialeuropora*

- Submargin with 5 pairs of large circular pores and 12 pairs of spearhead-like setae
 *decempuncta* Quaintance and Baker
 Submargin with 4 pairs of large circular pores and a smaller circular pore in the
 subdorsum on prothorax; dorsum with 16 pairs of minute setae in addition to usual
 3 pairs of dorsal setae. *pterolobiae* sp. n.

XV. Genus **Indoaleyrodes** n.

Pupal case.—Oval or subcircular, slightly constricted at thoracic and caudal tracheal pore areas, pores invaginated and inset; tracheal furrows reticulate for short distance; thoracic tracheal folds with minute tubercles. Margin smooth; marginal setae, cephalic setae, first abdominal setae, eighth abdominal setae laterad of vasiform orifice and caudal setae very small; transverse moulting suture not reaching margin; abdominal segment seven much shorter than six and eight. Vasiform orifice longer than wide, subtriangular, rounded apically; operculum semicircular; lingula with lateral knob on either side at base without terminal paired setae, exposed, included.

Type of the genus.—*Indoaleyrodes pustulatus* gen. et sp. n.

Indoaleyrodes pustulatus appears to be quite close to *Parabemisia reticulata* Dumbleton reported from New Caledonia. This species differs considerably in many structural details from the genera *Parabemisia* Takahashi and *Dialeurodes* Cockerell and a new genus is defined here for accommodating it. This genus is readily recognised from *Parabemisia* in not possessing a single row of teeth with a row of fine setae just behind base of teeth, and in the presence of well defined caudal furrow though closely resembling it in the structural details of vasiform orifice. It resembles *Dialeurodes* in the presence of tracheal pores but differs considerably in the structural details of dorsum and vasiform orifice.

46. **Indoaleyrodes pustulatus** sp. n.

(Plate II; Text-fig. 37)

Pupal case.—Case pale brown or white, subcircular, flat, constricted at thoracic and caudal pore areas, invaginated, pores deeply set in submargin, open and not closed; 1.46 mm long, 1.31 mm wide; occurs in small pits on the undersurface of leaves of *Morinda tinctoria* which results in formation of pustule-like eruptions on the upper surface of leaves.

Margin.—Smooth but with narrow short ridges immediately mesad of margin. Anterior and posterior marginal setae 10-13 long. Thoracic tracheal cleft distinct, invaginated ending in a pore with about nine irregular teeth-like projections. Caudal cleft invaginated, pore indistinct with irregular teeth-like projections.

Dorsal surface.—Minute paired setae on cephalic region and first abdominal segment and a pair of small setae (13) on the eighth abdominal segment laterad of base of orifice. A pair of very small caudal setae on either side of tracheal pore, 5 long. Transverse moulting suture not reaching margin, short but reaches outer margin of legs. Thoracic tracheal furrows that follow the pores immediately are hexagonally reticulate. Caudal furrow immediately after pore reticulate for a short distance (70), continues into a narrow fold (161 long) till the apex of vasiform orifice. Abdominal segment seven much shorter than segment six; pockets distinct and not contiguous.

Vasiform orifice longer than wide; 104 long, 72 wide; subtriangular but rounded apically, floor with subparallel transverse ridges.

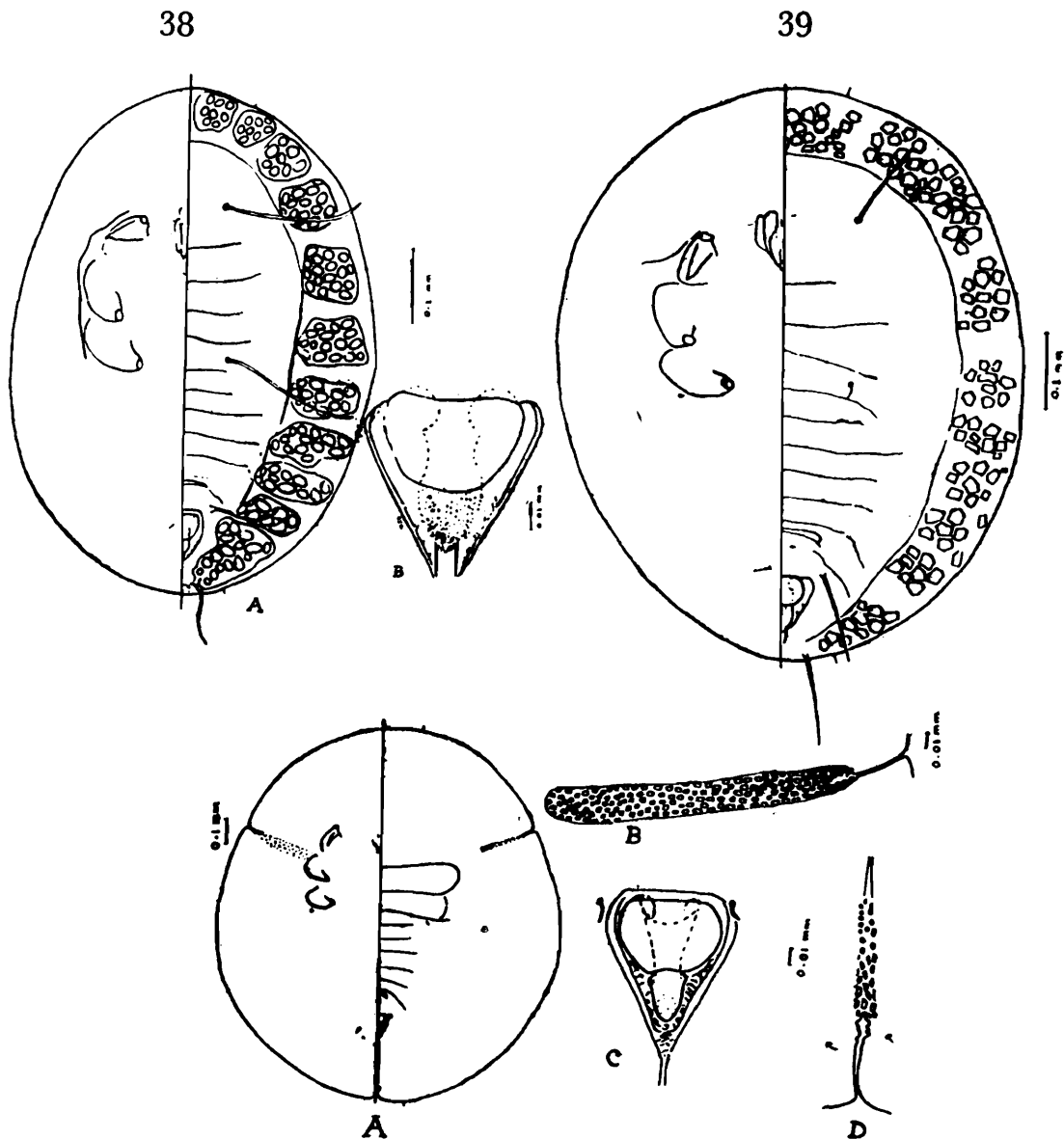
Operculum sub-semicircular, wider, length 42, width 60. Lingula with lateral knob at base on each side, exposed, included, terminal setae wanting.

Ventral surface.—Ventral abdominal setae 25 long, 80 apart. Anterior and posterior abdominal spiracles evident. Thoracic and caudal tracheal folds with minute tubercles. Setae at base of legs absent. A pair of small setae anterior to rostrum evident.

Host plant.—*Morinda tinctoria*.

Holotype.—One pupal case, on *Morinda tinctoria*, Coimbatore, 25-3-1967, B. V David.

Paratypes.—11 pupal cases mounted bearing the same details.



37

Text-figs. 37-39. (37) *Indoaleyrodes pustulatus* gen. et sp. n. A. Pupal case, B. Thoracic tracheal pore, C. Vasiform orifice, D. Caudal tracheal pore; (38) *Lipaleyrodes crossandrae* sp. n. A. Pupal case, B. Vasiform orifice; (39) Pupal case of *Lipaleyrodes euphorbiae* sp. n.

Numerous cases on leaves in collection. Pupal cases on leaves in the collections of Systematic Entomology Laboratory, Entomology Research Division, United States Department of Agriculture, Washington and the British Museum (Natural History), London, Mounted specimen deposited in the collection of the Z.S.I., Calcutta.

XVI. Genus **Lipaleyrodes** Takahashi, 1962

Type species.—*Lipaleyrodes phyllanthi* Takahashi, 1962, *Proc. R. ent. Soc. Lond.* (B) 31(7-8): 100.

Pupal case with submarginal area distinctly defined from dorsal disc; abdominal segment seven much shortened medially; submargin broad with wax plates in large clusters arranged in a row; marginal teeth, submarginal ridges and furrows, and tracheal pores, or combs wanting; vasiform orifice large, subcordate; operculum occupying over half length of orifice; lingula knobbed, etose.

47. **Lipaleyrodes crossandrae** sp. n.

(Plate II; Text-fig. 38)

Pupal case.—Found in groups on the undersurface of leaves in dense white fluff of fleecy curled filaments of wax. Oval in shape. Length 0.58-0.72 mm. Width 0.41-0.50 mm.

Margin.—Margin finely crenulate. Paired anterior and posterior marginal setae 11-22 long. Thoracic and caudal tracheal pores or combs absent.

Dorsal surface.—Three pairs of long dorsal setae are quite characteristic—the cephalic setae 127 long, the first abdominal setae 146-160 long and the eighth abdominal setae laterad to base of vasiform orifice 88 long. The caudal setae submarginal in position 80 long. Transverse moulting suture short. Abdominal segments distinct, seventh abdominal segment medially shortened. Dorsal disc separated from submargin by a distinct line. Submargin broad with 11 pairs of clusters of wax plates, each cluster consisting of 8-17 irregularly oval wax plates. Thoracic and caudal furrows absent.

Vasiform orifice bluntly pointed at caudal end, a little broader than long (52×47) with lateral ridges. Operculum wider than long (39×28). Lingula large, more or less club-shaped, setose, exposed, bearing a pair of long setae subapically, included.

Ventral surface.—A pair of ventral abdominal setae 36 long, 28 apart. Setae at base of legs and rostrum wanting. Antenna not extending beyond fore leg. Prothoracic, mesothoracic and posterior abdominal spiracles visible. Thoracic and caudal tracheal folds absent.

Host.—*Achyranthes aspera* and *Crossandra undulaefolia*.

Holotype.—One pupal case mounted, on *Crossandra undulaefolia*, Coimbatore, 15-11-1966, B. V. David.

Paratypes.—Thirteen pupal cases mounted, bearing the same details as that of Holotype. Nineteen pupal cases mounted, on *Achyranthes aspera*, Coimbatore, 18-11-1966, B. V David. [Deposited in the collections of the Entomology Research Division, U.S.D.A., Washington and the B.M., London].

This species is easily separated from *L. euphorbiae* sp. nov. by the long setae on first abdominal segment and the irregularly oval submarginal wax plates.

48. *Lipaleyrodes euphorbiae* sp. n.

(Text-fig. 39)

Pupal case.—Pupal cases found in groups on the undersurface of leaves and to a limited extent on the upper surface also in dense white fluff of fleecy curled filaments of wax. Case white, becomes transparent on clearing. Oval in shape. Length 0.78 mm. Width 0.60 mm.

Margin.—Margin finely crenulate. Paired anterior and posterior marginal setae, 5-11 long. Thoracic and caudal tracheal pores or combs absent.

Dorsal surface.—Three pairs of dorsal setae present; the cephalic setae 74 long, the first abdominal setae minute 11 long and the eighth abdominal setae laterad of base of vasiform orifice 80 long. Caudal setae at hind end of body, 80 long. Transverse moulting suture extends upto subdorsum; abdominal segments distinct. Seventh abdominal segment medially shortened; pockets well developed and contiguous; eighth segment much longer than sixth. Dorsal disc separated from submargin by a distinct line. Submargin broad with a series of wax plates in clusters of about 11 pairs, each cluster consisting of 5 to 16 polygonal wax plates. Thoracic and caudal tracheal furrows absent.

Vasiform orifice bluntly pointed at caudal end, a little wider than long; width 61 and length 58; lateral ridges indistinct. Operculum wider than long, 47×30. Lingula large, more or less club-shaped, exposed, bearing a pair of long setae subapically; included but sometimes extended beyond the posterior margin of the orifice.

Ventral surface.—A pair of ventral abdominal setae cephalad of base of vasiform orifice 8 long, 25 apart. A minute pair of setae at base of rostrum present. Setae at base of legs wanting. Antenna not extending beyond fore leg. Anterior and posterior abdominal spiracles visible. Thoracic and caudal tracheal folds absent.

Host.—*Euphorbia prostrata*

Holotype.—One pupal case mounted, on *Euphorbia prostrata*, Madurai, 28-1-1967, B. V David.

Paratypes.—Seventeen pupal cases mounted, bearing the same details. [Deposited in the collections of the Entomology Research Division, U.S.D.A., Washington, and the B.M., London].

This species is easily distinguished from other known species of *Lipaleyrodus* in the presence of small setae on first abdominal segments and in the arrangement of polygonal submarginal wax plates.

Key to Indian Species of Lipaleyrodus

1. Setae on first abdominal segment wanting; each submarginal cluster with 4 or 5 wax plates in close apposition. . *breyntiae* (Singh)*
 Setae on first abdominal segment present; each submarginal cluster with 5-17 wax plates.. 2
2. Setae on first abdominal segment very short; wax plates polygonal in shape, numbering 5-16 in each cluster.. . *euphorbiae* sp. n.
 Setae on first abdominal segment very long; wax plates irregularly oval numbering 8-17 in each cluster.. . *crossandrae* sp. n.

XVII. Genus **Neomaskellia** Quaintance and Baker, 1913

Type species.—*Aleyrodus comata* Maskell, 1896.

The quite distinctive feature of the species included in this genus is possession of transversely oval vasiform orifice with a very short operculum exposing a broader than long lingula.

49. **Neomaskellia bergii** (Signoret, 1868)
(Plate II)

1867. *Aleyrodus bergii* Signoret, *Soc. Ent. France, Ann.* **IV**, 8: 395.

1914. *Neomaskellia bergii* (Signoret), Quaintance and Baker, *U.S. Dept. Agric., Bur. Ent., Tech. Ser.* **27**(2): 104.

A well known pest of sugarcane in the tropics from Mauritius to the Pacific, this species is the most widely spread one in India.

Hosts.—Sugarcane (*Saccharum officinarum*), *Sorghum vulgare* (Singh, 1931), *Cenchrus ciliaris* and *Setaria italica* (new hosts).

Distribution.—Throughout India.

Material examined.—Seven pupal cases, on *Cenchrus ciliaris*, Coimbatore, 14-7-1960, B. V David; five pupal cases, on *Setaria italica*, Tudiyalur (Coimbatore), 27-8-1967, V T Sundaramurthy; fifteen pupal cases, on sugarcane, Cuddalore, 12-9-1967, G. Varadarajan; twenty-seven pupal cases, on *Sorghum vulgare*, Coimbatore, 7-2-1970, B.V David.

XVIII. Genus **Neopealius** Takahashi

Type species.—*Neopealius rubi* Takahashi, 1954, *Insecta Matsumurana*, **18**(3-4): 50-52.

Pupal case elliptic; marginal teeth short and rounded; tubercles, papillae and rhachis on dorsum lacking; submarginal area not defined from dorsal disc; tracheal folds or pores or clefts wanting, combs not well differentiated; seventh abdominal segment much shorter than the sixth; vasiform orifice much longer than wide, rounded at posterior end, not elevated; lingula setose, knobbed, exposed, included.

50. **Neopealius nilgiriensis** sp. n.

(Text-fig. 40)

Pupal case.—Pale brown, oval, with slight waxy secretion from margin; 0.66-0.78 mm long, 0.40-0.46 mm wide. Occurs on both surfaces of leaf.

Margin.—A row of rounded marginal teeth irregular in width, 21-22 teeth in 0.1 mm. Paired anterior and posterior marginal setae 8-21 long. Thoracic ends differentiated from the other part of margin in having a few very small rounded teeth. Caudal end not indented but distinct in having about twelve narrow ridges.

Dorsal surface.—Dorsum with three pairs of setae—the cephalic setae 130 long; the first abdominal setae short, 18 long and eighth abdominal setae laterad of base of vasiform orifice 57 long. Submarginal caudal setae on tubercles, 86 long. Dorsum lacking tubercles, papillae and rhachis. Transverse moulting suture bends to anterior slightly but does not extend beyond subdorsum. A pair of submedial depressed markings evident on the first four abdominal segments. Pockets not contiguous. Abdomen widely segmented, suture between second and third segments extends latero-anteriorly at the lateral part; seventh abdominal segment much shorter than the sixth.

Vasiform orifice longer than wide, 63 long and 44 wide; rounded posteriorly, lateral walls ridged. Operculum transverse cephalad, narrowed and rounded caudad, wider than long (30×25) occupying more than half the orifice. Lingula setose, knobbed, a pair of small setae subapically, exposed and included.

Ventral surface.—Ventral abdominal setae 26 long, 36 apart. Anterior and posterior abdominal spiracles visible. Thoracic and caudal tracheal folds and setae at base of legs and rostrum wanting.

Host.—*Azalea indica*.

Holotype.—One pupal case mounted, on *Azalea indica*, Ootacamund (The Nilgiris), 7000 ft., 3-7-1969, B. V. David.

Paratypes.—Twelve pupal cases mounted, bearing the same details. Numerous pupal cases on dry leaves in collection. [Deposited in the collection of the B. M., London and the Z.S.I., Calcutta.]

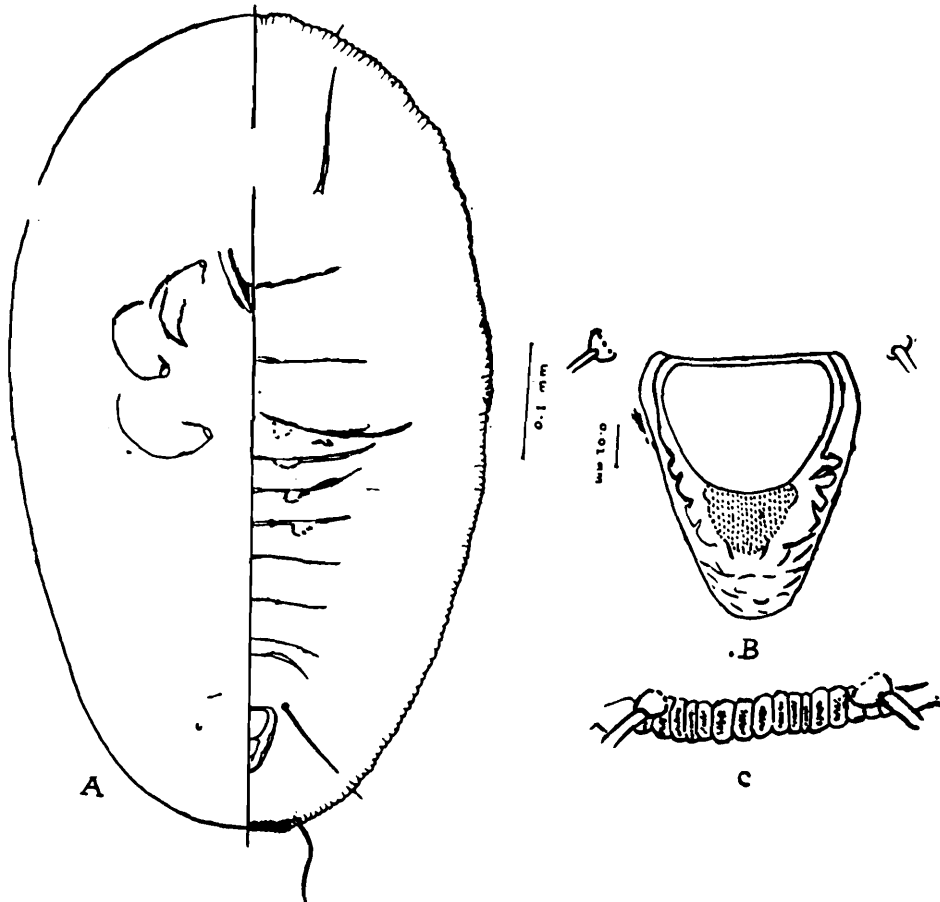
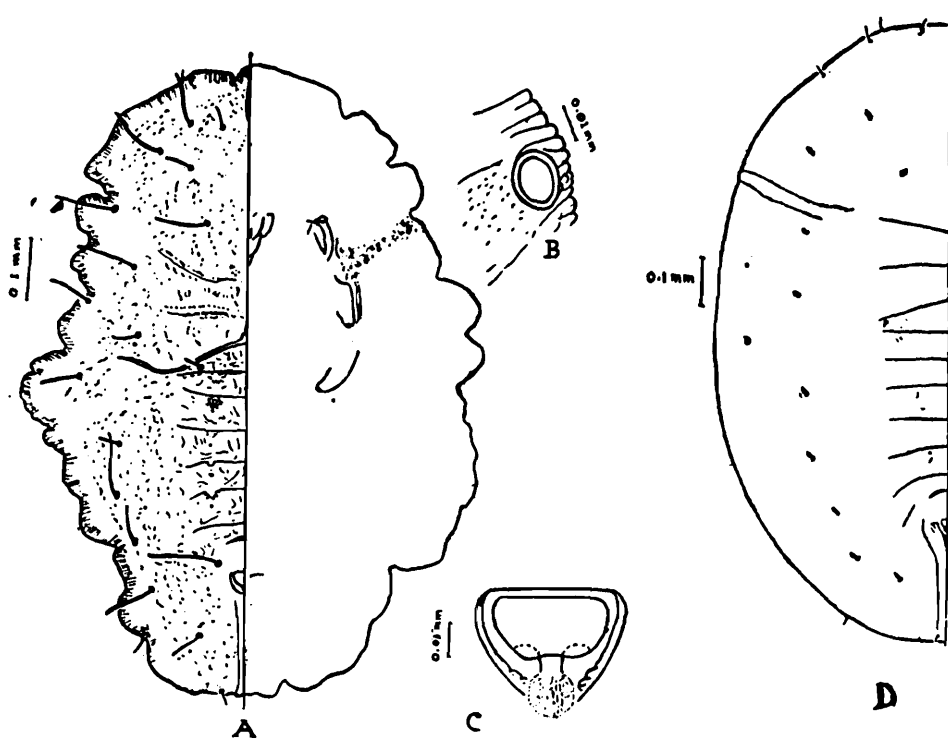
This species is distinct from *Neopealius rubi* Takahashi in the details of vasiform orifice, in not possessing a caudal furrow and in the length of dorsal setae.

XIX. Genus **Pealius** Quaintance and Baker, 1914

Type species.—*Aleyrodes maskelli* Bemis, 1904, *Proc. U.S. natn. Mus.*, 27 : 471-537.

Species included in this genus are characterised by the vasiform orifice situated in a ribbed pyriform pit; operculum subrectangular; lingula exposed, usually with a D-shaped tip; thoracic tracheal combs indicated; submargin with a series of setae.

41



40

Text-figs. 40-41. (40) *Neopealius nilgiriensis* sp. n. A. Pupal case B. Vasiform orifice, C. Caudal tracheal pore; (41) *Pealius indicus* sp. n. A. Pupal case, B. Thoracic tracheal end, C. Vasiform orifice, D. Pupal case from the upper surface of *Ficus bengalensis* leaf.

51. **Pealius indicus** sp. n.

(Text-fig. 41)

Pupal case.—White without any waxy secretion; oval; 0.68-1.09 mm long, 0.48-0.79 mm wide; occurs on both surfaces of leaf.

Margin.—Smoothly crenulate; pupal case from upper surface of leaf broadly oval with margin smooth; margin deeply indented in pupal case from undersurface of leaf. Thoracic and caudal combs indicated by slightly strengthened marginal crenulations numbering 3 to 5 and 7 to 12 crenulations respectively; an oval pore with a rim evident in some specimens. Paired anterior and posterior marginal setae 14-19 long.

Dorsal surface.—Setae on pupal cases from hairy undersurface of leaf long and of those from glabrous upper surface of leaf short (measurements indicated in brackets). Cephalic setae 72(17) long; first abdominal setae 40 (broken) long; eighth abdominal setae a short distance and cephalad of orifice 99 long (11 long but placed laterad of base of orifice on the elevated sides; submarginal caudal setae at caudal end 58(28) long. In addition, subdorsum with nine pairs of long blunt setae on tubercles, 40-88 long—two pairs on cephalic region, one pair on each of meso- and metathorax and five pairs on abdominal segments four to eight. Subdorsal setae on pupal cases from upper surface of leaf short, spearhead-like or spindle-shaped, 11-22 long. Submarginal setae five pairs—three pairs on cephalic region, a pair on thorax and a pair at anterior part of abdomen; setae 40-53 long; on pupal cases from upper surface of leaf pointed, 22-25 long. Transverse moulting suture extending to submargin; second abdominal suture bends latero-anteriorly; seventh abdominal segment medially shortened. Dorsum tuberculate and pores and porettes distributed all over body. Paired submedian depressed markings on meso- and metathoracic segments and on first six abdominal segments. Thoracic tracheal and caudal furrows indicated.

Vasiform orifice in a pit, subcircular, wider than long (39×28 in pupal case from hairy surface and 39×36 in pupal case from glabrous surface); floor of orifice with ridges. Operculum subrectangular, rounded laterally, wider than long, 28×19 in pupal case from hairy surface and 28×25 in pupal case from glabrous leaf surface. Lingula tip D-shaped, exposed.

