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-

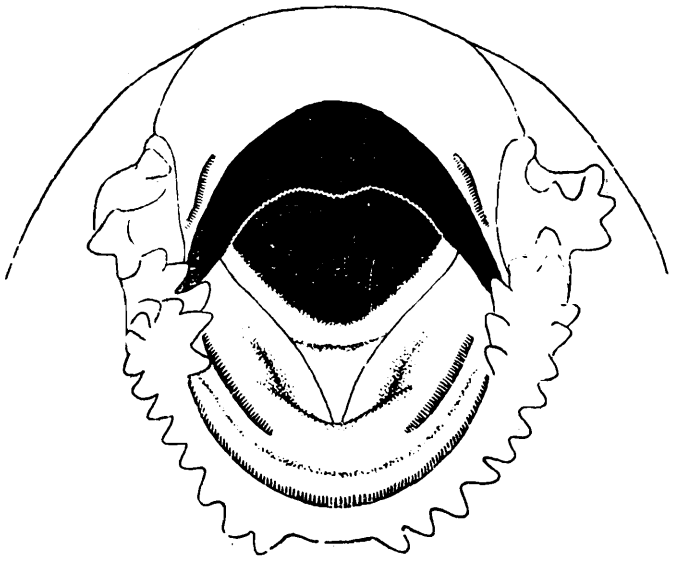

Fig. 1.—Mouth-disk of a tadpole of *Rana cyanophlyctis* with the upper tooth-row greatly reduced (considerably enlarged).

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.