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CONTENTS.

PART I.—*Published 30th March, 1918.*

PART II.—*Published 30th April, 1918.*

PART III.—*Published 30th August, 1918.*

PART IV.—*Published 10th October, 1918.*

PART V.—*Published 9th November, 1918.*

LIST OF PLATES.

ERRATUM

In explanation of plate XIX following p. 158 : Fig. 2 *for* "Lateral view of the larva of *C. mandibulata*" *read* "Labrum of the same."

LIST OF AUTHORS.

INDEX.

N.B.—An asterisk (*) preceding a line denotes a new variety or subspecies: a dagger (†) indicates a new species; a double dagger (‡) a new genus or subgenus; synonyms are printed in italics.

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I. RHYNCHOTA FROM BARKUDA ISLAND.

By C. A. PAIVA, *Assistant, Zoological Survey of India.*

INTRODUCTORY NOTE.

I have already described Barkuda I. in these "Records."[1] Here it will be sufficient to repeat that it is a rocky or rather stony island about one mile long by three-quarters of a mile broad, and lies, about a mile offshore, in the Chilka Lake some five miles from the southern end. It is thus situated in the extreme north-eastern corner of the Madras Presidency, in the Ganjam District.

The peculiar features that have influenced its Rhynchotal fauna may be considered a little more fully. The most important of these is the sclerophytic nature of the vegetation. The island is rather densely wooded, but all the trees and bushes have hard glossy foliage, and ordinary succulent vegetation is practically confined to a few creepers and one or two weeds that have established themselves at spots where the jungle has been felled. With these facts is correlated a great scarcity of the smaller Homoptera such as abound in grass and among soft herbage. Indeed, all those species of either Homoptera or Heteroptera that live by sucking leaves or stems of plants are very scarce, the few that occur being found mainly on introduced Leguminosae. The phytophagous species of the island live in most instances by sucking seeds or berries, but the most conspicuous form (*Empysurus johni*) sucks the fruit and young leaves of a fig, and the most abundant (*Petalocnemis obscura*) the stems of the Poison Apple *Datura stramonium*, Linn.,—both plants that are not as a rule attractive to insects. Other groups of insects, with the exception of certain families of beetles, notably the Tenebrionidae and Cicindelidae, are just as poorly represented on the island as the Rhynchota. A factor that may have been of importance in the scarcity of species is the strong breeze that blows across the island almost daily. Insectivorous birds and lizards are, however, few.

There is a small pond in the middle of the island. It is dug in laterite rock and the water has a depth of about five or six feet in the middle, but naturally varies with the rainfall. The pool is roughly circular and about 12 yards in diameter. The bottom is covered with black mud. There are no true water-plants, but a fairly dense growth of sedges springs up round the margin in wet weather. The water is very slightly brackish, opaque and muddy. In this pond certain aquatic Rhynchota abound. The commonest are *Anisops sardea* and *Plea palescens*; other species are much less so. The Hydrometridae are as a rule scarce, but *Gerris tristan*, though not always present, sometimes appears in considerable numbers. Apart from Rhynchota and water-beetles, of which a certain number of species are abundant, the fauna of the pond is by no means rich. The only vertebrate is the frog *Rana*

[1] *Rec. Ind. Mus.* XIII, p. 171 (1917).

cyanophlyctis, which breeds there, the only molluscs are *Planorbis exustus*, which is abundant, and *Limnaea ovalis*, which is scarce. A few Chironomid and Culicid larvae occur, and a water-mite, parasitic in its younger stages on *Ranatra*, is common. In the latter part of the "rains" the rocks near the edge become covered with a sponge (*Spongilla alba*)[1] and a Polyzoon (*Plumatella longigemmis*).[2]

The collections on which these notes are based were made on seven different visits to the island, some of which lasted for a week or more, between 1914 and 1917. They were obtained by different members of the Zoological Section of the Indian Museum, now the Zoological Survey of India. The most lengthy of our visits, which took place at all seasons, were made in July and the first week of August, that is to say, in the earlier part of the "rains," which is thus the season best represented in the collection; but there is comparatively little seasonal variation in the insect life of the island, the climate of which, for purely local reasons, is more uniform than that of most places in Peninsular India.

I have added certain ecological notes to Mr. Paiva's manuscript. They are enclosed in parentheses.

N. ANNANDALE,
Director, Zoological Survey of India.

List of Species.

Fam. Pentatomidae.
Coptosoma indicum, Dist.
Macroscytus subaeneus (Dall.)
Cydnus varians, Fabr.
Empysurus johni (Oshan.)
Fam. Coreidae.
Petalocnemis obscura (Dall.)
Homoeocerus albiguttulus, Stål.
Pendulinus antennatus (Kirby).
Eusthetus insularis, sp. nov.
Fam. Lygaeidae.
Aspilocoryphus guttiger (Dall.).
Dieuches femoralis, Dohrn.
Nysius ceylanicus (Motsch.)
Fam. Pyrrhocoridae.
Scantius forsteri (Fabr.)
Fam. Hydrometridae.
Mesovelia mulsanti, Buch. White.
Microvelia diluta, Dist.
Gerris tristan, Kirk.
Fam. Reduviidae.
Bagauda splendens, Dist.
Petalochirus burmanus, Dist.
Acanthaspis fulvipes (Dall.)
Ectomocoris cordiger, Stål.
Harpactor marginatus (Fabr.)
Harpactor squalus, Dist.
Harpactor fuscipes (Fabr.)
Harpactor varians, sp. nov.
Sycanus collaris (Fabr.)
Fam. Nepidae.
Laccotrephes griseus (Guer.)
Ranatra ? filiformis, Fabr.
Fam. Belostomatidae.
Sphaerodema molestum (Duf.)
Fam. Notonectidae.
Anisops sardea, Herr.-Schäff.
Anisops niveus (Fabr.)
Plea pallescens, Dist.
Fam. Corixidae.
Micronecta dione, Dist.
Fam. Cicadidae.
Terpnosia jenkinsi, Distant, var
Fam. Fulgoridae.
Dichoptera hyalinata (Fabr.)
Fam. Membracidae.
Leptocentrus substitutus (Walk.)
Coccosterphus minutus (Fabr.)
Fam. Jassidae.
Thomsoniella porrecta (Walk.)
Eutettix phycitis, Dist.

[1] See Annandale, *Mem. Ind. Mus.* V, p. 25 (1915).
[2] See Annandale, *Rec. Ind. Mus.* XI, pp. 166, 168 (1915).

Family PENTATOMIDAE.

[The members of this family, except *Empysurus johni* (Oshan.), are all very scarce on the island. I have occasionally seen *Macroscytus subaeneus* (Dall.) on the wing a few inches above the ground. In flight it closely resembles beetles of the family Histeridae.]

Coptosoma indicum, Distant.

1902. *Coptosoma indicum*, Distant, *Faun. Brit. Ind. Rhyn.* I, p. 33.

Barkuda, 21-vii-14.

Originally described from Point de Galle, Ceylon. Represented in the collection of the Zoological Survey of India from Calcutta; Medha, Yenna Valley, Satara district, *ca.* 2,200 ft., Bombay Presidency; and Vizagapatam, Madras Presidency.

Macroscytus subaeneus (Dall.)

1851. *Aethus subaëneus*, Dallas, *List Hem.* I, p. 116.
1866. *Macroscytus javanus*, Mayr, *Verh. zool. bot. Ges. Wien.*, p. 361.
1867. *Aethus aequalis*, Walker, *Cat. Het.* I, p. 159.
1868. *Aethus indicus*, Vollenhoven, *Faun. Ind. Néerl.* I, p. 17.
1874. *Macroscytus japonensis*, Scott, *Ann. Mag. Nat. Hist.* (4) XIV, p. 294.
1893. *Macroscytus javanus*, Lethierry and Severin, *Cat. Gen. Hem.* I, p. 71.
1893. *Cydnus subaëneus*, Lethierry and Severin, *tom. cit.*, p. 68.
1899. *Macroscytus subaëneus*, Distant, *Ann. Mag. Nat. Hist.* (7) IV, p. 222.
1902. *Macroscytus subaëneus*, Distant, *Faun. Brit. Ind. Rhyn.* I, p. 96.

Barkuda, at light, 20—21-vii-14, 25-vii—4-viii-17.

Recorded by Distant from Bombay; Deccan; Burma; Karennee, Katha, Schwego-Myo, Palon; Tenasserim; Thagata, Kawkareet. Widely distributed throughout the Malay Archipelago and found in Japan (*Distant.*) Represented in the collection of the Zoological Survey of India from Gopkuda Island, Chilka Lake.

Cydnus varians, Fabr.

1803. *Cydnus varians*, Fabricius, *Syst. Rhyng.* p. 187.
1860. *Aethus cyrtomenoides*, Dohrn, *Stett. ent. Zeit.* XXI, p. 400.
1868. *Aethus varians*, Stål, *Hem. Fabr.* I, p. 6.
1882. *Cydnus varians*, Signoret, *Ann. Soc. Ent. France* (6) II, p. 155, t. VI, f. 92.
1902. *Cydnus varians*, Distant, *Faun. Brit. Ind. Rhyn.* I, p. 92.

Barkuda, vii-14 and 25-vii—4-viii-1917.

Recorded from Bengal; Bombay; Ceylon; Burma; Mandalay; Tenasserim. Represented in the collection of the Zoological Survey of India from Habarane, Ceylon.

Empysurus johni (Oshan.)

1907. *Mussafira johni*, Oshanin, *Ann. Mus. Zool. Acad. Imp. Sci. St. Pétersb.* XII, p. 416.
1908. *Empysurus johni*, Distant, *Faun. Brit. Ind. Rhyn.* IV (Appendix), p. 460, text-fig. 272.

Barkuda, 17-vii-14, 15—22-vii-16, 25-vii—4-viii-17.

[This species is by no means uncommon on the island. It is gregarious in habits and feeds on the fruit and young leaves of the fig *Ficus Rumphii*, Bl., on which small companies of young and adults together may often

be discovered. The flight, though by no means strong, is less weak than might be expected from the shape of the body. Even females fly readily from tree to tree. The natural colour, though not the shape, closely approaches that of the young leaves on which the insect feeds. The colour in life is pale leaf-green ; antennae (except the base of the first joint), eyes and ocelli brick-red; tarsi tinged with brown, a brownish blotch on the dorsal surface of the 2nd joint of the 2nd and 3rd tarsi ; claws white at the base, black at the tip ; membraneous part of the hemelytron colourless, transparent; edge of abdomen dark brown, a reddish-brown line along lower surface of rostrum.]

In addition to the above characters it may be mentioned that there is a distinct tubercle within each posterior angle of the pronotum ; of the two black lines which are mentioned in the original description as bordering the inner and outer margins of the lateral gutta of the connexivum, the one on the inner border is very faint and sometimes entirely absent. The anal appendage of the male is almost pentagonal in shape, the anterior, lateral and posterior angles being rounded ; it is inserted at the apex of the deeply cleft apical margin of the sixth abdominal segment ; it is deeply excavate dorsally and slightly convex ventrally. The male is much smaller and narrower than the female, the sexes being respectively 22 and 26 millim. in length and 14·5 and 18 millim. in greatest breadth.

In the earlier stages the dorsal surface of the thorax and abdomen is marked with some irregular patches of bright red. A distinct narrow black border runs along the external margins of the head, thorax and abdominal segments. This species was originally described from Kandy, Ceylon, and was not previously represented in the collection of the Zoological Survey of India. It does not appear to be represented in the British Museum collection.

Family COREIDAE.

[In this family again only one species is common, namely *Petalocnemis obscura* (Dall.)]

Petalocnemis obscura (Dall.)

1852. *Acanthocoris obscura*, Dallas, *List Hem.* II, p. 518.
1902. *Petalocnemis obscura*, Distant, *Faun. Brit. Ind. Rhyn.* I, p. 386.

Barkuda, 17-vii-14, 25-vii—4-viii-17

[This species is by far the commonest bug on the island. It resembles the Malayan *Acanthocoris scaber* (Linn.) in habits, feeding on the poison apple *Datura stramonium*, Linn. The eggs are laid on the lower surface of the leaves in batches of from 17 to 42. Several females usually lay together or in succession, and the young insects of different clutches mingle in a common crowd. Shortly after hatching they migrate as a rule to the stems of the plant, on which they crowd together. Both adults and young in different stages may be discovered in a single crowd. Owing to their mottled colouration they are by no means conspicuous in the broken shadows thrown by the leaves of the plant.]

In the description of the species the dilatation of the apex of the 3rd joint of the antennae has been omitted. This is visible only when

the insect is viewed from the side, as the dilatation is vertical. In the earlier stages the insect is of a very pale colour, with only a few brown markings on its dorsal surface ; the dilatation of the 3rd joint of the antennae does not become apparent till about the last but one moult.

It has been recorded from North Bengal ; Khasi Hills ; Bombay ; Poona ; and Ceylon. It was not previously represented in the collection of the Zoological Survey of India.

Homoeocerus albiguttulus, Stål.

1873. *Homoeocerus albiguttulus,* Stål, *En. Hem.* III, p. 61.
1902. *Homoeocerus albiguttulus,* Distant, *Faun. Brit. Ind. Rhyn.* I, p. 361.

Barkuda, 25-vii—4-viii-17.

I have compared the only specimen from Barkuda with some specimens of this species in the collection which have been identified by Distant and I find they agree almost exactly in structure. The only very marked difference is the size of the pale luteous spot at the inner angle of the corium, which in the typical form is transverse and broadly margined posteriorly with piceous, while in the Barkuda specimen it is much smaller, being confined to the subquadrate cell of the corium, and without any piceous margin posteriorly. Antennae pale ochraceous with the basal joint greenish ochraceous and the apical half of the distal joint faintly brownish ochraceous. Apical area of the head also tinged with green. Pronotum thickly covered with minute brown punctures, those near the margins being smaller and paler ; the anterior and lateral margins greenish, the posterior margin pale ochraceous, impunctate, and the posterior pronotal area obscurely transversely striate. Scutellum ochraceous, rugosely, transversely striate, sparingly punctured, its apex pale and impunctate. Hemelytra ochraceous with the punctures on the clavus arranged almost in regular lines. Underside greenish ochraceous. Length 19 mm., breadth 5 mm. The green colouration in specimens of this genus invariably fades, becoming pale yellow or ochraceous.

Recorded from Sikkim ; Khasi Hills ; Sibsagar ; Burma ; Ruby Mines, Karen-ni, and Palon. The type was described from Cochin China ; Mr. Distant possesses specimens from the Malay Peninsula and Sumatra.

The specimens in the collection of the Zoological Survey of India are from Sikkim ; Arakan ; Sibsagar ; and Soondrijal, Nepal Valley.

Pendulinus antennatus (Kirby).

1891. *Homoeocerus antennatus,* Kirby, *Journ. Linn. Soc. Zool.* XXIV, p. 90, pl. iv, f. 6.
1902. *Pendulinus antennatus,* Distant, *Faun. Brit. Ind. Rhyn.* I, p. 389.

Barkuda, 25-vii—4-viii-17.

A specimen of this species in the collection of the Zoological Survey of India from Kandy, Ceylon, is identical with the Barkuda specimen, but as members of this genus also have a tendency to lose their natural colour, if preserved dry for any length of time, a few remarks may be made on the colouration of a comparatively fresh specimen. The first, second and third joints of the antennae are olivaceous green, thickly covered with numerous minute black dots, the " ring " at the base of the

third joint is very pale green without any black dots, the fourth joint is reddish-brown with a broad pale basal band. The anterior area of the pronotum, besides having four black dots, has also a distinct black, transverse, irregular fascia. The membrane is shining hyaline, but appears to be fuscous, when at rest, on the dark dorsal surface of the abdomen.

