

INTRODUCTION

Amphibia (Anura) is composed of more than four thousand species known from the world. In India, however, about 170 species grouped under 24 genera and six families occur in varied ecological conditions from the plains to mountains, low to heavy rainfall areas, from river beds to ponds, and even in deserts. Some species prefer to stay permanently in water, a few of them live in small bushes near some water sources, while some others live under boulders, rocks, stones or under decaying logs. Besides, a few of them are arboreal or prefer the crevices of rocks and trees, niches among foliage and leaf-litter or among loose soil. In nature, desert forms are even known to survive two to three metres under the sand dunes.

Amphibians, are usually least harmful in nature and never destroy or devour agricultural crops, fruits, vegetation, etc. On the contrary, their food mainly consists of small insects, insect larvae, algae, snails, etc. which are pests of cultivated crops and vectors of some diseases. Moreover, they are beneficial to mankind in a number of ways. It is unfortunate that these innocent creatures are subjected to indiscriminate killing and commercial exploitation. As a result the food chain is broken which consequently invite pests and other harmful vectors to multiply in abundance causing a threat to ecosystem. Many species in recent years have declined so much so, that active consideration has now been made for their protection.

Amphibian fauna of India has been studied by a number of workers from mid-nineteenth century. A few of the important works are : Theobald (1868, 1872), Stoliczka (1870-1872), Boulenger (1882-1920), Jerdon (1853-1870), Thruston (1888), Sclater (1892), Fergusson (1904), Annandale (1907-1919), Allen (1910), Rao (1915-1937), Smith (1917-1953), Wall (1922), Hora (1922-1928), Kampen (1923), Bhaduri (1929), (1930-1980), Mc. Cann (1932-1946), Parker (1934), Myers (1942-1968), Acharji & Kripalani (1961), Romer (1949-1951), Daniel (1962-1975), Kripalani (1953-1961), Abdulali (1954-1985), Bhaduri (1960-1962), Mayer & Leviton (1962), Satyamurthy (1967), Murthy (1967-1968), Myers (1952-1968), Chako (1968), Rangaswamy & Channabassana (1973), Mohanty-Hejmadi (1974), Mohanty-Hejmadi & Dutta (1977), Khan (1979), Paranjape & Mulherkar (1979), Mansukhani & Sarkar (1980-1981), Sarkar (1984-1993), Inger, Shaffer, Koshy & Bakde (1984), Pillai (1978-1986), Datta & Pradhan (1985), Datta (1976-1990), Rajtilak & Roy (1985), Inger & Datta (1986), Mehta & Rao (1987).

After the work of G. A. Boulenger (1890) in the "Fauna of British India including Ceylon and Burma, Reptilia and Batrachia" practically no comprehensive work has been carried out except a number of stray papers on the amphibian fauna of Indian region.

Northeast India presently consists of seven states viz., Arunachal Pradesh, Assam, Meghalaya, Manipur, Nagaland, Mizoram and Tripura. It is evident from the literature that very little attention has been paid to study the amphibian fauna of this region. Among the important works of this region are Boulenger (1890-1920), Smith (1921), Romer (1949), Roonwal & Kripalani (1961), Yazdani & Chanda (1973), Chanda & Talukdar (1973), Pillai & Yazdani (1961), Pillai & Chanda (1973-1981), Sahu & Khare (1983), Kiyasetuo & Khare (1986), Ao & Khare (1986), Chanda & Ghosh (1988-1989), Chanda (1986-1990).

These areas have varied climatic conditions, with abundance of vegetation, varied topography with hills and plains, streams and rivers and proved to be a storehouse for amphibians. Till now 54 species of toads and frogs under 18 genera and six families are known from this region. It is presumed that this difficult terrain may yield further novelty to science, if the inaccessible parts are thoroughly explored.

GEOGRAPHY, CLIMATE AND VEGETATION OF NORTHEAST INDIA

The northeast India comprises Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura lying in between $89^{\circ} 45'8''$ and $97^{\circ} 23'8''$ E longitudes and 22° and $29^{\circ} 28'N$ latitudes. This part of India is mainly a mountainous terrain, largely of tertiary origin and is remarkable for the luxuriant vegetation, consequent upon highly humid tropical climate.

The northeast India has three distinct physical features : The Brahmaputra valley or the Assam valley, the Surma valley or the Barak valley and a series of mountain and hill ranges, with the Himalaya in the north, the Meghalayan hills (Khasi, Garo and Jaintia Hills) in the south, and the Patkoi and the Naga hills and the Manipur plateau in the east and the Lushai Hills extending from south of Manipur to Burma as the Arakan Yoma. The Royal Kingdom of Bhutan, West Bengal and Bangladesh lie in the west of the northeast India.

The Brahmaputra valley is an old alluvial plain stretching over an approximate area of 750×80 km. with the Himalaya of Arunachal Pradesh and Bhutan in the north, the Meghalayan hills in the south and by the Patkoi and Naga hills in the east. The main river is the Brahmaputra which rises from the Himalaya in the north. This is known as Dihang or Siang in Arunachal Pradesh and is joined by the rivers Dibang and Lohit at the gateway

to Assam. The Surma valley is a plain through which flows the river Surma, raising on the southern slopes of the mountains along the border of Naga hills.

The Himalaya in the northeast India receiving Arunachal Pradesh is, in fact, the eastern most geographical sector of the massive range. It rises abruptly from the Brahmaputra valley, covering a length of about 720 km. There are innumerable mountain streams and rivers, such as Lohit, Dibang, Dihang, or Siang and Subansiri of which the Dihang is the most important.

The eastern hill ranges comprise the rather simple and narrow Patkoi hills with an average altitude of 2000-3000 m., forming the Naga hills in the south. The Japvo peak (alt. 3050 m.) is located at the south of Kohima. The main river is Doiang. The Manipur plateau drained by the Manipur river lies in the south of Naga hill. Manipur has a large natural lake, the Logtak lake. The southern part of the northeastern range is the Mizo hills or Lushai hills with the main rivers such as Sonai, Toivol, Koladyne and Karnaphuli.

The Meghalayan hill ranges running from east to west are situated in the south of the Brahmaputra valley. The Garo hills in the west rise sharply from the southern plains of Bangladesh. The Khasi hills, in the east of the Garo hills, rise abruptly to an elevation of over 1200 m. at a distance of 18 km. in the south, while in the north rise from the Assam-plain is gradual. The southern part along with the central one of the area is the Shillong plateau of Meghalaya. The Mikir hills are, however, a residue from the Meghalayan hill range projecting into the Brahmaputra valley.

Climate feature

Northeast India is well known for its highly humid tropical climate. Average annual temperature is difficult to determine for the region as a whole. The annual rainfall may be upto 250 cm or more, reaching the highest rainfall scale in the world, as in Mawsynrum-Cherrapunjia of Meghalaya. In strict sense, there are four main seasons in this region viz., Winter, Summer, Monsoon and Autumn. On the whole the climate of this region is generally cool. The monsoon generally withdraws from northeast India between the last week of September to first week of October.

Vegetation

Consequential to the varied climatic conditions, northeast India offers a wide variety of vegetation-types. These are Tropical vegetation, Temperate vegetation and Alpine vegetation.

(a) *Tropical vegetation* : This type of vegetation occurs upto an altitude of 900 m. and comprises of various types of evergreen and semievergreen types of forests, grasslands and swamps.

Tropical evergreen forests are found in the Assam valley, in the foothills of Eastern Himalayas and in the lower parts of Naga hills and Manipur. These forests are dark and thick and are known for a diverse wealth of species.

Tropical grasslands are found in riparian flats flooded by the waters of the River Brahmaputra. The grasses reach great heights and differ from these of higher elevations of the Shillong plateau and lower parts of North Cachar and Mikir hills.

(b) *Temperate vegetation* : This is found between altitudes of about 1300 m. to 2500 m in the Shillong plateau, the Naga, Mizo (Lushai) and Mikir hills, and in the Arunachal Himalaya. There is a great profusion of species in the temperate vegetation of the Khasi hills and Jaintia hills of Meghalaya, specially in the preserved "sacred" forests at Shillong peak, Mawphlang and Mawsmi.

(c) *Alpine vegetation* : It is limited to an altitude of 4500 m. to 5500 m. in Arunachal Pradesh. From this point the vegetation becomes gradually rare. In Alpine vegetation trees are absent which is followed by moorland or coarse meadow. The vegetation mainly consists of stunted, dwarf shrubs with deep roots.

MATERIALS and METHOD

To achieve the purpose of the present work several visits were made to different localities of northeast India viz, Assam, Meghalaya, Arunachal Pradesh, Manipur, Nagaland, Mizoram and Tripura. Collections were made from different habitats such as marshes, pools, or streams, river banks, sandy soil, under big boulders and stones, under decaying logs, inside the "caked earth", on the rock, inside certain hole, on tree, vicinity of shaded mountain streams, from open fields with vegetation, cultivated fields, from permanent quiet waters of plains, grasslands, from mountains of moderate altitudes, open level and hilly regions of low to medium altitude.

The specimens were killed by anesthetizing them with chloroform and then put into (8%) solution of formaldehyde for fixation. Before putting in formaldehyde solution a small incision (for bigger specimens) was made on the belly for penetration inside the viscera for their proper preservation. After proper fixation for two to three days the material was taken out from the solution and washed properly in water and then put them in 90% alcohol for permanent preservation.

MORPHOLOGY and TERMINOLOGY

The body of a typical anuran consists of two parts, the head and the trunk (Fig. 1) there being no distinct neck (Fig. 1). The entire body is covered with soft, smooth and

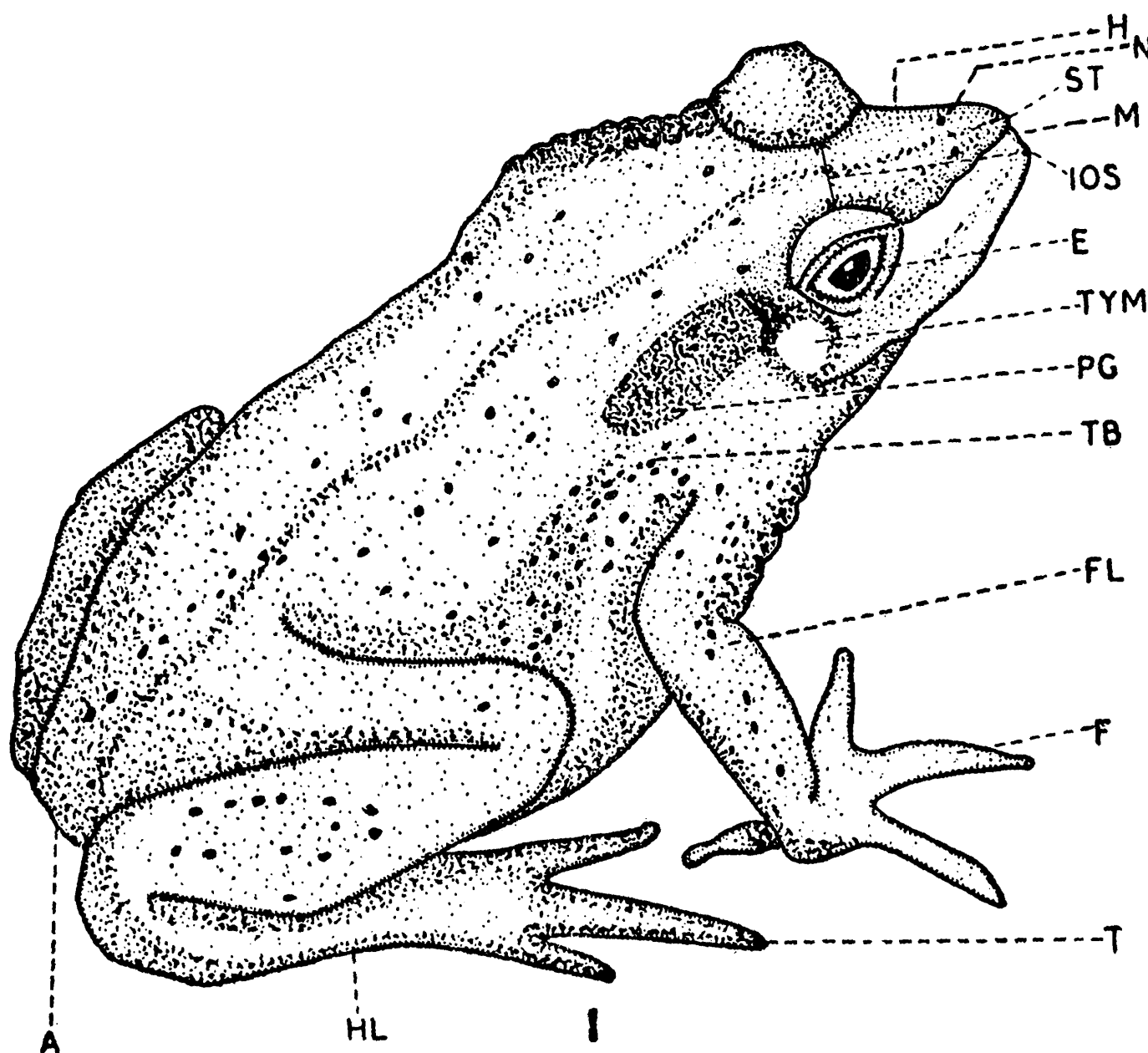


Fig. 1: A typical Anura (Toad).

moist skin. The head (Fig. H), bears a wide mouth, paired nostrils (N), near the tip of snout meant for respiration, two large spherical eyes (E) and behind the eyes a circular

eardrum or tympanic membrane (Tym.) which receives sound waves ; the tympanic membrane may sometimes be concealed and not easily visible ; parotoid glands (PG), which occur in almost all toads, are a pair of kidney-shaped glands situated just behind the eyes and above

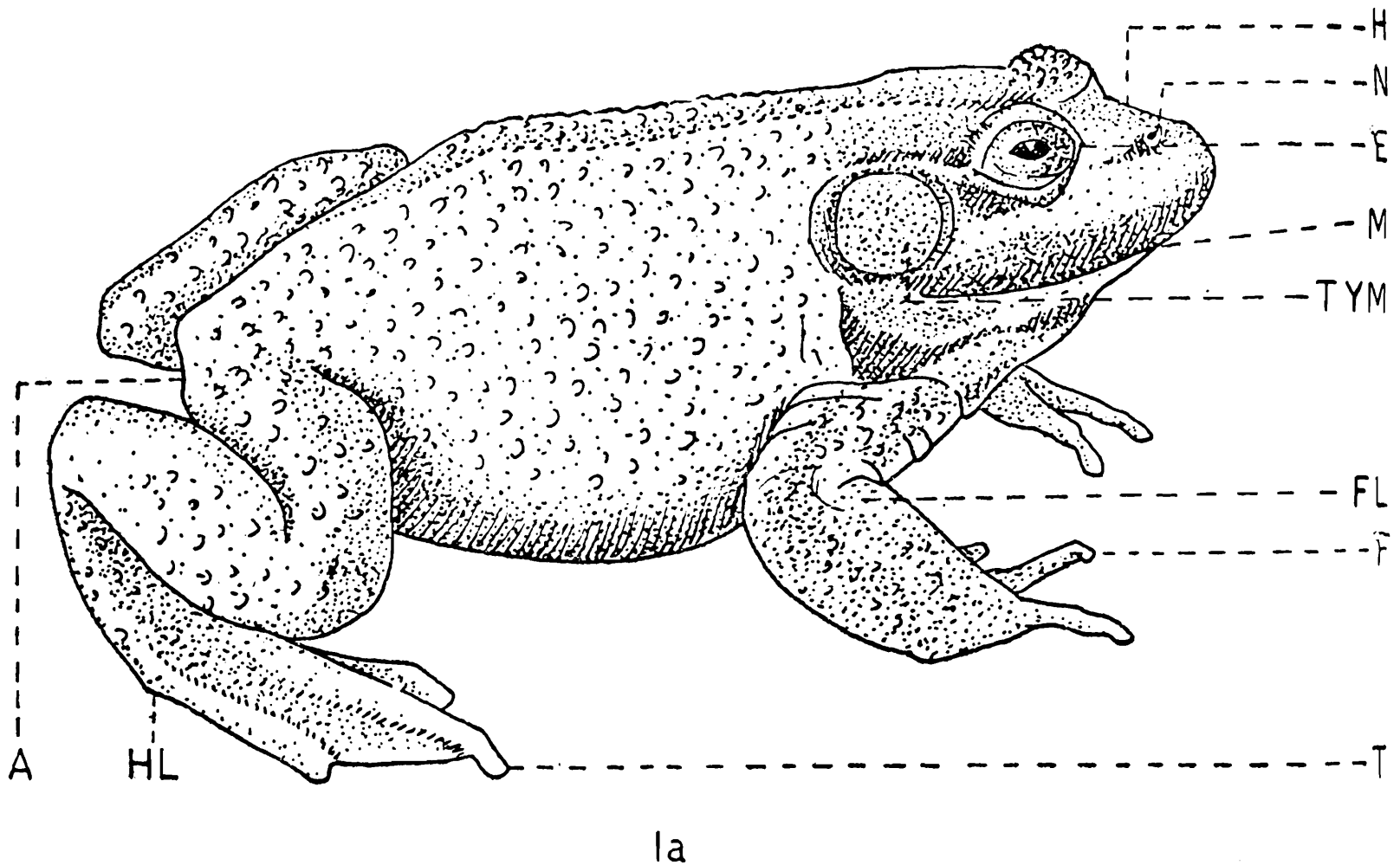
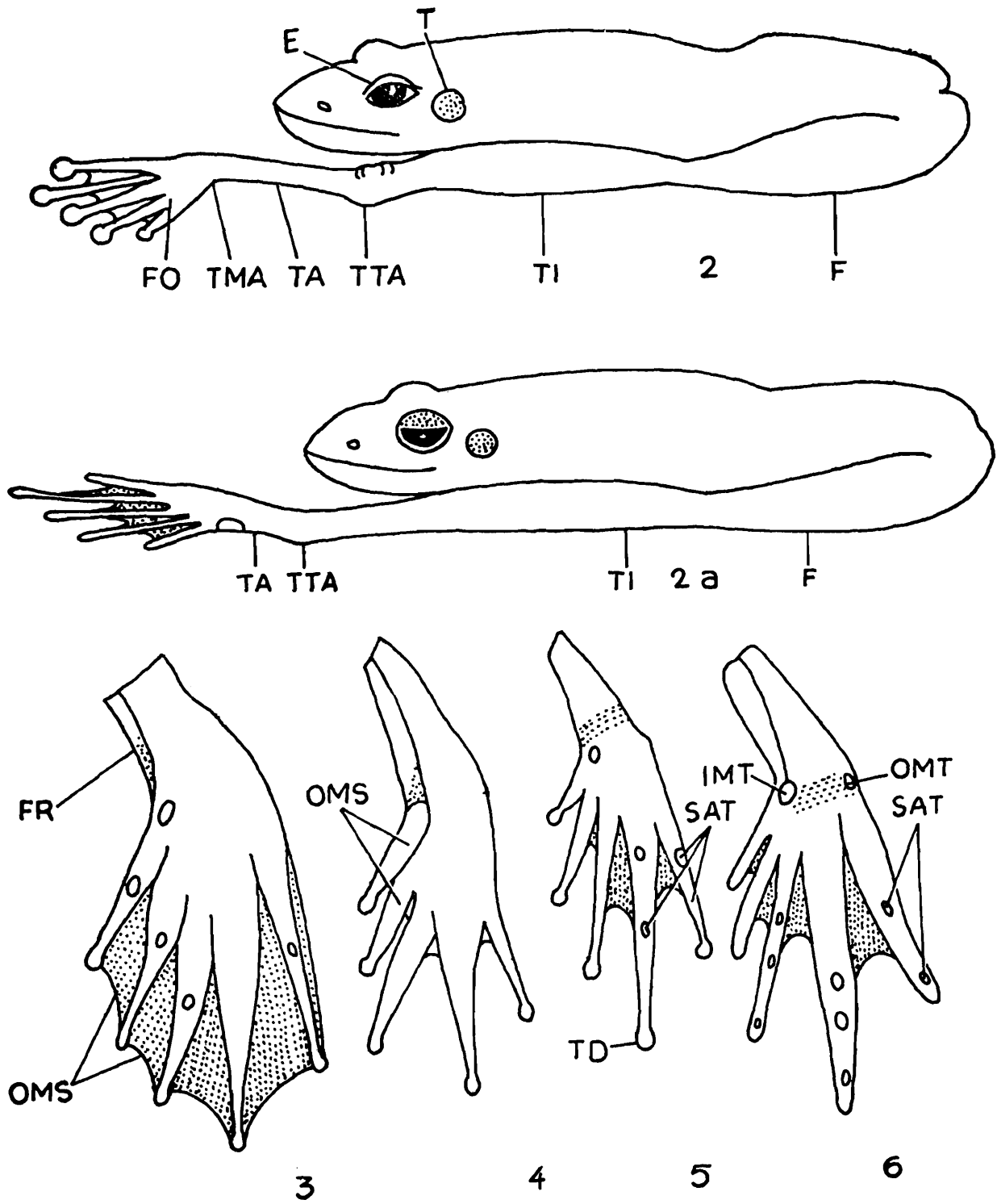


Fig. 1a : A typical Anuran (Frog).

the tympanum ; each eye has a fleshy opaque upper eyelid and a lesser lower eyelid and beneath these two eyelids there is a transparent third eyelid (nictitating membrane) that can move upwards over the eyeball to keep it moist in the air and to protect it under water.

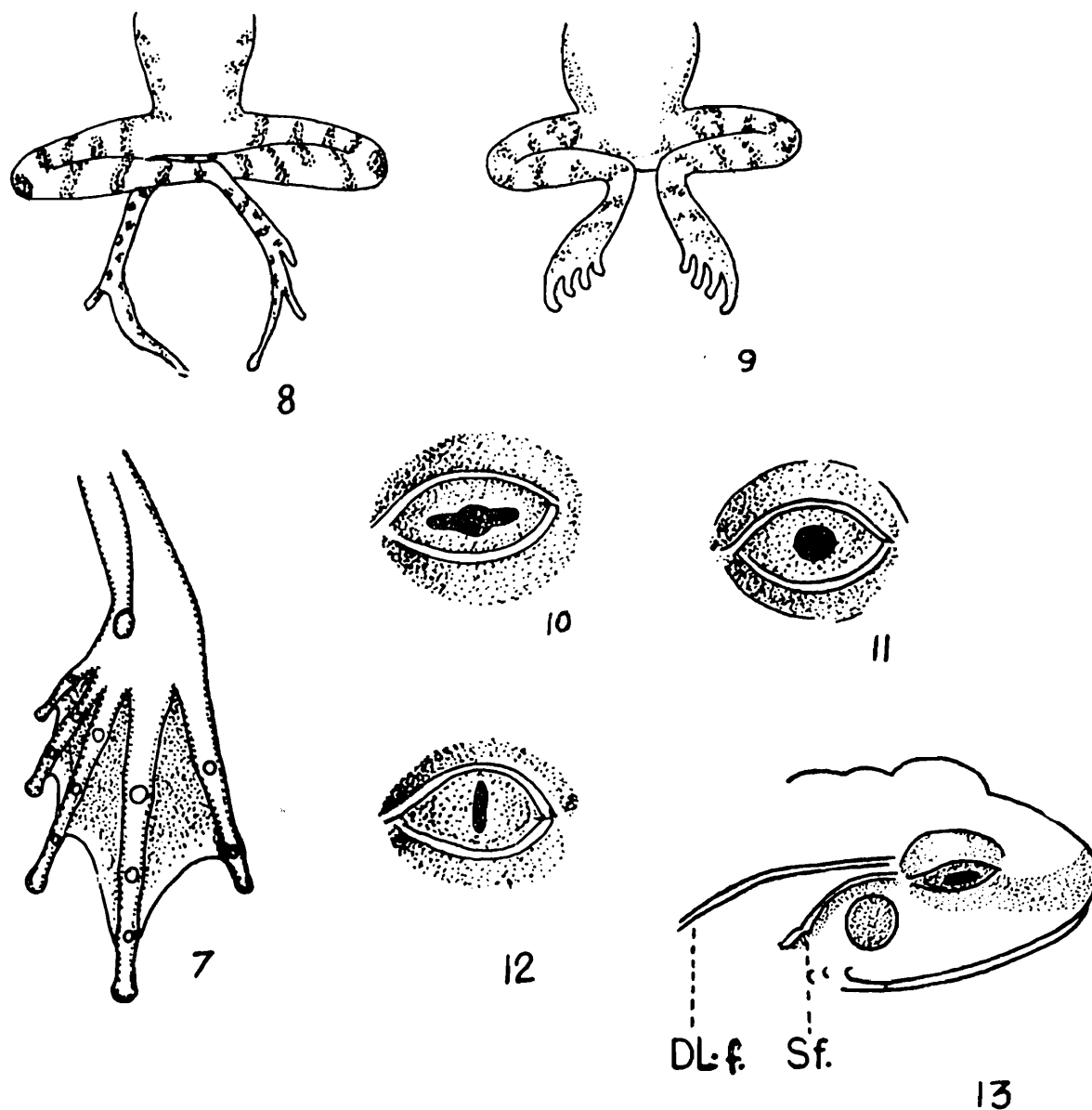
The trunk carries two pair of limbs. The forelimbs (FL) are shorter than the hindlimbs (HL) and comprises of an upper arm fore-arm, wrist and hand with four digits ; the inner digits are thickened in males, specially in the breeding season. Each hindlimb is comprised of a thigh or femur (Fig. 2, F), shank or tibia (Fig. 2, Ti), ankle or tarsus

(Fig. 2, TA) and bears five slender toes which are connected by broad thin webs (Fig. 3, OMS) and a long foot with narrow sole (Metatarsus); the junction of the tibia and tarsus



Figs. 2-6 : 2, Tibiotarsal articulation reaching eye ; 2a, Tibiotarsal articulation reaching snout ; 3, Toes fully webbed ; 4, Toes with rudimentary webbing ; 5, Toes one-fourth webbed ; 6, Toes half-webbed.

or tibiotarsal articulation (Fig. 2, TTA) helps in specific determination of toads and frogs. There are two metatarsal tubercles on the ventral side of the foot, the inner one being called inner metatarsal tubercle (Fig. 6, IMT) and the outer one called outer metatarsal tubercle (Fig. 6, OMT). The anus is situated at the hindermost part of the body.



Figs. 7-13 : 7, Toes three-fourth webbed ; 8, Position of feet when folded at right angles to body ; 9, Position of feet when folded at right angles to body (meeting) ; 10, Pupil horizontal ; 11, Pupil circular ; 12, pupil vertical ; 13, Supratympanic fold.

MEASUREMENTS OF THE DIFFERENT BODY PARTS

Measurements of the following body parts are generally used for the taxonomic studies of anuran amphibians.

1. Total length : From tip of snout to vent.
2. Length of head : From tip of snout to angle of jaws.
3. Width of head : At angle of jaws.
4. Length of snout : From tip of snout to anterior corner of eye.
5. Maximum length of eye : From anterior corner to posterior corner of eyes.
6. Interorbital space : Maximum gap between the two eyes.
7. Length of arm : From proximal end of junction of arm with the body to tip of longest finger.
8. Length of hand : From base of palm to tip of longest finger.
9. Length of first finger : From the base of palm to tip of first finger.
10. Length of second finger : From the base of palm to tip of second finger.
11. Length of third finger : From the base of palm to the tip of third finger.
12. Length of fourth finger : From the base of palm to the tip of fourth finger.
13. Length of leg : From midventral line of attachment of leg with body to tip of longest toe.
14. Length of tibia : From knee to tibiotarsal joint.
15. Length of foot : From base of foot to tip of longest toe.
16. Length of first toe : From the base to tip of first toe.
17. Length of second toe : From the base to tip of second toe.
18. Length of third toe : From the base to the tip of third toe.
19. Length of fourth toe : From the base to the tip of fourth toe.
20. Length of fifth toe : From the base to the tip of fifth toe.

The object of this work is limited to a study of the anuran fauna of northeast India so as to provide a stepping stone for more intensive studies on this group.

CLASSIFIED LIST OF ANURAN (AMPHIBIA) SPECIES
KNOWN FROM NORTHEAST INDIA

Class : AMPHIBIA

Order : ANURA

Family : PELOBATIDAE

Genus : 1. **Leptobrachium** Tschudi

Species : 1. *L. hasseltii* Tschudi

Genus : 2. **Megophrys** Kuhl & V. Hass

Species : 2. *M. boettgeri* (Boulenger)

3. *M. parva* (Boulenger)

Genus : 3. **Scutigera** Theobald

Species : 4. *S. sikkimensis* (Blyth)

Family : BUFONIDAE

Genus : 4. **Bufo** Laurenti

Species : 5. *B. himalayanus* Gunther

6. *B. melanostictus* Schneider

Genus : 5. **Bufoides** Pillai & Yazdani

Species : 7. *B. meghalayana* (Yazdani & Chanda)

Genus : 6. **Pedostibes** Gunther

Species : 8. *P. kempfi* Boulenger

Family : HYLIDAE

Genus : 7. **Hyla** Laurenti

Species : 9. *H. annectens* (Jerdon)

Family : MICROHYLIDAE

Genus : 8. **Microhyla** Tschudi

- Species : 10. *M. berdmorei* (Blyth)
11. *M. ornata* (Dum & Bibron)
12. *M. rubra* (Jerdon)

Genus : 9. **Uperodon** Dum & Bibron

- Species : 13. *U. globulosum* (Gunther)

Family : RANIDAE

Genus : 10. **Micrixalus** Boulenger

- Species : 14. *M. borealis* Annandale

Genus : 11. **Amolops** Cope

- Species : 15. *A. Afghanus* (Gunther)
16. *A. formosus* (Gunther)

Genus : 12. **Pterorana** Kiyasetuo & Khare

- Species : 17. *P. khare* Kiyasetue & Khare

Genus : 13. **Rana** Linn.

- Species : 18. *R. alticola* Boulenger
19. *R. assamensis* Sclater
20. *R. bilineata* Pillai & Chanda
21. *R. cyanophlyctis* Schneider
22. *R. anieli* Pillai & Chanda
23. *R. erythraea* (Schlegel)
24. *R. gerbillus* Annandale
25. *R. garoensis* Boulenger
26. *R. ghoshi* Chanda
27. *R. hexadactyla* Lesson
28. *R. khasiana* Boulenger
29. *R. limnocharis* Boisduval
30. *R. leptoglossa* (Cope)
31. *R. livida* (Blyth)
32. *Rana laticeps* Boulenger

- Species : 33. *Rana mawphlangensis* Pillai & Chanda
 34. *R. mawlyndipi* Chanda
 35. *R. tigerina* Daudin

Family : RHACOPHORIDAE

Genus : 14. **Chirixalus** Boulenger

- Species : 36. *Chirixalus doriae* Boulenger

Genus : 15. **Philautus** Gistel

- Species : 37. *Philautus andersoni* Ahl.
 38. *P. annandalii* (Boulenger)
 39. *P. argus* Annandale
 40. *P. cherrapunjiae* Roonwal & Kripalani
 41. *P. garo* (Boulenger)
 42. *P. kempiae* (Boulenger)
 43. *P. shyamrupus* Chanda & Ghosh
 44. *P. namdaphaensis* Sarkar & Sanyal
 45. *P. shillongensis* Pillai & Chanda

Genus : 16 : **Theloderma** Tschudi

- Species : 46. *Theloderma asper* (Boulenger)
 47. *T. moloch* Annandale

Genus : 17. **Polypedates** Tschudi

- Species : 48. *Polypedates leucomystax* (Gravenhorst)

Genus : 18. **Rhacophorus** Kuhl.

- Species : 49. *Rhacophorus bipunctatus* Ahl.
 50. *R. jerdonii* (Gunther)
 51. *R. maximus* Gunther
 52. *R. naso* Annandale
 53. *R. namdaphaensis* Sarkar & Sanyal
 54. *R. tuberculatus* Anderson.

Key to families of Amphibia (Anura) of northeast India

- | | | | |
|--|-----|----------------|---|
| 1. Upper jaw toothed | ... | ... | 2 |
| Jaws toothless | ... | ... | 5 |
| 2. Digits with an intercalary cartilage between penultimate and terminal phalanges ; fingers minutely to fully webbed ; toes two-thirds to fully webbed | ... | Rhacophoridae. | |
| Fingers free | ... | ... | 3 |
| 3. Terminal phalanges of fingers and toes free, pointed ; Omosternum present, small and cartilagenous ; sternum with or without a bony style | ... | Pelobatidae. | |
| Terminal phalanges of fingers and toes not pointed | ... | ... | 4 |
| 4. Terminal phalanges of fingers and toes claw shaped, swollen at the base ; Omosternum and sternum cartilagenous (rarely ossified) | ... | Hylidae. | |
| Terminal phalanges of fingers and toes of various shapes but never claw-shaped ; Omosternum and sternum with or without bony style | ... | Ranidae. | |
| 5. Pupil vertical and circular ; tongue oval ; skin smooth ; mouth narrow and pointed ; Omosternum rudimentary or absent ; sternum cartilagenous | ... | Microhylidae. | |
| Pupil horizontal ; tongue oval ; skin rough and tuberculated ; Omosternum usually absent, if present it is reduced to a narrow cartilage ; mouth narrow, pointed | ... | Bufonidae. | |

Family : PELOBATIDAE

Diagnosis : Upper jaw toothed, lower jaw toothless. Diapophyses of the sacral vertebrae strongly dilated. Terminal phalanges of fingers and toes free, simple and pointed. Omosternum present, but small and cartilagenous ; rarely calcified ; sternum with or without a bony style. Vertebrae procoelous or opisthocoelous. Ribs absent.

Type genus : *Megophrys* Kuhl & V Hass, 1822.

Distribution : Asia, Europe, Africa, North America, Central America, South America.

Remarks : Out of 10 genera known from the world, three genera viz, *Leptobrachium* Tschudi, *Megophrys* Kuhl & V. Hass and *Scutigera* (Blyth) have so far been recorded from Indian region which have also been recorded from northeast India,

Key to the genera of the family *Pelobatidae* of northeast India

- | | | |
|--|-----|---------------------------------|
| 1. Skin smooth ; tympanum indistinct or hidden | ... | <i>Leptobrachium</i> Tschudi. |
| Skin tuberculated | ... | ... |
| 2. Parotoid gland absent | ... | <i>Megophrys</i> Kuhl & V. Hass |
| Parotoid gland present | ... | <i>Scutiger</i> (Blyth). |

Genus : *Leptobrachium*, Tschudi, 1838

1838. *Leptobrachium* Tschudi, *Class. Batr.*, : 81.

1890. *Leptobrachium* Boulenger, *Fauna Brit. India including Ceylon and Burma Reptilia and Batrachia* : 510.

1985. *Leptobrachium* Frost, *Amphibian species of the world* : 409.

Diagnosis : Skin smooth, or may be provided with minute tubercles on the dorsum. Tongue heart-shaped ; vomerine teeth absent. Pupil vertical. Tympanum indistinct, sometime hidden ; paratoid glands absent. Fingers free ; toes webbed at the base, tips not dilated ; outer metatarsal united. Omosternum cartilagenous, rudimentary ; sternum with a bony style. Vertebrae procoelous ; sacral vertebra with much dilated diapophyses and one condyl e for articulation with coccyx.

Type species : *Leptobrachium hasseltii* Tschudi, 1838.

Distribution : India (Meghalaya) ; Indonesia ; Malaysia ; Philippines.

Remarks : A total of 12 species are known from the world of which one species *Leptobrachium hasseltii* Tschudi has been recorded from northeast India,

1. *Leptobrachium hasseltii* Tschudi, 1838

(Figs. 14-16)

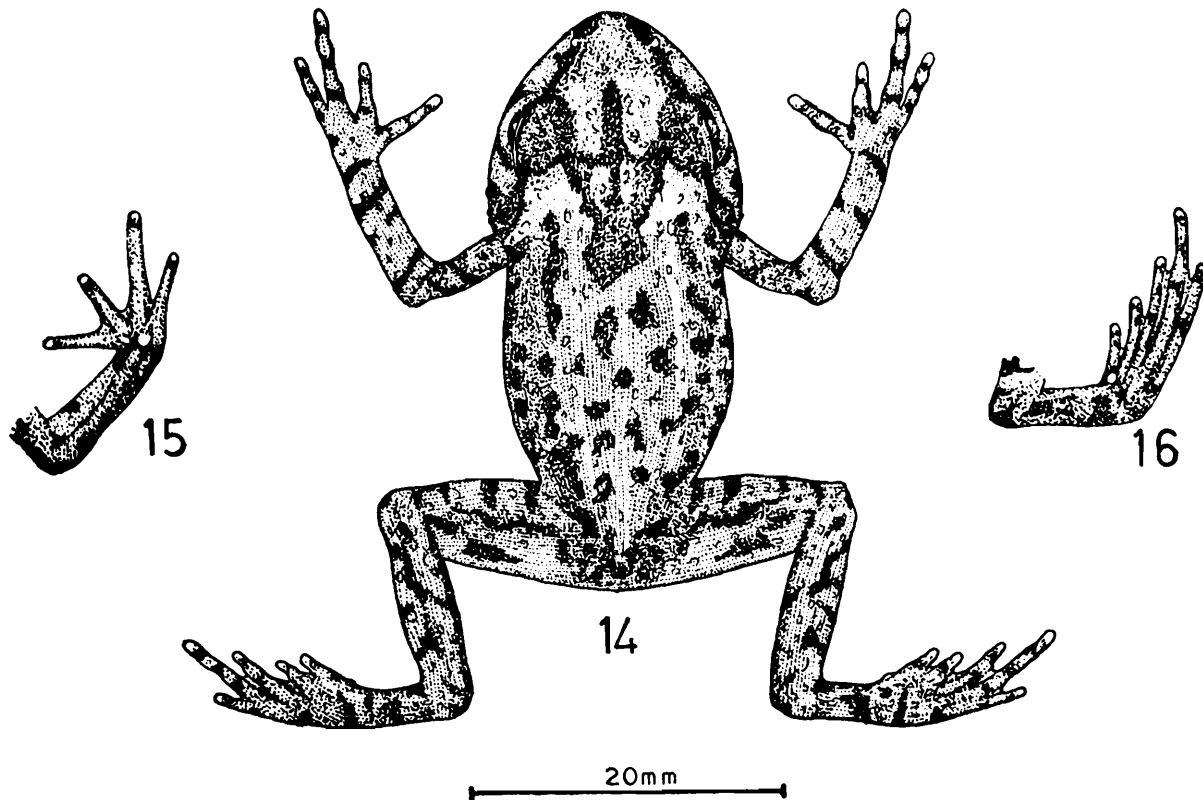
1838. *Leptobrachium hasseltii* Tschudi, *Class. Batr.*, : 81.

1890. *Leptobrachium hasseltii* : Boulenger, *Fauna Brit. India including Ceylon and Burma, Reptilia and Batrachia* : 511.

1985. *Leptobrachium hasseltii* Frost, *Amphibian species of the world* : 411.

Diagnosis : Dorsally varying from ashy to black with several brown and black spots and markings ; distinct canthal and temporal streaks present ; canthal streak surrounds the tympanum. Limbs with faint dark cross bars ; flanks with several dark spots

in rows ; throat and belly white. A humplike structure present above the vent. Male with internal vocal sac. Skin with small tubercles on back ; belly indistinctly granular ; a glandular fold present above the vent.



Figs. 14-16 : 14, *Leptobrachium hasseltii* (Dorsal view) ; 15, Forelimb (Ventral view) ; 16, Hindlimb (Ventral view).

Head large, broader than long. Canthus rostralis distinct, slightly curved ; snout rounded, not projecting beyond mouth ; loreal region oblique ; nostrils much nearer to tip of snout than to eyes ; interorbital width slightly less than upper eyelid ; tympanum not prominent, about half the diameter of eye.

Forelimbs short ; fingers free, moderate in size ; first finger a little longer than second, tips of fingers blunt, subarticular tubercles very prominent. Hindlimbs short ; tibiotarsal articulation reaching near tympanum ; toes nearly half webbed ; fourth toe longest, longer than snout. A small, oval, feebly prominent, inner metatarsal tubercle present ; outer metatarsal tubercle absent.

Measurements in mm : From snout to vent : 40·0-42·0 ; head : 11·5-12·0 ; width of head : 15·0-16·0 ; snout : 7·0-7·5 ; eye : 6·0-6·5 ; interorbital width : 4·5-6·0 ; tympanum : 3·0-3·5 ; forelimb : 27·0-28·0 ; first finger : 5·5-6·0 ; second finger 4·0-

4.5 ; third finger : 7.5-8.0 ; hindlimb : 52.5-54.0 ; tibia : 14.5-15.0 ; foot : 9.0-9.5 ; third toe : 5.5-6.0 ; fourth toe : 8.0-8.5 ; fifth toe : 4.0-4.5.

Material examined : India : 1 ♀, Mawphlang, Khasi hills, Meghalaya, 26.vi.1965, Coll. S. Biswas ; 1 ♀, Barapani, Khasi hills, Meghalaya, 13.vii.1972, Coll. S. K. Chanda.

Distribution : India (Meghalaya) ; Burma ; Malaysia ; Thailand ; Singapore ; Indonesia ; Philippines.

Remarks : Pillai & Chanda (1979) recorded the species for the first time from Meghalaya in northeast India ; since then it has been recorded for a second time from the same region but both are male specimens.

Genus : *Megophrys* Kuhl & V. Hass, 1822

1822. *Megophrys* Kuhl & V. Hass, *Alg. Konst en letter-bode*, : 102.

1979. *Megophrys* ; Pillai & Chanda, *Rec. zool. surv. India*, 75 : 384.

1985. *Megophrys* : Frost, *Amphibian species of the world* : 413.

Diagnosis : Skin tuberculated. Tongue subround, entire and free behind. Vomerine teeth present, sometimes absent. Pupil vertical. Tympanum indistinct or hidden. Paratoid gland absent. Fingers free ; toes free or minutely webbed ; tips of fingers and toes not dilated : outer metatarsals united, but partly separated by web.. Omosternum cartilagenous, sometimes calcified ; sternum with a bony style.

Type species : *Megophrys montana* Kuhl & V. Hass, 1822
(= *Megophrys monticola* Kuhl & V. Hass.)

Distribution : India, Nepal, China, Indochina, Malaysia, Indonesia, Philippines, Sumatra, Java, Borneo.

Remarks : A total of 24 species are included in this genus from the world of which three are known from Indian region and out of these, two, viz. *Megophrys boettgeri* (Boulenger) and *Megophrys parva* (Boulenger) have so far been recorded from northeast India. Noble (1924, 1972) considered *Megophrys* the most primitive of the pelobatid genera. Due to the dearth in knowledge on life history of members of this genus, its relationship to other pelobatid genera is not clear. Smith (1917) divided this genus into groups viz., one group where the larvae are unspecialised and the adults are *Rana*-like and the other group where the tadpoles have remarkable funnel-shaped oral apparatus and a median vent.

Key to the species of *Megophrys* of northeast India

1. Tympanum distinct, as large as eye ; vomerine teeth absent ; nostrils much nearer to tip of snout than to eyes ; first finger slightly shorter than second .. *boettgeri* (Boulenger).
2. Tympanum feebly distinct, about half to two-thirds of eyes ; vomerine teeth present ; nostrils equidistant from eyes and tip of snout ; first and second fingers equal
... .. *parva* (Boulenger).

2. *Megophrys boettgeri* (Boulenger)

(Figs. 17-19)

1899. *Leptobrachium boettgeri* Boulenger, *Proc. zool. Soc. Lond.*, : 171.1908. *Megalophrys boettgeri* Boulenger, *Proc. zool. Soc. Lond.*, 4 : 420-421.1985. *Megophrys boettgeri* Frost, *Amphibian species of the world* : 414.*Type locality* : Kuatun, China.*Location of type* : British Museum (Natural History), London.*Material examined* : India : 1 example ♂ Regd. No. ZSI, 16941, Upper Rotung, Arunachal Pradesh, 1912, coll. S. W. Kemp.*Diagnosis* : Dorsal surface dark olive with more or less symmetrically arranged greyish-green marks ; upper surface of snout of latter shade ; hindlimbs with dark olive bands ; throat with dark olive shade and also with clear yellowish spot. Skin on back, limbs, throat and chest smooth ; irregular tubercles present on the base of thighs.

Head moderate, little depressed and a little longer than broad ; snout longer than eyes, rounded at the tip, projecting a little beyond the lower jaw ; nostril much nearer to tip of snout than to eyes ; canthus rostralis distinct ; loreal region concave, interorbital width greater than width of eyes ; tympanum distinct, as large as eye ; vomerine teeth absent.