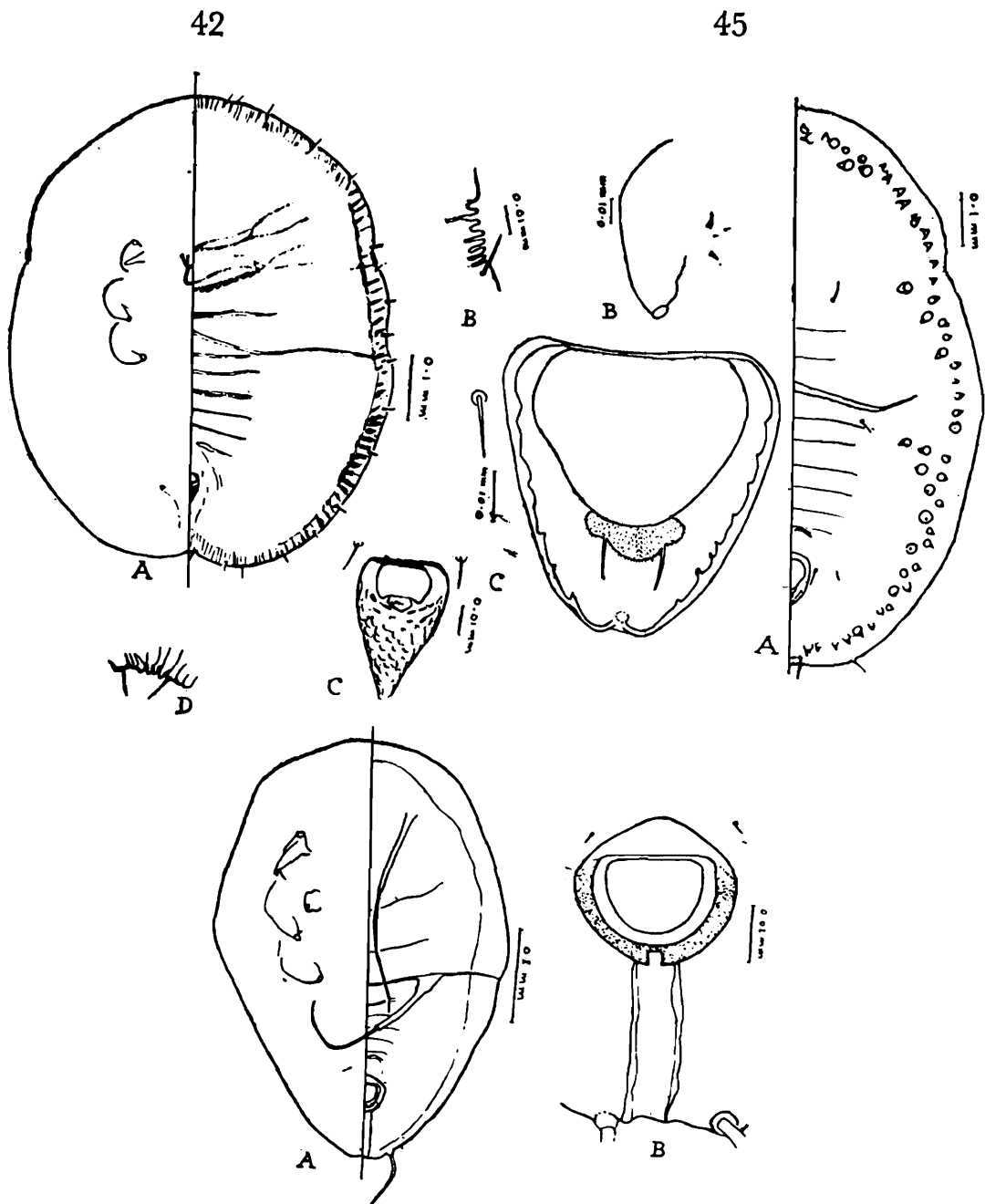
Ventral surface.—Ventral abdominal setae cephalad of orifice, 22-25 long, 30 apart. Anterior and posterior abdominal spiracles visible. Antenna not extending beyond fore leg. A pair of minute setae at base of rostrum; setae at base of legs wanting. Thoracic and caudal tracheal folds indicated, tuberculate.

Host.—*Ficus bengalensis*.

Holotype.—One pupal case mounted, on *Ficus bengalensis*, Coimbatore, 10-4-1967, B. V. David.

Paratype.—Fourteen pupal cases mounted, bearing the same details. Pupal cases on leaves in collection.

This species comes close to *Pealius misrae* Singh and *Pealius bengalensis* (Peal) but differs from them considerably in the number and arrangement of submarginal and subdorsal setae, in the tuberculate nature of dorsum and in the structural details of vasiform orifice.



Text-figs. 42, 44-45. (42) *Pealius schimae* A. Pupal case, B. Thoracic tracheal comb, C. Vasiform orifice, D. Caudal tracheal end; (44) *Taiwanaleyrodies indicus* A. Pupal case, B. Vasiform orifice; (45) *Trilaleurodes rara* A. Pupal case; B. Mesothoracic leg with conical spines, C. Vasiform orifice.

52. *Pealius schimae* Takahashi

(Text-fig. 42).

1950. *Pealius schimae* Takahashi, *Annotnes zool. Japan*, 23: 88,

Pupal case.—Pale brownish or pale brownish red, oval, broadest across transverse moulding suture, slightly constricted at thoracic and

caudal tracheal pores; 1.00 mm long, 0.76 mm wide; found on the undersurface of leaves.

Margin.—Irregularly crenulate. A pair of anterior and posterior marginal setae, 13 long, a pair of caudal submarginal setae on either side of caudal tracheal combs, 18 long. Thoracic tracheal combs with six teeth, caudal tracheal comb with four teeth.

Dorsal surface.—Fifteen pairs of submarginal setae, 5 pairs anterior to thoracic tracheal combs and ten pairs posterior to them, 16 to 18 long, evident. A pair of setae laterad of the base of vasiform orifice, 18 long. Setae on cephalic region and first abdominal segment wanting. All the setae on distinct tubercles. Dorsal disc granulated and slightly darker on dorsum with sutures well indicated. Transverse thoracic suture reaching margin of case. Pockets contiguous and well indicated. Submargin with narrow striations running mesad from margin. Thoracic tracheal furrows discernible.

Vasiform orifice in a cordate pit which includes eighth abdominal setae. Space between the caudal end and pit of orifice 104 long. Vasiform orifice longer than wide (65×42), roughly triangular, inner surface clearly dissected into small areas by ridges. Operculum rectangular, wider than long (21×36), postero-lateral corners pronounced. Lingula setose, short, exposed and tip D-shaped. Caudal furrow indicated, not reaching the margin.

Ventral surface.—A pair of ventral abdominal setae cephalad of vasiform orifice, 13 long, 47 apart. Mesothoracic and abdominal spiracles visible; setae at base of legs and rostrum wanting.

Host plant.—*Artocarpus heterophyllus* (Jack tree) and *Ipomoea* sp.

Distribution.—Coimbatore (Tamil Nadu).

Material examined.—Thirtyone pupal cases mounted, on *Artocarpus heterophyllus*, Coimbatore, 22-4-1961, B. V David; sixteen pupal cases mounted on *Ipomoea* sp., Coimbatore, 6-6-1957, S. K. David.

Pupal cases on dry leaves of *A. heterophyllus*, Coimbatore, 30-3-67, B. V David.

Takahashi in his original description of the species has stated that the dorsum lacks submarginal setae and the thoracic tracheal combs less distinct. However, it is clear from the series of specimens examined that fifteen pairs of submarginal setae are evident and the tracheal combs are well indicated.

The identity of the species was confirmed by L. A. Mound of the British Museum (Natural History), London, who studied co-types from Borneo.

This species is a new addition to the Aleyrodid fauna of India and so far known only from N. Borneo on *Schima robustum*.

53. **Pealius spina** (Singh, 1931) comb. n.
(Text-fig. 43)

1931. *Dialeurodes spina* Singh, *Mem. Dept. Agric. India, Ent. Ser.* **12**(1): 27.

Singh described this species from *Ficus religiosa*, through his description and figures are rather meagre in detail. In the present study specimens collected from the same host compare well with Singh's species. However, in view of the characters observed in the present material such as medially shortened seventh abdominal segment, presence of submarginal setae, vasiform orifice in a pit with floor dissected into ridges, sub-rectangular operculum and tip of lingula D-shaped and exposed, the species is referred to the genus *Pealius* and the new combination is suggested here.

Though Singh does not make any detailed reference to the tracheal combs and medially shortened seventh abdominal segment, he refers to the exposed tip of lingula in his description, and his figure indicates the submarginal position of the two posterior pairs of setae. A redescription of the species with detailed illustrations is provided here.

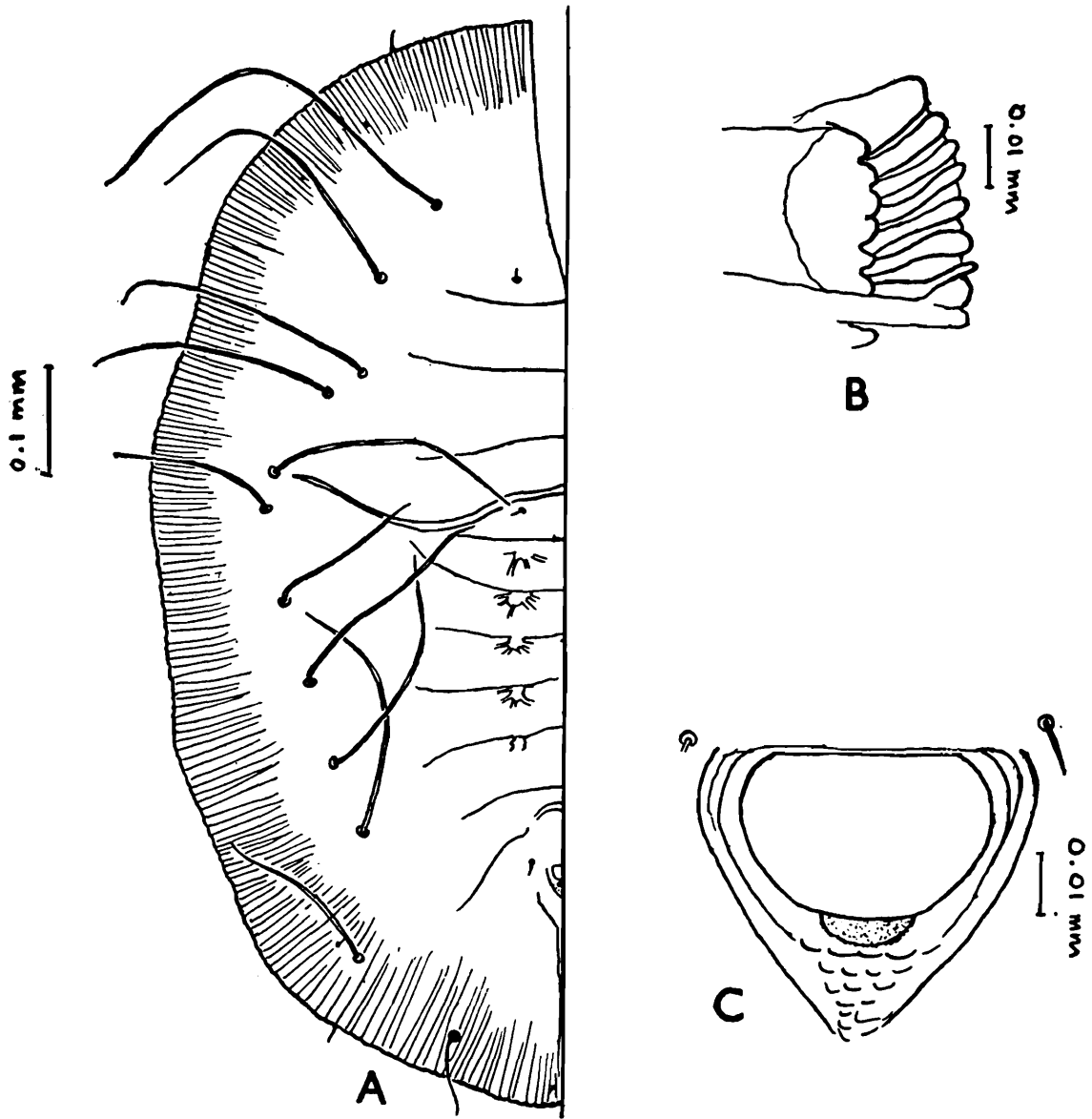
Pupal case.—Pale yellow, roundly elliptic, without any waxy secretion; 1.20-1.46 mm long, 1.00-1.28 mm wide; found on both upper and lower surfaces of leaves and a severe infestation causes yellowing of leaves.

Margin.—Crenulate, 15-16 crenulations in 0.1 mm; not indented; paired anterior and posterior marginal setae minute, 8-11 long; thoracic and caudal tracheal combs indicated by thickened marginal crenulations.

Dorsal surface.—Usual paired dorsal setae minute—cephalic setae, 5 long; first abdominal setae, 5 long; eighth abdominal setae laterad of base of orifice, 8 long. Dorsum lacking tubercles but minute pores and porettes distributed sparsely all over; submedial depressed markings evident on cephalic region, on all thoracic segments and on the first six abdominal segments; second abdominal suture bends latero-anteriorly; seventh abdominal segment medially shortened; pockets well developed; contiguous. Submargin broad with radial striations running mesad of margin. Twelve pairs of long setae on distinct circular tubercles evident on dorsal surface—two pairs posteriorly submarginal in position; five pairs subdorsally on abdomen and five pairs subdorsally on cephalothorax; 199-332 long. A pair of submarginal caudal setae on either side of caudal end, 5 long. Thoracic tracheal furrows not indicated but a distinct rimmed pore ending in combs evident in a few pupal cases; caudal tracheal furrow indicated.

Vasiform orifice small, situated in a shallow pit, floor dissected into ridges, subsemicircular, wider than long (41×30), rounded posteriorly. Operculum subtrapezoidal, transverse cephalad, wider than long (30×19), filling two-third orifice; lingula tip D-shaped, exposed, included.

Ventral surface.—A pair of ventral abdominal setae 28 long, 44 apart. Thoracic and caudal tracheal folds minutely tuberculate. Antenna



43

Text-fig. 43. *Pealius spina* A. Pupal case, B. Thoracic tracheal pore, C. Vasiform orifice.

not extending beyond fore leg; setae at base of legs wanting; a pair of minute setae at base of rostrum seen. All the four pairs of spiracles visible.

Host.—*Ficus religiosa* (Singh, 1931).

Distribution.—Mirpur Khas, Daulatpur (Singh) (Singh, 1931), Salem (Tamil Nadu) (new distribution record).

Material examined.—Fourteen pupal cases mounted, on *Ficus religiosa*, Salem, 21-7-1968, B. V David. Numerous pupal cases on dry leaves in collection.

Key to Indian species of Pealius

1. Transverse moulting suture not reaching margin.. 2
- Transverse moulting suture reaching margin; usual paired cephalic and first abdominal dorsal setae absent; submarginal setae 15 pairs; vasiform orifice in a distinct pyriform pit.. *schimae* Takahashi

- | | |
|---|-------------------------------|
| 2. Submarginal setae more than ten pairs, in a distinct row.. | 3 |
| Submarginal setae less than ten pairs, not in a distinct row.. | 4 |
| 3. Submarginal setae fifteen pairs.. | . <i>misrae</i> Singh* |
| Submarginal setae thirteen pairs.. | .. <i>bengalensis</i> (Peal)* |
| 4. Pupal case roundly elliptic; dorsum not tuberculate; ten pairs of sub-dorsal and two pairs of submarginal setae evident.. | . <i>spina</i> (Singh) |
| Pupal case oval; dorsum tuberculate; nine pairs of subdorsal and five pairs of submarginal setae present; shape and length of setae varies depending on hairy or glabrous nature of the leaf surface on which it develops.. | . <i>indicus</i> sp. n. |

XX. Genus **Rhachisphora** Quaintance and Baker, 1917

Type species.—*Dialeurodes* (*Rachisphora*) *trilobitoides* Quaintance and Baker, 1917, *Proc. U. S. natn. Mus.*, **51**: 430.

The species included in this genus are characterised by the pupal case with a row of submarginal spines; dorsal disc with a prominent rhachis, often with thickened ridges radiating from it; thoracic tracheal pores armed with teeth, folds distinct.

54. **Rhachisphora trilobitoides** (Quaintance and Baker), 1917 (Plate III)

1917. *Dialeurodes* (*Rachisphora*) *trilobitoides* Quaintance and Baker, *Proc. U.S. natn. Mus.* **51**: 433.

1931. *Dialeurodes trilobitoides* Quaintance and Baker, Singh, *Mem. Dept. Agric. India, Ent. Ser.* **12**(1): 28.

1952. *Rhachisphora trilobitoides* (Quaintance and Baker), Takahashi, *Mushi*, **24**(6): 22

The description of the species provided by Quaintance and Baker (1917) seems adequate.

Host.—*Cordia myxa*. *Syzigium jambolanum* (Singh, 1931), *Achras zapota*, *Mimusops hexandra* (Rao, 1958) and *Xeromphis malabarica* (new host).

Distribution.—Pusa (Bihar) (Singh, 1931); Hyderabad (Andhra Pradesh) (Rao, 1958); Kayarambedu and Madras (Tamil Nadu) (new distribution record).

Material examined.—Nine pupal cases mounted, on an unidentified shrub, Kayarambedu (Chingleput district), 6-3-1971, B. V. David; five pupal cases on *Xeromphis malabarica*, 8-7-1971, B. V. David.

On the unidentified shrub invariably the upper surface of leaf was found infested by *R. trilobitoides* (Quaintance and Baker) and the lower surface of the same leaf by *Dialeurodes ixorae* Singh.

XXI. Genus **Siphoninus** Silvestri, 1915

Type species.—*Siphoninus finitimus* Silvestri, 1915, *Boll. Lab. Zool. Portici*, **9**: 245.

The distinctive feature of the species included in this genus is the possession of numerous dorsal tubes, each with an open tip, on pupal case. Adults lack paronychium between the tarsal claws.

55. **Siphoninus phillyreae** (Haliday), 1835

1835. *Aleyrodes phillyreae* Haliday, *Entom. Mag.* 2: 119-120.

1931. *Siphoninus finitimus* Silvestri, 1915, Singh, 1931, *Mem. Dept. Agric. India, Ent. Ser.* 12(1): 12.

1966. *Siphoninus phillyreae* (Haliday), Mound, *Bull. Br. Mus. nat. Hist., Ent.* 17(9): 419.

Recently Mound (1966) provided a detailed description of the species. In India it is a common pest on pomegranate.

Host.—*Prunus persica* (peach), *Punica granatum* (pomegranate) and *Pyrus communis* (pear) (Singh, 1931).

Distribution.—Pusa (Bihar) (Singh, 1931); Bangalore (Karnataka State) (Usman and Puttarudraiah, 1955); Hyderabad (Andhra Pradesh) (Rao and Rao, 1962); Coimbatore (Ayyar, 1923) and throughout Tamil Nadu.

Material examined.—Eleven pupal cases, on *Punica granatum*, Coimbatore, 27-11-1966, B. V David; nine pupal cases, on *Pyrus communis*, Yercaud (Salem district), 14-8-1968, B. V David.

XXII. Genus **Taiwanaleyrodes** Takahashi, 1932

Type species.—*Taiwanaleyrodes meliosomae* Takahashi, 1932, *Rept., Dept. Agric.* 59: 28.

The species included in this genus are characterised by the pupal case with a single row of marginal teeth; marginal area bent downward; submarginal area not separated from dorsal disc; thoracic tracheal folds and pores absent; caudal tracheal fold and pore distinct; dorsum with a pair of long 2-segmented setae on cephalic region and a pair on first abdominal segment; vasiform orifice notched on posterior margin; operculum nearly filling orifice, concealing the lingula.

56. **Taiwanaleyrodes indicus** (Singh, 1931) comb. n.

(Text-fig. 44)

1931. *Aleurothrixus indicus* Singh, *Mem. Dept. Agric. India, Ent. Ser.* 12(1): 84.

Singh recorded the above species from *Ficus carica* and *Michelia champaka* and in his description refers to "margin finely crenulate; dorsum with two pairs of long spine-like hairs, a pair on head and one on first abdominal segment; each of these hairs usually composed of two parts, the distal thinner half socketed into the end of the proximal thicker half; vasiform orifice subcircular; operculum subcordate, almost entirely filling the orifice, obscuring the lingula; a broad groove runs from the end of the orifice to the caudal margin" In view of these characters satisfying the definition of the genus *Taiwanaleyrodes* the new combination is suggested here.

In the present study also specimens were collected from *Ficus* sp. at Madras which agree with the description given by Singh for his *Aleurothrixus indicus* and hence they are all included under *Taiwanaleyrodes indicus* (Singh).

Pupal case.—Small, convex, subelliptic, yellowish with a flocculent mass of bluish wax on dorsum and a palisade round the margin; empty pupal case colourless; 0.53 mm long, 0.31 mm wide.

Margin.—Finely crenulate; paired anterior and posterior marginal setae, 3-5 long. Thoracic tracheal combs or pores wanting, caudal tracheal pore indicated.

Dorsal surface.—Two pairs of 2-segmented setae—a pair on cephalic region, 264 long and a pair on first abdominal segment, 231 long; distal segment of 2-segmented setae thinner and socketed into the end of the proximal thicker segment; a pair of minute setae cephalad of vasiform orifice. A pair of submarginal caudal setae, 93 long, on either side of caudal furrow. Transverse moulting suture almost straight; cephalo-thorax much longer than abdomen; abdominal segments distinct; pockets evident, not contiguous.

Vasiform orifice subcircular (43×43), notched at caudal end; operculum subcordate, wider than long (33×26), nearly filling the orifice obscuring the setose lingula, rarely lingula tip exposed. Caudal furrow is quite distinct.

Ventral surface.—A pair of ventral abdominal setae 8 long, 14 apart. All the four pairs of spiracles and adhesive sac visible. A minute seta at base of mesothoracic legs; setae at base of rostrum wanting. Antenna short with a finger-like tip, not extending beyond fore leg.

Host.—*Ficus carica*, *Michelia champaka* (Singh, 1931) and *Ficus* sp.

Distribution.—Pusa (Bihar) (Singh, 1931) and Madras (Tamil Nadu) (new distribution record).

Material examined.—Twentyfive pupal cases, on *Ficus* sp., Madras, 25-7-1971, B. V David.

XXIII. Genus **Trialeurodes** Cockerell, 1902

Type species.—*Aleurodes pergandei* Quaintance, 1900, *Bull. U.S. Bur. Ent.* **8**: 1-43.

The dorsal surface of pupa is usually elevated from leaf surface and a vertical waxy palisade is evident. The most conspicuous features by which it is recognised from other genera are the presence of submarginal papillae with wax secreting pores and trilobed lingula in the cordate orifice.

57. **Trialeurodes rara** Singh, 1931

(Plate III Part, Text-figs. 45 & 46)

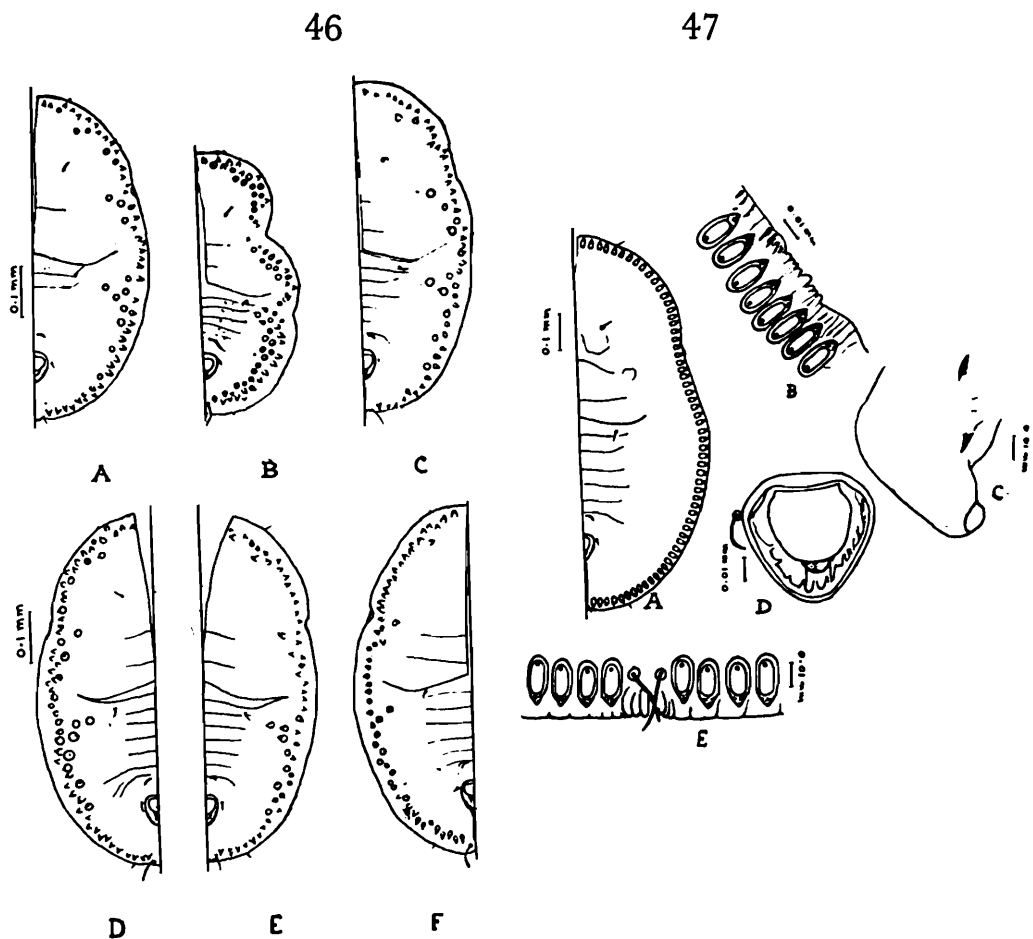
1931. *Trialeurodes rara* Singh, *Mem. Dept. Agric. India, Ent. Ser.* **12**(1): 47.

The following additional description is provided to the original description of the species by Singh.

Pupal case.—White with a palisade of wax and long marginal waxy filaments; elliptic; 0.44-0.64 mm long, 0.30-0.41 mm wide.

Margin.—Irregularly crenulate. Thoracic and caudal tracheal pores indicated by strong marginal crenulations.

Dorsal surface.—Submargin with 30 to 59 papillae on glabrous leaves submarginal papillae arranged in a single row; five to eight pairs of papillae on subdorsum. On hairy leaves papillae apparently in two or three rows, many being found on subdorsum. Submarginal disc pores mesad of papillae. Transverse moulting suture bends latero-anteriorly extending upto sub-dorsum. Seventh abdominal segment very much shortened medially; eighth abdominal setae arising postero-laterally to anterior margin of operculum. Vasiform orifice cordate, longer than wide, emarginate posteriorly, margin curving to anterior to meet an internal tooth; lateral margins with fine teeth internally. Lingula with the subapical paired setae and paired lobes exposed.



Text-figs. 46-47. (46) Host correlated variations as seen in the pupal cases of *Trialeurodes rara* from A. *Aristolochia labiosa*, B. *Bauhinia* sp., C. *Dolichos lab-lab*, D. *Gossypium hirsutum*, E. *Phyllanthus acidus*, F. *Richinus communis*; (47) *Trialeurodes cicini* A. Pupal case, B. Thoraci tracheal end, C. Mesothoracic leg with conical spine, D. Vasiform orifice, E. Caudal tracheal end.

Ventral surface.—Ventral abdominal setae 17 long, 28 apart. Two stout setae at base of meso- and metathoracic legs; two minute setae at base of mesothoracic legs evident. Anterior abdominal spiracles not seen.

The variations noticed in the structural details of pupal cases from different host plants are discussed elsewhere,

Host.—*Breynia* sp. (Singh, 1931), *Euphorbia* sp., *Murraya koenigi*, *Ricinus communis* (Rao, 1958), *Phyllanthus acidus* (Sundara Babu, 1971)*, *Anona glabra*, *Aristolochia bracteata*, *Bauhinia* sp., *Dolichos lab-lab*, *Gossypium hirsutum* and *Moringa oleifera* (new hosts).

Distribution.—Saharanpur (Singh, 1931), Hyderabad (Rao, 1958), Kunigal (Karnataka State) and Coimbatore (Tamil Nadu).

Material examined.—Twentyfive pupal cases, on *Ricinus communis*, Coimbatore, 27-10-1966, B. V David; nine pupal cases, *Phyllanthus acidus*, Coimbatore, 30-3-1967, B. V David; thirty pupal cases, on *Aristolochia labiosa*, Coimbatore, 3-4-1967, B. V David; twentyfive pupal cases, on *Bauhinia* sp., Coimbatore, 8-4-1967, B. V David; three pupal cases, on *Anona glabra*, Coimbatore, 10-4-1967, B. V David; three pupal cases, on *Moringa oleifera*, Coimbatore, 17-4-1967, B. V David; thirty-five pupal cases, on *Dolichos lab-lab*, Coimbatore, 18-11-1967 B. V David; five pupal cases, on *Ricinus communis*, Kunigal (Karnataka State), 28-3-1969, B. V David; fifty pupal cases, on *Gossypium hirsutum*, Coimbatore, 8-4-1969, B. V David.