Recorded only from Ceylon.

Eusthetus insularis, sp. nov.

Described from a single specimen taken at Barkuda on 20-vii-1914.

Head black with the lateral lobes, apex of central lobe, an irregular transverse band between eyes, a rather broad band bordering the inner margins of the eyes and extending posteriorly to the basal margin of the head, a linear longitudinal streak between the ocelli and a somewhat broad, medially interrupted fascia on each side of the head, below the antennae and the eyes, brownish ochraceous. Antennae light brown with the apices of the first, second and third joints narrowly piceous ; first and third joints subequal in length, second shortest, about half the length of the fourth, which is longest ; some short stiff black bristles on the first, second and third joints. Underside of head with a broad central, longitudinal, shining black fascia. Rostrum with the basal joint incrassate, black, the remaining joints brown, with the apical half of the last joint piceous. Rostrum reaching the middle of the mesonotum.

Pronotum brown with three discal, longitudinal, piceous bands, of which the central is broadest, and most distinct. Anterior area with a shallow transverse depression a little behind anterior margin, covered with short silky hairs and with a short, longitudinal, ochraceous line ; posterior area slightly raised, with numerous, small, black punctures on disk. Anterior angles rounded, posterior angles acute ; posterior margin concavely sinuate before scutellum, obliquely ascending at the sides. Scutellum black, with a central longitudinal line and the apex broadly luteous ; disk with some rather long, decumbent hairs. Hemelytra very dark brown, thickly punctured with black ; a few linear spots on disk of corium a little beyond middle, luteous ; costal margin paler ; membrane fuscous, thickly speckled with greyish-white.

Underside shining black, clothed with very fine silvery hairs, which are most dense on the sides of the sternum ; a large patch on each lateral area of the prosternum, the apices of the coxal cavities, a spot on the anterior margin of the mesosternum, the lateral and basal margins of the metasternum, a broad oblique lateral fascia on each side of the third abdominal segment and a small spot at the external basal angle of the fourth segment, luteous. Abdomen above black, with a broad longitudinal reddish ochraceous band extending from the basal segment to the apex of the fifth segment, the apical margin of the fifth segment narrowly and the centre of the remaining segments luteous ; connexivum black and luteous alternately, the luteous markings less distinct on the underside of the fifth and posterior segments.

Legs ochraceous above, thickly mottled with black, underside of femora blackish ; apices of tibiae and tarsi black ; intermediate and

posterior femora black with a subapical pale annulation; apices of intermediate femora luteous. Length 10·5 millim.

Type No. 7242/H.I. in the collection of the Zoological Survey of India.

Family LYGAEIDAE.

Aspilocoryphus guttiger (Dall.)

1852. *Lygaeus guttiger*, Dallas, *List Hem.* II, p. 574.
1904. *Aspilocoryphus guttiger*, Distant, *Faun. Brit. Ind. Rhyn.* II, p. 11.

Barkuda, 13—18-iv-14, 25-vii—4-viii-17.

[Single individuals of this species are not infrequently seen on the ground in the more open parts of the jungle.]

Recorded from North Bengal. Represented in the collection of the Zoological Survey of India from Calcutta; Ranchi; Dharampur (under stone), *ca.* 5,000 ft., Simla hills; and Kufri, near Simla, W. Himalayas, 8,000 ft.

Nysius ceylanicus (Motsch.)

1863. *Heterogaster ceylanicus*, Motsch., *Bull. Soc. Nat. Mosc.*, p. 78.
1904. *Nysius ceylanicus*, Distant, *Faun. Brit. Ind. Rhyn.* II, p. 18.

Barkuda, 25-vii—4-viii-17.

Recorded from East Himalayas: Mungphu; Chota Nagpur, Ranchi; Ceylon. A very widely distributed species.

Dieuches femoralis, Dohrn.

1860. *Dieuches femoralis*, Dohrn, *Stett. ent. Zeit.* XXI, p. 405.
1872. *Rhyparochromus anticus*, Walker, *Cat. Het.* V, p. 100.
1872. *Rhyparochromus siamicus*, Walker, *Cat. Het.* V, p. 102.
1889. *Dieuches alternatus*, Horvath, *Termész. Füzetek*, p. 36.
1904. *Dieuches femoralis*, Distant, *Faun. Brit. Ind. Rhyn.* II, p. 84.

Barkuda, 25-vii—4-viii-17.

Recorded from Assam: Margherita, Naga Hills; Sikkim; Kashmir; Ceylon; Burma: Palon, Bhamo; Tenasserim, Malewoon; Batchian. Represented in the collection of the Zoological Survey of India from Siliguri, base of E. Himalayas, Bengal; Kurseong, *ca.* 5,000 ft., Darjiling district, and Pashok, 3,500 ft., Darjiling district, E. Himalayas.

Family PYRRHOCORIDAE.

Scantius forsteri (Fabr.)

1781. *Cimex forsteri*, Fabricius, *Spec. Ins.* II, p. 368.
1781. *Cimex clavimanus*, Fabricius, *Spec. Ins.* II, p. 368.
1822. *Lygaeus deustus*, Thunberg, *Hem. Rostr. Cap.* IV, p. 3.
1848. *Pyrrhocoris clavimanus*, Herrich-Schäffer, *Wanz. Ins.* VIII, p. 102, f. 871.
1848. *Pyrrhocoris forsteri*, Herrich-Schäffer, *Wanz. Ins.* VIII, p. 102, f. 872.
1860. *Dermatinus centralis*, Signoret, *Ann. Soc. Ent. Fr.* p. 952.
1865. *Scantius forsteri*, Stål, *Hem. Afr.* III, p. 10.
? 1873. *Scantius volucris*, Gerstaecker, in V. d. Decken's *Reise*, III, p. 413.
1904. *Scantius volucris*, Distant, *Faun. Brit. Ind. Rhyn.* II, p. 117.
1910. *Scantius forsteri*, Distant, *Faun. Brit. Ind. Rhyn.* V (Appendix), p 98.

Barkuda, 15—22-vii-16, 25-vii—4-viii-17.

[This species is entirely terrestrial in habits, hiding under stones and recumbent tree trunks.]

Recorded from ? Madras ; ? Coonoor ; Purneah, Bihar ; S. Africa ; Madagascar ; Seychelle Islands. Represented in the collection of the Zoological Survey of India from Meerut, United Provinces of Agra and Oudh ; Purneah district, Bihar ; and on board ship off Coconada, Madras Coast.

Family HYDROMETRIDAE.

[*Gerris tristan*, Kirk., is the only species of this family that I have seen in large numbers on the pond in the middle of the island. It is not, however, a constant inhabitant, though it was common in July, 1916. I could not find a single specimen in July, 1917.]

Mesovelia mulsanti, Buch. White.

1879. *Mesovelia mulsanti,* Buchanan White, *Tr. Ent. Soc. Lond.*, p. 268.
1884. *Mesovelia bisignata,* Uhler, in Kingsley's *Stand. Nat. Hist.* II, p. 273, f. 324.
1893. *Mesovelia bisignata,* Uhler, *Proc. Zool. Soc. Lond.*, 1893, p. 706.
1898. *Mesovelia mulsanti,* Champion, *Biol. Centr. Amer. Rhyn.* II, p. 123, pl. viii, ff. 10 and 11.
1900. *Mesovelia orientalis,* Kirkaldy, *Ann. Mus. Civ. Gen.* XL, p. 808.
1904. *Mesovelia mulsanti,* Distant, *Faun. Brit. Ind. Rhyn.* II, p. 169.
1910. *Mesovelia mulsanti,* Distant, *Faun. Brit. Ind. Rhyn.* V (Appendix), p. 137.
1915. *Mesovelia mulsanti,* Annandale and Kemp, *Mem. Ind. Mus.* V, p. 181.

Barkuda, on pond in the middle of the island, 15—22-vii-16, 25-vii—4-viii-17.

Recorded from Bengal : Calcutta (at light), Port Canning (brackish pools), Rajshahi ; Puri, Orissa Coast ; Lucknow, United Provinces ; Peradeniya, Tangalla, Ceylon ; Sumatra ; also found in North and Central America, and in the Antilles. Represented in the collection of the Zoological Survey of India from Bengal : Calcutta and Port Canning. Orissa : Puri and Barkul. United Provinces : Lucknow. Kumaon : Naini Tal, *ca.* 6,400 ft. Madras : Ganta Sila hill near Rambha, Chilka Lake. South India : Bangalore. Tenasserim : Kawkareik, Amherst district. Andamans : Port Blair.

Microvelia diluta, Dist.

1909. *Microvelia diluta,* Distant, *Ann. Mag. Nat. Hist.* (8) III, p. 500.
1910. *Microvelia diluta,* Distant, *Faun. Brit. Ind. Rhyn.* V (Appendix), p. 139.

Barkuda, on pond in the middle of the island, 25-vii—4-viii-17.

Recorded from Calcutta and Rajshahi, Bengal, and represented in the collection of the Zoological Survey of India from Calcutta and Rajshahi, Bengal ; Lucknow, United Provinces ; Puri, Orissa Coast ; Rambha, Ganjam district, Madras Presidency.

Gerris tristan, Kirk.

1899. *Gerris tristan,* Kirkaldy, *Rev. Ent.* p. 88.
1904. *Gerris tristan,* Distant, *Faun. Brit. Ind. Rhyn.* II, p. 179.
1910. *Gerris tristan,* Distant, *Faun. Brit. Ind. Rhyn.* V (Appendix), p. 144.
1915. *Gerris tristan,* Annandale and Kemp, *Mem. Ind. Mus.* V, p. 182.

Barkuda, on pond in the middle of the island, 25-vii—4-viii-17.

Recorded from Bengal: Port Canning, Dhappa, near Calcutta, Rajshahi. Orissa: Sur Lake, Puri district. United Provinces: Naini Tal, Kumaon. Burma: Moulmein. Ceylon. Represented in the collection of the Zoological Survey of India from Bengal: Calcutta, Dhappa, Port Canning, Rajshahi, Berhampore Court. United Provinces: Naini Tal, 6,400 ft., Malwa Tal, 3,600 ft., Sat Tal, 4,500 ft., Bhim Tal, 4,450 ft., and Kathgodam, 1,200 ft., all in Kumaon. Orissa: Bhubaneswar, Barkul, Sur Lake, Puri district. Madras: on surface of Chilka Lake, among rocks at edge of Chilka Lake, base of Ganta Sila hill near Rambha.

Family REDUVIIDAE.

[All the members of this family found on the island are apparently of terrestrial habits and probably predaceous. None of them, however, are at all common, and in most cases only single specimens were captured.]

Bagauda splendens, Dist.

1906. *Bagauda splendens*, Distant, *Ann. Mag. Nat. Hist.* (7) XVIII, p. 364.
1909. *Bagauda decorus*, Breddin, *Ann. Soc. Ent. Belg.* 1909, p. 301.
1910. *Bagauda splendens*, Distant, *Faun. Brit. Ind. Rhyn.* V (Appendix), p. 176.

Barkuda, 15—22-vii-16, 25-vii—4-viii-17.

Recorded only from Ceylon and not previously represented in the collection of the Zoological Survey of India.

[This species lives amongst vegetation at the edge of water.]

Petalochirus burmanus, Dist.

1903. *Petalochirus burmanus*, Distant, *Ann. Soc. Ent. Belg.* 1903, p. 55.
1904. *Petalochirus burmanus*, Distant, *Faun. Brit. Ind. Rhyn.* II, p. 242.

Barkuda, 15-22-vii-16.

Recorded from Burma, Bhamo, and not previously represented in the collection of the Zoological Survey of India.

Acanthaspis fulvipes (Dall.)

1850. *Platymeris fulvipes*, Dallas, *Trans. Ent. Soc. Lond.* 1850, p. 6, pl. ii, fig. 3.
1863. *Acanthaspis fulvipes*, Stål, *Ann. Soc. Ent. France*, 1863, p. 149.
1873. *Acanthaspis quadrinotata*, Walker, *Cat. Het.* VII, p. 175.
? *Acanthaspis quadristillatus*, Stål, MS.
1902. *Acanthaspis fulvipes*, Distant, *Ann. Mag. Nat. Hist.* (7) X, p. 183.
1904. *Acanthaspis fulvipes*, Distant, *Faun. Brit. Ind. Ryhn.* II, p. 259.

Barkuda, at light, 19-vii-14 and 15-22-vii-16.

Recorded from Bhutan; Sikkim; Sibsagar, Assam; East Bengal; and represented in the collection of the Zoological Survey of India from Bengal: Rangamati, Chittagong Hill Tracts; Darjiling district: Sukna, 500 ft., Sevoke, in stable at Kalijhora, Teesta Valley. Chota Nagpur: Ranchi. Assam: Cachar and Sibsagar.

On the 19th of September, 1916 the Rev. Dr. Sutherland of Kalimpong gave us a larva of a Reduviid bug covered all over with dust and dirt, which he had caught crawling about the floor of a stable at Kalijhora, on the Teesta-Kalimpong Road. It was kept alive in a breeding cage, being fed occasionally with small flies, chiefly Muscids. On the 1st of November it cast its skin. This probably took place during

the night, as when it was observed on the morning of the 2nd November it was seen to have covered its new skin with a very thick coating of dust and dirt, much thicker even than in its earlier stage. As the days went on, several dead flies, together with other rubbish, were found collected on the back of the bug, presumably placed there by it after it had sucked them dry. It was also noticed that it seldom attacked the flies by day unless it had had no food for several days. These bugs have a habit of seeking dark corners in houses and crevices in trees and probably never feed in bright sunshine. Our larva was, however, always on the alert during the day and when disturbed it would make a sudden dart from one place to another, remaining perfectly still for some time, thus giving itself the appearance of a piece of rubbish being blown about by the wind. It continued to add fresh rubbish to its cloak and thus seemed to grow bigger daily until it emerged as an adult on the 10th of March, 1917 It is probable that a whole year is occupied in its complete life-cycle.

The two cast skins and the adult are preserved in the collection of the Zoological Survey of India.

Ectomocoris cordiger, Stål.

1866. *Ectomocoris cordiger*, Stål, *Öfv. Vet.-Ak. Förh.* 1866, p. 256.
1873. *Pirates adjunctus*, Walker, *Cat. Het.* VII, p. 114.
1902. *Ectomocoris cordiger*, Distant, *Ann. Mag. Nat. Hist.* (7) X, p. 283.
1904. *Ectomocoris cordiger*, Distant, *Faun. Brit. Ind. Rhyn.* II, p. 295.

Barkuda, 15—25-vii-16.

Recorded from North Bengal ; Sylhet ; Bombay ; Bor Ghát ; Ceylon ; Persian Gulf. Represented in the collection of the Zoological Survey of India from Bengal : Calcutta (at light), Madhupur (at light), Tinpahar, near Rajmahal. Behar : Purneah. Chota Nagpur : Ranchi and base of hills, Chakradharpur, Singhbhum district. United Provinces : Meerut, Almora, 5,500 ft., Kumaon. S. India : Nilgiris, 3,500 ft. Lower Burma : Kawkareik to third camp, Amherst district.

Harpactor marginatus (Fabr.)

1794. *Reduvius marginatus*, Fabricius, *Ent. Syst.* IV, p. 196.
1874. *Chirillus marginatus*, Stål, *Ent. Hem.* IV, p. 39.
1881. *Harpactor marginatus*, Reuter, *Ac. Soc. Sc. Fenn.* XII, p. 293.
1891. *Sycanus ? militaris*, Kirby, *Journ. Linn. Soc. Zool.* XXIV, p. 119.
1903. *Harpactor marginatus*, Distant, *Ann. Mag. Nat. Hist.* (7) XI, p. 205.
1904. *Harpactor marginatus*, Distant, *Faun. Brit. Ind. Rhyn.* II, p. 332.