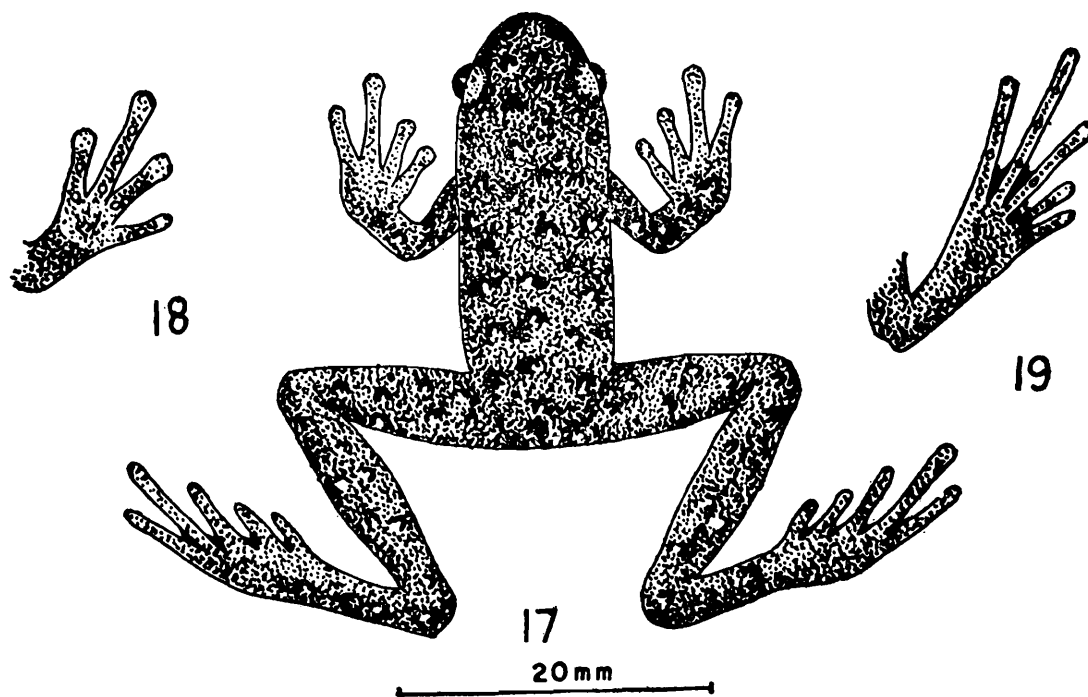
Forelimbs slender ; fingers short, free, bearing very small but distinct discs (except the first, which is merely blunt) ; first finger a little shorter than second ; subarticular tubercles minute. Hindlimbs long ; tibiotarsal articulation reaches tip of snout ; toes slender ; fourth toe very long with small discs and rudiments of web ; subarticular tubercles not very prominent ; metatarsal tubercles absent.

Measurements in mm : From snout to vent : 15.0 ; head : 5.0 ; snout : 4.5 ; width of head : 4.5 ; eye : 3.0 ; interorbital width : 4.5 ; tympanum : 3.0 ; forelimb :

10.5 ; first finger : 2.0 ; second finger : 3.0 ; third finger : 4.5 ; hindlimb : 26.5 ; tibia : 7.5 ; foot : 6.0 ; first toe 6.5 ; second toe : 7.5 ; fourth toe : 8.5.

Distribution : India (Arunachal Pradesh) ; China ; Fujian ; Zhejiang ; Jiangxi ; Anhui ; Gansu ; Guangdong ; Hunan ; Hongkong.

Remarks : This species was originally described from China (Boulenger, 1899). Annandale (1912) described *Megophrys kempii* from Arunachal Pradesh of northeast India



Figs. 17-19 : *Megophrys boettgeri* : 17, *Megophrys boettgeri* (Dorsal view) ; 18, Forelimb (Ventral view) ; 19, Hindlimb (Ventral view).

which is now considered a synonym of *Megophrys boettgeri* (Boulenger, 1908). Although the types of none of the above species were available for study, I have examined and compared other material identified by Annandale as *kempii* with Boulenger's original description of *boettgeri* and found insignificant variations. Though Annandale recorded this species from Arunachal Pradesh of northeast India, efforts to collect from the same area were unsuccessful.

Measurements of body parts have been taken from Annandale's material and incorporated here as these were not mentioned in earlier description (Boulenger 1899, 1908, Annandale, 1912). This species is strictly restricted to northeast India.

3. *Megophrys parva* (Boulenger)
(Figs. 20-22)

1893. *Leptobrachium parva* Boulenger, *Ann. Mus. Genova* (2) 13 : 344.
1908. *Megophrys parva* Boulenger, *Proc. zool. Soc. Lond.* 3 : 407-430.
1985. *Megophrys parva* Frost, *Amphibian species of the world* : 416.

Type locality : "District of Karin Bia-po", Burma.

Location of types : British Museum (Natural History), Natural History Museum, Genova, Itali.

Material examined : India : (5 ♀ ♀, 2 ♂ ♂), Cherrapunjiae, Khasi hills, Meghalaya, 5.vii.1970, Coll. G.M. Yazdani ; 2 ♂ ♂, Shillong, Khasi hills, Meghalaya, 8.vi.1969. Coll. S. K. Chanda ; 2 ♂ ♂, Rongrengiri, Garo hills, Meghalaya, 10.iv.1971, Coll. R. S. Pillai. 2 ♀ ♀, Kaziranga, Assam, 10.iv. 1972, Coll. A. K. Ghosh.

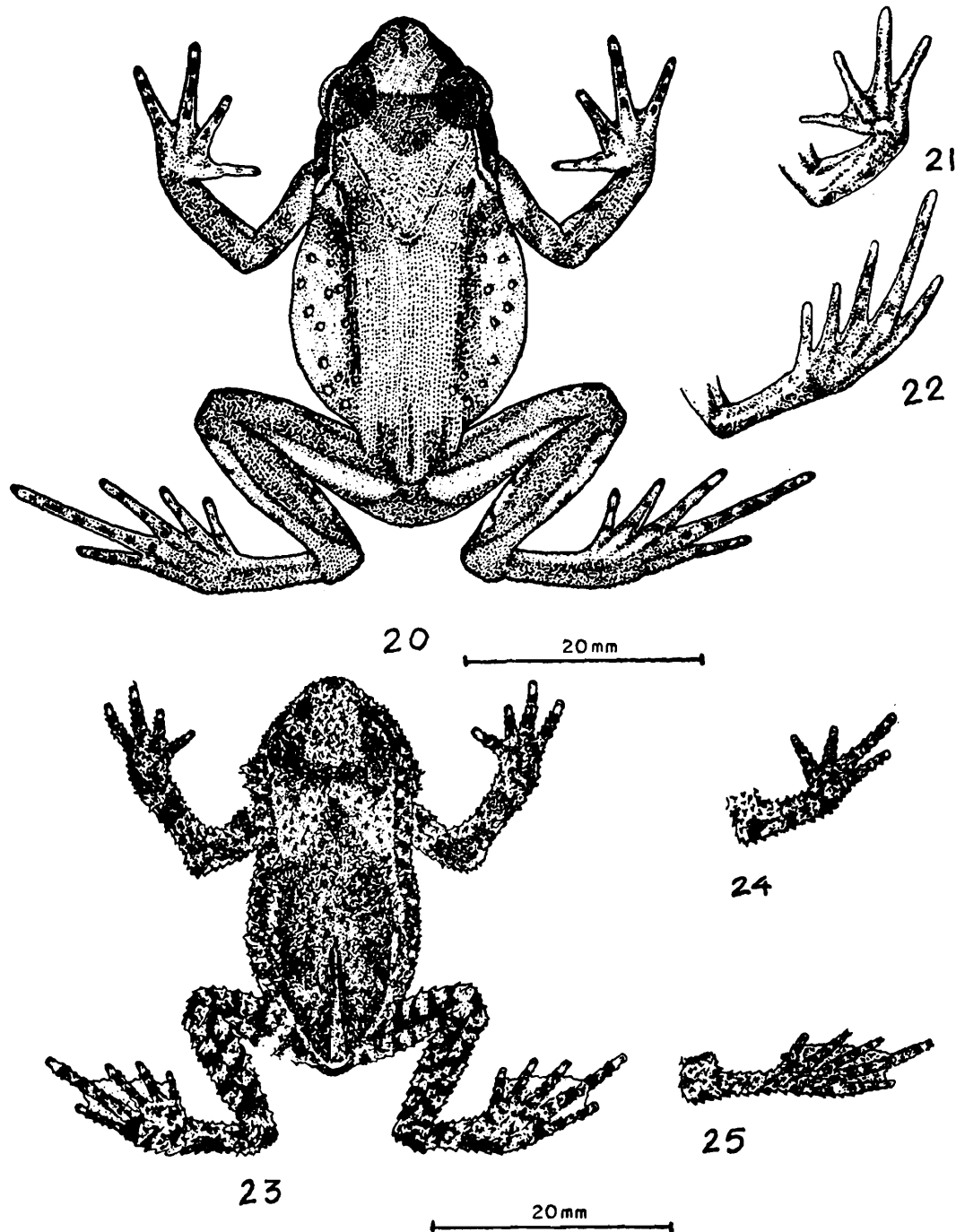
Diagnosis : Dorsally light brown with dark markings. An indistinct triangular spot present between the eyes. Limbs with more or less distinct cross bars. Ventral surface almost black. A small white tubercle present on either side of the breast. Skin smooth with a number of scattered minute conical tubercles. A very prominent median hornlike tubercle on level with anterior corner of eye ; a strong supratympanic fold connects the eyes and terminates at the shoulder in a glandule. A distinct fold running from the posterior corner of eye to the posterior part of tympanum. Upper eyelids with sharp raised edge, producing a triangular process. The lateral folds and two 'V' shaped folds present near the back of which one fold connects the upper eyelids and the other the tympanum.

Head : Large ; broader than long, depressed ; snout very short with angular canthus rostralis, projecting beyond lower jaw which is nearly as long as eyes ; loreal region slightly concave ; nostrils equidistant from eye and tip of snout ; interorbital width very broad and about one and a half to twice the width of eyes ; tympanum feebly distinct and about half to two-thirds of eye ; vomerine teeth in two widely separated small groups just behind the level of choanae.

Forelimbs : Moderately long ; tips of fingers feebly swollen ; first and second fingers equal ; subarticular tubercles not prominent.

Hindlimbs : Long ; tibiotarsal articulation reaches beyond mouth ; heels just meeting when hindlimbs folded at right angles to body ; tibia two and a half times as long as broad, more than half of snout to vent ; toes blunt and minutely webbed ; fourth toe longest, much longer than snout : subarticular tubercles indistinct ; an indistinct inner metatarsal tubercle present ; outer metatarsal tubercle absent.

Measurements in mm : From snout to vent : 36·0-41·0 ; head : 9·0-11·5 ; snout : 5·0-7·0 ; width of head : 11·5-13·0 ; eye : 4·5-5·5 ; interorbital width : 7·0-9·0 ; tympanum : 3·0-4·5 ; forelimb : 24·5-26·5 ; first finger : 4·5-5·0 ; second finger : 4·5-5·0 ; third finger : 6·5-7·0 ; hindlimb : 51·5-57·5 ; tibia : 24·0-26·0 ; foot : 13·0-14·5 ; third toe : 6·5-7·5 ; fourth toe : 10·5-11·5 ; fifth toe : 5·5-6·5.



Figs. 20-25 : *Megophrys parva* : 20, *Megophrys parva* (Dorsal view) ; 21, Forelimb (Ventral view) ; 22, Hindlimb (Ventral view) ; 23, *Scutigera sikkimensis* (Dorsal view) ; 24, Forelimb (Ventral view) ; 25, Hindlimb (Ventral view).

Distribution : India (Assam, Meghalaya, Sikkim, West Bengal) ; Bangla Desh ; Burma ; China ; Malaysia ; Thailand.

Remarks : This species was reported for the first time from Khasi hills, Meghalaya (Pillai & Chanda, 1979). During the present study more examples were collected from the above area and after careful study it has been found that the above species should be considered as *Megophrys parva*. It is being recorded for the first time from Assam.

Genus : *Scutiger* Theobald, 1868

1868. *Scutiger* Theobald, *J. Asiat. Soc. Beng.*, : 83.

1985. *Scutiger* Frost, *Amphibian species of the world* : 417-

Diagnosis : Skin laterally thick, glandular and tuberculated. Tongue round. Vomerine teeth generally absent, sometimes present. Pupil horizontal. Tympanum hidden. Parotoid gland present. Fingers free ; toes webbed ; tips of fingers and toes without prominent discs. In males, nuptial spine present in the first and sometimes in the third finger.

Type species : *Bombinator sikkimensis* Blyth, 1868.

Distribution : India ; Nepal ; Indo-China.

Remarks : A total of 19 species of this genus are known from the world, out of which only one viz., *Scutiger sikkimensis* (Blyth) has been recorded from northeast India.

4. *Scutiger sikkimensis* (Blyth) (Fig. 23-25)

1854. *Bombinator sikkimensis* Blyth, *J. Asiat. Soc. Beng.*, 23 : 300.

1868. *Scutiger sikkimensis* Theobald, *J. Asiat. Soc. Beng.*, 3 : 88.

1986. *Scutiger sikkimensis* Frost, *Amphibian species of the world* : 36.

Type locality : Sikkim, India.

Location of type : Not known.

Material examined : 2 examples ♀ ♀ (Type), Sikkim Himalayas, date ? Coll. W. S. Sherwell ; 1 ♂. Mawphlang, Khasi hills, Meghalaya, 14.viii. 1973, Coll. R. S. Pillai ; 2 ♂♂, Barapani, Khasi hills, Meghalaya, 19.vi.1978, Coll. S. K. Chanda.

Diagnosis : Dorsally varying from yellowish to brown ; posterior part more brownish than anterior part. A faint vertebral line running from posterior end upto middle of

dorsum. Entire hind part of the body including belly and throat yellowish with conspicuous black spots. Dorsal skin with large porous warts forming irregular longitudinal series on the back ; lower parts smooth. Dark brown patches present on dorsal part of both limbs ; whole body covered with various sizes of warts.

Head : Broader than long and without cranial ridges ; snout rounded not projecting beyond lower jaw ; canthus rostralis prominent ; loreal region slightly concave ; nostrils much nearer to tip of snout than eyes ; internarial space a little less than interorbital width which is nearly half of upper eyelid ; tympanum hidden ; parotoid glands small, moderate and distinct ; vomerine teeth absent ; tongue pyriform.

Forelimbs : Slender and shorter ; fingers free, moderate with slightly swollen tips : first finger a little longer than second, third finger longest, longer than snout ; subarticular tubercles small, distinct and of various sizes.

Hindlimbs : Short, slender ; tibiotarsal articulation reaching shoulder ; heels just meeting when hindlimbs folded at right angles to body ; tibia three to three and half times as long as broad, nearly one-seventh the length of snout to vent ; tips of toes minutely swollen ; toes half-webbed ; an oval shaped inner and outer metatarsal tubercles present.

Measurements in mm : From snout to vent : 45.0-46.5 ; head : 9.0-9.5 ; width of head : 13.0-14.0 ; snout : 5.0-5.2 ; eye : 5.0 ; interorbital width : 2.5-3.0 ; forelimb : 15.0-16.0 ; first finger : 4.5-4.8 ; second finger : 3.5-3.8 ; third finger : 5.5-5.8 ; hindlimb : 32.0-33.5 ; tibia : 7.0-7.4 ; foot : 11.0-11.5 ; third toe : 5.0-6.3 ; fourth toe : 8.0-8.5 ; fifth toe : 4.0-4.2.

Distribution : India (Meghalaya, Sikkim) ; Nepal ; China.

Remarks : Out of 19 valid species of this genus (known) from the world, only *Scutigera sikkimensis* has been recorded from northeast part of India. Pillai & Chanda (1979) first recorded the species from Meghalaya and misidentified it as *Bufo himalayanus* Gunther. During the present work few more examples were collected and after comparing the materials with the type, the author found that the above material should be considered as *Scutigera sikkimensis* (Blyth). Dubois (1974) recorded this species from Nepal.

Family : BUFONIDAE

Diagnosis : Tongue oval, skin rough and tuberculated. Mouth narrow and pointed. Pupil horizontal. Vomerine teeth absent. Jaws toothless. Diapophyses of sacral vertebrae dilated. Terminal phalanges of fingers and toes obtuse or T-shaped. Omosternum usually absent, if present it is reduced to a narrow cartilage. Sternum cartilagenous, in some cases ossified along the centre. Vertebrae procoelous. Ribs absent. Coccyx articulating by two (rarely one) condyles.

Type genus : *Bufo* Laurenti, 1768.

Distribution : Throughout the world, except Australia, Madagascar, New Guinea and Pacific Islands.

Remarks : Out of 18 genera known from the world, five genera have so far been recorded from Indian region and out of them three genera have been recorded from northeast India.

Key to the Genera of *Bufo*nidae of northeast India

- | | | | | |
|----|---|-----|------------------------------------|---|
| 1. | Parotoid gland present, tympanum present | ... | ... | 2 |
| | Parotoid gland absent, tympanum hidden | ... | <i>Bufo</i> ides Pillai & Yazdani. | |
| 2. | Fingers free, toes half to two-third webbed, tympanum distinct | ... | <i>Bufo</i> Laurenti. | |
| | Fingers webbed, toes almost fully webbed, tympanum distinct of hidden | ... | ... | |
| | ... | ... | <i>Pedostibes</i> Gunther. | |

Genus : *Bufo* Laurenti, 1768

1768. *Bufo* Laurenti, *Synopsis Rept. Vienna*, : 25.

1986. *Bufo* Frost, *Amphibian species of the world* : 29.

Diagnosis : Skin rough and tuberculated. Tongue elliptic, entire. Vomerine teeth absent. Pupil horizontal ; Tympanum distinct. Parotoid glands large and prominent. Head generally without any bony ridges. Fingers free ; toes more or less webbed ; tips simple or dilated into small discs. Outer metatarsal united. Omosternum, sometimes more or less calcified. Diapophyses of sacral vertebra more or less dilated. Terminal phalanges obtuse or triangular.

Type species : *Bufo vulgaris* Laurenti. 1768 (*Rana bufo* Linn.).

Distribution : Throughout the world except Australia, Madagascar, New Guinea and the Island of the Pacific.

Remarks : A total of 209 species have been included in this genus from the world of which 18 are known from Indian region and two species have so far been recorded from northeast India. The tadpoles of this genus are remarkably similar in a great number of species and are readily recognised as a group by their generally dark or black colour, thick set of bodies, median vent and rounded tails (Pope, 1931).

Key to the species of *Bufo* of northeast India

- Tympanum large and distinct, nearly two-thirds of eye ; tibiotarsal articulation reaching eyes *melanostictus* Schneider.
- Tympanum very small and indistinct, less than half of eye ; tibiotarsal articulation reaching nearly tip of snout *himalayanus* Gunther.

5. *Bufo himalayanus* Gunther
(Figs. 26-28)

1864. *Bufo himalayanus* Gunther, *Rept. Brit. India.*, : 422.
1912. *Bufo himalayanus* Annandale, *Rec. Indian Mus.*, 8 : 19-20,
1986. *Bufo himalayanus* Frost, *Amphibian species of the world* : 48.

Type locality : Sikkim and Nepal.

Location of type : Syntypes : British Museum (Natural History), London.

Material examined : 2 ♀ ♀, Shillong, Khasi hills, Meghalaya, 14.iv.1977, Coll. S. K. Chanda ; 2 ♀ ♀, Mawpat, Khasi hills, Meghalaya, 3.v.1979. Coll. K. P. Singh ; 1 ♂, Barapani, Khasi hills, Meghalaya, 23.vii.1975, Coll. M. Datta ; 1 ♀, Gibbons Land, Namdapha, Arunachal Pradesh, 15.xii.1983, Coll. S. Biswas.

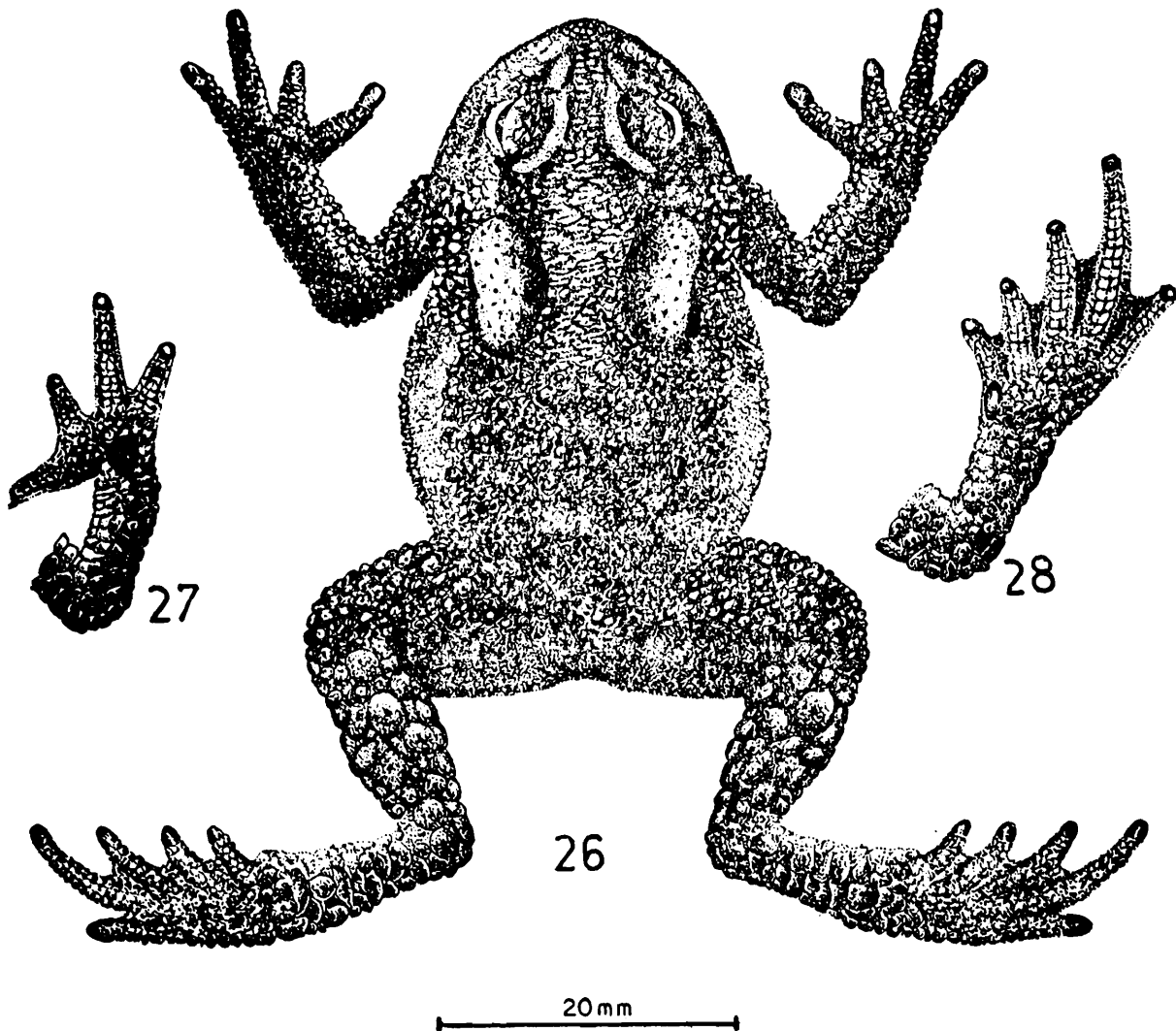
Diagnosis : Dorsally uniform brown to yellowish with dark brown to black dots. Tips of warts and tubercles black to brown. Ventrally yellowish, spotted with brown. Dorsal skin rough, with large warts and tubercles of various shapes and sizes. Ventral surface almost smooth.

Head : Broader than long with blunt supraorbital ridges ; snout blunt ; interorbital width broader than eyes ; loreal region flat ; canthus rostralis more or less angular ; nostrils closer to tip of snout than to eyes ; internarial space nearly equal to interorbital width which is nearly equal to upper eyelid ; tympanum very small and indistinct, less than half of eyes ; parotoid glands prominent, elongate and large, nearly as long as snout.

Forelimbs : Small, stout ; fingers free ; tips of fingers more or less blunt ; first finger slightly longer than second ; subarticular tubercles not well developed.

Hindlimbs : Moderately long ; tibiotarsal articulation reaching nearly tip of snout ; toes blunt, two-thirds webbed ; tibia three to four times as long as broad, half the length of snout to vent ; subarticular tubercles small ; a moderately large, elliptical inner and a smaller rounded outer metatarsal tubercle present.

Measurements in mm : From snout to vent : 28·0-53·0 ; head : 12·0-17·0 ; width of head : 13·0-19·0 ; tympanum : 3·5-6·5 ; forelimb : 17·5-27·5 ; first finger : 3·0-5·5 ; second finger : 2·5-4·5 ; third finger : 4·5-7·0 ; hindlimb : 40·0-51·5 ; tibia : 14·0-26·5 ; foot : 15·0-19·5 ; third toe : 5·0-7·5 ; fourth toe : 8·0-10·5 ; fifth toe : 4·0-5·0.



Figs. 26-28 : 26, *Bufo himalayanus* (Dorsal view) ; 27, Forelimb (Ventral view) ; 28, Hindlimb (Ventral view).

Distribution : India (Meghalaya, Arunachal Pradesh, Sikkim) ; Nepal.

Remarks : AnnanJale (1912) recorded the species from Arunachal Pradesh, and was doubtfully inclined to agree with Gunther (1864) to assign the species as an alpine race

of *Bufo melanostictus* Schn. In *Bufo himalayanus* tympanum is much smaller than in *Bufo melanostictus* and in some examples it is totally lacking. Moreover, the parietal ridges were also absent in some specimens. Since Annandale (1912), there was no record of this species from Arunachal Pradesh till a recent collection denotes its presence in the above area after a span of 70 years. During the present study, it has been recorded for the first time from Meghalaya.

6. *Bufo melanostictus* Schneider (Figs. 29-31)

1799. *Bufo melanostictus* Schneider, *Hist. Amph.*, 1, Jena., : 216.

1890. *Bufo melanostictus* Boulenger, *Fauna of Brit. India including Ceylon & Burma, Reptilia and Batrachia* : 500.

1985. *Bufo melanostictus* Frost, *Amphibian species of the world* : 54.

Type locality : "Ex India orientalis".

Location of type : Not traced.

Material examined : India : 225 examples (129 ♀ ♀, 96 ♂ ♂), from the states of Assam, Arunachal Pradesh, Meghalaya, Manipur, Mizoram, Nagaland and Tripura collected during the year 1960-1978 in April-July and October to December, besides a few in January-February and in August from Manipur in the year 1974-1978.

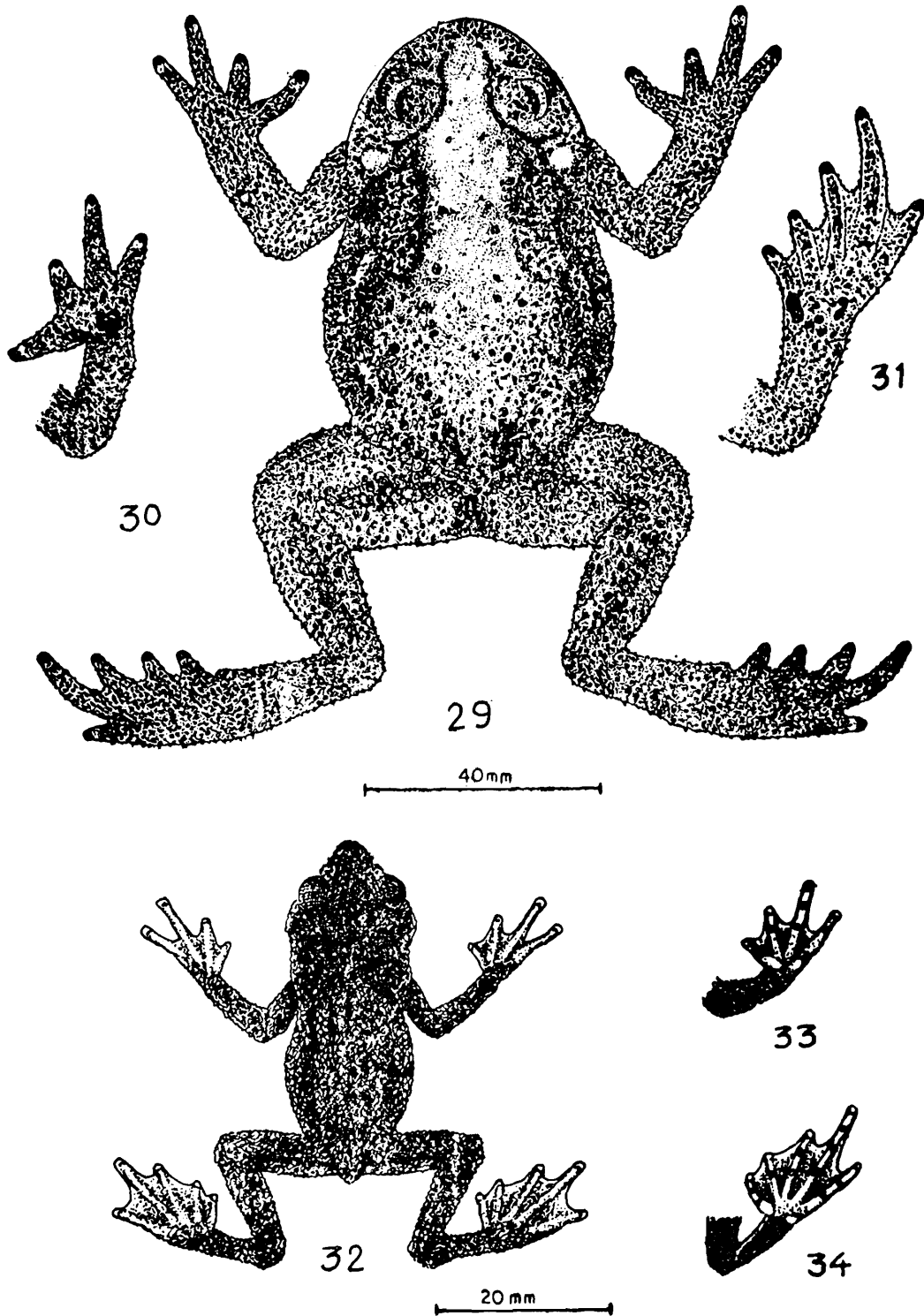
Diagnosis : Dorsally brown or yellowish brown, sometimes with black spots. Tips of warts and ridges of head usually deep brown to black. Ventrally yellowish, more or less spotted with brown. Dorsal skin rough with more or less prominent spiny warts and tubercles of various sizes. Ventral surface smooth.

Head : A little broader than long with a canthal, preorbital, supraorbital, postorbital and a short supratympanic bony ridge ; snout very short, blunt, slightly longer than upper eyelid ; interorbital width slightly broader than eyes ; loreal region little oblique, nearly flat ; canthus rostralis angular ; nostril nearer to tip of snout than eye ; tympanum large, very distinct, more than two-thirds the diameter of eyes ; parotoid glands very large, elliptical, more or less elongate.

Forelimbs : Short, stout ; fingers free ; tips of fingers blunt ; first finger slightly longer than second but shorter than fourth ; subarticular tubercles very prominent.

Hindlimbs : Short ; tibiotarsal articulation reaching eyes ; toes blunt, half-webbed ; tibia three and half to four times as long as broad, one-fifth to half the length of snout to vent, shorter than forelimb and foot. Subarticular tubercles very small and indistinct ; a moderately large, elliptical inner and a smaller outer metatarsal tubercle present.

Measurements in mm : From snout to vent : 31·0-96·0 ; head : 13·0-14·0 ; width of head : 13·5-20·0 ; snout : 4·0-7·0 ; interorbital width : 3·5-7·0 ; tympanum : 2·5-6·0 ; fore-



Figs. 29-34 : 29, *Bufo melanostictus* (Dorsal view) ; 30, Forelimb (Ventral view) ; 31. Hindlimb (Ventral view) ; 32, *Bufoides meghalayana* (Dorsal view) ; 33, Forelimb (Ventral view) ; 34. Hindlimb (Ventral view).

limb : 18.5-29.0 ; first finger : 3.5-6.0 ; second finger : 3.0-5.5 ; third finger : 5.0-7.5 ; fourth finger : 4.5-6.5 ; hindlimb : 42.5-53.5 ; tibia : 15.5-18.5 ; foot : 16.0-20.0 ; third toe : 6.0-6.5 ; fourth toe : 9.5-12.0 ; fifth toe : 5.0-6.8.

Distribution : India ; Burma ; Sri Lanka ; China ; Malaysia ; Indonesia ; Philippines.

Remarks : During the present study this species has been recorded from throughout northeast India. During breeding season the females develop excrescences on the two inner fingers (Van Kampen, 1923). According to Pope (1931) females are more variable in size.

Genus : *Bufoides* Pillai & Yazdani, 1973

1973. *Bufoides* Pillai & Yazdani *J. zool. Soc. India.*, 25 (1 & 2) : 65-70.

1985. *Bufoides* Frost, *Amphibian species of the world* : 65.

Diagnosis : Skin rough with prominent tubercles. Tongue elliptical ; vomerine teeth absent. Pupil horizontal. Tympanum hidden. Paratoid gland absent. Fingers free, toes almost fully webbed, tips not dilated. Omosternum absent ; sternum cartilagenous. Diapophyses of sacral vertebra dilated. Eggs large and distinctly pigmented.

Type species : *Ansonia meghalayana* (Yazdani & Chanda) 1971.

Distribution : India (Meghalaya).

Remarks : This genus is monotypic and endemic to northeast Indian region. The type species *meghalayana* (Yazdani & Chanda, 1971) was previously placed under the genus *Ansonia*, but on the basis of the hidden tympanum, pigmentation as well as size of eggs and absence of sucker-like oral discs in the tadpoles, it has been subsequently considered to be a species of the genus *Bufoides* (Pillai & Yazdani, 1973).

7. *Bufoides meghalayana* (Yazdani & Chanda)

(Figs. 32-34)

1971. *Ansonia meghalayana* Yazdani & Chanda, *J. Assam Sci. Soc.*, 14 (1) : 76-80.

1975. *Bufoides meghalayana* Pillai & Yazdani, *J. zool. Soc. India*, 25 (1 & 2) : 65-66.

1985. *Bufoides meghalayana* Frost, *Amphibian species of the world* : 65.

Type locality : Mawblong, Khasi hills, Meghalaya.

Location of type : Zoological Survey of India, Calcutta, India.

Material examined : 2 exs. ♀ ♀, Mawblong, Khasi hills, Meghalaya, 17.iv.1970, Coll. G. M. Yazdani ; 9 ♀ ♀ ; 3 ♂ ♂, Mawblong, Khasi hills, Meghalaya, 9.iii.1975, Coll.

R. S. Pillai ; 6 ♀ ♀ ; 4 ♂ ♂, Cherrapunjiae, Khasi hills, Meghalaya, 7.v.1977, Coll. S. K. Chanda.

Diagnosis : Dorsally uniform dark brown to black. Tips of warts and tubercles deep brown. Ventrally greyish, spotted with brown. Dorsal skin rough, with warts and tubercles of various sizes. Head with much larger tubercles. A longitudinal fold present between the limbs.

Head : Broader than long, depressed ; snout short and conical almost as long as eye ; canthal ridges on either side meet near the tip of snout ; both preorbital and post-orbital warts pronounced ; canthus rostralis distinct ; loreal region slightly concave ; nostrils laterally situated and much nearer to tip of snout than to eyes ; eyes prominent and directed downwards ; pupil horizontal ; upper eyelid broad and tuberculated ; tympanum hidden.

Forelimbs : Moderately long ; fingers free, dorsoventrally flattened with little dilated tips ; first finger shortest ; second finger slightly longer than first ; third finger longest ; fourth finger slightly shorter than third. Subarticular tubercles indistinct.

Hindlimbs : Moderately long ; tibiotarsal articulation reaching far posterior corner of eyes ; tibia three and half to four times as long as broad. Toes almost fully webbed ; first toe shortest, second toe longer than first ; fourth toe longest, nearly equal to snout ; tips of toes a little dilated ; sole with fleshy pad ; subarticular tubercles indistinct ; inner metatarsal tubercle large and prominent ; outer metatarsal tubercle very small.

Measurements in mm : From snout to vent : 37.5-41.5 ; head : 11.0-12.0 ; width of head : 16.8-17.5 ; snout : 5.0-6.0 ; eye : 6.0-7.0 ; interorbital width : 5.0-5.5 ; first finger : 2.0-2.8 ; second finger : 3.0-4.0 ; third finger : 4.5-5.5 ; fourth finger : 3.5-4.5 ; hindlimb : 51.0-53.5 ; tibia : 15.0-16.5 ; foot : 15.0-16.0 ; first toe : 1.0-1.5 ; second toe : 2.0-2.5 ; third toe : 2.5-3.0 ; fourth toe : 5.0-5.5 ; fifth toe : 3.5-4.0.

Distribution : India (Meghalaya).

Remarks : This species was originally described from Mawblong, Khasi hills, Meghalaya (Yazdani & Chanda, 1971). Subsequently Pillai and Yazdani (1973) created a new genus *Bufoides* to accommodate it. In spite of several efforts this species could not be collected from any other localities of northeast India.

Genus : *Pedostibes* Gunther, 1875

1875. *Pedostibes* Gunther, *Proc. zool. Soc., Lond.*, 576.

1876. *Neotophryne* Buchholz and Peters, *Monatsber. preuss. Akad. Wiss. Berlin*, : 202,

1985. *Pedostibes* Frost, *Amphibian species of the world* : 72,

Diagnosis : Dorsal skin tuberculated. Tongue elliptical, entire and free. Vomerine teeth absent. Pupil horizontal. Tympanum hidden or distinct. Parotoid gland present. Fingers webbed ; toes almost fully webbed ; discs present. Palate concave, without any transverse ridge.

Type species : *Pedostibes tuberculosa* Gunther, 1875.

Distribution : Asia : India (Meghalaya, Tamil Nadu).

Remarks : A total of seven species of this genus are known from the world, of which, two are known from Indian region. Out of these, *Pedostibes kempi* (Boulenger) is known from northeast India.

8. *Pedostibes kempi* (Boulenger) (Figs. 35-37)

1919. *Nectophryne kempi* Boulenger, *Rec. Indian Mus.*, 16 : 207.

1985. *Pedostibes kempi* Frost, *Amphibian species of the world* : 72.

Type locality : India (Tura, Garo hills, Meghalaya, northeast India).

Location of types : Zoological survey of India, Calcutta, India.

Material examined : 1 ex. Tura, Garo hills, Meghalaya, 1917 ; Coll. S. W. Kemp.

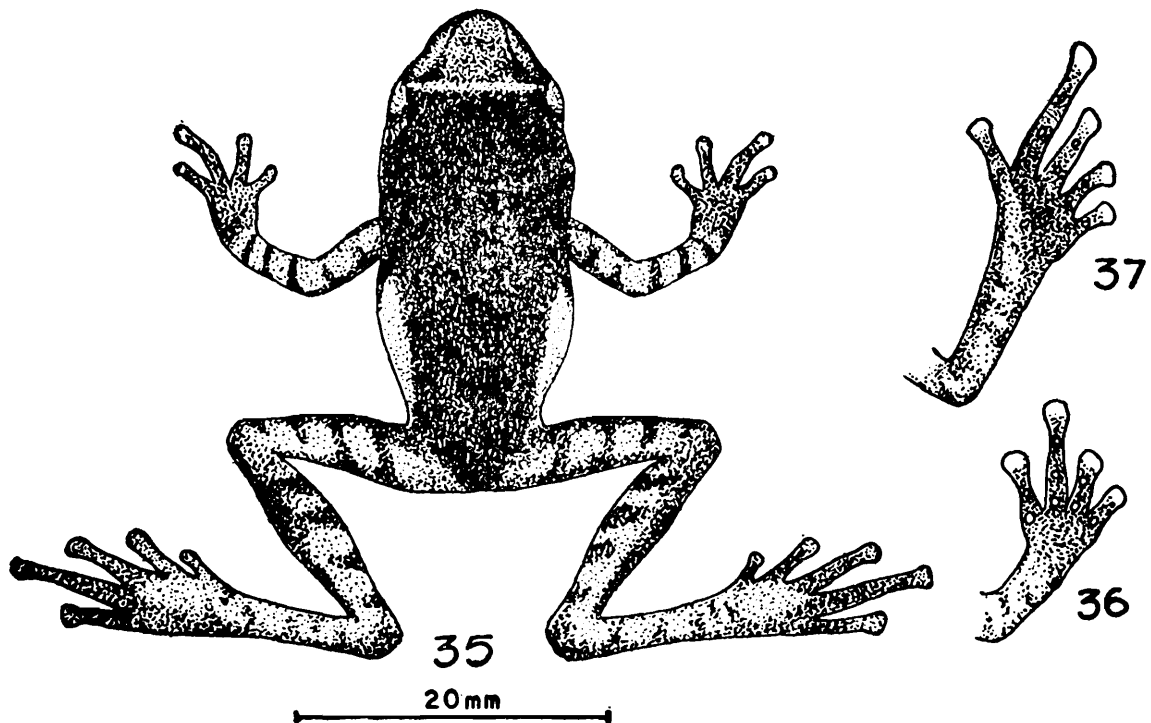
Diagnosis : Dorsally varying from dark grey to brown. Ventral surface almost dark brown. Skin rough with irregular tubercles of various shapes and sizes all over the body. Ventral surface finely granulated. A large round yellowish spot present on each side of the breast near the base of arm.

Head : Broader than long, depressed ; snout short, pointed, slightly projecting beyond mouth ; canthal ridges on either side meet near the tip of snout ; canthus rostralis distinct, loreal region slightly concave ; nostrils laterally situated and much nearer to tip of snout than to eyes ; interorbital width nearly equal to upper eyelid ; eyes prominent and directed downwards ; parotoid glands prominent ; tympanum hidden.

Forelimbs : Moderately large ; fingers moderately long, a little depressed, free, with rudiment of webs ; tips of fingers dilated into rounded tips ; first finger shorter than second, third finger much longer than snout ; subarticular tubercles feebly prominent.

Hindlimbs : Moderately long ; tibiotarsal articulation reaching shoulder ; tibia nearly four times as long as broad and less than one-third the length of snout to vent ; toes more than half-webbed with rounded tips ; subarticular tubercles small, prominent ; inner metatarsal tubercle prominent ; outer metatarsal tubercle indistinct.

Measurements in mm : From snout to vent : 30.0 ; head : 10.0 ; width of head : 11.5 ; snout : 5.0 ; eye : 4.0 ; interorbital width : 4.0 ; forelimb : 21.5 ; first finger : 3.0 ; second finger : 5.0 ; third finger : 6.5 ; hindlimb : 36.0 ; tibia : 12.5 ; third toe : 6.5 ; fourth toe : 8.5 ; fifth toe : 7.5.



Figs. 35-37 : 35, *Pedostibes kempii* (Dorsal view) ; 36, Forelimb (Ventral view) ; 37, Hindlimb (Ventral view).

Distribution : India [Meghalaya (Garo hills)].

Remarks : This species was originally recorded from Garo Hills, Meghalaya (Boulenger, 1919). Several faunistic surveys made in and around Garo Hills did not yield any result. During the present work the author studied the type material and compared it with the description (Boulenger, 1919) and found only insignificant variations.

Family : HYLIDAE

Diagnosis : Upper jaw toothed, lower jaw usually toothless. Diapophyses of the sacral vertebra dilated. Terminal phalanges of fingers and toes claw-shaped, swollen at the base. Omosternum cartilagenous (rarely ossified) ; sternum cartilagenous, vertebrae procoelous. Ribs absent. Coccyx attached by two condyles.

Type genus : *Hyla Laurenti*, 1768.

Distribution : Asia ; Eurasia ; Africa ; North and South America ; Australia ; New Guinea.

Remarks : Out of 35 genera known from the world only one genus, *Hyla* has been recorded from Indian region which is restricted to northeast India.

Genus : *Hyla Laurenti*, 1768

1768. *Hyla Laurenti*, *Synopsis Rept.*, Vienna, : 32.

1979. *Hyla Pillai & Chanda*, *Rec. zool. surv. India.*, 75 : 385.

1985. *Hyla Frost*, *Amphibian species of the world* : 125.

Type locality : Khasi hills, Meghalaya, India.

Location of type : Universitat Humboldt, Zoologisches Museum, Invalidenstrasse, Berlin.

Distribution : India (Meghalaya, Assam) Burma ; China ; Indo-China ; Malaysia.

Remarks : A total of 262 valid species have been included in this genus from the world of which only one species viz, *Hyla annectens* (Jerdon) is known from Indian region and is strictly restricted to northeast India.

9. *Hyla annectens* (Jerdon)

(Figs. 38-40)

1870. *Polypedates annectens* Jerdon. *Proc. Asiat. Soc. Beng.*, : 84.

