

# I. BATRACHIA.

(Plates ii-iv.)

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Mr. Kemp's collection of Batrachia from the Abor country and the frontiers of Assam comprises 57 specimens of frogs and toads and a considerable number of tadpoles. With those obtained on the Expedition of 1911-1912 I have included two interesting specimens taken by Mr. Kemp on a previous visit to the frontier of eastern Bhutan. In all at least 25 species are represented, of which about one-third are new to science, while several have only been recorded hitherto from Burma or from Assam south of the Brahmaputra. The collection, therefore, affords the opportunity of making important additions to the fauna of the Himalayas, the animals of the extreme eastern region of which have up to the present been almost unknown.

## PART I.—SYSTEMATIC.

List of species represented in Mr. Kemp's collection :—

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|--------------------------------------|---|
| 1. <i>Rana cyanophlyctis</i> .       | 14. <i>Rhacophorus maculatus him-</i>     |
| 2. <i>R. liebigii</i> .              | <i>alayensis</i> , nov.                   |
| 3. <i>R. tigrina</i> .               | 15. <i>Rh. tuberculatus</i> .             |
| 4. <i>R. limnocharis</i> .           | 16. <i>Ixalus asper</i> .                 |
| 5. <i>R. alticola</i> .              | 17. <i>I. annandalei</i> .                |
| 6. <i>R. granulosa</i> .             | 18. <i>I. argus</i> , nov.                |
| 7. <i>R. afghana</i> .               | 19. <i>I. tuberculatus</i> .              |
| 8. <i>R. gerbillus</i> , nov.        | 20. <i>Chirixalus doriae</i> .            |
| 9. <i>Micrixalus borealis</i> , nov. | 21. <i>Phrynoderma moloch</i> , nov.      |
| 10. <i>Rhacophorus maximus</i> .     | 22. <i>Bufo melanostictus</i> .           |
| 11. <i>Rh. bimaculatus</i> .         | 23. <i>B. himalayanus</i> .               |
| 12. <i>Rh. naso</i> , nov.           | 24. <i>Megalophrys</i> (?) <i>major</i> . |
| 13. <i>Rh. microdiscus</i> , nov.    | 25. <i>M. kempii</i> , nov.               |

(a) ADULTS.

Fam. RANIDAE.

### 1. *Rana cyanophlyctis*, Schneid.

Boulenger, *Fauna*, p. 442.

This frog occurs all over the plains of India and ascends the Himalayas to altitudes of at least 5,000 ft. In Kumaon in the Western Hima-

layas it is the common frog at 4,500 ft., but at 6,000 ft. is entirely replaced by *R. blanfordii*. It is very largely aquatic in habits and is not as a rule found in dense jungle.

Mr. Kemp obtained a single specimen at Dibrugarh.

## 2. *Rana liebighii*, Günth.

Boulenger, *Fauna*, p. 445.

*R. liebighii* is very common in the Darjiling Himalayas at altitudes between 4,000 and 10,000 feet; it also occurs, though rarely, in the Western Himalayas (Simla and Kashmir), while to the south-east its range extends to northern Tenasserim. It is essentially a jungle frog and is usually found among dense undergrowth or at the edge of streams.

No adults of this species were obtained on the expedition, but two tadpoles were taken in a small stream near Yembung (alt. 1,100 ft.) on the east side of the Dihang River.

## 3. *Rana tigrina*, Daud.

Boulenger, *Fauna*, p. 449.

Although it is apparently rare in the Himalayas, *R. tigrina* occurs all over the plains of India. In different parts of India, however, its habits differ considerably and certain structural differences also seem to occur, so that it is probable that several different races will ultimately have to be recognized as distinct. In Bengal *R. tigrina* is essentially a "tank" frog, inhabiting moderately large masses of water.

Two specimens were obtained by Mr. Kemp at Sadiya under a log at the edge of the Dikrang River.

## 4. *Rana limnocharis*, Wiegman.

Boulenger, *Fauna*, p. 450.

Being much more adaptable in its habits than *R. tigrina*, *R. limnocharis* has an even wider range than that species. It is equally at home in flooded rice-fields and at the edge of rocky streamlets in the densest jungle. Both in the Himalayas and in the mountains of Burma it ascends to an altitude of at least 6,000 ft.

Mr. Kemp obtained specimens at Sadiya, Kobo and Rotung and in the Siyom valley below Damda.

## 5. *Rana alticola*, Boulgr.

Boulenger, *Cat. Batr. Sal. Brit. Mus.* (2nd ed.), p. 63, fig. (1882).

The range of this frog is considerable both in longitude and latitude and also in altitude. Colonel Alcock obtained specimens of the charac-

teristic tadpole at an altitude of 8,500 ft. in the Hundur Yarm Valley in northern Kashmir, while Capt. R. B. Seymour Sewell has recently taken precisely similar larvae a few feet above sea-level and a few yards from the shore, in a small stream running into Heinze Basin on the coast of Tavoy. I have also examined larvae from other parts of Tenasserim and Assam and from Little Andaman I., and adults from Tenasserim and Assam, Bengal and Orissa. I have not, however, seen specimens from any place in the plains west of Calcutta. In Lower Burma and Orissa the frog is usually found amongst dense vegetation at the edge of ponds and lakes. On the shores of the Sar Lake near Puri it is abundant on the leaves of plants that grow out of the water and also on ledges in the sides of old wells.

The back of the young frog is brown, often mottled with black, but in the adult it becomes of a bright leaf-green. I have redescribed the tadpole below (p. 22). *R. alticola* is of much more slender habit and usually of smaller size than *R. erythraea*, which resembles it in habits, but apparently is not found west of the Bay of Bengal.

Mr. Kemp took a small specimen of *R. alticola* on the Assam-Bhutan frontier in the north-east of the Mangaldai division of the Darrang district in January, 1911.

#### 6. *Rana granulosa* (Anderson).

*Hylorana granulosa*, Anderson, *J.A.S.B.*, (2), xl, p. 23 (1871).

?*Rana tyleri*, Boulenger, *Fauna*, p. 458 (*partim*).

*Rana granulosa*, *id.*, *Ann. Mus. Genova* (2nd ser.), xiii, p. 333, pl. viii, fig. 2 (1893).

This frog is known from the Karin Hills and Pegu in Burma, from Yunnan and from north-eastern Assam (Sibsagar). It is apparently arboreal in habits.

A specimen was taken on a tree-trunk near Dibrugarh.

#### 7. *Rana afghana* (Günth.).

*Polypedates afghana*, Günther, *Rept. Brit. Ind.*, p. 432.

*Rana latopalmata*, Boulenger, *Fauna*, p. 462.

*Rana afghana*, *id.*, *Ann. Mus. Genova* (2nd ser.), v, p. 420 (1888).

It is very unfortunate that this frog should have to bear the inappropriate specific name "*afghana*," for there can be little doubt that its range does not extend west of Nepal. It is not uncommon in the Darjiling Himalayas at moderate altitudes and has also been found in Assam and Burma.

An adult was taken by Mr. Kemp at Yembung (alt. 1,100 ft.), and also two tadpoles, which are noticed below (p. 24).

8. *Rana gerbillus*, sp. nov.

(Plate ii, fig. 1.)

Allied to *R. jerboa* (Günther), from which it differs in its much smaller tympanum and in other particulars.

*Habit* slender. Length from snout to vent 33 mm.

*Head* broad, triangular; snout bluntly pointed, somewhat depressed at the tip, a trifle longer than the diameter of the orbit; nostril a little nearer the tip of the snout than the eye, which is large and prominent; interorbital space flat, as wide as the upper eyelid; canthus rostralis bluntly angular; loreal region concave; tympanum not very distinct, small, about  $\frac{1}{3}$  as wide as eye.

*Mouth*.—A distinct tooth at the tip of the lower jaw; no free papilla on the tongue; vomerine teeth ill-developed, in two small roundish patches situated close together in the middle of the palate between the choanae.

*Limbs* slender. Fingers slender, with well-developed disks; that on the third rather larger than the tympanum; that on the first small; a rudiment of a web between the third and fourth fingers; others quite free; first finger shorter than second. Hind limbs very long, the tarsotibial articulation reaching far beyond the edge of the snout. Toes almost completely webbed; their disks subequal, smaller than the tympanum; subarticular tubercles large but not prominent, oval; a low oval inner metatarsal tubercle; no outer one; no tarsal fold.

*Skin*.—A distinct glandular latero-dorsal fold and another, less distinct, extending from the eye above the tympanum almost to the shoulder. Dorsal surface of the head minutely pitted, of the back obscurely granular with large compressed longitudinal tubercles scattered more especially on the sides. Ventral surface and limbs smooth.

*Colouration*.—Dorsal surface very dark grey obscurely mottled with a paler shade; lips with pale vertical stripes; sides pale, spotted with dark grey; limbs, especially the thighs, conspicuously barred; ventral surface dull greenish yellow with large round or oval brown spots on the chin, throat and chest.