Barkuda, 21-vii-14.

Recorded from " North India ; " Vizagapatam ; Ceylon. Represented in the collection of the Zoological Survey of India from Bengal : Calcutta ; Tinpahar, near Rajmahal. Chota Nagpur : Chaibassa. United Provinces : Hardwar and Lucknow. Bombay : Dhom, Krishna Valley, *ca.* 2,400 ft. ; Beyt, Dwarka, Kathiawar ; Uparkot, Janagadh, Kathiawar ; Sasan, Kathiawar. Madras : Vizagapatam. South India : Bangalore.

Harpactor squalus, Dist.

1904. *Harpactor squalus*, Distant, *Faun. Brit. Ind. Rhyn.* II, p. 333.

Barkuda, xi-14 and 15—22-vii-16.

Recorded only from Sikkim ; Punkabari. Represented in the collection of the Zoological Survey of India from Bengal: Manbhum. Chota Nagpur: Chakradharpur ; pass between Chaibassa and Chakradharpur. Orissa: Balugaon and Dhauli, Puri district ; Hill above Barkul, Puri district, 0—1,000 ft. Madras: under stone on hill near Rambha, and at Rambha, Ganjam district.

Harpactor fuscipes (Fabr.)

1787. *Reduvius fuscipes*, Fabricius, *Mant. Ins.* II, p. 312.
1803. *Reduvius fuscipes*, Fabricius, *Syst. Rhyng.*, p. 278.
1804. *Reduvius sanguinolentus*, Wolff, *Ic. Cim.* IV, p. 166, f. 160.
1825. *Reduvius corallinus*, Le Pelétier et Serville, *Enc. Méth.* X, p. 279.
1868. *Reduvius fuscipes*, Stål, *Hem. Fabr.* I, p. 110.
1891. *Harpactor bicoloratus*, Kirby, *Journ. Linn. Soc. Zool.* XXIV, p. 120.
1903. *Harpactor fuscipes*, Distant, *Ann. Mag. Nat. Hist.*, (7) XI, p. 205.
1904. *Harpactor fuscipes*, Distant, *Faun. Brit. Ind. Rhyn.* II, p. 333.

Barkuda, 17—21-vii-14, 15—22-vii-16.

Recorded from Bombay, Bor Ghat ; Ceylon. Represented in the collection of the Zoological Survey of India from Bengal: Calcutta ; Siliguri ; Punkhabari, Darjiling district, and Bombay.

Harpactor varians, sp. nov.

Barkuda, 21-vii-14.

Head, pronotum, scutellum and legs shining black, with some short stiff hairs on the legs and the margins of the pronotum. A spot at the inner margin of each eye, posteriorly, a lateral spot before each eye, a linear spot between the ocelli on disk, and a central longitudinal fascia on the underside of the head, luteous ; (these markings are liable to variation) ; head deeply impressed behind eyes. Antennae light brown, the base of the first joint shining black, its apex and the whole of the second joint dark brown ; first joint longest, equal in length to the second and third together, second shortest, third and fourth subequal. Anteocular area of head a little shorter than the postocular.

Rostrum reaching the anterior coxae ; the first joint longer than anteocular area of head, equal to the second joint, third joint shortest. Pronotum with the anterior lobe convex, centrally longitudinally sulcate, the anterior angles produced into two short obtuse spines directed slightly backwards ; posterior lobe with the disk slightly rounded ; the sides depressed, lateral angles rounded and obliquely suberect, posterior margin straight before the scutellum, obliquely ascendant at the sides. Sometimes there are three very pale luteous spots on the disk of the posterior lobe, two on the anterior area and one on the posterior margin. Scutellum with its apex cretaceous-white. Hemelytra very pale luteous, transparent, the inner margin of the clavus slightly fuscous, apical angle of corium longly produced ; membrane shining, hyaline. Abdomen above and beneath luteous, the central portion of the disk above dark brown ; connexivum with linear brown marks on the third to the fifth segments. Legs with the femora nodulosely incrassate.

Length 7-8 millim.

Type No. 3924/H.I. in the collection of the Zoological Survey of India.

Sycanus collaris (Fabr.)

1781. *Reduvius collaris*, Fabricius, *Spec. Ins.* II, p. 380.
1874. *Sycanus collaris*, Stål. *Ent. Hem.* IV, p. 28.
1904. *Sycanus collaris*, Distant (part.), *Faun. Brit. Ind. Rhyn.* II, p. 351.
1910. *Sycanus collaris*, Distant, *Faun. Brit. Ind. Rhyn.* V (Appendix), p. 208.

Barkuda, 15—22-vii-16.

Recorded from Bengal; Ceylon; Malacca. Represented in the collection of the Zoological Survey of India from Bengal: Sahebganj; Darjiling, *ca.* 7,000 ft., Punkabari, Darjiling district, E. Himalayas. Chota Nagpur: Ranchi. Orissa: Angul. Madras. South India: Teppukadu, Nilgiri hills, 3,000 ft.

Family NEPIDAE.

Laccotrephes griseus (Guér.)

1829—1838. *Nepa griseus*, Guérin, *Iconogr. Règne Anim., Ins.*, p. 352, pl. lvii, f. 7.
1868. *Laccotrephes maculatus*, Stål (part.), *Hem. Fabr.* I, p. 135.
1906. *Laccotrephes maculatus*, Distant (part.), *Faun. Brit. Ind. Rhyn.* III, p. 19.
1910. *Laccotrephes griseus*, Montandon, *Ann. Mus. Zool. Napoli*, III, n. 10, p. 3.
1910. *Laccotrephes griseus*, Distant, *Faun. Brit. Ind. Ryhn.* V (Appendix), p. 314.

Barkuda, 15—22-vii-16, 25-vii—4-viii-17

Recorded from Bengal ; Madras; Pondicherry; Ceylon; Burma; Malacca; Seychelles; Mahe. Represented in the collection of the Zoological Survey of India from Punjab: Rawalpindi. W Himalayas: Dharampur Kooa, Patiala State, base of Simla hills; Lobha, Garhwal district. United Provinces: Bhimtal, 4,450 ft.; Kumaon; Gorakhpur; Lucknow; Mowai, Bara Banki; Chukri Mukri. Nepal Terai. Behar: Siripur, Saran. Bengal: Manbhum; Berhampore Court; Calcutta; Durgapur, near Calcutta (sitting on a reed at edge of brackish water canal. *N A.*); Rajshahi; Siliguri. Orissa: Puri; Satpura, Puri district. Bombay: Bandra; Dhankal, near Helvak, Satara district, 2,400-2,600 ft.; Kathiawar; Porbandar. Madras: south end of Lake Chilka. Cochin State: Kavalai, 1,300-3,000 ft. Travancore: Tenmalai, W. Ghats (west side). Ceylon: Colombo; Peradeniya. Siam: Pak Raw, Tale Sap (in small creek).

In his Appendix Distant states that the difference between *Laccotrephes maculatus* (Fab.) and *Laccotrephes griseus* (Guér.) is that the anterior area of the prosternum in the former is entirely straight and non-tuberculous, while in the latter this area has a strong acute tubercle. I have examined several specimens in the collection of the Zoological Survey of India including one from Lobha and find that the tubercle is present in all of them and there is no specimen, agreeing in size with *L. griseus*, which is without this acute tubercle. *L. maculatus*, therefore, does not appear to be represented in this collection.

Ranatra ? filiformis, Fabr.

1790. *Ranatra filiformis*, Fabricius, *Skrivt. af Naturh. Selsk.* I, i, p. 228.3.
1794. *Ranatra filiformis*, Fabricius, *Ent. Syst.* IV, p. 64.
1868. *Ranatra filiformis*, Stål, *Hem. Fabr.* I, p. 135.
1906. *Ranatra filiformis*, Distant, *Faun. Brit. Ind. Rhyn.* III, p. 21.

A very badly preserved specimen from Barkuda, 15—22-vii-16.

Owing to its bad condition I am not quite sure of the identity of this specimen. Structurally it agrees with the description given by Distant.

Recorded from Quetta; Karachi; Behar; Assam: Sibsagar; Tranquebar; Bombay; Johore; Phillippines.

Family BELOSTOMATIDAE.

Sphaerodema molestum (Duf.)

1863. *Appasus molestum*, Dufour, *Ann. Soc. Ent. Fr.*, 1863, p. 395.
1863. *Nervinops rusticus*, Dufour, *Ann. Soc. Ent. Fr.*, 1863, p. 399.
1871. *Diplonychus molestum*, Mayr, *Verh. zool.-bot. Ges. Wien*, XXI, p. 437.
1871. *Diplonychus subrhombeus*, Mayr, *Verh. zool.-bot. Ges. Wien*, XXI, p. 437.
1906. *Sphaerodema molestum*, Distant, *Faun. Brit. Ind. Rhyn.* III, p. 36.

Barkuda, in small pond in the middle of the island, 15-22-vii-16.

Recorded from Kashmir; Calcutta tanks; Malacca.

Family NOTONECTIDAE.

[All the species represented in the collection are abundant in the pond, but *Anisops niveus* is less so than the other two.]

Anisops sardea, Herr.-Schäff.

1775. *? Notonecta alba*, Forskål, *Descr. Amin. Orient.*, p. xxiii.
1837. *Anisops nivea*, Spinoret, nec Fabricius, *Ess. Hem.*, p. 58.
1851. *Anisops productus*, Fieber, *Rhynchotogr.*, p. 60.
1852. *Anisops sardea*, Herrich-Schäffer, *Wanz. Ins.* IX, p. 40, f. 904.
1855. *Anisops natalensis*, Stål, *Ofv. Vet.-Ak. Förh.* XII, p. 89.
1865. *Anisops productus*, Stål, *Hem. Afr.* III, p. 191.
1870. *Notonecta nanula*, Walker, *Zoologist*, 1870, p. 2381.
1904. *Anisops sardea*, Kirkaldy, *Wien. ent. Zeit.* XXIII, p. 114 et syn.
1906. *Anisops sardea*, Distant, *Faun. Brit. Ind. Rhyn.* III, p. 45.

Barkuda, in small pond in the middle of the island, 16-17-vii-14, 15—22-vii-1916, 25-vii—4-viii-17.

Recorded from Bombay; Burma: Minhla. Widely distributed in S. Palaearctic and Ethiopian Regions.

Anisops niveus (Fabr.)

1775. *Notonecta nivea*, Fabricius, *Syst. Ent.*, p. 690.
1798. *Notonecta ciliata*, Fabricius, *Ent. Syst. Suppl.*, p. 524.
1851. *Anisops hyalinus*, Fieber, *Abh. böhm. Ges. Wiss.* (5) VII, p. 482.
1868. *Anisops ciliatus*, Stål, *Vet.-Ak. Handl.* VII, 11, p. 137.
1873. *Anisops pellucens*, Gerstaecker, Van der Decken's *Reise*, III, 2, p. 424.
1895. *Anisops scutellaris*, de Carlini, *Ann. Mus. Civ. Gen.* XXXV, p. 123.
1899. *Anisops niveus*, Kirkaldy, *Ann. Soc. Ent. Fr.* 1899, p. 105.
1904. *Anisops niveus*, Kirkaldy, *Wien. ent. Zeit.* XXIII, p. 118.
1906. *Anisops niveus*, Distant, *Faun. Brit. Ind. Rhyn.* III, p. 46.

Barkuda, in small pond in the middle of the island, 16-vii-14, 25-vii—4-viii-17.

Plea pallescens, Dist.

1906. *Plea pallescens*, Distant, *Faun. Brit. Ind. Rhyn.* III, p. 48.
1910. *Plea pallescens*, Distant, var. *Faun. Brit. Ind. Rhyn.* V (Appendix), p. 336.

Barkuda, in small pond in the middle of the island, 15-22-vii-1916, 25-vii—4-viii-1917.

Recorded from Bengal: Calcutta (in tanks); Rajshahi. United Provinces: Lucknow. Cochin State: Ernakulam.

Family CORIXIDAE.

Micronecta dione, Dist.

1910. *Micronecta dione*, Distant, *Faun. Brit. Ind. Rhyn.* V (Appendix), p. 348.

Barkuda, 25-vii—4-viii-17
Recorded from Bengal: Asansol; Calcutta (at light).

Family CICADIDAE.

Terpnosia jenkinsi, Distant, var.

1912. *Terpnosia jenkinsi*, Distant, *Ann. Mag. Nat. Hist.* (8) IX, p. 183.
1916. *Terpnosia jenkinsi*, Distant, *Faun. Brit. Ind. Rhyn.* VI (Appendix), p. 9.

A single male from Ganta Sila hill near Rambha, Ganjam district, Madras Presidency, 22-vii-16.

This specimen agrees structurally with a specimen in the collection of the Zoological Survey of India from Paresnath hill, 4,000-4,400 ft., Bengal (v-1909), identified by Distant, except that it is slightly smaller and narrower. The markings on the body, both above and beneath, although similar in position and shape, are much smaller and narrower, giving the insect a paler appearance. It is probably a pale variety of *T jenkinsi* and like it there is an abnormality in the tegmen, where there is a distinct small cell at its apical margin between the first and second apical areas, the one on the right tegmen being larger than the one on the left.

[This Cicada is rare on Barkuda, but common on a neighbouring island and on the hill Ganta Sila near Rambha. It is diurnal in habits and always lives amidst a dense growth of trees or shrubs. Its song is very harsh and never prolonged for more than a few minutes at a time. It commonly settles on tree-trunks, on which it is most inconspicuous. The male begins to sing as soon as he is settled, and as a rule flies off to another tree as soon as his song is finished. Although the species was heard daily in July and August, and frequently seen, as it flew from tree to tree, we succeeded in catching only one specimen.]

Family FULGORIDAE.

Dichoptera hyalinata (Fabr.)

1781. *Fulgora hyalinata*, Fabricius, *Spec. Ins.* II, p. 315.
1791. *Fulgora hyalinata*, Olivier, *Enc. Méth.* VI, p. 572.
1800. *Fulgora hyalinata*, Donovan, *Ins. Ind.* t. vii, f. 3.
1818. *Flata hyalinata*, Germar, *Mag. Ent.* III, p. 190.
1834. *Pseudophana hyalinata*, Burmiester, *Handb. Ent.* II (1), p. 160.
1839. *Dichoptera hyalinata*, Spinoret, *Ann. Soc. Ent. Fr.*, 1839, p. 289, t. xiii, f. 3.
1886. *Dichoptera hyalinata*, Atkinson, *Journ. As. Soc. Bengal* LV, p. 23.
1906. *Dichoptera hyalinata*, Distant, *Faun. Brit. Ind. Rhyn.* III, p. 238.

Barkuda, 15—22-vii-16, 25-vii—4-viii-17.

[This species usually rests on the bark of trees, on which it is very inconspicuous. It is not at all rare on Barkuda.]

In one sex, probably the female, the tegmina have, besides the piceous transverse fascia at apices of ulnar veins, another piceous transverse fascia between this fascia and the base.

Recorded from Bengal; Calcutta; Bombay; Bangalore; Ceylon: Tangalla; Andamans.

Family MEMBRACIDAE.

[I doubt whether any species of this family breeds on the island.]

Leptocentrus substitutus (Walk.)