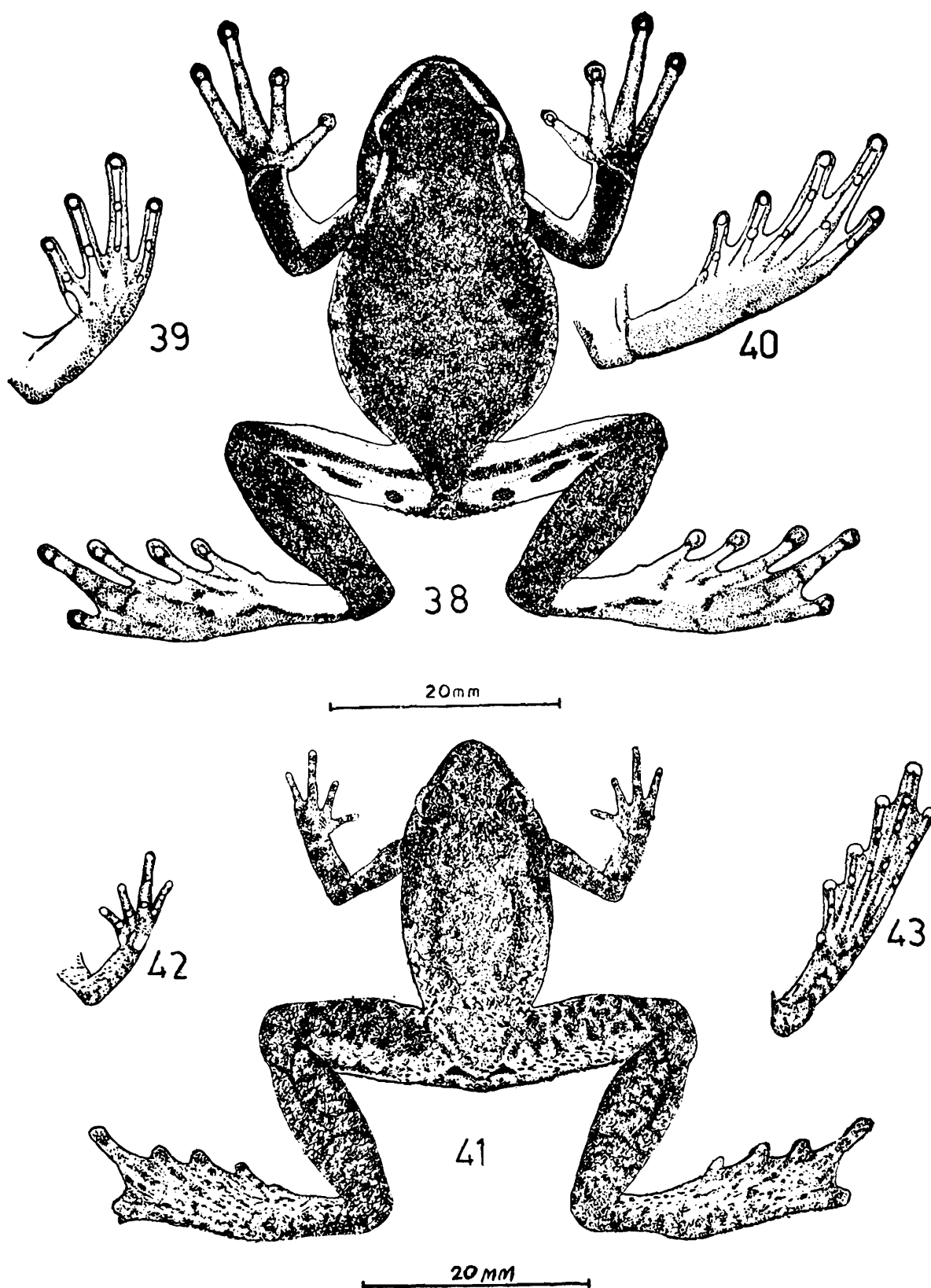
1979. *Hyla annectens* Pillai & Chanda, *Rec. zool. surv. India*, 75 : 385-387.

1985. *Hyla annectens* Frost, *Amphibian species of the world* 1 : 25.

Type locality : India (Khasi hills, Meghalaya).

Location of type : Universitat Humboldt, Zoologisches Museum, Berlin.

Material examined : 2 ♂♂, 1 ♀, Khasi hills, Meghalaya, date ? Coll. T. C. Jerdon ; 3 ♀♀, Mawphlang, Khasi hills, Meghalaya, 19.xi.1966, Coll. S. K. Chanda ; 2 ♀♀, Cherrapunjiae, Khasi hills, Meghalaya, 26.vi.1963, Coll. V. D. Srivastava ; 4 ♂♂, 2 ♀♀, Umran, Khasi hills, Meghalaya, 19.ii.1970, Coll. S. K. Talukdar ; 2 ♂♂, Kaziranga, Assam, 22.ii.1974, Coll. M. Datta ; 1 ♂, Kohima, Nagaland, 21.x.1978, Coll. S. G. Patil.



Figs. 38-43 : 38, *Hyla annectans* (Dorsal view) ; 39, Forelimb (Ventral view) ; 40, Hindlimb (Ventral view) ; 41, *Microhyla berdmorei* (Dorsal view) ; 42, Forelimb (Ventral view) ; 43, Hindlimb (Ventral view).

Diagnosis : Dark grey to slate-coloured on the dorsum. A light brownish streak from eyes to nostrils. A black lateral streak present up to groin, often terminating in two black spots of different sizes with interconnections. Ventral surface of thigh yellowish. A few black spots, arranged more or less in a line present on ventral surface of femer and tibia. Dorsal skin smooth. A strong tuberculated fold extend from the eyes to shoulder, over the tympanum. Ventral surface smooth.

Head : Broader than long ; snout rounded, longer than eyes ; canthus rostralis obtuse ; loreal region slightly concave. Nostrils much closer to tip of snout than to eyes ; distance between the nostrils less than that of interorbital width which is nearly two-thirds of upper eyelid ; tympanum distinct, slightly depressed and brownish in colour, nearly half the diameter of eye, separated from the latter by a space about its own diameter ; vomerine teeth in straight line on a level with posterior edge of choanae.

Forelimbs : Moderately long, nearly half of the total length of body. Fingers long, stout, free and claw-shaped with distinctly swollen tips, about two-thirds of tympanic diameter ; First finger much shorter than second, third finger much longer than snout ; subarticular tubercles prominent.

Hindlimbs : Long, slender and about one and a half times of total length of head and body ; tibiotarsal articulation reaching anterior corner of eyes ; heels just meeting when hind limbs folded at right angles to body ; tibia two to three and a half times as long as broad, nearly half or less than half the length from snout to vent ; toes clawed with distinct swollen tips which are equal to finger tips, two-third webbed with almost equal subarticular tubercles ; oval shaped inner metatarsal tubercles present ; outer metatarsal tubercle absent.

Measurements in mm : From snout to vent : 23·0-48·0 ; head : 6·0-8·0 ; width of head : 7·0-9·0 ; snout : 5·0-6·5 ; Eye : 4·0-5·5 ; interorbital width : 2·5-3·5 ; tympanum : 2·0-3·0 ; forelimb : 18·0-26·0 ; first finger : 2·5-3·5 ; second finger : 4·0-5·0 ; third finger : 6·5-7·5 ; hindlimb : 31·5-60·0 ; tibia : 12·5-21·5 ; foot : 12·5-21·5 ; third toe : 2·5-3·5 ; fourth toe : 3·5-4·5 ; fifth toe : 3·0-4·0.

Distribution : India (Meghalaya, Assam, Nagaland) ; Burma ; Thailand ; China ; Vietnam.

Remarks : This species was originally recorded as *Polypedates annectens* from Khasi hills, Meghalaya, northeast India (Jerdon, 1970). Out of 260 valid species of this genus from the world, it is the only species recorded from northeast India and in fact from the whole of India. It was later recorded from the same region after more than 100 years of its original record (Pillai & Chanda, 1979). During the present study the author recorded it for the first time from Assam and Nagaland of northeast India. It has also

been recorded from Burma (Boulenger, 1893) and China (Parker, 1925) and is considered as a common species of *Hyla* of the extreme west of Central and Southern China (Pope, 1931). According to Ao & Khare (1986) it is a common frog in Nagaland.

Family : MICROHYLIDAE

Diagnosis : Vomerine teeth absent. Jaws toothless. Pupil vertical and circular. Terminal phalanges of fingers and toes simple or T-shaped. Omosternum rudimentary or absent. Sternum cartilagenous. Procoracoids and clavicles usually absent. Vertebrae procoelous or diplasio-coelous. Ribs and intercalary phalanges absent. Diapophyses of sacral vertebra dilated.

Type genus : *Breviceps* Merrem, 1920.

Distribution : Asia ; Africa ; Madagascar ; South America ; Central America ; Australia ; New Guinea.

Remarks : Out of 60 genera known from the world, five genera have so far been recorded from Indian region and out of these two have been recorded from northeast India.

Key to the genera of *Microhylidae* of northeast India

Tips of fingers and toes more or less dilated. Tongue elliptical	<i>Microhyla</i> Tschudi
Tips of fingers and toes not dilated. Tongue oval	<i>Uperodon</i> Dum. & Bibron.

Genus : *Microhyla* Tschudi, 1838

1838. *Microhyla* Tschudi, *Mam. Soc. Sc. nat. Neuchatel*, 2 : 28.

1890. *Micrahyla* Boulenger, *Fauna Brit. India including Ceylon and Burma Reptilia and Batrachia*, : 491.

1985. *Microhyla* Frost, *Amphibian species of the world* : 385.

Diagnosis : Skin smooth or with small warts. Tongue narrow and elliptical, free and entire behind. Vomerine teeth absent. Pupil vertical and circular. Tympanum hidden. Parotoid gland absent. Fingers free ; toes free, webbed to a greater or lesser extent. Tips of fingers and toes more or less dilated. Outer metatarsal united. Omosternum absent, Terminal phalanges T-shaped,

Diagnosis : Dorsally varying from pink to dark brown, sometime with brownish spots or marbling scattered on dorsal surface of body. Characteristic sheds present dorsally in between the eyes, running up to trunk region ; occasionally few minute brown spots also present on lateral parts of hindlimbs as well as on flanks. A chevron-shaped black marking present near anus. Both throat and chest mottled with brown. Limbs with faint cross bands. Dorsum of body generally smooth. Skin smooth ; occasionally with few indistinct tubercles on back and on the sides of the body. Sometime dorsal skin is very loose. Ventrally smooth.

Head : Much broader than long, pointed, slightly depressed ; snout obtusely pointed, a little longer than eyes, projecting slightly beyond lower jaw ; canthus rostralis prominent ; nostrils a little closer to tip of snout than to eyes ; tympanum hidden.

Forelimbs : Moderately long ; fingers slender, free with rounded tips ; first finger much shorter than second ; third much longer than snout ; subarticular tubercles large and prominent.

Hindlimbs : Very long ; tibiotarsal articulation reaching beyond tip of snout ; heels strongly overlapping when hindlimbs folded at right angles to body ; tibia three and half to four times as long as broad, more than two-thirds the length of snout to vent ; tips of toes swollen into rounded tips which are slightly larger than finger tips ; fully webbed, web reaching near fourth phalanges of fourth toe, narrow but connecting tips ; inner metatarsal tubercle prominent and oval which is nearly two-thirds of first finger ; a small, rounded outer metatarsal tubercle present.

Measurements in mm : From snout to vent : 35.5-37.5 ; head : 10.0-11.5 ; width of head : 13.0-13.5 ; snout : 5.0-5.5 ; eye : 4.0-4.5 ; interorbital width : 4.0-4.5 ; forelimb : 17.5-20.0 ; first finger : 2.0-2.5 ; second finger : 4.0-5.0 ; third finger : 6.0-6.5 ; hindlimb : 51.1-53.5 ; tibia : 20.0-22.5 ; foot : 17.5-19.5 ; third toe : 11.5-19.5 ; fourth toe : 15.5-19.5 ; fifth toe : 13.5-16.5.

Distribution : India (Meghalaya, Assam, Arunachal Pradesh, Mizoram) ; Burma ; Indo-China ; Malaysia ; Indonesia.

Remarks : This species was originally described from Burma (Blyth, 1856). Pillai & Chanda (1981) recorded it for the first time in India. During the present study, it has been recorded from Assam, Mizoram and Arunachal Pradesh of northeast India.

11. *Microhyla ornata* (Dum. & Bibron)
(Figs. 44-46)

1841. *Engystoma ornata* Dum. & Bibron *Erp. Gen.*, 8 : 745.

1890. *Microhyla ornata* Boulenger, *Fauna Brit. India, including Ceylon and Burma, Reptilia and batrachia* : 165.

1920. *Microhyla eremita* Barbour, *Occ. Pap. Mus. zool.*, 76 : 1-4.

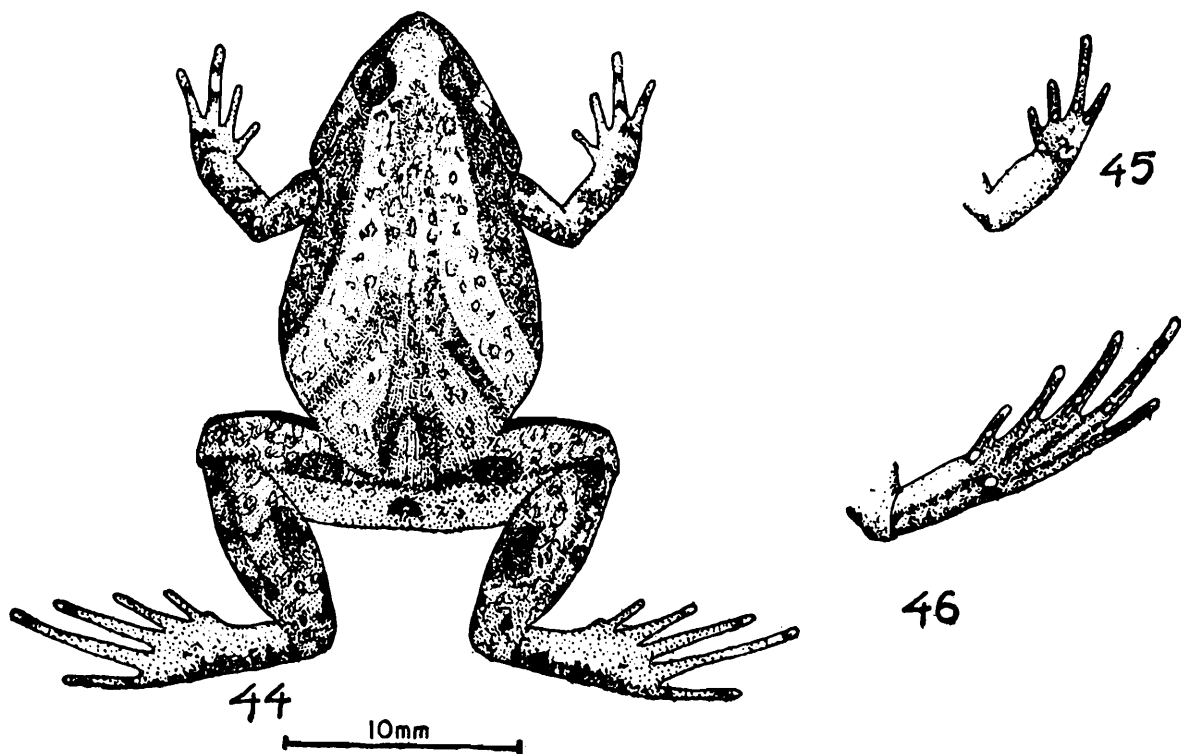
1981. *Microhyla ornata* Pillai & Chanda, *Rec. zool. Surv. India*, 79 : 166.

1985. *Microhyla ornata* Frost, *Amphibian species of the world* : 387.

Type locality : Malabar, India.

Location of type : Museum National d'Histoire Naturelle, Paris, France.

Material examined : 4 ♂♂, 2 ♀♀ ; Kaziranga, Assam, 24.xi.1972 ; Coll. G. M. Yazdani ; 1 ♀, Goalpara, Assam, 17.i.1972, Coll. R. S. Pillai ; 1 ♀, Dudhnai, Assam,



Figs. 44-49 : 44, *Microhyla ornata* (Dorsal view) ; 45, Forelimb (Ventral view) ; 46, Hindlimb (Ventral view) ; 47, *Microhyla rubra* (Dorsal view) ; 48, Forelimb (Ventral view) ; 49, Hindlimb (Ventral view).

17.xi.1973, Coll. S. Biswas ; 3 ♀♀, 2 ♂♂ ; Shillong, Khasi hills, Meghalaya, 9.xi.1978, Coll. S. K. Chanda ; 4 ♀♀, 1 ♂ ; Garo hills, Meghalaya, 17.xi.1973, Coll. S. Biswas ;

2 ♀ ♀ ; Ambassa, Tripura, 18.1.1971, Coll. V. C. Agarwal ; 2 ♀ ♀ , Serchip, Mizoram, 7.xi.1976, Coll. K. R. Rao ; 2 ♀ ♀ ; Kohima, Nagaland, 4.x.1976, Coll. S. G. Patil.

Diagnosis : Dorsally varying from olive to greyish brown with dark markings which extends from between the eyes backwards and widening posteriorly. Occasionally there are some longitudinal lines present on each of these markings. Sometimes a dark brown streak running behind the eyes up to shoulder. Limbs with incomplete dark cross bars. Ventral surface uniformly coloured. Skin smooth, sometimes with small tubercles on the dorsal surface. Ventrally almost smooth.

Head : Broader than long ; snout obtusely pointed, projecting slightly beyond lower jaw ; canthus rostralis obtuse ; nostrils closer to tip of snout than to eyes ; internarial space is equal to interorbital width which is less than diameter of eyes ; tympanum hidden.

Forelimbs : Slender, moderately long ; fingers free ; tips of fingers dilated into small discs ; first finger shorter than second ; third finger longest, longer than snout ; subarticular tubercles small and prominent.

Hindlimbs : Long ; tibiotarsal articulation reaching slightly in front of shoulder ; heels overlapping when hindlimbs folded at right angles to body ; tibia two and half times as long as broad, half the length from snout to vent ; toes with only rudiment of web ; tips of toes dilated into very small discs ; subarticular tubercles small and prominent ; an oval inner metatarsal tubercle present ; outer metatarsal tubercle absent.

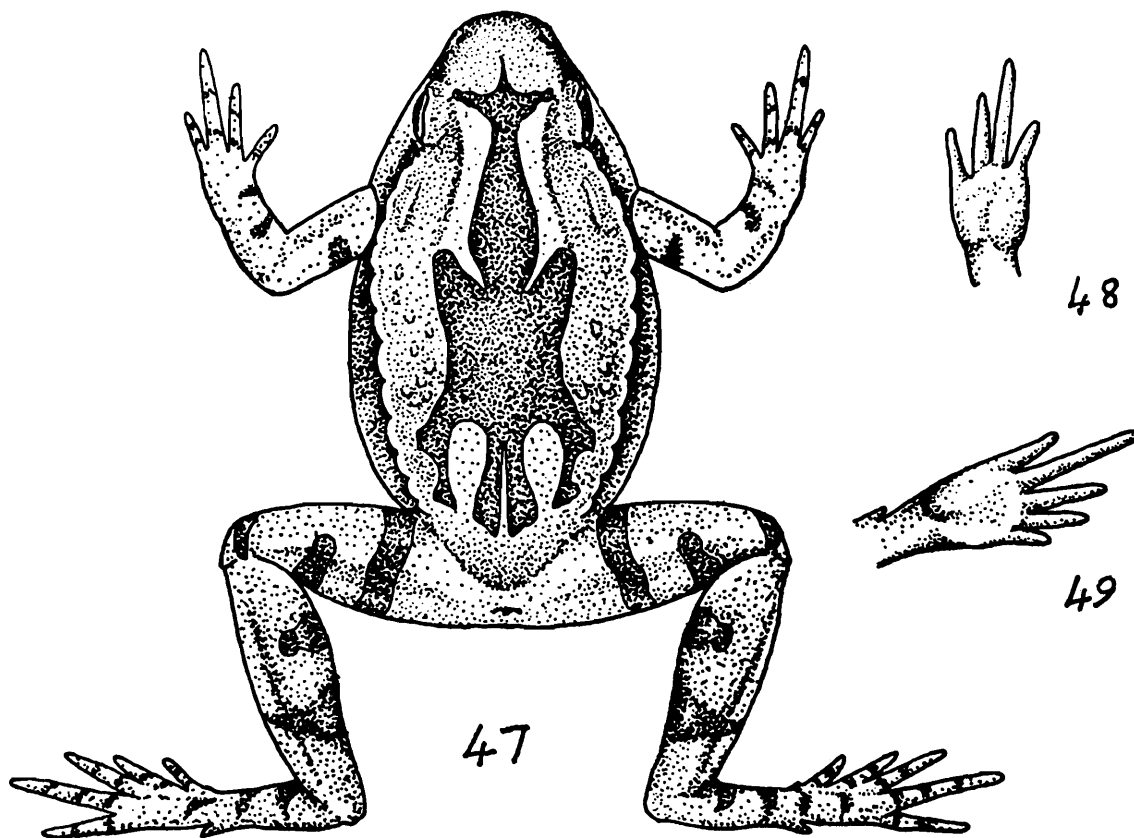
Measurements in mm : From snout to vent : 22.0-25.0 ; head : 5.5-6.0 ; width of head : 7.0-8.0 ; snout : 3.0-3.5 ; eye : 3.0-3.5 ; interorbital width : 2.0-2.5 ; forelimb : 10.0-11.0 ; first finger : 1.5-1.9 ; second finger : 2.0-2.5 ; third finger : 3.5-4.0 ; hindlimb : 35.5-38.0 ; tibia : 11.0-12.5 ; foot : 10.5-11.5 ; third toe : 8.0-8.5 ; fourth toe : 11.0-12.0 ; fifth toe : 8.0-9.0.

Distribution : India (West Bengal, Assam, Meghalaya, Mizoram, Nagaland, Manipur, Tripura, Kerala) ; Sri Lanka ; China ; Indo-China ; Malaysia.

Remarks : This species was originally recorded from Malabar coast of South India (Dumeril & Bibron, 1841). Subsequently it was recorded from Sri Lanka, China, (Ferguson, 1904, McCann, 1940, Thurston, 1888). Pillai & Chanda (1981) recorded the species for the first time from Garo hills, Meghalaya. During the present work the author recorded it for the first time from Mizoram.

12. *Microhyla rubra* (Jerdon)

(Figs. 47-49)

1853. *Engystoma rubra* Jerdon, *J. Asiat. Soc. Beng.*, 22 : 534.1858. *Diplopelma ornatum* Gunther, *Cat. Bat. Sal. Brit. Mus.*, London : 50.1890. *Microhyla rubra* Boulenger, *The Fauna of British India Reptila and Batrachia*, : 491.1955. *Microhyla rubra* Kirtisinghe, *The amphibia of Cylon* : 92.1985. *Microhyla rubra* Frost, *Amphibian species of the world* : 388.*Type locality* : "The Carnatic" Southern India.*Location of type* : Not known.

Figs. 47-49 : 47, *Microhyla rubra* (Dorsal view) ; 48, Forelimb (Ventral view) ; 49, Hindlimb (Ventral view).

Material examined : 1 ♀, Kaziranga, Assam, 24.xi.1972, Coll. G. M. Yazdani ; 2 ♀ ♀, Kohima, Nagaland, 4.x.1976, Coll. K. R. Rao.

Diagnosis : Dorsally light brown to pinkish brown in colour. Belly white, throat

spotted with brown. Dorsal skin nearly smooth. Sometimes numerous small warts present. A raised median line usually present along the dorsum. A glandular fold extending dorso-laterally from the posterior corner of eye to the groin.

Head : Broader than long ; snout prominent, blunt and as long as the diameter of eye ; Interorbital width nearly twice the diameter of eye ; tympanum hidden.

Forelimbs : Moderately long ; fingers free ; first finger shorter than second. Tips of fingers rounded.

Hindlimbs : Long ; tibiotarsal articulation reaching the eye ; heels overlapping when hind limbs folded at right angles to body ; toes nearly one-third webbed ; subarticular tubercles prominent ; a semicircular outer and a crescentic inner metatarsal tubercle present.

Measurements in mm : From snout to vent : 28.0-30.0 ; head : 5.6-6.2 ; width of head : 7.2-8.0 ; snout : 3.1-3.6 ; eye : 3.1-3.6 ; forelimb : 10.2-11.1 ; first finger : 1.6-2.0 ; second finger : 2.0-2.4 ; third finger : 3.6-4.2 ; hindlimb : 36.5-39.0 ; tibia : 11.2-12.3 ; foot : 10.6-11.7 ; third toe : 8.1-8.6 ; fourth toe : 11.1-12.2 ; fifth toe : 8.1-9.2.

Distribution ; India (Assam, Kerala, Nagaland, Tamil Nadu, West Bengal) ; Sri Lanka.

Remarks : This species was originally recorded from Southern India (Jerdon, 1854). Subsequently it was recorded from Assam. During the present study the author collected it from Nagaland.

Genus : *Uperodon* (Dum & Bibron, 1841)

1841. *Uperodon* Dumeril & Bibron, *Erp. Gen* , 8 : 749.

1890. *Cacopus* Boulenger, *Fauna Brit. India including Cylon & Burma, Reptilia and Batrachia* , : 495.

1985. *Uperodon* Frost, *Amphibian species of the world* : 391.

Diagnosis : Skin smooth or slightly tuberculated. Tongue oval and free behind. Vomerine teeth absent. Pupil vertical. Tympanum indistinct, sometimes hidden. Choanae very large, with a movable integumentary flap. Fingers free ; toes webbed at the base ; tips of fingers and toes not dilated. Outer metatarsals united. Sternum large, cartilagenous. Diapophysis of sacral vertebrae prominently dilated.

Type species : *Engystoma marmoratum* Cuvier, 1829 (= *Rana systoma* Schneider).

Distribution : India.

Remarks : Only two species of this genus viz., *Uperodon globulosum* (Gunther) and *Uperodon systoma* (Schneider) are known from the world. Both of them are endemic to

Indian region and *Uperodon globulosum* (Gunther), has only been recorded from northeast India.

13. *Uperodon globulosum* (Gunther)
(Figs. 50-52)

1864. *Cacopus globulosum* Gunther, *Rept. Brit. India* : 416.
1934. *Uperodon globulosum* Parker, *Mon. Micro.*, : 76.
1981. *Uperodon globulosum* Bhaduri & Saha, *J. Bombay nat. Hist. Soc.*, 77: 151-152.
1985. *Uperodon globulosum* Frost, *Amphibian species of the world* : 391.

Type locality : Russelconda, Orissa, India.

Location of type : British Museum (Natural History) England.

Material examined : 2 ♂♂, Manas wild life sanctuary, Assam, 14.vi.1975, Coll. S. S. Saha ; 3 ♀♀, Jhalukbari, Guwahati, Assam, 7.iii.1977, Coll. S. K. Chanda.

Diagnosis : Dorsally brown or spotted with dark or light brown. Ventrally white. Limbs resemble the colour of dorsum. Ventrally distal parts of fore and hindlimbs white. Skin smooth or slightly tuberculated on the dorsum. Ventrally smooth.

Head : Broader than long ; snout obtusely pointed, projecting slightly beyond mouth ; canthus rostralis moderately prominent ; loreal region flat ; nostrils much closer to tip of snout than to eyes ; internarial distance slightly less than interorbital width, which is equal to eyes ; tympanum hidden.

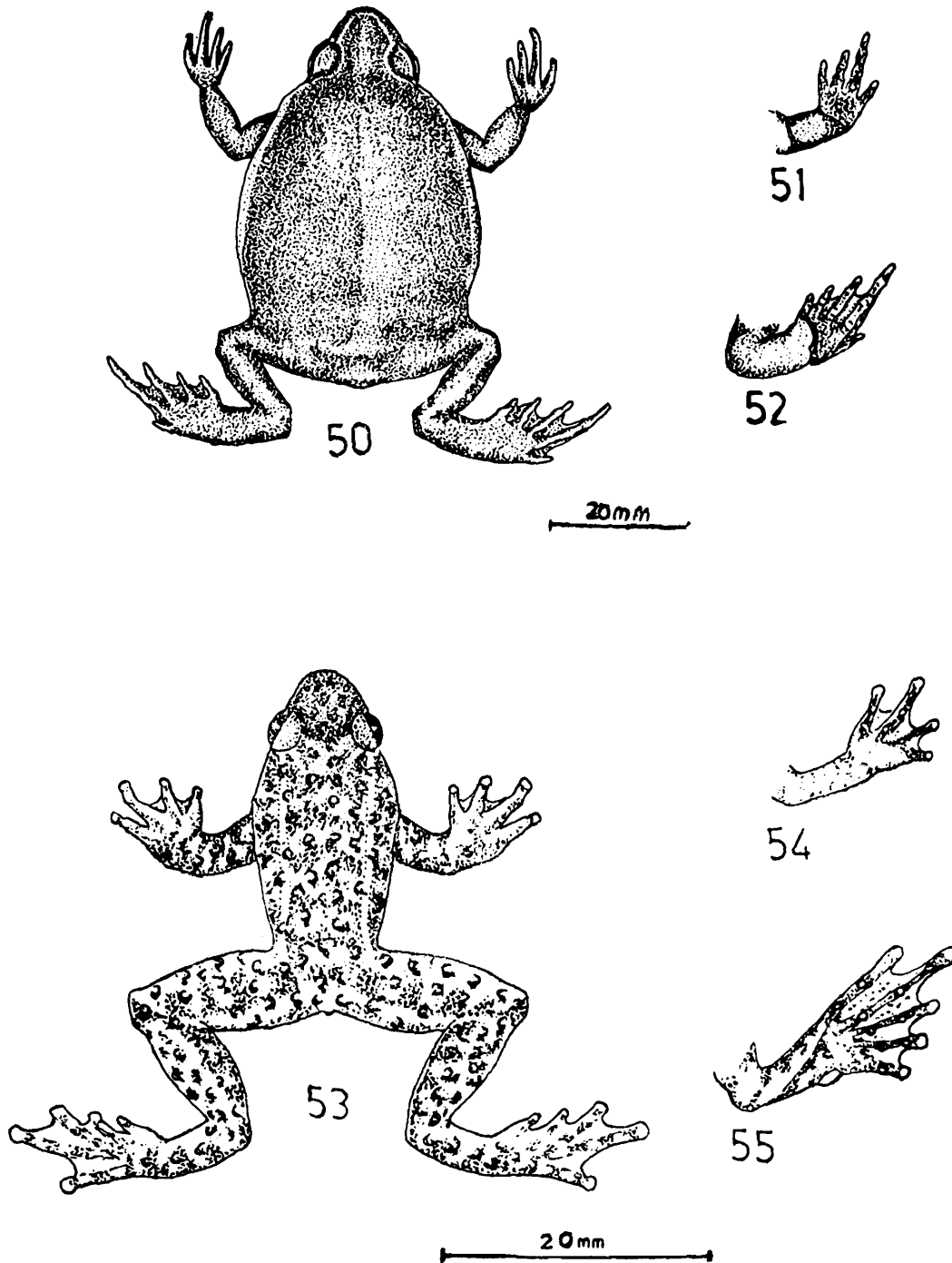
Forelimbs : Moderately long, less than half of total length of head and body ; fingers moderately long, free, without any discs ; first finger a little shorter than second ; third finger longest, slightly smaller than snout.

Hindlimbs : Short ; tibiotarsal articulation reaching the junction of the forelimbs with body ; heels not meeting when hindlimbs folded at right angles to body ; tibia two to two and half times as long as broad ; nearly one-fifth the length of snout to vent ; toes moderately long, free, without any discs ; inner metatarsal tubercle large, prominent and significantly larger than second toe.

Measurements in mm : From snout to vent : 52.0-54.0 ; head : 7.8-8.0 ; width of head : 8.8-9.0 ; snout : 5.0-5.5 ; interorbital width : 4.8-5.0 ; eye : 4.8-5.0 ; forelimb : 18.5-18.9 ; first finger : 2.8-3.0 ; second finger : 3.8-4.0 ; third finger : 4.8-5.0 ; hindlimb : 28.0-28.5 ; tibia : 10.8-11.0 ; foot : 12.8-13.0 ; third toe : 5.7-6.0 ; fourth toe : 9.2-9.5 ; fifth toe : 8.0-8.5.

Distribution : India (Assam, West Bengal, Orissa, Madhya Pradesh, Gujarat, Maharashtra).

Remarks : There are two valid species of this genus in the world and both are endemic to Indian region. Out of these *U. systoma* (Schneider), has been recorded from



Figs. 50-55 : 50, *Uperodon globulosum* (Dorsal view); 51, Forelimb (Ventral view); 52, Hindlimb (Ventral view); 53, *Micrixalus borealis* (Dorsal view); 54, Fore limb (Ventral view); 55, Hindlimb (Ventral view).

Agra and Allahabad in the Gangetic plains and also in Kerala and Tamil Nadu. On the other hand, *U. globulosum* (Gunther) has a much wider distribution being recorded from West Bengal (Daniel, 1963), Orissa, Madhya Pradesh, Gujarat, Maharashtra (Boulenger, 1890) as well as from northeast India. The remarks by Bhaduri and Basu (1956) regarding the possible occurrence of this species in Assam has been fully borne out by the recent finding of this species from Assam by Bhaduri & Saha (1980). During the present study the author collected the species for the second time from Assam.

Family : RANIDAE

Diagnosis : Upper jaw toothed, lower one nearly always toothless. Diapophyses of sacral vertebra cylindrical or slightly dilated. In most species of this family, the fingers are perfectly free, but the toes are more or less completely webbed. Foot may be provided with one or more metatarsal tubercles which may be blunt, sharp or shovel-shaped and adapted for digging. Terminal Phalanges of fingers and toes of various shapes and sizes. Omosternum and sternum with or without bony style. Vertebrae procoelous. Ribs absent.

Type genus : *Rana* Linnaeus, 1758.

Distribution : Eurasia ; Africa ; North and South America ; Australia.

Remarks : Out of 39 genera of this family known from the world, only ten genera have so far been recorded from Indian region and of these four genera are known to occur in northeast India,

Key to the genera of *Ranidae* of northeast India

- | | | | |
|--|-----|-----|-------------------------------------|
| 1. Vomerine teeth absent ; tympanum indistinct, sometimes hidden | ... | ... | <i>Micrixalus</i> Boulenger. |
| Vomerine teeth present | ... | ... | 2 |
| 2. Tips of fingers and toes with circum-marginal groove | ... | ... | <i>Amolops</i> Cope. |
| Tips of fingers and toes simple, without any groove | ... | ... | 3 |
| 3. Large flap of skin present on each lateral side of the body and inner side of thigh ; pupil horizontally oval | ... | ... | <i>Pterorana</i> Kiyasetuo & Khare, |
| Flap of skin absent on the lateral side of the body ; pupil horizontal | ... | ... | <i>Rana</i> Linnaeus, |

Genus : *Micrixalus* Boulenger, 18881888- *Micrixalus* Boulenger, *Proc. zool. Soc. Lond.*, : 204.1981. *Micrixalus* Dubois, *Mont. zool. Italiano.*, 13 : 244.1985. *Micrixalus* Frost, *Amphibian species of the world* : 460.

Diagnosis : Skin with warts and tubercles. Tongue bifid and free behind. Vomerine teeth absent. Pupil horizontally rounded. Tympanum indistinct, sometimes hidden. Fingers free, toes three-fourth webbed ; tips dilated into small distinct round discs with circum-marginal groove. Outer metatarsals separated by web.

Type species : *Ixalus fuscus* Boulenger, 1882.

Distribution : India (Northeast India, South India).

Remarks : A total of 15 species of this genus are known from the world (Frost, 1985), of which seven species are known from Indian region (Inger & Dutta, 1986) and out of them only one species has been found to occur in northeast India.

14. *Micrixalus borealis* Annandale

(Figs. 53-55)

1912. *Micrixalus borealis* Annandale, *Rec Indian Mus.*, 8 : 10-12.1978. *Micrixalus borealis* Pillai, *Proc. Indian. Acad. Sci.*, 87 B (Animal Sciences-2), (6) : 176.1985. *Micrixalus borealis* Frost, *Amphibian species of the world* : 461.

Type locality : "Rotung" Arunachal Pradesh, northeast India.

Location of type : National Zoological collection, Zoological Survey of India, Calcutta, India.

Material examined : 1 ex. ; ♀ ; Rotung, Abor hills, Arunachal Pradesh, 9.i.1912, Coll. S. W. Kemp.

Diagnosis : Dorsally dark brown to black ; a dark interorbital cross-bar usually present ; limbs and digits with dark bands.

Ventral surface yellowish, throat and chin purple brown ; ventral surface of hands, feet and thighs powdered with brown ; belly spotted with black dots. Dorsal surface of skin warty ; ventral surface almost smooth.

Head : Short, broad, triangular, not depressed ; snout blunt, convex at the top ; canthus rostralis rounded ; loreal region not concave but sloping outwards and downwards ;

eyes large and not very prominent ; interorbital width slightly broader than eyes ; tympanum hidden ; a prominent fold running backwards and downwards from the eyes to a point slightly behind the interorbital region ; prominent tooth present at the apex of the lower jaw ; vomerine teeth absent ; choanae situated far forward ; an internal vocal pouch present in the male.

Forelimbs : Short ; fingers short ; first finger slightly shorter than second ; discs of fingers very small, distinct ; a rudiment of web evident between the fingers ; subarticular tubercles fairly large.

Hindlimbs : Long ; tibiotarsal articulation reaching eyes ; toes slender, discs of toes small, bearing groove ; almost fully webbed but not quite reaching the discs of first and fifth toes ; subarticular tubercles moderately prominent ; tibia three to four times as long as broad, more than half the length of snout to vent ; inner metatarsal tubercle prominent ; outer metatarsal tubercle absent.

Measurements in mm : From snout to vent : 25.0 ; head : 10.5 ; width of head : 11.0 ; snout : 4.5 ; eye : 4.0 ; interorbital width : 5.0 ; fore limb : 21.0 ; first finger : 3.0 ; second finger : 4.5 ; third finger : 6.5 ; hind limb : 55.0 ; tibia : 15.5 ; foot : 16.0 ; third toe : 8.0 ; fourth toe : 11.0 ; fifth toe : 8.0.

Distribution : India (Arunachal Pradesh).

Remarks : This species is so far known only from the type, collected from Rotung, Arunachal Pradesh (Annandale, 1912). During the present work efforts were made to collect it from the same area but did not yield any result. Annandale (1912) described the species on the basis of 10 examples but only one example could be traced in the type collection. The author compared Annandale's original description with the type and found insignificant variation. Measurements of body parts taken from the type have been incorporated here as these were not mentioned in his earlier description (Annandale, 1912). Out of seven species of the genus *Micrixalus* hitherto known from India, six are from Western Ghats of South India (Boulenger, 1890, Myers, 1942) and one from Arunachal Pradesh of northeast India.

Genus : *Amolops* Cope, 1865

1865. *Amolops* Cope, *Nat. Hist. Rev.* (N. S.), 5 : 97.

1981. *Amolops* Dubois, *Mont. zool. Italiano.*, 13 : 237.

1985- *Amolops* Frost, *Amphibian species of the world* : 452.

Diagnosis : Skin smooth, sometimes tuberculated. Tongue, bifid, free. Vomerine teeth present, Pupil horizontal. Tympanum distinct. Parotoid gland absent, Fingers

free ; toes more or less webbed. Tips of fingers and toes dilated into distinct discs with crescentic or horse-shoe shaped groove, separating upper from the lower surface. Outer metatarsal separated at the base. Omosternal style forked at the base, sometimes with a notch. Terminal phalanges with feeble transverse expansion. Males having gular pouches.

Type species : *Polypedates afghana* Gunther, 1858.

Distribution : India ; Burma ; China.

Remarks : 24 species of this genus are known from the world ; only three species occur in the Indian region and out of these, two species have been recorded in northeast India.

Key to the species of *Amolops* of northeast India

Tibiotarsal articulation extending beyond tip of snout ; interorbital width less than upper eyelid ; subarticular tubercles large and prominent ... *afghanus* (Gunther).

Tibiotarsal articulation reaching nostril or tip of snout ; interorbital width equal to upper eyelid ; subarticular tubercles moderate *formosus* (Gunther).

15. *Amolops afghanus* (Gunther)

(Figs. 56-58)

1858, *Polypedates afghanus* Gunther, *Cat. Bat. Sal. Brit. Mus.*, London : 160.

1920. *Rana latopalmata* Boulenger, *Rec. Ind. Mus.*, 20 : 217.

1979. *Amolops afghanus* Pillai & Chanda, *Rec. zool. Surv. India*, 75 : 387.

1985. *Amolops afghanus* Frost, *Amphibian species of the world* : 453.

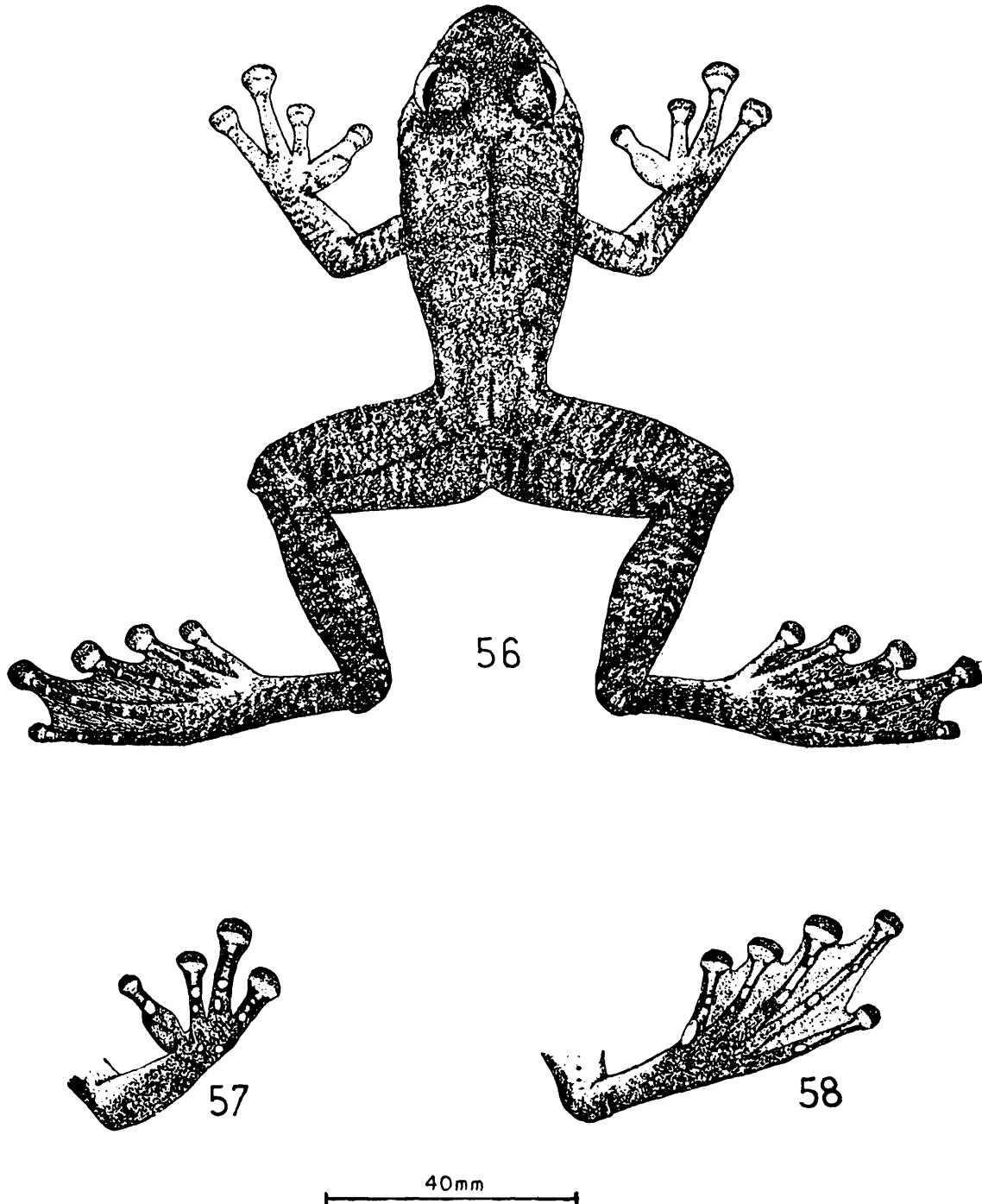
Type locality : "Afghanistan" -?

Location of type : British Museum (Natural History), London.