*Habitat*.—Yembung, Abor foot-hills at an altitude of 1,100 ft. A single specimen was found at the edge of a small stream in February.

*Type*.—No. 16925 of Indian Museum register of Reptiles and Batrachia.

*Rana jerboa* (Günther), to which this new species is most closely allied, is found in Burma, the Malay Peninsula, Java, Borneo, etc.

9. *Micrixalus borealis*, sp. nov.

(Plate ii, fig. 2.)

Closely allied to *Rana tenasserimensis*,<sup>1</sup> Sclater, from which it may be distinguished by the small size of the disks on its fingers, its hidden tympanum and its almost completely webbed toes.

<sup>1</sup> P. Z. S., 1892, p. 345, pl. xxiv, fig. 4, and *List Batrachia Ind. Mus.*, p. 8 (1892).

*Habit* stout. Length from snout to vent 25 mm.

*Head* short, broad, triangular, by no means depressed; snout bluntly pointed, convex at the tip, a little shorter than the orbit; canthus rostralis rounded; loreal region not concave, sloping outwards and downwards; eye large, not very prominent; interorbital region slightly convex, a little broader than the upper eyelid; tympanum concealed; a prominent fold running backwards and downwards from the eye to a point a little behind the gape.

*Mouth*.—A prominent tooth at the apex of the lower jaw; no trace of vomerine teeth; the choanae situated far forward; no papilla on the tongue. An internal vocal pouch in the male.

*Skin*.—No dorso-lateral fold. Dorsal surface minutely warty; ventral surface almost smooth but with a rather indistinct reticulation of grooves; a transverse fold running across the posterior end of the throat in the male.

*Limbs* stout. Fore limbs short; fingers short; the first a little shorter than the second; disks very small but distinct; a rudiment of a web between all the fingers; subarticular tubercles inconspicuous but of fairly large size. Tibio-tarsal articulation reaching the eye; toes moderately slender, with very small disks; web almost complete but not quite reaching or barely reaching the disks of the first and fifth toes; subarticular tubercles inconspicuous; an elongate but not very prominent internal metatarsal tubercle followed by a fold of skin on the tarsus; another fold on the external margin of the foot; no outer metatarsal tubercle.

*Colouration*.—Back dark brown mottled with purplish black; a dark interorbital cross-bar usually present; limbs obscurely barred and digits more conspicuously so; ventral surface yellowish, powdered on the throat and chin with purple-brown, as a rule so densely that the skin appears almost black to the naked eye; ventral surface of hands, feet and thighs powdered in a similar manner but not so densely; belly sometimes spotted.

*Localities*.—Rotung (alt. 1,300 ft.) and about 3 miles S. of Yembung.

*Type*.—No. 16932 in Indian Museum register of Reptiles and Batrachia.

I think I am right in referring this species, of which I have examined eleven specimens, to Boulenger's genus *Micrixalus* rather than to *Rana*; for I can find no trace of vomerine teeth, while the small size of the frog and its general facies are features in which it resembles the south Indian species included in the former genus. Sclater's *Rana tenasserimensis*, of which three type-specimens are now in our collection, has apparently vomerine teeth in some individuals and none in others, but these teeth are never well developed. It should also, in my opinion, rank as *Micrixalus*.<sup>1</sup>

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<sup>1</sup> See Boulenger, *P.Z.S.*, 1883, p. 205, and *Fauna*, p. 464; also W. L. Sclater, *P.Z.S.*, 1892, p. 345, pl. xxiv, fig. 4, 4a, and Boulenger, *Ann. Mus. Genova* (2nd ser.), xiii, p. 331.

Ten specimens of *M. borealis* were taken under stones in a stream at Rotung and one a few miles S. of Yembung.

#### 10. *Rhacophorus maximus*, Günth.

Boulenger, *Fauna*, p. 472.

A common species on the lower slopes of the Darjiling Himalayas and the Khasi Hills. Colonel Godwin-Austen obtained specimens in the Dafla country.

Mr. Kemp obtained a half-grown specimen at Upper Rotung at an altitude of about 2,000 ft.

#### 11. *Rhacophorus bimaculatus*, Boulgr.

Boulenger, *Fauna*, p. 472.

Not uncommon in the Khasi Hills. Mr. Kemp's only specimen, which was taken at Rotung (alt. 1,300 ft.) in January, has the web of the feet of a bright scarlet colour and lacks the dark spots on the sides usually so characteristic of the species. In the former particular it agrees with other specimens in our collection.

#### 12. *Rhacophorus naso*, sp. nov.

(Plate ii, fig. 3.)

This peculiar species can be distinguished from any other of the genus that occurs in Assam or Burma by the dermal appendage on its snout.

*Habit* moderately stout. Length from snout to vent 43 mm.

*Head* rather broad, triangular, with convex sides; snout much longer than orbit, pointed, convex above, nostril much nearer tip of snout than eye; canthus rostralis indistinct; loreal region concave, almost horizontal. Diameter of tympanum, which is distinct, about  $\frac{2}{3}$  that of eye.

*Mouth*.—No prominent tooth at apex of lower jaw; no papilla on the tongue; vomerine teeth forming two small, almost circular patches, one close to the inner margin of each choana; choanae small.

*Skin* of dorsal surface rugose with many prominent and irregular tubercles; a small subquadrangular dermal projection on the snout; rounded tubercles scattered on the basal part of the thighs; ventral surface coarsely granular, more so on the chest and throat than on the belly. A fairly distinct dorso-lateral fold and a more prominent one running from the eye above the tympanum to the shoulder; serrated cutaneous fringes on the outer edges of the forearm and the shin.

*Limbs* stout, not very long. Fingers with a rudimentary web; their disks well developed, transversely oval; that on the third finger almost as large as the tympanum; subarticular tubercles well developed. The tibio-tarsal articulation reaches the eye; toes almost completely

webbed ; their disks like those of the fingers ; subarticular tubercles well developed ; a somewhat elongate but not very prominent inner metatarsal tubercle ; no corresponding outer tubercle.

*Colouration*.—Dorsal surface purplish-brown irregularly marked with dark slate-colour ; irregular paler markings on the sides ; limbs irregularly marked ; fingers and toes barred with alternate brown and grey stripes. Ventral surface dirty white, shaded posteriorly with dark grey ; dark grey spots on throat and an irregular reticulation of the same shade on the chest. Ventral surface of hands and feet grey, with the tubercles white ; a white spot on the soles in the place where an external metatarsal tubercle would be.

*Habitat*.—Egar stream between Renging and Rotung (9-i-12).

*Type* (a unique specimen). No. 16929 in the Indian Museum register of Reptiles and Batrachia.

### 13. *Rhacophorus microdiscus*, sp. nov.

(Plate ii, fig. 4.)

This species is easily recognized by the small size of its digital disks.

*Habit* slender. Length from snout to vent 29 mm.

*Head* large, flat, broadly ovoid ; snout rounded in front, by no means prominent, rather shorter than the orbit ; nostril much nearer tip of snout than eye ; canthus rostralis indistinct ; loreal region concave, oblique ; tympanum distinct, close to eye ; its diameter about  $\frac{1}{3}$  of that of eye ; interorbital space about as wide as upper eye-lid, flat.

*Mouth*.—No tooth at apex of lower jaw ; no papilla on the tongue ; choanae large ; vomerine teeth in two short, ridge-like series running obliquely backwards and inwards from a point near the anterior inner margin of the choanae but widely separated from one another.

*Limbs* slender but short. Fingers with a slight rudiment of a web ; their disks very small, that on the third being much less than  $\frac{1}{2}$  as wide as the tympanum ; subarticular tubercles well developed ; a large rounded inner metacarpal tubercle. Tibio-tarsal articulation barely reaching the eye ; disks of toes like those of fingers ; feet less than half webbed ; subarticular tubercles well developed ; an elongate but by no means prominent inner metatarsal tubercle.

*Skin* of dorsal surface, throat and chest smooth ; that of belly separated into polygonal areas by a very distinct network of grooves ; on the posterior part these areas gradually take the form of low conical tubercles ; isolated rounded tubercles on basal part of thighs. No dorso-lateral fold ; an indistinct fold running from above tympanum to shoulder.

*Colouration*.—Dorsal surface pale slate-grey irregularly marked with darker grey and powdered with black ; dorsal surface of limbs

indistinctly barred; outer margin of thigh reddish; ventral surface dirty white.

*Habitat*.—Kobo, at base of Abor foot-hills (alt. 400 ft.) : 29-30-iii-12.

*Type* (a unique specimen). No. 16924 in Indian Museum register of Reptiles and Batrachia.

#### 14. *Rhacophorus maculatus* (Günther).

*Rhacophorus maculatus* and *R. leucomystax*, Boulenger, *Fauna*, pp. 474, 475.