58. *Trialeurodes ricini* (Misra), 1923

(Text-fig. 47)

1923. *Aleyrodes ricini* Misra, *Proc. 5th ent. Mtg. Pusa.*, 129-135.

1931. *Trialeurodes ricini* (Misra), Singh, *Mem. Dept. Agric., India, Ent. Ser.* **12**(1): 46.

The following additional notes are provided to the original description of the species by Singh.

Pupal case.—0.62-0.63 mm long and 0.39-0.40 mm wide.

Margin.—Irregularly crenulate with 25 crenulations in 0.1 mm. Tracheal pore areas strongly marked by narrowness and depth of 6-8 crenulations. Anterior and posterior marginal setae 11-14 long.

Dorsal surface.—A row of submarginal papillae, 68-73 evident; none on subdorsum. Three pairs of dorsal setae—cephalic setae 22 long; first abdominal setae 19 long; eighth abdominal setae lateral of anterior margin of operculum, 14 long. A pair of submarginal caudal setae 25 long. Seventh abdominal segment medially very much shortened. Vasiform orifice with fine teeth internally on posterior margin and lateral walls; 50 long, 50 wide; operculum 28 long, 30 wide; lingula with a pair of setae subapically, exposed.

Ventral surface.—Two thick conical setae at base of legs. All the four pairs of spiracles evident.

Host.—*Achras zapota*, *Breynia rhamnoides*, *Ricinus communis* (Singh, 1931), *Euphorbia* sp., *Murraya koenigii*, *Phyllanthus* sp., *Rosa* sp. (Rao, 1958), *Anona glabra* and *Gossypium hirsutum* (new hosts).

Distribution.—Pusa (Bihar), Nadiad (Bombay), Baroda, Bhagalpur (Singh, 1931), Hyderabad (Andhra Pradesh) (Rao, 1958), Coimbatore and Madras (Tamil Nadu).

* Reported as *Aleyrodes sizoukinensis* Kuwana due to misidentification of the species.

Material examined.—Three pupal cases on *Ricinus communis*, Coimbatore, 27-10-1966, B. V David; one pupal case, on *Anona glabra*, Coimbatore, 10-4-1967, B. V David; five pupal cases, on *Gossypium hirsutum*, Coimbatore, 8-4-1969, B. V David; one pupal case, on *Murraya koenigii*, Madras, 25-7-1971, B. V David.

59. **Trialeurodes vaporariorum** (Westwood), 1856
(Text-fig. 48)

1856. *Aleurodes vaporariorum* Westwood, 1856, *Gdnr's Chron.* **1856**: 852.
1914. *Asterochiton vaporariorum* (Westwood), Quaintance and Baker, *Tech. Ser. Bur. Ent. U.S.* **27(11)**: 95-114.
1948. *Trialeurodes vaporariorum* (Westwood), Russell, *Misc. Publs. U.S. Dep. Agric.* **635**: 85 pp.

Russell (1948) has provided a detailed description of the species. The material collected during the present study from the undersurface of leaves of potato (*Solanum tuberosum*) agrees well with the illustration and description by Russell of pupal case of *I. vaporariorum* from moderately hairy leaf.

Pupal case.—Length 0.78-0.83 mm; width 0.48-0.53 mm.

Dorsal surface.—Submarginal papillae more than 50; 6 large pairs are evident—2 pairs on cephalic region, 1 on prothoracic segment, 1 just posterior to transverse moulting suture, and 1 each on sixth and eighth abdominal segments; submarginal disc pores mostly distad of papillae, a few usually mesad or laterad. Four pairs of subdorsal papillae, one pair on each of cephalic, mesothoracic and third and fourth abdominal segments evident; papillae directed vertically, nearly uniform in size.

Ventral surface.—A minute seta at base of meso- and metathoracic legs present.

Host.—*Solanum tuberosum*.

Distribution.—Thummanatty (6500 feet, Nilgiris).

Material examined.—Eleven pupal cases, on *Solanum tuberosum*, Thummanatty (Nilgiris), 4-8-1969, B. V David.

This is a new addition to the alleyrodid fauna of India.

Key to Indian species of Trialcurodes

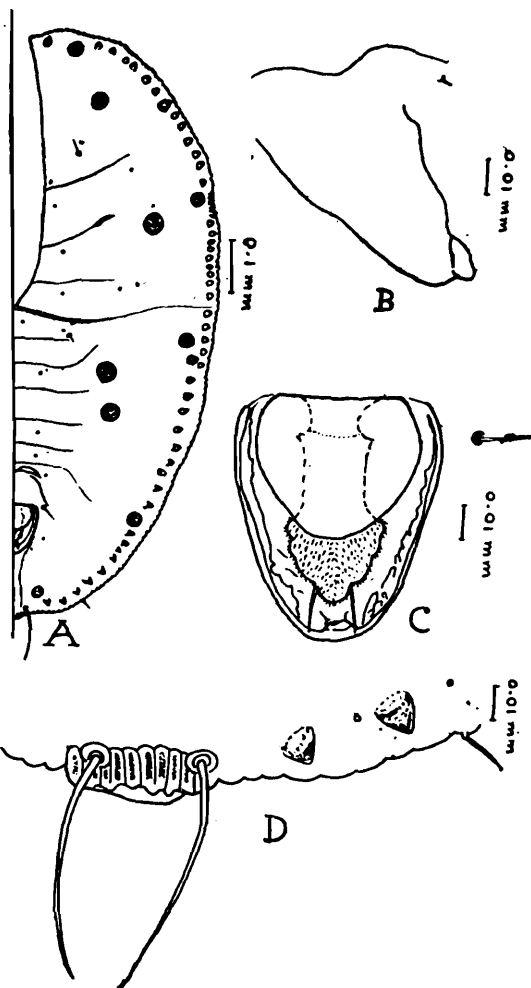
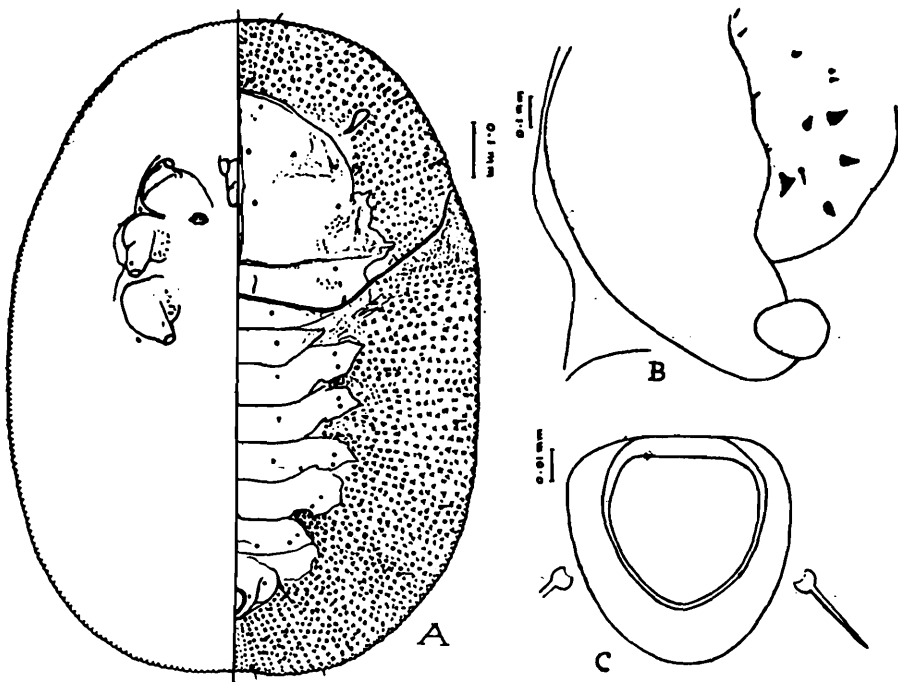
1. Submarginal papillae not all equal in size; variable number of sub-dorsal papillae evident... .. 2
Submarginal papillae all equal in size; papillae wanting on subdorsum...*ricini* (Misra)
2. Submarginal disc pores mesad of papillae; two stout and two thin minute setae at base of middle legs.. .. *rara* Singh
Submarginal disc pores mostly distad of papillae, a few usually mesad or laterad; a thin seta at base of middle legs.. .. *vaporariorum* (Westwood)

XXIV Genus **Zaphanera** Corbett, 1926

Type species.—*Zaphanera cyanotis* Corbett, 1926, *Bull. Ent. Res.* **16**: 267-284.

Pupal case oval with two rows of marginal teeth; submarginal area not separated from dorsal disc. Thoracic and caudal pores or combs

49



48

Text-figs. 48-49. (48) *Trialeurodes vaporariorum* A. Pupal case, B. Mesothoracic leg, C. Vasiform orifice, D. Caudal tracheal end. (49) *Zaphanera publicus* A. Pupal case, B. Mesothoracic leg, C. Vasiform orifice.

absent, folds indistinct. Dorsum with small circular pores and without prominent setae. Cephalo-thoracic region with a well defined median area; rhachis prominent and abdominal sutures with a well defined median area. Vasiform orifice subcordate, elevated; operculum similarly shaped filling the orifice; lingula hidden.

60. **Zaphanera publicus** (Singh, 1938) Comb. n.

(Plate III, part; Text-fig. 49)

1938. *Aleuroputeus publicus* Singh, *Rec. Indian Mus.*, **40**: 189-192.

Singh described *Aleuroputeus publicus* from Nagpur (Maharashtra State) on *Tephrosia purpurea* infesting the under-surface of leaf and occasionally the petiole. He referred the species to the genus *Aleuroputeus* in spite of the elevated vasiform orifice with the operculum filling the orifice and concealing the lingula which is characteristic of *Zaphanera*.

In the present study specimens were collected from the same host from South India as well as from Maharashtra State (Badnera) infesting the same parts of the plant. The specimens were referred to Dr. L. M. Russell, Systematic Entomologist, Entomology Research Division, United States Department of Agriculture, Washington, who identified it as belonging to the genus *Zaphanera*. A comparison of the species with the type available with the Zoological Survey of India, Calcutta confirmed that the species is assignable to the genus *Zaphanera*.

In view of certain other characters like double row of marginal teeth and number and arrangement of submarginal setae being not adequately given by Singh, a detailed description is provided below to supplement the description of the species by Singh.

Pupal case.—Black with white marginal fringe of wax and pronounced wax secretion along mid-dorsal line; oval, 1.18-1.29 mm long, 0.88-0.90 mm wide. Found on the undersurface of leaflets and on petioles and stem. On *Commelina* sp. it occurs only on stem portion of the plant.

Margin.—Margin with a double row of rounded teeth, 8 in 0.1 mm. Thoracic and caudal tracheal pores or combs absent. Paired anterior and posterior marginal setae 17 and 55 long respectively.

Dorsal surface.—A pair of setae on the eighth abdominal segment laterally on tubercles on the elevated part of vasiform orifice, 28-30 long. A pair of caudal setae on tubercles, submarginal in position, 124 long. Dorsal setae on cephalic segment and first abdominal segment not discernible. The cephalothorax with a well defined median area and rhachis prominent. Transverse moulting suture runs posteriorly for a short distance and bends sharply to anterior extending upto margin; the thoraco-abdominal suture extends upto subdorsum. A pair of light eye spots on cephalic region evident. No trace of thoracic and caudal tracheal furrows. Minute circular pores about 9 pairs (varies occasionally) within the well defined median area of cephalothorax; a pair of pores medially on each of abdominal segments 3-7 (occasionally being three pairs or two on one side and three on the other on segments 3 and 4) arranged in rows. Small circular pores are also seen scattered on the subdorsal and submedial areas. Submargin with five pairs of minute setae, 28 long

—a pair on cephalic region just opposite eye spots; a pair on the prothoracic segments and three pairs on the abdomen corresponding to the level of abdominal segments 4, 6 and 8. Minute pores, about forty pairs, found at shorter intervals at base of marginal teeth in a row. Subdorsal and submarginal area ornamented with paired dark markings arranged in a more or less radial fashion.

Vasiform orifice subcordate, 47 long, 44 wide; elevated. Operculum similarly shaped (41 long, 39 wide) filling the orifice and obscuring the lingula.

Ventral surface.—Ventral abdominal setae 28 long, 61 apart. Thoracic and caudal tracheal folds not evident. Rostrum large and truncate without any setae at base. Antenna normal extending upto base of fore leg. All four pairs of spiracles discernible. Adhesive sacs well developed. Base of legs with peg-like spines; meso- and metathoracic legs with a thin spine at base of each leg.

Host.—*Tephrosia purpurea* (Singh, 1938) and *Commelina* sp. (new record).

Distribution.—Nagpur (Singh 1938); Badnera (Maharashtra State), Neyveli, Sawyerpuram, Kayaramabedu (Madras) and Thimbam (Tamil Nadu State) (new distribution records).

Material examined.—Nine pupal case, on *Tephrosia purpurea*, Neyveli, 23-1-1967, B. V. David; Twentynine pupal cases, on *Tephrosia purpurea*, Sawyerpuram, 29-7-1969, B. V. David; eight pupal cases, on *Tephrosia purpurea*, Badnera, (Maharashtra), 30-8-1969, B. V. David; twentytwo pupal cases, on stem of *Commelina* sp., Thimbam (Coimbatore district), 2000 feet, 10-8-1971, B. V. David.

Collections in the Systematic Entomology Laboratory, United States Department of Agriculture, Washington D. C. Pupal cases on dry leaves in collection.

DISCUSSION

Our meagre knowledge of the family Aleyrodidae an economically important group of insects, as evident from the literature appears to be due to paucity of sufficient morphological characteristic features of all the postembryonic stages. This also restricts to a great extent the accurate definition of the various taxa. The scarcity of positively associated stages with the adults of both sexes and the remarkably little variation shown by the adults of very few species studied, have naturally led to the recognition of the so-called pupal cases, the exuviae of the fourth instar nymphs, in the matter of generic and specific classification of the aleyrodids—a rather unusual procedure in the taxonomic study of these insects. This stage is the one most often collected and known for the majority of world species and also possesses a multitude of diagnostic features than any other stage.

This insufficient knowledge of this group in this country is evident from the fact that eventhough taxonomic studies on this group have been commenced as early as 1903, only 23 genera and 62 species were known upto 1958. As such, judged by the limitations of the scope of this work the present investigations have contributed substantially to

the taxonomic study of this group in as much as 30 new species have been added, including in it a new genus and five genera reported for the first time in this country and three species newly recorded in India. The genera *Lipaleyrodes* hitherto known from Madagascar and Malaya, *Neopealius* from Japan, *Aleurocybotus* and *Zaphanera* from Ceylon and *Asterochiton* from New Zealand form important additions to the aleyrodids of India. The record of the cosmopolitan species *Trialeurodes vaporariorum* (Westwood). *Pealius schimae* Takahashi from North Borneo and *Aleurotrachelus multipapillus* Singh from Burma and *Bemisia hancocki* Corbett from Western Africa in South India is another addition.

The present investigations have also brought to light the following three new combinations of Singh's species:

Dialeurodes spina Singh = *Pealius spina* (Singh)

Aleurothrixus indicus Singh = *Taiwanaleyrodes indicus* (Singh)

Aleuroputeus publicus Singh = *Zaphanera publicus* (Singh)

In this connection it may be added that the genera *Aleuroguteus* and *Aleurothrixus* are not represented in India.

Some of the economically important cosmopolitan species—the citrus blackfly *Aleurocanthus woglumi* Ashby, the cotton whitefly *Bemisia tabaci* (Gennadius), the jasmine whitefly *Dialeurodes kirkaldyi* (Kotinsky), the sugarcane whitefly *Neomaskellia bergii* (Signoret) and the greenhouse whitefly *Trialeurodes vaporariorum* (Westwood) have been known to have a wide range of hosts (Russell, 1963), and the last species in particular has been noticed to infest *Solanum tuberosum* (potato) in the Nilgiris in this country. Hence the recording of this economically important species for the first time appears to be of significance.

The identity of the pomegranate whitefly, earlier placed by Singh (1931) in *Siphoninus finitimus* has now been confirmed as *Siphoninus phillyreae* (Haliday), known commonly as the Phillyrea whitefly elsewhere.

Another important observation relates to the castor whitefly hitherto frequently reported as *Trialeurodes ricini* (Misra). However, detailed examination of very large populations has brought to light the coexistence of two closely allied species *T. rara* Singh and *T. ricini* (Misra), the former being more predominant. This is again confirmed by observations on the occurrence of the two species together on *Anona glabra* and *Gossypium hirsutum*, *T. rara* Singh being predominant. In as much as these two forms appear to coexist on leaves of the same host plant, the possible conclusion regarding their structural similarity in many respects especially in the arrangement of conical spines at the base of legs, cannot be overlooked. Differences in the size and arrangement of submarginal papillae and presence or absence of subdorsal papillae [equal sized and arranged in a regular row in *T. ricini* (Misra) and variously sized and arranged irregularly in *T. rara* Singh; absence of subdorsal papillae in the former and presence in the latter] defy attempts at synonymising *T. rara* Singh with *T. ricini* (Misra) and it remains to be demonstrated experimentally as was established for *Bemisia tabaci* (Gennadius) by Mound (1963). Further in view of *T. rara* Singh agreeing in all respects with *T. desmodii* Corbett, the synonymy of the latter with *T. rara* Singh remains to be confirmed.

The aleyrodids *Lipaleyrodes crossandrae* sp. nov. on the flowering shrub *Crossandra undulaefolia*, and *Neapeolius nilgiriensis* sp. nov. on *Azalea indica* also appear to be interesting additions to the list of economically important aleyrodids.

Host correlated variation.—Interesting data have been gathered in the present studies as regards host correlated variation in aleyrodids and the discovery of host correlated variation appears to be an important contribution to our knowledge of this group in this country particularly because this relates to the ability of some species to develop on particular types of leaves leading to the development of plasticity of the species concerned as a direct reaction to the change of immediate environment as revealed by studies on (a) *Bemisia tabaci* (Gennadius) on *Aristolochia labiosa*, *Gauzuma tomentosa* and *Oryza sativa*; (b) *Trialeurodes rara* Singh on *Aristolochia labiosa*, *Bauhinia* sp., *Dolichoslab-lab*, *Gossyium hirsutum*, *Phyllanthus acidus* and *Ricinus communis*; (c) *Dialeurodes bassiae* sp. nov. on *Bassia longifolia*; and (d) *Pealius indicus* sp. nov. on *Ficus bengalensis*. Results presented herein show that the pupal cases developing on hairy leaves are comparatively smaller in size with deeply indented margin, more number of subdorsal papillae and elongated dorsal setae as against large sized pupal case with smooth margin, less number of subdorsal papillae and very short dorsal setae which confirm the views of earlier workers. Mention may be made of variations correlated with the structure of the host leaf by Russell (1948) in *Trialeurodes vaporariorum* (Westwood). Several species of *Bemisia* were sunk in *B. tabaci* (Gennadius) for the same reason by Russell (1957) and more recently Mound (1963) has also synonymised several African species of *Bemisia* with *B. tabaci* (Gennadius). This naturally reveals that in order to reach the nature of species stability, an understanding of structural variations in response to change of host appears necessary. The observation that aleyrodids infesting both sides of leaves show no structural variations of significance and the development of striking differences in species normally inhabiting the lower surface of leaves moving to the upper side as in *Dialeurodes bassiae* sp. nov. and *Pealius indicus* sp. nov. is interesting.

Association with other insects.—The occurrence of aleyrodids along with members of the same group as also with members of other groups of insects are on record. Rao (1958) mentions of association of *Dialeurodes ixorae* Singh with *Rhachisphora trilobitoides* (Q. & B.). Singh (1931) makes reference to association of different species of ants with *Neomaskellia bergii* (Signoret) and *Rhachisphora trilobitoides* (Q. & B.). Quaintance and Baker (1917) have recorded *Aleurocanthus citricolus* (Newstead) and the scale insect *Aonidiella aurantii* (Maskell) on citrus.

In the present study also interesting association of aleyrodids with other insects has been observed. *Aleurotrachelus caerulescens* Singh is found with the thrips *Rhipiphorothrips cruentatus* Hood on rose, and *Neomaskellia bergii* (Signoret) with black ant on *Cenchrus ciliaris*, *Saccharum officinarum* and *Sorghum vulgare*. *Dialeuroloonga fici* sp. nov. occurs along with the scale *Icerya* sp. (Plate III) on *Ficus religiosa*. *Dialeuropora decempuncta* (Q. & B.) and the scale *Aonidiella* sp. occur together on *Streblus asper*. Interesting inter-specific aleyrodid associations have been observed in a few species. *Bemisia tabaci* (Gennadius) has been noticed

to be in association with *Lipaleyrodes crossandrae* sp. nov. on *Achyranthes aspera*, while it is found with *Trialeurodes rara* Singh on *Aristolochia labiosa*. The associations of *Dialeurodes bassiae* sp. nov. with *Aleurolobus moundi* sp. nov. on *Bassia* spp., and *Dialeurodes kirkaldyi* (Kotinsky) with *Bemisia jasminum* sp. nov. on jasmine are interesting. Similarly, *Dialeuropora decempuncta* Q. & B. has been found in association with *Aleurocanthus loyolae* sp. nov. on *Streblus asper* and with *Aleurocanthus rugosa* Singh on *Anona* sp. On *Polyalthia longifolia* and *P. pendula* it is found with *Aleuroplatus alcocki* (Peal) and *Aleurocanthus rugosa* Singh and on *Cordia myxa* with *Aleurotuberculatus takahashii* sp. nov. and *Asterochiton cordiae* sp. nov. The associations of *Dialeuropora pterolobiae* sp. nov. with *Aleuromarginatus kallarensis* sp. nov. on *Pterolobium indicum*, and *Zaphanera publicus* (Singh) with *Bemisia hancocki* Corbett on *Tephrosia purpurea* are also interesting. In aleyrodid taxonomy, as it is customary to preserve leaves with pupal cases, information on the occurrence of two or more species together on the same leaf would be of much significance.

SUMMARY

1. A study of the some Indian Aleyrodids in the background of a review of literature is presented taking into account the conventional classificatory system and the economic importance of this group of insects.
2. A total of sixty species representing 24 genera is dealt with. Of these, 30 species are described as new to science and 4 species as new records to India. Of the genera recorded, one is described as new and five as generic records new to this country.
3. Keys are provided for the genera and species of Indian Aleyrodidae.
4. Information on host correlated intraspecific variations is given in this work with reference to the four species, *Bemisia tabaci*, *Trialeurodes rara*, *Dialeurodes bassiae* and *Pealius indicus*. These observations tend to emphasise caution in determining the status of these species.
5. Inter-specific associations within the family of Aleyrodidae as well as with other insects are discussed.
6. A relevant list of references pertaining to this study is annexed.

ACKNOWLEDGEMENTS

The first author wishes to express his sense of gratitude to Dr. A. R. Seshadri, former Professor of Entomology, Agricultural College and Research Institute, Coimbatore for initiating this investigation. Grateful thanks are due to Dr. T. N. Ananthakrishnan for facilities provided for the completion of the work at the Entomology Research Unit, Loyola College, Madras and for critical suggestions in the preparation of the manuscript.

Thanks are also due in no small measure to Dr. (Miss) Louise M. Russell, Systematic Entomologist, Entomology Research Division, United States Department of Agriculture, Washington for confirmation of identification of species and for the gift and loan of literature. To Mr. L. A. Mound of the Department of Entomology, British Museum (Natural History), London we are grateful for confirming the identities

of some species sent to him and also for literature. Thanks are also due to Monsieur F. Cohic, Le Directeur, Adjoint Institut Universitaire D'Ecologie Tropicale, Universite D'Abidjan, Abidjan, Western Africa for his communication on *Acaudaleyrodes* and for literature on African species, and to Dr. L. J. Dumbleton, Department of Scientific and Industrial Research, Christchurch, New Zealand for the reprints sent by him. To Dr. A. P. Kapur, Director, Zoological Survey of India, Calcutta our thanks are due in no small measure for readily obliging with the loan of type materials whenever requested.

The first author is grateful to the Director of Agriculture, Government of Tamil Nadu for permission granted to carry out the work at the Agricultural College and Research Institute, Coimbatore in addition to his normal duties while he was Lecturer in Entomology at the Agricultural College and Research Institute, Coimbatore.

REFERENCES

- AGARWAL, R. A. & SIDDIQI, Z. A. 1964. Sugarcane Pests. *Entomology in India*, 149-186, *Entomological Society of India publn.*
- AVIDOV, Z. 1956. Bionomics of the tobacco whitefly, *Bemisia tabaci* Gennad in Israel, *Ktavim* 7(1): 25-41.
- AYYAR, T V R. 1923. Short notes on some south Indian insects. Whiteflies. *Rept. Proc. 5th Entl. mtg.*: 263-269.
- AYYAR, T V R. 1940. *Handbook of Economic Entomology for South India*. Superintendent, Government Press, Madras : 311.
- BAKER, J. M. 1937. Notes on some Mexican Aleyrodidae. *Ann. Inst. Biol. Mex.* 8: 599-629.
- BASHEER, M. 1956. Note on the whitefly (*Aleurolobus barodensis* Mask.) and its control in the Madras State. *Madras agric. J.* 43: 117-120.
- BEMIS, F E. 1904. The Aleyrodids or Mealy winged flies of California. *Proc. U. S. nat. Mus.*, 27: 471-537.
- BENNETT, F D. & L. W. VAN WHERVIN 1965. The occurrence of *Aleurocanthus woglumi* Ashby in Barbados and the establishment of its natural enemies. *F.A.O. Plant Protection Bull.* Vol. 13, No. 4.
- BONDAR, G. 1923. Alleyrodideos do Brasil. *Publ. Secret. Agric., Industr. Obr. Publ. Est. Bahia, Sec. Pathol. Veg.*, 1-182.
- BUCKTON, G. B. 1903. Description of a new species of Aleurodes destructive to betel. *Indian Mus. Notes*, 5(2): 36.
- BURMEISTER, H. 1835. *Handb. der Entom.*, 2: 82.
- BUTLER, C. G. 1938a. On the ecology of *Aleurodes brassicae* Walk. (Hemiptera). *Trans. R. ent. Soc. Lond.*, 87(15): 291-311.
- BUTLER, C. G. 1938b. A further contribution to the ecology of *Aleurodes brassicae* Walk. (Hemiptera). *Proc. R. ent. Soc., Lond. (A)*, 13: 161-172.
- CHOU, I. 1949. Listo de la konotaj Aleurodoj Homopteroj en Cinio. *Ent. sinica. Shensi*, 3: 1-17.
- COCKERELL, T D. A. 1902. List of species. *Proc. Aad. nat. Sci. Philad.* 54: 279-282.