1851. *Centrotus substitutus*, Walker, *List Hom.* II, p. 605.
1858. *Centrotus obliquus*, Walker, *Ins. Saund., Hom.* p. 79.
1858. *Centrotus flexicorne*, Walker, *Ins. Saund., Hom.* p. 78.
1885. *Leptocentrus substitutus*, Atkinson, *Journ. As. Soc. Bengal* LIV, p. 87.
1886. ? *Centrotus flexicorne*, Atkinson, *Journ. As. Soc. Bengal* LV, p. 197.
1886. ? *Centrotus obliquus, id. ibid.* LV, p. 197.
1908. *Leptocentrus substitutus*, Distant, *Faun. Brit. Ind. Rhyn.* IV, p. 29.
1916. *Leptocentrus substitutus*, Distant, *Faun. Brit. Ind. Rhyn.* VI (Appendix), p. 154.

Barkuda, 15—22-vii-16, 25-vii—4-viii-17.

Recorded from Bengal: Calcutta, Rajmahal. Behar: Bhogaon, Purneah district. Orissa: Puri. Bombay. Madras: Gopkuda Island, Chilka Lake, Ganjam district. S. India: Mysore. Ceylon: Peradeniya, Elephant Pass, Balangoda, Colombo, Yatiyantota, Kelan Valley.

[This is a very common insect on diverse plants in many parts of India. On Barkuda I have only seen it on the leguminous shrub *Crotolaria striata*, D. C., and have never succeeded in finding the young, which in other parts of India are usually to be found with the adult.]

Coccosterphus minutus (Fabr.)

1798. *Membracis minutus*, Fabricius, *Ent. Syst. Suppl.*, p. 514.
1803. *Centrotus minutus*, Fabricius, *Syst. Ryhng.*, p. 22.
1846. ? *Scaphula minutus*, Fairmaire, *Ann. Soc. Ent. Fr.* 1846, p. 495.
1869. *Coccosterphus minutus*, Stål, *Hem. Fabr.* II, p. 51.
1885. *Coccosterphus minutus*, Atkinson, *Journ. As. Soc. Beng.* LIV, p. 89.
1903. *Coccosterphus minutus*, Melichar, *Hom. Faun. Ceylon*, p. 121.
1908. *Coccosterphus minutus*, Distant, *Faun. Brit. Ind. Rhyn.* IV, p. 71.
1916. *Coccosterphus minutus*, Distant, *Faun. Brit. Ind. Rhyn.* VI (Appendix), p. 175.

Barkuda, 25-vii—4-viii-17, also one specimen identified by Distant from the Chilka Survey, 21-vii-14.

Stål recorded it from "Tranquebar."

Family JASSIDAE.

[The members of this family are very scarce on this island. I have observed *Eutettix phycitis*, Dist., feeding on *Crotolaria striata*, D. C., but with this exception, the few specimens we obtained flew to light in the evening.]

Thomsoniella porrecta (Walk.)

1858. *Acocephalus porrectus*, Walker, *List Hem. Suppl.*, p. 262.
1859. *Platymetopius lineolatus*, Motsch., *Étud. Ent.* VIII, p. 114.
1870. *Hecalus kirschbaumii*, Stål, *Ofv. Vet.-Ak. Förh.*, 1870, p. 737.
1880. *Thomsoniella kirschbaumii*, Signoret, *Ann. Soc. Ent. Fr.* 1880, p. 52, t. i, f. 44.
1885. *Thomsoniella kirschbaumii*, Atkinson, *Journ. As. Soc. Beng.* LIV, p. 104.
1903. *Thomsoniella porrecta*, Melichar (part.) *Hom. Faun. Ceylon*, p. 173.
1906. *Thomsonia lineolatus*, Kirkaldy, *Rep. Exp. Stat. Haw. Plant. Assoc.*, pt. IX, p. 337.
1906. *Thomsonia kirschbaumii*, Kirkaldy, *Rep. Exp. Stat. Haw. Plant. Assoc.* pt. IX, p. 338.
1908. *Thomsoniella porrecta*, Distant, *Faun. Brit. Ind. Rhyn.* IV, p. 278.

Barkuda, 25-vii—4-viii-17.

Recorded from Bengal : Calcutta. Behar : Pusa. Burma : N. Shan Hills. Maldive Islands : Minikoi. Ceylon : Peradeniya, Newara Eliya, Puttalam, Negombo, Bandarawella. Phillippines. Queensland : Cairns.

Eutettix phycitis, Distant.

1908. *Eutettix phycitis*, Distant, *Faun. Brit. Ind. Rhyn.* IV, p. 363.

Barkuda, 25-vii—4-viii-19.

Recorded from Bengal : Calcutta. Behar : Pusa ; Purneah. Ceylon : Kandy.

Also three specimens representing three species of Jassidae. They all belong to very minute species which appear to fall into the subfamily Typhlocybinae.

II. SOME UNDESCRIBED TADPOLES FROM THE HILLS OF SOUTHERN INDIA.

By N. ANNANDALE, *D.Sc.*, *F.A.S.B.*, *Director, Zoological Survey of India.*

(Plate I.)

With one exception the tadpoles here described were found in the hills of Cochin, in most cases with young frogs of their species, by Dr. F. H. Gravely and Mr. B. Sundara Raj in September, 1914. The tadpole of *Nyctibatrachus pygmaeus* was, however, obtained by Capt. R. B. S. Sewell, I.M.S., in a small lake in the Nilgiris. The species from Cochin are particularly interesting as illustrating peculiar adaptations in tadpoles that live in hill-streams.

Rana verrucosa, Günther.

(Plate I, figs. 1, 1*a*.)

Boulenger, *Faun. Brit. Ind., Rept.*, p. 448 (1890).

The tadpole is small, by no means stout ; the head and body are rather narrowly ovoid and somewhat depressed ; the snout is bluntly pointed and declivous ; the nostrils as seen from above appear to be nearer the tip of the snout than to the eyes ; the distance between them is about half that between the eyes, which are situated on the dorsal surface but directed outwards and are evidently prominent in life. The spiracle is situated a little below the eye, nearer to it than to the posterior end of the body ; it is tubular in form and points backwards and a little upwards. The ventral surface is convex.

The mouth-disk is very small and of the normal type, directed downwards and a little forwards, distinctly transverse in form, with a lateral emargination on either side ; the anterior margin of the upper lip is fringed with teeth and devoid of papillae ; the lateral margins are fringed with papillae, which become rather longer at the sides of the posterior margin ; the middle part of this margin is smooth. The dental formula is 1 : 1+1/3. The upper beak is crescentic and slender ; the lower beak broadly V-shaped. The margins of both parts are very minutely serrated ; the basal half of the lower beak is colourless.

The tail is relatively short and slender, tapering gradually, sharply pointed, with the fin-membranes relatively broad and the upper one commencing on the posterior part of the body. The anus is directed to the right.

The dorsal surface of the body is blackish, indistinctly mottled and marbled with white ; on the snout and sides the colourless markings are of greater extent and more conspicuous ; a dark spot occurs over each nostril ; the ventral surface is colourless and transparent ; the tail is whitish with conspicuous dark brown spots and irregular markings.

Measurements of a specimen with the hind legs well-developed :—

	mm.
Total length .	27·5
Length of head and body .	11
Breadth of head and body	7
Depth of body	5
Greatest depth of tail . .	4

Specimens of this tadpole were found in an isolated pool in a rock beside a stream in the Cochin forests in September, 1914. Although it occurs in hill-country, the species probably does not breed as a rule in streams, for the larva is normal and not of any of the types commonly associated with life in running water.

In general appearance and structure the tadpole resembles that of *Rana limnocharis*, but it is stouter and has a relatively shorter tail.

Distribution.—Jungles of the southern part of the Malabar zone.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

17659-60. Parambikulam, 1700-3200 ft., Cochin State (*F. H. Gravely*).

Rana beddomei (Günther)

(Plate I, figs. 4, 4*a*, 4*b*.)

Boulenger, *op. cit.*, p. 453.

The tadpole is small and very slender ; the branchial region is prominent on either side ; the head and body are narrowly oval ; the snout is pointed and declivous ; the eyes are situated on the dorsal surface and directed upwards ; they are very large and prominent ; the nostril, which is small and inconspicuous, is nearer to the eye than to the tip of the snout. The spiracle, which is not at all tubular but small and slit-like, is situated on the lower part of the left side of the body and is directed outwards and a little backwards ; it is rather nearer to the eye than to the posterior edge of the body. On the dorsal surface a narrow groove extends inwards in a slanting direction from near the middle of each eye to meet its fellow on the opposite side ; the combined groove extends backwards from a line joining the posterior third of the eyes as far as the base of the dorsal fin.

The mouth-disk is broadly triangular, entirely ventral in position ; the upper lip, which is devoid of tubercles, is very distinct from the lower ; it is narrowly but deeply notched in the middle line ; the lower lip has a marginal fringe of minute tubercles. The dental formula is 1+1 : 1 : 2+2/2+2 : 2 ; the outermost row of teeth on the upper lip is situated on its margin ; the beak is narrow and prominent, strongly hooked like that of a parrot ; both the upper and the lower beaks are entirely black and have smooth edges.

The tail is extremely long and slender, and has, even in the young tadpole, the fin-membranes very poorly developed ; the muscular part tapers gradually to a fine point ; the dorsal membrane consists of a low ridge very inconspicuous on the anterior half of the tail ; the ventral membrane is slightly better developed but also vestigial. The anus

is dextral, but not very strongly so; it does not form a prominent tubercle or tube.

The dorsal surface of the head and body is of a dark purplish-brown, minutely speckled with white and somewhat marbled on the snout. The lateral surface of the tail is also purplish-brown marbled with white; the whole of the ventral surface is colourless.

The hind limbs appear at an early stage of development and attain a large size and well-developed condition long before the appearance of the fore limbs.

The following are measurements of (A) of a specimen in which the hind limbs appear as small but elongated buds, and (B) of one in which they are fully developed.

	A. mm.	B. mm.
Total length	14·5	34
Length of head and body	3	11
Breadth of head and body	2·5	7
Depth of body	2	4
Greatest depth of tail	1·5	1·5

A large series of this remarkable tadpole and of young frogs was taken by Dr. F. H. Gravely at the edge of a rocky stream on the Cochin hills in September, 1914. He describes the larger individuals (in which the fore limbs had not appeared) as skipping rapidly over damp rocks when disturbed. It is very curious that a frog so closely allied to *R. leptodactyla* and *R. semipalmata* should possess a larva so different, but it is clear that the tadpoles of all these forms are very highly modified.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

17671. Parambikulam, 1700-3200 ft., Cochin State (*F. H. Gravely*).

Rana leptodactyla, Boulenger.

(Plate I, figs. 2, 2*a*, 2*b*.)

Boulenger, *op. cit.*, p. 454.

The tadpole is moderately small; the head and body are moderately stout, oval; the snout is narrowly rounded in front, somewhat constricted laterally, declivous; the eyes are situated far forward, directed forwards and outwards, lateral rather than dorsal, probably very prominent in life; nostrils about half way between eye and tip of snout, further apart than their distance from the eyes; the interorbital breadth nearly twice the internasal; a row of minute white glands runs round the outer and upper margins of the orbit, passing along above the nostril on each side to meet its fellow in the middle line a short distance from the tip of the snout. The spiracle is small, sinistral, situated nearer the dorsal surface than the ventral and nearer the eye than the base of the hind limb. The ventral surface is strongly convex.

The mouth-disk is small, directed downwards and a little forwards, without horny teeth; the upper lip is very distinct, forming a crescentic membrane which can be closed down over the mouth, fringed with short, pointed papillae and bearing two or three rows of similar papillae at its

base just above the upper beak ; the lower lip is divided into five lobes, of which two are lateral in position and much larger than the other three, which occupy the posterior margin of the disk; the upper one-third of these lateral lobes, each of which is half as broad as the upper lip, is capable of being folded backwards ; the three posterior lobes of the lower lip are sub-equal, pointed below and edged with short processes ; similar processes are scattered on the base of the three lobes near the lower beak ; both parts of the beak are slender, the upper beak relatively broader than the lower, which is a little stouter and V-shaped ; both parts are minutely serrated and the upper is entirely black ; the basal part of the lower beak is white.

The tail is powerful, tapering gradually to a rather blunt point ; both membranes and muscular part are well-developed, the latter about twice as deep as either membrane at its base, both membranes reaching the posterior extremity of the body.

The dorsal surface of the head and body are yellow, with boldly contrasting black marks, which extend on to the lateral surfaces ; the ventral surface is shaded with black, the pigment being distributed in minute, short hair-like lines ; the colour of the tail is similar to that of the dorsal surface of the head and body.

Measurements of a specimen in which the hind limbs are just making their appearance :—

	mm.
Total length	31
Length of head and body	12·5
Breadth of head and body	7·5
Depth of body	6
Greatest depth of tail	5

I have examined only two specimens of this tadpole. Although they are accompanied by young frogs of the species, as well as by those of *R. semipalmata* and *R. verrucosa*, the series is by no means complete and I rely for the identification rather on circumstantial evidence and on the resemblance between the specimens and those of the larva of *R. semipalmata* than on any more definite grounds.

The specimens were obtained in a small pool at the edge of a jungle-stream in the hills in September. Unfortunately no information is available that would cast light on the peculiar structure of the mouth-parts in this and the next species.

Distribution.—Hills of the southern part of the Malabar zone and the neighbouring districts.

Specimens of larvae in the collection of the Indian Museum :—

17698. Kavalai, 1300-3000 ft., Cochin State (*F. H. Gravely*).

Rana semipalmata, Boulenger.

(Plate I, figs. 3, 3*a*, 3*b*.)

Boulenger, *op. cit.*, p. 454.

This tadpole closely resembles that of *R. leptodactyla*, from which it differs in the following particulars :—

1. The whole animal is slighter and smaller.

2. The tail is a little longer in proportion to the head and body, its length being more than five times its greatest depth.
3. The upper lip is relatively much broader, being more than three times the breadth of one of the lateral lobes of the lower lip.
4. The beak is relatively broader and stouter.
5. The markings are less conspicuous and the ventral surface is colourless.

Mr. Gravely obtained a complete series of this larva, with many young frogs, in the same circumstances as those in which he found the tadpoles of *R. leptodactyla* and *R. verrucosa*.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

17702. Parambikulam, 1700-3200 ft., Cochin State (*F. H. Gravely*).

Nyctibatrachus pygmaeus (Günther).

(Plate I, figs. 5, 5*a*.)

Boulenger, *op. cit.*, p. 467.

The tadpoles are of moderately large size ; the head and body rather narrowly oval, flattened moderately, the ventral surface being distinctly convex ; the snout is rounded, the nostrils rather widely separated, nearer to one another and to the eyes than to the tip of the snout, the distance between them being much more than half the interorbital breadth ; the eyes are dorsal but directed outwards, situated at about one-third the distance between the tip of the snout and the base of the hind limbs. The spiracle is lateral, sinistral, somewhat tubular, pointing upwards and backwards.

The mouth-disk is large and somewhat sucker-like, entirely ventral, but with opposible lips and a lateral emargination on either side. The lower lip is edged with minute finger-like processes, the lateral region of the disk, which is produced in two lobules, is densely covered with similar processes ; the upper beak is shallow, broadly U-shaped, entirely black, with smooth or almost smooth margins, the lower beak much narrower, V-shaped, distinctly but minutely serrated on the margins, white at the base for at least half its depth. The dental formula is 2 : 5+5/1+1 : 5, the three upper tooth-rows being equal and the interruption in the third being very slight ; the five upper tooth-rows of the lower lip are equal and the sixth rather shorter ; the interruption in the first row of this lip is very slight.

The tail is long and slender, narrowly lanceolate, the muscular part relatively deep in the middle, the whole tapering to a fine point ; both membranes arise a considerable distance behind the base of the hind limbs.