I have little doubt that what may be called the "Common Tree-frog" of Peninsular India, the Himalayas and the Malay Peninsula really represents three local races of a single species. These three races or subspecies may be distinguished as follows :—

1. *Rhacophorus maculatus* (Günther) (*forma typica*). No parieto-squamosal arch; dorsal surface of skull smooth; skin of dorsal surface of head free. *Distribution*.—Peninsular India and Ceylon.

2. *Rhacophorus maculatus himalayensis*, subsp. nov. A well-developed parieto-squamosal arch; dorsal surface of skull smooth; skin of dorsal surface of head free. *Distribution*.—The Eastern Himalayas, Assam, western China.

3. *Rhacophorus maculatus leucomystax* (Gravenhagen). A well-developed parieto-squamosal arch; dorsal surface of skull rugose; skin of dorsal surface of head adhering to the skull. *Distribution*.—Lower Burma, the Malay Peninsula and many of the Malay islands.

Mr. Kemp's specimens belong to the second race. The larvae of the three races are discussed below (p. 24).

Two small specimens were taken at Kobo and a very large one on the east side of the Dihang R. at an altitude of 1,100 feet.

#### 15. *Rhacophorus tuberculatus*, Anderson.

(Plate ii, fig. 5.)

Anderson, *J.A.S.B.*, (2), xl, p. 26; Boulenger, *Fauna*, p. 474.

The specimens in Mr. Kemp's collection agree well as regards structure and dimensions with the late Dr. Anderson's description and with his type specimens, which are in the same condition as they were when the species was described. The colours of the latter specimens had, however, already faded at that date and the fresh ones now before me are particularly interesting in this respect. No two of the four.



brought back from the Abor country and taken together in circumstances which I will describe immediately, are precisely identical in colouration ; but in all the colours are so blended that those commonly found on the stems of bamboos growing in thickets in damp jungle are accurately reproduced. The back and the dorsal surface of the head and limbs are in all dull clay-colour sparingly powdered with black and suffused more or less definitely with yellow, the canthus rostralis is outlined in black, the ventral surface is pale yellow and the inner surface of the thighs wholly or partly scarlet. In one individual there is a narrow black, white-edged line running backwards along each side from the eye to the base of the hind limb, while the back of the head and the back are ornamented with two large irregular marks outlined by similar lines. In this specimen, which appears to be an adult male, there are also dark longitudinal lines on the limbs and on the inner margin of the fifth toe and the web that intervenes between that toe and the fourth. In the second individual, a female, the sides of the back are so strongly suffused with yellow that they may be described as ochraceous, the webs of the feet are almost black and the red colour of the inner surface of the thigh extends down that of the shin. In another male, rather smaller than the first, there are small black spots on the back and a dark-edge white line running transversely on the dorsal surface above the vent. The fourth specimen, probably a young male, has no very definite markings. The colouration of the dorsal surface in all the specimens bears a close resemblance to that of a bamboo stem overgrown with minute fungi and lichens such as are usually found on bamboo-stems in a very damp atmosphere. The scarlet of the thighs would be completely concealed in the attitude of rest.

It is interesting to have the opportunity of comparing Anderson's types with fresh specimens of the species, but it is still more interesting to be able to put on record the peculiar circumstances in which these specimens were taken. They were found in an internode of bamboo which was intact as regards both its sides and its two nodes, except that there was in one side a small hole apparently made by some insect, less than a quarter of an inch in diameter. When the bamboo was split open in preparation for bridge-making the four frogs were seen seated on the inner surface near one end (the upper at the time), while two earthworms and a land planarian occupied the other. There can be little doubt, therefore, that they had entered the bamboo as small frogs and had been supplied with food by the intrusion of worms and other small animals through the hole by which they had originally entered, and from which their increase in bulk rendered it impossible for them to emerge. In spite of the fact that they must have lived for some considerable time practically in the dark they had preserved their colouration, which was of a distinctly protective type.

Four specimens from Upper Rotung (alt. *ca.* 2,000 ft.) : 22nd January 1912, collected by Capt. the Hon. M. de Courcy. Anderson's specimens were from Sibsagar in N.-E. Assam. This place is situated on the northern bank of one of the smaller tributaries of the Brahmaputra.

16. *Ixalus asper*, Boulgr.

Boulenger, *P.Z.S.*, 1886, p. 415, pl. xxxix, and *Ann. Mus. Genova* (2nd ser.), xiii, p. 340, 1893 ; Sclater, *P.Z.S.*, 1892, p. 347 ; Robinson, *Journ. F.M.S. Mus.*, i, p. 24.

This species appears to be the most widely distributed of the Indian *Ixali*. It was originally described from the mountains of Perak in the Malay Peninsula and was found by the late Signor Fea in the Karin Hills and by one of our collectors in the hills between Burma and Siam. The Indian Museum possesses a specimen labelled as being from Kolasi in the Purnea district of Bihar, but this specimen very possibly came actually from the foot-hills of eastern Nepal.

The irregular white or greyish-white markings on the posterior part of the body of *I. asper* give it exactly the appearance of being overgrown with a mould or fungus. Whether this is of any protective advantage to the frog may perhaps be doubted, but I have noticed a similar phenomenon in the case of several Malayan insects belonging to the orders Coleoptera and Rhynchota and it is well known that in tropical jungles insects are frequently attacked by fungi which produce a white mycelium and finally, having killed them, fasten their dead bodies by means of this mycelium to tree-trunks or other inanimate objects.

A specimen of *Ixalus asper* was taken on a tree-trunk at the edge of Egar stream between Renging and Rotung on 9th January, 1912. With it were taken the type specimen of *Rhacophorus naso*, a specimen of *Ixalus tuberculatus* and also tadpoles of two species, a *Megalophrys* (*M. ? major*) and a Ranid which cannot be identified.

17. *Ixalus annandalei*, Boulgr.

(Plate iii, fig. 2.)

Boulenger, *J.A.S.B.*, 1906 (2), p. 335.

This species was not taken on the Abor Expedition, but a single specimen was obtained by Mr. Kemp in December, 1910, on the Bhutan frontier of Assam in the Mangaldai division of the Darrang district. It is common in the Darjiling district between 4,000 and 5,000 ft. and occurs both among dead leaves and low herbage in the jungle and on tea-bushes.

18. *Ixalus argus*, sp. nov.

(Plate iii, fig. 3.)

*Habit* moderately-slender, *Rhacophorus*-like. Length from snout to vent 27 mm.

*Head* short and broad, triangular ; snout blunt, somewhat depressed at tip, obliquely truncate vertically, projecting, a little longer than the orbit ; nostril nearer tip of snout than eye ; canthus rostralis fairly distinct ; loreal region vertical, concave ; tympanum distinct, small, about  $\frac{1}{3}$  as broad as eye, interorbital space broader than upper eye-lid.

*Mouth*.—A small tooth at apex of lower jaw; no papilla on the tongue; choanae small, widely separated, situated far forwards.

*Skin*.—No latero-dorsal or supratympanic folds. Skin of head and neck smooth, of back beset with small scattered tubercles; ventral surface smooth.

*Limbs* slender. Fingers slender, free, with large disks; that on third finger as large as tympanum; first finger a little shorter than second; subarticular tubercles large, rounded, a little prominent; no metacarpal tubercles. Tibio-tarsal articulation reaching nostril; toes fully webbed; disks a little smaller than those on fingers; subarticular tubercles distinct but by no means prominent; a very distinct inner, but no outer, metatarsal tubercle; no tarsal fold.

*Colouration*.—Dorsal surface dark slate-grey with a paler reticulation on the back that gives it the appearance of being faintly ocellated; limbs and fingers conspicuously barred with dark grey and white; ventral surface dirty white faintly spotted on the throat and chest with grey; soles of feet and palms of hands dark grey.

*Habitat*.—Upper Renging, alt. 2,150 feet.

*Type* (a unique specimen). No. 16950 in the Indian Museum register of Reptiles and Batrachia.

### 19. *Ixalus tuberculatus*, Anderson.

(Plate iii, fig. 1.)

Anderson, *Anat. Zool. Res. Yunnan Exp.*, p. 855, pl. lxxviii, fig. 7 (1878).

I think I am right in identifying a series of specimens in Mr. Kemp's collection with this species, but Anderson's figure is poor and his specimens are not forthcoming for comparison. It is evidently variable in several characters, notably in stoutness of habit, in colouration, in roughness of skin and in the relative size of the disks of the fingers and toes. In some of the Abor specimens the skin of the dorsal surface is smooth except for small scattered tubercles, in others the tubercles are so much larger and closer together that it is quite rough; in some the finger-disks are much smaller than the toe-disks, but in others they are of almost exactly the same size, while some individuals are much stouter than others. In all the ground-colour of the dorsal surface is very dark slate-grey rather than olive, but this may be due to the fact that the specimens had been hardened in formalin before being preserved in spirit. A pale cross-bar between the eyes can usually be detected and there is always a pale patch on the sides near the groin marked diversely with black; the corresponding surface of the outer margin of the thighs is similarly marked; in some individuals there is a large dark x-shaped mark on the back.