- COHIC, F. 1959a. Contribution a l'etude des Aleurodes de Nouvelle—Caledonie (Hom.). *Bull. Soc. ent. Fr.* **64**: 130-136.
- COHIC, F. 1959b. Aleyrodidae actuellement connus de Nouvelle—Caledonie et Dependances. *L'Agronomie Tropicale*, **14**(2): 242-243.
- COHIC, F. 1959c. Notes sur les especes neocaledoniennes du genre *Orchamoplatus* Russell (Homoptera Aleyrodidae). *Journal D'Agriculture Tropicale et de Botanique Appliquee*, **6**(10): 494-497.
- COHIC, F. 1966a. Contribution A. L'etude des Aleurodes Africains (1^{re} Note). *Cah. Orstom, Ser. Biol.*, **1**(1): 3-59.
- COHIC, F. 1966b. Contribution A L'etude des Aleurodes Africains. (2^e Note). *Cah. Orstom, ser. Biol.* **1**(2): 13-72.
- COOPER, S. P. 1950. Yellow vein mosaic of Bhindi. *B. tabaci* transmit virus of the disease. *Indian J. agric. Sci.*, **20**: 217.
- COOPER, S. P. & VARMA, P. N. 1948. Yellow mosaic of *Phaseolus lunatus* (Double bean). *Curr. Sci.*, **17**: 152-153.
- CORBETT, G. M. 1926. Contribution towards our knowledge of the Aleyrodidae of Ceylon. *Bull. ent. Res.*, **16**: 267-284.
- CORBETT, G. M. 1927. Three new aleyrodids on coconuts in Malaya. *Malayan Agric. J.*, **15**. 24-25.
- CORBETT, G. M. 1935a. Three new Aleurodids (Hem.) *Stylops* **4**(1): 8-10.
- CORBETT G. M. 1935b. On New Aleurodidae (Hem.) *Ann. Mag. nat. Hist.* (10) **16**: 240-252.
- CORBETT, G. M. 1935c. Malayan Aleurodidae. *J.F.M.S. Mus.*, **17**: 722-852.
- CORBETT, G. M. 1936. New Aleurodidae (Hem.) *Proc. R. ent. Soc. London*, (B) **5**: 18-22.
- CORBETT, G. M. 1939. A new species of Aleyrodidae from India. *Indian F. Ent.*, **1**(3) : 69-74.
- DANZIG, E. M. 1964. Contribution of the knowledge of the whiteflies (Homoptera, Aleyrodidae) of the Caucasus (in Russian) *Ent. Obzr.*, **43**: 633-646.
- DAVID, B. V. 1961. *Effect of weather factors on the occurrence of Aleyrodids in South India*: 61. Dissertation submitted in part fulfilment for the award of M.Sc. (Ag.) degree, Madras University.
- DAVID, B. V. 1963. Effect of weather factors on the host-predators relationship in the aleyrodid, *Siphoninus phillyreae finitimus* Goux on pomegranate. *Madras agric. J.*, **50**(1): 3-21.
- DAVID, B. V. & RADHA, N. V. 1964. The castor whitefly, *Trialeurodes ricini* M. and its control (Abstract). *Madras agric. J.*, **51**(2): 90-91.
- DAVID, S. K. 1958. Insects and mites affecting Jasmine in the Madras State. *Madras agric. J.*, **45**(4): 146-150.
- DESHPANDE, V. G. 1933. On the anatomy of some British Aleurodidae. *Trans. R. ent. Soc. Lond.*, **81**: 117-132.
- DOBREANU, E. & MANOLACHE, C. 1956. Contribution a la connaissance des Aleurodes (Homoptera-Aleyrodinea) de la Republique populaire Roumaine. *Rev. de Biol.*, **1**(2): 119-143.

- DOZIER, H. L. 1927. An undescribed whitefly attacking citrus in Porto Rico. *J. agric. Res.*, **34**(9): 853-855.
- DOZIER, H. L. 1928. Two new Aleyrodid (Citrus) pests from India and the South Pacific. *J. agric. Res.*, **36**(12): 1001-1005.
- DOZIER, H. L. 1934. Descriptions of new genera and species of African Aleyrodidae. *Ann. Mag. nat. Hist.*, (10)**14**: 184-192.
- DREWS, E. A. & SAMPSON, W. W. 1956. *Tetralicia* and a new related genus, *Aleuropleurocelus* (Homoptera: Aleyrodidae). *Ann. ent. Soc. America*, **49**(3): 280-283.
- DREWS, E. A. & SAMPSON, W. W. 1958. California Aleyrodids of the genus *Aleuropleurocelus*. *Ann. ent. Soc. America*, **51**(2): 120-125.
- DUMBLETON, L. J. 1953. A note on *Aleuroplatus* (*Orchamus*) *samoanus* Laing (Hemiptera-Homoptera: Aleyrodidae). *Proc. Hawaii. ent. Soc.*, **15**(1): 21-22.
- DUMBLETON, L. J. 1956a. The Australian Aleyrodidae (Hemiptera-Homoptera). *Proc. Linn. Soc. New South Wales*. Vol. lxxxix, pt. 2 : 159-183.
- DUMBLETON, L. J. 1956b. New Aleyrodidae (Hemiptera: Homoptera) from New Caledonia. *Proc. R. ent. Soc. Lond. (B)*, **25**(7-8): 129-141
- DUMBLETON, L. J. 1957. The New Zealand Aleyrodidae (Hemiptera: Homoptera) *Pacif. Sci.*, **11**: 141-160.
- DUMBLETON, L. J. 1961a. The Aleyrodidae (Hemiptera-Homoptera) of New Caledonia. *Pacif. Sci.*, **15**(1): 114-136.
- DUMBLETON, L. J. 1961b. Aleyrodidae (Hemiptera: Homoptera) from the South Pacific *N.Z. J. Sci.*, **4**: 770-774.
- EDWARDS, W. H. 1932. Importation into Jamaica of a parasite (*Eretmocerus serius* Silv.) of the citrus black fly (*Aleurocanthus woglumi* Ash.) *Entom. Bull. Dep. Agric. Jamaica*, **6**: 12.
- EL KHIDIR, E. 1967. Ecological studies on *Aleyrodes brassicae* Walk. (Homoptera: Aleyrodidae) 1. The development of *Aleyrodes brassicae* in relation to temperature. *Indian J. Ent.*, **29** (2): 189-196.
- ENDERLEIN, G. 1909. Udamoselis eine neue Aleurodiden Gattung. *Zool. Anz.*, **34**: 230-233.
- GIRIDHARI LAL 1958. Whitefly of sugarcane in North Western Uttar Pradesh. *Indian Sugar*, **8**(7): 445-450.
- GOLDING, F. D. 1930. A vector of leaf curl of cotton in Southern Nigeria *Emo. Cotton Gr. Rev.*, **7**: 120-126.
- GOLDING, F. D. 1936. *B. nigeriensis* Corb. a vector of Cassava mosaic in Southern Nigeria. *Trop. Agriculture. Trin.*, **13**: 182-186.
- GOMEZ-MENOR, J. 1943. Contribucion al conocimiento de los Aleyrodidos de Espana (Hemiptera, Homoptera). *Eos, Madr.* **19**: 173-209.
- GOMEZ-MENOR, J. 1954. Aleurodidos de Espana, islas Canarias Y Africa occidental (tercera nota) *Ibid.*, **30**: 363-377.
- GOUX, L. 1949. Contribution a' l' etude des *Aleyrodes* (Hem. Aleyrodoidea) de la France. VI-Le genere *Siphoninus* Silvestri *Bull. Soc. Linn. Lyon.*, **18**: 7-12.

- GOWDEY, C. C. & ASHBY, S. F. 1921. The Citrus blackfly (*Aleurocanthus woglumi* Ashby) with notes on control by fungi. *Entom. Cic. No. 3*. (Dep. Agric. Jamaica).
- GUPTA, B. D. 1938. Ann. Rept. of Sugarcane Research work in U.P. for 1937-38: 59-70.
- GUPTA, B. D. 1939. Ann. Rept. of Sugarcane Research work in U.P. for 1938-39: 62-72.
- GUPTA, B. D. 1953. Resume of work done under the Sugarcane Insect Pests Scheme during 1946-47 to 1950-51: 70.
- GUPTA, B. D. & AVASTHY, P. N. 1955. The scope of modern insecticides in the control of sugarcane pests. *Indian Sug.*, 5(2): 67-94.
- HARGEAVES, E. 1915. The life-history and habits of the Green house whitefly (*Aleyrodes vaporariorum* Westd.). *Ann. appl. Biol.*, 1: 303-334.
- HARRISON, J. W. H. 1920. New and rare British Aleurodidae. *Entomologist*, 53: 255-257.
- HEMPEL, A. 1922. Algumas Especies novas de Hemipteros da Familia Aleyrodidae. *Not. prelim. edit. pela red. da Rev. Mus. Paulista*, 2: 3-10.
- HEMPEL, A. 1923. Hemipteros novos on pouco conhecidos da Familia Aleyrodidae. *Rev. Mus. Paulista*, 13: 1121-1191.
- HUSAIN, M. A. 1930. A preliminary report on the whitefly of cottons in the Punjab. *Agric. J. India* 25: 508-526.
- HUSAIN, M. A. & KHAN, A. W. 1945. The Citrus Aleyrodidae (Homoptera) in the Punjab and their control. *Mem. ent. Soc. India* No. 1: 41.
- HUSAIN, M. A. & TREHAN, K. N. 1933. Observations on the life-history, bionomics and control of the whitefly of cotton (*Bemisia gossypiperda* M. & L.) *Indian J. agric. Sci.*, 3(4): 701-753.
- HUSAIN, M. A. & TREHAN, K. N. 1940. Report on the scheme of investigations on the whitefly of cotton in the Punjab. *Indian J. agric. Sci.*, 10: 101
- HUSAIN, M. A. & TREHAN, K. N. 1942. The nature and extent of damage caused by *Bemisia gossypiperda*, whitefly of cotton in the Punjab. *Ibid.*, 12: 793-831.
- HUSAIN, M. A. & VERMA, P. M. 1936. Studies on *B. gossypiperda* M. & L. III, Seasonal activities of *B. gossypiperda* M. & L. in the Punjab. *Ibid.*, 6(4): 893-903.
- JOHN, V. T. 1957. A Review of Plant Viruses in India. *J. Madras Univ.*, B. 27(2 & 3): 373-450.
- KHAN, M. Q. & KRISHNAMURTUY RAO, B. H. 1956. Factors favouring the incidence and activity of Sugarcane whitefly, (*Aleurolobus barodensis* Mask.) *Indian Sugar*. 6(4): 267-270.
- KHANNA, K. L. 1949. *Ann. Rept. Sugarcane Research Station 1948-49, Pusa, Bihar.*
- KHANNA, K. L., NIGAM, L. N., B. R. SEHGAL & BANDYOPADHYAY, K. S. 1948. Studies in sampling technique. 1. Estimation of whitefly (*Aleurolobus barodensis*) incidence in sugarcane.
- KIRKALDY, G. W. 1907. Systematic, biological and bibliographic catalogue. *Div. Ent. Board of Agric. and For. Hawaii, Bull.* 2: 1-92.

- KIRPATRICK, T. W. 1930. A preliminary note on the leaf crinkle of cotton in the Gazira Area, Sudan. *Bull. ent. Res.*, **21**: 134-136.
- KIRPATRICK, T. W. 1931. Leaf curl of cotton in Sudan. *Ibid.* **22**: 323-363.
- KLIMASZEWSKI, M. S. & SZELEGIEWICZ, H. 1962. Materially do Znajomości maczlikow (Homoptera, Aleyrodidae) Polski. *Fragmenta Faunistica*, **10**(4): 35-46.
- KURIAN, J. 1962. *Studies on the morphology and biology of Trialeurodes ricini Misra (Aleyrodidae, Homoptera)*. Dissertation submitted in part fulfilment for the award of M.Sc. (Ag.) degree, Madras University: 59.
- KUWANA, S. I. 1911. New species from Japan. *Pomona J. Ent.*, **3**(4): 620-627.
- KUWANA, S. I. 1927. On the genus *Bemisia* found in Japan, with description of a new species. *Annotnes Zool. Japan*, **2**: 245-251.
- LATREILLE 1796. *Precis des caracteres generiques des Insectes*: 93.
- LEELA DAVID, A., KALYANARAMAN, V. M., & NARAYANASWAMY, P. S. 1962. Ecology and distribution of the sugarcane whitefly, *Aleurolobus barodensis* M. in Madras State and its control. *Indian J. Sugarcane Res. & Dev.*, **6**(4): 212-216.
- LINNAEUS 1758. *Syst. Nat.*. (ed. 10): 537.
- LLOYD, L. 1922. The control of the greenhouse whitefly (*Asterochiton vaporariorum*) with notes on its biology. *Ann. Appl. Biol.* **9**: 1-32.
- MAHMOOD, S. H. 1955. Morphology and biology of the sugarcane whitefly (*Aleurodes barodensis* Maskell) in India. *Mem. ent. Soc. India*, **4**: 1-34.
- MASKELL, W. M. 1895. Contributions towards on Monograph of the Aleyrodidae. *Trans. New Zealand Inst.*, **28**: 411-449.
- MATHUR, R. N. 1933. Leaf curl in *Zinnia elegans*. *Indian J. agric. Sci.*, **3**: 89-96.
- MATHUR, R. N. 1941. Certain observations on the nitrogen nutrition of the sugarcane plant in relation to susceptibility to attack of whitefly. *Proc. 10th Ann. Conv. Sug. Tech. Assoc. Ind.*: 45-53.:
- MISRA, C. S. 1921. Some Indian Economic Aleyrodidae. *Agric. Res. Inst. Pusa Bull.*, **103**.
- MISRA, C. S. 1923. The Citrus whitefly, *Dialeurodes citri* in India and its parasites, together with the lifehistory of *Aleyrodes ricini* n. sp. *Proc. 5th Ent. Mtg. Pusa*: 129-135.
- MISRA, C. S. & LAMBA, K. S. 1929. The cotton whitefly. *Agric. Res. Inst. Pusa Bull.*, **196**.
- MORRILL, A. W. 1903. Life-history and description of the straw berrys *Aleyrodes*, *Aleyrodes packardi* n. sp. *Canad. Ent.*, **35**: 25-35.
- MORRILL, A. W. & BACK, E. A. 1911. Whitefly injurious to citrus in Florida. *U. S. Dept. Agric. Bur. Ent. Bull.*, **92**.
- MORRILL, A. W. & BACK, E. A. 1912. Natural control of whiteflies in Florida. *Ibid.* **102**.
- MOUND, L. A. 1961. A new genus and four new species of whitefly from ferns (Homoptera, Aleyrodidae). *Rev. Zool. Bot. afr.*, **64**: 127-132.

- MOUND, L. A. 1962a. *Aleurotrachelus jelinekii*(Fraven) (Homoptera, Aleyrodidae), in Southern England. *Entomologist's mon. Mag.* **97**: 196-197.
- MOUND, L. A. 1962b. Studies on the olfaction and colour sensitivity of *Bemisia tabaci* (Genn.) (Homoptera, Aleyrodidae) *Entomologia exp. appl.*, **5**: 99-104.
- MOUND, L. A. 1963. Host-correlated variation in *Bemisia tabaci*(Gennadius) (Homoptera, Aleyrodidae). *Proc. R. ent. Soc. London*, (A) **38**: 171-180.
- MOUND, L. A. 1965a. An introduction to the Aleyrodidae of Western Africa (Homoptera). *Bull. Br. Mus. nat. Hist., Ent.*, **17**(3): 113-160.
- MOUND, L. A. 1965b. The effect of white-fly (*Bemisia tabaci*) on cotton in the Sudan Gezira. *Emo. Cott. Grow. Rev.*, **42**: 290-294.
- MOUND, L. A. 1966. A revision of the British Aleyrodidae (Homoptera: Homoptera). *Bull. Br. Mus. nat. Hist. Ent.*, **17**(9): 399-428.
- MOUND, L. A. 1967. A new species of whitefly (Homoptera: Aleyrodidae) from ferns in British glasshouses. *Proc. R. ent. Soc. Lond.*, (B) **36** (1-2): 30-32.
- NEWSTEAD, R. 1911. On a collection of Coccidae and Aleurodidae, chiefly African, in the collection of the Berlin Zoological Museum. *Mitt. Zool. Mus. Berl.*, **5**: 155-174.
- NEWSTEAD, R. 1921. A new Southern Nigerian *Aleurodes* (Aleyrodidae). *Trans. R. ent. Soc. Lond.*,: 528-529.
- OSSIANNILSSON, F. 1944. A new whitefly from Sweden, *Aleurolobus purihennis* n. sp. Hom. Aleyrodidae). *Kungl. Eysioogr. Sallsk. i Lund Forh.*, *Lund.* **14**: 1-11.
- OSSIANNILSSON, F. 1955. To the knowledge of Swedish white-flies (Hem. Hom. Aleyrodina). *Opusc. ent.*, *Lund*, **20**: 192-199.
- PEAL, H. W. 1903. Contributions towards a monograph of the Oriental Aleyrodidae. Part I. *J. Asiat. Soc. Bengal*, **72**: 61-98.
- PRASAD, V G. 1954. *Neomaskellia bergii* Sign -another whitefly pest of sugarcane in Bihar. *Indian J. ent.*, **16**: 256-260.
- PRIESNER, H. & HOSNY, M. 1932. Contributions to a knowledge of the white-flies (Aleyrodidae) of Egypt I. *Bull. Minist. Agric. Egypt.* No. **121**: 1-8.
- PRIESNER, H. & HOSNY, M. 1934a. Contributions to a knowledge of the whiteflies (Aleyrodidae) of Egypt II. *Ibid.* No. **139**: 1-21.
- PRIESNER, H. & HOSNY, M. 1934b. Contributions to a knowledge of the whiteflies (Aleyrodidae) of Egypt III. *Ibid.* No. **145**: 1-11.
- PRUTHI, H. S. & SAMUEL, C. K. 1937. Entomological investigations on the leaf-curl disease of tobacco in North Bihar. I. Transmission experiments with some suspected insect vectors. II. An alternative host of the virus and the insect transmitter. *Indian J. agric. Sci.*, **7**: 659-670.
- PRUTHI, H. S. & SAMUEL, C. K. 1939. Entomological investigations on the leaf curl disease of tobacco in Northern India. III. The transmission of the whitefly *Bemissia gossypiharda* to tobacco, sunnhemp and a new alternate host of the leaf curl virus. *Ibid.*, **9**: 223-275.

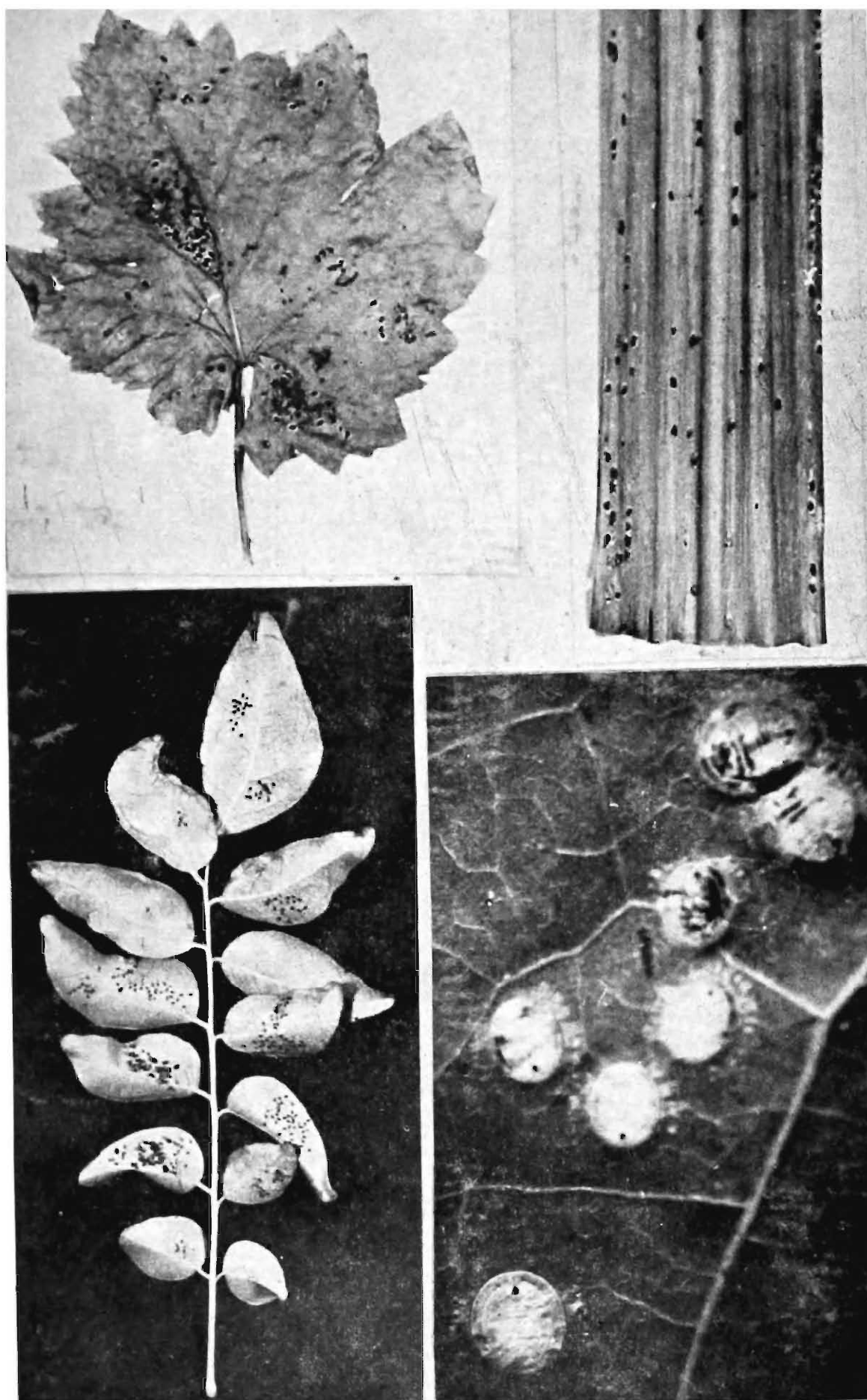
- PRUTHI, H. S. & SAMUEL, G. K. 1941. Entomological investigations on the leaf-curl disease of tobacco in Northern India. IV Transmission of the disease by whitefly (*Bemisia gossypiperda*) from some new alternate hosts. *Ibid*, **11**: 387-409.
- PRUTHI, H. S. & SAMUEL, C. K. 1942. Entomological investigations on the leaf curl disease of tobacco in Northern India. V Biology and population of the whitefly vector (*Bemisia tabaci* Gen.) in relation to the incidence of the disease. *Ibid*, **12**: 35-57.
- QUAINTANCE, A. L. 1900. Contributions toward a monograph of the American Aleurodidae. *U.S. Dept. Agr. Div. Ent. Bull. 8: Tech. Ser.*, 1-64.
- QUAINTANCE, A. L. 1909. The genera of Aleurodidae and list of the species. *Genera Ins.* **87**: 11.
- QUAINTANCE, A. L. & BAKER, A. C. 1913. Classification of the Aleyrodidae, Part I. *U.S. Dept. Agric. Bur. Ent. Tech. Ser.* **27**(1): 1-93.
- QUAINTANCE, A. L. & BAKER, A. C. 1914. Classification of the Aleyrodidae, Part II. *U. S. Dept. Agric. Bur. Ent. Tech. Ser.* **27**(2): 94-109.
- QUAINTANCE, A. L. & BAKER, A. G. 1917. A contribution to our knowledge of the whiteflies of the subfamily Aleyrodinae. *Proc. U. S. nat. Mus.* **51**: 335-445.
- RADHA, N. V. 1971. Efficacy of some synthetic insecticides in the control of the castor whitefly, *Trialeurodes ricini* M. *Madras agric. J.*, **58**(4): 300-302.
- RAKSHPAL, R. 1940a. The morphology of the genitalia in the Aleyrodidae (Homoptera) and their modes of working. *Indian J. Ent.*, **2**: 27-43.
- RAKSHPAL, R. 1940b. Post-embryonic development of the respiratory system of *Dialeurodes eugeniae* Maskell (Homoptera, Aleurodidae) together with preliminary observations regarding the mechanism of respiration in the different instars. *J. R. Asiat. Soc. Bengal, Sci.* **6**(1): 1-20.
- RAKSHPAL, R. 1941. On the post-embryonic development of the male genital organs in Aleyrodidae (Homoptera). *Indian J. Ent.* **3**: 1-11.
- RAO, A. S. 1958. Notes on Indian Aleyrodidae with special reference to Hyderabad. *Proc. 10th int. Congr. Ent.* (1956). **1**: 331-336.
- RAO, RAGHAVA, N. & RAO, B. H. K. 1962. Final report of the Scheme for Biology and Control of whiteflies, Rajendranagar for the period 8-2-1960 to 31-3-1962, Andhra Pradesh. *Dept. Agric., Andhra Pradesh, Hyderabad*: 20.
- REAUMUR 1734. *Memoires sur les Insectes* **2**(25): 302-317.
- ROONWAL, M. L. 1936. Sexual dimorphism and post-embryonic growth in *Dialeurodes dissimilis* Quaint. and Baker (Homoptera, Aleurodidae). *Proc. natn. Acad. Sci. India* **6**: 197-203.
- RUSSELL, L. M. 1943. A new genus and four new species of whiteflies from the West Indies (Homoptera, Aleyrodidae). *Proc. ent. Soc. Wash.* **45**(6): 131-141.
- RUSSELL, L. M. 1947. A classification of the whiteflies of the new Tribe Trialeurodini (Homoptera: Aleyrodidae). *Rev. de Entomologia*, **18**(1-2): 1-44,

- RUSSEL, L. M. 1948. The North American species of whiteflies of the Genus *Trialeurodes* Misc. Publs. U.S. Dep. Agric. **635**, 85.
- RUSSEL, L. M. 1957. Synonyms of *Bemisia tabaci* (Gennadius) (Homoptera, Aleyrodidae). *Bull. Brooklyn ent. Soc.* **111**: 122-123.
- RUSSEL, L. M. 1959. New name combinations in a list of the species of *Dialleuropora* Quaintance and Baker. *Proc. ent. Soc. Wash.* **61**(4): 185-186.
- RUSSEL, L. M. 1960. A taxonomic study of the genus *Corbettia* Dozier (Homoptera, Aleyrodidae). *Rev. Zool. Bot. Afri.*, **LXII**, (1-2): 120-137.
- RUSSEL, L. M. 1962. New name combinations and notes on some African and Asian species of Aleyrodidae (Homoptera). *Bull. Brooklyn ent. Soc.* **LVII**: 63-65.
- RUSSEL, L. M. 1963. Hosts and distributions of five species of *Trialeurodes* (Homoptera, Aleyrodidae). *Ann. ent. Soc. Am.* **56**: 149-153.
- SAMPSON, W. W. 1943. A Generic synopsis of the Hemipterous Superfamily Aleyrodoidea. *Ent.* **23** (new series) (3): 173-223.
- SAMPSON, W. W. 1944. Additions to the Aleyrodidae of Mexico (Hem. Hom.). *An. Esc. Nac. de Cien. Biol.* **3**: 437-444.
- SAMPSON, W. W. 1945. Five new species of Aleyrodidae from California (Homoptera). *Pan-Pacific Entomologist* **21**(2): 58-62.
- SAMPSON, W. W. 1947. Additions and corrections to "A Generic synopsis of the Aleyrodoidea" *Bull. Brooklyn Ent. Soc.* **XLII**(2): 45-50.
- SAMPSON, W. W. & DREWS, E. A. 1940. *Gymnaleurodes*, a new genus of Aleyrodidae from California. *Pan-Pacific Entomologist* **16**(1): 2-30.
- SAMPSON, W. W. & DREWS, E. A. 1941. A Review of the Aleyrodidae of Mexico. *An. Esc. Nac. de Cien. Biol.*, **2**: 143-189.
- SAMPSON, W. W. & DREWS, E. A. 1956. Key to the Genera of the Aleyrodidae and notes on certain Genera (Homoptera: Aleyrodinae). *Ann. Mag. nat. Hist. Ser.*, 12, **9**: 689-697.
- SAMUEL, C. K. 1950. Parasites and predatism of the whitefly (*Bemisia tabaci* Gen.). Vector of tobacco leaf curl in Northern India. *Indian J. Ent.*, **12**: 248-250.
- SCHRADER, F. 1920. Sex determination in the whitefly (*Trialeurodes vaporariorum*). *J. Morph.*, **34**: 267-305.
- SCHRADER, F. 1926. Notes on the English and American races of the greenhouse whitefly (*Trialeurodes vaporariorum*). *Ann. Appl. Biol.*, **13**: 189-196.
- SIGNORET. 1868. *Ann. Soc. Ent. France*, **8**: 369-402.
- SILVESTRI, F. 1914. A new genus and species from Italy. *Boll. Lab. Portici* **9**: 247.
- SILVESTRI F. 1915. Contributo alla Conoscenza degli Insetti dell'olivo dell' Eritrea e dell' Africa meridional. *Boll. Lab. Zool. Portici*, **9**: 240-334.
- SINGH, KARAM 1931. A contribution toward our knowledge of the Aleyrodidae (whiteflies of India). *Mem. Dept. Agric. India, Ent. Ser.*, **12**: 1-98.