The dorsal and lateral surfaces of the head and body are purplish-brown with a few dark spots, becoming paler between the eyes, the ventral surface yellowish, the proximal third of the tail brown with a few dark spots, the distal two-thirds as a rule more deeply pigmented, marbled with purplish-brown and buff or almost entirely of the former colour, the membranes bearing scattered pigment-cells.

Measurements of a specimen with the hind limbs fairly well developed :—

	mm.
Total length	51
Length of head and body	19
Breadth of head and body	10
Depth of body	7
Greatest depth of tail	6

The specimens in the Indian Museum were collected in a small lake in June, 1912. They include a young frog with the tail still unabsorbed.

Distribution.—Anamalai and Nilgiri Hills, South India.

Specimens of larvae in the collection of the Indian Museum :—

17248. Coonoor, Nilgiri district, Madras (*Capt. R. B. S. Sewell, I.M.S.*)

Species Incertae Sedis.

(Plate I, figs. 6, 6*a*.)

Annandale and Narayan Rao, *Proc. As. Soc. Bengal* (n. s.) XIII, p. clxxxvi (1917).

The tadpole is large ; the head and body massive but flattened, broadly rounded in front, relatively very large ; the eyes and nostrils are situated far back, the latter about half way between the hind limbs and the tip of the snout ; the distance between the nostrils is much less than that between them and the eyes, about half the inter-orbital breadth ; the eyes are small, entirely dorsal ; the distance from the tip of the snout to the nostrils is more than twice that from nostril to eye.

The ventral surface is flattened. The spiracle is sinistral, laterally tubular, pointing upwards and backwards, situated rather nearer the anus than to the tip of the snout.

The mouth-disk is ventral, transversely oval, sucker-like, surrounded entirely by a margin covered with small rounded tubercles, occupying (when the mouth is open) about one-third of the ventral surface ; the upper and lower lips are not opposible ; the dental formula is 2/3 or 2/1+1 : 2 ; the two upper tooth-rows are equal and a little longer than the three lower rows, which are also equal ; the upper and lower beaks are each in a single piece, rather shallow (especially the lower beak), moderately stout, with their margins very minutely serrated ; they are white with black margin.

The tail is relatively short and feeble, shallow, sharply pointed ; the fin-membranes moderate both above and below, each of about the same depth as the muscular portion in the middle of the tail, the upper membrane commencing some little distance behind the base of the hind legs.

The colour of the dorsal and lateral surfaces is dark grey with small black spots, the tail is marbled with dirty white ; the ventral surface is colourless except for a few scattered pigment-cells.

The anus opens by a transverse slit, which extends right across the base of the tail on to a little flattened leaf-shaped membrane, which extends backwards on the ventral surface and is situated to the right of the middle line.

Measurements of a specimen which has the hind limbs fairly well-developed :—

	mm.
Total length	62
Length of head and body	24
Breadth of head and body	15
Depth of body	9
Greatest depth of tail	8

The inner metatarsal tubercle on the feet makes its appearance at an early stage and is spade-like and very conspicuous, being almost white while the sole of the foot is black.

The pectoral girdle, which has been dissected out from a nearly adult tadpole by Mr. C. R. Narayan Rao, closely resembles that of *Leptodactylus*,[1] except that the sternum is poorly developed, and the frog possibly belongs to the Cystignathidae as we suggested in the paper cited. It is improbable that it belongs to any species of which the adult has been described, and new genus of the family as recorded from India. I thought at first that it was the larva of *Nyctibatrachus major*,[2] but have since received a series of tadpoles and young frogs of that species in hardly good enough condition for description. They are quite different. In some respects this tadpole bears a close resemblance to that of *Heleophryne natalensis*, a South African Cystignathid recently described by J. Hewitt.[3] It differs from those of *Bufo penangensis*[4] and *Bufo asper*[5], both of which have greatly enlarged lips modified to form an organ of adhesion, in that both the lips are equally enlarged, instead of the lower lip being much the greater of the two. The tadpoles in the collection of the Indian Museum were collected in September, 1914 ; they were found clinging to rocks by means of their oral suckers in rapid-running streams in the neighbourhood of waterfalls. The larvae of *H. natalensis* were observed in similar situations in the valley of the Krantz Kloff in October, 1912.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

17709. Kavalai, 1,300-3,000 ft., Cochin State
17719. Parambikulam, 1,700-3,200 ft., Cochin State } (*F. H. Gravely*).
17720. Forest Tramway, mi. 10-14, 0-300 ft., Cochin

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[1] See Boulenger, *Cat. Batr. Sal. Brit. Mus.* p. 238, fig. (1882).
[2] My *Rana travancorica* (*Rec. Ind. Mus.* V, p. 191 : 1910) is synonymous with *N. major*.
[3] *Ann. Natal Mus.* II, p. 478, pl. xxxix, figs. 5, 6, 7 (1913).
[4] Flower, *Proc. Zool. Soc., London*, 1899, p. 909, pl. lx, figs. 3, 3*a*.
[5] Van Kampen, *Nat. Tijd. Ned. Ind.* LXIX, p. 30, pl. ii, fig. 2.

EXPLANATION OF PLATE I.

South Indian Tadpoles.

Rana verrucosa, Günther.

Fig. 1.—Tadpole, × 2.

,, 1*a*.—Mouth-disk of tadpole with mouth open, × 8.

Rana leptodactyla, Boulenger.

Fig. 2.—Tadpole, × 2.

,, 2*a*.—Mouth-disk of tadpole with mouth open, × 16.

,, 2*b*.—The same with the mouth closed.

Rana semipalmata, Boulenger.

Fig. 3.—Tapdole, × 2.

,, 3*a*.—Mouth-disk of tadpole with mouth open, × 16.

,, 3*b*.—The same with the mouth closed.

Rana beddomei (Günther).

Fig. 4.—Young tadpole, × 4.

,, 4*a*.—Older tadpole, × $1\frac{1}{2}$.

,, 4*b*.—Mouth-disk of tadpole, × 8.

Nyctibatrachus pygmaeus (Günther).

Fig. 5.—Tadpole, × $1\frac{1}{4}$.

,, 5*a*.—Mouth-disk of tadpole, × 8.

Species incertae sedis.

Fig. 6.—Tadpole (nat. size).

,, 6*a* —Mouth-disk of tadpole, × 2.

III. THE TADPOLES OF THE FAMILIES RANIDAE AND BUFONIDAE FOUND IN THE PLAINS OF INDIA.

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(Plate II.)

In his admirable account of the larvae of the European toads and frogs Dr. G. A. Boulenger[1] discussed the differential characters proper to species, genera and families. He was, however, dealing with a fauna comparatively little specialized, in which the Batrachian larvae were not highly modified in correlation with different modes of life. In a short note [2] published in the Proceedings of the fourth meeting of the Indian Science Congress we have pointed out the extreme complexity of evolution in the Indian tadpoles, due both to convergence and to divergence in structure as well as in habits. Before a satisfactory account can be given of those that live in hill-streams and in pools on the Indian plateaux—and the majority of the Indian frogs inhabit hill-jungles—further investigations are necessary, more particularly in Southern India. The tadpoles of the plains, however, living in open country and as a rule in still water, do not exhibit the same diversity of structure or the same degree of specialization. With the exception of a few rare and apparently geographically restricted species such as *Rana strachani* from Malar in Sind and *Rana dobsoni* from Mangalore on the West Coast of Madras, they are well-known ; we have been able to examine fresh or at least fairly well-preserved material of all the species except the two mentioned by name. In the present paper, therefore, we propose to give a succinct taxonomic account of the tadpoles of the great majority of the toads and frogs of the families Bufonidae and Ranidae that are found in the plains of India and Assam ; material is not yet forthcoming that would enable us to deal with the species peculiar to Burma and Ceylon. When good descriptions are already available in readily accessible journals such as the *Proceedings of the Zoological Society of London*, the *Journal of the Bombay Natural History Society*, the *Records of the Indian Museum* or the *Memoirs of the Asiatic Society of Bengal* it is unnecessary, at a time when paper and printing are so expensive, to duplicate them. We have, therefore, contented ourselves with a reference and such explanatory remarks as seem necessary. Our object is merely to facilitate future work on the anatomy and bionomics of the species.

Animals so soft as tadpoles, even when preserved with great care, are very apt to be distorted owing to pressure or shrinkage. We have, therefore, relied in our descriptions on definite structural characters, such as those connected with the mouth, rather than on comparative

[1] *Proc. Zool. Soc. London*, pp. 593-626, pls. xlv-xlvii (1891).
[2] *Proc. As. Soc. Bengal* (n. s.) 1917, p. clxxxv.

measurements or proportions, except when the differences are very great. In dealing with certain tadpoles, however, especially those of the genus *Bufo*, it is often impossible to find differential structural characters, and we have been obliged to accept less satisfactory methods of diagnosis. The larva of each species has probably a characteristic appearance in life, but the differences are hard to define and often somewhat evanescent. Allowance must be made for these facts in naming specimens.

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Our references under the name of each species are to descriptions of or notes on the larva.

Key to the Families of Batrachian Larvae found in the Plains of India.

I. Mouth-disk more or less developed; transverse rows of horny teeth usually, and an upper and lower horny beak always present; spiracle on the left side.	
A. Anus (in the natural position) directed towards the right	Ranidae.
B. Anus (in the natural position) directed backwards	Bufonidae.
II. Mouth-disk not developed; no horny teeth or beak; spiracle in the mid-ventral line.	Engystomatidae.

In using this key care must be taken that the anus is correctly identified and that its natural position is ascertained. In some species of Ranid larvae its dextral direction is not very strongly marked, while in the Bufonidae it is usually situated at the end of a more or less tubular sheath which is apt to be twisted *post mortem* to one side or the other. The only Ranid larva likely to be found in the plains of India in which the horny teeth are absent is that of *Oxyglossus lima*, a species said to occur in Bengal. In the tadpole of this genus the mouth-disk is very feebly developed and the closed mouth appears as a vertical slit.

The Engystomatidae will be dealt with in another paper (pp. 41-45, *postea*).

Family RANIDAE.

It does not seem possible (except in the case of *Oxyglossus*, the tadpoles of which differ from those of all other Ranidae[1] in the vestigial character of the upper lip and in the absence of horny teeth on the mouth-disk) to distinguish the larvae of the different genera of this family.

Key to the Ranid Larvae found in the Plains of India.

I. Mouth-disk poorly developed; lower lip horseshoe-shaped; no horny teeth . . . . . *Oxyglossus lima.*

II. Mouth-disk well-developed; at least three transverse rows of teeth (as a rule at least one of them interrupted in the middle-line) present on the disk.

A. Three rows of teeth on the mouth-disk.

1. Beaks shallow; long finger-shaped processes on the lower lip . . . . . ? *Rana brevipalmata.*

2. Beaks stout; processes on lower lip short.

(*a*) Habit stout; tail spotted with black, not more than twice as long as head and body *R. cyanophlyctis.*

(*b*) Habit rather slender; tail without black spots, more than twice as long as head and body *R. hexadactyla.*

B. More than three transverse rows of teeth on disk.

1. Five transverse rows of teeth on disk.

(*a*) Habit very stout; snout broadly rounded; fringe on margin of lower lip widely interrupted in the middle line . . . . . *R. breviceps.*

(*b*) Habit slender; snout bluntly pointed; fringe on margin of lower lip not or slightly interrupted.

(i) Dorsal profile of tail strongly sinuate; fringe on margin of lower lip papilliform, uninterrupted . . . *R. limnocharis.*

(ii) Dorsal profile of tail not sinuate; fringe on margin of lower lip digitiform, slightly interrupted in the middle *R. tytleri.*

2. Seven rows of teeth on mouth-disk *Rhacophorus maculatus.*

3. More than seven rows of teeth on mouth-disk.

(*a*) Interior of mouth inside beaks armed with a horny plate on the palate and a horny tubercle on each side; not more than five tooth-rows on upper-lip; lips rather feebly developed.

(i) Abdomen nearly flat *Rana tigrina.*

(ii) Abdomen distinctly convex *R. crassa.*

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[1] In those of two species of *Rana* from the hills of Southern India there are no horny teeth, but the disk and beaks are well developed. See pp. 19, 20 of this volume.

(*b*) Interior of mouth unarmed; seven rows of teeth on upper lip.
(i) Lips enlarged, forming a cup-like structure . *R. sternosignata.*
(ii) Lips not enlarged . *Rhacophorus maiabaricus.*

Oxyglossus lima, Gravenh.

1916. *Oxyglossus lima*, Smith, *Journ. Nat. Hist. Soc. Siam*, II, p. 173, pl.

An excellent description of this peculiar tadpole has recently been given by Smith in the paper cited, which is not always accessible to naturalists in India. As we have not been able to examine fresh specimens, we quote his description.

"Head and body, length twice, or nearly twice its breadth, snout long, obtusely pointed. Nostrils equidistant between the eyes and the tip of the snout. Eyes towards the upper surface of the head, looking outwards and upwards, twice as far apart as the nostrils. Spiraculum sinistral, directed straight backwards, nearer the vent than the eye, long and prominent in life. Anal tube very short, median. Mouth small, terminal, without papillae; lower lip vertically horse-shoe shaped, upper lip, a small rounded flap; no teeth; beak entirely black, lower mandible deeply semilunar in shape. The lower lip, which occupies the greater part of the mouth, itself projects from a sheath of skin, which is formed by, and is part of, the skin of the rest of the body.

Tail sharply pointed, very high at its commencement where it rises almost abruptly from the base of the tail, diminishing gradually as it passes backwards; at its highest point about four times as deep as the lower crest, which is very shallow. Toes webbed as in the adult.

Colour (in life).—Light olive above, with darker markings; a dark streak through the eye passing backwards, and dark patches at the base of the tail. Caudal membranes handsomely veined and marbled with shades of brown. Below, white.

Dimensions.—Total length, 33 mm., head and body 11.

A feature of the tadpole is its high, festooned upper crest, which gives it a very handsome appearance."

Geographical distribution.—The species is said to occur in Bengal, but it is doubtful whether it is to be found in the plains. Boulenger (*Faun. Malay Penin., Rept.*, p. 225) gives the distribution as "Bengal and Southern China to the Malay Archipelago."

Smith's tadpoles were from Siam.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

18291. Bangkok, Siam. Dr. Malcolm Smith.

? Rana brevipalmata, Peters.

? 1904. *Rana limnocharis*, Ferguson, *Journ. Bombay Nat. Hist. Soc.*, XV, p. 501, pl. A., fig. 3.
1917. ? *Rana brevipalmata*, Annandale, *Mem. As. Soc. Bengal* VI, p. 134, ? pl. vi, fig. 5.

There is considerable doubt as to the tadpole of this species, which appears to be found both in Pegu and Tenasserim to the east and in the Malabar Zone to the west of India. Without further material than we possess it is useless to attempt to give a detailed description.

Specimens of larvae in the collection of the Indian Museum :—

17708. Chalakudi, Cochin State. Dr. F. H. Gravely.
17730. Kawkareik, Amhrst district, Tenasserim. Dr. F. H. Gravely.

Rana cyanophlyctis, Schneider.

(Plate II, fig. 1.)

1895. *Rana cyanophlyctis*, Anderson, *Proc. Zool. Soc. London*, 1895, p. 660, pl. xxxvii, fig. 2.

An excellent description and figures of Arabian specimens of this tadpole were given by the late Dr. J. Anderson in the paper cited above. Through the kindness of Dr. Boulenger we have been able to compare some of these specimens with Indian examples. They are larger and stouter than any we have seen from this country, but there is considerable difference in this respect between specimens from different Indian localities.