Specimens were taken at Janakmukh (600 ft.), in Egar stream between Renging and Rotung, at Rotung (1,300 ft.) and at Kalek (3,800 ft.). At the two last-named localities several individuals were found between the 24th and 29th of December hiding under the leaf-stems

of banana-trees. Probably they were hibernating. In all seven specimens were found.

## 20. *Chirixalus doriae*, Boulgr.

Boulenger, *Ann. Mus. Genova* (2nd ser.), xiii, p. 341, pl. x, fig. 5 (1893).

A single male taken under a log at Kobo (alt. 400 ft.) agrees well with Mr. Boulenger's figure and description. *Ch. doriae*, which is the only known species of the genus, was originally found by the late Signor Fea in the Karin Hills.

## 21. *Phrynoderma moloch*, sp. nov.

(Plate iii, fig. 4.)

This species differs from *Phrynoderma asperum*, Boulenger,<sup>1</sup> the only one hitherto known, in several important characters, notably in the much more pronounced nature of the asperities on its back.

*Habit* slender. Length from snout to vent 41 mm.

*Head* short, broad, triangular, depressed; snout about as long as orbit, sinuously truncate transversely, obliquely truncate vertically; nostril close to tip of snout, very prominent; eye large, prominent; canthus rostralis indistinct; loreal region almost vertical, slightly concave; inter-orbital region slightly concave, broader than upper eyelid; tympanum fairly distinct, about  $\frac{2}{3}$  as wide as eye.

*Skin*.—No supratympanic or dorso-lateral folds; back bearing very prominent ridge-like, more or less serrated, warts which run longitudinally and obliquely; these warts larger on neck and across shoulders, on which they form V-shaped figures; shorter warts on head and dorsal surface of limbs; throat and ventral surface of limbs smooth; belly and sides coarsely granular.

*Limbs* slender but rather short. Fingers free, slender, flattened; disks very large, that on the 3rd finger nearly equalling the tympanum; subarticular tubercles small; external and internal subcarpal tubercles indistinct. Tibio-tarsal articulation reaching tympanum; toes  $\frac{1}{2}$  webbed, the web reaching the disks of all but the 4th, up which it extends as a narrow fringe almost to the disk; subarticular tubercles small and by no means prominent; a very small and indistinct internal metatarsal tubercle; no external metatarsal tubercle; a narrow serrated fringe on the 5th toe and a less distinct serrated ridge running along middle of ventral surface of shin.

*Colouration*.—Back grey with black spots; the larger warts buff; the tympanum black; a large black and white diversified patch on each side between the two fore and hind limbs and a white patch in the axilla; external surface of thigh irregularly banded and marbled with black, white and grey; ventral surface black with a faint vermicular

<sup>1</sup> *Ann. Mus. Genova* (2nd ser.), xiii, p. 342, pl. xi, fig. 1.

reticulation running all over the body and onto the ventral surface of the thighs.

*Habitat*.—Upper Renging (alt. 2,150 ft.) : 5-10-ii-12.

*Types* (two adults). Nos. 16951 and 16952 : presented by Capt. the Hon. M. de Courcy.

The circumstances in which these frogs and their tadpoles were found are of considerable interest. Capt. de Courcy writes about them as follows :—

“ [The frogs were taken] between Upper Renging and the Yernu Kotal. It was a few yards this side of Prospect Col that some of my men found the new *Phrynoderma* frogs—3 of them, under a log—and kept them, trying to make me see them among some lumps of earth—almost an impossibility. One escaped a few minutes after I had taken them over, and while I was standing there, the men cut off a big bit of the same log, the usual old felled tree on a *jhoom* [clearing], and rolled it down on to the road. Some water gushed out of a hole and I saw the tadpoles wriggling about on the ground and collected all I could.”

The tadpoles, which are described below (p. 25), evidently belong to the same species as the adult frogs, for one of them has progressed far in its metamorphosis and has begun to develop the characteristic ridge-like warts on the back.

#### Fam. BUFONIDAE.

##### 22. *Bufo melanostictus*, Schneid.

A typical specimen of this toad was taken by Mr. Kemp at Dibrugarh in the middle of November and on the same date he found a number of tadpoles in which the hind limbs were not developed.

##### 23. *Bufo himalayanus*, Günth.

*Bufo melanostictus* var. *himalayanus*, Günther, *Rept. Brit. Ind.* p. 442.

*Bufo himalayanus*, Boulenger, *Fauna*, p. 505.

I am inclined to agree with Dr. Günther in regarding this form merely as an Alpine race of *B. melanostictus*. The greatest difficulty is often experienced in separating specimens and quite typical individuals of *B. melanostictus* are often found at considerable altitudes in the Himalayas. Almost every gradation between the two forms can be found. Tadpoles (plate iv, fig. 7), however, from above 4,000 ft. in the E. Himalayas can, so far as my experience goes, be distinguished from those found in the plains of India by the fact that the eyes are not prominent but rather sunken. Tadpoles from the plains agree well with one from the Malay Peninsula figured by Flower (*P.Z.S.*, 1896, p. 911, pl. xlv, fig. 3), and I have found similar specimens at an altitude of over 7,000 ft. in the W. Himalayas near Naini Tal.

Mr. Kemp obtained four toads at Kobo in November and December, which I assign to Günther's "variety" with some doubt. Their tympana

are smaller than is usually the case in *B. melanostictus* and in two of them are also somewhat obscured. The parietal ridges are absent in one specimen and in the others, although they are present, they are very indistinct.

#### Fam. PELOBATIDÆ.

The genus *Megalophrys* is represented in the collection by tadpoles which seem to belong to at least two species and also by a single small frog, which I have accepted as the type of a new species. The tadpoles are discussed below (p. 28).

#### 25. *Megalophrys kempii*, sp. nov.

(Plate iii, fig. 5.)

Although the only specimen obtained is very small, I am inclined to think from its general appearance that it is at least sub-adult. The species is clearly related to *M. heteropus* (Boulenger),<sup>1</sup> but the snout is rather longer, the tympanum larger and the hind legs longer.

*Habit* slender. Length (of type) from snout to vent 15 mm.

*Head* moderate, little depressed; snout longer than eye, sloping forwards above, rounded at the tip, truncate vertically, projecting very little beyond lower jaw; nostril much nearer tip of snout than eye; canthus rostralis distinct; loreal region concave, nearly vertical; inter-orbital distance much greater than width of upper eye-lid; tympanum fully exposed, nearly as large as eye, close to which it is situated.

*Mouth*.—No vomerine teeth; tongue slightly cleft behind.

*Skin* of back, limbs, throat and chest smooth, of belly obscurely granular; some irregular tubercles on the base of the thighs. No dorso-lateral or supratympanic folds.

*Limbs* slender. Fingers short, free, bearing (except the first, which is merely blunt) very small but distinct disks; first finger shorter than second; lower surface of hand smooth; subarticular tubercles poorly developed; no metacarpal tubercles. Hind limb long; the tibio-metatarsal articulation reaches the tip of the snout; toes slender, the fourth very long, with small disks and the rudiments of a web; sub-articular tubercles poorly developed; no metatarsal tubercles; no tarsal fold.

*Colouration*.—Dorsal surface dark olive with more or less symmetrically arranged greyish-green marks; upper surface of snout of latter shade; hind limbs obscurely banded with dark olive; ventral surface yellowish, suffused with dark olive; throat densely powdered with that shade but ornamented with clear yellowish spots.

*Habitat*.—Upper Rotung (2,000 ft.): i-i-12.

*Type*.—No. 17013 in Indian Museum register of Reptiles and Batrachia.

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<sup>1</sup> *Ann. Mag. Nat. Hist.*, (7), vi, p. 186 (1900), and *P.Z.S.*, 1908 (1), p. 422, fig. 2.

## (b) TADPOLES.

The tadpoles here discussed are those of :—

- |                                     |                                   |
|-------------------------------------|-----------------------------------|
| A. <i>Rana liebigii</i> ,           | D. <i>Rhacophorus maculatus</i> , |
| B. <i>Rana alticola</i> ,           | E. <i>Phrynoderma moloch</i> ,    |
| C. <i>Rana afghana</i> ,            | F. An unidentified Ranid,         |
| G. and H. <i>Megalophrys</i> , spp. |                                   |

## Fam. RANIDAE.

A. Larva of RANA LIEBIGII, Günth. (Plate iv, fig. 2.)

Annandale, *J.A.S.B.*, 1906 (2), p. 290.

The tadpole of this species is very abundant in small jungle streams in the neighbourhood of Kurseong (4,000—5,000 ft.), E. Himalayas, both in April and May and in July, August and September. Mr. Kemp obtained two specimens in a small stream on the east side of the Dihang R. near Yembung between the 13th and the 17th of January. Their hind legs were just beginning to appear.