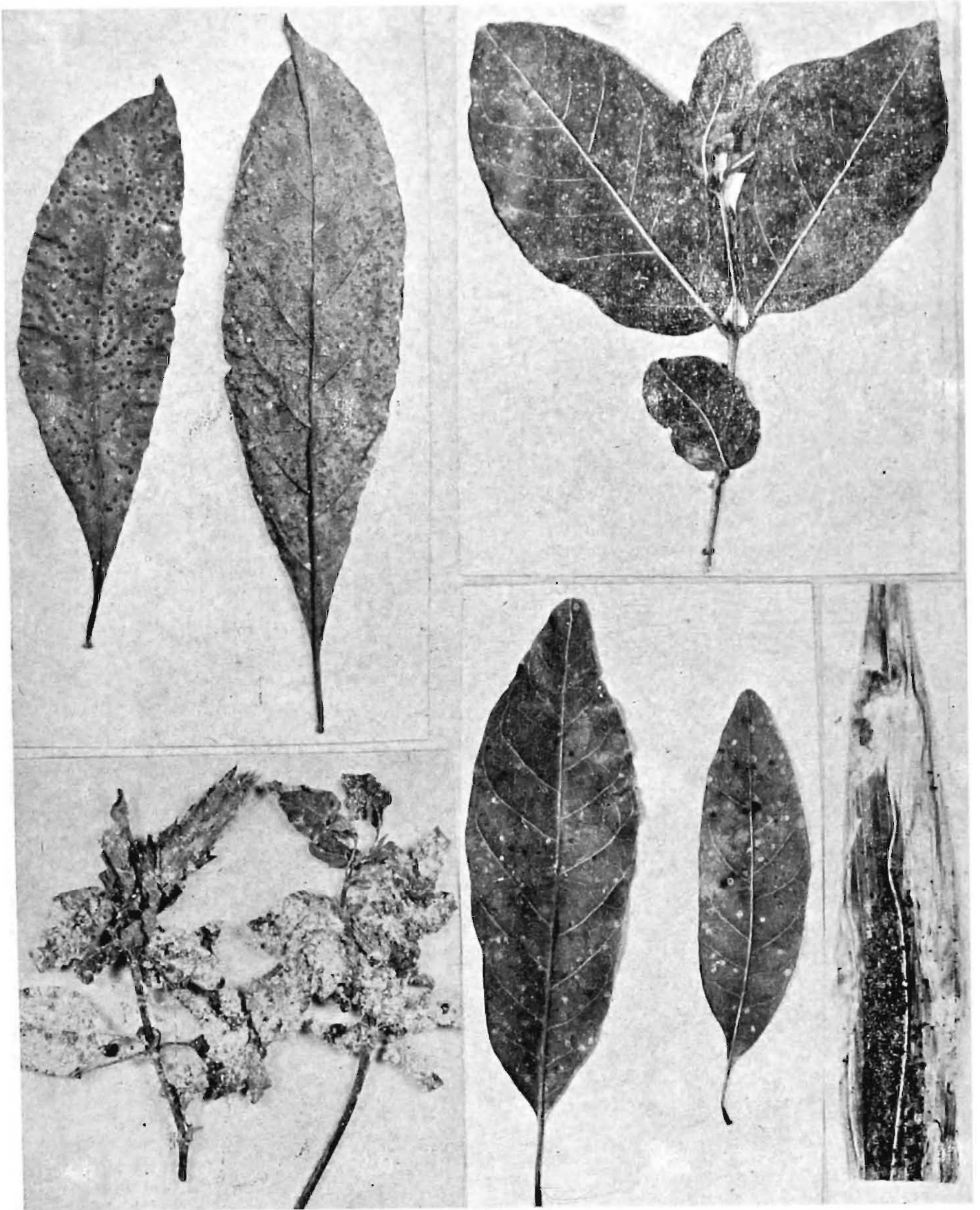
- SINGH, KARAM 1932. On some Rhynchota of the family Aleyrodidae from Burma. *Rec. Indian. Mus.*, **34**: 81-88.
- SINGH, KARAM 1933. On four new Rhynchota of the family Aleurodidae from Burma. *Ibid.* **35**: 343-346.
- SINGH, KARAM 1936. The antennae of Aleyrodidae. *Curr. Sci.*, **5**: 304.
- SINGH, KARAM 1938. Notes on Aleurodidae (Rhynchota) from India I. *Rec. Indian. Mus.*, **XL**: 189-192.
- SINGH, KARAM 1940. Notes on Aleurodidae (Rhynchota) from India II. *Ibid.* **42**: 453-456.
- SINGH, KARAM 1943. The external genitalia of Aleyrodidae. *Curr. Sci.* **12**(5): 160.
- SINGH, KARAM 1944. Notes on Aleurodidae from India III. *Indian J. Ent.*, **6**: 75-78.
- SINGH, KARAM 1948. The vasiform orifice of larval Aleyrodidae. *Curr. Sci.*, **17**(7): 220.
- SINGH, KARAM 1955. The vasiform orifice of Aleyrodidae. *Ibid.* **24**(4): 128-129.
- SMITH, H. D., MALTBY, H. L. & JIMENEZ, E. 1964. Biological control of the citrus black fly. *Tech. Bull. U.S. Dept. Agric. no.* **1311**: 30.
- STOLL, N. R. & SHULL, A. F. 1919. Sex determination in the whitefly. *Genetics* **4**: 251-260.
- SUNDARA BABU, P. C. 1971. A note on the occurrence of the aleyrodid, *Aleyrodes schizoukinensis* on Star goose-berry *Phyllanthus acidus* and its control. *Madras agric. J.*, **58**: 413-414.
- TAKAHASHI, R. 1932. The Aleyrodidae of Formosa I. *Formosa Govt. Res. Inst. Dept. Agr. Rept.*, **59**: 1-57.
- TAKAHASHI, R. 1933. The Aleyrodidae of Formosa II. *Ibid.* **60**: 1-24.
- TAKAHASHI, R. 1934a. The Aleyrodidae of Formosa III. *Ibid.* **63**: 39-71.
- TAKAHASHI, R. 1934b. Notes on the Aleyrodidae of Japan I. *Kontyu*, **8**: 223-224.
- TAKAHASHI, R. 1935a. The Aleyrodidae of Formosa IV *Formosa Govt. Res. Inst. Dept. Agr. Rept.*, **66**: 39-65.
- TAKAHASHI, R. 1935b. Notes on the Aleyrodidae of Japan II. *Kontyu*, **9**: 25-27.
- TAKAHASHI, R. 1935c. Notes on Aleyrodidae of Japan (Homoptera) III *Ibid.* **9**: 279-283.
- TAKAHASHI, R. 1936. Some Aleyrodidae, Aphididae, Coccidae (Homoptera), and Thysanoptera from Micronesia. *Tentheredo*, **1**(2): 109-114.
- TAKAHASHI, R. 1937. A new species of Aleyrodidae from New Zealand (Hemiptera). *Trans. nat. Hist. Soc. Formosa*, **27**(170): 251-253.
- TAKAHASHI, R. 1938a. Notes on the Aleyrodidae of Japan (Homoptera) VI. *Kontyu*, **12**(2): 70-74.
- TAKAHASHI, R. 1938b. A new genus and species of Aleyrodidae from the Island of Reunion (Homoptera). *Trans. nat. Hist. Soc. Formosa*, **28** (179): 269-271.

- TAKAHASHI, R. 1939. Some Aleyrodidae from Mauritius. *Insecta Matsum*, **14**(1): 1-5.
- TAKAHASHI, R. 1942a. *Aleurocanthus* of Thailand and French Indo-China (Aleyrodidae, Homoptera). *Kontyu*, **16**(2): 57-61.
- TAKAHASHI, R. 1942b. Two new genera and species of Aleyrodidae from Thailand and French Indo-China (Homoptera). *Annotnes Zool. Japan*, **21**(2): 102-105.
- TAKAHASHI, R. 1943. *Trialeurodes* of Thailand (Aleyrodidae) Homoptera). *Mushi*, **15**: 28-32.
- TAKAHASHI, R. 1946. *Aleurolobus* of Japan (Aleyrodidae, Homoptera). *Kontyu*, **20**: 49-54.
- TAKAHASHI, R. 1949a. *Bemisia* and *Acanthobemisia* of Japan (Aleyrodidae, Homoptera). *Kontyu*, **23**: 1-5.
- TAKAHASHI, R. 1949b. Some Aleyrodidae from the Riouw Islands (Homoptera). *Mushi*, **20**: 47-53.
- TAKAHASHI, R. 1950. Four new species of Aleyrodidae (Homoptera) from Australia, India and Borneo. *Annotnes Zool. Japan*, **23**(2): 85-88.
- TAKAHASHI, R. 1951a. Some species of Aleyrodidae (Homoptera) from Madagascar with a species from Mauritius. *Mem. Inst. scient. Madagascar*, **6**(A): 353-385.
- TAKAHASHI, R. 1951b. Descriptions of six interesting species of Aleyrodidae from Malaya (Homoptera). *Kontyu*, **19**(1): 1-8.
- TAKAHASHI, R. 1952a. Some Malayan species of Aleyrodidae (Homoptera). *Mushi* **24**: 21-27.
- TAKAHASHI, R. 1952b. Some species of Aleyrodidae from Madagascar. *Tananarive*, (E) **1**: 111-133.
- TAKAHASHI, R. 1952c. *Aleurotuberculatus* and *Parabemisia* of Japan (Aleyrodidae, Homoptera). *Misc. Rep. Res. Inst. nat. Resour.*, **25**: 17-24.
- TAKAHASHI, R. 1954. Key to the tribes and Genera of Aleyrodidae of Japan, with descriptions of three new genera and one new species (Homoptera). *Insecta Matsum.*, **18**(3-4): 48-53.
- TAKAHASHI, R. 1955a. Some species of Aleyrodidae from Madagascar. III. (Homoptera). *Mem. Inst. scient. Madagascar*, **6** E : 375-441.
- TAKAHASHI, R. 1955b. *Odontaleyrodes* and *Pealius* of Japan (Aleyrodidae, Homoptera). *Mushi*, **29**(3): 9-16.
- TAKAHASHI, R. 1956. Insects of Micronesia. Homoptera: Aleyrodidae. *Insects of Micronesia*, **6**(1): 1-13.
- TAKAHASHI, R. 1957. Some Aleyrodidae from Japan (Homoptera). *Insecta Matsum*, **21**(1-2): 12-21.
- TAKAHASHI, R. 1960. *Aleyrodes*, *Tuberleyrodes* and *Dialeurodes* from Japan (Aleyrodidae, Homoptera). *Mushi*, **31**: 63-68.
- TAKAHASHI, R. 1961. Some species of Aleyrodidae from Madagascar. IV *Mem. Institut scient. Madagascar, Serie. E*, **12**: 323-339.
- TAKAHASHI, R. 1962. Two new genera and species of Aleyrodidae from Madagascar (Homoptera). *Proc. R. ent. Soc. London (B)* **31**: 100-102.

- TAKAHASHI, R. 1963. Some species of Aleyrodidae from Japan (Homoptera). *Kontyu*, **31**: 49-57.
- TAKAHASHI, R. & MAMET, R. 1952. Some species of Aleyrodidae from Madagascar. *Mem. Inst. scient. Mddagascar*, **6 E**: 111-133.
- THOMSEN, M. 1925. Sex determination in *Trialeurodes vaporariorum*. *Nature (London)*, **116**: 428.
- THOMSEN, M. 1927. Studien uber die parthenogenese bei einigen cocciden und Aleurodiden. *Ztschr. f. Zellforsch. u. Mikros. Anat.*, **5**: 1-116.
- TREHAN, K. N. 1938. Two new species of Aleurodidae found on ferns in Greenhouses in Britain (Hemiptera). *Proc. R. ent. Soc. Lond.(B)* **7(9)**: 182-189.
- TREHAN, K. N. 1939. A note on the seasonal colour variations in a British whitefly, *Aleurodes lonicerae* Walk. *Indian J. Ent.* **1(3)**: 71-76.
- TREHAN, K. N. 1940. Studies on the British whiteflies (Homoptera, Aleyrodidae). *Trans. R. ent. Soc. Lond.*, **90**: 573-625.
- UPPAL, B. N., VARMA, P. M. & CAPOOR, S. C. 1940. Yellow mosaic of Bhandi. *Curr. Sci.*, **9**: 227.
- USAMAN, S. & PUTTARUDRAIAH, M. 1955. A list of the insects of Mysore including the mites. *Dept. Agric. Ent. Ser. Bull.*, **16**: 1-194.
- WESTWOOD 1840. *Modern classification of Insects*, **2**: 442.
- WHERVIN, VAN WALTER 1968. The introduction of *Prospaltella opulenta* Silvestri into Jamaica and its competitive displacement of *Eretmoceris serius* Silvestri. *PANS*, **14(4)**: 456-464.
- WILLIAMS, C. B. 1917. Some problems of sex ratios and parthenogenesis. *J. Genet.*, **6**: 255-267.
- WOGLUM, R. S. 1913. Report of a trip to India and the Orient in search of the natural enemies of the citrus whitefly. *U.S. Dept. Agric. Bur. Ent. Bull. No.* **120**.
- ZAHRADNIK, J. 1956. Tri Nove druhy molice (Aleyrodoidea) pro Ceskoslovenskou zvirnu. *Acta faun. ent. Mus. nat. Praha* **1**: 43-45.
- ZAHRADNIK, J. 1957. Drei fur die osterreichische Fauna neue Aleyrodien—Arten. *Acta faun. ent. Mus. nat., Praha* **2**: 9-11.
- ZAHRADNIK, J. 1961. La redescription d'*Asterobemisia avellanae* (Signoret, 1868) (Homoptera, Aleyrodinea). *Sb. ent. Odd. nar. Mus. Praze* **34(593)**: 433-438.
- ZAHRADNIK, J. 1963. Aleyrodina In *Die Tierwelt Mitteleuropas*, **4**: 10d, 19 Leipzig.



(See figures clockwise) *Aleurocanthus spiniferus* on grape wine; *Aleurolobus barodensis* on sugar cane; *Aleurolobus moundi* on *Bassia* sp.; *Aleurocanthus woglumi* on *Murraya koenigii*.

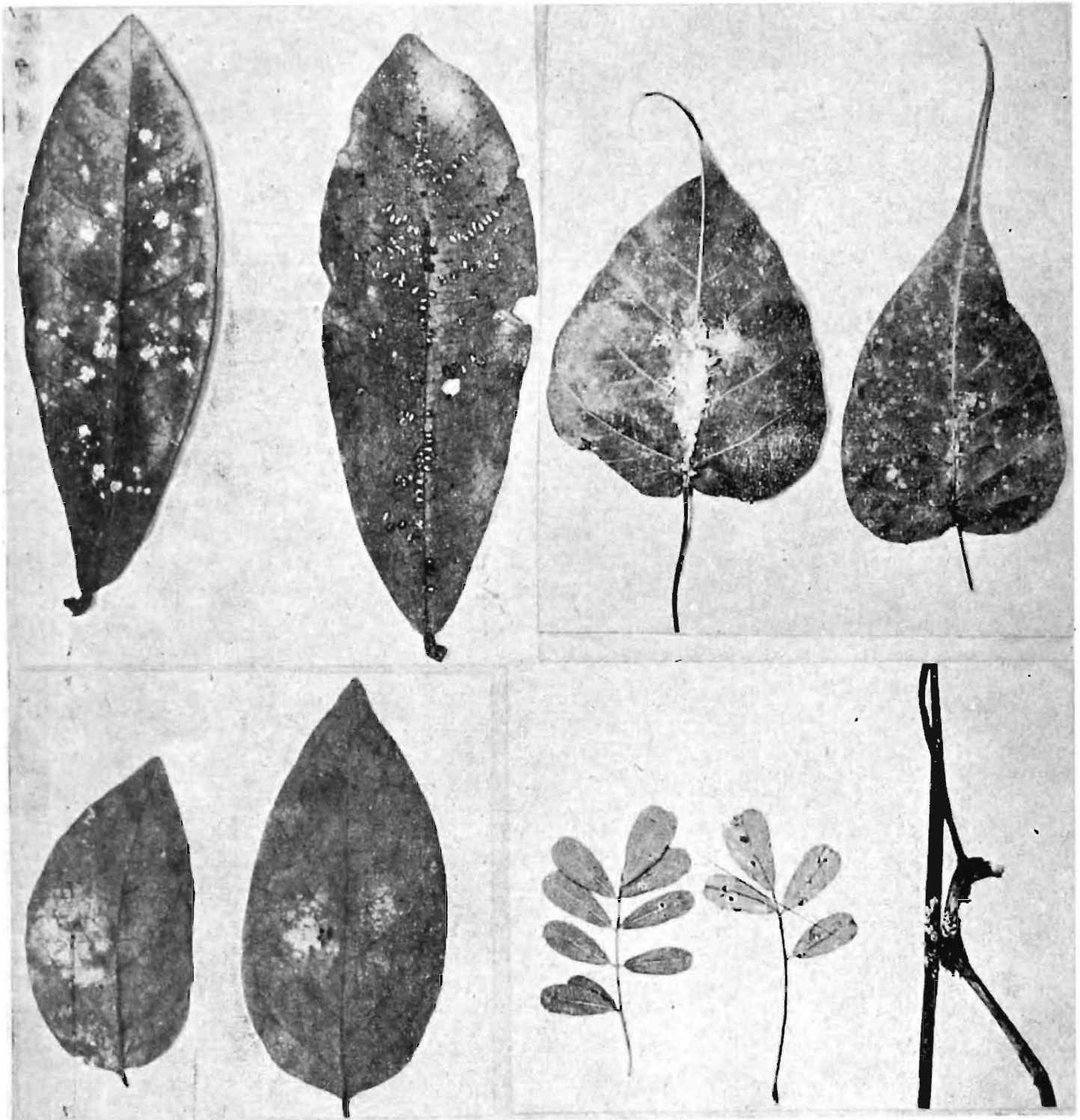


(See figures clockwise) *Indoaleyrodes pustulatus* on *Morinda tinctoria*; *Dialeurodes kirkaldyi* on *Jasminum auriculatum*; *Neomaskellia bergii* on *Sorghum vulgare*; *Dialeurodes bassiae* on *Bassia* sp.; *Lipaleyrodes crossandrae* on *Crossandra undulaefolia*.

Records of the Zoological Survey of India

DAVID AND SUBRAMANIAM

Plate III



(See figures Clockwise) *Dialeurodes ixorae* on the lower surface and *Rhachispora trilobitoides* on the upper surface of an unidentified plant leaf; *Dialeuroloa fici* in association with the scale *Icerya* sp. on *Ficus religiosa*; *Zaphanea publicus* on *Tephrosia purpurea* stem and leaf of *Commelina* sp.; *Trialeurodes rara* on *Phyllanthus acidus*.

LES VENERIDAE INDÉTERMINÉES DAS COLLECTIONS DE CALCUTTA

Par

E. FISCHER-PIETTE

Museum National d'Histoire naturelle de Paris

(With 1 plate)

Thanks the Authorities of the Zoological Survey of India we have had the opportunity of studying the unnamed material of Veneridae from the collections of Calcutta. Here are the results, with data on the distribution around India and description of new species.

Grace a l'amabilité de Autorités du Zoological Survey of India nous avons eu la possibilité d'étudier les Veneridae non-déterminées se trouvant dans les collections de Calcutta. Nous donnons ci-dessous les resultats de cet examen, qui comporte des données sur la distribution de chaque espèce autour de la péninsule indienne et des descriptions d'espèces nouvelles.

Venus reticulata Linné

Venus reticulata, Linné, 1758, ed. X: 687.

Venus N°64 testa. ., Linné, 1764: 503.

Venus reticulata L., Linné, 1767, ed. XII: 1133; Hanley, 1855: 72; Dodge, 1952, 100, art. 1: 105.

Hione reticulata L., Standen et Leicester, 1906, V: 293.

Antigona reticulata L., Fischer-Piette, 1974, 5 (2-3): 269, fig. 1.

Nous jugeons inutile de donner une longue liste de références pour cette espèce bien connue. On trouvera diverses citations et figures mentionnées dans notre travail de 1974, et une liste extrêmement étendue sera publiée dans une monographie des Venerinae que nous allons donner à l'impression.

Le Musée de Calcutta nous a soumis deux lots d'exemplaires récoltés a Tuticorin.

Venus toreuma Gould

Venus toreuma, Gould, 1850, III: 277.

Venus toreuma Gld., Gould, 1852, XII: 419; atlas, 1856, pl. 37, fig. 538, 538a et 538b; Reeve, 1864, XIV, pl. XVI, fig. 64a et 'b; Yokoyama, 1924, 45 (1): 6 et 43, pl. 2, fig. 22; Habe, 1951; 166, fig. 379 et 380 p. 171; Kira, 1955, pl. 56, fig. 15; Kira, 1962: 160, pl. 57, fig. 15; Okutani et takemure, 1967: 181, fig. 1; Fischer-Piette, 1968: 785; Kuroda, Habe et Oyama, 1971: 658 et 428, pl. 93, fig. 11; Fischer-Piette, 1974, 5 (2-3): 268,

Venus jukesi, Deshayes, 1853a, **I**: 100.

Venus sculpta, Deshayes, 1853b: 3.

Venus crebrisulca Lmk., Sowerby (*non* Lamarck), 1853, **II**: 728, pl. 161, fig. 187, 188 et 189.

Venus sculpta Des ., Reeve, 1863, **XIV**, pl. II, fig. 5.

Venus jukesi Des ., Pfeiffer, 1869, ed. II, **XI** (1): 217, pl. **XXXV**, fig. 7 à 9.

Chione toreuma Gld., Melvill et Standen, 1899, **XXVII**: 196.

Venus hawaiiensis, Dall, Bartsch et Rehder, 1938, **153**: 164, pl. 42, fig. 13 à 15.

Ventricolaria toreuma Gld., Rippingale et MacMichel, 1961: 192, pl. 27, fig. 13.

On trouvera une liste de references dans notre travail actuellement a l'impression.

Dans le matériel qui nous a été soumis se trouve une valve (coll. Ray) venant des environs de Krusedai (Tuticorin Survey).

Timoclea cochinensis Sowerby

Venus cochinensis, Sowerby, 1853, **II**: 716, pl. CLVI, fig. 79-80.

Chione cochinensis Sow., Deshayes, 1853a, **I**: 132.

Venus (Chione) cochinchinensis Sow., Römer, 1867, **XIV**: 59.

Timoclea cochinensis Sow., Keen, 1945, **X** (49): 36.

Les provenances des échantillons soumis sont les suivantes: Porto Novo, Tranquebar, Port Cochin (Kerala), Mangalore.

Gafrarium pectinatum Linné

Cette espèce est l'une des plus communes de l'Indo-Pacifique, de sorte qu'elle abonde dans toutes les collections; et c'est une des plus variables qui soient. Il n'est donc pas étonnant qu'elle ait reçu de nombreuses dénominations qui doivent être considérées comme synonymes. La consultation de trois travaux qui ont rassemblé une abondante documentation (455 références dans le dernier d'entre eux) permet de se faire une idée de ce que nous venons de dire, ce sont ceux de Oostingh 1925, de Prashad 1932, et de Fischer-Piette et Vukadinovic 1975. Dans les présentes pages nous n'y ajouterons qu'un choix d'autres références en petit nombre, après avoir donné la liste ci-dessous des diverses dénominations spécifiques employées.

Pectinata Linne 1758; *incrūstata* Born 1778; *divaricata* Chemnitz 1782; *nexilis* Martyn 1784; *aequivoca* Chemnitz 1791; *dispar* Chemnitz 1795; *tumidum* Röding 1798; *angulatum* Röding 1798; *depressum* Röding 1798; *cardiodeum* Röding 1798; *costatum* Röding 1798; *discors* Dillwyn 1817; *numulina* Lamarck 1818; *muscaria* Lamarck 1818; *pulicaris* Lamarck 1818; *mixta* Lamarck 1818; *abbreviata* Lamarck 1818; *gibbia* Lamarck 1818; *ranella* Lamarck 1818; *testudinalis* Lamarck 1818; *cuneata* Lamarck 1818; *placunella* Lamarck 1818; *bufonia* Bory de St. Vincent 1827; *hyla* Bory de St. Vincent 1827; *savignyi* Jonas 1846; *menkei* Jonas 1846; *australis* Sowerby 1851; *transversaria* Deshayes 1853; *marmorata* Reeve 1863; *gibbosa* Fraser 1865; *adunca* Römer 1869; *pythinoides* Tenison-Woods 1878; *barandae* Hidalgo 1885; *catillus* Hedley 1909; *alfredensis* Bartsch 1915.