Material examined : 6 ♀ ♀ ; 4 ♂ ♂, Cherrapunjiae, Khasi hills, Meghalaya, 20.x.1921, Coll. S. L. Hora ; 1 ♂, Shillong, Khasi hills, Meghalaya, 20.1.1969, Coll. R. S. Pillai ; 2 ♂ ♂, Cherrapunjiae, Khasi hills, Meghalaya, 27.x.1977, Coll. S. K. Chanda ; 2 ♀ ♀, Siju Cave, Garo hills, Meghalaya, 7.iii.1965, Coll. A. S. Rajagopal ; 2 ♀ ♀, Barapathar, Assam, 9.iv.1976, Coll. A. K. Sahu ; 2 ♂ ♂, Serchip, Mizoram, 7.x.1976, Coll. K. R. Rao ; 2 ♀ ♀, Subal Singh, Tripura, 24.viii.1978, Coll. S. K. Chanda.

Diagnosis : Dorsally dark olive to brown, ventrally slightly yellowish. Both fore-and

hindlimbs with dark cross bars. Skin smooth any very often with large warts on sides. A faint glandular fold present just above the tympanum. Belly and hinder parts of thighs slightly granulated.



Figs. 56-58: 56, *Amolops afghanus* (Dorsal view); 57, Forelimb (Ventral view); 58, Hindlimb (Ventral view).

Head : Slightly broader than long, depressed ; snout projecting slightly beyond lower jaw ; canthus rostralis prominent, concave ; nostrils equidistant from eyes and tip of snout ; interorbital width slightly less than upper eyelid ; tympanum distinct, small and nearly one-third diameter of eye, separated from the latter by a space about its own diameter ; vomerine teeth prominent, large, slightly oblique in position, much nearer to each other than choanae.

Forelimbs : Short, strong and stout ; fingers long, free with prominent dermal boarder and large discs which are much larger than tympanum and also with prominent well developed grooves separating upper from lower surface ; a prominent well developed pad present on inner side of first finger which is about one and a half time of snout ; first finger nearly equal to second ; third finger longest, longer than snout ; subarticular tubercles large and prominent.

Hindlimbs : Long ; tibiotarsal articulation reaching beyond tip of snout ; tibia four to four and half times as long as broad, half the length of snout to vent ; toes having large discs with prominent well developed grooves separating upper from lower surface ; fully webbed ; subarticular tubercles large and prominent ; a narrow, elliptical, flat inner metatarsal tubercle present ; outer tubercle absent.

Measurements in mm : From snout to vent : 54.5-63.0 ; head : 15.0-19.0 ; width of head : 18.0-21.0 ; snout : 3.5-4.5 ; eye : 6.5-7.0 ; interorbital width : 5.0-5.5 ; tympanum : 2.0-2.5 ; forelimb : 35.0-39.5 ; first finger : 8.0-10.0 ; second finger : 8.5-11.5 ; third finger : 10.5-13.5 ; hindlimb : 39.0-39.5 ; tibia : 27.0-31.0 ; foot : 25.0-27.0 ; third toe : 16.0-17.5 ; fourth toe : 22.0-23.5 ; fifth toe : 16.0-17.5.

Distribution : India (Assam, Arunachal Pradesh, Meghalaya, Mizoram, Tripura, West Bengal) ; Nepal ; Burma ; China.

Remarks : This species was previously recorded from West Bengal, Meghalaya, Assam and Arunachal Pradesh (Daniel, 1962, Pillai & Chanda, 1979, Boulenger, 1920, Annandale, 1912). During the present work the author recorded it for the first time from Mizoram and Tripura of northeast India.

16. *Amolops formosus* (Gunther)

1875. *Polypedates formosus* Gunther, *Proc. zool. Soc.*, London : 570.
 1920. *Rana formosa* Boulenger, *Rec. Indian Mus.*, 20 : 220.
 1981. *Amolops formosus* Dubois, *Paleogeographie et biogeographie de L' Himalaya et du sous-continent Indien*, Paris, C. N. R. S., Cahiers nepalais, : 72.
 1985. *Amolops formosus* Frost, *Amphibian species of the world* : 453.

Type locality : Khasi hills, Meghalaya, India.

Location of type : British Museum (Natural History), London.

Material examined : None.

Diagnosis : Dorsally bright green with blackish spots on the head and body. Limbs with cross bands. Posterior part of thigh marbled with black. Lower parts and web between the toes whitish to brown. Dorsal skin smooth ; a glandular fold present above the tympanum ; belly granulated. Males with internal vocal sac ; during breeding season a thick pad found on the inner side of the first finger.

Head : Slightly broader than long, much depressed ; vomerine teeth in oblique series, just on the posterior level of choanae, much nearer to each other than choanae ; snout rounded, slightly projecting beyond mouth ; canthus rostralis obtuse ; loreal region feebly oblique, concave ; nostrils equidistant from eyes and tip of snout ; tympanum not very distinct, one-third diameter of eye.

Forelimbs : Fingers very long ; discs very large with prominent grooves separating upper from the lower surface ; first finger shorter than second, third finger longest, more than twice of snout ; subarticular tubercles moderate.

Hindlimbs : Long ; tibiotarsal articulation reaching beyond nostril or tip of snout ; heels strongly overlapping when hindlimbs folded at right angles to body ; tibia four to five times as long as broad, more than half the length of snout to vent ; toes with swollen tips like fingers but considerably smaller ; entirely webbed, webs rather deeply notched but involving the base of the discs ; outer metatarsals separated at the base ; subarticular tubercles moderate ; inner metatarsal tubercle oval, flat, one-third to one-fifth the length of inner toe ; outer metatarsal tubercle absent.

Measurements in mm : From snout to vent : 53·0-75·0 ; head : 19·0-23·0 ; snout : 6·0-8·0 ; width of head : 20·0-24·0 ; eye : 6·0-8·0 ; interorbital width : 4·0-6·0 ; Tympanum : 2·0-3·0 ; fore limb : 41·0-56·0 ; first finger : 7·0-10·0 ; second finger : 9·0-12·0 ; third finger : 15·0-18·0 ; fourth finger : 10·0-12·0 ; hind limb : 96·0-125·0 ; tibia : 32·0-41·0 ; foot : 31·0-40·0 ; third toe : 17·0-22·0 ; fourth toe : 23·0-34·0 ; fifth toe : 18·0-26·0.

Distribution : India (Meghalaya) ; Nepal.

Remarks : Although this species was originally recorded from Meghalaya, northeast India, several surveys made by the author during the present study in and around Meghalaya did not yield any result. Descriptions based on Boulenger (1920).

Genus : **Pterorana** Kiyasetuo & Khare, 1986

1986. *Pterorana* Kiyasetuo & Khare, *Asian J. Expl. Sci.*, 1 : 12-17.

Diagnosis : Skin of dorsum coarsely granular. Belly smooth. Dorsolateral ridge distinct. Large flap of skin on lateral side of the body and inner side of the thighs. Vomerine and maxillary teeth present. Pupil horizontally oval. Tympanum distinct, half the diameter of eye. Fingers free ; toes webbed. Fingers and toes with discs. First finger longer than second finger. Tibiotarsal articulation reaching snout level. Colour of dorsum dark slate brown. Belly white.

Type species : *Pterorana khare* Kiyasetuo & Khare, 1986.

Distribution : India (Kohima, Nagaland, Northeast India).

Remarks : This genus was erected on the basis of two examples from Nagaland, northeast India Kiyasetuo & Khare (1986).

17. **Pterorana khare** Kiyasetuo & Khare, 1986

(Figs. 59-61)

1986. *Pterorana Khare* Kiyasetuo & Khare, *Asian J. Expl. Sci.*, 1 : 12-17.

Type locality : Kohima, Nagaland, Northeast India.

Location of type : Zoological Survey of India, Eastern Regional station, Shillong, India.

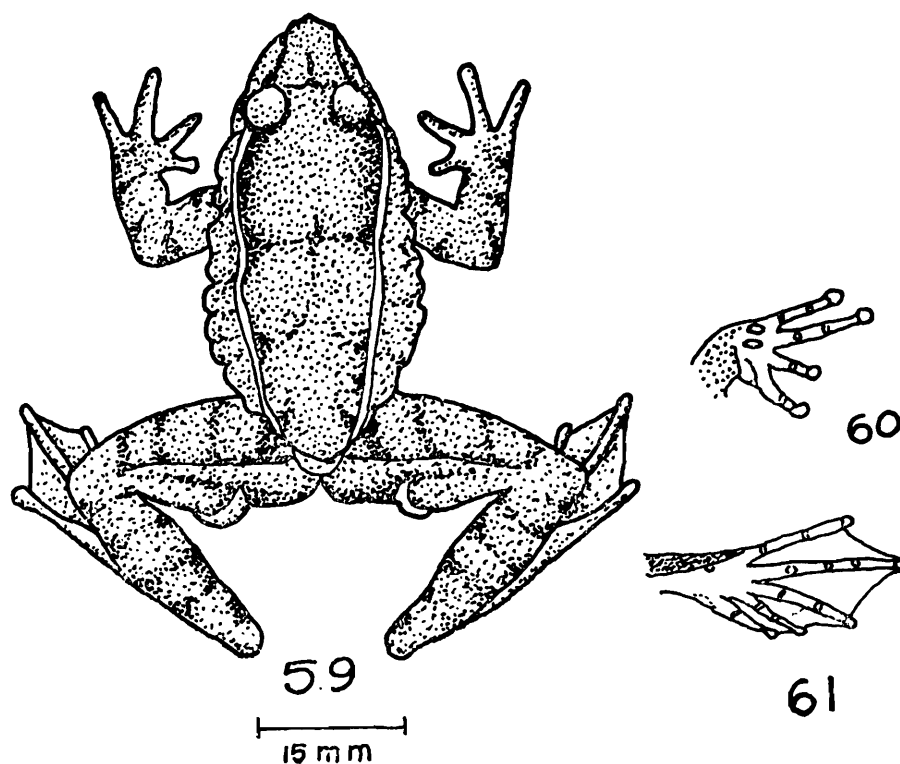
Material examined : 1 ♀, Loc. Sanuoru river, Kohima, Nagaland, 1.x.1983, Coll. Kiyasetuo ; 1 ♀, Loc. Rukhroma river, Kohima, Nagaland, 15.v.1984, Coll. Kiyasetuo.

Diagnosis : Dorsally slate dark brown. Belly white. Skin of dorsum coarsely granulated. Belly smooth. A large glandular tubercle at the angle of jaws. A distinct dorsolateral ridge runs from eye to hind part of the body. The lateral sides of body have flaps of skin measuring about 13 mm. when spread (at the middle part). Each thigh also has flaps of skin on the inner border measuring about 5 mm when spread. A flap of skin present over the vent.

Head : Longer than broad, greatly depressed. Snout round in dorsal view, truncate in lateral profile, projecting over the mouth. Interorbital and internarial distance shorter than the diameter of eye. Eyes moderately large ; pupil horizontally oval. Tympanum indistinct, round, half the horizontal diameter of eye. Vomerine teeth soft,

small, in oblique series, innerly run from anterior to hinder border of choanae. Upper jaw toothed, lower one toothless. Tongue large, oval and bifid behind.

Forelimbs : Short. Fingers free with fairly equal oblong discs. Subarticular tubercles prominent,



Figs. 59-61: 59, *Pterorana khare* (Dorsal view); 60, Forelimb (Ventral view); 61, Hindlimb (Ventral view).

Hindlimbs : Long; tibiotarsal articulation reaching snout; toes fully webbed; tips of toes dilated into oblong discs; Subarticular tubercles distinct and oval shaped; a large oblong inner and a small circular outer metatarsal tubercle present.

Remarks : This is an endemic, monotypic species of frog of northeast India. Due to the wing like lateral flaps of the skin it has been named *Pterorana* (Ptero—wings, Rana—frog). This is an edible frog among the local tribes. It is nocturnal, found in swift waterfalls among rocks. Sometimes it glides for a considerably long distance, and may be called as 'gliding frog'

Genus : **Rana** Linnaeus, 17581758. *Rana* Linnaeus, *Syst. Nat. ed.*, 10 Holmiae : 210.1890. *Rana* Boulenger, *Fauna Brit. India, including Ceylon and Burma, Reptilia and Batrachia*, : 438.1981. *Rana* Dubois, *Mont. zool. italiana.*, 13 : 249.1985. *Rana* Frost, *Amphibian species of the world* : 510.

Diagnosis : Skin not smooth. Tongue free, deeply notched and bifid behind. Vomerine teeth present (rarely absent), Pupil horizontal. Tympanum distinct, sometimes hidden. Paratoid gland absent. Fingers free ; toes webbed (rarely nearly free). Tips of fingers and toes simple or dilated ; discs without transverse grooves. Outer metatarsals separated by web. No intercalary ossicle between the penultimate and terminal phalanges. Terminal phalanges obtuse or T-shaped. Omosternum and sternum with a bony style.

Type species : *Rana temporaria* Fitzinger, 1843.

Distribution : Cosmopolitan, except in Southern parts of South America, Australia and Newzealand.

Remarks : A total of 280 species have been included in this genus from the world, of which 51 species are known from Indian region and out of them 18 species have been recorded from northeast India.

Key to the species of *Rana* of northeast India

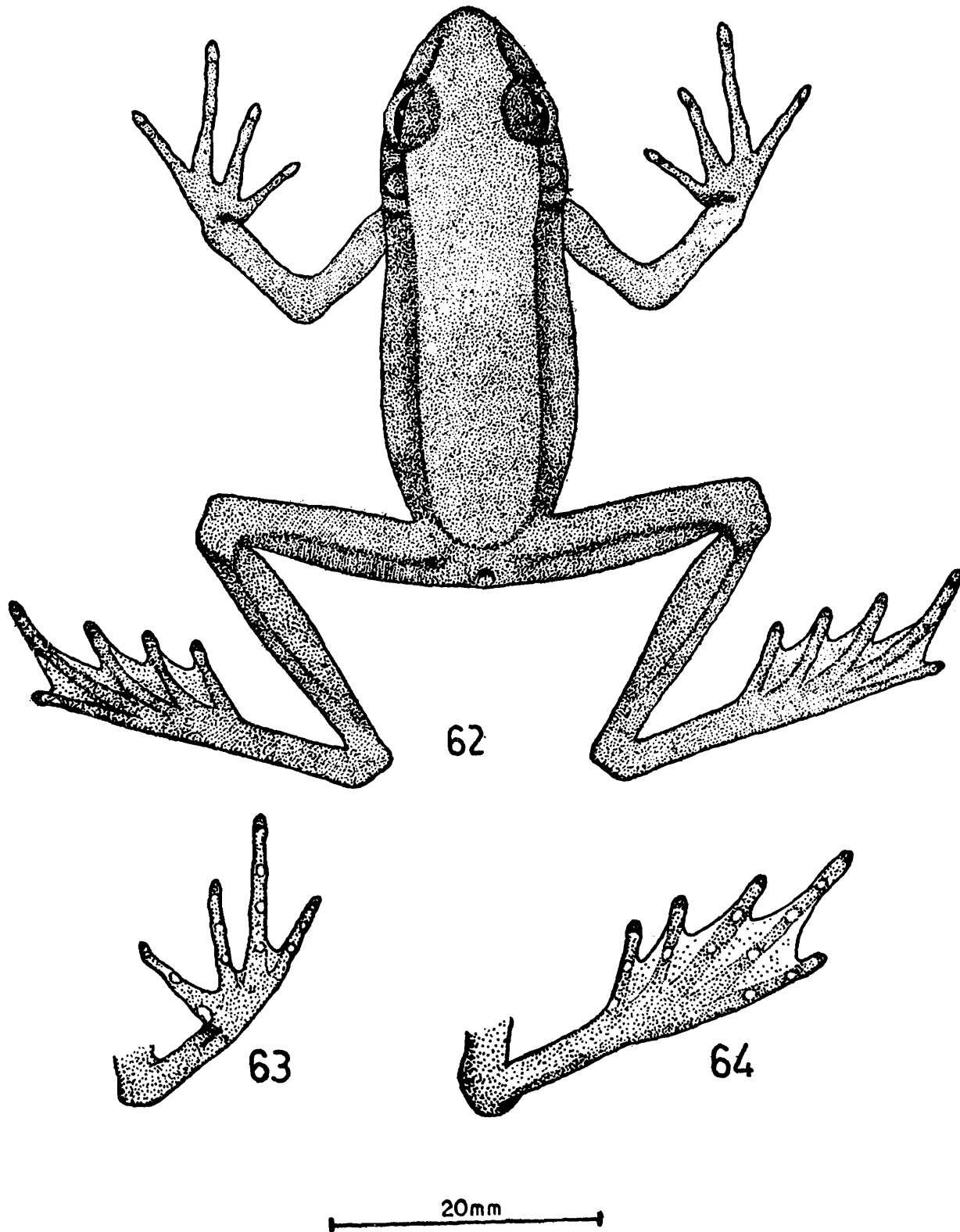
- | | | | |
|---|-----|------------------------------|---|
| 1. Head broader than long | ... | ... | 2 |
| Head as long as broad or longer than broad | ... | ... | 9 |
| 2. Tympanum covered by skin but faintly visible ; shovel-shaped inner metatarsal tubercle present ; outer metatarsal tubercle absent ; nostrils equidistant from eyes and tip of snout | ... | <i>hasiana</i> Boulenger. | |
| Tympanum not covered by skin, distinctly of fairly distinct | ... | ... | 3 |
| 3. Tibiotarsal articulation reaching snout or beyond snout | ... | ... | 4 |
| Tibiotarsal articulation not reaching snout | ... | ... | 6 |
| 4. Nostrils equidistant from eyes and tip of snout ; tibiotarsal articulation reaching tip of snout ; heels strongly overlapping when hind limbs folded at right angles to body ; fingers free ; toes half-webbed ; both inner and outer metatarsal tubercles present | ... | <i>limnocharis</i> Wiegmann. | |

- Nostrils nearer to tip of snout than to eyes 5
 Tympanum distinct, two-third of eyes ; tibiotarsal articulation reaching eyes ; nostrils nearer to tip of snout than to eyes ; first finger longer than second ;
5. Toes fully webbed and with dilated tips ; fingers with rudiment of web ; first and second fingers equal ; inner metatarsal tubercle present, outer metatarsal tubercle absent *assamensis* Sclater.
 Toes three-fourth webbed ; fingers free with swollen tips ; first finger shorter than second ; inner metatarsal tubercle present ; outer metatarsal tubercle absent *laticeps* Boulenger.
6. Toes fully webbed 7
 Toes two-thirds webbed ; tibiotarsal articulation reaching nostril ; tympanum less than half the diameter of eyes ; toes more than two-thirds webbed ; inner metatarsal tubercle present ; outer metatarsal tubercle absent *mawlyndipi* Chanda.
7. Tympanum half the diameter of eyes ; tibiotarsal articulation reaching tympanum ; heels just meeting when hindlimbs folded at right angles to body ; fingers free with rounded tips ; first finger longer than second ; toes with rounded tips... .. *ghoshi* Chanda.
 Tympanum more than half the diameter of eyes 8
8. Tympanum distinct, two-third diameter of eyes ; tibiotarsal articulation reaching between eyes and nostrils ; nostrils equidistant from eyes and tip of snout ; fingers free with minute dermal border except in the fourth ; first and second fingers equal ; inner metatarsal tubercle present, outer metatarsal tubercle absent... .. *cyanophlyctis* Schneider.
 Tympanum distinct, two-thirds of eyes ; tibiotarsal articulation reaching eyes ; nostrils nearer to tip of snout than to eyes ; first finger longer than second ; inner metatarsal tubercle present, outer metatarsal tubercle absent *hexadactyla* Lesson.
9. Head as long as broad 10
 Head longer than broad 15
10. Tibiotarsal articulation reaching eyes or between eyes and nostrils ; fingers free, first finger longer than second ; toes half to two-thirds webbed ; discs of toes with grooves separating upper from the lower surface ; inner and outer metatarsal tubercles present *leptoglossa* (Cope).
 Tibiotarsal articulation reaching snout or beyond snout 11
11. Tympanum one-third of eyes ; tibiotarsal articulation reaching beyond tip of snout ; fingers free with horizontally grooved discs ; toes fully webbed ; inner metatarsal tubercle present, outer metatarsal tubercle absent *gerbillus* Annandale.
 Tympanum half to two-thirds of eyes 12

12. Toes three-fourth webbed ; tympanum less than diameter of eyes ; fingers free ; toes three-fourths webbed ; nostrils equidistant from eyes and tip of snout ; inner metatarsal tubercle present, outer metatarsal tubercle absent ... *mawphlangensis* Pillai & Chanda.
Toes fully webbed 13
13. Outer metatarsal tubercle present ; nostrils nearer to tip of snout than to eyes ; fingers free ; toes fully webbed ; tibia three and half times as long as broad...
... .. *danieli* Pillai & Chanda.
Outer metatarsal tubercle absent 14
14. Tibia two to three times as long as broad, less than half the length of snout to vent ; interorbital width less than half of eyes *tigerina* Daudin.
Tibia four to five times as long as broad, more than half the length of snout to vent ; interorbital width half the diameter of eyes *livida* (Blyth).
15. Tibiotarsal articulation reaching eyes ; toes fully webbed but two terminal phalanges of fourth toe free ; tibia four times as long as broad, half the length of snout to vent ; inner metatarsal tubercle present *bilineata* Pillai & Chanda.
Tibiotarsal articulation reaching snout or beyond snout 16
16. Tympanum half of eyes ; nostrils equidistant from eyes and tip of snout ; fingers free ; toes fully webbed ; both inner and outer metatarsal tubercles present...
... .. *garioensis* Boulenger.
Tympanum half to three-fourths of eyes 17
17. Tympanum three-fourths of eyes : fingers free ; toes fully webbed ; nostrils nearer to tip of snout than to eyes : tibia more than half of snout to vent ; both inner and outer metatarsal tubercles present *alticola* Boulenger.
Tympanum two-thirds of eyes ; fingers free, toes two-thirds webbed ; nostril nearer to tip of snout than to eyes ; tibia five to six times as long as broad, half the length of snout to vent ; inner metatarsal tubercle present, outer metatarsal tubercle absent
... .. *erythraea* Schlegel.

18. *Rana alticola* Boulenger
(Figs. 62-64)

1882. *Rana alticola* Boulenger, *Cat. Bat. Sal. Brit. Mus.*, : 62.
1912. *Rana alticola* Annandale, *Rec. Indian Mus.*, 8 : 8.
1979. *Rana alticola* Pillai & Chanda, *Rec. zool. Surv. India*, 75 : 389.
1985. *Rana alticola* Frost, *Amphibian species of the world* : 480.



Figs. 62-64 : 62, *Rana alticola* (Dorsal view) ; 63, Forelimb (Ventral view) ; 64, Hindlimb (Ventral view).

Type locality : "Shillong", Meghalaya, northeast India and "Moulmein", Tenasserim, Burma.

Location of type : British Museum (Natural History), London.

Material examined : 9 ♀ ♀, Cherrapunjia, Khasi hills, Meghalaya, 3.iii.1960, Coll. J. H. Borne ; 2 ♀ ♀, Myllem, Khasi hills, Meghalaya, 19.vii.1973, Coll. R. S. Pillai ; 8 ♀ ♀, Tura, Garo hills, Meghalaya, 25.x.1973, Coll. S. K. Chanda ; 2 ♂ ♂, Dirak, Assam, 9.xi.1974, Coll. S. K. Chanda ; 2 ♂ ♂, Parathia, Tripura, 19.iii.1983, Coll. S. K. Chanda.

Diagnosis : Dorsally yellowish to light brown. A feebly prominent, narrow, glandular dorsolateral fold running from posterior region of eyes and above the tympanum to hip. Ventrally almost white. Skin smooth. A feebly prominent glandular lateral fold present. Another glandular fold running from the posterior region of tympanum to shoulder.

Head : Longer than broad, depressed ; snout slightly longer than eyes, obtusely pointed, projecting slightly beyond mouth ; canthus rostralis distinct ; loreal region concave ; internarial space slightly less than interorbital width, which is slightly less than eye ; nostrils much closer to tip of snout than to eyes ; tympanum very distinct, dark brown to reddish brown in colour, two-thirds of eyes, separated from the latter by a space about half of tympanic diameter ; vomerine teeth oblique in position between the choanae, equidistant from each other and choanae.

Forelimbs : Short ; fingers long, slender free with horse-shoe shaped discs, separating upper from the lower surface ; first finger slightly longer than second, third longest, much longer than snout ; subarticular tubercles moderately large and prominent.

Hindlimbs : Long, slender ; tibiotarsal articulation reaching beyond tip of snout ; heels strongly overlapping when hindlimbs folded at right angles to body ; tibia five to six times as long as broad, more than half of the length of snout to vent ; toes having small discs like fingers but slightly broader than the latter ; entirely webbed ; two phalanges of fourth toe free ; subarticular tubercles moderately large and prominent ; outer metatarsals separated at the base ; inner metatarsal tubercle small, oval and one-fourth of inner toe ; a small indistinct outer metatarsal tubercle present.

Measurements in mm : From snout to vent : 41.5-54.0 ; head : 15.5-19.5 ; width of head : 12.5-16.5 ; snout : 5.5-7.5 ; eye : 5.0-6.0 ; interorbital width : 4.0-4.5 ; tympanum : 3.6-4.5 ; fore limb : 28.5-37.0 ; first finger : 5.5-6.0 ; second finger : 5.0-5.5 ; third finger : 7.6-9.0 ; hindlimb : 73.5-93.0 ; tibia : 25.5-30.5 ; foot : 21.5-27.5 ; third toe : 11.3-14.5 ; fourth toe : 16.5-22.5 ; fifth toe : 12.5-16.5.

Distribution : India (Meghalaya, Assam, Tripura, West Bengal, Orissa, Andaman) ; Sri Lanka ; Nepal ; China ; Japan ; Indonesia ; Malaysia.

Remarks : This species was originally recorded from Khasi hills, Meghalaya (Boulenger, 1882). This species appears close to *Rana erythraea* (Schlegel). Pillai and Chanda (1979) recorded the species for the second time from Meghalaya following its first record by Boulenger (1882), but otherwise it has been recorded over wide areas in northeast India and Islands of Andaman, besides extralimitally in Southeast Asia. During the present study it has been observed that the adults of this species are extremely rare and nocturnal but their tadpoles are abundantly available.

19. *Rana assamensis* Sclater (Figs. 65-67)

1892. *Rana assamensis* Sclater, *Proc. zool. Soc. London.*, : 343.

1920. *Rana assamensis* Boulenger, *Rec. Indian Mus.*, 20 : 80-82.

1986. *Rana assamensis* Inger & Dutta, *J. Bombay nat. Hist. Soc.*, 83 (Supplement) : 135-146.

Type locality : Khasi hills, Meghalaya, northeast India.

Location of type : Zoological survey of India, Calcutta, India. (Apparently lost).

Material examined : 3 ♀ ♀ , Kurseong, West Bengal, 7.v.1912, Coll. J. Gommie.

Diagnosis : Dorsally yellowish to brown with a brownish temporal band involving tympanum. A faint, dark band present between the eyes. Lips with brownish cross bars. Both fore and hindlimbs with brownish cross bars, Skin smooth. A narrow feebly prominent dorsolateral glandular fold converging on to the anterior part of neck region. Another glandular fold extends from eye to shoulder. Ventral surface almost smooth.

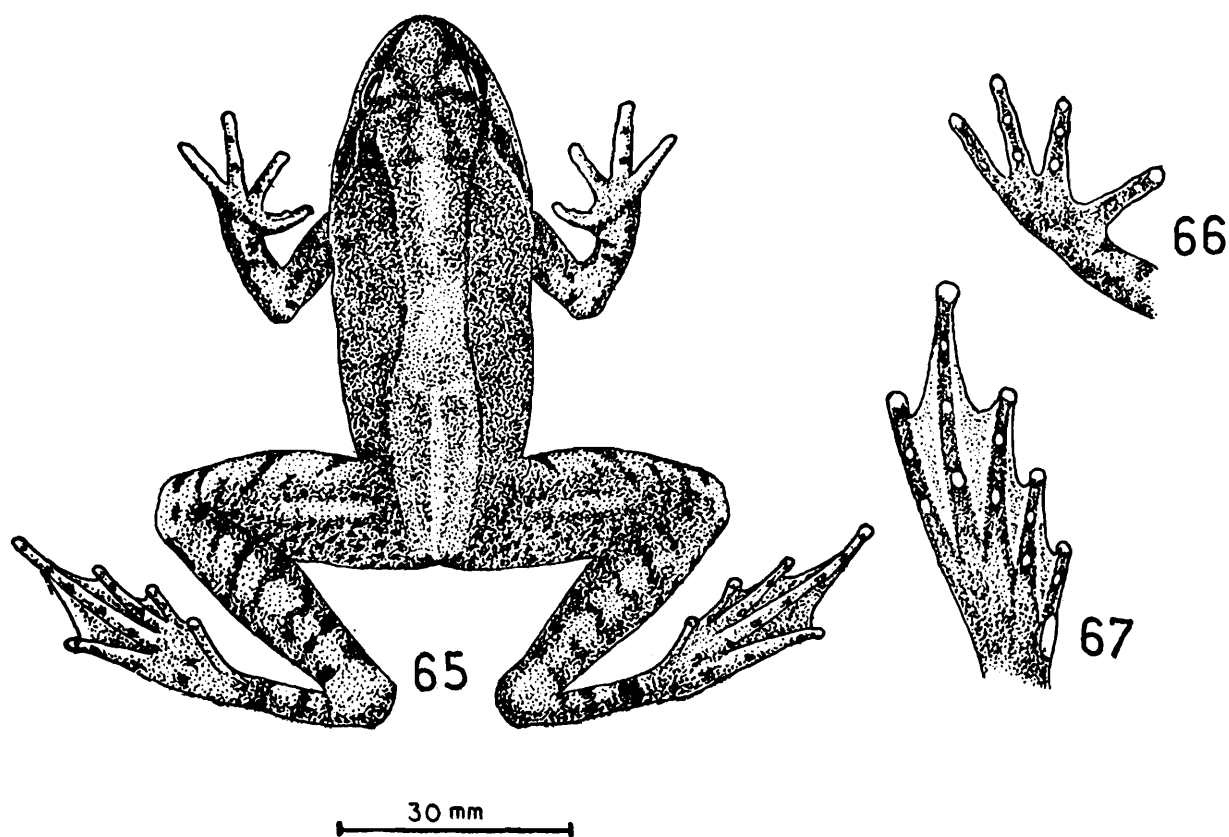
Head : Broader than long, depressed ; snout pointed projecting beyond lower jaw which is much longer than eyes ; canthus rostralis prominent ; loreal region feebly concave ; nostrils nearer to tip of snout than to the eyes ; distance between the nostrils much broader than interorbital width which is nearly half of eyes ; tympanum fairly distinct, half or a little less than half of eyes ; vomerine teeth in oblique series and much nearer to choanae.

Forelimbs : Moderately long ; fingers obtusely pointed, free with rudiment of web ; first and second fingers equal ; third finger longest, longer than snout ; subarticular tubercles prominent.

Hindlimbs : Very long ; tibiotarsal articulation reaching far beyond tip of snout ; heels strongly overlapping, when hindlimbs folded at right angles to body ; tibia three times as long as broad, nearly half or less than half the length of snout to vent ; toes

with dilated tips, entirely webbed; inner metatarsal tubercle present; outer tubercle absent.

Measurements in mm : From snout to vent : 55.0-74.0 ; Length of head : 20.0-24.0 ; width of head : 21.0-26.0 ; snout : 7.0-10.0 ; eye : 6.0-8.0 ; interorbital width : 3.5-4.5 ; tympanum : 3.0-3.5 ; forelimb . 33.5-42.5 ; first finger : 7.0-8.0 ; second finger : 7.0-8.0 ; third finger : 7.5-10.5 ; fourth finger : 7.0-7.3 ; hindlimb : 104.0-125.0 ; tibia : 27.0-35.0 ; foot : 30.0-38.0 ; third toe : 15.0-18.0 ; fourth toe : 24.0-31.0 ; fifth toe : 18.0-23.0.



Figs. 65-67 : 65, *Rana assamensis* (Dorsal view) ; 66, Forelimb (Ventral view) ; 67, Hindlimb (Ventral view).

Distribution : India [West Bengal (Darjeeling dist.), Meghalaya] ; Nepal.

Remarks : This species was erected on the basis of single specimen collected from Khasi hills, Meghalaya, is considered close to *Rana andersoni* (Sclater, 1882).

Annandale (1917) considered *R. assamensis* specifically identical to *R. vicina* but having certain variations specially with regard to the position of vomerine teeth, tympanum

and by the presence of dorsolateral glandular fold. Later he opined that his determination of male of *Rana vicina* should be referred to the male of *R. assamensis*.

Boulenger (1920) examined three specimens of the *assamensis* collected from Darjeeling dist., West Bengal and according to him, in the breeding male there is no thickening of the arms as well as inner fingers. Moreover, there is no spine either on the forelimbs or on chest. Although the type locality of this species is Khasi hills, Meghalaya, intensive collection in and around Meghalaya did not yield any more material. Though the type material was not available during the study, all the three of Boulenger's specimens from Darjeeling were available to the author and after careful study found certain variations in them. For example tympanum is fairly distinct, nostrils closer to tip of snout than to eyes and vomerine teeth nearer to choanae etc. But according to Sclater (1892) and Boulenger (1920), tympanum is very distinct, nostrils equidistant from eyes and tip of snout and vomerine teeth lie exactly between the choanae.

20. *Rana bilineata* Pillai & Chanda

(Figs. 68-70)

1981. *Rana bilineata* Pillai & Chanda, *Rec. zool. Surv. India.*, 79 : 163-166.

1985. *Rana bilineata* Frost, *Amphibian species of the world* : 483.

Type locality : Dainadubi forest, Garo hills, Meghalaya, India.

Location of type : Zoological Survey of India, Eastern Regional Station, Shillong, Meghalaya, India.

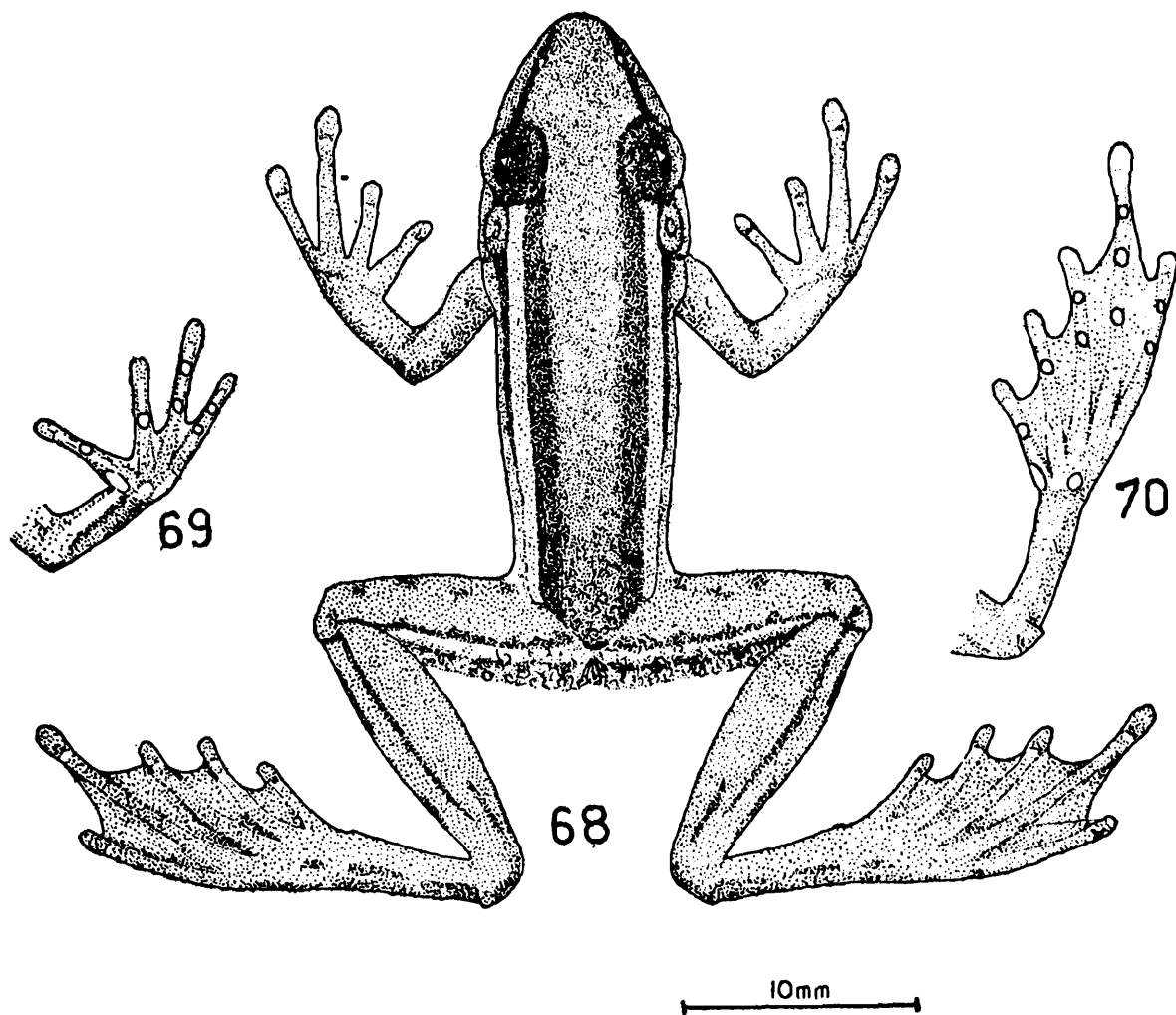
Material examined : 1 ex ♀, Dainadubi, Garo hills, Meghalaya, 8.iv.1971, Coll. R. S. Pillai.

Diagnosis : Dorsum brownish without any spot ; two prominent white lines from behind the eyes to base of thighs, inner edge of the line is deeper brown and the other edge blackish in colour. Another stripe similar to the above one runs from the anterior region of eyes to tip of snout. Longitudinal stripes present on the femur, tibia and tarsus and no trace of transverse markings on the above region. Lower parts almost white. Dorsal skin smooth, faintly tuberculated posteriorly ; white glandular fold present from eyes to groin. Another glandular fold present from the posterior region of eyes which ends in two glandules near shoulder. A faint fold present above tympanum. Belly, breast and throat with white subcutaneous dots.

Head : Longer than broad ; snout rounded, projecting beyond mouth ; canthus rostralis obtuse ; loreal region slightly concave ; nostrils closer to tip of snout than to eyes ;

tympanum distinct, nearly as large as eyes ; vomerine teeth oblique in position situated at the anterior end of choanae.

Forelimbs : Short, thin ; fingers fairly long, free ; tips of fingers dilated into small discs ; first finger slightly shorter than second, third finger longer than snout ; subarticular tubercles prominent.



Figs. 68-70 : 68, *Rana bilineata* (view) ; 69, Forelimb (Ventral view) ; 70, Hindlimb (Ventral view).

Hindlimbs : Long, thin ; tibiotarsal articulation reaching eyes ; heels overlapping when hindlimbs folded at right angles to body ; tibia four times as long as broad, half of the length from snout to vent ; toes entirely webbed except two terminal phalanges of fourth toe free ; tips of toes dilated into small discs ; subarticular tubercles well developed ; both inner and outer metatarsal tubercles present.

Measurements in mm : From snout to vent : 30.0 ; head : 10.0 ; width of head : 9.0 ; snout : 5.0 ; eye : 3.5 ; interorbital width : 3.0 ; tympanum : 3.0 ; forelimb : 15.0 ; first finger : 4.0 ; second finger : 4.5 ; third finger : 6.0 ; fourth finger : 4.5 ; hindlimb : 44.0 ; tibia : 15.0 ; foot : 15.0 ; third toe : 10.0 ; fourth toe : 14.0 ; fifth toe : 10.0.

Distribution : India [Meghalaya (Garo hills)].

Remarks : This species is known only from the Holotype which was erected on a single young frog collected from Garo hills, Meghalaya, Northeast India, (Pillai & Chanda, 1981). Although the type locality of this species is Dainadubi, Garo hills, (Meghalaya) intensive collection in and around the type locality did not yield any more examples.

21. *Rana cyanophlyctis* Schneider (Figs. 71-73)

1799. *Rana cyanophlyctis* Schneider, *Hist. Amph.*, 1 : 137.

1860. *Dicroglossus adolfi* Gunther, *Proc. zool. Soc. Lond.*, : 148-149.

1890. *Rana cyanophlyctis* Boulenger, *Fauna Brit. India including Ceylon and Burma, Reptilia and Batrachia*, : 442-443.

1985. *Rana cyanophlyctis* Frost, *Amphibian species of the world* : 487.

Type locality : "India Orientalis".

Location of type : Not known.

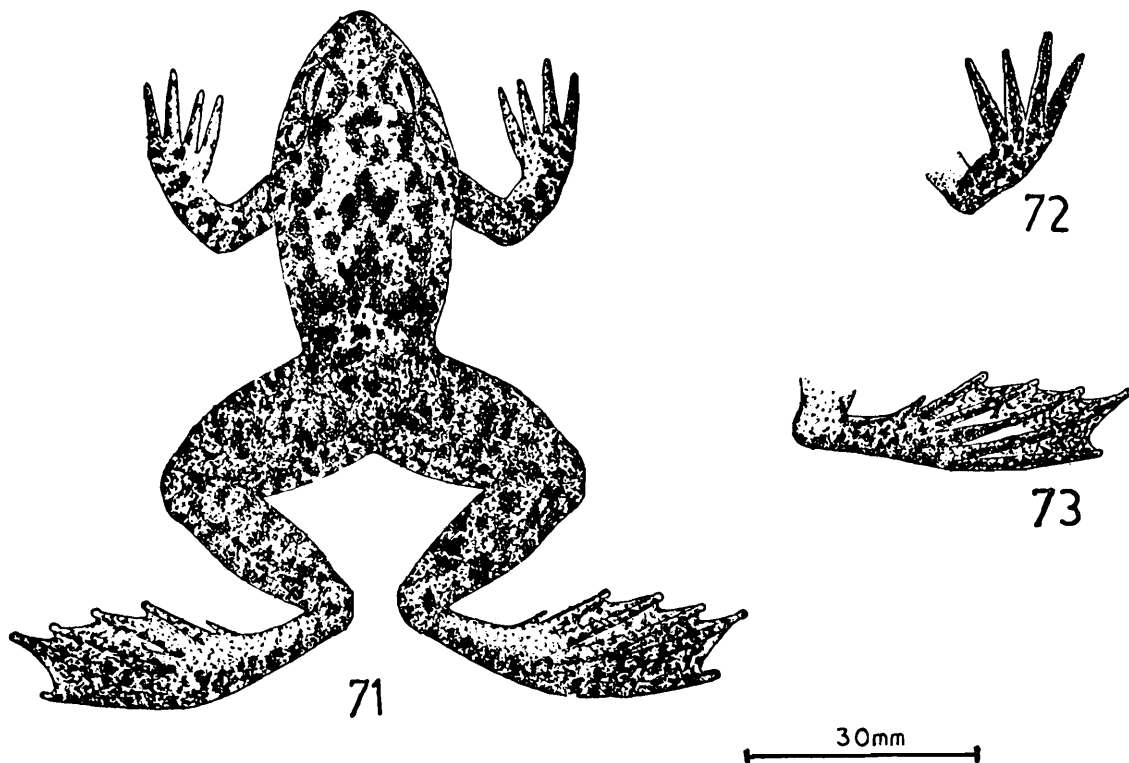
Material examined : 576 examples (398 ♀♀, 178 ♂♂), from Meghalaya, collected during the months January to December in the years 1960-1975, besides a few during the months April to August in 1970-1980 from Assam, Mizoram, Manipur, Arunachal Pradesh and Tripura.

Diagnosis : Colour greyish to brownish above, spotted or marbled with black or dark markings. A more or less prominent, dark, light-edged band present along each flank and on the anterior and posterior parts of thighs but may be absent in some adults. Limbs with incomplete dark bands. Ventral surface white or pale yellowish, speckled with blackish dots. Most young specimens have the ventral surface almost white, without any trace of black markings, while in some, black markings may be present sometimes in the form of a few scattered fine dots. Dorsum with small tubercles and warts and rows of pores. Ventral surface almost smooth.

Head : Slightly broader than long, depressed ; snout pointed, slightly projecting beyond mouth ; canthus rostralis indistinct ; loreal region oblique and concave ; nostrils equidistant from eyes and tip of snout ; internarial space is equal to interorbital width ; tympanum distinct, more than half of eyes, separated from the latter by a space about one-

fourth of tympanic diameter ; vomerine teeth small, oblique in position on a level with the posterior border of choanae, equidistant from each other and from choanae.

Forelimbs : Moderately long ; fingers pointed, free with minute dermal border except in fourth finger ; first and second fingers equal, third finger longest, longer than snout ; subarticular tubercles small and prominent.



Figs. 71-73 : 71, *Rana cyanophlyctis* (Dorsal view) ; 72, Forelimb (Ventral view) ; 73, Hindlimb (Ventral view).