The larva of *R. liebigii* may be redescribed as follows :—

*Head and body* feebly arched above but not quite flat, sloping slightly from behind forwards, convex on ventral surface, broadly ovoid as seen from above ; the tip of the snout rounded.

*Mouth* ventral ; lips broad but not excessively so, directed inwards and enclosing a considerable cavity ; posterior lip directed backwards, anterior lip forwards and inwards, thus forming a vestibule to the mouth ; lower lip with a complete double row of rather elongate tubercles ; upper lip fringed with a single row of rather smaller tubercles which is widely interrupted in the middle ; dental formula usually  $2 : 5 + 5 \quad 1 + 1 : 2$ ,<sup>1</sup> sometimes three uninterrupted rows of teeth present on the upper lip ; neither upper nor lower beak divided ; both horseshoe-shaped and minutely serrated ; upper lip very narrow.

*Nostril and eye* small, by no means prominent ; the former situated midway between the eye and the tip of the snout ; eye directed obliquely upwards, situated at the junction of the dorsal and the ventral surfaces, much nearer the tip of the snout than the base of the tail.

*Glands*.—None apparent.

*Spiracle* sinistral, pointing backwards and slightly upwards, small, circular, not markedly tubular.

*Vent* dextral.

*Tail* gradually pointed, tapering, twice as long as head and body ; its greatest depth  $\frac{1}{5}$  of total maximum length ; fin-membranes well

<sup>1</sup> For convenience in printing this and other dental formulae in this paper are printed in a somewhat novel form. The figures to the right of the central dark vertical line represent the tooth-rows of the upper, those to the left of this line the tooth-rows of the lower lip. The colons merely separate the number of undivided from that of divided rows.

developed for its whole length both above and below the muscular portion ; the greatest depth twice that of the muscular portion.

*Colouration* somewhat variable ; dorsal surface brownish, marked in some individuals with yellow ; fin-membrane pale, with large dark pigment-cells which in some individuals tend to be arranged in vertical bars ; a dull yellowish mid-dorsal streak sometimes present at base of tail ; spiracle surrounded by a white ring.

*Dimensions* of an individual in which the hind legs are beginning to appear :—

Total length	..	44 mm.
Length of head and body		15 „
Length of tail	..	29 „
Maximum breadth of body		12 „
Maximum depth of body		10 „
Maximum depth of tail		12 „
Full-grown tadpoles measure about 56 mm. in length.		

B. Larva of RANA ALTICOLA, Boulgr. (Plate iv, fig. 1.)

Boulenger, *Cat. Batr. Sal. Brit. Mus.*, p. 62, fig. ; Annandale *P.Z.S.*, 1905 (I), p. 58, pl. vi.

The tadpoles figured and described by Mr. Boulenger were evidently badly preserved and faded. I have, therefore, re-described this larva from well-preserved and recently captured specimens.

*Head and body* flattened both above and also on the anterior part of the ventral surface, oval, truncate anteriorly.

*Mouth* ventral ; lips well developed, the posterior lip directed backwards, not excessively broad, with a single row of rather small tubercles running all along its margin ; anterior lip directed forwards and inwards, fringed for rather less than a third of its length on either side and bearing on its ventral surface in the same region numerous small tubercles, bare in the middle. Dental formula 2 : 5+5 1+1 : 8, the outer row of teeth on the posterior lip feebly developed ; beak in two parts, an upper and a lower ; both parts roughened on the surface but not serrated at the margin ; upper part crescentic, projecting slightly in the middle ; lower part broadly V-shaped.

*Nostril and eye* small, by no means prominent ; the former in well-preserved specimens rather nearer the eye than the tip of the snout ; eye directed obliquely upwards, situated near the dorsal surface, much nearer the snout than the base of the tail.

*Spiracle* sinistral, tubular, directed outwards and a little upwards.

*Vent* dextral.



*Glands*.—A large and prominent oval parotoid gland<sup>1</sup> present on each side and a small and less conspicuous single gland (in large tadpoles) on the dorsum at the base of the tail.

*Tail* bluntly pointed, about  $1\frac{1}{3}$  times as long as head and body, very shallow at its base owing to poor development of both fin-membranes; these become deep shortly afterwards and then diminish again somewhat abruptly, so that the outline of the tail is strongly sinuous.

*Colouration*.—In the young tadpole the head and body are boldly diversified with dark and pale markings not of a symmetrical nature, while the muscular part of the tail bears numerous large and small ocelli, which are replaced on the fin-membranes by small black spots. As the tadpole grows and the limbs begin to develop the colours darken and the caudal ocelli become indistinct or disappear, with the exception, as a rule, of one large ocellus on each side at the base of the tail. Sometimes a second smaller and more distal ocellus also persists and occasionally there is a row of ocelli all along the tail of even full-grown larvae, gradually diminishing in size from in front backwards. The central spot of each ocellus is black, the outer ring yellow. The number of ocelli is not always the same on both sides of the body.

*Dimensions*.—The tadpole reaches a length of at least 57 mm. The following are the measurements of two specimens in one of which (A) the hind limbs appear as minute buds, while in the other (B) the toes can just be detected :—

	A (tail injured).	B.
Total length	— mm.	42 mm.
Length of head and body	27 „	18 „
Length of tail	— „	24 „
Maximum breadth of body	16 „	10 „
Maximum depth of body	14 „	9 „
Maximum depth of tail	16 „	9 „

I was at first inclined to adopt the opinion that the large series of ocellate Ranid larvae in our collection represented two distinct species, one with a distinct supra-caudal gland, prominent parotoids and not more than two ocelli on each side of the tail, the other with no supra-caudal gland, much less prominent parotoids, the head and body spotted and mottled, and numerous caudal ocelli. Specimens, however, recently obtained by Mr. F. H. Gravely and Capt. R. B. Seymour Sewell, I.M.S., in Lower Burma, show that there is a complete gradation between the two forms, the latter being merely a younger stage of the former. Mr. Gravely's specimens, in none of which were the hind limbs developed, were taken in a small pond near Kawkarcik in November and Capt.

<sup>1</sup> This gland is not nearly so conspicuous in fresh specimens as it is in old and faded ones.

Sewell's, which were in a slightly more advanced stage of development, on the coast of Tavoy in spring. A young frog which had already assumed the green back of the adult was taken with Mr. Gravely's tadpoles.

C. Larva of RANA AFGHANA (Gunth.) (Plate iv, fig. 3.)

? *Rhacophorus reinwardtii* (Larva), Boulenger, *Cat. Batr. Sal. Brit. Mus.*, p. 89, fig.

*Rana afghana*, *id.*, *Ann. Mus. Genova* (2nd ser.), v, p. 420 (1883), and *P.Z.S.*, 1893, pp. 526, 527.

Mr. Boulenger has given an excellent description of this larva in the "Annali" of the Genoa Museum and has also published a key whereby those tadpoles of the genus *Rana* which are provided with large ventral suckers may be distinguished from one another. This key is in the *P.Z.S.* for 1893.

Mr. Kemp obtained two tadpoles that agree well with Mr. Boulenger's description in a small stream running into the Dihang R. near Yembung in January. Their hind limbs have not yet appeared. An adult *R. afghana* was taken at the same place in the same month.

D. Larva of RHACOPHORUS MACULATUS (Gray).

(Plate iv, figs. 4, 5.)

*Rhacophorus leucomystax*, Flower *P.Z.S.* 1896, p. 906, pl. xlv, fig. 2, and 1899, p. 898, pl. lix, figs. 3, 3a, Butler, *Journ. Bombay Nat. Hist. Soc.*, xv, p. 202.

*Rh. maculatus*, Ferguson, *ibid.*, p. 504, pl. B, fig. 4.

Captain Flower, in the first of the two papers cited after his name, describes and figures the tadpoles of the Malay race (*leucomystax*) of this species, his specimens being from Singapore. In his second paper he does the same for tadpoles from Bangkok, which seem to differ in more than one particular from those of the Malay race. I propose here to describe those of the Himalayan and the Peninsular races—the latter from specimens taken in September in Orissa, the former from tadpoles caught in the neighbourhood of Darjiling and identified after breeding out several individuals from the same lot in Calcutta. In both cases the tadpoles were taken in pools of rain-water.

1. Tadpoles of Himalayan race (*himalayensis*).

*Head and body* moderately flat above, ovoid, rounded in front, convex on ventral surface.

*Mouth* nearly terminal, comparatively small; lips relatively narrow, both directed forwards; upper lip smooth except at the corners, which bear numerous rounded papillae; lower lip with a fringe interrupted in the middle, and consisting of similar papillae about three deep; dental formula 1: 3+3 1+1: 2 or 1: 3+3 3; beak in two parts; the upper beak not hooked, the lower crescentic; both parts massive, both serrated.

*Eye and nostril*.—Eye lateral, directed outwards ; nostril nearer tip of snout than eye.

*Glands*.—There is a large gland in front of and slightly below each eye.