- Venus pectinata*, Linne, 1758, ed. X: 689.
 ., Savigny, 1809, pl. 8, fig. 17.
- Cytherea abbreviata* Lmk., Delessert, 1841, pl. 9, fig. 1a, b, c, d.
- Cytherea pulicaris* Lmk., Delessert, 1841, pl. 9, fig. 5a, b, c; Chenu, 1847, pl. 12, fig. 2 a, b et fig. 3 a, b.
- Cytherea gibbia* Lmk., Reeve, 1841, I : 94, pl. 70, fig. 5; Chenu, 1847, pl. 12, fig. 6 a-c, 7 a-c, 8 a-c.
- Cytherea muscaria* Lmk., Chenu, 1847, pl. 12, fig. 1a, b.
- Cytherea abbreviata* Lmk., Chenu, 1847, pl. 12, fig. 4a, b.
- Cytherea pectinata* Lmk., Chenu, 1847, pl. 12, fig. 5.
- Cytherea ranella* Lmk., Chenu, 1847, pl. 12, fig. 9 a-c.
- Cytherea divaricata* Lmk., Chenu, 1847, pl. 13, fig. 1 à 3.
- Cytherea testudinalis* Lmk., Chenu, 1847, pl. 13, fig. 4 a, b.
- Circe pectinata* L., Reeve, 1863, XIV, pl. V, fig. 20; Mitchell, 1867: 65; Lamy, 1906: 212; Lamy, 1909, XXII: 346, Lynge, 1909, V (3): 234; Lamy, 1930: 138; Lamy, 1938, XXXVII: 27.
- Circe gibba* Lmk., Reeve, 1863, XIV, pl. VI, fig. 21; Mitchell, 1867: 65.
- Circe aequivoca* Chemn., Reeve, 1863, XIV, pl. VI, fig. 22; Lamy, 1932: 984.
- Circe divaricata* Chemn., Reeve, 1863, XIV, pl. VI, fig. 23; Mitchell, 1867: 65; Melvill et Abercrombie, 1892, ser. 4, VII: 45; Lynge, 1909, V (3): 235.
- Circe dispar* Chemn., Reeve, 1863, XIV, pl. VI, fig. 24; Lynge, 1909, V (3): 235.
- Circe nummulina* Lmk., Reeve, 1863, XIV, pl. VI, fig. 25.
- Circe marmorata*, Reeve, 1863, XIV, pl. VIII, fig. 30.
- Crista pectinata* L., Jousseau, 1888: 208; Lamy et Fischer-Piette, 1938: 82.
- Circe gibbia* Lmk., Lynge, 1909, V (3): 234; Lamy, 1932: 984.
- Gafrarium pectinatum* L., Oosting , 1925, 29 (1): 296; Prashad, 1932: 228; P.-H. et E. Fischer, 1938: 409; Adam et Leloup, 1939, II (20): 81, pl. 5, fig. 2; Satya murti, 1956, N.S., I: 108, pl. 15, fig. 4a et b; Fischer-Piette, 1958, 98: 122; Fischer-Piette, 1968: 785; Fischer-Piette, 1974, 5 (2-3): 277;
- Circe savignyi* Jonas, Lamy, 1931: 306.
- Gafrarium dispar* Dillw., Prashad, 1932: 230.
- Gafrarium tumidum* Rod., Prashad, 1932: 231; Adam et Leloup, 1939: 82, pl. 5, fig. 3; Satyamurti, 1956, N.S., I: 108, pl. 15, fig. 3a et b; Kundu, 1965, 62 (2): 214, pl. XX, fig. 63.
- Gafrarium catillus* Hedl., Prashad, 1932: 233, pl. VI, fig. 15 et 16.
- Circe abbreviata* Lmk., Lamy et Fischer-Piette, 1937: 386.
- Gafrarium mixtum* Lmk., P.-H. et E. Fischer, 1938: 409.
- Gafrarium divaricatum* Gmel., Adam et Leloup, 1939: 82, pl. V, fig. 4.
- Gafrarium divaricatum*, Gravely, 1941, N.S., V (1): 48, fig. 20b.
- Gafrarium divaricatum* Dillw., Ray, 1948, XLVI: 118.
- Gafrarium dispar* Chemn., Satyamurti, 1956, N.S., I: 109, pl. 15, fig. 5a et b.
- Gafrarium divaricata* Chemn., Satyamurti, 1956, N.S., I: 110, pl. 16, fig. 1a et b; Kundu, 1965, 62(2): 214, pl. XIX, fig. 62.
- Gafrarium gibbium* Lmk., Fischer-Piette; 1968: 786.

Les provenances des nombreux échantillons soumis sont situées dans les régions suivantes. Sur la côte est, Waltair, région de Vizagapatam; golfe de Palk; golfe de Manaar. Sur la côte ouest, Cannanore; Kumta; Anjaded Isl.; Karwar; Baima Beach (Goa); St. Mary Island; Bombay.

Sunetta meroe Linné

Chama sunet, Adanson, 1757: 229, pl. 17, fig. 13.

Venus meroë, Linne, 1758, ed. X: 687.

Venus meroë, testa. ., Chemnitz, 1784, **VII**: 55, pl. 43, fig. 450-454.

Cuneus costatus, Megerle von Mühlfeld, 1811: 50.

Meroe picta (M. zigzag), Schumacher, 1817: 149, pl. 14, fig. 3.

Cytherea meroe L., Crouch, 1826: 13, pl. 7, fig. 5.

Meroe meroe L., Gray, 1838, **VIII**: 303.

Meroe picta Schum., Sowerby, 1851, **II**: 609, pl. CXXVI, fig. 1 et 2; Crosse, 1874, 22: 91.

Cuneus meroë L., Deshayes, 1853a, **I**: 41.

Cytherea meroë L., Hanley, 1855: 71.

Meroe picta Schum., Reeve, 1864, **XIV**, pl. II, fig. 5.

Sunetta meroë L., Pfeiffer, 1869, ed. II, XI (1): 78, pl. 21, fig. 3 à 8; Römer, 1870, **II**: 3, pl. 1, fig. 1; Fischer-Piette et P.-H. Fischer, 1939, **83**: 189, pl. VI, fig. 39 et 40; Prashad, 1939, **83**: 46, pl. 2, fig. 1; Fischer-Piette, 1942, **85**: 324, pl. XIV, fig. 11.

Sunetta meroe L., Standen et Leicester, 1906, **V**: 293.

Meroe chilkaensis (*pars*), Preston, 1914, **X**: 304, fig. 13-13a p. 305 (tantum type figure) (teste Prashad 1939).

Venus meroe L., Dodge, 1952, 100, art. 1: 103.

Les échantillons soumis viennent de Chilka; Waltair; Bimlipatam; Porto Novo (Tamil Nadu); Pondichery; Tranquebar.

Sunetta scripta Linné

., Rumphius, 1711, pl. 42, fig. L et M.

Donax scripta, Linné, 1758, ed. X: 683.

Donax scripta L., Linné, 1764: 495; Gmelin, 1791, ed. XIII: 3264; Dodge, 1952, 100, art. 1: 84.

Donax scripta Linnaei, testa. ., Chemnitz, 1782, **VI**: 267, pl. 26, fig. 261 à 263 (*non* 264).

Meroe scripta L., Gray, **VIII**: 303; Sowerby, 1851, **II**: 610, pl. CXXVI, fig. 3 à 8; Hanley, 1855: 62; Reeve, 1864, **XIV**, pl. II, fig. 6; Crosse, 1876, 22: 94.

Cuneus truncatus, Deshayes (*non* Costa), 1853b: 1; Deshayes, 1853a, I: 43.

Cuneus scriptus L., Deshayes, 1853a, I: 44.

Venus abducta, Römer, 1858: 50.

Sunetta concima, Dunker, 1858: 74, pl. 25, fig. 4 à 6.

Meroe truncata Desh., Reeve, 1864, **XIV**, pl. II, fig. 3a, b et c; Crosse, 1874, 22: 94.

Sunetta adelinae, Angas, 1867: 909, pl. 44, fig. 5.

Sunetta scripta L., Pfeiffer, 1869, ed. II, XI (1): 79, pl. 16, fig. 11 à 16; Römer, 1870, **II**: 8, pl. 2, fig. 2a à h; Prashad, 1939, **83**: 46, pl. 2, fig. 2 à 5; Crichton, 1941, **42**: 325; Satyamurti, 1956, **I** (2): 115, pl. 17, fig. 2a et b; Kundu, 1965, **62** (2): 214, pl. XIX, fig. 61.

Sunetta truncata Desh., Römer, 1870, **II**: 10, pl. 3, fig. 1; Hedley, 1918, **LI**, Suppl.: 22.

Meroe adelinae Ang., Crosse, 1874, 22: 95.

Meroë chilkaensis (*pars*), Preston, 1914, **X**: 304 (*fide* Prashad, 1939).

Meroë satparaensis, Preston, 1914, **X**: 305, pl. 12 et 12a.

Sunetta adelinae Ang., Iredale, 1924, **XLIX**: 208.

Sunemeroe adelinae Ang., Iredale, 1930, **XVII**: 395,

Les échantillons soumis viennent de: Suratkal Beach; Vizagapatam; Porto Novo (Tamil Nadu); Tuticorin; Mangalore et St. Mary Island.

***Sunetta donacina* Gmelin**

- , Knorr, 1771, **VI**, pl. 28, fig. 7.
Venus donacina, Gmelin, ed. **XIII**: 3295.
Donax seminuda, Anton, 1837, **III**: 283.
Venus (Cytherea) seminuda Anton, Anton, 1839: 7.
Cytherea seminuda Anton, Philippi, 1846, **II**: 25 = 97, pl. 3, fig. 4.
Cytherea birmanica, Philippi, 1848, **III**: 42 = 74, pl. 9, fig. 8.
Meroe seminuda Phil., Sowerby, 1851, **II**: 610, pl. CXVI, fig. 15; Mitchell, 1867: 65.
Cuneus seminudus Anton, Deshayes, 1853a, **I**: 42.
Cuneus birmanicus Phil., Deshayes, 1853a, **I**: 44.
Meroë seminuda Anton, Reeve, 1864, **XIV**, pl. I, fig. 1a, b, c, d et e.
Sunetta donacina Gmel., Pfeiffer, 1869, ed. II, **XI** (1): 81, pl. 29, fig. 14 et 15; Römer, 1870, **II**: 6, pl. 1, fig. 3a, 3b, 3c; Fischer-Piette et P.-H. Fischer, 1939, **73**: 195, pl. VI, fig. 42 et 43.
Sunetta birmanica Phil., Römer, 1870, **II**: 7, pl. 2, fig. 1.
Sunetta aurora, Jousseaume, 1872, 2 ser., **23**: 9, pl. 2, fig. 7-9.
Meroe roetersiana, Crosse, 1873, **21**: 284.
Meroe seminuda Anton, Crosse, 1874, **22**: 92.
Meroe birmanica Phil., Crosse, **22**: 92.
Meroe aurora Jous., Crosse, **22**: 92.
Meroe roetersiana Crosse, Crosse, 1874, **22**: 93, pl. 3, fig. 7.
Sunetta kurachensis, Sowerby, 1895, **I**: 216, pl. 13, fig. 1.
Sunetta donacina Gmel. var. *birmanica*, Fischer-Piette, 1939, **XI**: 142.
Sunetta donacina Gmel. var. *aurora*, Fischer-Piette, 1939, **XI**: 142.
Sunetta donacina Gmel. var. *nuda*, Fischer-Piette, 1939, **XI**: 143.
Sunetta donacina, Gravely, 1941, N.S., **V** (1): 50.

Les échantillons soumis viennent des localités suivantes: Waltair; Bimlipatam; Mangalore; Bombay.

***Sunetta solanderii* Gray**

- Donax scripta* Linnaei. (*pars*), Chemnitz, 1782, **VI**: 267, pl. 26, fig. 264 (non 261, 262, 263, 265).
Cytherea solanderii Gray, 1825, **IX**: 134.
Venus hians, Wood, Suppl., 1828b: 5, pl. 2, fig. 11.
Meroe solandri Gray, Gray, 1838, **VIII**: 303; Sowerby, 1851, **II**: 611, pl. CXXVI, fig. 10; Sowerby, 1853, **II**: 742, pl. CLXIII, fig. 18 et 19; Mitchell, 1867: 65; Crosse, 1874, **22**: 95; Melvill et Abercrombie, 1892, ser. 4, **VII**: 45.
Cytherea solandri Gray, Hanley, 1843: 109.
Cuneus solandri Gray, Deshayes, 1853a, **I**: 44.
Meroë solandri Gray, Reeve, 1864, **XIV**, pl. III, fig. 10.
Meroë hians, Reeve, 1864, **XIV**, pl. III, fig. 12.
Sunetta solandri Gray, Pfeiffer, 1869, ed. II, **XI** (1): 86, pl. 29, fig. 7 à 9; Römer, 1870, 1870, **II**: 10, pl. 3, fig. 2; Dall, 1902, **XXVI**: 350; Jukes-Browne, 1914, **XI**: 66.
Sunetta tumidissima, Tomlin, 1922, **XVI**: 312.
Sunetta solanderii Gray, Tomlin, 1922, **XVI**: 312.
Sunetta solanderi Gray, Fischer-Piette, 1939: (145; Fischer-Piette, 1939, **83**: 211.

Les échantillons soumis, nombreux, viennent des localités suivantes. Madras; Pondichery; Trivandrum; Port Cochin; Beypore; embouchure de la rivière Korapuzha; environs de Calicut; Mahe; Mangalore; Kumta; Karwar; Goa.

Meretrix meretrix Linne

Cette espèce bien connue a fait l'objet d'innombrables citations qu'il nous paraît inutile de vouloir toutes reproduire ici. Prashad a donné en 1932, in *Lamellibranchia Siboga Exped.*, p. 212-214, une liste considérable à laquelle il y a peu de choses à ajouter pour la période 1705-1928 dont il s'est occupé, E. Fischer Piette et P.-H. Fischer (1941, *J. Conchyl.*, p. 318) ont donné une liste de citations postérieures à Prashad. Nous ne donnerons donc ci-après que des références postérieures à 1941, et sans nous efforcer d'être complets.

Venus lamarckii Gray, Mitchell, 1867: 64.

Meretrix meretrix, Gravely, 1941, N.S., **V** (1): 30.

Venus meretrix Linne, Dodge, 1952, 100, art. 1: 100.

Meretrix lusoria Rod., Kira, 1962: 159, pl. 57, fig. 1; Kuroda, Habe et Oyama, 1971: 647 et 419, pl. 94, fig. 3 a 6.

Meretrix meretrix L., Kundu, 1965, **62** (1): 102, pl. XV, fig. 51; Fischer-Piette, 1968: 786; Fischer-Piette, 1974, **5** (2-3): 281.

Meretrix lamarcki Desh., Kuroda, Habe et Oyama, 1971: 648 et 419, pl. 93, fig. 1.

Les échantillons Ioumis viennent de Chilka, Waltair, Vizagapatam, Kakinada, Madras, Pondichery, Cuddalore, Porto Novo, Tuticorin, Quilon, Etat de Kerala, Bhatkal, Elattur, Mangalore, Kunta, Karwar et Bombay.

Meretrix casta Gmelin

Nous distinguons la forme *Meretrix casta* proprement dite et sa variété *ovum* Hanley.

I. Meretrix casta s.s.

Venus casta. . ., Chemnitz, 1782, **VI**: 349, pl. 33, fig. 346.

Venus casta Chemn., Gmelin, ed. **XIII**: 3278; Wood, 1828a: 36, pl. 7, fig. 46.

Cytherea casta Gmel., Lamarck, 1818, **V**: 573 (563); Sowerby, 1851, **II**: 621, pl. CXXIX fig. 43, 44, 46.

Cytherea casta Lmk., Deshayes, 1835, ed. 2, **VI**: 301; Chenu, 1847, pl. 2, fig. 3-3c.

Cytherea ovum Hanl., Reeve, 1864, **XIV**, pl. VI, fig. 19c.

Meretrix casta Chemn., Römer, 1865, **I**: 31, pl. 12, fig. 2; Melvill et Standen, 1898, **IX**: 82; Preston, 1915, **XI**: 300 (sauf la valve de 67×73 mm qui est *M. meretrix* d'après Hornell, 1917); Hornell, 1917, **XIII**: 166, pl. 5, fig. 22; pl. 6, fig. 34-38.

Meretrix exilis, Römer, 1865, **I**: 35, pl. 10, fig. 3.

Cytherea casta Chemn., Pieffer, 1869, ed. II, **XI** (1): 19, pl. 3, fig. 3.

Meretrix casta Gmel., Fischer-Piette et P. -H. Fischer, 1941, **84**: 338.

Meretrix casta, Gravely, 1941, N.S., **V** (1): 50, fig. 20c.

Les échantillons soumis ont des provenances nombreuses. Chilka, Waltair, Kakinada, Pondichery, Cuddalore, Porto Novo, Tranquebar, Cochin, Beypore, Etat de Kerala, Calicut, Mahe, Elattur, Mangalore, Karwar, Côte de Mysore, St. Mary Island, Goa.

II. *Meretrix casta* var. *ovum* Hanley

- Cytherea ovum*, Hanley, 1842: 21, Suppl., pl. 15, fig. 21.
Cytherea ovum Hanl., Hanley, 1845: 21; Sowerby, 1851, **II**: 621, pl. CXXIX, fig. 45.
Venus (Cytherea) creplini, Dunker, 1852, **IX**: 61 (sans figure).
Meretrix ovum Hanl., Deshayes, 1853a, **I**: 34; Römer, 1866, **I**: 38, pl. XII, fig. 4.
Cytherea ovum Hanl., Reeve, 1864, **XIV**, pl. VI, fig. 19a (non 19c); Mitchell, 1867: 64.
Meretrix creplini Dunk., Römer, 1866, **I**: 39, pl. XII, fig. 3.
Cytherea creplini Dunk., Mitchell, 1867: 64.
Meretrix casta Chemn. var. *ovum* Hanl., Hornell, 1917, **XIII**: 171, pl. 4, fig. 1-4, pl. 5, fig. 23-26, pl. 6, fig. 34-38.
Meretrix casta Gmel., var. *ovum* Hanl., Fischer-Piette et P.-H. Fischer, 1941, **84**: 340.
Meretrix ovum, Gravely, 1941, N.S., V(1): 50.

Cette variété est plus régulièrement ovale et plus allongée que le type, et ses sommets sont moins saillants, sa taille est moindre. Selon Hornell (1917, p. 169), l'élongation serait une conséquence de la desalure, cette variété se trouvant dans les eaux saumâtres de la côte occidentale de l'Inde et de la côte malaise.

Les échantillons soumis ont les provenances suivantes. Etat de Kerala, Elattur, Mangalore (Fish Market), Kunta, Cote de Mysore, Enfin, un lot est marqué de Mergui.

Callista erycina Linné

- Venus erycina*, Linné, 1758, ed. X: 686.
Venus erycina L., Linne, 1767, ed. XII: 1131; Wood, 1828a: 35, pl. 7, fig. 38; Dodge, 1952, **100**, art. 1: 97.
Venus erycina Linnaei, Chemnitz, 1782, **VI**: 334, pl. 32, fig. 337 à 339.
Venus costata, Chemnitz, 1795, **XI**: 226, pl. 202, fig. 1975.
Venus chinensis, Chemnitz, 1795, **XI**: 227, pl. 202, fig. 1976.
Venus pacifica, Dillwyn, 1817, **I**: 175.
 ., Savigny, 1817, pl. 9, fig. I, I₂, I₆.
Cytherea erycina L., Lamarck, 1818, **V**: 574 (564); Sowerby, 1851, **II**: 623, pl. CXXX, fig. 69; Pfeiffer, 1869, ed. II, XI (1): 7, pl. 1, fig. 3.
Cytherea lilacina, Lamarck, 1818, **V**: 574 (564).
Cytherea erycinella, Lamarck, 1818, **V**: 575 (565).
Cytherea pectoralis, Lamarck, 1818, **V**: 575 (565).
Cytherea florida, Lamarck, 1818, **V**: 575 (565).
Venus costata Chemn., Wood, 1828a: 35, pl. 7, fig. 39.
Venus pulchra, Wood, 1828b, suppl.: 6, pl. 2, fig. 16.
Cytherea florida Lmk., Delessert, 1841, pl. 8, fig. 7 a, b, c, d; Chenu, 1847, pl. 5, fig. 7; Philippi, 1847, **II**: 28, pl. V, fig. 4; Sowerby, 1851, **II**: 627, pl. CXXXVI, fig. 193, 195, 196.
Cytherea erycina Lmk., Chenu, 1847, pl. 5, fig. 1 à 4 et fig. 6; et pl. 6, fig. 5.
Cytherea erycinella Lmk., Chenu, 1847, pl. 5, fig. 5; Sowerby, 1851, **II**: 624, pl. CXXXI, fig. 85.

- Cytherea pectoralis* Lmk., Chenu, 1847, pl. 5, fig. 8; Sowerby, 1851, **II**: 625, pl. CXXX, fig. 75.
- Cytherea lilacina* Lmk., Chenu, 1847, pl. 5, fig. 11; Sowerby, 1851, **II**: 626, pl. CXXX, fig. 74; Pfeiffer, 1869, ed. II, **XI** (1): 9, pl. 1, fig. 4, 5.
- Cytherea hagenowi*, Dunker, 1848, **V**: 184.
- Cytherea multiradiata*, Sowerby, 1851, **II**: 623, pl. CXXX, fig. 76.
- Cytherea costata* Chemn., Sowerby, 1851: **II**: 623, pl. CXXX, fig. 70-71; Pfeiffer, 1869, ed. II; **XI** (1): 30, pl. 2, fig. 1.
- Cytherea semisulcata*, Sowerby, 1851, **II**: 624, pl. CXXXI, fig. 82.
- Cytherea pulchra* Gray; Sowerby, 1851, **II**: 624, pl. CXXX, fig. 73.
- Cytherea sinensis*, Sowerby, 1851, **II**: 624, pl. CXXXI, fig. 80-81.
- Cytherea spathulata*, Sowerby, 1851, **II**: 625, pl. CXXXI, fig. 78-79.
- Cytherea festiva*, Sowerby, 1851, **II**: 625, pl. CXXX, fig. 72.
- Dione festiva* Sow., Deshayes, 1853a, **I**: 59; Reeve, 1864, **XIV**, pl. I, fig. 2.
- Dione grata*, Deshayes, 1853a, **I**: 62.
- Dione florida* Lmk., Reeve, 1864, **XIV**, pl. I, fig. 1a, b.
- Dione erycina* L., Reeve, 1864, **XIV**, pl. I, fig. 3; Mitchell, 1867: 64.
- Dione chinensis* Chemn., Reeve, 1864, **XIV**, pl. I, fig. 4.
- Dione lilacina* Lmk., Reeve, 1864, **XIV**, pl. I, fig. 5.
- Dione semisulcata* Sow., Reeve, 1864, **XIV**, pl. II, fig. 6a.
- Dione hagenowi* Dkr., Reeve, 1864, **XIV**, pl. II, fig. 6b.
- Dione costata* Chemn., Reeve, 1864, **XIV**, pl. II, fig. 7 et 9.
- Dione grata* Desh., Reeve, 1864, **XIV**, pl. IV, fig. 14 a et b.
- Callista festiva* Sow., Römer, 1869, **I**: 58, pl. XVII, fig. 3.
- Callista erycina* L., Römer, 1869, **I**: 59, pl. XVIII, fig. 1; Shikama, 1964, **II**, pl. 46, fig. 4; Fischer-Piette, 1974, **5** (2-3): 290.
- Callista lilacina* Lmk., Römer, 1869, **I**: 61, pl. XVIII, fig. 2.
- Callista costata* Chemn., Römer, 1869, **I**: 62, pl. XVIII, fig. 3.
- Callista grata* Desh., Römer, 1869, **I**: 64, pl. XIX, fig. 5.
- Callista chinensis* Chemn., Römer, 1869, **I**: 66, pl. XIX, fig. 3.
- Callista horrida* Lmk., Römer, 1869, **I**: 67, pl. XX, fig. 1; S opland, 1902: 171; Fisc er-Piette, 1968: 791.
- Callista multiradiata* Sow., Römer, 1869, **I**: 69, pl. XX, fig. 2.
- Callista spathulata* Sow., Römer, 1869, **I**: 70, pl. XXI, fig. 5.
- Cytherea chinensis* Chemn., Pfeiffer, 1869, ed. II, **XI** (1): 31, pl. 2, fig. 2.
- Pitar erycina*, Gravely, 1941, **N.S.**, **V**(1): 50.
- Venus chinensis* Chemn., (Holten *in*) Winckworth, **XXV**: 147.
- Pitar erycina* L., Satyamurti, 1956, **N.S.**, **I** (2): 113, pl. 16, fig. 4 a et b; Kundu, 1965, **62** (2): 212, pl. XVII, fig. 56.
- Callista chinensis* (Holten), Kira, 1962, pl. 57, fig. 3; Kuroda, Habe et Oyama, 1971; 644 et 417, pl. 90, fig. 9.

Callista erycina L. est une espèce des plus variables. Il n'est donc pas étonnant que de nombreux noms aient été formulés, que nous considérons comme synonymes. Le nom *florida* Lmk. est celui qui a été le plus employé pour la région du canal de Mozambique, et il l'a été également jusqu'aux Indes, tandis que le nom *erycina* L. a surtout été employé des Indes au Japon. Mais tous les intermédiaires existent, ainsi qu'avec les formes qui ont reçu les autres noms figurant sur la liste ci-dessus.

Un seul échantillon nous a été soumis, venant de Trivandrum.

Pitar hebraea Lamarck

Cytherea hebraea, Lamarck, 1818, **V**: 578 (568).

Cytherea hebrasea Lmk., Delessert, 1841, pl. 8, fig. 6; Smith, 1885: 138; Lynge, 1909, **V**(3): 131.

Grice hebraea Lmk., Reeve, 1863, **XIV**, pl. VIII, fig. 34.

Pitar hebraea Lmk., Fischer-Piette, 1968: 788, pl. 1, fig. 1 et 2; Fischer-Piette, 1974, **5** (2-3): 286.

Un échantillon nous a été soumis avec comme provenance Tuticorin.

Pitar alabastrum Reeve

Dione alabastrum, Reeve, 1863, **XIV**, pl. X, fig. 42.

Pitar alabastrum, Gravely, 1941, **V** (1): 50.

Pitar alabastrum Rve, Satyamurti, 1956, **I**, n°2, part 7: 113, pl. 16, fig. 3.

Un échantillon soumis, venant de Porto Novo.

Dosinia (Sinodia) excisa (Chemnitz) Schröter

Venus excisa testa. ., Chemnitz, 1784, **VII**: 17, fig. 400 et 401.

Venus excisa, Schröter, **X**, 1788: 112 du Namen-Register.

Venus sinuata, Gmelin, 1791, ed. **XIII**: 3285.

Cytherea immaculata, Lamarck, 1818, **V**: 581 (571).

Cytherea immaculata Lmk., Deshayes, 1835, ed. 2, **VI**: 313.

Cytherea excisa, Hanley, 1843: 103.

Cytherea excisa Chemn., Philippi, 1845, **I**: 170, pl. II, fig. 4.

Artemis excisa, Reeve, 1850, **VI**, pl. VIII, fig. 43.

Dosinia excisa Chemn., Deshayes, 1853a, **I**: 21; Römer, 1862: 19, pl. IV, fig. 2 (*non* fig. 3 *nec* fig. 4).

Artemis excisa Chemn., Martens, 1889, **XXI**: 155.

Dosinia excisa Phil., Ray, 1950, **XLVI**: 117.

Echantillons soumis. Tous les spécimens viennent d'une même région, celle de Tranquebar. Deux valves sont de Tranquebar même, 16 ont été récoltés à 3 miles au nord, et 3 à 1 mile au sud.

Dosinia (Sinodia) insularum Fischer-Piette et Delmas

Dosinia insularum, Fischer-Piette et Delmas, 1967, N.S., Zool., **XLVII**: 8, pl. II, fig. 1 à g.