The tadpole may be distinguished from all other Oriental larvae with which we are acquainted, except that of *Rana hexadactyla*, by the arma-

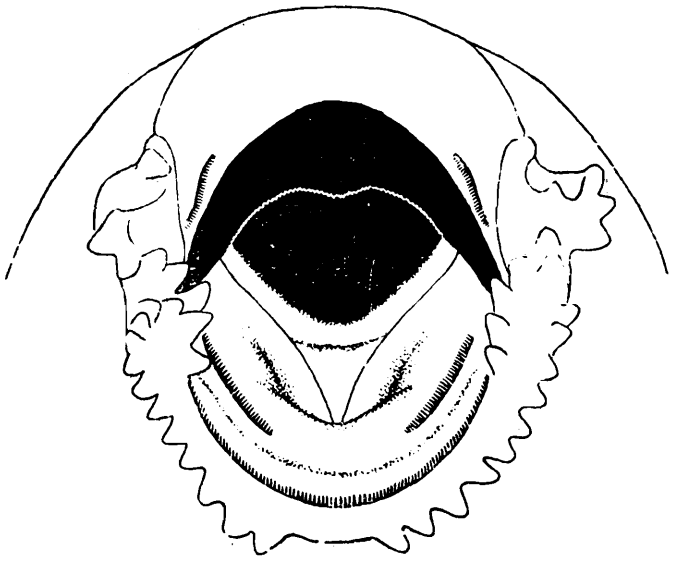

Fig. 1.—Mouth-disk of a tadpole of *Rana cyanophlyctis* with the upper tooth-row greatly reduced (considerably enlarged).

ture of its mouth. Its beak, though stouter than that of most species, is less stout and less prominent than that of the tadpole of *Rana corrugata*,[1] in which there is no horny pad on the mouth-disk below the beak. The condition of the inner row of teeth on the upper lip is variable. Sometimes it extends right across the disk, but it is usually interrupted more or less broadly in the middle line. Occasionally it is almost completely absent.

Full-grown Indian specimens are usually about 65 to 75 mm. long ; the tail is less than twice as long as the head and body ; its dorsal membrane rises more or less abruptly a little in front of the posterior extremity of the body, and the top of the head is flat.

[1] *Mem. As. Soc., Bengal*, VI, pt. 11, p. 149, fig. 7A and B.

Measurements of full grown specimens with the hind legs well-developed :—

	A. mm.	B. mm.
Total length	65	71
Length of head and body	24	25
Breadth of head and body	15	14
Greatest depth of tail	17	14

Specimen A is from an island in the Chilka Lake, specimen B from Kashmir.

Geographical distribution of the species.—The species occurs in Baluchistan and all over India proper : also in Southern Arabia, Ceylon and the northern part of the Malay Peninsula. It ascends the Himalayas to a height of at least 6,000 ft.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

16532. Hardramaut, South Arabia. Brit. Mus. (Ex.).
18281. Kashmir. Col. H. T. Pease, I.C.V.D.
17247. Junagara, Kathiawar. S. P. Agharkar.
17736. Rausali, Naini Tal district., W. Himalayas. Mus. Coll.
17737. Kalka, alt. 2,400 ft., base of Simla Hills. Mus. Coll.
17739. Mirzapur, United Provinces. Mrs. Johnstone.
17194. Marihan, Mirzapur district, United Provinces. Capt. R. B. S. Sewell, I.M.S.
17740. Hamirpur Road, United Provinces. J. W. Caunter.
17735. Chupra, Saran district, Bihar. M. Mackenzie.
17738. Puri, Orissa. Dr. N. Annandale.
18470. Barkuda Island, Chilka Lake, Ganjam district, Madras. Dr. N. Annandale.

Rana hexadactyla, Lesson.

(Plate II, figs. 2, 2*a*, 2*b*.)

1904. *Rana hexadactyla*, Ferguson, *op. cit.*, p. 500, pl. A., fig. 2.

In structure this tadpole resembles that of *Rana cyanophlyctis*, but it is much smaller and more slender and has the tail shallower and longer in proportion, the snout is more produced and the mouth is rather smaller, with the beak shallower. There is a deep groove, with its sides and base sometimes cornified, across the lower lip ; the margin of the upper beak fits into this groove when the mouth is shut. There are no dark spots on the tail, the ventral surface of the head and body is silvery and there are usually silvery spots on the sides of the head, body and tail. The colouration is, however, variable.

Measurements of a specimen in which the hind legs are not quite fully developed :—

	mm.
Total length	35
Length of head and body	12
Breadth of head and body	6
Greatest depth of tail	7

Geographical distribution of the species.—South Peninsular India and Ceylon. The most northern record with which we are acquainted is from Puri in Orissa.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

17722. Puri, Orissa Coast. Dr. N. Annandale.
17726. Madras (town). Museum Coll.
17665-66. Chalakudi, Cochin State. Dr. F. H. Gravely.
17727. Kandy, Ceylon. Dr. F. H. Gravely.

Rana breviceps, Schneider.

1904. *Rana breviceps*, Ferguson, *op. cit.*, p. 502, pl. B., fig. 1.
1915. *Rana breviceps*, Narayan Rao, *Rec. Ind. Mus.*, XI, p. 34, figs. 2A, 2B.

This tadpole has been described by Ferguson and by Narayan Rao, who points out certain differences between the specimens examined by him and those described by the former author.

Geographical distribution of the species.—The Punjab (including the Kashmir Valley); the Himalayas up to 7,000 ft.; the Indo-Gangetic plain; Peninsular India; Assam.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

16534. Trivandrum, Travancore. Brit. Mus. (Ex.).
16633. Bangalore, South India. C. R. Narayan Rao.
17676. Coorg, South India. C. R. Narayan Rao.

Rana limnocharis, Weigm.

1909. *Rana limnocharis*, van Kampen, *Natuurh. Tijdsch. Ned.-Ind.*, LXIX, p. 35.
1916. *Rana limnocharis*, Smith, *op. cit.*, pp. 165-166.
1917. *Rana limnocharis*, Annandale, *Mem. As. Soc. Bengal* VI, p. 132, figs. 2B, (p. 124), 3B (p. 132), pl. vi, fig. 2.

Tadpole usually small, but variable in size; head and body broadly oval, somewhat depressed, snout bluntly pointed, declivous; nostrils as seen from above much nearer tip of snout than to eyes, the distance between them not quite half that between the eyes; interorbital space about as wide as distance between eye and nostril; eyes lateral, directed outwards, but protruding above in the living animal. Spiracle tubular, its opening hardly below the level of the eye, nearer to the eye than to the posterior extremity of the body. Ventral surface slightly convex.

Mouth-disk small, transverse; upper lip edged with teeth, lower lip, the lateral lobes of which are not well developed, with papillae. Dental formula 1 : 1+1/13, the uppermost tooth-row much the longest, the first and second rows on the lower lip sub-equal; beak black, slender, not serrated on the margins, the upper part V-shaped, with a distinct convexity in the middle, the lower part simply V-shaped.

Colouration whitish, more or less densely covered with black pigment-cells on the dorsal and lateral surfaces of the head and body and a more or less distinct dark Y-shaped mark on the top of the head. Ventral surface almost colourless; tail whitish blotched with black.

Tail relatively slender, sharply and gradually pointed, with the membranes particularly well-developed; dorsal membrane arising almost on a level with the posterior extremity of the body, distinctly deeper than the lower membrane, its margin sinuous.

Measurements of a large specimen with the hind legs well-developed :—

	mm.
Total length	51
Length of head and body	17·5
Breadth of head and body	10
Greatest depth of tail	8·5

Geographical distribution of the species.—The plains of India; the Himalayas up to 7,000 ft.; Burma up to 6,000 ft.; Siam; China; Japan; the Malay Peninsula and Archipelago.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

17265-73[1]. Gangtok, 6,150 ft., Sikkim. Museum Coll.
17729. River Tista, Jalpaiguri district, East Bengal. Dr. N. Annandale.
17724. Mirzapur, United Provinces. Mrs. Johnstone.
17723. Khemsa, 2,650 ft., Bombay Presidency. S. P. Agharkar.
17732. Nechal, Western Ghats, Satara district. Dr. F. H. Gravely.
17721. Madras (town). Dr. J. R. Henderson.
18303. Prae, Siam. Dr. Malcolm Smith.
16268. Batavia, Java. Dr. P. N. van Kampen.

Rana tytleri (Theobald).

(Plate II, figs. 3, 3*a*.)

Tadpole moderately large, but of graceful shape; head and body narrowly ovoid, flattened above but not depressed; snout rather broadly rounded, slightly declivous; eyes lateral, but situated close to the dorsal surface; nostrils situated nearer the tip of the snout than the eyes, the distance between them much less than the interorbital space or the distance from eye to nostril. Spiracle tubular, directed upwards and backwards, situated much nearer eye than to posterior extremity of the body; throat somewhat flattened, abdomen convex.

Mouth-disk small, pointing forwards rather than downwards, distinctly transverse; the upper lip nearly straight, edged with teeth; the lower lip with a distinct lateral lobe on either side, which is constricted in the middle; the lateral lobes edged with rather broad and blunt papillae, which extend inwards at the constriction; the posterior lobe fringed with two rows of finger-like processes, which are interrupted for a short distance in the middle; dental formula $1:1+1/3$ or $1:1+1/1+1:2$; the anterior tooth-row relatively broad; the two halves of the divided row on the upper lip very short and widely separated; first and second rows on the lower lip sub-equal, third row much shorter; the first row on this lip very slightly interrupted, perhaps by accident; beak wide and shallow, both the upper and the lower parts white, with black edges; the middle part of the upper beak almost straight.

Tail powerful, of graceful shape, sharply pointed, with both muscular and membranous portions well-developed; dorsal membrane arising well in front of the posterior extremity of the body, the dorsal and ventral margins almost straight and parallel for the first half of their

[1] Possibly these specimens represent a distinct local race.

length, then approaching one another rather abruptly. Anus directed to the right.

Dorsal and lateral surfaces chestnut-brown ; a dark longitudinal streak extending back along the body from the eye, edged with white above ; ventral surface of throat chestnut-brown, of abdomen whitish ; tail with small white and dark brown spots.

Measurement of a specimen with the hind legs well-developed :—

	mm.
Total length	61
Length of head and body	21
Breadth of head and body	12·5
Greatest depth of tail	11·5

We have seen a single specimen of this tadpole, which one of us obtained in June, 1911, together with a tadpole of *R. limnocharis*, in a small weedy pool some miles from the base of the Eastern Himalayas near Siliguri. The hind legs are well developed and agree with those of the type specimen of *R. tytleri*, the only species found in the district to which this larva could belong.

The tadpole somewhat resembles that of *R. limnocharis*, from which it is easily distinguished by its colouration, by the shape of its tail and by the formation of its mouth-disk.

Rana tigrina, Daud.

1917. *Rana tigrina*, Annandale, *Mem As. Soc. Bengal*, VI, p. 125, fig. 2A, pl. vi, figs. 1, 1*a*.

The tadpole of this species has recently been described and figured from living specimens by Annandale. Attention may, however, be directed to an error in his account of the mouth-disk. The dental formula of the lower lip in normal specimens is usually 2+2 ; 2 or 3+3 : 2 and the third row of teeth appears to be divided only in degenerate specimens. In individuals kept in captivity some or all of the teeth on both lips are apt to disappear.

Measurements :—

	A. mm.	B. mm.	C. mm.
Total length	35	45	50
Length of head and body	13·5	16	16
Breadth of head and body	8	9·75	11
Greatest depth of tail	5·5	8	6·5

Specimen A is from Calcutta and has the hind legs about half developed. Specimen B is from Damukdia Ghat on the Ganges, and has the hind legs in almost the same condition as specimen A. Specimen C is from Khoolna in the Gangetic delta and has the hind legs fully developed.

We give here for comparison measurements of tadpoles of the closely related species *Rana rugulosa* (from Bangkok, Siam) and *R. crassa* (from Madras). In both cases the hind legs are fully developed.

Measurements :—

	R. rugulosa.	*R. crassa.*
	mm.	mm.
Total length . .	62·5	68·5
Length of head and body	22·5	24·5
Breadth of head and body	14·5	16
Greatest depth of tail	12	11·5

Geographical distribution of the species.—The plains of the whole of Northern and Peninsular India, with the exception of a few localities in Madras; the Nepal Valley; Assam; Burma and Yunnan.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

17733. Siliguri, base of East Himalayas. J. B. Richardson.
16096. Damukdia Ghat, River Ganges, Bengal. R. H. Hodgart.
15718. Sara Ghat, River Ganges, Bengal. R. H. Hodgart.
16097. Khoolna, Eastern Bengal. J. W. Caunter.
17162-8, 9004. Calcutta. Dr. Jerdon.
10802-10810-11. No history.

Rana crassa, Jerdon[1]

Boulenger[2] has recently shown that this frog, which he regards as a variety of *R. tigrina*, is at any rate racially distinct. It is distinguished by its very short hind limbs and by the peculiar structure of the internal metatarsal tubercle.

The tadpoles differ from that of the true *R. tigrina* in the following particulars :—

They are larger and of stouter build, with the abdomen more convex; the dorsal surface is more densely pigmented and there is a pale band extending backwards in an oblique direction from the nostril to a pale space surrounding the eye. This band probably covers a glandular channel.

The tadpole very closely resembles that of *R. rugulosa*, Wiegmann,[3] except that the dorsal membrane of the tail is not so elevated and that the colouration of the dorsal and lateral surfaces of the head and body are less uniform.

We have been able to examine only two tadpoles that can be assigned to this species. In one of them the hind legs are fairly well-developed, while in the other the toes are already differentiated.

Geographical distribution of the species.—The frog is said to occur to the exclusion of the true *Rana tigrina* in the immediate neighbourhood of the town of Madras. Jerdon gives its distribution as " a few tanks in the Carnatic " and Boulenger records specimens from Benares as well as from various localities in South India and Ceylon. There are specimens in the Indian Museum from Colombo, Madras, Chandbally in Orissa and Agra in the United Provinces.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

17734. Madras (town). Dr. J. R. Henderson.

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[1] *Rana crassa*, Jerdon, *Journ. As. Soc. Bengal*, XXII, p. 531.
[2] *Rec. Ind. Mus.*, XV (1918).
[3] *R. tigrina*, Flower, *Proc. Zool. Soc. London*, p. 891, pl. lix, figs. 2, 2*a* (1899).

Rana sternosignata, Murray.

The tadpoles of this species that we have examined are not in good condition. In general facies they appear to resemble those of *Rana pleskii* [1] but the build is stouter and the head and body are distinctly broader and probably flatter. The mouth-disk is transverse, and large ; the margin of the upper lip is beset with horny teeth except at its lower extremities, which bear a double or triple row of elongate tubercles. A similar fringe of somewhat larger tubercles runs round the edge of the lower lip and there is also at its upper extremity, near the ends of the tooth-rows, a patch of similar structures. There are about seven rows on the upper lip and three on the lower lip ; the most anterior of the latter is usually divided in the middle, while the others are complete. The nostril is nearer the tip of the snout than to the eye. The spiracle is nearer to the eye than to the posterior extremity of the body. It is prominent and tubular and is situated about half way up the left side. The anus, which is provided with a large triangular flap, is distinctly dextral. The tail, which is acutely pointed, is apparently more than twice as long as the head and body and has both the muscular and membranous portions well-developed. The upper tail membrane commences as a low ridge above the posterior extremity of the body. Specimens in which the legs are beginning to appear are at least 75 mm. long. The tail is apparently marked with large black or brown blotches, but no detailed description of the colouration can be given.