*Spiracle* sinistral, pointing backwards and a little upwards, flap-like, large.

*Anus* dextral.

*Tail* long and slender, about twice as long as head and body, sharply pointed ; its outline not strongly sinuous ; fin-membranes deep throughout its length.

*Colouration*.—Mottled with dark brown on dorsal surface and sides ; fin-membranes minutely spotted ; ventral surface white.

*Dimensions*.—The following are the measurements of a tadpole with well developed hind legs (A) and of one in which the hind legs are just about to appear (B) :—

	A.	B.
Length	62 mm.	33 mm.
Length of head and body	20 „	12 „
Length of tail	42 „	21 „
Maximum width of body	13 „	8 „
Maximum depth of body	10 „	7 „
Maximum depth of tail	14 „	8 „

## 2. Tadpole of Peninsular Indian race (*maculatus*).

The larvae of this race differ from those of the Himalayan race in the following points :—

- i. The head and body are flatter above.
- ii. The lips are even narrower.
- iii. The habit is more slender and the dimensions less.
- iv. The colour is very pale brown or green with scattered pigment-cells of a darker shade on the back and sides.

Both races apparently differ from the Malay one in having the outline of the tail less strongly sinuous and in colouration. In all essential structural characters, however, they are identical. Ferguson's Travancore tadpoles differed slightly in colouration from my Orissa ones. The breeding season in Travancore lasts, according to that author, from June to November ; both in the E. Himalayas and the plains of Lower Bengal, it is in progress in July, August and September. I have never seen the tadpoles of either race in running water. The eggs in their frothy covering are usually laid at the edge of small pools.

## E. Larva of *PHRYNODERMA MOLOCH*, sp. nov.

(Plate iv, fig. 6.)

The tadpoles are very like those of *Ixalus horridus*, Blgr.,<sup>1</sup> but have a longer and more pointed tail, and when full-grown develop the

<sup>1</sup> Report on the Reptiles in Annandale and Robinson's *Fasciculi Malayenses*, i. p. 139, pl. vi, figs. 2a, 2b (1902)

characteristic dorsal rugosities of the adult before the fore-legs break through.

*The head and body* are flattened and broadly oval, being only a little longer than broad. The tail as a whole tapers gradually and is nearly twice as long as the head and body. The colour is an almost uniform black or dark grey, except that the margins of the lips are white and the lower surface slightly paler than the dorsal. At the time at which the hind limbs begin to sprout out the skin is still quite smooth, but as they develop ridge-like warts appear on the dorsal surface. There are numerous little sensory pits arranged in lines on the head and body.

*Mouth* subterminal, small ; its lips by no means strongly developed. The margin of the upper lip for the most part smooth but with a few conical tubercles where it joins the lower lip, the margin of which is completely fringed with a double row of similar tubercles. The dental formula is 1 : 3+3 3, the first interrupted row of teeth being much longer than the other two. The beak consists of an upper and a lower part each of which is undivided ; both are rather narrow ; the anterior is narrowly crescentic in form, while the posterior is deeply excavated in the middle ; neither has a concavity on the exposed surface and both are minutely serrated.

*Nostril and eye* small, dorsal, directed upwards, by no means prominent. The internasal space is about  $\frac{2}{3}$  the interorbital and  $\frac{1}{2}$  that between the nostril and the eye ; the nostril is equidistant from the tip of the snout and the eye.

*Sensory pits*.—On the dorsal surface of the head and body four longitudinal lines of minute white pits can be distinguished, two on either side of the middle line. Two on each side start close together on the snout and after diverging in a sinuous manner so as to include between them a nostril and an eye meet together behind the latter. On the ventral surface there are three backwardly concave transverse lines, one just behind the mouth and two, the corner of which is somewhat sinuous, posterior to it. There is also a lateral line of pits along the muscular portion of the tail and a row of larger, isolated ones along the upper fin-membrane.

*Spiracle* sinistral, large and patent, directed backwards and situated somewhat low down on the side.

*Vent* in the middle line.

*Tail*.—The muscular portion is slender and tapers to a fine point. In the middle part of the tail the membrane equals it in depth both above and below, but at the base the membrane is shallow on both sides.

*Dimensions* of an individual with well-developed hind limbs (A) and of one (B) in which they have just begun to sprout :—

	A.	B.
Total length	58 mm.	55 mm.
Length of head and body	20 „	17 „
Length of tail	38 „	38 „

	A.	B.
Maximum breadth of body	16 mm.	13 mm.
Maximum depth of body	.. 11 „	9 „
Maximum depth of tail	10 „	12 „

*Habitat, etc.*—Four tadpoles were taken by Capt. de Courcy near Upper Renging between the 5th and the 10th of January, 1912. They were in a small pool of rain-water inside a log of rotten wood and were accompanied by two adults, the types of the species. There can be no doubt as to their identity, for the largest tadpole has already begun to develop the characteristic features of the adult. It has the hind limbs well developed.

#### F. UNDETERMINED RANID LARVA.

(Plate iv, fig. 11.)

A number of large Ranid larvae were taken on the 9th and 16th of January in the Egar stream between Renging and Rotung by Mr. Kemp and Capt. de Courcy. Specimens of *Rhacophorus naso*, *Ixalus asper* and *I. tuberculatus* were taken with one of them, and also several *Megalophrys* tadpoles. Mr. Kemp suggests that they may be the larvae of one of the adults captured on the same occasion and they may well be that of a *Rhacophorus*. There is, however, no direct evidence as to their parentage and none of them have reached a stage in their metamorphosis that would render it possible to throw any definite light on the subject. It may be as well to describe them, however, as they present certain features of biological interest. There can be no doubt that they are specifically identical.

*Head and body* convex above, flattened on the ventral surface, ovoid, snout bluntly rounded, projecting.

*Mouth* ventral, very large with both lips highly developed and the lower lip directed backwards and of unusual size ; upper lip not fringed except at the corners ; lower lip extending backwards for some distance behind the last row of teeth and covered in this region with relatively large rounded tubercles, also completely fringed with smaller and more elongate tubercles ; dental formula  $2+2 : 1 : 5+5$  ;  $1+1 : 2$  ; the outermost row of teeth on each side of the upper lip curving upwards and inwards to the margin of the lip which it reaches near the middle without meeting its fellow of the opposite side ; beak stout, in two parts ; the upper part having a flattened, nearly triangular area in the middle of the free margin ; this area separated from the rest of the upper beak by a minutely serrated ridge which is in continuity with the edge of the beak on either side ; the lower beak broadly V-shaped, minutely serrated on the margin.

*Nosil and eye* by no means prominent, of moderate size ; eyes lateral but near the dorsal surface, directed outwards and upwards ; nostril nearer eye than tip of snout.

*Glands, etc.*—No very definite glands can be detected but there are numerous little pits arranged along the upper lip, in a line extending

from near the tip of the snout upwards outside each nostril to the eye, round the eye and in two patches behind it.

*Spiracle* sinistral, large and tubular, pointing directly backwards.

*Tail* rather more than twice the length of the head and body, stout, with both fin-membranes well developed throughout its length.

*Dimensions* of tadpoles without hind limbs :—

Total length	76 mm.
Length of head and body	25 „
Length of tail	51 „
Maximum width of body	16 „
Maximum depth of body	15 „
Maximum depth of tail	18 „

*Colour* an almost uniform dark brown ; fin-membranes and ventral surface a little paler.

There can be no doubt that the lips form in this species a powerful sucker, as they do even in such tadpoles as that of *Rana liebigii*. It is the largest Indian tadpole with which I am acquainted.

#### Fam. PELOBATIDAE.

G. H. Larvae of MEGALOPHRYS spp. (Plate iv, figs. 8, 9, 10.)

Weber, *Ann. Jard. Bot. Buitenzorg*, xv, suppl. ii, p. 5, 1898 ; Laidlaw, *P.Z.S.*, 1900, p. 889 ; Gadow, *Camb. Nat. Hist., Amphib. and Rept.*, p. 60, fig. 11 ; Boulenger, "Report on the Reptiles," *Fascic. Malay., Zool.*, i, p. 131 ; Annardale, *ibid.*, p. 275, fig. I ; van Kampen, *Natuurk. Tijd. v. Ned.-Ind.*, lxix (1), p. 27 ; Boulenger, *P.Z.S.*, 1908 (1), pp. 413, 426.

It has been pointed out by Mr. Boulenger and other authors that the larvae of the Oriental genus *Megalophrys* fall into two groups one of which resembles the larvae of European Pelobatidae and is in no way remarkable, while the other is distinguished from all other known tadpoles by the peculiar structure of the mouth. It is with the latter group that I am at present concerned.