Hindlimbs : Stout, long ; tibiotarsal articulation reaching between eyes and nostril ; heels not meeting when hindlimbs folded at right angles to body ; tibia two and half to three times as long as broad, less than half the length of snout to vent ; toes fully webbed ; tips of toes swollen into small discs ; outer metatarsals separated at the base ; subarticular tubercles small, prominent ; a small, prominent, pointed digitiform inner metatarsal tubercle present ; outer metatarsal tubercle absent.

Measurements in mm : From snout to vent : 44.5-66.5 ; head : 15.5-21.0 ; width of head : 16.5-24.0 ; snout : 5.5-6.5 ; eye : 4.5-6.5 ; interorbital width : 1.5-2.0 ; tympanum : 4.0-4.5 ; forelimb : 24.5-37.5 ; first finger : 6.5-7.5 ; second finger : 6.5-7.5 ; third finger :

7.5-9.5 ; hindlimb : 69.0-93.0 ; tibia : 21.0-28.5 ; foot : 24.5-31.0 ; third toe : 15.5-19.5 ; fourth toe : 20.0-25.0 ; fifth toe : 16.5-20.5.

Distribution : All over India ; Pakistan ; Afghanistan ; South Arabia and Sri Lanka.

Remarks : The present study extends the distribution of the species beyond Assam (Annandale, 1912) and Meghalaya (Pillai & Chanda, 1979). A few of the specimens collected from Meghalaya appears "toad-like" (Pillai & Chanda, 1979). In Meghalaya this species has been found to occur throughout the year, while in Arunachal Pradesh and Tripura it has been recorded only during the breeding season.

22. *Rana danieli* Pillai & Chanda, 1977

(Figs. 74-76)

1977. *Rana danieli* Pillai & Chanda, *J. Bombay nat. Hist. Soc.*, 74 (1) : 136-137.

1985. *Rana danieli* Frost, *Amphibian species of the world* : 488.

Type locality : Mawphlang, Khasi hills, Meghalaya, Northeast India.

Location of type : Zoological Survey of India, Calcutta, India.

Material examined : 1 ex, ♀, Mawphlang, Khasi hills, Meghalaya, 1.xii.1969, Coll. S. Biswas ; 2 exs, ♂♂, Nongkren, Khasi hills, Meghalaya, 20.i.1969, Coll. B. Datta ; 2 ♀♀, Rongren, Garo hills, Meghalaya, 8.ix.1978, Coll. S. K. Chanda ; 2 ♀♀, Namdapha, Arunachal Pradesh, 20.xii.1982, Coll. S. Biswas ; 2 ♂♂, 1 ♀, Guwahati, Assam, 5.vi.1979, Coll. S. K. Chanda.

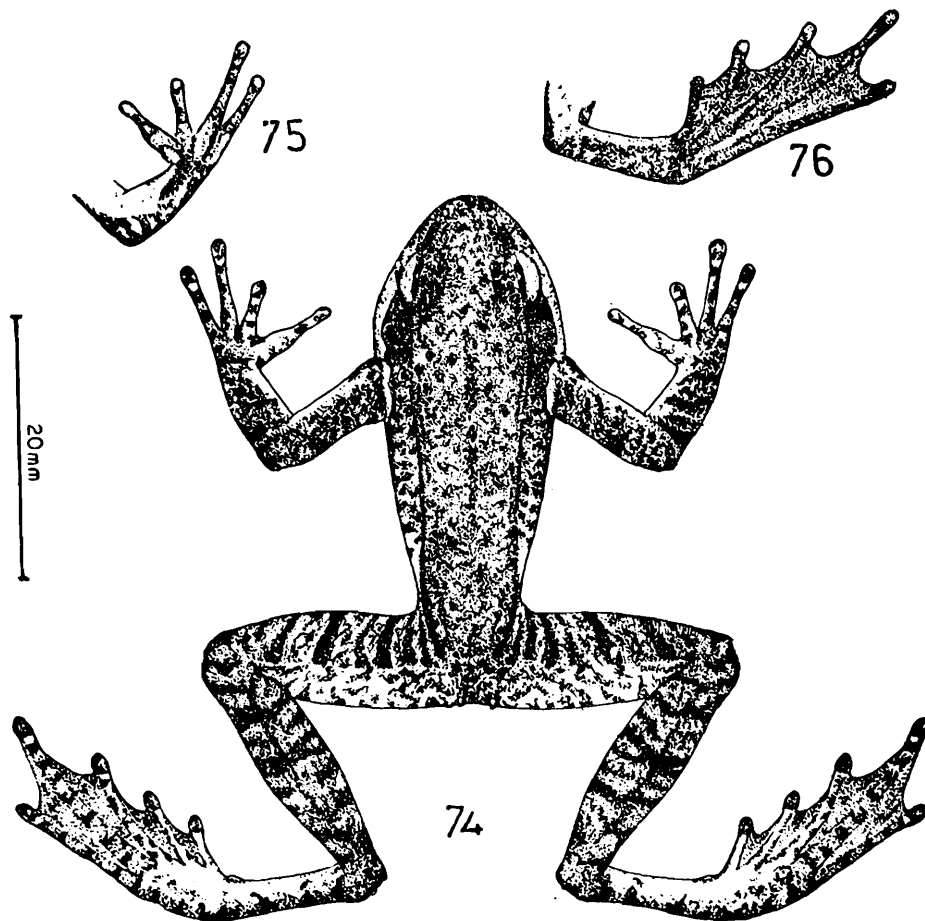
Diagnosis : Colour light brown to dark brown, occasionally with dark irregular patches on the dorsum. Two dorsolateral stripes extending from the posterior region of eyes ending near the anterior part of pelvic region. Limbs with dark cross bars. Skin smooth ; belly and lateral sides with minute granules. Ventral surface almost smooth.

Head : As long as broad, depressed ; snout projecting slightly beyond mouth ; canthus rostralis obtuse ; loreal region concave ; nostrils closer to tip of snout than eyes ; interorbital width slightly less than the diameter of eyes ; tympanum distinct, slightly depressed, smooth, more than half of eyes and separated from the eyes by a space nearly of its own diameter ; vomerine teeth oblique in position between the choanae.

Forelimbs : Moderately long ; fingers with swollen tips ; free ; first finger longer than second, third finger longest, slightly longer than snout ; subarticular tubercles prominent.

Hindlimbs : Long ; tibiotarsal articulation reaching tip of snout or a little beyond the snout ; heels overlapping when hindlimbs folded at right angles to body ; tibia three

and a half times as long as broad, nearly half or a little more than half the length from snout to vent ; tips of toes swollen into small discs ; fully webbed, webbing on the distal digits of fourth toe narrowing apically but retaining connecting tips ; subarticular tubercles prominent ; both inner and outer metatarsal tubercles present.



Figs. 74-76 : 74 *Rana danieli* (Dorsal view) ; 75, Forelimb (Ventral view) ; 76, Hindlimb (Ventral view).

Measurements in mm : From snout to vent : 60.0-65.0 ; head : 20.0-21.0 ; width of head : 20.0-21.0 ; snout : 10.0-11.0 ; eye : 7.0-8.5 ; interorbital width : 5.0-6.5 ; tympanum : 4.0-5.5 ; forelimb : 33.0-34.0 ; first finger : 10.0-11.5 ; second finger : 8.0-9.5 ; third finger : 11.0-12.5 ; fourth finger : 8.0-9.5 ; hindlimb : 98.0-102.0 ; tibia : 30.0-33.5 ; foot : 29.0-31.0 ; third toe : 20.0-21.5 ; fourth toe : 28.0-29.0 ; fifth toe : 20.0-21.0.

Distribution : India (Meghalaya, Assam, Arunachal Pradesh).

Remarks : This species was originally recorded from Mawphlang, Khasi hills, Megha-

laya (Pillai & Chanda, 1977). It is now being recorded for the first time from Assam and Arunachal Pradesh.

23. *Rana erythraea* (Schlegel, 1837)
(Figs. 77-79)

1837. *Hyla erythraea* Schlegel, *Abbild.* : 27.

1868. *Hylorana titleri* Theobald, *J. Cat. Rept. Asiat. Soc., Mus.* : 84.

1890. *Rana erythraea* Boulenger, *Fauna Brit. India including Ceylon and Burma, Reptilia and Batrachia* : 460.

1985. *Rana erythraea* Frost, *Amphibian species of the world* : 490.

Type locality : Java (Indonesia).

Location of type : Rijks Museum, Netherlands. (Syntypes).

Material examined : 2 exs., ♀ ♀, Shillong, Khasi hills, Meghalaya, 5.viii.1976, Coll. A. K. Sahu ; 1 ♀, Barapani, Khasi hills, Meghalaya, 5.vi.1974, Coll. M. Datta ; 2 ♀ ♀, Serchip, Mizoram, 7.xi.1976, Coll. K. R. Rao.

Diagnosis : Dorsally bright green to dark green. Tympanum reddish. Limbs yellowish with faint irregular cross bars or black bands. Ventral surface almost white. Skin almost smooth. Prominent glandular dorsolateral folds running dorsally from the anterior parts of the body to the posterior region ending near the groin. Another glandular fold present from the posterior parts of eyes up to the shoulder and ends in a prominent glandule. Ventral surface smooth.

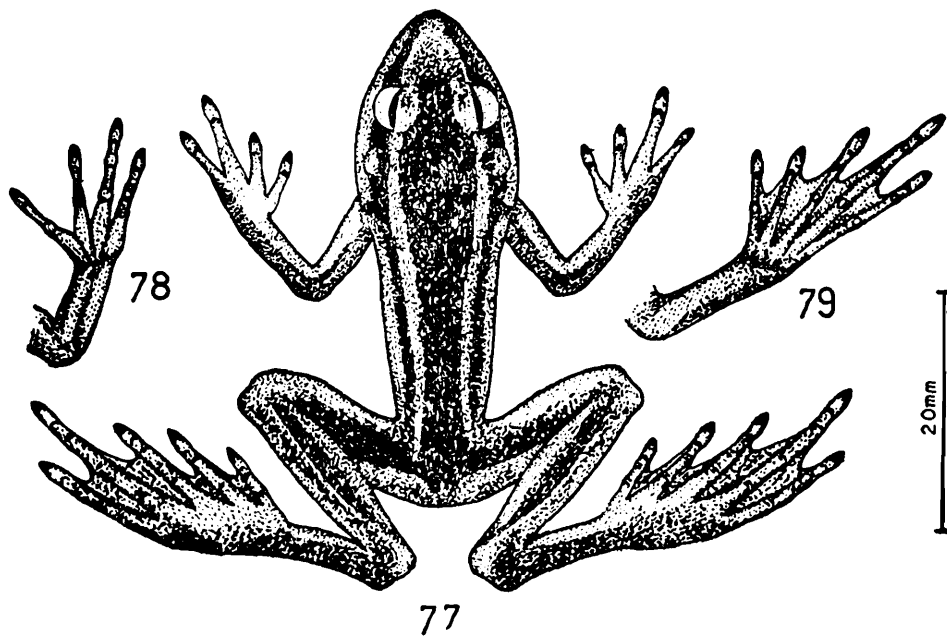
Head : Longer than broad, depressed ; snout pointed, projecting much beyond lower jaw ; canthus rostralis prominent ; loreal region slightly oblique and concave ; nostrils nearer to tip of snout than to eyes ; internarial width two-thirds diameter of eyes ; tympanum distinct, slightly depressed and two-thirds of eyes ; abdomen very narrow ; vomerine teeth small, oblique in position on a level with posterior border of choanae much nearer to each other than to choanae.

Forelimbs : Slender ; fingers long, free ; tips of fingers dilated into small discs with grooves separating upper from the lower surface ; first finger a little longer than second, third finger longest, much longer than snout ; subarticular tubercles moderately large and prominent.

Hindlimbs : Long ; tibiotarsal articulation reaching tip of snout ; heels strongly overlapping when hindlimbs folded at right angles to body ; tibia five to six times as long as broad, half the length from snout to vent ; toes long and slender ; tips of toes dilated into

small discs with grooves, two-thirds webbed ; two phalanges of fourth toe free ; subarticular tubercles prominent ; inner metatarsal tubercles present ; outer metatarsal tubercles absent.

Measurements in mm : From snout to vent : 44.0-46.0 ; head : 17.0-18.5 ; width of head : 14.0-15.0 ; snout : 7.0-8.0 ; eye : 6.0-5.5 ; interorbital width : 4.0-4.5 ; tympanum : 4.0-4.5 ; forelimb : 28.0-29.5 ; first finger : 6.5-6.8 ; second finger : 6.0-6.3 ; third finger : 9.0-9.5 ; hindlimb : 66.0-68.0 ; tibia : 22.0-23.0 ; foot : 24.0-25.2 ; third toe : 14.0-15.0 ; fourth toe : 20.0-20.5 ; fifth toe : 15.0-15.5.



Figs. 77-79 : 77, *Rana erythraea* (Dorsal view) ; 78, Forelimb (Ventral view) ; 79, Hindlimb (Ventral view).

Distribution : India (West Bengal, Assam, Meghalaya, Mizoram) ; Burma ; Malaysia ; Indo-China ; Indonesia.

Remarks : This species was originally recorded from Java (Schlegel, 1837). Boulenger (1920) recorded it from Assam. During the present study it has been recorded for the first time in Meghalaya and Mizoram of northeast India.

24. *Rana gerbillus* Annandale

(Figs. 80-82)

1912. *Rana gerbillus* Annandale, *Rec. Indian Mus*, 8 : 10.1979. *Rana gerbillus* Pillai & Chanda, *Rec. zool. Surv. India.*, 75 : 390.1985. *Rana gerbillus* Frost, *Amphibian species of the world* : 492.

Type locality : "Yumbung" Abor foot hills, at an altitude of 1100 ft, Arunachal Pradesh, India.

Location of type : Zoological Survey of India, Calcutta, India.

Material examined : 1 ex., ♀, Yumbung, Arunachal Pradesh, Coll. S. W. Kemp, date ? ; 4 ♀ ♀, 1 ♂, Cherrapunjia, Khasi hills, Meghalaya, 5.vi.1976, Coll. S. K. Chanda ; 2 ♂ ♂, Shillong peak, Khasi hills, Meghalaya, 3.vii.1973, Coll. R. S. Pillai ; 1 ♀, Mawphlang, Khasi hills, Meghalaya, 13.vii.1970, Coll. G. M. Yazdani ; 2 ♀ ♀, Umtham, Khasi hills, Meghalaya, 9.vii.1974, Coll. M. Datta ; 2 ♂ ♂, 1 ♀, Hornbill, Arunachal Pradesh, 13.xii.1983, Coll. S. Biswas ; 2 ♀ ♀, Dibrugarh, Assam, 18.xi.1974, Coll. S. K. Chanda.

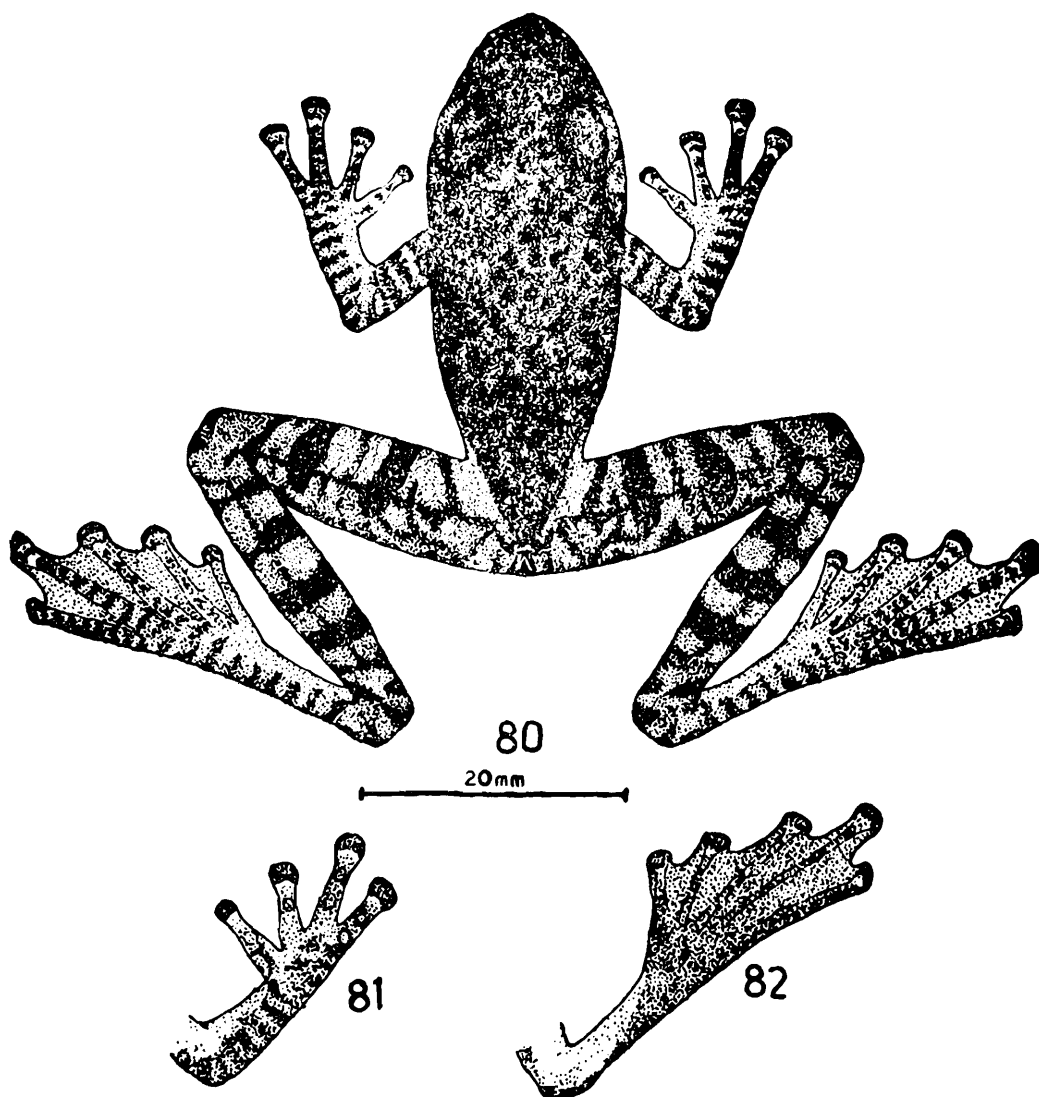
Diagnosis : Dorsally dark grey, marbled with black. Limbs with brown and white cross bars of irregular patterns. Thighs and throat light brown to yellowish. Tympanum dark brown. Skin smooth, occasionally finely granulated. Sometimes few minute tubercles present on lateral sides of belly. A very faint dorsolateral glandular fold running from the posterior border of eyes to groin. Ventral surface smooth.

Head : As long as broad, slightly depressed ; snout rounded, projecting slightly beyond lower jaw ; canthus rostralis prominent, loreal region concave ; nostrils equidistant from the eyes and tip of snout ; internarial distance a little greater than interorbital width which is less than eyes ; tympanum distinct, about one-third diameter of eyes ; vomerine teeth large, oblique in position between the choanae, extending much beyond the posterior border of choanae and close to each other than to choanae.

Forelimbs : Short ; fingers free, moderately long with prominent horizontally grooved discs, which are broader than long ; discs of third finger as large as tympanum ; first finger a little shorter than second ; third finger longest, longer than snout ; subarticular tubercles small and prominent.

Hindlimbs : Long, slender ; tibiotarsal articulation reaching beyond tip of snout ; heels overlapping when hindlimbs folded at right angles to body ; tibia slender, five to six times as long as broad, a little more than half the length from snout to vent ; tip of toes with prominent discs which are slightly smaller than finger discs, fully webbed ; subarticular tubercles prominent and oval ; inner metatarsal tubercle oval ; outer metatarsal tubercle absent.

Measurements in mm : From snout to vent : 67.0-71.0 ; head : 23.0-24.5 ; width of head : 23.0-24.5 ; snout : 9.5-10.0 ; eye : 7.0-7.5 ; interorbital width : 6.0-6.5 ; tympanum : 2.0-2.5 ; forelimb : 40.0-42.5 ; first finger : 10.5-11.0 ; second finger : 11.5-12.0 ; third finger : 13.0-13.5 ; hindlimb : 104.0-108.0 ; tibia 37.5-38.5 ; foot : 30.5-32.0 ; third toe : 19.0-20.5 ; fourth toe : 25.0-26.5 ; fifth toe : 16.0-17.5.



Figs. 80-82 : 80, *Rana gerbillus* (Dorsal view) ; 81, Forelimb (Ventral view) ; 82, Hindlimb (Ventral view).

Distribution : India (Meghalaya, Assam, Arunachal Pradesh).

Remarks : The present species was originally described from Abor foot-hills, Arunachal Pradesh on the basis of a single example. Pillai and Chanda (1979) recorded

the species for the first time from Khasi hills, Meghalaya. The present study records the species for the second time from Arunachal Pradesh after a span of more than 70 years. As the type was available, I have compared my materials with the type and found certain variations, the most significant being the distinct tympanum (not distinct in the type), well developed vomerine teeth (not well developed in the type) and the position of the nostrils which are equidistant from eyes and tip of snout (much closer to tip of snout than eyes in the type). Moreover, the chin, throat and chest in my material are almost white but these are marked with large round and oval dark spots in the type.

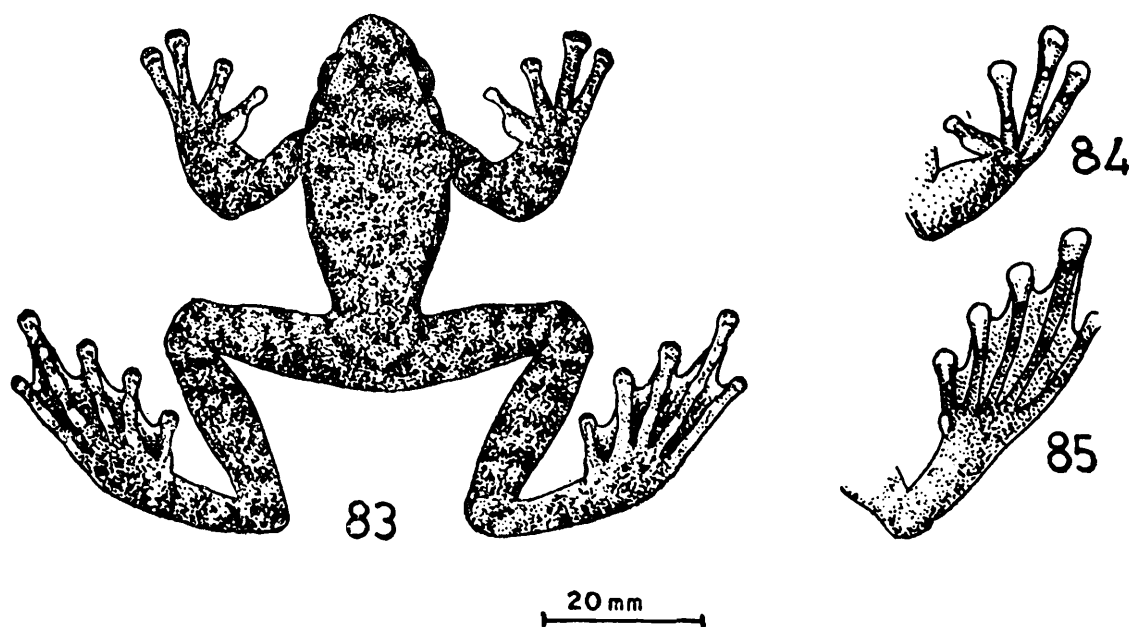
25. *Rana garoensis* Boulenger

(Figs. 83-85)

1920. *Rana garoensis* Boulenger, *Rec. Indian Mus.*, 20 : 170-171.

1976. *Rana garoensis* Cillai & Chanda, *J. Assam Sci. Soc.*, 19 : 55.

1985. *Rana garoensis* Frost, *Amphibian species of the world* : 492.



Figs. 83-85 : 83, *Rana garoensis* (Dorsal view) ; 84, Forelimb (Ventral view) ; 85, Hindlimb (Ventral view).

Type locality : Tura, Garo hills, Meghalaya, India (alt. 3500-3900 feet).

Location of type : British Museum (Natural History), London.

Material examined : 2 ♀♀, Garo hills, Meghalaya, vii. 1917, Coll. S. W. Kemp.

Diagnosis : Dorsally greyish brown in colour, blackish brown on the sides ; a white streak along the upper lip ; limbs with dark cross bars. Lower parts white. Dorsal skin granulated, a feebly prominent, narrow, interrupted glandular dorsolateral fold, running above the tympanum up to the hip ; lower parts smooth.

Head : Longer than broad, much depressed ; snout pointed, projecting much beyond the mouth, as long as the eyes ; canthus rostralis strong ; loreal region slightly oblique, concave ; nostrils equidistant from eyes and tip of snout ; distance between the nostrils a little more than interorbital width, which is equal to upper eyelid ; tympanum very distinct, half of eye, separated from the eye by a space of one and half to two times its own diameter ; vomerine teeth oblique in position between the choanae.

Forelimbs : Fingers rather slender ; free, tips of fingers dilated into very small discs with a groove separating the upper surface from the lower ; first and second fingers equal, third a little longer than snout ; subarticular tubercles moderately large and prominent.

Hindlimbs : Long ; tibiotarsal articulation reaching a little beyond the tip of snout ; heels strongly overlapping when hindlimbs folded at right angles to body ; tibia four and a half to five times as long as broad, nearly two-third the length of snout to vent ; tip of toes more prominently dilated than those of the fingers, entirely webbed ; outer metatarsals separated nearly to the base ; subarticular tubercles small but very prominent ; tarsal fold absent ; inner metatarsal tubercle oval, one-fourth the length of inner toe ; a round, small outer metatarsal tubercle present.

Measurements in mm : From snout to vent : 32.0 ; head : 14.5 ; width of head : 13.0 ; snout : 5.5 ; eye : 5.5 ; interorbital width : 3.0 ; tympanum : 2.0 ; forelimb : 24.0 ; first finger : 5.0 ; second finger : 5.0 ; third finger : 7.5 ; hindlimb : 68.5 ; tibia : 23.5 ; foot : 20.5 ; third toe : 11.5 ; fourth toe : 17.0 ; fifth toe : 17.0.

Distribution : India (Meghalaya).

Remarks : Boulenger (1920) described the species from Garo hills, Meghalaya. However, during several faunistic surveys carried out subsequently in and around the same area did not yield any more specimen of this species. As measurements of different body parts were not provided earlier, these have been measured from the type and incorporated here.

26. *Rana ghoshi* Chanda
(Figs. 86-88)

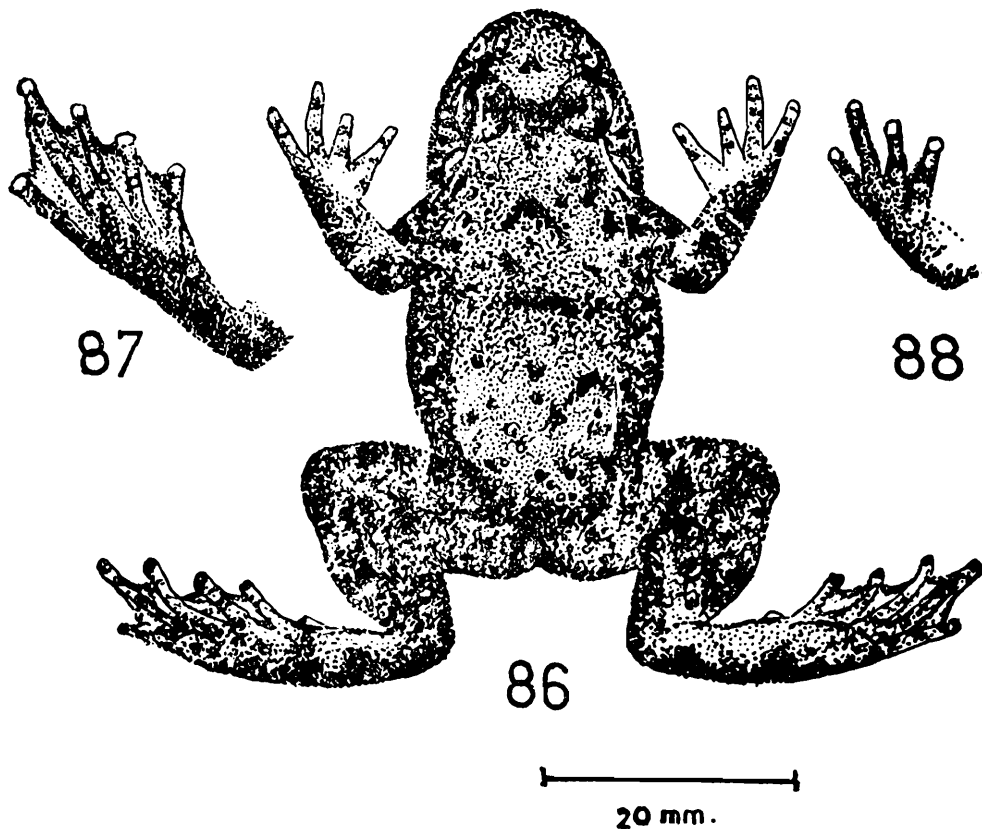
1990. *Rana ghoshi* Chanda, *Hamadryad*, 15 (1) : 16-17.

Type locality : Khugairk Reserve forest, Manipur, India.

Location of type : Zoological Survey of India, Calcutta, India.

Material examined : 1 ♀, Khugairk Reserve forest, Manipur, 18.i.1975, Coll. A. K. Ghosh.

Diagnosis : Dorsally light brown with dark irregular blotches. A dark stripe extends from posterior border of eyes to the shoulder. Ventrally pale. Skin of dorsum rough with small tubercles, ventral surface almost smooth. A glandular dorsolateral fold extends from eyes to posterior region of the body, ending near the groin.



Figs. 86-88 : 86, *Rana ghoshi* (Dorsal view) ; 87, Hindlimb (Ventral view) ; 88, Forelimb (Ventral view),

Head : Depressed, broader than long ; snout rounded, slightly projecting beyond lower jaw ; canthus rostralis concave ; nostrils much closer to eyes than to tip of snout ; internarial space about one and half times of interorbital width ; tympanum half the diameter of eyes, separated from the latter by a gap about half the tympanic diameter ; lower jaw with two tooth-like bony processes that fit in grooves on the upper jaw ; vomerine teeth oblique, much nearer each other than to choanae.

Forelimbs : Moderately long ; fingers free with rounded tips ; first finger slightly longer than second ; third finger longest, slightly shorter than snout ; subarticular tubercles small but very prominent.

Hindlimbs : Short ; tibiotarsal articulation reaching tympanum ; heels just meeting when hindlimbs folded at right angles to body ; tibia twice as long as broad, more than one-third snout-vent length ; toes with rounded tips, fully webbed ; subarticular tubercles small but prominent ; inner metatarsal tubercle oval, prominent, nearly half the length of inner toe ; outer metatarsal tubercle absent.

Measurements in mm : From snout to vent : 60.0 ; Head : 19.5 ; width of head : 22.0 ; snout : 9.0 ; eye : 8.0 ; interorbital width : 4.0 ; tympanum : 4.0 ; forelimb : 12.0 ; length of first finger : 8.0 ; second finger : 7.5 ; third finger : 8.0 ; hindlimb : 76.0 ; third toe : 14.5 ; fourth toe : 21.5 ; fifth toe : 19.0.

Distribution : India (Manipur).

Remarks : This species has been described for the first time from Manipur, northeast India (Chanda, 1990). It is very close to *Rana cyanophlyctis*. It is found to occur in the overhanging vegetation near the small stream, and is a diurnal species.

27. *Rana hexadactyla* Lesson

(Figs. 89-91)

1834. *Rana hexadactyla* Lesson, *Voy. Ind. Or. Rept.* : 331.

1853. *Rana cutipora* Jerdon, *J. Asiat. Soc. Beng.*, : 531.

1854. *Rana robusta* Blyth, *J. Asiat. Soc. Beng.*, : 298

1890. *Rana hexadactyla* Boulenger, *Fauna Brit. India including Ceylon and Burma, Reptilia and Batrachia*, : 441.

1985. *Rana hexadactyla* Frost, *Amphibian species of the world* : 495

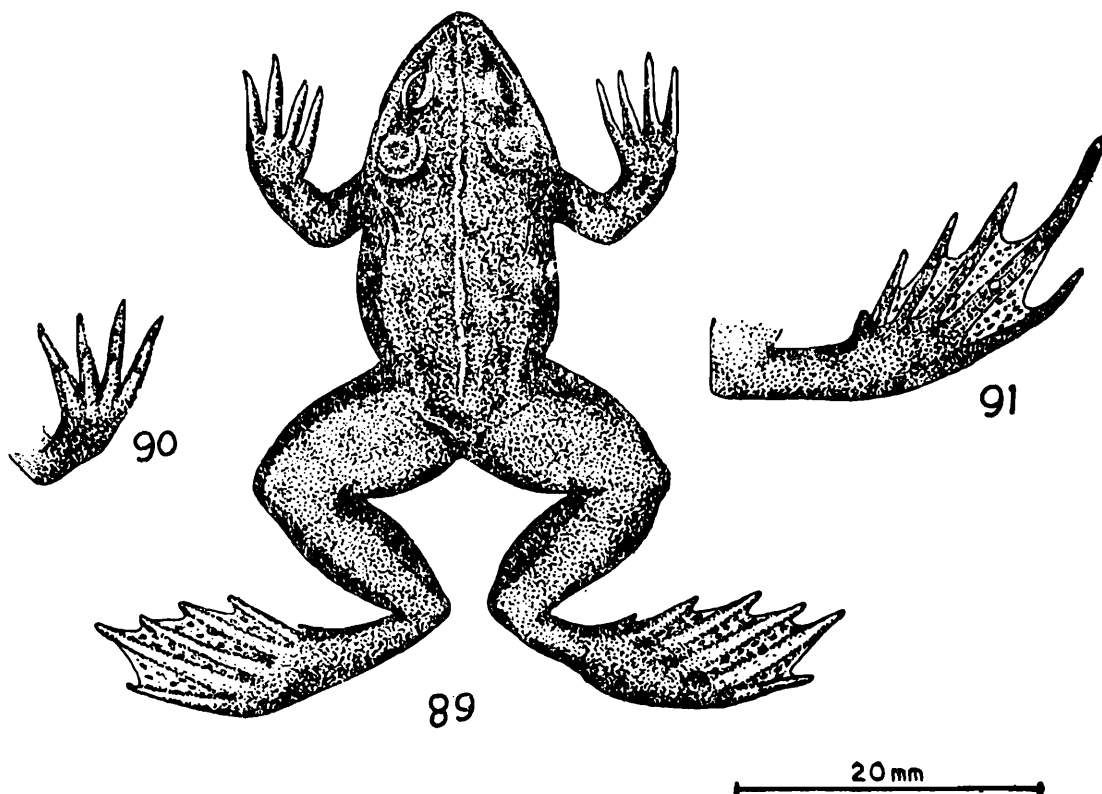
Type locality : India (South India).

Location of type : Not known.

Material examined : 5 ♀ ♀, 1 ♂, Ambassa, Tripura, India, 12.viii.1979, Coll. S. K. Chanda.

Diagnosis : Dorsally olive to green in colour, sometimes with a yellowish vertebral stripe along the mid-dorsum from snout to vent ; thighs ventrally dark green. Body white to pale yellowish on the ventral surface. Dorsal skin almost smooth with minute porous warts. A strong glandular fold extends from eye to shoulder, connecting its fellow across the head behind eyes.

Head : Slightly broader than long, a little depressed ; snout obtusely pointed, slightly projecting beyond mouth ; canthus rostralis indistinct ; loreal region oblique and concave ; nostrils closer to snout than to eyes ; internarial distance greater than interorbital



Figs. 89-91 : 89, *Rana hexadactyla* (Dorsal view) ; 90, Forelimb (Ventral view) ; 91, Hindlimb (Ventral view).

width which is less than half of eyes ; tympanum distinct, two-thirds diameter of eyes ; vomerine teeth oblique in position, running from anterior margin of choanae and projecting a little beyond its posterior border.

Forelimbs : Slender with more or less distinct dermal border ; fingers free ; first finger slightly longer than second ; third finger longest ; subarticular tubercles small, prominent.

Hindlimbs : Moderately long ; tibiotarsal articulation reaching eyes ; heels overlapping when hindlimbs folded at right angles to body ; tibia two to three times as long as broad, less than half of the length from snout to vent ; toes pointed, fully and broadly webbed, webs reaching the tips of toes ; fourth toe longest, exceeding a little beyond third and fifth ; subarticular tubercles small and indistinct ; a small, prominent, digitiform inner metatarsal tubercle present ; outer metatarsal tubercle absent.

Measurements in mm : From snout to vent : 59.0-61.0 ; head : 21.0-21.5 ; width of head : 21.5-22.0 ; snout : 7.0-7.5 ; eye : 7.0-8.0 ; interorbital width : 2.0-2.5 ; tympanum : 5.0-5.5 ; forelimb : 33.5-34.0 ; first finger : 7.0-7.2 ; second finger : 6.0-6.4 ; third finger : 8.0-8.5 ; hindlimb : 85.0-87.5 ; tibia : 25.0-26.0 ; foot : 30.0-30.5 ; third toe : 18.0-18.5 ; fourth toe : 25.0-25.5 ; fifth toe : 21.0-21.5.

Distribution : India (West Bengal, Tripura, Maharashtra, Tamil Nadu, Kerala) ; Sri Lanka.

Remarks : Earlier this species was known only from South India and Sri Lanka (Boulenger, 1920). Subsequently it was recorded from West Bengal, Punjab and Maharashtra (Bhaduri, 1944 ; Mc Cann, 1940). A bright, leaf-green colour with a primrose yellow vertebral streak in the living specimen can be considered as a characteristic feature of this species. During the present study it has been recorded for the first time from Tripura of northeast India.

28. *Rana khasiana* (Anderson)

1871. *Pyxicephalus khasianus* Anderson, *J. Asiat. Soc. Beng.*, 40 : 23.
 1882. *Rana khasiana* Boulenger, *Cat. Zool. Brit. Mus.*, : 34.
 1920. *Rana khasiana* Boulenger, *Rec. Indian Mus.*, 20 : 66-67.
 1985. *Rana khasiana* Frost, *Amphibian species of the world* : 498.

Type locality : Khasi hills, Meghalaya, India.

Location of type : Not known.

Material examined : None.

Diagnosis : Dorsally uniform brown in colour, spotted with brown on lateral sides ; thighs faintly barred. Chin, thorax and legs spotted with brown. Dorsal skin smooth. No trace of tubercle ; ventral surface almost smooth.

Head : Short, broader than long ; snout short, rounded ; tongue small, notched behind ; nostrils directed upwards and backwards, equidistant from eyes and tip of snout ; eyes large and prominent ; tympanum small, covered by skin, faintly visible, more than

half the diameter of eyes ; two apophyses on the lower jaw ; choanae distinct, rounded. Vomerine teeth oblique in position running up to posterior margin of choanae and separated from each other by a narrow space.

Forelimbs : Fingers free, three small subarticular tubercles present on the palm ; inner tubercle largest, elongate in shape and more or less similar to the inner metatarsal tubercle ; first and second fingers nearly equal but less than half of third finger.

Hindlimbs : Short ; tibia slightly shorter than thigh ; inner metatarsal tubercle shovel-shaped and laterally compressed ; outer metatarsal tubercle absent.

Distribution : India (Meghalaya).

Remarks : Although this species has been recorded from Meghalaya, (Boulenger, 1882), I have not come across even a single specimen during my studies. Moreover, I could not study any material of this species including the type ; hence I am unable to comment on this species. Gorham (1974) includes it doubtfully under *Rana kuhlii* Dum & Bibron. According to Frost (1985) it is a valid species. Description is based on Boulenger (1882, 1980).

29. *Rana limnocharis* Boisduval

(Figs. 92-94)

1835. *Rana limnocharis* Boie, *Nova. Acta. Acad. Leop.*, : 255.

1864. *Rana gracilis* Gunther, *Rept. Brit. India* : 409.

1871. *Rana brevipalmata* Peters, *Mon. Berl. Acad.*, : 646.

1890. *Rana limnocharis* Boulenger, *Fauna Brit. India including Ceylon and Burma, Reptilia and Batrachia* : 52.

1985. *Rana limnocharis* Frost, *Amphibian species of the world* : 500.

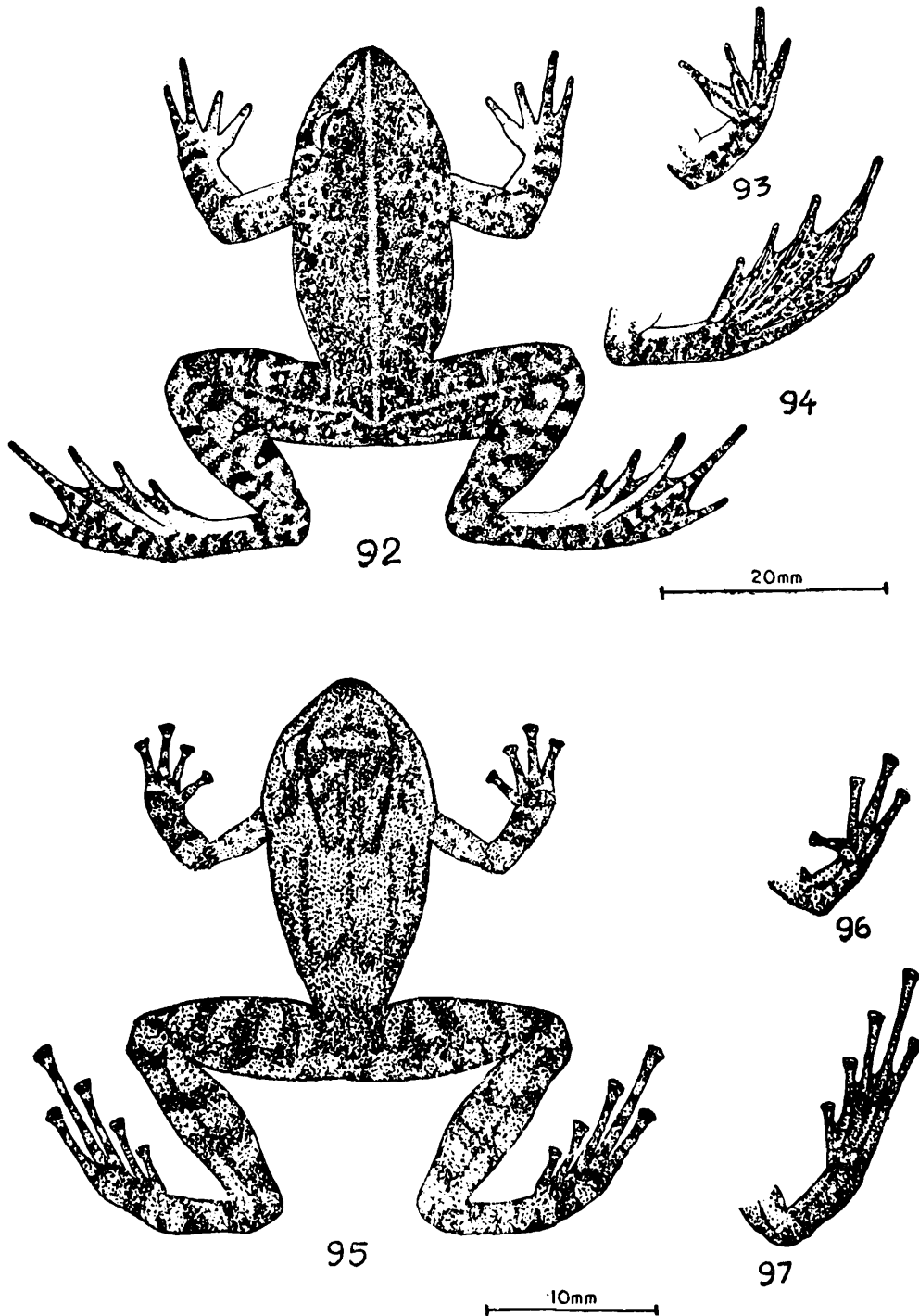
Type locality : Java (Indonesia).

Location of type : Not known.

Material examined : India : 727 examples (467 ♂♂ ; 260 ♀♀), from the states of Tripura, Mizoram, Arunachal Pradesh collected during the year 1968-1972 in the months of January to May and November-December ; January-February and January-April, besides a good number of them were collected in the year 1960-1975 in the months of January-December, January-April and November-December from Meghalaya and Assam.

Diagnosis : Light brown to black with distinct or variable markings on the dorsal side. In most cases a mid-dorsal vertebral band present from snout to vent. Similar band may also be present along the thighs right upto the heels. This band may be very thin,

faint, broad and conspicuous. A triangular marking present between the eyes. A straight "V"-shaped band present dorsally on the sacral region. Lips with dark vertical bars. Limbs with complete or incomplete cross bars. Dorsal skin rough with longitudinal ridges ; a fold behind the tympanum ; thighs posteriorly granulated ; ventrally smooth.