Geographical distribution of the species.—Kashmir at moderate altitudes ; Baluchistan ; Sind.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

14719. Quetta. Major C. G. Nurse.

Rhacophorus maculatus (Gray).

1912. *Rhacophorus maculatus*, Annandale, *Rec. Ind. Mus.* VIII, p. 14.

This tadpole is an extremely variable one. It seems to be readily affected by life in different types of environment and to become much paler and smaller in muddy water. It is possible that differences due to environment are greater than racial differences. Three local races of the species are distinguished by Annandale.

Geographical distribution :—

1. *Rhacophorus maculatus* (Günther) (*forma typica*).—Peninsular India and Ceylon.
2. *Rhacophorus maculatus himalayensis*, Annandale.—The Eastern Himalayas, Assam, Western China.
3. *Rhacophorus maculatus leucomystax* (Gravenhagen).—Lower Burma, Tenasserim, the Malay Peninsula and the Malay Islands ; ? Bengal east of the Bay (Chittagong).

[1] Annandale, *Rec. Ind. Mus.*, II, p. 345 (1908) and XIII, p. 417, figs. 1,2 (1917).

Flower's [1] excellent description of the tadpoles from Bangkok applies to some Indian specimens.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

Rhacophorus maculatus (Günther).

16461. Sukna, base of Eastern Himalayas. Museum Coll.
17717. Balighai, near Puri, Orissa. Dr. N. Annandale.
17767. Madras (Museum compound). Dr. J. R. Henderson.
18295. } Bangalore, South India. { C. R. Narayan Rao.
17718. } { Dr. N. Annandale.
12607-10. Calcutta Zoological Gardens. Dr. J. Anderson.

Rhacophorus maculatus himalayensis, Annandale.

17774. Pashok, Darjeeling district, Eastern Himalayas, alt. 2,500-3,500 ft. Dr. F. H. Gravely.
16098. }
17706. } Kurseong, 5,000 ft., Eastern Himalayas. Museum Coll., Dr. N. Annandale.
17068. }

? *Rhacophorus maculatus leucomystax*, Gravenhagen.

18267. Rangamati, Chittagong Hill Tracts, Bengal. R. Hodgart.

Rhacophorus malabaricus, Jerdon.

1904. *Rhacophorus malabaricus*, Ferguson, *op. cit.*, p. 503, pl. B, fig. 3, pl. C.

We have no personal acquaintance with the tadpole, which has been described and figured by Ferguson.

Geographical distribution of the species.—Southern part of the Malabar zone and the forests of Mysore.

Family BUFONIDAE

KEY TO THE BUFONID LARVAE FOUND IN THE PLAINS OF INDIA.

I. Colour almost uniform black or brown; only slightly paler on the fin-membranes and ventral surface.	
A. Nostril half as large as eye .	*Bufo fergusoni.*
B. Nostril less than half as large as eye.	*Bufo melanostictus.*
C. Nostril more than three-fourths as large as eye	*Bufo microtympanum.*
II. Colour more or less mottled or speckled; ventral surface distinctly paler than dorsal surface, at any rate anteriorly.	
1. Dorsal profile of tail with a low and gradual convexity; habit rather slender; dorsal surface of head and body with minute white specks	*Bufo stomaticus.*
2. Dorsal tail fin elevated immediately behind the body; habit stouter; colouration dark	*Bufo viridis.*

The only genus known from the plains of India is the universally distributed genus *Bufo*. The tadpoles of most species of this genus resemble one another very closely and can only be distinguished by slight differences in proportions, in colouration and in the relative lengths of the rows of teeth on the disk. In all those found in the plains

[1] Flower, *Proc. Zool. Soc. London*, 1896, p. 905, pl. xliv, fig. 2.

of India the dental formula is either 2/3 or 1+1 : 1/3, the lips are poorly developed and only tuberculate on the lateral margins, and the beaks are weak. In two Oriental species that live in hill-streams, *viz.*, *Bufo asper* [1] and *Bufo penangensis*, [2] however, the lips are greatly enlarged and modified to form an apparatus for clinging to rocks.

So far as the species of the plains are concerned it is difficult to distinguish the larvae specifically unless extremely well-preserved material is available. The tadpole of *Bufo melanostictus*, however, and that assigned provisionally to *B. fergusoni* can be separated from those of *B. stomaticus* and *B. viridis* by their uniform colouration. *B. fergusoni* apparently occurs only in the southern part of the Peninsula and it is doubtful whether *B. viridis* descends into the plains at all ; if so, it only does so in the north-west. Any black Bufonid tadpole from the Indo-Gangetic plain or the northern part of Peninsular India is, therefore, almost certain to be that of *B. melanostictus*.

Bufo melanostictus, Schneider.

1896. *Bufo melanostictus*, Flower, *Proc. Zool. Soc. London*, 1896, p. 911, pl. xliv, fig. 3.
1899. *Bufo melanostictus, id., ibid.*, p. 910.
1906. *Bufo melanostictus*, Annandale, *Journ. As. Soc. Bengal*, II, p. 289.

Flower has published an admirable description of the tadpole. His figure also is good, but is considerably larger than the normal size. Individuals, however, sometimes grow very large in abnormal conditions.

The toad is found all over the Oriental Region.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

16104. Naini Tal, Western Himalayas. R. Hodgart.
17784. Patari, Naini Tal district, Western Himalayas. Museum Coll.
17794. Mashobra, Simla Hills, Western Himalayas. Baini Parsad.
17750. Bhim Tal, alt. 4,450 ft., Western Himalayas. S. W. Kemp.
17746. Tista River, 4,500 ft., Eastern Himalayas. Dr. L. L. Fermor.
17747. Jalpaiguri (Tista River), North Bengal. Dr. N. Annandale.
17999. Sevok, Darjeeling district, Eastern Himalayas. H. E. Lord Carmichael.
17751. Lucknow, United Provinces. S. W. Kemp.
17753. Siripur, Saran, Bihar. M. Mackenzie.
17752. Calcutta. Dr. B. L. Chaudhuri.
17754. Tribeni, Gangetic delta. Dr. B. L. Chaudhuri.
17755. Madras (town). Dr. N. Annandale.
16102. Mandalay, Upper Burma. Dr. N. Annandale.
18479. Old Valley of Kalaw River, East of Ngot, *ca.* 3,500 ft., Southern Shan States. Dr. F. H. Gravely.
18178. Singgora, Siam. Dr. N. Annandale.

Bufo fergusoni, Boulenger.

(Plate II, figs. 4, 4*a*.)

We assign provisionally to this species a number of tadpoles from small pools on the Travancore coast, where the toad is abundant. These tadpoles are very like those of *Bufo melanostictus* but smaller, of brownish instead of blackish colour and with the nostrils relatively much

[1] Van Kampen, *Natuurh. Tijdsch. Ned-Ind*, LXIX, p. 30, pl. ii, fig. 2 (1909).
[2] Flower, *Proc. Zool. Soc. London*, 1899, p. 908, pl. lx, fig. 3, 3*a*.

larger. The teeth also are smaller, especially on the last row on the lower lip, and the beak even less powerful and with the margin of the upper part nearly straight. Our specimens are not in sufficiently good condition to provide material for a detailed statement as to proportions but we believe that our figure gives an adequate idea of the outline.

Geographical distribution of the species.—Plains of Southern India and Ceylon.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

17771. Varkallai, Travancore. Dr. N. Annandale.

Bufo microtympanum, Boulenger.

The tadpoles can be recognised by the obcardate body whose greatest width is about the pectoral region. The snout slopes, is blunt and rounded. The eyes and nostrils are dorso-lateral in position ; the latter nearly five-sixths as long as the eye, looking upwards and outwards. The internasal space equals the distance between the nares and eyes and the width of the mouth. The mouth is fairly large, the lower lip being better developed. The papillae are confined to the corner of the mouth and slightly extend to the margin of the lips. Dental formula 1 : 1+1/3. The three series on the lower disc are subequal. The skin is smooth. A preorbital or lachrymal gland may be frequently present, as also series of sensory pits on the dorsum and about the flanks of the body. A frontal gland is faintly marked. The spiraculum is a conspicuous tube, visible from below, directed backwards, nearer to vent. The length of the tail slightly more than $3\frac{1}{2}$ times the total depth. The dorsal lobe is more strongly arched, the tip rounded. The colour of the dorsal surface is deep black, the throat bronzed. The abdomen and fin membranes are white, immaculate.

The following are the dimensions of a fully grown larva :—

	mm.
Total length	27
Length of head and body	11
Length of tail	16
Maximum breadth of body	8
Maximum depth of body	5
Maximum depth of tail	5

Geographical distribution of the species.—Fairly common in southern Peninsular India.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

18736. Bangalore, South India. C. R. Narayan Rao.

Bufo stomaticus, Lütken.

(Plate II, figs. 5, 5*a*.)

A series of tadpoles and toads from Rawalpindi in the north of the Punjab belong to this species.

The tadpoles are very small, not exceeding 20 mm. in length when full grown. The head and body are moderately flat, rather narrowly

oval in shape ; the snout is narrowly and evenly rounded ; the nostrils are large and situated about half way between the eye and the tip of the snout. The spiracle is situated at some considerable distance behind the eye. The mouth is ventral ; the dental formula is 1 : 1+1/3, the lower row on the upper lip being moderately interrupted ; the teeth are rather long and of a black colour ; the margin of the upper beak is feebly convex and minutely denticulate. The lower beak, which is situated far within the upper, is broad and almost U-shaped, with its margin minutely serrated. The tail, which is less than twice as long as the head and body, is bluntly pointed and has both the fin-membranes well developed. The upper membrane starts in front of the posterior extremity of the body and rises rather gradually.

The dorsal surface of the head and body is dark, densely covered with silvery white and black dots. The fleshy part of the tail is mottled with dark markings and is darker above than below. The fin-membranes are almost colourless, but with a few scattered black and white pigment-cells. The ventral surface is colourless, but densely covered with minute silvery dots.

The specimens on which this description is based agree very closely with Anderson's description and figures of the larva of *B. andersoni* from Arabia, except that the first row of teeth is not divided—a probable abnormal condition. It is very doubtful whether the two species are distinct. Specimens of toads from India assigned to *B. andersoni* are certainly identical with the species from Eastern Bengal named *Bufo stomaticus* by Lütken, [1] whose name has priority.

Geographical distribution of the species.—Bufo stomaticus is found all over the Indo-Gangetic plains ; in the Western and Eastern Himalayas up to an altitude of at least 6,000 ft. in Nepal, and occasionally in those parts of Bengal and Bihar that lie south of the Ganges Valley. Sclater's record [2] of specimens from Burma was apparently based on a wrong identification.

Specimens of larvae in the collection of the Indian Museum :—

18526. Rawalpindi, Punjab. R. Hodgart.

Bufo viridis, Laur.

1891. *Bufo viridis*, Boulenger, *Proc. Zool. Soc. London*, 1891, p. 612, pl. xlvi, fig. 5.
1899. *Bufo viridis*, Bolkay, *Ann. Mus. Nat. Hung.*, VII, pp. 85 and 106, pl. i, fig. 5.

It is doubtful whether this Palaearctic species is found in the plains of India, but it is common in the Kashmir Valley and in many districts north and west of the Punjab. An excellent description is given by Boulenger in his account of the European tadpoles. Specimens from Srinagar agree in every respect with this description.

Specimens of larvae in the collection of the Indian Museum :—

18473. Srinagar, Kashmir. F. J. Mitchell.

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[1] Lütken (1862) ? See also Boulenger, *Ann. Mag. Nat. Hist.* (6), VII, p. 463 (1891), and Annandale, *Rec. Ind. Mus.*, III, p. 283 (1909).
[2] *Proc. Zool. Soc. London*, 1892, p. 347.

IV. NOTES ON THE TADPOLES OF INDIAN ENGYSTOMATIDAE.

By C. R. NARAYAN RAO, *M.A., L.T., Mysore University, Bangalore.*

The main object of this paper is to bring together all that is known about the larvae belonging to this family found in India and the Malay Peninsula, in order to facilitate further investigation being undertaken. Of the species reported to occur in India, Burma, and the Malay Peninsula, the life-history of only ten species has been worked out and it is the experience of herpetologists that to obtain the larvae of some of these and other forms is by no means easy, owing to the special modes of life adopted by the great majority of them. I am indebted to Dr. Annandale for the courtesy of allowing me to examine the tadpoles belonging to the species *Microhyla achatina*, ? *M. berdmorei* and *Kaloula pulchra* contained in the Indian Museum collection. The larvae of eight species have been described and annotated by different authors and only two[1] are described here for the first time.

The following is the bibliography on the subject :—

Annandale, N., *Mem. As. Soc. Beng.*, Vol. VI, pp. 150-153 (1917).

Butler, A. L., *Journ. Bombay Nat. Hist. Soc.*, Vol. XV, pp. 387-392 (1903-1904).

Ferguson, H. S., *Journ. Bombay Nat. Hist. Soc.*, Vol. XV, pp. 505-508 (1903-1904).

Flower, S. S., *Proc. Zool. Soc. London*, 1899, pp. 902-903.

Narayan Rao, C. R., *Rec. Ind. Mus.*, Vol. XI, p. 31 (1915).

Narayan Rao, C. R., *Rec. Ind. Mus.*, Vol. XIII, p. 281 (1917).

Smith, M., *Journ. Nat. Hist. Soc. Siam*, Vol. II, pp. 37 and 40 (1916).

Key for the identification of the larvae discussed below :—

Spiracle median, ventral; mouth without beak or horny teeth	Engystomatidae.
A. Tip of tail ends in flagellum; lower caudal lobe twice the dorsal at the base	*Microhyla.*
1. Head two-thirds of the body, former squarish. Body transparent, but not the sides	*M. ornata.*
2. Head less than half the body; snout rounded, not squarish. Body not transparent	*M. rubra.*
3. Mouth surrounded by a float	*M. achatina.*
4. Body broader than long; snout abbreviated and truncate	? *M. berdmorei.*
5. Body less regularly oval; snout shorter; tint green	*M. pulchra.*
B. Tip of tail not flagellate, but pointed; caudal fin membranes of equal depth	*Kaloula.*
6. Spiracle a very large tube, nicked posteriorly. Body elongated, elliptical	*K. variegata.*

[1] They belong to the species *K. variegata* and *K. triangularis*. Dr. Annandale tells me that Dr. F. H. Gravely recently collected specimens of *K. variegata* at Chakradharpur in Chota Nagpur

7. Spiracle an inconspicuous transparent tube, not nicked. Body perfectly transparent, with a horseshoe-shaped mark on the head . *K. triangularis.*
8. Spiracle almost forms a sheath for the root of the anal tube. Body densely pigmented *K. pulchra.*
9. Spiracle not forming a sheath for the anal tube; length of body more than one and a half times the width . . . . . *K. obscura.*[1]

C. Tip of tail obtusely rounded. Tail lobes delicate and at greatest depth individually three-fourths of the muscular portion . . *Cacopus.*

10. Spiracle a conical tube opening almost interfemorally. Body and muscular part of tail densely pigmented *C. systoma.*

Microhyla rubra (Jerd).

LARVA.

1904. Ferguson, *Journ. Bombay Nat. Hist. Soc.*, Vol. XV, p. 506.
1915. Narayan Rao, *Rec. Ind. Mus.*, Vol. XI, p. 31.
1917. Narayan Rao, *Rec. Ind. Mus.*, Vol. XIII, p. 282.

I have shown that Mr. Ferguson has mixed up these larvae with those of *M. ornata.*

Microhyla ornata. (Dum and Bibron).

LARVA.