The first representative of this group to be described was *M. montana* (Kuhl), a species not uncommon in hilly districts of Java and the Malay Peninsula but not known to occur in the Indian Empire. This larva has frequently been described and I need only refer to its colouration. The whole of the body and tail are dark brown with paler markings along the sides. At altitudes of from 2,000 to 5,000 ft. in the E. Himalayas a tadpole of precisely similar structure is abundant in small jungle streams, but it differs in colouration in two particulars, firstly in that the ventral surface is much paler than the sides and secondly that there are dark

instead of pale markings on the latter. These markings take the form of irregular spots and veinings. I have found every stage in the metamorphosis of this tadpole into *M. parva*, Boulenger.

A second tadpole of identical structure but slightly different colouration, larger size and more slender form also occurs in the E. Himalayas and was taken in considerable numbers in the Abor foot-hills. It differs from that of *M. parva* in lacking the dark markings on the sides or at any rate in having them much less conspicuous and consisting only of minute spots. I believe that this larva, which I have seen from the N. Shan States, is that of *M. major*, Boulenger, but have only circumstantial evidence in support of this belief.

A fourth *Megalophrys* tadpole was taken by Mr. Kemp in the Abor foot-hills. It differs from the one I have assigned provisionally to *M. major* in being of an almost uniform dark brown colour both above and below. There is no evidence that this is the tadpole of *M. kempii*, but it may be stated that a very similar larva was taken by Mr. F. H. Gravely on the Siamese frontier of Tenasserim near the Dawna Hills in company with a young frog that apparently represents *M. heteropus* (Boulenger), a species hitherto known from the hills of the Malay Peninsula.

It is a remarkable fact that whereas the tadpoles of *M. hasseltii* (Tshudi), a Malayan species, are of typical Pelobatid structure, those of other members of the genus from the same region are not only extremely different from that form but also extremely close to one another in structure. Were it not proved that the common Darjiling tadpole is the larva of *M. parva*, it would be difficult to believe that it was specifically distinct from that of *M. montana*, although there is no difficulty in distinguishing the adults. Seeing that these two larvae belong to different species, it is evident that the larva of other species must only be identified with great caution.

## PART II.—BIOLOGICAL.

Of all the frogs and toads taken in the Abor foot-hills only two (*Rana limnocharis* and *Bufo himalayanus*) entirely lack adhesive digital disks, and we may take it that the majority of the other species are normally arboreal in habits. Some few of them, however, seem rather to be rupicolous and to live among stones at the edge of streams. It is probable that *Micrixalus borealis* belongs to the latter category, but *Ixalus tuberculatus*, although individuals were actually found at the edge of a stream, is known also to frequent tree-trunks. *Phrynoderma moloch* apparently affects dead tree-trunks and lays its eggs in or near small masses of water that accumulate in them. In the dense jungles of the Malayo-Himalayan tract most of the *Batrachia* are as a rule arboreal and Mr. Kemp's collection in this respect is no exception. It may be noted, further, that the great majority of his specimens are protectively coloured and resemble either the lichen-clad bark of jungle trees or the green leaves of their foliage.

A very interesting set of biological phenomena is illustrated by the tadpoles of the Abor foot-hills, which agree precisely in this respect with those of the Darjiling district and of hilly districts in the Malay Peninsula. In the great majority of cases their structure is adapted for life in rapid-running mountain streams subject to sudden floods, and they are provided with special apparatus with which to contend against the dangers incidental to such a life. In other words, they possess special structural facilities either for clinging to fixed objects or else for floating away lightly on the surface of the flood.

There has been considerable dispute as to the function of the lozenge-shaped structure surrounding the mouth of the tadpole of *Megalophrys montana* and similar species. Dr. Gadow suggests that the peculiar teeth on the inner surface may be used for scraping the leaves of water-plants and Dr. van Kampen has observed the tadpoles rasping algae from the sides of a glass aquarium with them ; but observations made in the Malay Peninsula, Burma and the Himalayas confirm me in the

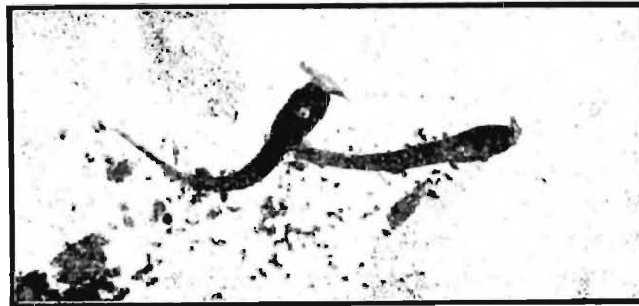


FIG. 1.—Tadpoles of *Megalophrys montana*.

opinion, which was originally advanced by Prof. Max Weber, that the chief function of the whole structure is to act as a float whereby the tadpole can be carried along on the surface, and also convince me that this function is correlated with the fact that floods are one of the chief dangers which tadpoles living in mountain streamlets have to fear. I reproduce above a photograph of two living tadpoles of *M. montana* taken some years ago in the Malay Peninsula. One of these tadpoles is lying at the bottom of the basin of water in which they were photographed and has the float folded, the other has it expanded on the surface. The water was too shallow for this tadpole's tail to hang vertically downwards as it usually does. Dr. Gadow's figure in the *Cambridge Natural History* is therefore more correct in this respect.

Although to act as a float is the main function of the oral apparatus of these *Megalophrys* tadpoles, and although the teeth on this apparatus are used for scraping off algae from stones (and, I think from an examination of the contents of their stomachs, also fungi from rotting wood), the apparatus has at least two other uses. In the first place it facilitates breathing when the tadpole is lying among vegetable débris in the corner of little pools, and in the second it assists it to crawl over wet rocks and thus, perhaps, to reach a fresh pool if the one in which it is confined dries up during a period of drought. The first of these secondary func-



tions only comes into play when the funnel is folded. As is shown in my figure in *Fasciculi Malayenses*, the mouth is well protected by the manner in which the lower part of the apparatus folds upwards over the upper part, but the lateral parts do not completely close together. Each margin bends inwards towards the other in such a way that on each side a narrow tube is formed down which water free from all but very minute fragments of débris is drawn to the mouth by the respiratory movements.

I have often observed the larvae of *M. parva* adhering to rocks at the edge of small streams in the E. Himalayas and even making their way up the faces of rocks in this position until at least the anterior part of the body was out of water. Adhesion was brought about very largely by the application of the outer surface of the lower part of the apparatus, which only bears teeth on the inner surface, to the face of the rock ; but the ventral surface of the body was applied in the same manner, while the movements of the powerful tail thrust the animal upwards. A small fish (*Nemachilus rupicola*) common in the same little streams actually, as I have myself observed, makes its way over rocks from pool to pool in a very similar manner, adhering partly by means of the smooth skin of its belly and partly by means of its lips.

Other tadpoles which frequent the streams of the Himalayas, instead of allowing themselves to be borne away lightly on the surface of the flood, adhere to rocks at the bottom or sides of the stream and have been found firmly fixed even in the immediate vicinity of waterfalls. The majority of the species both of the Darjiling district and of the Abor foot-hills adhere mainly by means of their lips, the inner, tooth-bearing surface of which is applied to the rocks. It is for this reason that in these species the position of the mouth is much more nearly horizontal than it is in many other tadpoles and the lips themselves are more or less enlarged. In such forms as the larva of *Rana liebigii* the lips, although they are distinctly broader than in the typical *Rana* tadpole and are directed forwards and backwards respectively instead of both forwards, are not monstrously developed ; but in other forms, such as the large unidentified Ranid larva described above, they attain enormous dimensions and form together a powerful sucker possibly rendered necessary by the large size and heavy build of their possessor, for even the lips of the tadpole of *R. liebigii* enable it to cling tightly.

In some other species a sucker quite separate from the lips and not homologous with the sucker that many young *Batrachia* larvae possess, is found on the ventral surface, doubtless for the same purpose. *Rana afghana* and several allied Himalayo-Malayan frogs have this sucker in their larval stage.

It is noteworthy that the means whereby the fishes of the streams of the Himalayas adhere to rocks are analogous to those adopted by the tadpoles which live in the same environment. *Nemachilus rupicola*, as has already been stated, clings to rocks by means of the smooth skin of its belly and of its enlarged lips, just as the tadpole of *Megalophrys parva* does ; several other mountain Cyprinidae have their mouths

modified in a manner that would suggest their being used in the same way as the lips of *Rana liebigii*, while *Discognathus lamta* certainly adheres to the bottom in rapid water very largely by means of the lips, which recall those of the unidentified Ranid tadpole of the Abor foot-hills. The Silurid genera *Pseudecheneis* and *Glyptosternum*, on the other hand, cling by means of a separate abdominal sucker as the tadpole of *R. afghana* does.