Figs. 92-97 : 92, *Rana limnocharis* (Dorsal view) ; 93, Forelimb (Ventral view) ; 94, Hindlimb (Ventral view) ; 95, *Rana leptoglossa* (Dorsal view) ; 96, Forelimb (Ventral view) ; 97, Hindlimb (Ventral view).

Head : Broader than long, depressed ; snout pointed, projecting beyond mouth ; canthus rostralis obtuse ; loreal region concave ; nostrils equidistant from eyes and tip of snout ; internarial space slightly greater than interorbital width which is much less than half of eyes ; tympanum distinct, half of eyes, very close to eyes but separated from the latter by a space about one-third of tympanic diameter ; vomerine teeth oblique in position, on a level with anterior border of choanae, projecting far beyond its posterior border.

Forelimbs : Moderately long ; fingers pointed, free ; first finger a little longer than second, third longest, nearly as long as snout ; subarticular tubercles small, very prominent.

Hindlimbs : Long ; tibiotarsal articulation reaching tip of snout ; heels strongly overlapping when hindlimbs folded at right angles to body ; tibia two and half to three times as long as broad, more than half of the length from snout to vent, shorter than forelimb and foot ; toes pointed, half webbed ; three phalanges of fourth toe free ; subarticular tubercles small, prominent, oblong ; inner metatarsal tubercles oblong and small and rounded, outer metatarsal tubercle present.

Measurements in mm : From snout to vent : 47.5-60.0 ; head : 16.0-20.0 ; width of head : 18.0-19.0 ; snout : 6.0-8.0 ; interorbital width : 2.5-3.0 ; tympanum : 3.0-4.0 ; forelimb : 28.0-31.0 ; first finger : 6.5-7.5 ; second finger : 4.5-5.5 ; third finger : 6.5-7.5 ; hindlimb : 79.0-89.0 ; tibia : 26.5-30.5 ; foot : 29.0-38.0 ; third toe : 12.5-15.5 ; fourth toe : 19.5-21.5 ; fifth toe : 12.5-15.5.

Distribution : All over India ; Sri Lanka ; China ; Malaysia ; Indonesia ; Philippines.

Remarks : This species was originally described from Java (Boiesduval, 1835). It is the most common and widely distributed of the Indian frogs after *R. cyanophlyctis* and has been recorded from an altitude of 2133 m. in Sikkim (Boulenger, 1920). Several authors (Annandale, 1912 ; Satyamurthy, 1967 ; Smith, 1923 ; Daniel, 1975 ; Pillai & Chanda, 1979) have given accounts of the habits of this frog. *R. limnocharis* is a gregarious breeder and the larval form reaches maturity within 28 days (Pope, 1931). In northeast India, species exhibits certain intraspecific variations specially in colour pattern with reference to the dorsal vertebral line which may be totally non-existent or sometimes very broad and prominent.

30. *Rana leptoglossa* (Cope)
(Figs. 95-97)

1868. *Hylorana leptoglossa* Cope, *Proc. Ac. Philad.*, : 139.
1871. *Hylorana granulosa* Anderson, *J. Asiat. Soc. Beng.*, 11 : 23.
1920. *Rana leptoglossa* Boulenger, *Rec. Indian Mus.*, 20 : 145.
1985. *Rana leptoglossa* Frost, *Amphibian species of the world* : 499.

Type locality : Assam, India.

Location of type : Museum of Comparative Zoology, Harvard University, Cambridge.

Material examined : 3 ♀ ♀, 1 ♂, Regd. No. B. N. H. S. 1292, 1294, 1295, 1297 without any collection data.

Diagnosis : Dorsally brown with small to large black spots or markings ; sides sometimes black with white spots or marblings ; loreal and temporal region dark brown or black. Tympanum reddish brown ; canthus rostralis, dorsolateral fold and upper lip white ; limbs with blackish cross-bands ; posterior side of thighs marbled black and white. Ventral parts white, spotted or marbled with brown. Skin strongly granulate on the head and back, often with larger warts on the sides ; a strong and broad glandular dorsolateral fold running above the tympanum up to the hip. Another glandular fold extends from posterior region of eyes upto the shoulder, followed by a glandule. Ventrally smooth.

Head : As long as broad, depressed ; snout obtusely pointed ; canthus rostralis obtuse ; loreal region feebly concave ; nostrils slightly nearer to snout than eyes ; internarial space nearly equal to interorbital width which is nearly half the diameter of eyes ; tympanum very distinct, three-fourth diameter of eyes ; vomerine teeth oblique in position between the choanae, equidistant from each other and from the choanae.

Forelimbs : Moderately long ; fingers long, free, with small discs bearing minute transverse groove ; first finger longer than second, third finger longest, longer than snout ; subarticular tubercles large, prominent.

Hindlimbs : Long. Tibiotarsal articulation reaching eyes or between eyes and nostrils ; heels strongly overlapping when hindlimbs folded at right angles to body ; tibia four to four and a half times as long as broad, half or a little more than half the length of snout to vent ; toes with small discs, and with grooves separating upper from the lower surface, half to two-thirds webbed, web not reaching the discs of third and fifth toes ; three phalanges of fourth toe free ; outer metatarsals separated nearly to the base ; subarticular tubercles prominent ; inner metatarsal tubercle oval, nearly half the length of inner toe ; a very prominent, rounded outer metatarsal tubercle present.

Measurements in mm : From snout to vent ; 51.0-61.0 ; head : 19.0-22.0 ; width of head : 19.0-22.0 ; snout : 7.0-8.0 ; eye : 6.5-7.0 ; interorbital width : 3.0-4.0 ; tympanum : 5.0-5.5 ; forelimb : 35.0-37.0 ; first finger : 8.0-9.0 ; second finger : 6.0-7.0 ; third finger : 9.0-10.0 ; fourth finger : 6.0-7.0 ; hindlimb : 85.0-103.0 ; tibia : 26.0-32.0 ; foot : 26.0-32.0 ; fifth toe : 15.0-20.0.

Distribution : India (Assam) ; Burma.

Remarks : Although this species was described from Assam, several surveys in Assam region did not yield more specimens.

31. *Rana livida* (Blyth) (Figs. 98-100)

1855. *Polypedates livida* Blyth, *J. Asiat. Sec. Bengal*, 24 : 718.

1882. *Rana chloronata* Boulenger, *Cat. Bat. Sul. Brit. Mus.*, : 69.

1920. *Rana livida* Boulenger, *Rec. Indian Mus.*, 20 : 214.

1985. *Rana livida* Frost, *Amphibian species of the world* : 500.

Type locality : Tenasserim (Burma).

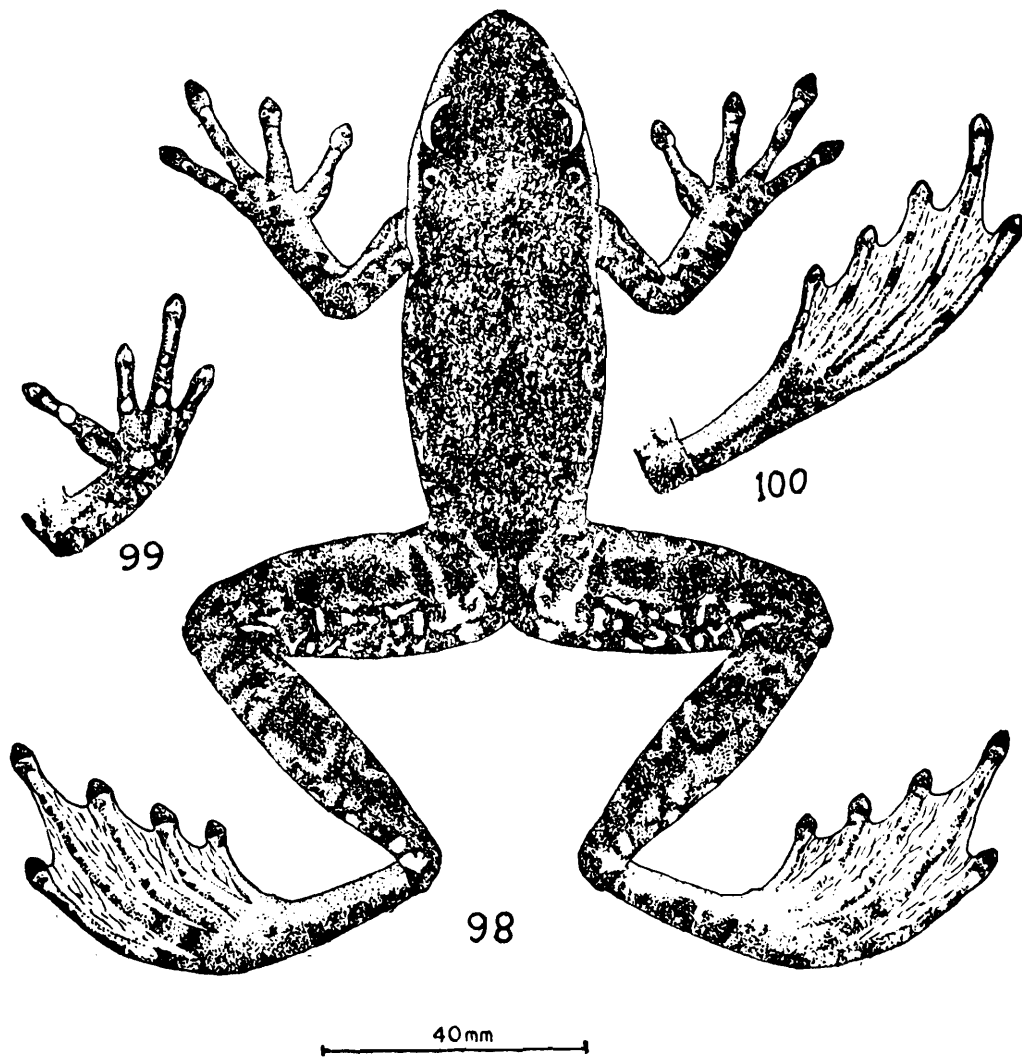
Location of type : Not traced.

Material examined : India : 2 ♀ ♀, 2 ♂ ♂, Shillong, Khasi hills, Meghalaya, 7.vi.1967, Coll. S. K. Chanda ; 9 ♀ ♀, Cherrapunjia, Khasi hills, Meghalaya, 3.ix.1972, Coll. R. S. Pillai ; 3 ♀ ♀, Barapani, Khasi hills, Meghalaya, 7.ii.1978, Coll. K. P. Singh ; 2 ♀ ♀, Umsning, Khasi hills, Meghalaya, 8.ix.1978, Coll. S. Biswas ; 8 ♀ ♀, 1 ♂, Goalpara, Assam, 17.i.1972, Coll. R. S. Pillai ; 2 ♀ ♀, 1 ♂, Kaibul, Manipur, 24.iii.1974, Coll. K. R. Rao.

Diagnosis : Dorsally green to grey, sometimes a row of large black spots present on the head which are smaller towards interorbital region in adult specimen. A prominent white streak present on the upper jaw. Tympanum brown with a clear whitish circular rim. Limbs with brownish cross bands. Ventrally light to dark brown. Skin smooth ; flanks and posterior parts of thighs granulated. A glandular fold originating from the posterior corner of eyes to shoulder, followed by a glandule.

Head : As long as broad, much depressed ; snout slightly pointed, a little projecting beyond mouth ; canthus rostralis obtuse ; loreal region feebly concave ; interorbital width nearly half the diameter of eyes ; tympanum very distinct, depressed, about two-thirds the diameter of eyes ; vomerine teeth oblique in position, extending slightly beyond posterior margin of choanae ; nostrils much nearer to tip of snout than eyes.

Forelimbs : Short ; fingers free, moderately large with very faint dermal border ; tips of fingers with prominent discs, slightly smaller than tympanum ; discs with prominent grooves separating upper from the lower surface ; first finger slightly longer than second, third longest, much longer than snout. Subarticular tubercles prominent, oval, well developed pad present on the inner side of the first finger.



Figs. 98-100 : 98, *Rana livida* (Dorsal view) ; 99, Forelimb (Ventral view) ; 100, Hindlimb (Ventral view).

Hindlimbs : Very long ; tibiotarsal articulation reaching beyond tip of snout ; heels strongly overlapping when hindlimbs folded at right angles to body ; tibia four to five times as long as broad, more than half the length from snout to vent ; toes fully webbed ;

subarticular tubercles moderately large and prominent ; inner metatarsal tubercle small, oval and nearly half of inner toe ; outer metatarsal tubercle absent.

Measurements in mm : From snout to vent : 47.5-59.5 ; head : 16.5-28.5 ; width of head : 16.5-28.5 ; snout : 6.5-10.0 ; eye : 6.5-10.0 ; interorbital width : 3.3-5.0 ; tympanum : 4.5-5.5 ; forelimb : 35.5-58.5 ; first finger : 6.8-13.0 ; second finger : 6.0-12.0 ; third finger : 10.0-17.0 ; hindlimb : 89.5-165.5 ; tibia : 29.5-56.0 ; foot : 28.5-51.5 ; third toe : 15.0-29.0 ; fourth toe : 22.0-43.0 ; fifth toe ; 18.5-34.0.

Distribution : India (West Bengal, Meghalaya, Assam, Manipur).

Remarks : This species was originally described from Burma (Blyth, 1855) and subsequently recorded from Assam and Meghalaya (Boulenger, 1920 ; Pillai & Chanda, 1979). During the present study it was recorded for the first time in Manipur.

32. *Rana laticeps* Boulenger (Figs. 101-103)

1882. *Rana laticeps* Boulenger, *Cat. Bat. Sal. Brit. Mus.*, : 20.
1890. *Rana laticeps* Boulenger, *Fauna Brit. India including Ceylon and Burma, Reptilia and Batrachia* : 441.
1920. *Rana laticeps* Boulenger, *Rec. Indian Mus.*, 20 : 67.
1979. *Rana laticeps* Pillai & Chanda, *Rec. zool. surv. India.*, 75 : 389.
1985. *Rana laticeps* Frost, *Amphibian species of the world* : 498.

Type locality : Khasi hills, Meghalaya, India.

Location of type : Syntypes : British Museum, (Natural History), London.

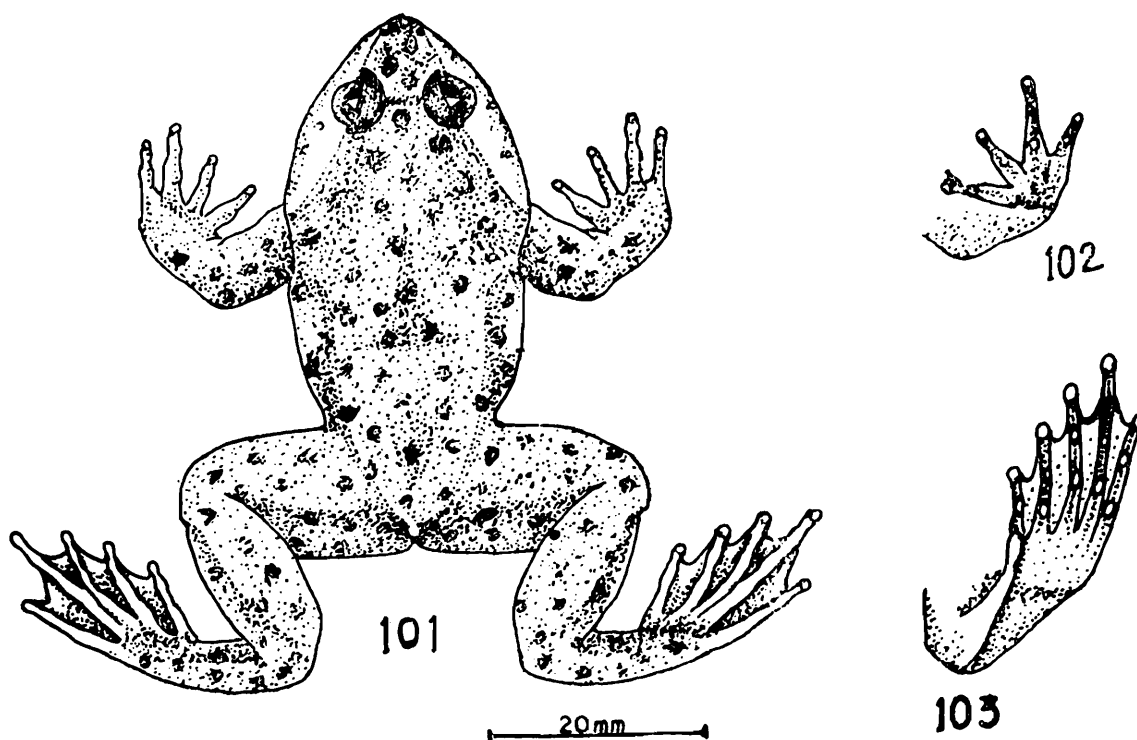
Material examined : India : 2 ♀ ♀, Mawphlang, Khasi hills, Meghalaya, 7.v.1969, Coll. S. K. Chanda ; 3 ♀ ♀ ; 1 ♂ ; Cherrapunjia, Khasi hills, Meghalaya, 5.v.1970, Coll. J. H. Bourne ; 2 ♂ ♂ ; Barapani, Khasi hills, Meghalaya, 5.vi.1978, Coll. S. K. Chanda ; 2 ♀ ♀, Tura, Garo hills, Meghalaya, 5.vii.1979, Coll. S. Biswas ; 1 ♀ ; Kaziranga, Assam, 22.ii.1974, Coll. M. Datta.

Diagnosis : Dorsally varying from light brown to dark brown, sometimes with brownish spots or marblings. A dark bar connecting the eyes. A faint brownish "V"-shaped marking present dorsally at the level of forelimbs. Limbs with more or less distinct dark cross bars. Ventrally almost white except throat which has brownish irregular blotches. Dorsal skin rough with circular and longitudinal warts and tubercles of different sizes. A distinct glandular fold extending from tympanum to forelimbs.

Head : Broader than long, a little depressed ; snout obtusely pointed, slightly projecting beyond mouth ; canthus rostralis obtuse ; loreal region concave ; nostrils nearer

to tip of snout than to eyes ; internarial space less or equal to interorbital width ; tympanum not very distinct, slightly smaller than eye ; vomerine teeth oblique in position, more towards the posterior border of choanae, much nearer to each other than to choanae.

Forelimbs : Thick and stout ; fingers moderate, free with swollen tips ; first finger shorter than second ; third finger longest, longer than snout ; subarticular tubercles moderately prominent.



Figs. 101-103 : 101, *Rana laticeps* (Dorsal view) ; 102, Forelimb (Ventral view) ; 103, Hindlimb (Ventral view).

Hindlimbs ; Long ; tibiotarsal articulation reaching tip of snout ; heels strongly overlapping when hindlimbs folded at right angles to body ; tibia two and half times as long as broad, more than half of the length from snout to vent, shorter than forelimb but nearly as long as or slightly longer than foot ; tips of toes dilated into small discs ; toes three-fourth webbed ; ultimate and penultimate phalanges of fourth toe free ; subarticular tubercles moderately prominent ; inner metatarsal tubercle small, narrow and oval ; outer metatarsal tubercle absent.

Measurements in mm : From snout to vent : 30.0-50.0 ; head : 12.5-19.5 ; width of head : 15.5-20.5 ; snout : 3.5-5.5 ; eye : 3.5-5.5 ; interorbital width : 2.5-4.5 ;

tympanum : 2.0-3.0 ; forelimb ; 20.5-31.0 : first finger : 3.5-7.0 ; second finger : 4.5-6.5 ; third finger : 4.0-8.0 ; hindlimb : 35.0-81.0 ; tibia : 18.0-25.0 ; foot : 17.0-29.0 ; third toe : 5.5-11.0 ; fourth toe : 11.5-17.0 ; fifth toe : 5.5-11.0.

Distribution : India (West Bengal, Meghalaya, Assam) ; Burma ; Malaysia.

Remarks : This species was originally described from Khasi hills, Meghalaya (Boulenger, 1882). Pillai & Chanda (1979) recorded the species from Khasi hills, Meghalaya after a span of more than 70 years. During the present study the author collected a number of specimens from different parts of Meghalaya and Assam. It has now been recorded for the first time from Assam.

33. *Rana mawphlangensis* Pillai & Chanda (Figs. 104-106)

1977. *Rana mawphlangensis* Pillai & Chanda, *J. Bombay nat. Hist. Soc.*, 74 (1) : 136-140.

1985. *Rana mawphlangensis* Frost, *Amphibian species of the world* : 504.

Type locality : Mawphlang, Khasi hills, Meghalaya, India.

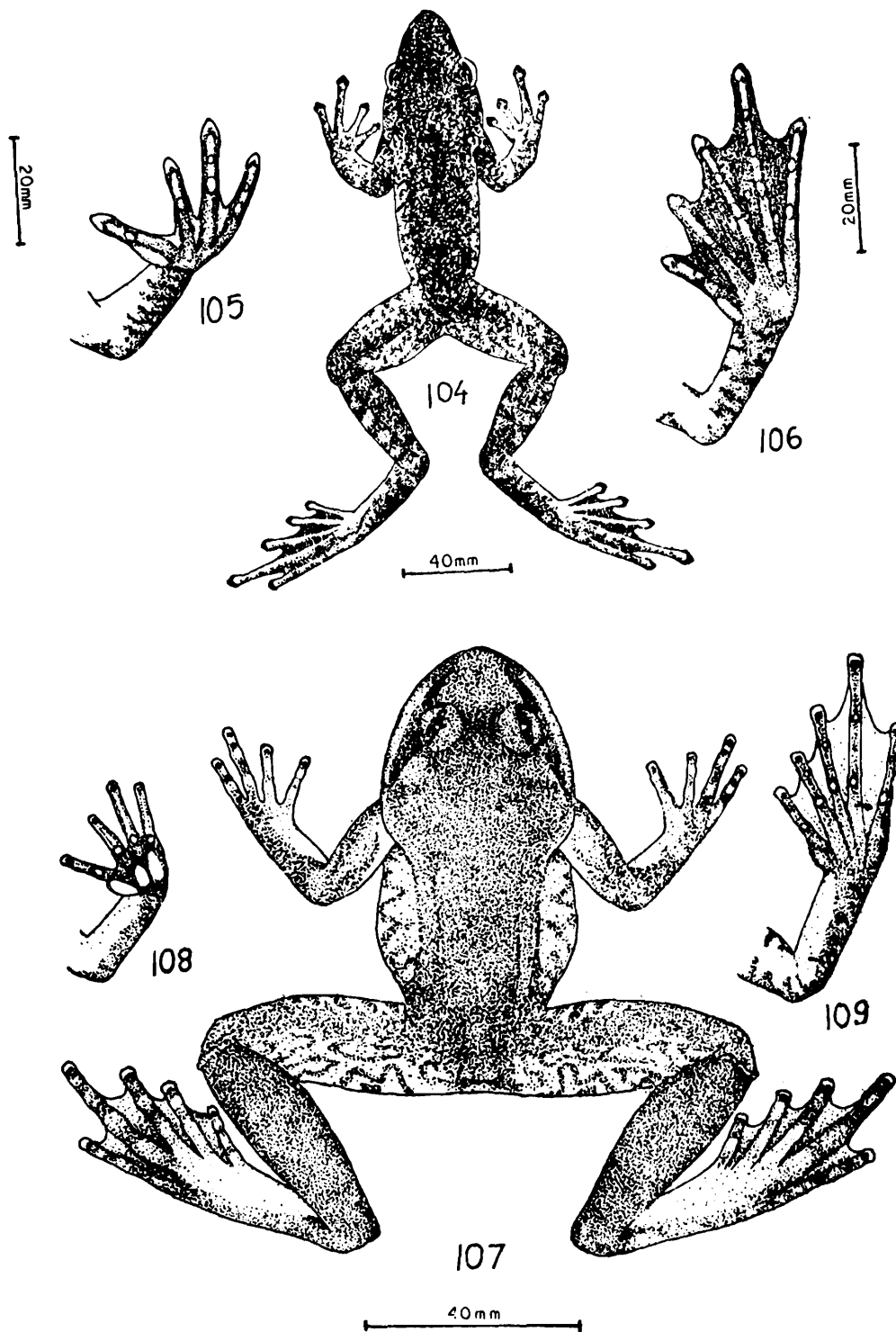
Location of type : National zoological collection, Zoological Survey of India, Calcutta, India.

Material examined : 1 ♂, Mawphlang, Khasi hills, Meghalaya, 13.vii.1973, Coll. R. S. Pillai ; 1 ♀, Mawphlang, Khasi hills, Meghalaya, 19.viii.1975. Coll. S. K. Chanda ; 1 ♀, Churachandpur, Manipur, 19.viii.1976, Coll. K. R. Rao.

Diagnosis : Dorsally bluish black to slate-coloured, ventrally yellowish to white. Lower jaw, lateral sides of body and ventral sides of limbs spotted or marbled with black. Inner two toes whitish and the outer toes bluish black. Skin almost smooth on the dorsum. Throat smooth. Abdomen weakly granulated. An indistinct fold extends from tympanum to eyes, ventral surface smooth.

Head : As long as broad, depressed ; snout obtusely pointed, projecting slightly beyond lower jaw ; canthus rostralis obtuse ; loreal region slightly concave ; nostrils equidistant from eyes and tip of snout ; internarial distance more than one and a half times of interorbital width ; tympanum distinct, more than half of eyes, separated from eyes by two-third of tympanic diameter ; vomerine teeth fairly oblique in position, running to posterior level of choanae ; tongue large, free, filling almost the entire buccal cavity.

Forelimbs : Fingers long, free ; tips of fingers swollen into small discs ; first finger slightly longer than second ; third finger longest ; subarticular tubercles prominent ; an elongated pad present on the inner side of thumb.



Figs. 104-109 : 104, *Rana mawplangensis* (Dorsal view); 105, Forelimb (Ventral view); 106, Hindlimb (Ventral view); 107, *Rana mawlyndipi* (Dorsal view); 108, Forelimb (Ventral view); 109, Hindlimb (Ventral view).

Hindlimbs : Long ; tibiotarsal articulation reaching tip of snout ; heels overlapping, when hindlimbs folded at right angles to body ; tibia four times as long as broad, more than half the length from snout to vent ; tips of toes dilated into prominent discs ; toes three-fourth webbed ; ultimate and penultimate phalanges of fourth toe free ; subarticular tubercles prominent ; inner metatarsal tubercles moderately prominent ; outer metatarsal tubercle absent.

Measurements in mm : From snout to vent ; 60.0-90.0 ; head : 22.5-31.5 ; width of head : 22.5-31.5 ; snout : 10.5-14.5 ; interorbital width : 3.5-4.0 ; tympanum : 3.5-4.5 ; forelimb : 40.0-56.0 ; first finger : 10.0-15.0 ; second finger : 9.0-14.0 ; hindlimb : 90.0-130.0 ; tibia : 35.5-51.0 ; foot : 29.0-45.0 ; third toe : 14.4-30.0 ; fourth toe : 27.5-43.0 ; fifth toe : 17.0-32.0.

Distribution : India (Meghalaya, Manipur).

Remarks : This species was originally described from Mawphlang, Khasi hills, Meghalaya (Pillai & Chanda, 1977). The present study extends its distribution upto Manipur.

34. *Rana mawlyndipi* Chanda (Figs. 107-109)

1990. *Rana mawlyndipi* Chanda, *J. Bengal nat. Hist. Soc.* N.S. 9 (1) : 44.

Type locality : Mawlyndip, Khasi hills, Meghalaya, India.

Location of type : National zoological collections, Zoological Survey of India, Calcutta, India.

Material examined : 1 ♀, Mawlyndip, Khasi hills, Meghalaya, 19.v.1980, Coll. S. K. Chanda.

Diagnosis : Dorsally deep brown to blackish, with black canthal and temporal bands. Throat and ventral side of limbs spotted or marbled with black to brown. Skin smooth. A prominent fold extends from posterior corner of eyes above the tympanum to forelimbs. Ventral surface smooth.

Head : Broader than long, slightly depressed ; snout slightly pointed, projecting beyond lower jaw ; canthus rostralis obtuse ; loreal region slightly concave ; nostrils equidistant from eyes and tip of snout ; internarial distance about one and half times the interorbital width ; tympanum small, prominent, less than half of eyes, separated from the latter by a space of three-fourth the diameter of eyes ; eyes large ; pupil horizontal ;

vomerine teeth oblique in position, projecting upto posterior border of choanae ; tongue large, entire.

Forelimbs : Short and stout ; fingers long, free, without intercalary ossicle ; tips of fingers dilated into small discs ; first finger a little shorter than second ; third finger equal to snout ; subarticular tubercles well developed.

Hindlimbs : Long ; tibiotarsal articulation reaching nostrils ; heels strongly overlapping when hindlimbs folded at right angles to body ; tibia two and half times as long as broad, less than half the length from snout to vent ; toes long, more than two-thirds webbed ; ultimate phalanges of fourth toe free ; tips of toes dilated into prominent discs which are equal to finger discs ; subarticular tubercles prominent and well developed ; an oval, prominent, inner metatarsal tubercle present ; outer metatarsal tubercle absent ; outer metatarsals separated on distal half.

Measurements in mm : Snout to vent : 83.0 ; head : 30.0 ; width of head : 35.5 ; snout : 13.0 ; eye : 7.5 ; interorbital width : 6.5 ; tympanum : 3.0 ; forelimb : 46.0 ; first finger : 11.5 ; second finger : 12.5 ; third finger : 13.0 ; fourth finger : 12.0 ; hindlimb : 127.0 ; tibia : 46.0 ; foot : 45.5 ; third toe : 25.0 ; fourth toe : 32.0 ; fifth toe : 24.5.

Distribution : India (Mawlyndip, Khasi hills, Meghalaya).

Remarks : This species has been recorded originally from Meghalaya, Khasi hills, northeast India (Chanda 1990). It is a very rare species of frog and nocturnal in habit. The present material was collected from the overhanging vegetation near a lake of Mawlyndip. This frog appears to have certain resemblance with *Rana mawphlangensis* Pillai & Chanda which was collected and described from Mawphlang, Khasi hills, Meghalaya.

35. *Rana tigerina* Daudin

(Figs. 110-112)

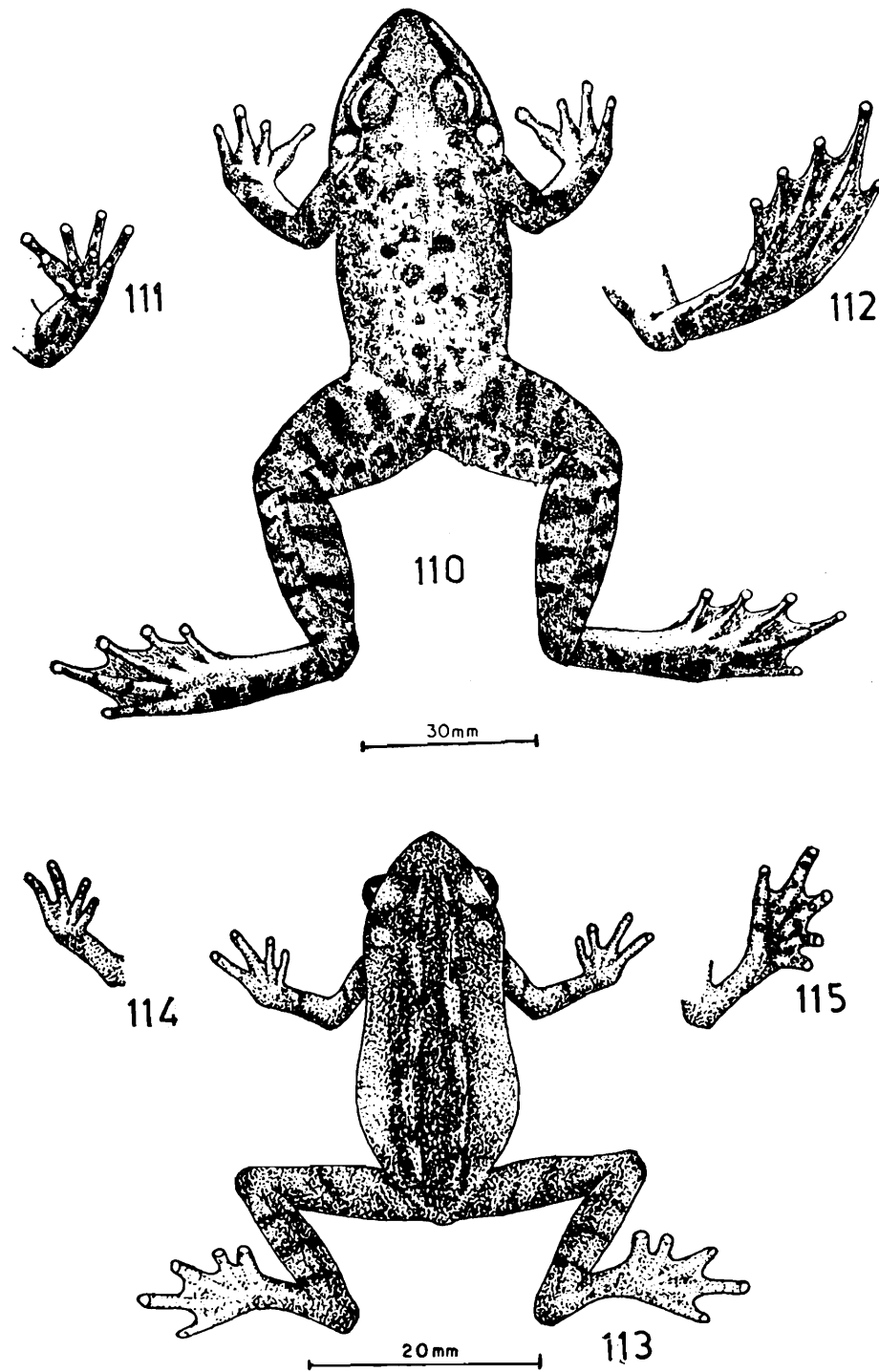
1805. *Rana tigerina* Daudin, *Hist. Rain. Gren. Crap.*, : 64.

1890. *Rana tigerina* Boulenger, *Fauna Brit. India including Ceylon and, Burma Reptilia and Batrachia* : 449.

1985. *Rana tigerina* Frost, *Amphibian species of the world* : 518.

Type locality : Bengal, India.

Location of type : Museum National d'Histoire Naturelle, Laboratoire des Amphibiens et Reptiles, Paris, France. (Now lost).



Figs. 110-115 ; 110, *Rana tigerina* (Dorsal view) ; 111, Forelimb (Ventral view) ; 112, Hindlimb (Ventral view) ; 113, *Chirixalus doriae* (Dorsal view) ; 114, Forelimb (Ventral view), 115, Hindlimb (Ventral view).

Material examined : 3 ♀ ♀, 1 ♂, Barapathar, Assam, 5.iii.1976, Coll. A. K. Sahu ; 3 ♀ ♀, 5 ♂ ♂, Guwahati, Assam, 15.v.1977, Coll. A. K. Sahu ; 2 ♀ ♀, 1 ♂, Goalpara, Assam, 12.i.1972, Coll. S. Biswas ; 3 ♀ ♀, Sibsagar, Assam, 18.xi.1976, Coll. K. R. Rao ; 2 ♂ ♂, Churachandpur, Manipur, 18.i.1976, Coll. A. K. Ghosh ; 4 ♀ ♀, 2 ♂ ♂, Udaipur, Tripura, 16.vi.1983, Coll. S. K. Chanda ; 2 ♀ ♀, Kohima, Nagaland, 3.vii.1976, Coll. K. R. Rao.

Diagnosis : Dorsally yellowish to olive green, marked with large irregular blackish spots which may be disposed in longitudinal series on the back or forming two or three cross bands. Towards the posterior side of the back, these spots become more numerous and crowded. A dark band running anteriorly from eye to snout over the nostril. Occasionally a very narrow light yellow vertebral stripe from snout to vent. The young bears a yellowish lateral band behind eyes which are absent in the adults. Ventrally white, without spots or few spots on the throat. In males seasonal changes in colour is well known. Dorsal skin covered with longitudinal folds ; a strong glandular fold extends from eye to shoulder. Ventral skin smooth.

Head : As long as broad, slightly depressed ; snout pointed, projecting much beyond lower jaw, nearly equal to tympanum ; canthus rostralis obtuse ; loreal region concave ; nostrils nearer to tip of snout than to eyes ; interorbital width less than internarial space which is about one-third of eyes ; tympanum very distinct, two-thirds of eyes ; vomerine teeth strong, curved and oblique in position, extending to the anterior border of choanae and running beyond the level of posterior border of choanae.

Forelimbs : Much shorter in comparison to hindlimb ; fingers free, long with rounded tips ; first finger longer than second, third finger slightly longer than snout ; subarticular tubercles small but very prominent.

Hindlimbs : Very long ; tibiotarsal articulation reaching beyond tip of snout ; heels overlapping when hindlimbs folded at right angles to body ; tibia two to three times as long as broad, less than half the length of snout to vent, longer than forelimb and foot ; toes long, entirely webbed with prominent rounded tips ; webbing on two distal digits of fourth toe very narrow but with connecting tips ; subarticular tubercles small, very prominent ; prominent dermal fold present on inner side of fifth toe ; a more or less prominent dermal fold present on inner side of tarsus, interrupted by inner metatarsal tubercle which is blunt and about two-thirds of inner toe ; outer metatarsal tubercle absent.

Measurements in mm : From snout to vent : 71.0-88.5 ; head : 24.0-30.5 ; width of head : 25.0-32.5 ; snout : 9.0-11.5 ; eye : 8.0-10.0 ; interorbital width : 3.0-3.4 ; tympanum : 6.0-6.5 ; forelimb : 37.0-45.0 ; first finger : 7.5-9.5 ; second finger : 5.0-6.5 ; third finger : 7.0-9.5 ; hindlimb : 99.0-123.5 ; tibia : 31.5-42.5 ; foot : 32.5-44.5 ; third toe : 15.5-22.5 ; fourth toe : 23.5-36.5 ; fifth toe : 17.5-25.5.

Distribution : All over India including Assam, Manipur, Mizoram, Nagaland, Tripura ; Nepal ; Burma ; China ; Indo-China.

Remarks : This species occurs throughout the Indian region. In northeast India it was earlier recorded from Assam and Tripura. During the present study it has been recorded for the first time from Manipur, Mizoram and Nagaland. Boulenger (1920) recorded four forms of this species viz, *Rana tigerina*, *Rana crassa*, *Rana occipitalis* and *Rana pantherina* and out of them only *Rana tigerina* in northeast India. This species was killed extensively for the export of frogleg. Uninhibited collections from the wild has caused serious concern as it is well known that the species acts as a predator of several harmful insect pests specially in agricultural fields. This depletion of natural population is believed to have caused ecological imbalance in northeast India which served as the major area of collection for export markets. In view of great concern, the Government of India have banned collection during the breeding season and also fixed a quota for yearly export. Now it is totally banned from the export list.

Family : RHACOPHORIDAE

Diagnosis : Upper jaw toothed ; lower jaw toothless. Vomerine teeth present or absent. Tongue free and deeply bifurcated. Tympanum distinct. Intercalary cartilage present between the penultimate and terminal phalanges. Fingers minutely to fully webbed ; toes two-thirds to fully webbed. Tips of fingers and toes dilated into prominent discs or rounded tips. Vertebrae procoelous. Omosternum and sternum with bony style.

Type genus : *Rhacophorus* Kuhl & V. Hass, 1827.

Distribution : India ; Sri Lanka ; Burma ; China ; Indo-China ; Malaysia ; Indonesia ; Phillipines ; Africa ; Madagascar.

Chirixalus (Boulenger)

1890. *Ixalus* Boulenger, *The Fauna of British India including Ceylon and Burma. Reptilia and Batrachia* : 480.

1970. *Chirixalus* Liem : *Fieldiana zoology*, 57 : 94.

1985. *Chirixalus* Frost : *Amphibian species of the world* : 538.

Diagnosis : Medium-sized slender rhacophorids (3-4 cm. in snout-vent length) ; skin of body and limbs smooth ; pupil horizontal ; two inner fingers free, two outer ones two-thirds to three-fourths webbed ; toes extensively webbed. Omosternum moderately forked at base ; vertebral column procoelous and relatively elongate ; nasal squash-shaped ; fronto-

parietal rectangular or dilated anteriorly ; vomerine teeth absent ; terminal phalanges bifurcated.

Type species : *Chirixalus doriae* Boulenger.

Distribution : Assam ; Burma ; Thailand ; Indo-China ; Hainan ; Formosa.

Remarks : A total of seven species of this genus has been recorded from the world of which, only one species *Chirixalus doriae* has been recorded from northeast India. Species of this genus are arboreal, living on trees or shrubs.

36. *Chirixalus doriae* Boulenger (Figs. 113-115)

1893. *Chirixalus doriae* Boulenger, *Ann. Mus. Civ. Stor. Nat. Genova*, (2) 13 : 341.

1985. *Chirixalus doriae* : Frost, *Amphibian species of the world* : 538.

Type locality : Karin Bia-po, Burma.

Location of types : Museo Civico di Storia Naturale di Genova "Glacoma Doria", Via Brigata Liguria, Genova, Italy ; Naturhistorisches Museum, Zoologische Abtheilung, Postfach 417, 1014 Wien, Austria and Britias Museum (Natural History), London, U. K.

Material examined : 1 ex., ♀, Abor hills, Arunachal Pradesh, 9.i.1912, Coll. S. W. Kemp.

Diagnosis : Dorsally varying from dark grey to brown ; two dorsolateral glandular folds extending from anterior to posterior region of body. Limbs dark brown with indistinct cross-bars. Ventral surface of belly and limbs almost white. Eyes blackish. A faint dark line extends from anterior corner of eye to tip of snout. Skin smooth, sometimes several minute tubercles present on the dorsum. Ventrally smooth.

Head : As long as broad, slightly depressed ; snout pointed, projecting a little beyond lower jaw ; canthus rostralis prominent ; loreal region slightly concave ; nostrils much closer to tip of snout than to eyes ; internarial distance equal to interorbital width which is slightly broader than eyes ; tympanum distinct, slightly depressed, half the diameter of eyes ; separated from the eyes by a space about one-third of tympanic diameter.

Forelimbs : Moderately long, slender ; fingers moderately long, free ; tips of fingers dilated into rounded tips ; first finger a little shorter than second ; third finger longest but shorter than snout ; subarticular tubercles indistinct.

Hindlimbs : Long, slender ; tibiotarsal articulation reaching tip of snout ; heels

overlapping when hindlimbs folded at right angles to body ; tibia four and half times as long as broad, less than half the length from snout to vent ; toes long and slender ; fourth toe longest, shorter than snout ; tips of toes dilated into small rounded discs ; toes two-third webbed ; both inner and outer metatarsal tubercles present.

Measurements in mm : From snout to vent : 20.0 ; head : 6.0 ; width of head : 6.0 ; snout : 7.5 ; eyes : 3.0 ; interorbital width : 3.5 ; tympanum : 1.5 ; forelimb : 10.0 ; first finger : 3.5 ; second finger : 3.0 ; third finger : 4.5 ; hindlimb : 36.0 ; tibia : 9.0 ; foot : 9.0 ; third toe : 3.5 ; fourth toe : 5.0 ; fifth toe : 3.5.

Distribution : India (Arunachal Pradesh) ; Burma ; China ; Indo-China.

Remarks : Boulenger (1893) described the species under the genus *Chirixalus*. Subsequently, it was recorded from Arunachal Pradesh (Annandale, 1912). Subsequent surveys in Arunachal Pradesh however did not yield any more specimens. Although the type was not available I have examined Annandale's material and compared the same with the description Boulenger (1893) and did not find any marked variation. Measurements of body parts have been taken from Annandale's material and incorporated here as these were not mentioned in earlier descriptions (Boulenger, 1893, Annandale, 1912). The females of the above species are comparatively larger than males and the skin of the throat is quite loose (Pope, 1931).

Genus : *Philautus* Gistel

1848. *Philautus* Gistel, *Naturgesch. Thierr.*, : 10.

1893. *Chirixalus* Boulenger, *Ann. Mus. Genova.*, 13 (2) : 340.

1985: *Philautus* : Frost, *Amphibian species of the world* : 525.

Diagnosis : Skin smooth, sometimes granulated. Tongue free and deeply notched behind. Vomerine teeth absent. Pupil horizontal. Tympanum distinct or hidden. Fingers free or minutely webbed at the base. Toes webbed ; tips of fingers and toes dilated into swollen discs or rounded tips. Omosternum and sternum with a bony style. Outer metatarsal separated by a groove or a narrow web. Presence of an intercalary ossicle between the penultimate and terminal phalanges. Terminal phalanges obtuse or bifurcate.

Type species : *Hyla aurifasciatus* Schlegel, 1837 by monotypy.

Distribution : India ; Sri Lanka ; Burma ; Indo-China ; Malaysia ; Indonesia ; Philippines.

Remarks : A total of 89 species of this genus have so far been recorded from the

world, of which 27 species are known from Indian region and only nine species known from northeast India.