Espèce décrite de Batavia, connue aussi d'autres localités de Java ainsi que des Célèbes et de Ceylan. Elle n'avait pas encore été signalée de l'Inde. Une seule valve nous en a été soumise. Elle provient du la côte ouest: Port Cochin.

Dosinia (Sinodia) jousseaumiana Fischer-Piette et Delmas

Dosinia jousseaumiana, Fischer-Piette et Delmas, 1967, N.S., Zool., **XLVII**: 10, pl. III, fig. 1 à 5,

Cette espèce était connue par un seul spécimen, marqué de Malabar, et mesurant 34×31 mm. Trois valves nous en ont été soumises, provenant cette fois de la côte est: Tranquebar. Elles mesurent: 29×27 ; $24,5 \times 22$; 23×20 mm.

Dosinia (Sinodia) katiawarensis Fischer-Piette et Métivier

(Pl. I, fig. 1)

Dosinia (Sinodia) katiawarensis, Fischer-Piette et Métivier, 1971a, **XLII** (1970): 1282, fig. 1.

Cette espèce n'était connue que par deux valves, toutes deux gauches. Nous lui rapportons un troisième échantillon, assez usé, mais que nous figurons car c'est une valve droite. Elle mesure 18×18 mm, avec une épaisseur de 5 mm, ce qui ferait 10 mm pour un bivalve. Sa provenance est Port Cochin.

Dosinia (Sinodia) eudeli Fischer-Piette et Delmas

Dosinia (Sinodia) eudeli, Fischer-Piette et Delmas, N.S., Zool., **XLVII**: 12, pl. III, fig. 12 à 16.

Dosinia (Sinodia) eudeli Fischer-Piette et Delmas, Fischer-Piette et Métivier, 1971a, **XLII** (1970): 1284.

Cette espèce n'était connue que par cinq échantillons. Nous lui rapportons une valve gauche venant de Hejamadi-Codi au nord de Mangalore.

Dosinia (Sinodia) rajagopali n. sp.

(Pl. I, fig. 2)

Espèce fondée sur une valve droite récoltée sur la plage de Ganguli. Diamètre umbo-ventral 16 mm. Diamètre antéro-postérieur 15,5 mm. Épaisseur 4,5 mm, ce qui ferait 9 mm pour un bivalve. Coloration gris foncé, vraisemblablement due à un séjour en vase. Sommet presque pointu. Bord antérieur en saillie, sub-rectiligne au-dessus de la partie saillante, arrondi ensuite. Bord inférieur arrondi, avec un rayon de courbure augmentant un peu de l'avant à l'arrière, bord postérieur avec un rayon de courbure diminuant au contraire en allant vers le sommet. Lunule superficielle, délimitée par une dépression très peu marquée, visible de profil par la légère saillie qu'elle forme, largeur maximale 2 mm, longueur 7 mm, se terminant au point le plus saillant du bord antérieur. Area ligamentaire à peine discernable. Côtes très régulières, consistant en cordons peu saillants, s'affaiblissant beaucoup sur la lunule et sur l'area. Elles font défaut (par usure ?) sur 1,5 mm à partir du sommet; on en compte 27 dans le centimètre suivant de la ligne médiane et 13 dans les 6,5 mm qui restent jusqu'au bord inférieur. Plateau cardinal de peu de hauteur (2 mm sur 7 mm). Dent postérieure assez étroite, presque accolée à la dent médiane triangulaire, dent antérieure plus distante et assez réduite. Le bord inférieur du plateau cardinal est régulièrement arrondi, sans flexuosité. La ligne palléale est remarquablement distante du bord inférieur: elle en

est séparée par 6 mm c'est à dire plus du tiers de la hauteur totale de la coquille. Le sinus palléal, moyennement ascendant, est très large à sa base et se termine en darrondi un peu en avant du centre de la coquille.

Rapports et différences. La grande distance qui sépare la ligne palléale du bord inférieur évoque ce qui existe chez *Dosinia* (*Asa*) *alta*. Dkn. Mais ne se voit chez aucune des *Sinodia* jusqu'ici décrites.

***Dosinia* (*Asa*) *fibula* Reeve**

Artemis fibula, Reeve, 1850, VI, pl. V, fig. 20.

Artemis fibula Rve, Sowerby, 1852, II: 667, pl. CXLII, fig. 49.

Dosinia fibula Rve, Deshayes, 1853 a, I: 27; Römer, 1862: 45, pl. VIII, fig. 5 et pl. XII, fig. 2; Mitchell, 1867: 65; Serene, 1937, 30° Note: 61; Fischer-Piette et Delmas, 1967, N.S., Zool., XLVII: 21; Fischer-Piette et Métivier, 1971: 1284.

Dosinia lineolata, Adams, 1855: 223.

Dosinia lineolata Ad., Römer, 1862: 41.

"*Dosinia fibula* Rve (var. Röm.)", Dautzenberg et H. Fischer, 1905, 53: 460.

Les échantillons soumis viennent de Chilka. Waltair et Porto Novo.

***Dosinia* (*Asa*) *tranquebarica* n.sp.**

(Pl. I, fig. 3)

Espèce fondée sur une valve gauche récoltée à 3 miles au nord de Tranquebar.

Diamètre umbono-ventral 14 mm. Diamètre antéro-postérieur 13 mm. Epaisseur 4 mm, ce qui ferait 8 mm pour un bivalve. Coloration salie indiquant un séjour en sédiment. Sommet bien dégagé, fortement incliné vers l'avant. Bord antérieur assez nettement projeté en avant, en-dessous du golfe lunulaire. Bord inférieur régulièrement arrondi. Bord postérieur sub-anguleux en deux régions, à sa jonction avec le bord inférieur et à 4 mm du sommet. Lunule petite 3×2 mm délimitée par un profond sillon, visible de profil du fait de sa saillie en demi carène. Area ligamentaire longue de 7 mm, large de 1 mm au maximum, perpendiculaire au plan de séparation des valves. Les quelques côtes qui ne sont pas trop usées indiquent que la costulation était bien régulière, s'affaiblissant à ses deux extrémités (sur la lunule et sur l'area). Planteau cardinal de peu de hauteur, dont le bord inférieur est peu flexueux. La dent médiane a son extrémité supérieure projetée en avant comme un crochet, et s'élargit de là à sa base (son bord antérieur et son bord postérieur sont tous deux courbes). La dent postérieure est une lamelle rectiligne dont l'extrémité antérieure domine le sommet de la dent médiane. La dent antérieure, plus large, fort courte, a son sommet dominé par le crochet de la dent médiane. La dent latérale, mousse, est assez importante. Le sinus palléal, très ascendant, assez étroit, presque pointu, se termine un peu plus haut que le centre de la valve.

Rapports et différences. Cette espèce rappelle par sa forme générale *Dosinia altenai* Fischer-Piette et Delmas. Elle en diffère par son bord

antérieur qui s'avance nettement au lieu d'être sub-parallèle avec le bord postérieur, et par son sinus palléal plus long et très ascendant au lieu d'être sub-horizontale.

Dosinia (Asa) tumida Gray

Cette espèce a reçu beaucoup de dénominations. Dans notre travail de 1967 nous avons relevé les suivantes: *tumida* Gray 1838, *scabriuscula* Philippi 1847, *pubescens* Philippi 1847, *lamellata* Reeve 1850, *japonica* Reeve 1850, *duplicata* Reeve 1850, *tenuilamellata* Sowerby 1852, *roemeri* Dunker 1858, *specularis* Römer 1860, *carpenteri* Römer 1862, *spaldingi* Jousseume 1894. Nous ne donnons ci dessous qu'une liste abrégée des nombreuses citations qui en ont été faites.

Cytherea tumida, Gray, 1838, **VIII**: 309.

Cytherea scabriuscula, Philippi, 1847, **II**: 229, pl. VI, fig. 2.

Cytherea pubescens, Philippi, 1847, **III**: 24, pl. VIII, fig. 3.

Artemis lamellata, Reeve, 1850, **VI**, pl. III, fig. 13.

Artemis japonica, Reeve, 1850, **VI**, pl. III, fig. 17.

Dosinia roemeri, Dunker, 1858: 43, pl. 13, fig. 7 et 8.

Dosinia tumida Gray, Römer, 1862: 67, pl. XII, fig. 4; Fischer-Piette et Delmas, 1967, N.S., Zool., **XLVII**: 37; Fischer-Piette et Metivier, 1971a; 1286; Fisher-Piette, 1974, 5 (2-3): 292.

Dosinia pubescens Phil., Melvill et Abercrombie, 1893, ser. 4, VII: 45; Prashad, 1932: 245.

Echantillons soumis. Trois provenances. Chilka (1 valve), Tranquebar (2 valves), Tuticorin (1 valve), Karwar (1 valve), Goa (2 valves).

Dosinia (Dosinella) bruguieri Gray

Arthemis bruguieri, Gray, 1838, **VIII**: 309.

Artemis bruguieri, Hanley, 1842: 107.

Artemis prostrata, Reeve, 1850, **VI**, pl. IV, fig. 23.

Artemis prostrata Rve, Sowerby, 1852, **II**: 674, pl. CXLIV, fig. 80; Deshayes, 1853a, I: 21.

Dosinia prostrata L., Hanley, 1855: 74, pl. 1, fig. 7; Melvill et Abercrombie, 1892, ser. 4, **VII**: 45.

Dosinia bruguieri Gray, Römer, 1862: 75, pl. XIV, g. 3; Hedley, 1916, **I**: 163; Nomura, 1940, **12**(1): 96; Fischer-Piette et Delmas, 1967, N.S., Zool., **XLVII**: 73.

Venus prostrata L., Dodge, 1952, 100, art. 1: 110.

Gravely (1941, Bull. Madras Govt. Mus., N. S., V (1), p. 50, fig. 20 f) a cité *D. prostrata* de Madras; mais sa figure ne montre pas le contour anguleux que cette espèce acquiert d'une taille inférieure à celle de l'exemplaire représenté, et son texte; ou il considère *D. modesta* [c'est à dire *D. lupinus*] et *D. cretacea* comme des variétés de *D. prostrata*, nous rend prudent.

Echantillons soumis. Quatre provenances. Porto Novo (1 valve). Tranquebar (8 valves). Karikkal (3 valves). Et Port Cochin, dans le sud de la côte ouest (1 valve).

Ruditapes bruguieri Hanley

- ., Tabl. Encycl., 1798, Vers, I, pl. 283, fig. 4.
Venus decussata L. var. (4), Lamarck, 1818, **V**: 608 (588).
Venus decussata Lmk., Bory de St. Vincent, 1827: 154.
Venus bruguieri, Hanley, 1845: 21.
Venus bruguieri Hanl., Sowerby, 1852, **II**: 696, pl. CLI, fig. 130 et 131.
Tapes bruguieri Hanl., Reeve, 1864, **XIV**, pl. XIII, fig. 73; Mitchell, 1867: 65. Römer, 1871, **II**: 94, pl. XXXII, fig. 4; Standen et Leicester, 1906, **V**: 293; Gravely, 1941, N.S., **V** (1): 53 et 100, fig. 20 p. 49.
Ruditapes bruguieri Hanl., Fischer-Piette et Metivier, 1971b, N.S., Zool., **LXXI**: 36.

Où trouvera d'autres références dans notre travail de 1971.

Les échantillons soumis viennent de Waltair, Bimlipatam, Bhatkal et de Kunta.

Paphia malabarica (Chemnitz) Schröter

- Venus malabarica*. ., Chemnitz, 1782, **VI**: 323, pl. 31, fig. 324 à 325.
Venus malabarica Chemn., Schröter, 1788, X, Namen Register: 112; Chenu, 1847, pl. VI, fig. 4, 4a, 4b; Pfeiffer, 1869, éd. II, XI (1): 175, pl. 17, fig. 1 et 2.
Venus gallus, Gmelin, 1791, éd. XIII: 3277.
 ., Tabl. Encycl., 1798, Vers, I, pl. 282, fig. 1.
Venus sinuosa, Lamarck, 1818, **V**: 614 (604).
Venus rhombifera, Hanley, 1843: 120, pl. 13, fig. 45.
Tapes malabarica Chemn., Sowerby, 1852, **II**: 682, pl. CIXV, fig. 6 à 8; Reeve, 1864, **XIV**, pl. VI, fig. 27; Römer, 1870, **II**: 34, pl. 10, fig. 3 et pl. 17, fig. 1; Melvill et Abercrombie, 1893, ser. 4, **VII**: 46.
Tapes sinuosa Lmk., Sowerby, 1852, **II**: 683, pl. CIXV, fig. 10; Reeve, 1864, **XIV**, pl. V, fig. 18; Römer, 1870, **II**: 35, pl. XI, fig. 1.
Tapes lentiginosa, Reeve, 1864, **XIV**, pl. VI, fig. 25.
Tapes turgidula Desh., Reeve (*non* Deshayes), 1864, **XIV**, pl. VII fig. 32.
Tapes browniana, Preston, 1906, **XLI**: 73, fig. 6.
Acritopaphia transfusa Iredale, 1936, **19**: 280, pl. 20, fig. 12; Allan, 1950: 334, pl. 39, fig. 4; pl. 37, fig. 18.
Paphia malabarica Dillw., Gravely, 1941, N.S., V (1): 52 et 100, fig. 20 p. 49.
Paphia malabarica, Crichton, 1941, n°2: 331.
Tapes semirugatus, Allan, 1950: 334, pl. 39, fig. 11.
Paphia malabarica Chemn., Satyamurti, 1956, N.S., **I**, n°2: 130; Kundu, 1965, **62** (2): 211, pl. XVI, fig. 54; Fischer-Piette et Métivier, 1971b, N.S., Zool., **LXXI**: 39, pl. IX, fig. 7 à 10; Fischer-Piette, 1974, **5** (2-3): 297.

On trouvera d'autres références dans notre travail de 1971.

Les provenances des échantillons soumis sont les suivantes. Porto Novo, Tranquebar, Tuticorin, Ganguli et Bhatkal.

Paphia undulata Born

- Venus undulata*, Born, 1780: 67.
Venus rimosa, *Philippi*, 1848, **III**: 77, pl. VII, fig. 7.
Tapes rimosa Phil., Sowerby, 1853, **II**: 682, pl. CXLVI, fig. 29.

- Tapes undulata* Born, Reeve, 1864, **XIV**, pl. III, fig. 8; Römer, 1870, **II**: 20, pl. V, fig. 2.
Paratapes scordalus, Iredale, 1936, **19**: 279, pl. 20, fig. 11.
Paphia undulata Born, Crichton, 1941, **42**, n°2: 331; Taki, 1954, pl. 39, fig. 5; Kira, 1955, pl. 56, fig. 24; Kira, 1962, pl. 57, fig. 24; Fischer-Piette et Métivier, 1971b, N.S., Zool., **LXXI**: 50.
Paphia undulata, Gravely, 1941, N.S., **V** (1): 52.
Paratapes undulata Born, Habe, 1951: 184, fig. 426 à 428 p. 183.

Des références plus nombreuses se trouvent dans notre travail de 1971.

Les échantillons soumis viennent de Hooghly, de Porto Novo et de Tuticorin.

Paphia textrix (Chemnitz) Schröter

- Venus textrix*. ., Chemnitz, 1784, **VII**: 48, pl. 42, fig. 442.
Venus textrix Chemn., Schröter, 1788, **X**, Namen Register: 112; Pfeiffer, 1869, ed. II, **XI** (1): 169, pl. 15, fig. 7.
Venus textile, Gmelin, 1791, éd. **XIII**: 3280.
Tapes textile Gmel., Sowerby, 1852, **II**: 681, pl. CXLVI, fig. 26 à 28.
Tapes textrix Chemn., Reeve, 1864, **XIV**, pl. II, fig. 3; Mitchell, 1867: 66; Römer, 1870, **II**: 19, pl. V, fig. 1a, 1b, 1c; Melvill et Abercrombie, 1893, ser. 4, **VII**: 46; Standen et Leicester, 1906, **V**: 293.
Tapes sumatranus, Thiele et Jaeckel, 1931, 21 (1932): 235, pl. IV, fig. 109.
Paphia textile, Gravely, 1941, **V** (1): 51, pl. 20, fig. m.
Paphia textile Gmel., Crichton, 1941, **42**, n°2: 325; Ray, 1950, **XLVI**: 119; Satyamurti, 1956, N.S., I, n 2: 129, pl. 20, fig. 1a et b; Shikama, 1964, **II**: 81, pl. 47, fig. 8-10; Kundu, 1965, **62** (2): 211, pl. XVI, fig. 53; Fischer-Piette et Métivier 1971b, N.S., Zool., **LXXI**: 51; Fischer-Piette, 1974, **5**(2-3): 296.

On trouvera dans notre travail de 1971 une liste de citations beaucoup plus étendue que celle que nous donnons ci dessus.

Les provenances des échantillons soumis sont les suivantes. Porto Novo, Etat de Kerala, Karwar, Goa.

Marcia pinguis (Chemnitz) Schröter

- Venus pinguis seu corpulenta*. ., Chemnitz, 1782, **VI**: 355, pl. 34, fig. 355 à 357,
Venus triradiata, testa subcordata. ., Chemnitz, 1782, **VI**: 356, pl. 34, fig. 358.
Venus nebulosa, testa subcordata. ., Chemnitz, 1782, **VI**: 356, pl. 34, fig. 359 à 361.
Venus pinguis Chemn., Schröter, 1788, **X**, Namen Register: 112; Pfeiffer, 1869, éd. II, **XI** (1): 126, pl. 5, fig. 3 à 5 et 8 à 10.
Venus opima, Gmelin, 1791, éd. **XIII**: 3279.
Venus gravida, Röding, 1798: 181.
Tapes ceylonensis, Sowerby, 1852, **II**: 683, pl. CXLVI, fig. 24, 25.
Tapes ceylonensis Sow., Reeve, 1864, **XLV**, pl. VII, fig. 30a, 30b; Römer, 1872, **II**: 117, pl. XXXIX, fig. 2, 2a, 2b, 2c.
Venus ceylonensis Sow., Pfeiffer, 1869, éd. II, **XI** (1): 236, pl. 40, fig. 10, 11.
Tapes pinguis Chemn., Römer, 1872, **II**: 116, pl. XXXIX, fig. 1 à le.
Venus (Chione) pinguis (Hinds), Melvill et Abercrombie, 1893, ser. 4, **VII**: 46.
Catylasia opima Gmel., Gravely, 1941, N.S., I: 52 et 100, fig. 201 p. 49; Satyamurti, 1956, N.S., I (2): 128.

Katelsia opima Gmel., Ray, 1950, XLVI: 118.

Marcia opima Gmel., Fischer-Piette et Métivier, 1971b, N.S. Zool., LXXI: 53; Fischer-Piette, 1974, 5 (2-3): 297.

Nous n'avons énuméré ci-dessus qu'un petit nombre de references. On en trouvera une liste plus étendue dans notre travail de 1971.

Les provenances des échantillons soumis sont : Chilka. Bimlipatam, Vizagapatam, Andhra Coast: Uppada, Kakinada, Masulipatam, Pondichery; Porto Novo, Golfe de Manaar, Mandapam, Rameswaran, Tuticorin, Quilon, Mangalore, Hejamadi, Kunta, Karwar.

Marcia hiantina Lamarck

- Venus hiantina*, Lamarck, 1818, V: 603 (593).
Venus callipyga Born, Lamarck (*non* Born), 1818, V: 611 (601).
Venus rimularis, Lamarck, 1818, V: 614 (604).
Venus vermiculosa, Lamarck, 1818, V: 614 (604).
Venus hammiculata, Lamarck, 1818, V: 615 (605).
Venus hiantina Lmk., Delessert, 1841, pl. 10, fig. 8a à c; Chenu, 1847, pl. VI, fig. 3, 3a, 3b; Philippi, 1849, III: 27, pl. VIII, fig. 1.
Venus virginea L., Philippi, 1849, III: 28, pl. VIII, fig. 2, 3 et 4.
Venus striata Gmel. (*pars*), Philippi, 1849, III: 29, pl. VIII, fig. 6.
Tapes flammiculata Lmk., Sowerby, 1852, II: 686, pl. CXLVIII, fig. 56 à 61.
Tapes luzonica, Sowerby, 1852, II: 687, pl. CXLVIII, fig. 55.
Tapes biradiata, Sowerby, 1852, II: 687, pl. CXIL, fig. 100 et 101.
Tapes rimularis Lmk., Reeve, 1864, XIV, pl. VI, fig. 29.
Tapes luzonica Sow., Reeve, 1864, XIV, pl. IX, fig. 40; Römer, 1870, II: 58, pl. XXI, fig. 1, 1a, 1b.
Tapes biradiata Desh., Reeve, 1864, XIV, pl. IX, fig. 46b; Römer, 1870, II: 57, pl. XX, fig. 3.
Tapes hiantina Lmk., Reeve, 1864, XIV, pl. VI, fig. 28a et 28b.
Venus virginea L., Pfeiffer, 1869, ed. II, XI (1): 201, pl. 32, fig. 9 et 10.
Venus biradiata Desh., Pfeiffer, 1869, ed. II, XI (1): 236, pl. 40, fig. 12 et 13.
Tapes virginea L., Römer, 1872, II: 98, pl. XXXIII, fig. 3, 3a, 3b, 3c et 3d.
Tapes hiantina Lmk., Römer, 1872, II: 99, pl. 34, fig. 1 à 1c.
Tapes tristis Lmk., Römer (*non* Lmk), 1872, II: 100, pl. XXXIV, fig. 2.
Katelsia hiantina Lmk., Adam et Leloup, 1939, H.S., II: 86, pl. V, fig. 5; Habe, 1962, II: 132, pl. 59, fig. 16; Habe, 1964: 193, pl. 59, fig. 16.
Marcia hiantina Lmk., Fischer-Piette et Metivier, 1971b, N.S., Zool., LXXI: 57, pl. XI, fig. 4 à 9 et pl. XII, fig. 1 à 9.

Notre travail de 1971 contient une liste de references beaucoup plus importante.

Les échantillons soumis viennent de Kerala, Kunta et Karwar.

Marcia recens Chemnitz

- Venus recens*, Chemnitz, 1795, XI: 229, pl. 202, afig. 1979.
Venus marmorata, Lamarck, 1818, V: 610 (600).
Venus marmorata Lmk., Delessert, 1841, pl. 10, fig. 13a et c.

- Venus variabilis*, Philippi, 1844, **I**: 12, pl. III, fig. 8 et 9.
Venus interrupta, Philippi, 1849, **III**: 30, pl. VIII, fig. 7.
Tapes recens Chemn., Sowerby, 1852, **II**: 685, pl. CXLVIII, fig. 62 a 64 et fig. 66;
 Römer, 1872, **II**: 105, pl. XXXV, fig. 2a, b, c.
Tapes laterisulca Lmk., Sowerby (*non* Lamarck), 1852, **II**: 686, pl. CXLVIII, fig. 67a
 76; Römer, 1872, **II**: 107, pl. XXXVI, fig. 2 a 2e.
Chione ustulata, Deshayes, 1853: 8.
Tapes vitulata, Reeve, 1864, **XIV**, pl. IV, fig. 15a et b.
Tapes sinensis, Reeve, 1864, **XIV**, pl. V, fig. 24.
Tapes marmorata Lmk., Reeve, 1864, **XIV**, pl. V, fig. 26a et b; Mitchell, 1867: 65;
 Römer, 1872, **II**: 104, pl. XXXIV, fig. 3a, b, c; Melvill et Abercrombie, 1893,
 ser. 4, **VII**: 46.
Tapes orientalis, Reeve, 1864, **XIV**, pl. VIII, fig. 34a et b.
Tapes occidentalis, Reeve, 1864, **XIV**, pl. VIII, fig. 35.
Tapes bicolorata, Reeve, 1864, **XIV**, pl. IX, fig. 42.
Tapes ferruginosa, Reeve, 1864, **XIV**, pl. X, fig. 51.
Venus recens Chemn., Pfeiffer, 1869, ed. II, **XI** (1): 151, pl. 11, fig. 11.
Venus declivis Sow., Pfeiffer (*non* Sowerby), 1869, ed. II, **XI** (1): 237, pl. 41, fig. 1 et 2;
 Römer (*non* Sowerby), 1870, **II**: 32, pl. IX, fig. 3.
Tapes variabilis Phil., Römer, 1872, **II**: 106, pl. XXXVI, fig. 1a a 1c.
Tapes exserta, Römer, 1872, **II**: 112, pl. XXXVIII, fig. 1.
Tapes sinensis Rve, Römer, 1872, **II**: 113, pl. XXXVIII, fig. 4.
Paphia marmorata Rve, Gravely, 1941, N.S., **V** (1): 52 et 100.
Marcia recens Chemn., Fischer-Piette et Métivier, 1971b, N.S., Zool., **LXXI**: 61.

On trouvera diverses autres citations dans notre travail de 1971.

Les échantillons soumis viennent de Beypore, Mangalore, Kunta, Karwar et Goa.

Gomphina aequilatera Sowerby

- Venus donacina*, Chemnitz (*non* Gmel.), 1795, **XI**: 231, pl. 202, fig. 1983, 1984.
Donax aequilatera, Sowerby, 1825: 12.
Venus semicancellata Koch, Philippi, 1843, **I**: 40, pl. I, fig. 2 et 3.
Venus donacina Chemn., Sowerby, 1853, **II**: 739, pl. CLIX, fig. 165, 166 et 167; Reeve,
 1863, **XIV**, pl. XX, fig. 95; Pfeiffer, 1869, ed. II, **XI** (1): 185, pl. 23, fig. 1 et 2.
Venus ae uilate a Sow., Sowerby, 1853, **II**: 739, pl. CLIX, fig. 168 et 169; Reeve, 1863,
XIV, pl. XX, fig. 92.
Gomphina melanaegis, Römer, 1861, **VII**: 157.
Gomphina melanaegis Röm., Dunker, 1862: 40, pl. 12, fig. 12 et 13; Habe, 1951: 179, fig.
 415, 416 p. 178.
Gomphina veneriformis Lmk., Habe (*non* Lamarck), 1951: 178.
Gomphina aequilatera Sow., Fischer-Piette et Métivier, 1971b, N.S., Zool., **LXXI**: 70.

On trouvera une liste de références plus étendue dans notre travail de 1971.

Un échantillon jeune, du golfe de Manaar, se trouvait dans le matériel qui nous a été soumis.