There can be no doubt that these are instances of convergence, and there is some evidence that even in the case of the tadpoles of mountain streams, the same method of adhering to fixed bodies in rapid-running water has been acquired independently in some instances by different species. The lips of the tadpole of *Bufo penangensis*,<sup>1</sup> for example, appear to resemble closely those of the unidentified Abor larva, which must certainly be assigned to the Ranidae, and enlarged lips like those of *Rana liebigii* are found in different species the adults of which are by no means closely allied. It can hardly be that the adaptation of such tadpoles, striking as it is, has been brought about by genetic relationship between the different species that possess it. The adults of most of the Abor frogs and toads have developed adhesive disks on their fingers without being in all cases closely related to one another, and we must suppose that the development of special abdominal suckers or of greatly enlarged lips is a similar phenomenon due, directly or indirectly, to environment rather than to the possession of a common ancestry by animals which have undergone parallel evolution in one particular.

### PART III.—GEOGRAPHICAL.

#### GEOGRAPHICAL LIST OF THE SPECIES IN THE COLLECTION.

NAME.	SIK HIM.	ASSAM.	BURMA.	REMARKS.
RANA ..	x	x	x	Cosmopolitan.
1. <i>R. cyanophlyctis</i> ..	x	x	x	Throughout Oriental Region.
2. <i>R. liebigii</i> ..	x	x	x	..
3. <i>R. tigrina</i> ..	x	x	x	Almost all over Oriental Region.
4. <i>R. limnocharis</i> ..	x	x	x	Even more widely distributed.
5. <i>R. alticola</i> ..	..	x	x	Also in N. W. Himalayas, Bengal and Orissa.

<sup>1</sup>Flower, *P.Z.S.*, 1899, p. 909.

NAME.	SIKKIM.	ASSAM.	BURMA.	REMARKS.
6. <i>R. granulosa</i> ..	..	x	x	Also in Yunnan; in Assam only N. of Brahmaputra.
7. <i>R. afghana</i> ..	x	x	x	Not in Afganistan.
8. <i>R. gerbillus</i> * ..	..	..	..	..
MICRIXALUS ..	..	..	x	Hitherto regarded as peculiar to S. India and Ceylon.
9. <i>M. borealis</i> * ..	..	..	..	..
RHACOPHORUS ..	x	x	x	Oriental Region, China, Japan, Madagascar.
10. <i>Rh. maximus</i> ..	x	x	..	..
11. <i>Rh. bimaculatus</i> ..	..	x	..	Only known hitherto from the Khasi Hills.
12. <i>Rh. naso</i> * ..	..	..	..	..
13. <i>Rh. microdiscus</i> * ..	..	..	..	..
14. <i>Rh. maculatus himalayensis.</i>	x	x	x	Also in Yunnan.
15. <i>Rh. tuberculatus</i> ..	..	x	..	Not known S. of Brahmaputra.
IXALUS ..	x	x	x	S. India, Ceylon, E. Himalayas, Assam, Burma, Indo-China, Malaysia.
16. <i>I. asper</i> ..	..	..	x	Also in Malay Peninsula and islands.
17. <i>I. annandalei</i> ..	x	x	..	Not known S. of Brahmaputra.
18. <i>I. argus</i> * ..	..	..	..	..
19. <i>I. tuberculatus</i> ..	..	..	x	Described from the Chinese frontier of Burma.
CHIRIXALUS ..	..	..	x	Hitherto only known from Burma.
20. <i>Ch. doriae</i> ..	..	..	x	..
PHRYNODERMA ..	..	x	x	Hitherto only known from Burma.
21. <i>Ph. moloch</i> * ..	..	..	..	..

NAME.	SIKHEM.	ASSAM.	BURMA.	REMARKS.
Bufo ..	x	x	x	Almost cosmopolitan; not in Australia or Madagascar.
22. <i>B. melanostictus</i> ..	x	x	x	Throughout Oriental Region.
23. <i>B. himalayanus</i> ..	x	..	..	E. Himalayas only.
MEGALOPHRYS ..	x	x	x	Damper parts of Oriental Region; not in S. India or Ceylon.
24. <i>M. major</i> ..	x	x	..	..
25. <i>M. kempii</i> * ..	..	..	..	..

So far as the genera mentioned in the foregoing list are concerned, its most striking features are the number of species of *Ixalus* included and the fact that the allied Burmese genera *Chirixalus* and *Phrynoderma* are also represented. Until recently the genus *Ixalus*, which abounds in Burmese and Malay forms, was not known from any part of the Himalayas or Assam, and even now only one species has been proved to exist in the Himalayas, west of Bhutan, namely *Ixalus annandalei*, Boulenger.<sup>1</sup> It is probable that another species (*I. asper*) also occurs in the Nepal foot-hills, but, even so, the genus is characteristically non-Himalayan.<sup>2</sup> *Chirixalus* and *Phrynoderma* have hitherto been monotypic genera, as the former still remains, and have only been recorded from the Karin Hills.

The occurrence of the S. Indian genus *Micrixalus* in the Abor foot-hills is exactly parallel to that of the lacertilian genus *Salea*, a species of which has recently been described from the adjacent Dafia country.

We may analyse the list further as regards species in the following manner, dividing them into seven geographical groups:—

- |   |       |
|---|-------|
| A. Species apparently endemic in the foot-hills E. of Bhutan      | 7=28% |
| B. Forms found in the Himalayas, Assam and Burma                  | 5=20% |
| C. Species of very wide distribution                              | 4=16% |
| D. Species known from Sikkim and from Assam S. of the Brahmaputra | 2= 8% |
| E. Species hitherto only known from Assam                         | 2= 8% |
| F. Species hitherto only known from Burma or Burma and Malaysia   | 3=12% |
| G. Species only known from the Himalayas                          | 2= 8% |

<sup>1</sup> J.A.S.B., 1906 (2), p. 385.

<sup>2</sup> Cf. Blanford, *Phil. Trans. Roy. Soc.*, cxciv (B), p. 421 (1901).

Stated in this manner the figures show at a glance how very distinct the Batrachian fauna of the N. E. corner of Assam and the Abor foot-hills is from that both of the Himalayan foot-hills W. of Bhutan and from that of the district S. of the Brahmaputra. They also show, however, that there is considerably greater affinity in the latter direction than in the former, and it is by no means improbable that further research among the Batrachia of southern Assam will increase rather than diminish the resemblance. It is, moreover, noteworthy that one of the two purely Himalayan forms (*Bufo himalayanus*) represented in Mr. Kemp's collection of frogs and toads is of doubtful validity as a species and that specimens from the Abor hills do not agree in every respect with those from Darjiling.

Several of the species whose names occupy a place in Mr. Kemp's list were not taken actually in the foot-hills, but in the plains at their base. These species are the following :—*Ixalus assamensis* from group G ; *Rana alticola* and *R. granulosa* from group B, and *Rana cyanophlyctis*, *R. tigrina* and *Bufo melanostictus* from group C. If we eliminate these names, we get the following numbers and percentages in the different groups :—

A. Species apparently endemic in the Himalayan foot-hills E. of Bhutan	7=37%
B. Species from the Himalayas, Assam and Burma .	3=16%
C. Species of very wide distribution	1=5.25%
D. Species from Sikhim and from Assam S. of the Brahmaputra	2=10.5%
E. Species hitherto known only from Assam	2=10.5%
F. Species hitherto known only from Burma or from Burma and Malaysia	3=16%
G. Species known only from the Himalayas	.. 1=5.25%

These percentages, which are calculated roughly, show that the Batrachian fauna of the Abor foot-hills, in so far as it is illustrated by Mr. Kemp's collection, includes about 37% of apparently endemic species, about 16% of species that also occur both in Sikhim on the one hand and in Burma and Assam on the other and also of species hitherto known from Burma but not from Assam, about 10½% of species not known from Burma but common to the E. Himalayas and Assam, and the same percentage of species only known hitherto from Assam and about 5¼% both of widely distributed species and of exclusively Himalayan forms. A true jungle fauna, if the jungle be of the damp equatorial kind, rarely includes many species of Batrachia of a very wide distribution, and it is no exception to this rule to find that such forms are scarce in the Abor foot-hills ; the large number of endemic species is a correlated fact. It is well known to be the case that the reptiles and Batrachia of the E. Himalayas, Assam and Burma have a strong affinity, and it seems probable that a rich Malayan element has made its way northwards and westwards into the damp evergreen jungles of these countries, gradually becoming more and more attenuated as the climate grows drier and less equable towards the west.

All the evidence at present available, therefore, supports the view that the fauna of the extreme eastern part of the Himalayan foot-hills is not, at any rate so far as the frogs and toads are concerned, Himalayan in the sense in which the term has hitherto been understood, but allied rather to the fauna of Assam south of the Brahmaputra or even to that of Burma. In other words, Blanford's "Eastern Himalayan Tract" does not extend, so far as the Batrachia are concerned, nearly so far to the east as he believed, while his "Assam Tract" extends northwards to include the foot-hills north of the Brahmaputra as well as its upper valley and the mountains lying south of it. It is probable also that no very clear line of division exists between his "Assam Tract" and his "Upper Burma Tract."

In conclusion I must thank Mr. Kemp for the very careful way in which his collection was preserved and labelled, and also those who helped him, especially Capt. the Hon. M. de Courcy, for the interesting specimens they contributed.