Key to the species of *Philautus* of northeast India

1. Head as long as broad or longer than broad 2
 Head broader than long 3
2. Tympanum two-third the diameter of eyes ; snout obtusely pointed, slightly longer than eyes ; toes more than two-third webbed ; inner and outer metatarsal tubercle present *shyamrupus*.
 Tympanum more than half the diameter of eyes ; snout slightly pointed ; toes fully webbed ; inner metatarsal tubercle present, outer metatarsal tubercle absent *argus*.
3. Tympanum distinct or fairly distinct 4
 Tympanum hidden ; toes webbed at the base ; nostril equidistant from eyes and tip of snout *kempiae*.
4. Tibiotarsal articulation reaching tip of snout or beyond tip of snout 5
 Tibiotarsal articulation not reaching tip of snout 6
5. Toes only webbed at the base ; nostrils equidistant from eyes and tip of snout ; tympanum as large as eye ; tibia three to three and a half times as long as broad *annandalii*.
 Toes three-fourth webbed ; nostrils closer to tip of snout than to eyes ; tympanum fairly distinct *cherrapunjiae*.
6. Tibiotarsal articulation reaching eye 7
 Tibiotarsal articulation not reaching eye 8
7. Tibiotarsal articulation reaching anterior corner of eyes ; tibia more than half the length of snout to vent ; tympanum more than one-third the diameter of eye *andersoni*
 Tibiotarsal articulation reaching eye ; tibia half the length of snout to vent ; tympanum one-third the diameter of eye *garo*.
8. Tibiotarsal articulation reaching in between eyes and anterior part of nostril ; tympanum indistinct ; toes nearly half-webbed, web reaching the second penultimate

phalange of fourth toe and first penultimate phalange of third and fifth toe
 *namdaphaensis*.
 Tibiotarsal articulation reaching posterior corner of eyes ; tympanum fairly distinct ;
 toes free ; inner metatarsal tubercle present ; outer metatarsal tubercle absent
 *shillongensis*.

37. *Philautus andersoni* (Ahl) (Figs. 116-118)

1927. *Ixalus andersoni* Ahl, *Sitzungsber Ges. naturf. Freunde Berlin* : 35-37.
 1974. *Philautus andersoni* : Gorham, *Checklist of world amphibians upto January, 1976* : 166.
 1979. *Philautus andersoni* : Pillai & Chanda, *Rec. zool. Surv. India*, 75 : 391.
 1985. *Philautus andersoni* : Frost, *Amphibian species of the world* : 326.

Type locality : Kakhyen hills, Burma.

Location of type : Not known.

Material examined : 4 ♀ ♀, 3 ♂ ♂, Shillong, Khasi hills, Meghalaya, 9.iii.1971, Coll. R. S. Pillai ; 7 ♂ ♂, 3 ♀ ♀, Barapani, Khasi hills, Meghalaya, 3.vi.1973, Coll. S. K. Chanda ; 4 ♀ ♀, 2 ♂ ♂, Umtham, Khasi hills, Meghalaya, 5.vi.1979, Coll. S. K. Chanda ; 3 ♀ ♀, Mawphlang, Khasi hills, Meghalaya, 3.vi.1974, Coll. M. Datta ; 2 ♂ ♂, 1 ♀, Garampani, Meghalaya, 29.i.1975, Coll. S. K. Chanda.

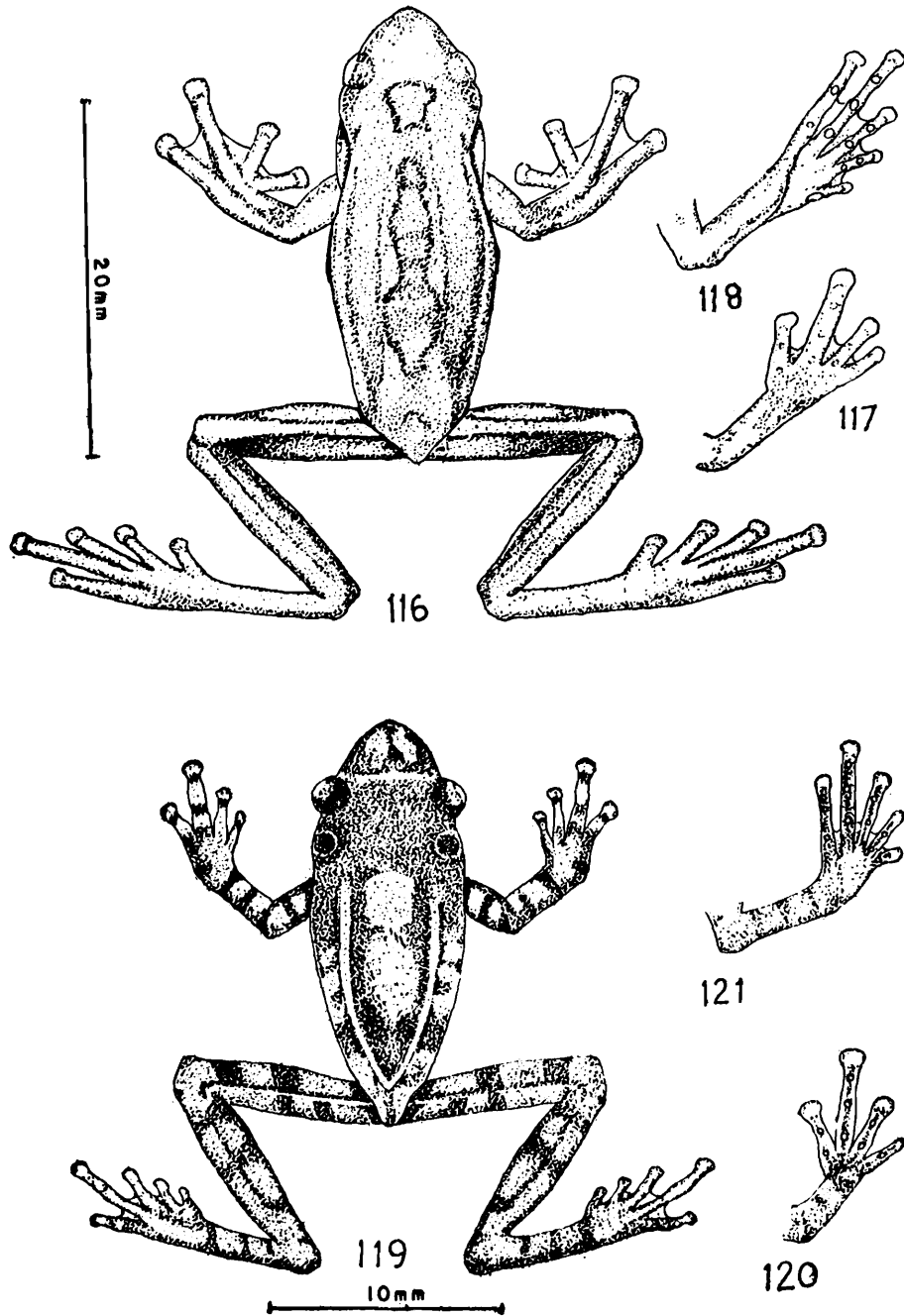
Diagnosis : Dorsally brown to olive. Ventral surface white to yellowish. Dorsal skin smooth ; lateral parts of body and thighs with numerous small warts, which are also present on the upper and lateral parts of the head. A narrow fold extends from posterior corner of eyes to shoulder. Ventral surface of body and limbs smooth.

Head : Broader than long, slightly depressed ; snout moderately long ; canthus rostralis slightly concave ; nostrils closer to tip of snout than to eyes ; internarial space nearly equal to interorbital width, which is slightly greater than diameter of eyes ; tympanum distinct, more than one-third of eyes, separated from the eyes by a space about one-fourth of tympanic diameter.

Forelimbs : Short ; fingers moderately long, slender, free with swollen tips ; first finger shorter than second ; third finger longest, slightly longer than snout ; subarticular tubercles small, indistinct ; palm with moderately fleshy pad.

Hindlimbs : Moderately long ; tibiotarsal articulation reaching anterior corner of eyes ; heels just meeting when hindlimbs folded at right angles to body ; tibia three to three and a half times as long broad, more than half the length from snout to vent ; toes

slender, webbed at the base with prominent swollen tips ; first toe a little shorter than second ; fourth toe longest, much longer than snout ; subarticular tubercles small and indistinct ; small, indistinct inner and outer metatarsal tubercles ; sole with moderately fleshy pad.



Figs. 116-121 : 116, *Philautus andersoni* (Dorsal view) ; 117, Forelimb (Ventral view) ; 118, Hindlimb (Ventral view) ; 119, *Philautus annandalii* (Dorsal view) ; 120, Forelimb (Ventral view) ; 121, Hindlimb (Ventral view).

Measurements in mm : From snout to vent : 25.0-31.0 ; head ; 11.0-13.0 ; width of head : 12.0-13.5 ; snout : 4.5-6.0 ; Interorbital width : 4.0-5.0 ; eye : 4.0-5.5 ; tympanum : 1.5-2.0 ; forelimb : 20.0-23.5 ; first finger : 1.5-2.5 ; second finger : 2.0-3.0 ; third finger : 5.5-6.5 ; hindlimb : 55.0-61.0 ; tibia : 16.5-19.5 ; foot : 17.0-20.0 ; first toe : 6.5-8.5 ; second toe : 7.0-9.5 ; fourth toe : 8.0-10.5.

Distribution : India (Meghalaya, Arunachal Pradesh) ; Burma.

Remarks : Subsequent to its description by Ahl (1927) this species remained rare as no further records were made till Pillai & Chanda (1979) reported it from Meghalaya and Arunachal Pradesh.

38. *Philautus annandalii* (Boulenger) (Figs. 119-121)

1906. *Ixalus annandalii* Boulenger, *J. Asiat. Soc. Beng*, (2) : 385-386.

1912. *Ixalus annandalii* : Annandale, *Rec. Indian Mus.*, 8 : 16.

1974. *Philautus annandalii* Gorham, *Checklist of world amphibians up to January 1, 1970* : 166.

1986. *Philautus annandalii* : Frost, *Amphibian species of the world* : 526.

Type locality : East Himalayas, Kurseong, Darjeeling district (alt. 1524 m), West Bengal, India.

Location of type : Zoological Survey of India, Calcutta, India.

Material examined : 4 ♀♀, Goalpara, Assam, 10.vii.1978, Coll. S. K. Chanda ; 2 ♂♂, Gibbons Land, Namdapha Biosphere Reserve, Arunachal Pradesh, 15.xii.1983, Coll. S. Biswas.

Diagnosis : Dorsally grey to brown ; a dark bar connecting two eyes ; a "v"-shaped band extends from the posterior region of eyes to groin ; a dark streak present below the canthus rostralis and another vertical streak present below the eyes ; limbs with dark bands ; ventrally greyish, spotted or marbled with brown. Skin smooth ; a strong glandular fold extends from the posterior region of eyes to shoulder ; throat smooth ; belly and ventral parts granulated.

Head : Broader than long, slightly depressed ; snout pointed, slightly projecting beyond the lower jaw ; canthus rostralis prominent ; loreal region concave ; interorbital space slightly broader than eyes ; nostrils equidistant from eyes and tip of snout ; internarial distance nearly equal to interorbital width ; tympanum distinct, as large as eyes, separated from the eyes by a space about half of tympanic diameter.

Forelimbs : Slender ; fingers short, free ; tips of fingers dilated into rounded tips ; first finger a little shorter than second ; third finger longest, nearly equal to snout ; subarticular tubercles not very prominent.

Hindlimbs : Moderately long ; tibiotarsal articulation reaching tip of snout ; heels just meeting when hindlimbs folded at right angles to body ; toes webbed at the base ; tips of toes swollen into rounded tips ; fourth toe longest ; tibia three to three and half times as long as broad, less than half the length from snout to vent ; both inner and outer metatarsal tubercles absent.

Measurements in mm : From snout to vent : 16.0-20.0 ; head : 4.5-5.0 ; width of head : 5.0-5.3 ; snout : 2.5-3.0 ; eye : 3.0-3.5 ; interorbital width : 3.5-3.8 ; tympanum : 3.0-3.5 ; forelimb : 11.0-14.0 ; first finger : 1.3-1.5 ; second finger : 2.0-2.3 ; third finger : 2.3-2.5 ; hindlimb : 27.0-29.0 ; tibia : 7.0-7.5 ; foot : 5.5-6.5 ; third toe : 2.0-2.5 ; fourth toe : 3.0-3.5 ; fifth toe : 2.0-2.4.

Distribution : India (West Bengal, Assam, Arunachal Pradesh).

Remarks : This species was originally described from Kurseong, (alt. 1350 m) West Bengal (Boulenger, 1906). Annandale (1912) recorded the species from Assam. During the present study it has been recorded for the second time from Assam after a span of more than 70 years and for the first time from Arunachal Pradesh. Although the types were not available, the author compared the present material with the original description (Boulenger, 1906 ; Annandale, 1912) and did not find any marked variations. Measurements of different body parts have been incorporated here as these were not mentioned in earlier descriptions (Boulenger, 1906 ; Annandale, 1912).

39. *Philautus argus* (Annandale) (Figs. 122-124)

1912. *Ixalus argus* Annandale, *Rec. Indian Mus.*, 8 : 16.

1974. *Philautus argus* : Gorham, *Checklist of world amphibians up to January 1, 1970* : 166.

1985. *Philautus argus* : Frost, *Amphibian species of the world* : 527.

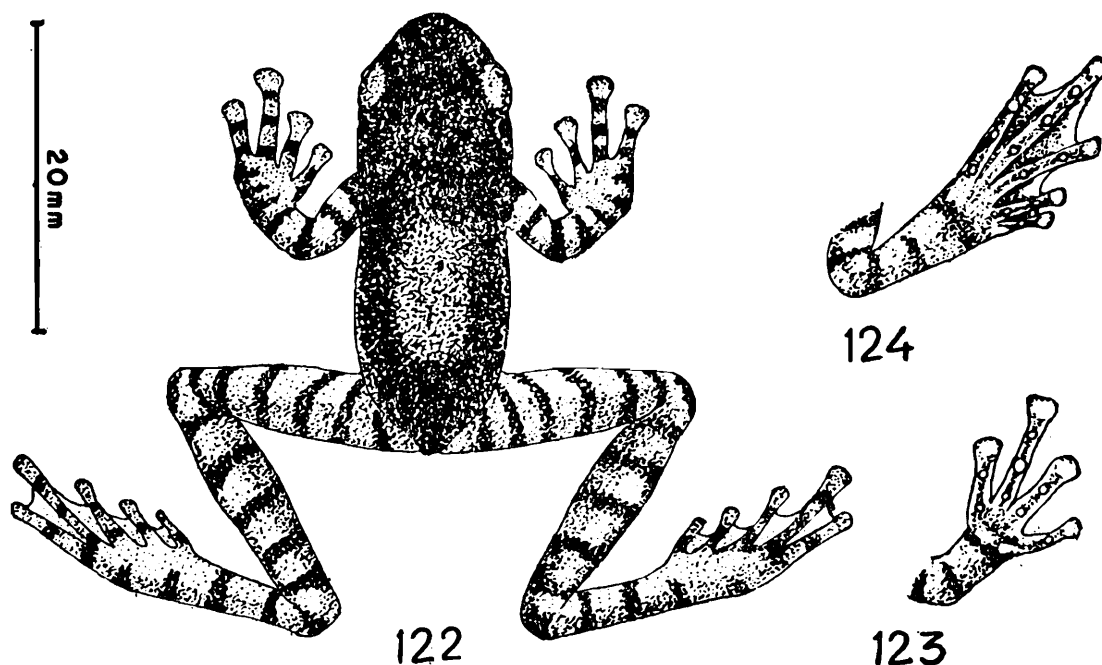
Type locality : "Upper Ranging, Abor country", Arunachal Pradesh, India.

Location of type : Zoological Survey of India, Calcutta, India.

Material examined : 1 ♀, Upper Ranging, Abor hills, Arunachal Pradesh, 1911, Coll. S. W. Kemp.

Diagnosis ; Dorsally dark grey to brown. Ventral surface almost white. Throat and chest greyish, spotted or marbled with brown. Sole and palm dark grey to brown. Limbs, fingers and toes with dark grey bands. Skin smooth ; few small scattered tubercles present on the posterior region of the body. Ventral surface almost smooth.

Head : Longer than broad, depressed ; snout slightly pointed ; nostrils a little nearer to tip of snout than to eyes ; canthus rostralis more or less distinct ; loreal region concave ;



Figs. 122-124 : 122, *Philautus argus* (Dorsal view) ; 123, Forelimb (Ventral view) ; 124, Hindlimb (Ventral view).

tympanum small, distinct, more than half of eyes ; interorbital space broader than upper eyelid ; a small toothlike process present at the apex of lower jaw.

Forelimbs : Moderately long, slender ; fingers moderately long, free with prominent discs ; first finger slightly shorter than second ; third finger longest, much longer than snout ; subarticular tubercles large and prominent.

Hindlimbs : Moderately long ; tibiotarsal articulation reaching nostrils ; tibia three to four times as long as broad, more than half the length from snout to vent ; tips of toes dilated into small discs ; toes fully webbed ; subarticular tubercles prominent ; inner metatarsal tubercle present, outer metatarsal tubercle absent.

Measurements in mm : From snout to vent : 27.0 ; head : 12.0 ; width of head : 11.0 ; snout : 5.0 ; eye : 5.0 ; tympanum : 2.8 ; forelimb : 22.0 ; first finger : 2.0 ;

second finger : 5.0 ; third finger : 7.0 ; hindlimb : 58.0 ; tibia : 17.0 ; foot : 18.0 ;
third toe : 9.0 ; fourth toe : 12.0 ; fifth toe : 9.0.

Distribution : India (Arunachal Pradesh).

Remarks : This species was originally described from Abor hills, Arunachal Pradesh (Annandale, 1912). Several surveys in and around Arunachal Pradesh did not yield any further result. The author compared the original description with the type and found certain variation *viz.*, diameter of tympanum more than half of eyes, discs of fingers small but prominent, subarticular tubercles very prominent and snout slightly pointed, etc. According to Annandale (1912) tympanum is one-third diameter of eyes, discs of fingers very large and prominent, subarticular tubercles indistinct and snout blunt. As measurement of different body parts were not provided earlier these have been incorporated here.

40. *Philautus cherrapunjiae* Roonwal & Kripalani (Figs. 125-127)

1961. *Philautus cherrapunjiae* Roonwal & Kripalani, *Rec. Indian Mus.*, 59 : 325-330.

1974. *Philautus cherrapunjiae* : Gorham, *Checklist of world amphibian up to January 1, 1970* : 166.

1976. *Philautus cherrapunjiae* : Pillai & Chanda, *J. Assam Sci. Soc.*, 19 : 55.

1985. *Philautus cherrapunjiae* : Frost, *Amphibian species of the world* : 528.

Type locality : Near Circuit house, *ca.* 3 km from Cherrapunjiae Town, Khasi hills, Meghalaya, India.

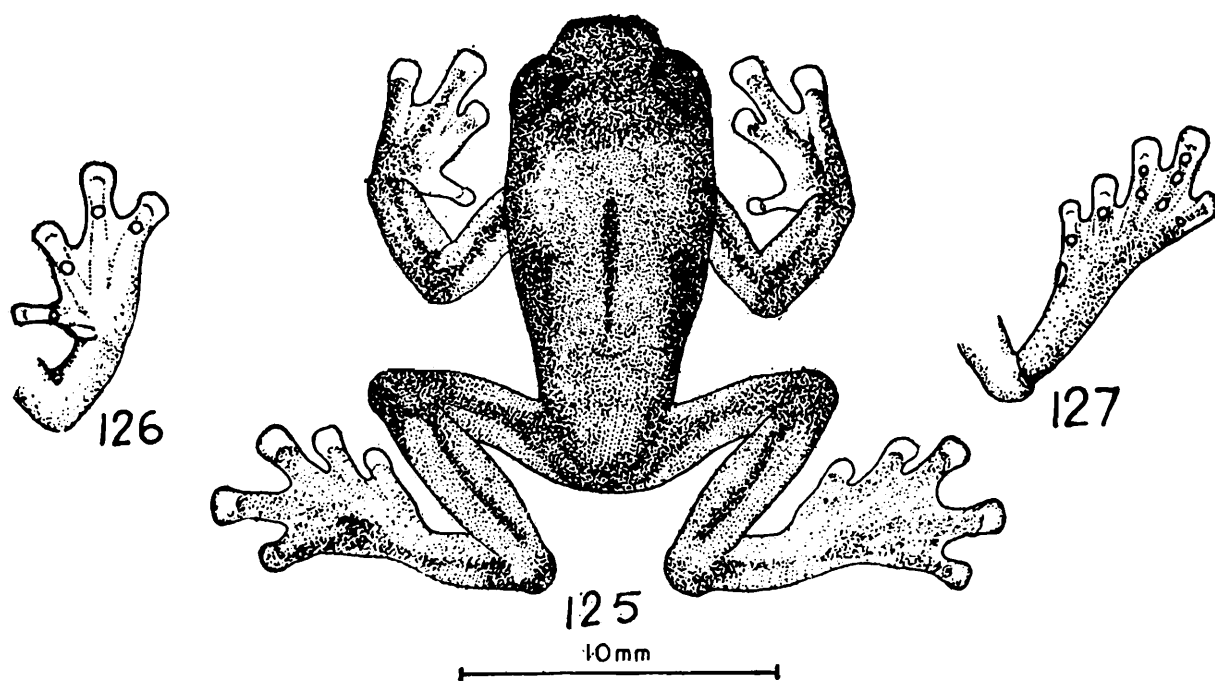
Location of type : Zoological Survey of India, Calcutta, India.

Material examined : 1 ♂, Cherrapunjiae, Khasi hills, Meghalaya, 16.v.1960, Coll. M. L. Roonwal & A. P. Kapur ; 1 ♀, Cherrapunjiae, Khasi hills, Meghalaya, 22.ix.1970, Coll. G. M. Yazdani ; 3 ♀ ♀, Mawblong, Khasi hills, Meghalaya, 12.vi.1970, Coll. J. M. Julka ; 31 (Juvenile), Pynursla, Khasi hills, Meghalaya, 17. viii.1970, Coll. S. K. Chanda ; 2 ♀ ♀, 3 ♂ ♂, Mawblong, Khasi hills, Meghalaya, 19.xi.1971, Coll. S. K. Chanda.

Diagnosis : Dorsally pale green to dark green. Lower jaw whitish. Chest and abdomen grey to light brown. Eyes dark brown to blackish. Skin smooth. Sometimes with faint folds. A narrow, faint fold extends from eye to shoulder. Abdomen faintly granulated on the ventral side.

Head : Broader than long, slightly depressed ; snout short, nearly equal to eyes ; canthus rostralis not prominent ; loreal region concave ; nostrils much closer to tip of snout

than to eyes ; internarial space smaller than interorbital width which is nearly equal to eyes ; tympanum fairly distinct, half the diameter of eyes ; eyes prominent and directed upward and forward.



Figs. 125-127 : 125, *Philautus cherrapunjiae* (Dorsal view); 126, Forelimb (Ventral view); 127, Hindlimb (Ventral view).

Forelimbs : Short ; fingers moderately long, nearly half-webbed ; first finger slightly shorter than second ; third finger longest, longer than snout ; tips of fingers dilated into prominent semicircular discs ; subarticular tubercles small, prominent.

Hindlimbs : Long ; tibiotarsal articulation reaching tip of snout ; heels just meeting when hindlimbs folded at right angles to body ; tibia three to four times as long as broad, less than half the length from snout to vent. Toes three-fourths webbed ; fourth toe longest ; third and fifth toes subequal ; tips of toes dilated into subround discs ; subarticular tubercles moderately developed ; both inner and outer metatarsal tubercles absent.

Measurements in mm : From snout to vent : 17.0-21.0 ; head : 5.0-6.0 ; width of head : 7.0-8.0 ; snout : 3.5-4.5 ; eye : 3.0-4.0 ; tympanum : 1.5-2.0 ; interorbital width : 3.5-4.5 ; forelimb ; 13.0-14.0 ; first finger : 3.0-4.0 ; second finger ; 2.5-3.5 ;

third finger : 4·5-5·5 ; hindlimb : 27·0-31·0 ; tibia : 8·0-9·0 ; foot : 6·5-7·5 ; third toe : 2·5-3·5 ; fourth toe : 4·0-5·0 ; fifth toe : 2·5-3·5.

Distribution : India (Meghalaya).

Remarks : This species was not reported since Roonwal & Kripalani (1961) described it from northeast India. This species is endemic to northeast India and is at present restricted to Khasi hills, Meghalaya.

41. *Philautus garo* Boulenger (Figs. 128-130)

1919. *Philautus garo* Boulenger, *Rec. Indian Mus.*, 15 : 207.

1974. *Philautus garo* : Gorham, *Checklist of world amphibians up to January 1, 1970* : 166.

1985. *Philautus garo* : Frost, *Amphibian species of the world* : 528.

Type locality : Tura, Garo hills, Meghalaya, India.

Location of type : Not traced.

Material examined : 1 ♀, Tura, Garo hills, Meghalaya, 1911, Coll. S. W. Kemp.

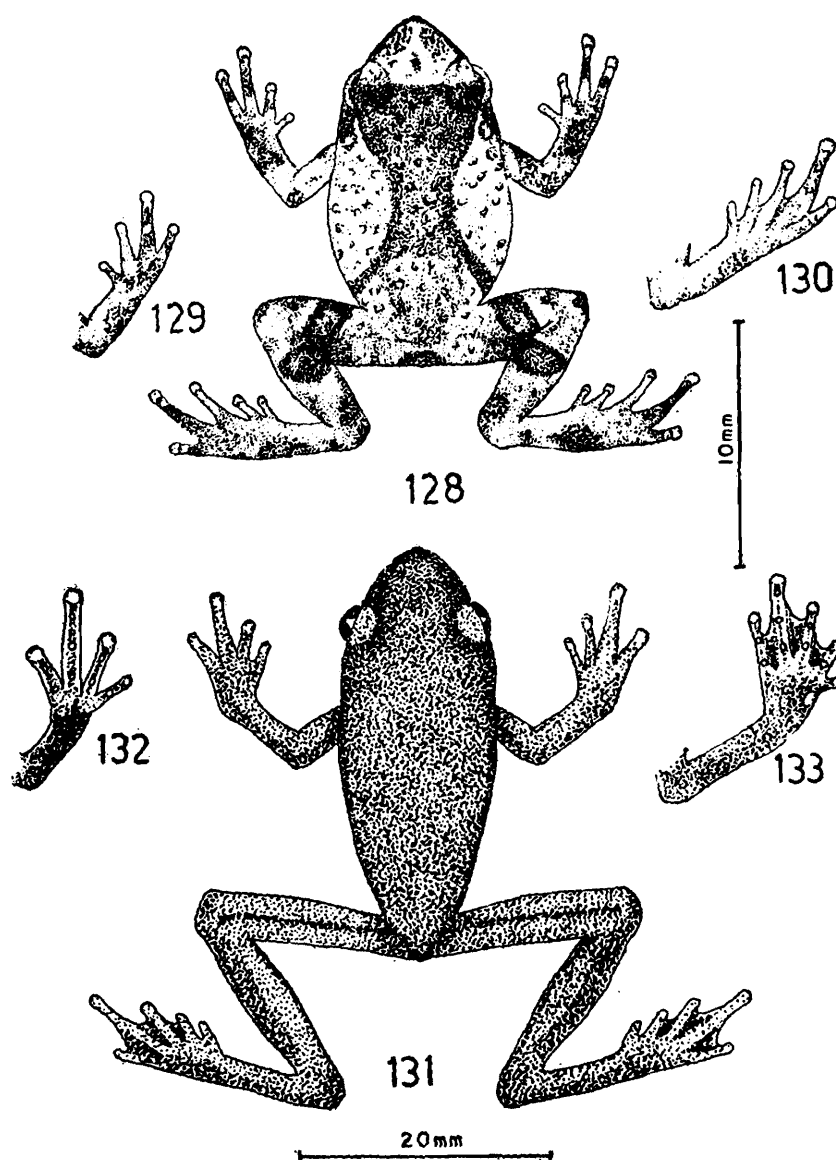
Diagnosis : Dorsally dark brown to blackish ; ventrally greyish to white ; lateral sides greenish. A dark brown patch present on loreal and temporal region. Limbs with irregular dark brown patches. Skin smooth. A glandular fold extends from posterior region of eyes to shoulder. Ventrally smooth.

Head : Broader than long, depressed ; snout pointed ; canthus rostralis prominent ; loreal region slightly oblique, concave ; nostrils equidistant from eyes and tip of snout ; interorbital width less than diameter of eyes ; tympanum distinct, one-third of eye.

Forelimbs : Short ; fingers short, free ; first finger shorter than second, third finger longest, longer than snout ; discs of fingers nearly as large as tympanum ; subarticular tubercles moderate.

Hindlimbs : Moderately long ; tibiotarsal articulation reaching eyes ; tibia two to three times as long as broad, half the length from snout to vent ; toes webbed at the base ; fourth toe longest, more than twice of snout ; discs of toes round, nearly as large as

tympanum ; heels overlapping when hindlimbs folded at right angles to body ; inner and outer metatarsal tubercles absent,



Figs. 128-133 : 128, *Philautus garo* (Dorsal view) ; 129, Forelimb (Ventral view) ; 130, Hindlimb (Ventral view) ; 131, *Philautus kempiae* (Dorsal view) ; 132, Forelimb (Ventral view) ; 133, Hindlimb (Ventral view).

Measurements in mm : From snout to vent : 16.0 ; head : 6.0 ; width of head : 7.0 ; interorbital width : 3.0 ; snout : 2.0 ; eye : 3.5 ; tympanum ; 1.2 ; forelimb :

9.0 ; first finger : 1.5 ; second finger : 2.5 ; third finger : 3.0 ; hindlimb : 25.0 ; tibia : 8.0 ; foot : 6.0 ; third toe : 3.0 ; fourth toe : 5.0 ; fifth toe : 4.0.

Distribution : India (Meghalaya).

Remarks : This species was originally described from Tura, Garo hills, Meghalaya (Boulenger, 1919) and is known only from the type. During the present study intensive collection in and around the type locality did not yield any further material. The author has compared the original description with type and found certain variations ; viz., interorbital width less than eyes, skin smooth, etc. According to Boulenger (1919) interorbital width equal to eye, skin faintly tuberculated on the lateral sides of the body. As measurements of different body-parts of the type were not provided earlier, these have been incorporated here.

42. *Philautus kempiae* (Boulenger) (Figs. 131-133)

1919. *Ixalus kempiae* Boulenger, *Rec. Indian Mus.*, 16 : 208.

1974. *Philautus kempiae* : Gorham, *Checklist of world amphibians up to January 1, 1970* : 166.

1985. *Philautus kempiae* : Frost, *Amphibian species of the world* : 529.

Type locality : Tura, Garo hills, Meghalaya, India.

Location of type : British Museum, (Natural History), London, U. K.

Material examined : 1 ♂, Tura, Garo hills, Meghalaya, 1911, Coll. S. W. Kemp.

Diagnosis : Dorsally grey to brown with blackish spots ; a black cross-bar between the eyes and a "V"-shaped marking on the back ; limbs with irregular dark cross-bars ; vertical bars present on the upper lip ; throat and belly almost white, spotted or marbled with brown. Skin dorsally tuberculated ; throat smooth ; belly with minute granules. ventral surface almost smooth.

Head : Broader than long ; snout rounded, slightly projecting beyond lower jaw ; canthus rostralis not prominent ; loreal region oblique and concave ; nostrils equidistant from eyes and tip of snout ; interorbital space less than the diameter of eyes ; tympanum hidden.

Forelimbs : Short, thin ; fingers short, free ; first finger shorter than second, third longest, longer than snout ; tips of fingers with prominent discs ; subarticular tubercles not very prominent.

Hindlimbs : Long ; tibiotarsal articulation reaches tip of snout ; heels overlapping when hindlimbs folded at right angles to body ; toes with prominent discs ; fourth toe longest, slightly longer than snout ; toes webbed at the base ; tibia two and half to three times as long as broad, less than half the length from snout to vent ; inner and outer metatarsal tubercles absent.

Measurements in mm : From snout to vent : 17.5 ; head : 6.0 ; width of head : 7.0 ; snout : 2.5 ; eye : 3.0 ; interorbital width : 2.5 ; forelimb : 13.0 ; first finger : 2.0 ; second finger : 2.6 ; third finger : 3.0 ; hindlimb : 27.0 ; tibia : 8.0 ; foot : 6.0 ; third toe : 2.0 ; fourth toe : 3.0 ; fifth toe : 2.0.

Distribution : India (Meghalaya).

Remarks : This species was originally described from Garo hills, Meghalaya (Boulenger, 1919) and is known only from the type. Several surveys made in and around the type locality did not yield any further material. The author studied the type material and compared it with the original description (Boulenger, 1919) and did not find any variation. Measurement of body parts have been taken from the type and incorporated herewith as these were not mentioned in earlier description (Boulenger, 1919).

43. *Philautus shyamrupus* Chanda & Ghosh

(Figs, 134-136)

1989. *Philautus shyamrupus* Chanda & Ghosh, *J. Bombay nat. Hist. Soc.*, 86 (2) : 215-217.

Type locality : Hornbill Camp, Namdapha Biosphere Reserve, Arunachal Pradesh, India.

Locatian of type : National zoological collection, Zoological Survey of India, Calcutta, India.

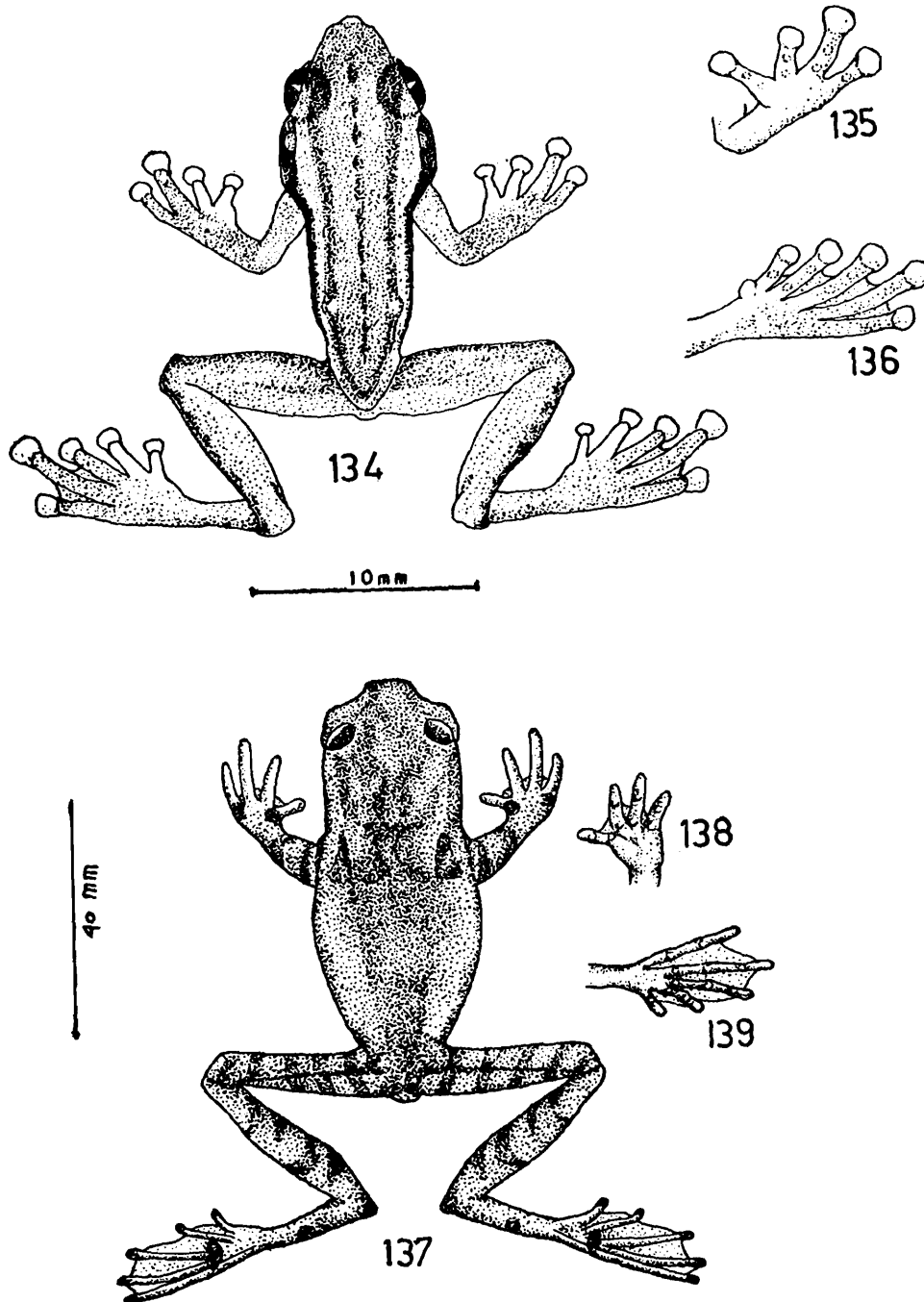
Material examined : 2 ♀ ♀, 3 ♂ ♂, Namdapha, Hornbill, Arunachal Pradesh, 13.xii.1983, Coll. S. Biswas.

Diagnosis : Varying from grey to brown on the dorsum. A dorsolateral white band on either side extending from posterior region of eyes and ending posteriorly near the vent. Limbs dark brown to grey. Eyes blackish. Ventral surface dirty white. A dark, narrow line originating from the interorbital region extends posteriorly to the hind end of the body. Skin smooth on the dorsal surface. Chest and belly smooth. Vental surface smooth.

Head ; As long as broad ; snout obtusely pointed, slightly longer than eyes ; canthus rostralis distinct ; nostrils closer to tip of snout than to eyes ; internarial distance

slightly less than interorbital width which is equal to eyes ; tympanum distinct, two-thirds of eyes ; tongue free and deeply notched behind.

Forelimbs : Moderately long and slender ; fingers free with prominent rounded tips ; first finger shorter than second.



Figs. 134-139 : 134, *Philautus shyamrupus* (Dorsal view) ; 135, Forelimb (Ventral view) ; 136, Hindlimb (Ventral view) ; 137, *Philautus namdaphaensis* (Dorsal view) ; 138, Forelimb (Ventral view) ; 139, Hindlimb (Ventral view).

Hindlimbs : Fairly long ; tibiotarsal articulation reaching nostrils : heels just meeting when hindlimbs folded at right angles to body ; tibia half the length from tip of snout to vent and three to four times as long as broad : fourth toe longest, longer than snout and with prominent discs ; discs of toes broader than long ; toes more than two-thirds webbed ; two distal phalanges of fourth toe free ; subarticular tubercles not prominent ; both inner and outer metatarsal tubercles absent.

Measurements in mm : From snout to vent : 19.6-25.0 ; head : 4.0-6.5 ; width of head : 4.0-6.5 ; snout : 3.5-4.5 ; eye : 2.5-3.5 ; interorbital width : 2.0-3.5 ; tympanum : 1.2-2.4 ; forelimb : 14.0-16.5 ; first finger : 2.0-3.5 ; second finger : 2.5-4.0 ; third finger : 3.5-5.0 ; hindlimb : 27.0-33.5 ; tibia : 9.3-12.5 ; foot : 6.0-9.0 ; third toe : 2.5-5.0 ; fourth toe : 3.0-4.5 ; fifth toe : 2.0-3.0

Distribution : India (Arunachal Pradesh).

Remarks : This species was recorded originally from Namdapha Biosphere Reserve, Arunachal Pradesh (Chanda & Ghosh, 1989). It is very closely related to *Philautus aurifasciatus* (Kuhl & V. Hass) and *Philautus argus* (Annandale, 1912). It is a very rare frog, endemic to northeast India.

44. *Philautus namdaphaensis* Sarkar & Sanyal (Figs. 137-139)

1985. *Philautus namdaphaensis* Sarkar & Sanyal, *Rec. zool. Surv. India.*, 82 (1-4) : 285-295.

Type locality : India : Farmbase camp, Tirap district, Arunachal Pradesh, northeast India.

Location of type : National zoological collections, Zoological Survey of India, Calcutta.

Material examined : 3 ♀ ♀, Farmbase Camp (alt. 350 m), Tirap district, Arunachal Pradesh, India, 18.vi.1981, Coll. S. Biswas,

Diagnosis : Dorsum dark brown, speckled with irregular brown spots. A thin mid-dorsal line from snout to vent. Limbs dorsally dark brown with indistinct cross bands. A prominent, broad white band present between the eyes covering the anterior part of the upper eyelids. Thigh, tibia and groin laterally brownish with dark blotches. Ventrally dirty white. Dorsal skin more or less smooth or with minute scattered tubercles ; belly and under surface of thighs granular. Throat and upper surface of limbs smooth.

Head : More or less triangular, slightly broader than long ; snout subacuminate, a little longer than the maximum diameter of the eye ; canthus rostralis not very distinct ; loreal region slightly concave ; nostril equidistant from the eye and snout ; interorbital width more than the diameter of eye ; tympanum fairly distinct ; tongue fairly large, free and bifid and without papilla ; vomerine teeth absent.

Forelimbs : Fairly stout, fingers moderate with intercalary ossicle, free with distinct, round discs which are nearly equal to that of the toes ; subarticular tubercles very distinct ; a feebly prominent, long palmar wart present laterally at the base of first finger.

Hindlimbs : Fairly stout ; toes moderately long with intercalary ossicles ; nearly half-webbed, webs reaching the base of the third and fifth toes ; a small feebly prominent inner metatarsal tubercle present ; outer metatarsal tubercle absent ; tibiotarsal articulation reaching between the anterior corner of eye and the nostril ; subarticular tubercles indistinct.

Measurements in mm : From snout to vent : 26.0-28.0 ; head : 7.0-7.5 ; width of head : 8.0 ; snout : 4.0 ; eye : 2.0 ; interorbital width : 3.0-3.5 ; forelimb : 17.0-18.0 ; first finger : 2.0-3.0 ; second finger : 3.0-4.0 ; third finger : 5.0-6.0 ; hindlimb : 39.0-42.0 ; tibia : 12.0-12.5 ; foot : 9.5-10.5 ; first toe : 2.0-2.5 ; third toe : 4.0-5.0 ; fourth toe : 6.5-7.5 ; fifth toe : 4.5-5.0.

Distribution : India (Tirap District, Arunachal Pradesh).

Remarks : This species was originally recorded from Arunachal Pradesh, northeast India (Sarkar & Sanyal, 1985). It is a rare species of frog endemic to northeast India. According to Sarkar & Sanyal (1985) this species is closely related to *Philautus parvulus* (Boulenger, 1893) known from Burma. This species is diurnal in habits.

45. *Philautus shillongensis* Pillai & Chanda (Figs. 140-142)

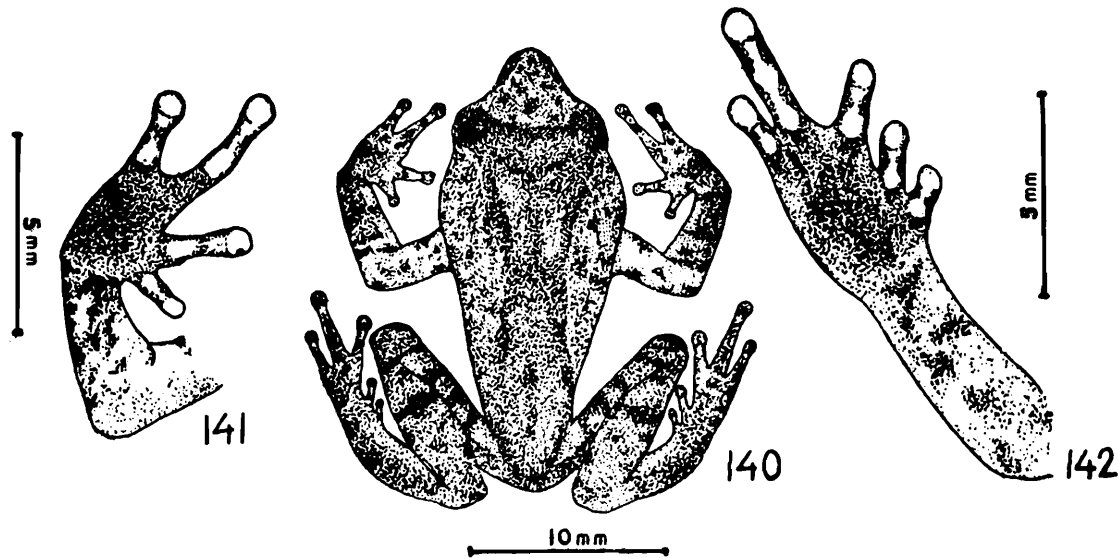
1973. *Philautus shillongensis* Pillai & Chanda, *Proc. Indian Acad. Sci.*, 70 (B) Sec. B (1) : 30-36.
1981. *Philautus shillongensis* : Dubois, *Peleogeographie et biogeographie de L' Himalaya et du sous-continent indien*, Paris, C. N. R. S. cahiers nepalais : 64.
1985. *Philautus shillongensis* : Frost, *Amphibian species of the world* : 532.