REFERENCES BIBLIOGRAPHIQUES

- ADAM, W., et E. LELOUP, 1939. Gastropoda—Pulmonata, Scaphopoda et Bivalvia. Résultats scientifiques. Voyage aux Indes orientales néerlandaises. *Mem. Mus. Roy. Hist. nat. Belg.*, H.S., **II** (20): 126p., 7 pl.
- ADAMS, A., 1855. Descriptions of Twenty-Five new Species of Shells from the collection of H. Cuming. *Proc. zool. Soc. Lond.*: 221-226.
- ADANSON, M., 1757. *Histoire naturelle du Senegal. Coquillages*. 190 p. +XCVI p. +275 p., 19 pl. Paris, C.J.B. Bauche.
- ALLAN, J., 1950. *Australian Shells*. XIX p. +470 p., 44 pl. Melbourne.
- ANGAS, G. F., 1867. On a new Genus and some new Species of marine Mollusca from Port Jackson, New South Wales. *Proc. zool. Soc. Lond.*: 908-911, pl. XLIV
- ANTON, H. E., 1837. Diagnosen einiger neuen Conchylien-Arten. *Archiv f. Naturg.*, **III**; n°1: 280-283.
- ANTON, H. E. 1839. *Verzeichniss der Conchylien*. 110 p., Halle.
- BORN, I., 1780. Testacea Musei Caesarei Vindobonensis. 442 p., XVIII pl., Vindobonae, J. P. Kraus.
- BORY DE ST. VINCENT, J. B. M., 1827. Tableau encyclopédique et méthodique des trois regnes de la nature. Vers, Coquilles, Mollusques et Polypiers. I: 180 p., 95 pl. Paris, Mme V Agasse.
- CHEMNITZ, J. H. Neues Systematisches Conchylien Cabinet. 1782, **VI**: 375 p., 36 pl. 1784, **VII**: 356 p., pl. 37 à 68. 1795, **XI**: p. 222 à 231, pl. 202. Nürnberg, Raspe.
- CHENU, J. C., 1847. Illustrations conchyliologiques. 14 pl. Paris.
- CRICHTON, M. D., 1941. Marine Shells of Madras. *J. Bombay nat. Hist. Soc.*, **42**, n° 2: 323-341, pl. I-IV
- CROSSE, H., 1873. Diagnoses Molluscorum novorum. *J. Conchyliol.*, **21**: 284-285.
- CROSSE, H. 1874. Catalogue des espèces du genre *Meroe* accompagné de la description d'une espèce nouvelle. *J. Conchyliol.*, **22**: 89-97.
- CROUCH, E. A., 1826. Illustrated Introduction to Lamarck's Conchology. 47 p., 22 pl. London.
- DALL, W. H., 1902. Synopsis of the family *Veneridae*, and of the North American recent species. *Proc. U.S. Nat. Mus.*, **XXVI**: 335-412, pl. XII-XVI.
- DALL, W. H., P. BARTSCH, et H. F. REHDER, 1938. A manual of the recent and fossil marine Pelecypod Mollusks of the Hawaiian Islands. *Bernice Bishop Mus.*, Bull. 153, IV p. +233 p., 58 pl.
- DAUTZENBERG, P. H., et H. FISCHER, 1905. Liste des Mollusques récoltés par M. H. Mansuy en Indo-Chine et au Yunnan et description d'espèces nouvelles. *J. Conchyliol.*, **53**: 342-471.
- DELESSERT, B., 1841. Recueil de coquilles décrites par Lamarck et non encore figurées. 40 pl. Paris, Fortin, Masson et Cie.
- DESHAYES, G. P., 1835. *Historire naturelle des animaux sans vertèbres*. Ed. 2, **VI**: 600 p., Paris, Baillièrre.

- DESHAYES, G. P., 1853a. Catalogue of the Conchifera or Bivalve Shells in the collection of the British Museum. Part I. *Veneridae*, *Cyprinidae*, *Glauconomidae*, *Petricolidae*. 292 p. London.
- DESHAYES, G. P., 1853b. Descriptions of new Species of Shells in the collection of M. Cuming. *Proc. Zool. Soc. Lond.*: 1-11.
- DILLWYN, L. W., 1817. Descriptive catalogue of recent Shells, arranged according to the Linnaean method; with particular attention to the Synonymy, I.: 580 p. London, J. and A. Arch.
- DODGE, H., 1952. A historical review of the Mollusks of Linnaeus. Part 1. The classes *Loricata* and *Pelecypoda*. *Bull. Amer. Mus. Nat. Hist.*, 100, art. 1: 263 p.
- DUNKER, G., 1848. Diagnoses Molluscorum novorum. *Zeitschr. f. Malakozool.*, **V** (12): 177-192.
- DUNKER, G., 1852. Diagnoses Molluscorum novorum. *Zeitschr. f. Malakozool.*, **IX**: (4): 49-62.
- DUNKER, W., 1858. Novitates Conchologicae. 144 p., XLV pl.
- FISCHER, P. H., et E. FISCHER, 1938. Mollusques Lamellibranches recueillis aux Nouvelles-Hébrides par M. Aubert de la Réüe. *Bull. Mus. Nat. hist. nat. Paris*, 2°ser., **X**(4): 406-409.
- FISCHER, P. H., et E. FISCHER-PIETTE, 1939. Les coquilles d'Adanson. Des exemplaires figurés dans l'"Histoire naturelle du Senegal" existent encore. *J. Conchylol.*, **83**: 163-166, pl. VI.
- FISCHER, P. H., et E. FISCHER-PIETTE, 1972. Récolte de Mollusques Lamellibranches sur la côte du Cambodge. *J. Conchylol.*, **110**: 22-30.
- FISCHER-PIETTE, E., 1939. Sur quelques espèces de *Sunetta* (Veneridae) et sur les divisions de ce genre. *Bull. Mus. Nat. hist. nat. Paris*, 2°ser., **XI** (1): 142-146.
- FISCHER-PIETTE, E., 1942. Les Mollusques d'Adanson. *J. Conchylol.*, **85**: 103-366, XVI pl.
- FISCHER-PIETTE, E., 1958. Mollusques des plages soulevées de Madagascar recoltées par M. R. Battistini. *J. Conchylol.*, **98**: 117-123.
- FISCHER-PIETTE, E., 1968. Contribution à la connaissance des Veneridae du Mozambique. *Bull. Mus. Nat. hist. nat. Paris*, 2°ser., **XL**(4): 784-796, pl. I.
- FISCHER-PIETTE, E., 1974. Sur des Veneridae de l'océan Indien occidental (Mollusca, Pelecypoda). *Tethys*, **5** (2-3): 267-316, 6 pl.
- FISCHER-PIETTE, E., et D. DELMAS, 1967. Révision des Mollusques Lamellibranches du genre *Dosinia* Scopoli. *Mem. Mus. Nat. hist. nat. Paris*, Sér. A, Zool., **XLVII**: 91 p., 16 pl.
- FISCHER-PIETTE, E., et P. H. FISCHER, 1939. Révision des espèces vivantes de *Sunetta* du Muséum National d'histoire naturelle. *J. Conchylol.*, **83**: 181-213. pl. VI.
- FISCHER-PIETTE, E., et P. H. FISCHER, 1941. Révision des espèces vivantes de *Meretrix* s.s. du Muséum National d'histoire naturelle. *J. Conchylol.*, **84**: 313-344.
- FISCHER-PIETTE, E., et B. ME'TIVIER, 1971a. Les *Dosinia* (Moll. Viv.) indéterminées de Calcutta. *Bull. Mus. Nat. hist. nat. Paris*, 2°ser., **XLII** (6), 1970: 1282-1287, 2 fig.

- FISCHER-PIETTE, E., et B. MÉTIVIER, 1971b. Révision des *Tapetinae* (Mollusques bivalves). *Mem. Mus. Nat. hist. nat. Paris, Sér. A., Zool.*, **ILXX**: 106 p., XVI pl.
- GMELIN, J. F., 1759. *Caroli a Linné, Systema Naturae*, ed. XIII (VI): 3264-3295.
- GOULD, A. A., 1850. New Shells of the U.S. Explor. Exped. *Proc. Boston Soc. Nat. Hist.*, **III** (1849): 275-278.
- GOULD, A. A., 1852. Mollusca and Shells. XII. U.S. Exploring Expedition during the years 1838-1842. 510 p. Atlas, 1856, pl. 37, fig. 538, 538a, et 538b.
- GRAVELY, F. H., 1941. Shells and other animals remains found on the Madras Beach. *Bull. Madras Govt Mus., N.S.*, **V** (1): 23-70.
- GRAY, J. E., 1825. A list and description of some Species of Shells not take. Notice of by Lamarck. *Ann. Philos., N.S.*, **IX**: 134-138.
- GRAY, J. E., 1838. Catalogue of the Species of the Genus *Cytherea*. *Analyst.*, **VIII**: 302-309.
- HABE, T., 1951-1953. Genera of Japanese Shells. Pelecypoda and Scaphopoda. 326 p.
- HABE, T. 1962. Coloured Illustrations of the Shells of Japan, II. 182 p., 66 pl.
- HABE, T., 1964. Shells of the Western Pacific in color, 223 p., 66 pl.
- HANLEY, S., 1842 to 1956. An Illustrated and Descriptive Catalogue of Recent Bivalve Shells. 389 p., 24 pl. London, Williams and Norgate.
- HANLEY, S. 1845. Descriptions of three new Species of Bivalve Shells, of the Genera *Cytherea* and *Venus*. *Proc. zool. Soc. Lond.*,: 21-22.
- HANLEY, S. 1855. The Shells of Linnaeus, determined from his manuscripts and collection. *Ipsa Linnaei Conchyliæ*, 556 p. London, Williams and Norgate.
- HEDLEY, C., 1916. A Preliminary Index of the Mollusca of Western Australia. *J. Roy. Soc. West. Austr.*, **I** (1914-1915): 152-226.
- HEDLEY, C., 1918. A Check-List of the marine Fauna of New South Wales. Part I. Mollusca. *J. Proc. Soc. N.S.W.*, **LI** (1917): 120 p.
- HORNELL, J., 1917. A Revision of the Indian Species of *Meretrix*. *Rec. Indian Mus.*, **XIII**: 153-173, pl. IV-VII.
- IREDALE, T., 1924. Results from Roy Bell's Molluscan Collections. *Proc. Linn. Soc. N.S.W.*, **XLIX**: 179-278, pl. XXXIII-XXXVI.
- IREDALE, T., 1930. More Notes on the marine Mollusca of New South Wales. *Rec. Austr. Mus., Sydney*, **XVII** (9): 384-407.
- IREDALE, T., 1936. Australian Molluscan Notes, n°2. *Rec. Austr. Mus. Sydney*, **XIX** (5): 267-340, pl. XX-XXIV.
- JOUSSEAUME, F., 1872. Description de quatre Mollusques nouveaux. *Rev. Mag. Zool.*, 2°sér., **XIII**: 5-15, pl. 2.
- JOUSSEAUME, F., 1888. Description de Mollusques recueillis par M. le Dr. Faurot dans la mer Rouge et le golfe d'Aden. *Mem. Soc. Zool. Fr.*, **13**: 165-223.

- JUKES-BROWNE, A. J., 1914. A Synopsis of the family *Veneridae*. Part I. *Proc. Malac. Soc. Lond.*, **XI**: 58-74.
- KEEN, A. M., 1945. List of Shells collected in vicinity of Oro Bay, New Guinea by Lt. Col. Hubert G. Schenck and associates. *Min. Conch. Club S. Calif.*, **X**, 49: 36-38.
- KIRA, T., 1955. Coloured Illustrations of the Shells of Japan. 204 p., 67 pl.
- KIRA, T., 1962. Shells of the Western Pacific in color. 224 p., 72 pl.
- KNORR, G. W., 1771. Vergrüßen der Augen. , VI: 76 p., XL pl. Nürnberg.
- KUNDU, H. L., 1965. On the marine fauna of the gulf of Kutch. Part III. Pelecypods. *J. Bombay nat. Hist. Soc.*, **62** (1): 38-103; **62** (2): 211-236, **XXI** pl.
- KURODA, T., T. HABA, et K. OYAMA, 1971. The Sea Shells of Sagami Bay. 741 p.+489 p., 121 pl. Tokyo, Maruzen.
- LAMARCK, J. B., 1818. Histoire naturelle des animaux sans vertèbres, V: 612 p.
- LAMY, E., 1906. Liste des Lamellibranches recueillis par M. L. G. Seurat aux îles Tuamotu et Gambier (1902-1905). *Bull. Mus. Nat. hist. nat. Paris*, **12**: 205-215.
- LAMY, E., 1909. Coquilles marines recueillies par M. F. Geay a Madagascar (1905). *Bull. Soc. Zool. Fr.*, **34**: 299-346.
- LAMY, E., 1930. Les Cytherées de la mer Rouge (d'après les matériaux recueillis par le Dr. Jousseume). *Bull. Mus. Hist. nat. Paris*, 2° ser., **II** (1): 133-142.
- LAMY, E., 1931. Voyage de M. P. Lesne dans l'Afrique du sud, 1928-1929. Mollusques marins. *Bull. Mus. Nat. hist. nat. Paris*, 2° ser., **III** (3): 304-307.
- LAMY, E., 1932. Liste des Lamellibranches recueillis en Nouvelle-Calédonie par M. J. Risbec (1928-32). *Bull. Mus. Nat. hist. nat. Paris*, 2° sér., **IV**(8): 982-984
- LAMY, E., 1938. VII. Mollusca Testacea. Mission R. Ph. Dollfus en Egypte. *Mem. Inst. Egypte*, **XXXVII**, 89 p. Le Caire.
- LAMY, E., et E. FISCHER-PIETTE, 1937. Notes sur les espèces lamarckiennes de *Circe* (Moll. Lamellibr.). *Bull. Mus. Nat. hist. nat. Paris.*, 2° sér., **IX**: 384-386.
- LAMY, E., 1938. Notes sur les espèces lamarckiennes de *Crista* (Moll. Lamellibr.). *Bull. Mus. Nat. hist. nat. Paris.*, 2° sér., **X**(1): 82-85.
- LINNE, C., 1758. Systema Naturae, éd. X, I: 824 p. Salvius.
- LINNE, C., 1764. Museum Ludovicae Ulricae Reginae...720 p. Holmiae.
- LINNE, C., 1967. Systema Naturae, ed. XII, I (II): 1327 p. Salvius.
- LYNGE, H., 1909. The Danish Expédition to Siam 1899-1900. IV Marine Lamellibranchiata. *Mèm. Acad. Roy. Danemark*, 7° sèr., **V**(3): 100-299, 5 pl. Copenhagen.
- MARTENS, E. V., 1889. List of the Shells of Mergui and its Archipelago, collected for the Trustees of the Indian Museum, Calcutta, by Dr. J. Anderson. *J. Linn. Soc., Zoology*, **XXI**: 247 p., pl. XVII-XVIII.

- MEGERLE VON MÜHLFELD, J. K., 1811. Entwurf eines neuen System's der Schalthier-gehäuse. *Magaz. d. Ges. Naturf.*, Berlin, **5**: 38-72.
- MELVILL, J. C., et A. ABERCROMBIE, 1892. The marine Mollusca of Bombay. *Mem. Proc. Manchester Lit. Phil. Soc.*, ser. 4, **VII**: 17-51.
- MELVILL, J. C., et R. STANDEN, 1898. The marine Mollusca of Madras and the immediate neighbourhood. *J. of Conchol.*, **IX**: 75-85.
- MELVILL, J. C., 1899. Report on the marine Mollusca obtained during the first expedition of Prof. A. C. Haddon to the Torres Straits in 1888-89. *J. Linn. Soc. Lond.*, Zool., **XXVII**: 150-206, 2 pl.
- MITCHELL, J., 1867. Catalogue of the Mollusca in the collection of the Government central Museum, Madras. 78 p.
- OKUTANI, T., et T. TAKEMURE, 1967. *Shells of Japan*. 212 p.
- OOSTINGH, C. H., 1925. Report on a collection of recent Shells from Obi and Halmahera (Moluccas). *Mededeel. Landb. -Hooges.*, **29**(1): 362 p. Wageningen, H. Veenman & Zonen.
- PFEIFFER, L., 1869. Die Familie der Venusmuscheln, Veneracea in MARTINI, F. H. W. & CHEMNITZ, J. H., Systematisches Conchylien Cabinet, éd. II, XI (1): 302 p., 42 pl., Nürnberg, Bauer & Raspe.
- PHILIPPI, R. A., Abbildungen and Beschreibungen neuer oder wenig gekannter Conchylien. I, 1843: *Venus*: 1 = 39-4 = 42, pl. I. —I, 1844; *Venus*: 9 = 175-12 = 178, pl. III—I, 1845: *Cytherea*: 3 = 169-7 = 173, pl. II-II, 1846: *Cytherea*: 23 = 95-25 = 97, pl. III-II, 1847: *Cytherea*: 31 = 229-33 = 231, pl. VI et VII—III, 1847: *Cytherea*: 35 = 23-37 = 25, pl. VIII-III, 1848: *Cytherea*: 40 = 71-42 = 74, pl. IX-III, 1848: *Venus*: 23 = 75-26 = 78, pl. VII-III, 1849: *Venus*: 21 = 28-25 = 31, pl. VIII. Th. Fischer, Cassel.
- PRASHAD, B., 1932. The Lamellibranchia of the Siboga Expedition, Systematic. Part II. Pelecypoda. 353 p., IX pl. Leiden, Brill.
- PRASHAD, B., 1939. A Note on *Meroë chilkaensis* Preston and *Meroë satparaensis* Preston from the Chilka Lake, India. *J. Conchylol.*, **83**: 46-47, pl. II.
- PRESTON, H. B., 1906. Descriptions of new Species of marine Pelecypoda from the Philippine Islands. *Ann. Soc. Roy. Zool. Malac. Belg.*, **XLI**: 72-73.
- PRESTON, H. B., 1914. Mollusca from the Chilka Lake on the East Coast of India. *Rec. Indian Mus.*, Calcutta, **X**: 297-310.
- PRESTON, H. B., 1915. A further report on Mollusca from Lake Chilka on the East Coast of India. *Rec. Indian Mus.*, Calcutta, **XI**: 289-310.
- RAY, H. C., 1950. On a collection of Mollusca from the Coromandel Coast of India. *Rec. Indian Mus.*, Calcutta, **XLVI**: 87-122.
- REEVE, L., 1841. *Conchologia Systematica*, I. 195 p., CXXIX pl. London.
- REEVE, L. *Conchologia Iconica*: or, Illustrations of the Shells of Molluscous animals. 1850, VI. *Artemis*: X pl. 1863 et 1864, XIV *Venus*: XXVI pl. 1863, XIV *Circe*: X pl.—1864, XIV *Meroë*: III pl.—1864, XIV *Dione*: XII pl. 1864, XIV *Tapes*: XIII pl. 1864, XIV *Cytherea*: X pl.

- RIPPINGALE, O. H., et D. F. MACMICHAEL, 1961. Queensland and Great Barrier Reef Shells, 210 p., 29 pl. Brisbane, The Jacaranda Press.
- RODING, P. F., 1798. Museum Boltenianum. Pars II. 199 p. Hamburg.
- ROMER, E., 1858. Kritische Untersuchung der Arten des Molluskengeschlechts *Venus* bei Linné und Gmelin. XIII p. + 135 p. Cassel.
- ROMER, E., 1861. Beschreibung neuer *Venus*-Arten. *Malakozool. Blätt.*, **VII**: 148-165.
- ROMER, E., 1862. Monographie der Molluskengattung *Dosinia* Scopoli (*Artemis*, Poli). 87 p., XVI pl. Th. Fischer, Cassel.
- ROMER, E., 1867. Kritische uebersicht aller lum subgenus *Chione* gehorenden arten von *Venus*. *Malakozool. Blätt.*, **XIV**: 28-62.
- ROMER, E., Monographie der Molluskengattung *Venus* L. Bd. I, 1865: 31-35, pl. X-XII. Bd. I, 1866: 38-39, pl. XII-Rd. I, 1869: 58-70, pl. XVII-XXI. Bd. II, 1870: 3-58, pl. I-XXI. Bd. II, 1871: 94, pl. XXXII. Bd. II, 1872: 98-117, pl. XXXIII-XXXIX. Th. Fischer, Cassel.
- RUMPHIUS, G. E., 1711. Thesaurus imaginum Piscium Testaceorum... IX pl. Lugduni Batavorum.
- SATYAMURTI, S. T., 1956. The Mollusca of Krusadai Island (in the gulf of Manaar). II. Scaphopoda, Pelecypoda and Caphalopoda. *Bull. Madras Govt. Mus.*, N.S., Nat. Hist. Sect., I, 2, Part 7: 189 p., XXX pl. Madras.
- SAVIGNY, J. C., 1805-1817. Planches de l'expédition d'Egypte. Histoire naturelle. Mollusques. 14 pl. Paris, Panckouke.
- SCHROTER, J. S., 1788. Namen Register in Conchylien Cabinet, **X**: 124 p. Nürnberg.
- SCHUMACHER, C. F., 1817. Essai d'un nouveau système des habitations des Vers Testacés. 287 p., XXII pl. Copenhague, Schultz.
- SERENE, R., 1937. Inventaire des Invertébrés marins de l'Indochine (lere liste). *Notes Inst. Océanogr. Indochine*, 30 Note: 1-83.
- SHIKAMA, T., 1964. Selected Shells of the world. Illustrated in colours, II: 212 p., 70 pl.
- SHOPLAND, E. R., 1902. List of marine Shells collected in the neighbourhood of Ader between 1892 and 1901. *Proc. Malac. Soc. Lond.*, **V**: 171-179.
- SMITH, E. A., 1885. Report on the Lamellibranchiata collected by H M S Challenger, during the years 1873-1876, Zoology, **XIII**: 341 p., 25 pl. London.
- SOWERBY, G. B., 1825. A Catalogue of the Shells contained in the collection of the late Earl of Tankerville ...An Appendix containing Descriptions of many new Species. 92 p. + XXXIV p., 9 pl.

- SOWERBY, G. B., Thesaurus Conchyliorum or Monographs of Genera of Shells. 1851, II. *Meroe*: 609-611, pl. CXXVI. 1851, II. *Cytherea*: 611-646, pl. CXXVII-CXXXVI. 1852, II. *Artemis*: 655-676, pl. CXL-CXLIV. 1852, II. *Tapes*: 679-699, pl. CXLV-CLI. 1853, II. *Venus*: 703-742, pl. CLII-CLXII.
- SOWERBY, G. B., 1895. Descriptions of nine new Species of Shells. *Proc. Malac. Soc. Lond.*, **I**: 214-217, pl. XIII.
- STANDEN, R., et A. LEICESTER, 1906. Report on the Molluscan Shells collected by Prof. Herdman, at Ceylon, in 1902. Ceylon Pearl Oyster Fisheries. Supplementary Reports, XXXVIII, V: 267-294.
- Tableau Encyclopedique et methodique des trois regnes de la nature. 1798. Pl. 160 a 314. Paris., Panckoucke.
- TAKI, I., 1954. An Illustrated Handbook of Shells in Natural colors from the Japanese Islands and adjacent Territory. 134 pl.
- THIELE, J., et S. JAECKEL, 1931. Muscheln der Deutschen Tiefsee-Expedition, Bd. **XXI**, Heft I: 161-268.
- TOMLIN J. R. le B., 1922. On *Sunetta hians* (Reeve). *J. of Conchol.*, **XVI**: 312.
- WINCKWORTH, R., 1943. Holten's Systematic List of the Shells of Chemnitz. *Proc. Malac. Soc. Lond.*, **XXV**: 146-150.
- WOOD, W., 1828a. Index Testaceologicus, or a Catalogue of Shells, British and Foreign. 2° éd., London. 212 p., 38 pl.
- WOOD, W., 1828b. Supplement to the Index Testaceologicus, or a Catalogue of Shells, British and Foreign. London, 59 p., 8 pl.
- YOKOYAMA, M., 1924. Mollusca from the Coral Beds of Awa. *J. Coll. Sc. Imp. Univ. Tokyo*, **45** (1): 1-62, 2 pl.
-

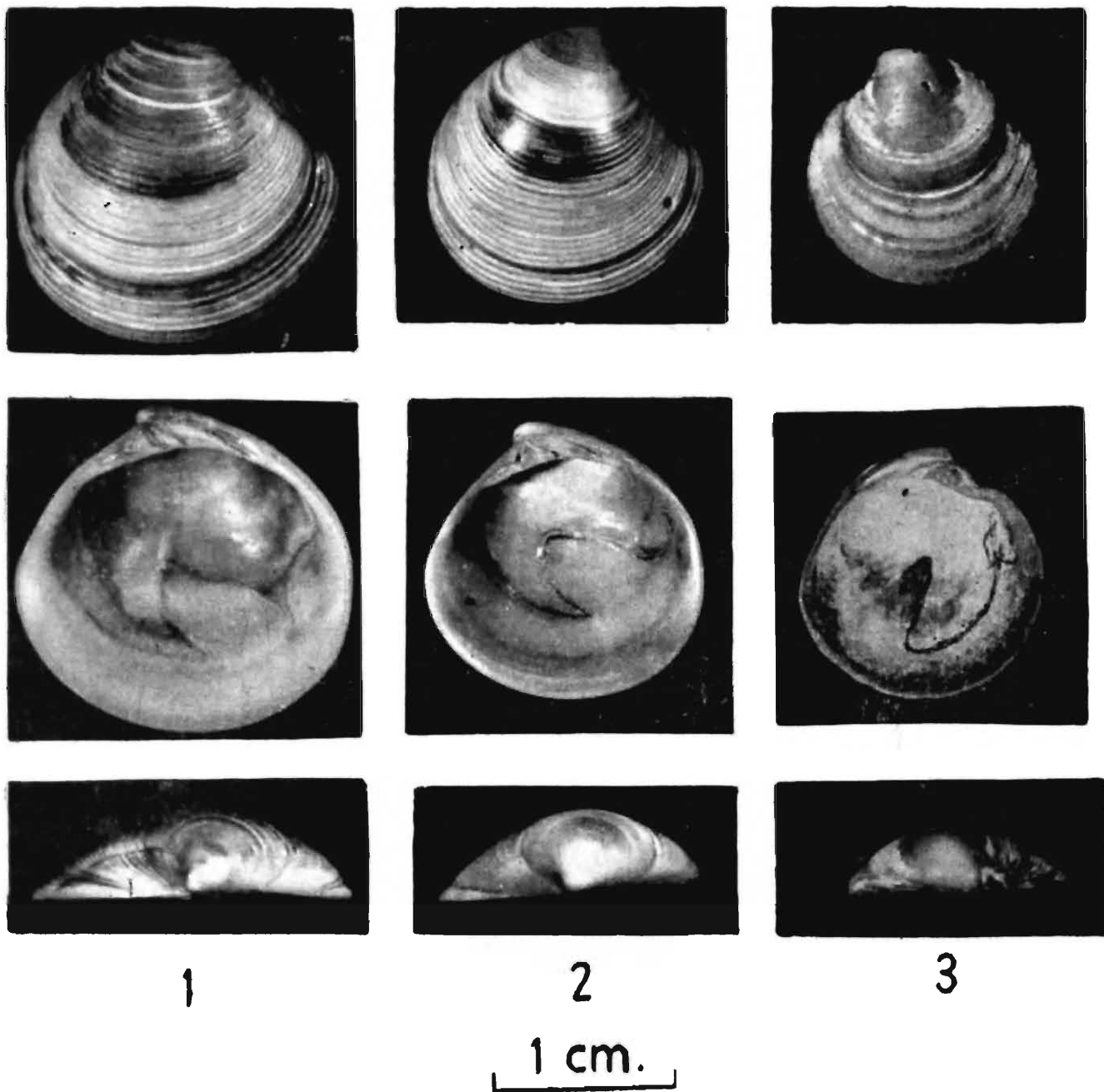


Fig. 1. *Dosinia (Sinodia) katiawarensis* Fischer-Piette et Metivier

Fig. 2. *Dosinia (Sinodia) rajagopali* sp. n.

Fig. 3. *Dosinia (Asa) tranquebarica* sp.n'.