1899. Flower, *Proc. Zool. Soc. London*, p. 902.
1903-1904. Ferguson, *Journ. Bombay Nat. Hist. Soc.*, Vol. XV, p. 506.
1903-1904. Butler, *Journ. Bombay Nat. Hist. Soc.*, Vol. XV, p. 387.
1917. Narayan Rao, *Rec. Ind. Mus.*, Vol. XIII, p. 282.

Butler remarks " the tadpoles of this and other species of *Microhyla* are very peculiar, being almost perfectly transparent, with the viscera showing through conspicuously." The larvae of *M. ornata* have an opaque reflecting tissue on the sides and the only organ that shows through is the heart. Further down he observes " owing to their extraordinary delicacy I never managed to keep them alive." In my aquarium they thrive quite as well as any of the hardiest of the Ranid larvae.

Microhyla achatina (Boie).

LARVA.

1916. Smith, *Journ. Nat. Hist. Soc. Siam*, Vol. II, p. 37.
1917. Annandale, *Mem. As. Soc. Bengal*, Vol. VI, p. 150.

The modification of the lower lip into a float-like structure resembling that met with in certain species of *Megalophrys* is an interesting fact.

? **Microhyla berdmorei,** Blyth.

LARVA.

1899. Flower, *Proc. Zool. Soc. London*, p. 902.
1917. Annandale, *Mem. As. Soc. Bengal*, Vol. VI, p. 151.

Dr. N. Annandale[2] has shown that the 'transparent larvae' described by Flower are probably those of *M. berdmorei.*

[1] I have not had an opportunity to examine the larva and have had to rely on the description of Ferguson (*op. cit.*, p. 506).
[2] *Mem. As. Soc. Bengal*, VI, p. 151 (1917).

Microhyla pulchra (Hallow).

LARVA.

1917. *Microhyla pulchra*, Smith, *Journ. Nat. Hist. Soc. Siam* II, p. 229.

Kaloula obscura, Günth.

LARVA.

1903-04. Ferguson, *Journ. Bombay Nat. Hist. Soc.*, Vol. XV, p. 507.

Kaloula pulchra, Gray.

LARVA.

1917. Annandale, *Mem. As. Soc. Bengal,* Vol. VI, p. 152.
1916. Smith, *Journ. Nat. Hist. Soc. Siam,* Vol. II, p. 40.
1903-04. Butler, *Journ. Bombay Nat. Hist. Soc.*, Vol. XV, p. 391.

Kaloula variegata (Stoliczka).

This is a very common frog in South India, whose presence after a heavy shower (not less than two inches) is detected by the peculiar cry represented by the syllables "Qhauy, Qhuay, Qhauy." It has been taken in the termites' nest in company with the black scorpion *Palamnaeus*.[1]

LARVA.

Body oval, flat on both surfaces; length to breadth as 3 is to 2, snout rounded, truncate. Nostrils close to the median line, equidistant

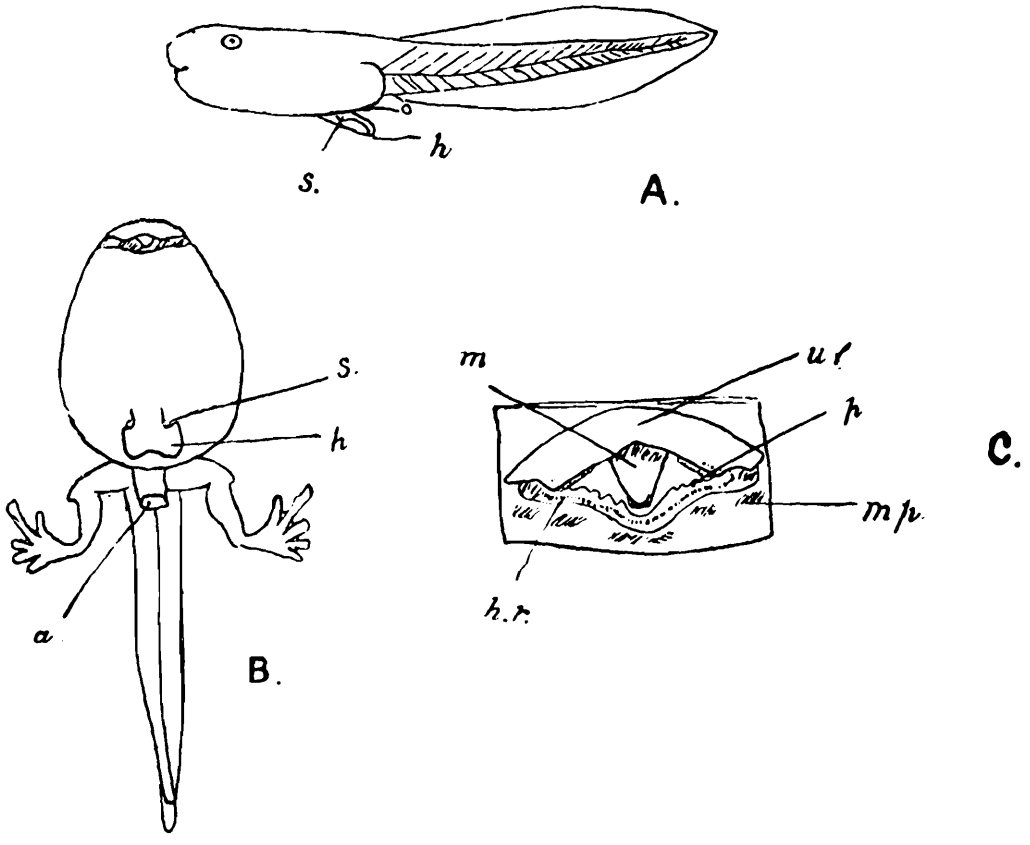

FIG. 1.—Larva of *Kaloula variegata.*

A. Side view. B. Ventral view. C. Mouth-parts.

a = vent; h = spiracular hood; h.r. = horny ridge; m = mouth; mp = muciferous pits; p = papillae; s = spiracular opening.

[1] I am indebted for this information to Dr. J. R. Henderson of the Madras Museum.

between snout and eyes. Internasal space about one-seventh the interorbital. Mouth terminal, both lips contractile and the lower occasionally with a horny rim and microscopic papillae which may extend to the corners of the mouth. A sensory groove connecting nostrils and eye.

Spiracle a large tube, notched behind ; anal tube median. Tip of tail pointed but not flagellate ; both lobes of equal depth, and arched. Greatest depth of tail about one-third the total length.

Body brownish, or gray with minute black spots ; occasionally a blue spot in the groin ; muscular part of tail blotched.

The following are the measurements of a fully grown tadpole :—

	mm.
Total length	45
Length of body	15
Length of tail . .	30
Maximum width of body .	10
Maximum depth of body	8
Maximum depth of tail .	10

In the aquarium these tadpoles were noticed to hide themselves under stones and avoid the lighted portion and in ponds they secrete themselves in the deeper recesses, darting to the surface periodically for the purpose of breathing. The metamorphosis is completed in 20 to 30 days in the aquarium, but in nature I have noticed it is over in a fortnight.

Kaloula triangularis (Günther.).

In South India this frog is more common in the hills[1], but is also frequently met with in the plains under a heap of dried leaves or other suitable cover in close proximity to pools of rain-water. Little is known about the habits of the adult.

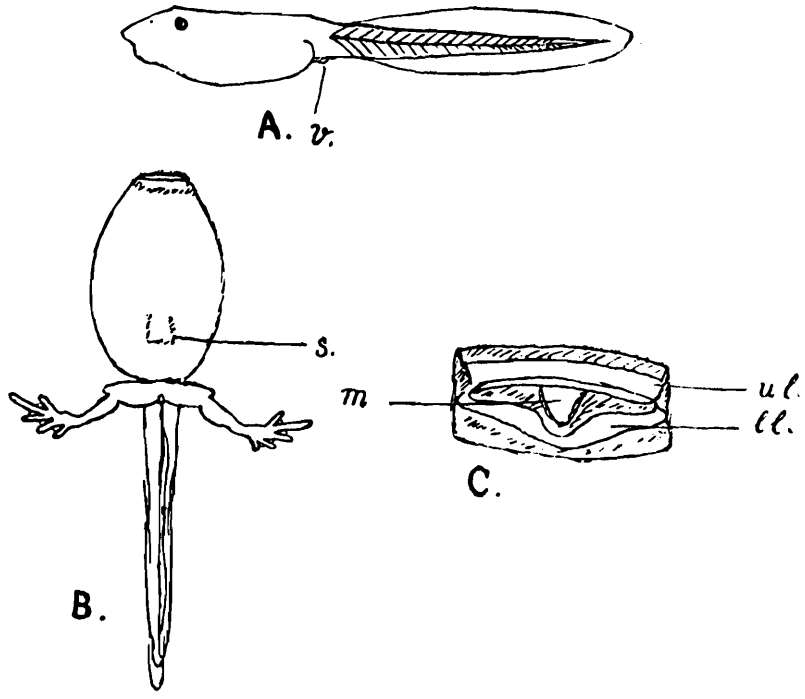

FIG. 2.—Larva of *Kaloula triangularis*.
A. Side view. B. Ventral view, C. Mouth-parts.

[1] Ferguson, *Journ. Bombay Nat. Hist. Soc.*, Vol. XV, p. 507.

Larva.

Body oval, flat ; breadth about three-quarters of the length. Snout acumiate, slightly truncated ; nostrils equidistant between the snout and eyes. Interorbital space about one-sixth the distance between eyes. Mouth small, without a horny rim or papillae. A naso-orbital sensory groove present.

Spiracle inconspicuous, the free hind edge not notched. Vent inconspicuous, median.

Tail very delicate, tip pointed. The muscular part deeper than the lobes.

Larvae perfectly transparent, with the viscera showing through. They become brown[1] when the front limbs sprout. A dark oval or horseshoe-shaped mark on the back which develops into a triangular blackish spot, occupying nearly the whole length of the back as metamorphosis progresses.

The following are the dimensions of a fully grown tadpole :—

	mm.
Total length . . .	32
Length of body	13
Length of tail . .	19
Maximum breadth of body	9½
Maximum depth of body	6
Maximum depth of tail	7

The development is more rapid in this species than in *K. variegata* ; it was completed in the aquarium within two weeks ; the larvae when introduced measured about 22 mm. If it is assumed that the larvae take about a week to attain this size, then the whole metamorphosis occupies about three weeks.

Cacopus systoma, Schneider.

The adults, which are very common during the monsoon, are great burrowers. They emit a very characteristic sound by which their presence is easily detected. The cry[2] is not unlike the bleating of a goat.

Larva.

Ferguson, *Journ. Bombay Nat. Hist. Soc.*, Vol. XV, p. 507.

Addendum.

Dr. Malcolm A. Smith has just published an account of tadpoles from Siam in which he describes the larva of *Glyphoglossus molossus*, Günther, and shows that Flower's " transparent tadpoles " are those of *Microhyla butleri*, Boulenger. See *Journ. Nat. Hist. Soc. Siam* II, p. 261 ; 1917.

Ed.—21-2-1918.

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[1] Butler makes a similar remark in connection with the larvae of *K. pulchra* (*Journ. Bombay Nat. Hist. Soc.*, Vol. XV, p. 392).

[2] I am informed by Dr. J. R. Henderson that in captivity, which they stand very well, they feed on termites in large numbers. This habit, coupled with their burrowing tendencies, must account for the small size of the mouth and the hind limbs armed with powerful metatarsal tubercles, a character shared by species like *Rana breviceps* belonging to a different family which have also similar habits.

V ON TWO ABNORMAL SPECIMENS OF DUCKS IN THE COLLECTION OF THE ZOOLOGICAL SURVEY OF INDIA.

By HERBERT C. ROBINSON, *M.B.O.*U.

Amongst some six hundred duck shot on a swamp near Pathshala in Assam, near the Bhutan Hills, in April, 1917 by Mr. A. Milton were two somewhat uncommon specimens which were presented by him to the Indian Museum.

One of these (25450, Z.S.I.) is a typical male Gadwall *Chaulelasmus streperus* (Linn.) and calls for no special remark.

The other (25451, Z. S. I.), also a male, caused me some considerable trouble in its identification, and until recently I was inclined to consider it as a hybrid between the Common Mallard *Anas boschas*, (Linn.) and the Gadwall *Chaulelasmus streperus* (Linn.).

Comparison of the specimen with other skins and further consultation of the literature has convinced me that I was in error in this identification and that the bird is a hybrid between *Eunetta falcata* (Georgi) and *Chaulelasmus streperus* (Linn.), in which the characters of the first mentioned species are dominant.

The bird is not in full plumage and the highly elongate occipital feathers and strongly decurved and sickle-shaped tertiaries characteristic of the fully adult male Falcated Teal are not strongly in evidence.

The following is a full description of the bird :—

Tail, apparently of sixteen and not fourteen feathers, therein agreeing with *Chaulelasmus* and not *Eunetta*. Upper and lower tail coverts as long as rectrices. Occipital feathers produced, forming a slight "mane."

Anterior lores and an ill-defined frontal patch and a small subocular spot dirty white ; top of the head dull chestnut, sides of the head and occipital mane bronzy green, the feathers faintly tipped with whitish ; chin, throat and an interrupted collar white, narrowly bordered above with blackish ; a broad bronze green collar succeeded by a narrower white one, interrupted behind.

Mantle, hind-neck and breast with broad V-shaped vermiculations of white and brownish-black, with a bronzy tint, the white element narrowest. Scapulars and flanks the same, but the vermiculations finer and straighter. A black spot on the outer webs of the outer elongated scapulars. Upper back brownish, faintly vermiculated with white, lower back and upper tail coverts black.

Tail feathers greyish above, whitish beneath, the outer webs with dark edges. Under tail coverts black, the outermost with a large median spot of buff. Belly whitish, finely vermiculated with greyish-black.

Lesser wing coverts dove grey, the innermost vermiculated with whitish ; median coverts grey, the median portion of each feather whitish with the tips of the outer webs broadly chestnut, forming a double wing bar. Outer secondaries black on their outer webs, the inner

secondaries largely white, the inner webs brownish. Elongated tertiaries brownish with white shafts, the outermost with an oily green tinge, edges buff.

Primaries brownish, darker at the tips ; inner aspect of wing whitish, axillaries white.

Bill apparently uniform black, feet dull yellowish-brown (in skin).

Wing 248 mm. ; culmen 45 mm.

The Gadwall is of course a very common duck in India during the winter, though it is not known to breed within the Empire. *Eunetta falcata* on the other hand is very rare indeed within Indian limits, being normally an East Asiatic species. Individuals have, however, been recorded from localities so far apart as Bhamo, Burma and Narra, Sind. Several obtained in the Calcutta bazaar by Mr. F. Finn are in the collection of the Zoological Survey of India and full details of other occurrences are given by E. C. Stewart Baker (*Indian Ducks and their Allies*, p. 143. *et seq.*, London, 1908).

In 1891 Mr. W. L. Sclater (*Proc. Zool. Soc. London*, 1891, p. 313) described a male duck (20505, Z.S.I.) brought in alive to the Indian Museum which he considered to be a hybrid between the Mallard and Gadwall (*Anas boschas* × *Chaulelasmus streperus*).

There is nothing to add to his very full description, but it would appear probable that the bird is a hybrid between *Anas boschas* and *Querquedula crecca* rather than with *Ch. streperus*. The sides of the head are rich brown and the breast has a distinctly spotted appearance, both of which features occur in *Q. crecca*, but cannot be said to be represented in *Ch. streperus*.

The cross is well known and numerous references to it occur in ornithological literature generally under the name of *Anas bimaculata* (Bp.).

The attached plate gives a good idea of the general appearance of the two specimens.