Type locality : Malki forest, Shillong, Meghalaya, India.

Location of type : National Zoological collection, Zoological Survey of India, Calcutta, India.

Material examined: 5 ♀♀, 3 ♂♂, Malki forest, Shillong, 13.ii.1971, Coll. R. S. Pillai; 146 ♀♀, 95 ♂♂, Shillong, Khasi hills, Meghalaya, collected during the months January-May, July-August, October-December in the years 1970-1978 from various localities around shillong, Khasi hills, Meghalaya, Coll. S. K. Chanda.

Diagnosis: Grey to black on the dorsum; anterior region of head darker than rest of the body. A dark band connecting the eyes. Upper eyelids dark. A light black patch



Figs. 140-142: 140, *Philautus shillongensis* (Dorsal view); 141, Forelimb (Ventral view); 142, Hindlimb (Ventral view)-

just above angle of jaws. Ventrally almost white. Skin almost smooth, belly with scattered warts and tubercles; a distinct longitudinal fold extends from axilla to anterior region of thighs.

Head: Slightly broader than long, depressed; snout slightly pointed; canthus rostralis fairly distinct; loreal region slightly concave; nostrils closer to tip of snout than to eyes; tympanum fairly distinct.

Forelimbs: Slender, short; fingers free, short with intercalary ossicle; first finger shorter than second; third longest, equal to snout; subarticular tubercles not very prominent.

Hindlimbs: Moderately long; tibiotarsal articulation reaching posterior corner of eyes; tibia two to three times as long as broad, half the length from snout to vent; toes free with small rounded discs; fourth toe longest, slightly longer than snout; subarticular tubercles moderately prominent; inner metatarsal tubercles indistinct; outer metatarsal tubercle absent,

Measurements in mm : From snout to vent : 18.0-22.0 ; head : 5.5-6.0 ; width of head : 6.0-6.5 ; snout : 3.0-3.5 ; eye : 2.5-3.5 ; interorbital width : 3.0-3.5 ; tympanum : 1.0-1.5 ; forelimb : 15.5-17.5 ; first finger : 1.6-2.0 ; second finger : 2.5-3.0 ; third finger : 3.0-3.5 ; hindlimb : 29.0-30.5 ; tibia : 8.5-9.0 ; foot : 6.5-7.0 ; third toe : 2.5-3.0 ; fourth toe : 3.5-4.0 ; fifth toe : 2.3-2.5.

Distribution : India (Meghalaya).

Remarks : This species was originally recorded from Shillong, Khasi hills, Meghalaya. During the present study the author collected a good number of specimens from Shillong, Meghalaya mostly from fissures more than a metre high in caked earth, two or more huddled together. Generally they were found in torpid state, their colour harmonising perfectly with the slightly moist earth. It is endemic to northeast India.

Genus : **Theloderma** Tschudi, 1838

1838. *Theloderma* Tschudi, *Classif. Batr.* : 32.

1985. *Theloderma* : Frost, *Amphibian species of the world* : 549.

Diagnosis : Skin rough ; body and limbs covered with numerous large or small and sometimes with calcified warts. Vomerine teeth present or absent. Fingers half-webbed or webbed at the base. Omosternum moderately forked at base. Terminal phalanges 'Y'-shaped.

Type species : *Theloderma leporosa* Tschudi, 1838.

Distribution : India (Arunachal Pradesh).

Remarks : 10 species of the above genus are known from the world of which *Theloderma asperum* (Boulenger) and *Theloderma moloch* (Annandale) have so far been recorded from Indian region, both restricted to northeast India. *Theloderma moloch* is endemic to Indian region.

46. **Theloderma asper** Boulenger

1886. *Theloderma asper* Boulenger, *Proc. Zool. Soc. London* : 415.

1985. *Theloderma asper* : Frost, *Amphibian species of the world* : 549.

Type locality : "Hill garden, Larut, Perak" Malaysia.

Location of type : British Museum (Natural History) London, U.K.

Material examined : None. Description based on literature.

Diagnosis : Dorsally varying from dark grey to brown. Ventrally greyish to white. Limbs dark brown with indistinct cross-bar. Ventrally almost white. Skin more or less smooth, occasionally with microscopic tubercles on the dorsum. Ventral surface almost smooth.

Head : Broader than long, slightly depressed ; snout short ; nostril much closer to eye than to tip of snout ; internarial space equal to interorbital width ; tympanum distinct, slightly depressed, slightly smaller than eye.

Forelimbs : Moderate ; fingers free ; tips of fingers dilated into rounded tips ; first finger slightly shorter than second ; subarticular tubercles not prominent.

Hindlimbs : Moderately long ; tibiotarsal articulation nearly reaching nostril ; toes half-webbed with prominent tips ; subarticular tubercles moderately large ; Both inner and outer metatarsal tubercles present.

Distribution : This species was originally recorded from Malaysia (Boulenger 1886). Although it is evident from the literature that the above species occurs in Assam and Arunachal Pradesh (Inger & Datta, 1986 ; Frost, 1985) several surveys in and around Assam and Arunachal Pradesh did not yield any more material. As the type was not available, the author could not compare the description with the type.

47. *Theلودerma moloch* (Annandale)

(Figs. 146-148)

1912. *Phrynodesma moloch* Annandale, *Rec. Indian Mus.*, 8 : 18.

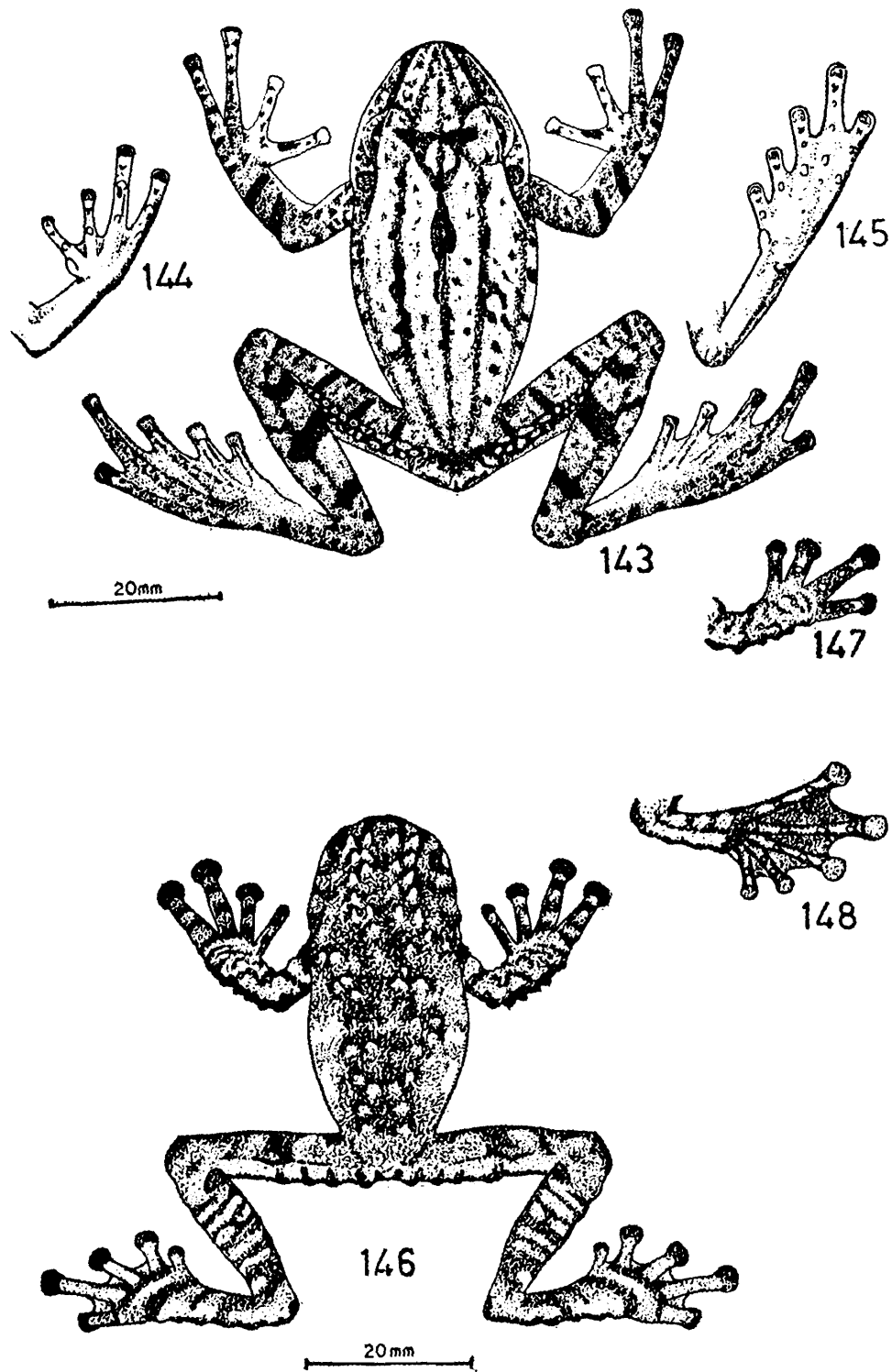
1974. *Rhacophorus moloch* : Gorham, *Checklist of world amphibians up to January 1, 1970* : 170.

1985. *Theلودerma moloch* : Frost, *Amphibian species of the world* : 550.

Type locality : Upper Renging, Abor country, Assam (Arunachal Pradesh), India.

Location of type : National Zoological Collection, Zoological Survey of India, Calcutta, India.

Material examined : 2 ♀♀, Abor hills, Arunachal Pradesh, 5.xi.1911. Coll. M. D. Courey.



Figs. 143-148 : 143, *Polypedates leucomystax* (Dorsal view) ; 144, Forelimb (Ventral view) ; 145, Hindlimb (Ventral view) ; 146, *Theloderma moloch* (Dorsal view) ; 147, Forelimb (Ventral view) ; 148, Hindlimb (Ventral view).

Diagnosis : Grey to brown with black spots on the dorsum. A large blackish patch over both sides of fore and hind-limbs and a white patch present on the axilla. Thighs with irregular dark bands. Ventrally almost black. Prominent warts and tubercles of various shapes and sizes scattered all over the dorsum which are comparatively larger on the head and shoulder region and much smaller on the dorsal surface of the limbs. Belly and sides granulated. Ventral surface of the body including limbs and throat almost smooth.

Head : A little broader than long, slightly depressed ; snout rounded ; canthus rostralis prominent ; loreal region concave, oblique ; nostrils a little closer to tip of snout than to eyes ; interorbital space a little broader than eye ; tympanum large, prominent, as long as the diameter of eyes ; vomerine teeth slightly oblique in position, running from the anterior margin of choanae, much closer to each other than to choanae.

Forelimbs : Moderately long ; slender ; fingers long, free, with large discs ; disc of third finger nearly equal to tympanum ; first finger longer than second, third finger longest, longer than snout ; subarticular tubercles small but prominent.

Hindlimbs : Long ; tibiotarsal articulation reaching eyes ; heels just meeting when hindlimbs folded at right angles to body ; tibia three to four times as long as broad, half the length from snout to vent ; toes two-thirds webbed with prominent well developed discs ; webs reaching all the toes except fourth where it extends nearly to disc as a narrow fringe ; subarticular tubercles small, moderately prominent ; a small indistinct inner metatarsal tubercle present ; outer metatarsal tubercle absent.

Measurements in mm : From snout to vent : 42·0-43·5 ; head : 18·5-19·0 ; width of head : 20·0-20·5 ; snout : 5·0-5·5 ; eye : 5·0-6·0 ; interorbital width : 5·5-6·0 ; tympanum : 5·0-6·0 ; forelimb : 28·5-29·0 ; first finger : 6·0-6·5 ; second finger : 5·5-6·0 ; third finger : 7·0-7·5 ; hindlimb : 78·0-79·5 ; tibia : 21·0-22·0 ; foot 23·5-24·0 ; third toe : 9·5-10·0 ; fourth toe : 11·5-12·0 ; fifth toe : 9·0-9·5.

Distribution : India (Arunachal Pradesh).

Remarks : Although originally recorded from Abor hills, Arunachal Pradesh, several surveys in and around Arunachal Pradesh did not yield any further material. The author compared the description (Annandale, 1912) with type and did not find any variation. Measurements of body parts have been incorporated here as these were not mentioned in earlier description (Annandale, 1912).

Genus : **Polypedates** Tschudi, 1838

1838. *Polypedates* Tschudi, *Classif. Batr.* : 34.

1985. *Polypedates* : Frost, *Amphibian species of the world* : 540.

Diagnosis : Skin smooth or shagreen. Vomerine teeth always present. Fingers webbed at the base, sometimes two-thirds webbed. Omosternum slightly forked at base. Distal end of metacarpal distinctly dilated and bony knob on distal metacarpal of third digit large. Terminal phalanges of fingers and toes "Y"-shaped.

Type species : *Hyla leucomystax* Gravenhorst, 1829.

Distribution : India ; Sri Lanka ; Burma ; Thailand ; Indo-China ; China ; Sumatara ; Java ; Borneo ; Philippines.

Remarks : 12 species of this genus are known from the world (Frost, 1985), of which two are known from Indian region (Inger & Dutta, 1985). One, out of this, *Polypedates leucomystax* has so far been recorded from northeast India.

48. **Polypedates leucomystax** (Gravenhorst)
(Figs. 143-145)

1829. *Hyla leucomystax* Gravenhorst, *Syst. Rept.*, : 31.

1830. *Polypedates leucomystax* Gravenhorst, *Delic. Mus. zool. vrbatslav.*, Fasc. i, Lipsiae : 26.

Type locality : Java (Indonesia).

Location of type : Breslau Museum, Poland.

Material examined : 2 ♀ ♀, Shillong, Khasi hills, Meghalaya, 7.iii.1973, Coll. S. K. Chanda ; 3 ♂ ♂, 2 ♀ ♀, Barapani, Khasi hills, Meghalaya, 18.v.1968, Coll. R. K. Varshney ; 2 ♀ ♀, Cherrapunjia, Khasi hills, Meghalaya, 21.x.1971, S. Biswas ; 2 ♀ ♀, Umtynger, Khasi hills, Meghalaya, 27.vii.1966, Coll. B. K. Tikader ; 2 ♂ ♂, 1 ♀, Ronjeng, Garo hills, Meghalaya, 2.iv.1971, Coll. R. S. Pillai ; 1 ♀, Kaziranga, Assam, 21.ii.1972, Coll. S. K. Chanda ; 2 ♀ ♀, Imphal, Manipur, 24.viii.1975, Coll. S. G. Patil.

Diagnosis : Dorsally yellowish to grey, sometimes greenish to reddish brown with black spots on the dorsum. A black streak on canthal and temporal region often present. Three to four longitudinal bands extending from snout to vent which may often be faintly visible. Limbs with dark cross bands. Ventral surface almost white.

Skin finely granulated. A distinct supratympanic fold extends from posterior corner of eyes to shoulder ; belly and ventral surface of thighs granulated.

Head : Broader than long, depressed ; snout pointed, projecting slightly beyond lower jaw ; canthus rostralis distinct ; loreal region slightly concave ; nostrils nearer to tip of snout than to eyes ; tympanum very distinct, half the diameter of eyes, separated from the latter by a space about one-third of tympanic diameter ; interorbital width equal to the diameter of eyes ; vomerine teeth small, slightly oblique in position, originating from the anterior border of choanae.

Forelimbs : Moderately long ; fingers with rudimentary web and well developed discs ; discs slightly narrower than long with a distinct cutaneous circum-marginal groove ; first finger a little shorter than second, third finger longest, much longer than snout ; subarticular tubercles small and not well developed.

Hindlimbs : Long ; tibiotarsal articulation reaching anterior corner of eyes ; heels strongly overlapping when hindlimbs folded at right angles to body ; tibia four to five times as long as broad, shorter than forelimb but longer than foot ; tips of toes dilated into well developed discs with circum-marginal grooves which are a little smaller than finger discs ; toes two-thirds webbed ; last three digits of fourth toe free ; disc of toes with distinct circum-marginal groove ; inner metatarsal tubercle small, prominent ; outer metatarsal tubercle absent.

Distribution : India (West Bengal, Assam, Arunachal Pradesh, Nagaland, Manipur, Sikkim) Sri Lanka ; China ; Malaysia ; Philippines.

Remarks : This species appears to be rare in northeast India as no further record could be noted since Kuhl (1829). Annandale (1912) reported the same as a new subspecies of *maculatus* from Abor hills, Arunachal Pradesh. Subsequently Pillai & Chanda (1979) recorded the species from Meghalaya. During the present study it has been recorded from Assam, Manipur and Nagaland.

Genus : *Rhacophorus* Kuhl & V. Hasselt

1822. *Rhacophorus* Kuhl & V. Hass., *Alg. Konst-en Latter-bode* : 7 : 104.

1985. *Rhacophorus* : Frost, *Amphibian species of the world* : 542.

Diagnosis : Skin smooth or sometimes tuberculated. Tongue free and deeply notched behind. Vomerine teeth present (except sometimes in *Rhacophorus edentulus*). Pupil horizontal. Tympanum generally distinct. Fingers free or webbed. Toes webbed. Tip

of fingers and toes dilated into regular discs. Outer metatarsal separated by web. Omosternum and sternum with a bony style. Terminal phalanges generally bifurcated. An intercalary ossicle present between penultimate and ultimate phalanges.

Type species : *Rhacophorus moschatus* Kuhl & V. Hass.

Distribution : India ; China ; Burma ; Japan ; Indo-China ; Malaysia ; Indonesia ; Philippines ; Madagascar.

Remarks : A total of 95 species have been included in this genus from the world (Frost, 1985), six of which are known from Indian region and all of them have been found to occur in northeast India.

Key to the species of *Rhacophorus*

- | | | | |
|---|-----|--------------------------------|---|
| 1. Head longer than broad | ... | ... | 2 |
| Head broader than long | ... | ... | 3 |
| 2. Tibiotarsal articulation reaches eye ; tympanum distinct, more than one-third the diameter of eye ; toes one-third webbed ; tips of toes dilated into small discs ; vomerine teeth running obliquely near anterior margin of choanae but widely separated from one another | ... | ... <i>jerdonii</i> (Gunther). | |
| Tibiotarsal articulation reaches anterior corner of eye ; tympanum more or less distinct, about two-thirds diameter of eye ; toes fully webbed ; tips of toes dilated into large discs ; vomerine teeth closer to anterior corner of choanae | ... | <i>tuberculatus</i> Anderson. | |
| 3. Toes fully webbed | ... | ... | 4 |
| Toes not fully webbed | ... | ... | 5 |
| 4. Tympanum two-thirds the diameter of eyes ; tibiotarsal articulation reaches anterior corner of eye ; fingers with prominent discs as well as with distinct circum-marginal grooves ; vomerine teeth in two oblique series between the choanae, much nearer to each other than to choanae | ... | ... <i>bipunctatus</i> Ahl. | |
| Tympanum one-third the diameter of eye ; tibiotarsal articulation reaching posterior corner of eye ; fingers with well developed discs devoid of circum-marginal grooves ; vomerine teeth in two oblique series on a level with the anterior edge of choanae | ... | ... <i>maximus</i> Gunther. | |

5. Tibiotarsal articulation reaches tympanum ; fingers free ; toes two-thirds webbed ; vomerine teeth originating at the anterior border of choanae, running at the same level to the posterior border of choanae *naso* Annandale

Tibiotarsal articulation reaches eye ; fingers partly webbed ; toes nearly entirely webbed ; vomerine teeth in two distinct longitudinal transverse series in between the choanae and touching its anterior corner *namdaphaensis* Sarkar & Sanyal.

49. *Rhacophorus bipunctatus* Ahl.

1927. *Rhacophorus bipunctatus* Ahl. *Sitz. Ges. Naturf. Freunde Berlin*. 147.

1974. *Rhacophorus reinwardtii* : Gorham, *Checklist of world amphibians up to January 1, 1970* : 171.

1979. *Rhacophorus reinwardtii* : Pillai & Chanda, *Rec. zool. Surv. India*, 75 : 392.

1985. *Rhacophorus bipunctatus* Frost, *Amphibian species of the world* : 543.

Type locality : "Khasyya" (= Khasi hills) and "Assam", India.

Location of type : British Museum (Natural History), London, U. K.

Material examined : 3 ♀ ♀, Shillong, Khasi hills, Meghalaya, 8.iv.1970, Coll. S. K. Chanda ; 3 ♂ ♂, 2 ♀ ♀, Pynursla, Khasi hills, Meghalaya, 4.v.1978, Coll. S. Biswas ; 2 ♀ ♀, 1 ♂ ; Umroi, Khasi hills, Meghalaya, 18.v.1968, Coll. R. K. Varshney ; 2 ♀ ♀, Shillong, Khasi hills, Meghalaya, 17.vii.1966, S. N. Prasad ; 2 ♀ ♀, Thadlaskein, Khasi hills, Meghalaya, 17.vi.1971, Coll. M. R. Rynth ; 2 ♂ ♂, Kaziranga, Assam, 21.ii.1974, Coll. M. Datta ; 1 ♂, Siang, Arunachal Pradesh, 18.xi.1973, Coll. R. S. Pillai ; 2 ♀ ♀, Saikot, Manipur, 23.iii.1975, Coll. M. Datta ; 2 ♂ ♂, Parathia, Tripura, 12.iii.1983, Coll. S. K. Chanda.

Diagnosis : Colour variable. Dorsum green to olive, leaf green in life. Limbs slate-coloured on the dorsum. Ventrally whitish. The characteristic black spots are very prominent on flanks. The number of spots are variable, sometimes two large spots occur on the right side with three smaller spots on the left ; in some examples, there are two spots on both sides and in a few, only one spot on each side. Generally the anterior spot is larger than others. Dorsal skin smooth. Belly, lateral sides of body and things fully granulated.

Head : Broader than long, slightly depressed ; snout obtusely pointed, projecting a little beyond lower jaw ; canthus rostralis obtuse ; loreal region slightly oblique ; nostrils equidistant from eyes and tip of snout ; internarial space a little less than interorbital width ; interorbital width greater than the orbit of eye ; tympanum distinct, two-thirds of

eyes ; vomerine teeth in two oblique series between the choanae, much nearer to each other than choanae.

Forelimbs : Moderately long ; fingers moderately long with prominent discs and with distinct circum-marginal groove ; first finger shorter than second, third finger longest, longer than snout ; all fingers webbed to discs except the first ; subarticular tubercles moderately large and prominent.

Hindlimbs : Long ; tibiotarsal articulation reaching posterior corner of eye ; heels strongly overlapping when hindlimbs folded at right angles to body ; tibia three to four times as long as broad ; less than half the length from snout to vent ; toes with large discs and with circum-marginal groove, fully and broadly webbed ; outer metatarsal completely separated by web ; subarticular tubercles small and prominent ; a small inner metatarsal tubercle present ; outer metatarsal tubercle absent ; a cutaneous flap present above the vent and also along the hindlimbs.

Measurements in mm : From snout to vent : 55·0-65·0 ; head : 17·0-18·0 ; width of head : 20·0-21·0 ; snout : 8·5-9·5 ; eye 6·0-7·0 ; interorbital width : 8·0-8·5 ; tympanum : 4·0-4·6 ; forelimb : 29·5-30·5 ; first finger : 6·0-6·5 ; second finger : 7·5-8·5 ; third finger : 11·5-13·0 ; hindlimb : 81·5-83·0 ; tibia : 26·5-28·0 ; foot : 22·0-23·0 ; third toe : 15·0-15·5 ; fourth toe : 21·0-22·5 ; fifth toe : 17·0-18·0.

Distribution : India (Meghalaya, Assam, Arunachal Pradesh, Manipur, Nagaland, Tripura) ; Indonesia.

Remarks : This species was known previously from Arunachal Pradesh, and Meghalaya (Annandale, 1912 ; Pillai & Chanda, 1979). During the present study it was recorded from Assam, Manipur, Nagaland and Tripura.

50. *Rhacophorus jerdonii* (Gunther)

(Figs. 152-154)

1875. *Polypedates jerdonii* Gunther, *Proc. zool. Soc., London* : 571.
1912. *Rhacophorus microdiscus* Annandale, *Rec. Indian Mus.*, 8 : 13-14.
1974. *Rhacophorus jerdonii* : Gorham, *Checklist of world amphibians up to January 1. 1970* : 169.
1976. *Rhacophorus jerdonii* : Pillai & Chanda, *J. Assam Sc. Soc.*, 19 : 55.
1985. *Rhacophorus jerdonii* : Frost, *Amphibian species of the world* : 544.

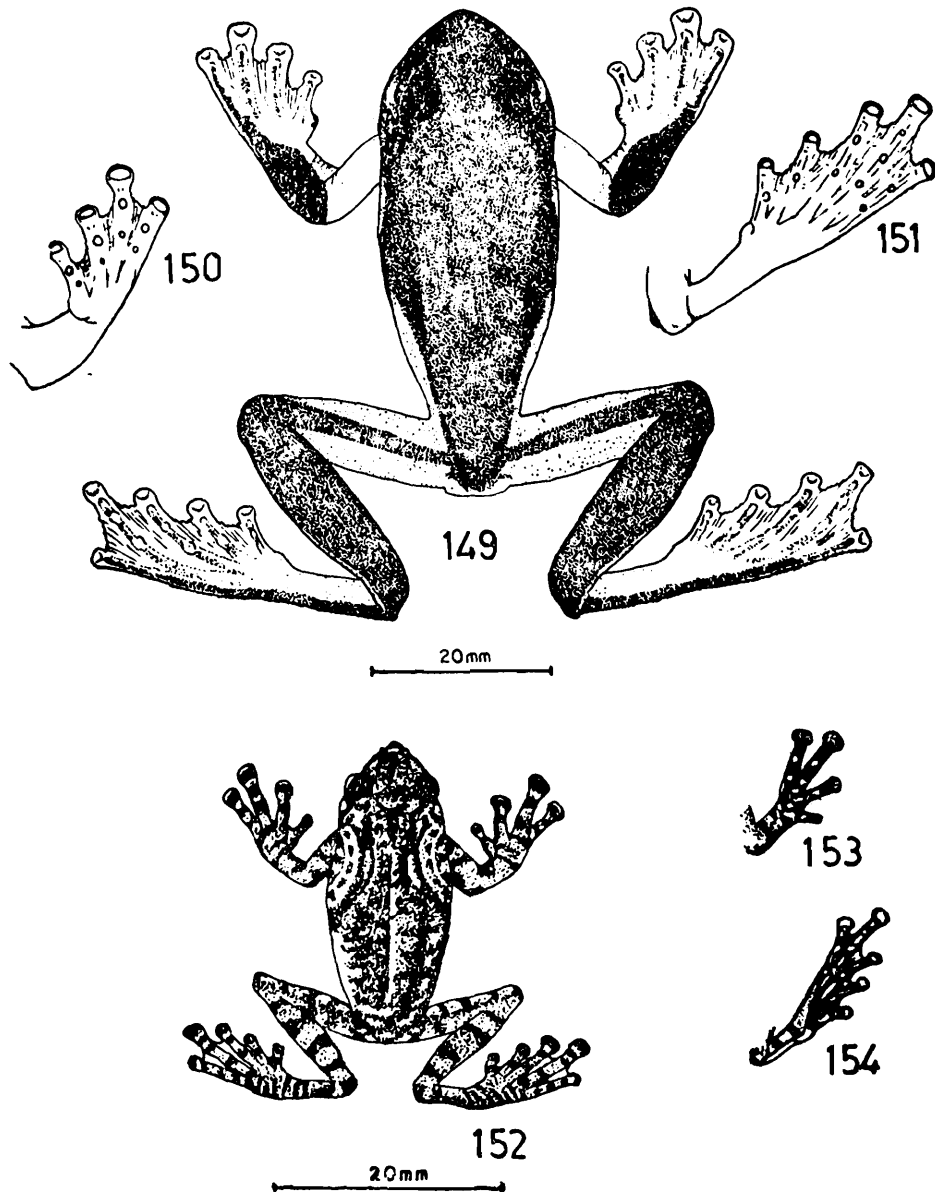
Type locality : Darjeeling, West Bengal, India.

Location of type : British Museum (Natural History), London, U. K.

Material examined : 1 ♀, Abor hills, Arunachal Pradesh, 1911, Coll. S. W. Kemp.

Diagnosis : Dorsum grey to black. Limbs indistinctly barred with black. Ventrally dirty white. Skin not smooth on the dorsum. Throat and chest smooth. Lateral sides of body tuberculated. Small rounded, scattered tubercles present dorsally on thighs. An indistinct fold extends posteriorly from tympanum to shoulder.

Head : Longer than broad ; snout rounded ; nostrils nearer to tip of snout than to eyes ; canthus rostralis not prominent ; loreal region concave ; tympanum distinct, slightly



Figs. 149-154 : 149, *Rhacophorus maximus* (Dorsal view) ; 150, Forelimb (Ventral view) ; 151, Hindlimb (Ventral view) ; 152. *Rhacophorus jerdonii* (Dorsal view) ; 153, Forelimb (Ventral view) ; 154, Hindlimb (Ventral view).

more than one-third diameter of eyes ; interorbital width greater than the diameter of eyes ; vomerine teeth running obliquely near the anterior margin of choanae up to the posterior border of choanae but widely separated from one another,

Forelimbs : Short ; fingers with rudiments of webs ; first finger shorter than second, third longest, twice longer than snout ; subarticular tubercles prominent.

Hindlimbs : Moderately long ; tibiotarsal articulation reaches eyes ; toes one-third webbed ; discs of toes small ; subarticular tubercles prominent ; inner metatarsal tubercle elongated and feebly prominent ; outer metatarsal tubercle absent.

Measurements in mm : From snout to vent ; 44.5 ; head : 19.5 ; width of head : 18.0 ; snout : 5.0 ; interorbital width : 6.5 ; tympanum : 2.0 ; eye : 5.6 ; forelimb : 21.5 ; first finger : 7.0 ; second finger : 8.5 ; third finger : 10.0 ; hindlimb : 68.0 ; tibia : 18.0 ; foot : 11.5 ; third toe : 10.5 ; fourth toe : 14.5 ; fifth toe : 11.5.

Distribution : India (West Bengal, Arunachal Pradesh).

Remarks : This species was originally described from Darjeeling, alt. ca 1830 m. West Bengal (Gunther, 1875). Annandale (1912) described it from hills, Arunachal Pradesh as *Rhacophorus microdiscus*. Several surveys in and around Arunachal Pradesh did not yield any more material. Although the type of *jerdonii* was not available for present study, the author studied and compared Annandale's type material of *microdiscus* with original description of *jerdonii* (Gunther, 1875) and found certain variations viz., tympanum less than one-third of eyes, skin not smooth ; interorbital width greater than eyes etc. According to Gunther, (1875) tympanum is one-third of eye, skin smooth, interorbital width is equal to eye. Measurements of body parts from Annandale's material are incorporated here.

51. *Rhacophorus maximus* Gunther

(Figs. 149-151)

1858. *Rhacophorus maximus* Gunther, *Cat. Batr. Sal., Brit. Mus* : 83.
 1895. *Rhacophorus nigropalmatus* Boulenger, *Ann. Mag. nat. Hist.*, 16 : 170.
 1974. *Rhacophorus nigropalmatus* : Gorham, *Checklist of world amphibians up to January 1, 1970* : 170.
 1976. *Rhacophorus nigropalmatus* : Pillai & Chanda, *J. Assam Sci. Soc.*, 19 : 55.
 1985. *Rhacophorus maximus* : Frost, *Amphibian species of the world* : 545.

Type locality : "Nepal" and "Afghanistan" (in error). According to Frost (1985).

Location of type : British Museum (Natural History), England, London, U.K.

Material examined : 9 ♀♀, 10 ♂♂, Shillong, Khasi hills, Meghalaya, 5.vii.1979, Coll. S. K. Chanda; 2 ♀♀, 1 ♂; Garo hills, Meghalaya, 23.ii.1971, Coll. G. M. Yazdani; 2 ♀♀, Haflong, Assam, 22.x.1972, Coll. S. K. Chanda; 1 ♂, Barapani, Khasi hills, Meghalaya, 24.x.1972, Coll. S. K. Chanda; 3 ♂♂, Goalpara, Assam, 13.xi.1972, Coll. S. Biswas; 2 ♀♀, Siang, Arunachal Pradesh, 12.viii.1973, R. S. Pillai; 2 ♀♀; Namdapha, Arunachal Pradesh, 24.xii.1976, Coll. K. R. Rao; 2 ♂♂, Churachandpur, Manipur, 19.iii.1974, Coll. K. R. Rao.

Diagnosis : Dark grey to pale green on the dorsum. One or two whitish spots present on the dorsal surface of thighs. Flank yellowish to cream; belly and ventral surface of limbs yellowish. Skin almost smooth dorsally; ventral and lateral sides of body minutely granulated.

Head : Broader than long, a little depressed; snout more or less rounded, feebly projecting beyond lower jaw; canthus rostralis prominent and slightly oblique; tympanum distinct, half the diameter of eyes; interorbital width broader than eyes; nostrils closer to tip of snout than to eyes; vomerine teeth in two oblique series on a level with anterior edge of choanae.

Forelimbs : Short; fingers fully webbed with prominent, well developed discs; first finger shorter than second, third finger longest, longer than snout; subarticular tubercles well developed.

Hindlimbs : Long; tibiotarsal articulation reaching anterior corner of eyes or nostril; heels strongly overlapping when hindlimbs folded at right angles to body; tibia four to five times as long as broad, less than half the length from snout to vent; toes fully webbed with prominent well developed discs and distinct circum-marginal grooves; subarticular tubercles distinct; inner metatarsal tubercles present; outer metatarsal tubercles absent.

Measurements in mm : From snout to vent: 38.0-45.0; head: 13.0-15.0; width of head: 17.0-19.5; snout: 5.5-7.0; eye: 3.0-4.0; interorbital width: 5.0-6.5; tympanum: 1.5-2.0; forelimb: 17.5-26.0; first finger: 2.0-3.0; second finger: 4.5-6.0; third finger: 6.0-8.0; hindlimb: 60.0-70.5; tibia: 15.5-20.0; foot: 18.5-25.0; third toe: 4.3-6.0; fourth toe: 5.5-8.0; fifth toe: 3.8-6.0.

Distribution : India (Meghalaya, Assam, Arunachal Pradesh, Nagaland, Manipur, Mizoram); Malaysia, Southern China; Indonesia.

Remarks : This species was originally recorded from Borneo (Boulenger). Subsequently it was recorded from Arunachal Pradesh (Annandale, 1912) and Meghalaya (Pillai & Chanda, 1979). During the present study it was recorded for the first time from Assam, Mizoram and Manipur. In India it appears to be restricted to northeast India.

52. *Rhacophorus naso* Annandale

1912. *Rhacophorus naso* Annandale, *Rec. Indian Mus*, 8 : 12.

1985. *Rhacophorus naso* Frost, *Amphibian species of the world* : 546.

Type locality : "Egar stream between Renging and Rotung", Arunachal Pradesh, India.

Location of type : National Zoological Collection, Zoological Survey of India, Calcutta, India.

Material examined : 1 ♀ ; Rotung, Arunachal Pradesh, India, 9.i.1912, Coll. S. W. Kemp.

Diagnosis : Brown to slate-coloured on the dorsum. Limbs with irregular dark bands. Dark grey spots present on the throat and chest. Ventral surface of hands and feet grey with white tubercles and the dorsal surface of the hands and feet slate-coloured. A white spot present on the sole. Dorsum with prominent scattered tubercles ; a small dermal appandage present on the snout ; a fairly dorsolateral fold and another prominent fold extends from the posterior region of eyes to shoulder. Chest and throat thickly granulated ; belly weakly granulated. Ventral surface coarsely granulated.

Head : Triangular, broader than long ; snout pointed with prominent dermal appandage ; nostrils closer to tip of snout than to eyes ; canthus rostralis indistinct ; loreal region concave ; tympanum distinct, two-thirds the diameter of eyes ; interorbital width broader than eyes ; vomerine teeth originating at the anterior border of choanae terminating at the level of its posterior border.

Forelimbs : Moderately long ; fingers free ; first finger shorter than second, third finger longest, much longer than snout ; discs of fingers well developed ; web of third finger almost as large as tympanum ; subarticular tubercles prominent, well developed.

Hindlimbs : Moderately long ; tibiotarsal articulation reaches tympanum ; toes two-thirds webbed ; discs of toes similar to finger discs ; subarticular tubercles well developed ; somewhat elongate, inner metatarsal tubercle indistinct ; outer metatarsal tubercle absent.

Measurements in mm : From snout to vent : 45.0 ; head : 17.5 ; width of head : 19.5 ; snout : 6.5 ; eye : 6.0 ; interorbital width : 7.5 ; tympanum : 2.0 ; forelimb : 21.0 ; first finger : 5.0 ; second finger : 7.5 ; third finger : 10.5 ; hindlimb : 50.0 ; third toe : 12.5 ; fourth toe : 15.5 ; fifth toe : 13.0.

Distribution : India (Arunachal Pradesh).

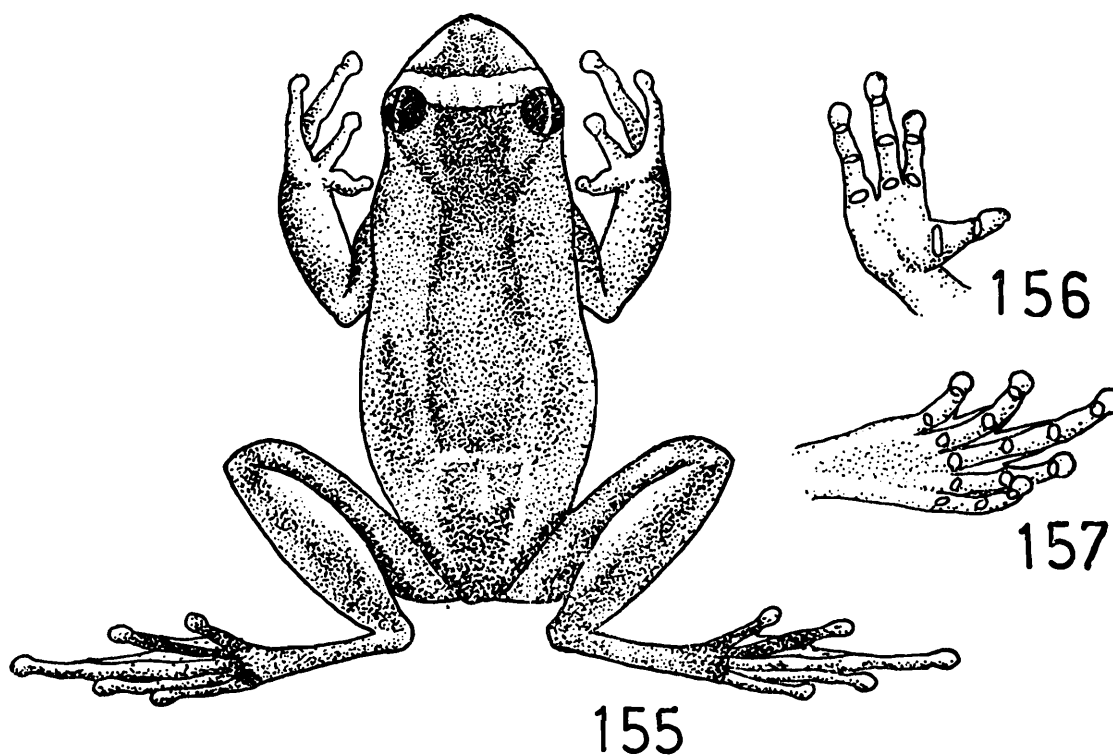
Remarks : This species was originally described from Arunachal Pradesh, northeast India (Annandale, 1912). Several surveys made in and around Arunachal Pradesh, north-east India did not yield any more material. Careful comparison with the original description and the type revealed certain variations, viz., fingers free, tibiotarsal articulation reaching tympanum, toes two-thirds webbed and small rounded indistinct inner metatarsal tubercles, etc. According to Annandale (1912) fingers have rudiments of webs, tibiotarsal articulation reaches eye, toes almost fully webbed and an elongated inner metatarsal tubercle. Measurement of body parts have been incorporated here from the type.

53. *Rhacophorus namdaphaensis* Sarkar & Sanyal
(Figs. 155-157)

1985. *Rhacophorus namdaphaensis* Sarkar & Sanyal, *Rec. zool. Surv. India*, 82 (1-4) : 288-293.

Type locality : 58 km from Miao, Tirap dist., Arunachal Pradesh, India.

Location of type : National Zoological Collection, Zoological Survey of India, Calcutta, India.



Figs. 155-157 : 155, *Rhacophorus namdaphaensis* (Dorsal view), 156, Forelimb (Ventral view); 157, Hindlimb (Ventral view).

Material examined : 5 exs., Namdapha camp (alt. 350 m) ca. 58 km from Miao, Tirap District, Arunachal Pradesh, India, 21.iv.1981, Coll. S. Biswas.

Diagnosis : Dorsum reddish-brown intermixed with variable brown and black spots. Limbs dorsally with faint cross bands. Undersurface of hindlimbs reddish brown. A large, more or less round black spot present on each side behind the armpit. Ventral surface brownish. Dorsal skin including the limbs scattered with microscopic warts. Belly and lower surface of thighs granular. Chest and throat smooth. A glandular fold running from the posterior border of eye to shoulder ending above the tympanum. A dermal fringe present along the outer margin of fore-arm (except humerus) and fourth finger and along the tarsus and fifth toe ; transverse flap of skin present above the vent as well as on the heel.

Head : Triangular, slightly broader than long ; snout slightly longer than the diameter of eyes ; canthus rostralis not very prominent ; loreal region slightly concave ; nostrils equidistant from eyes and tip of snout ; interorbital width much broader than the diameter of eyes ; tympanum not very prominent, about half the diameter of eyes ; tongue fairly large free and bifid behind and without any papilla ; vomerine teeth in two distinct longitudinal transverse series in between the choanae and touching the anterior corner of the same.

Forelimbs : Stout ; fingers moderately long with interclary ossicle ; fingers partly webbed, webs reach the base of penultimate phalanges of first and third fingers ; first finger shorter than second ; discs of fingers smaller than the tympanum and slightly larger than toe discs ; subarticular tubercles well developed ; a long, prominent palmer wart present laterally at the base of first finger.

Hindlimbs : Slender ; toes long, with intercalary ossicle ; toes nearly entirely webbed, web reaches the discs of toes, except the fourth toe where it reaches the middle of the penultimate phalange ; outer metatarsal separated by web at the base ; subarticular tubercles very prominent ; tibiotarsal articulation reaching eye ; a small, feebly prominent inner metatarsal tubercle present, outer metatarsal tubercle absent.

Measurements in mm : From snout to vent : 35.0-40.0 ; head : 10.0-11.0 ; width of head : 11.0-12.5 ; snout : 5.0-6.0 ; eye : 4.0-5.5 ; interorbital width : 4.0-4.5 ; tympanum : 2.0-3.0 ; forelimb : 23.0-26.0 ; first finger : 4.0-5.0 ; second finger : 5.0-6.5 ; third finger : 7.0-9.0 ; hindlimb : 56.0-60.0 ; tibia : 17.0-18.0 ; foot : 13.0-14.0 ; third toe : 8.0-10.0 ; fourth toe : 12.0-13.0 ; fifth toe : 10.5-11.5.

Distribution : India (Namdapha, Tirap district, Arunachal Pradesh).

Remarks : This species was originally described from Namdapha, Arunachal Pradesh (Sarkar & Sanyal, 1985). During the present study the author could not collect any more specimens. It is one of the rare and endemic frog of northeast India.

54. *Rhacophorus tuberculatus* (Anderson)

1871. *Polypedates tuberculatus* Anderson, *J. Asiat. Soc. Bengal*, 40 : 26.
 1890. *Rhacophorus tuberculatus* Boulenger, *Fauna Brit. India, including Ceylon and Burma. Reptilia and Batrachia*, London (Taylor & Francis), pp. xvii+541.
 1912. *Rhacophorus tuberculatus* Annandale, *Rec. Indian Mus.*, 8 : 14-15.
 1985. *Rhacophorus tuberculatus* Frost, *Amphibian species of the world* : 548.

Type locality : Sibsagar, Assam, India.

Lacation of type : Not traced.

Material examined : None. Description based on literature.

Diagnosis : Dorsal surface of head and limbs dull clay, sparingly powdered with black and suffused more or less with yellow; canthus rostralis with black margin; occasionally a narrow black white-edged line extending backwards along each side from the eye to the base of hindlimbs, while back of the head as well as dorsum ornamented with two large irregular marks outlined by similar lines. Tubercles of the abdomen and thighs darker; faint black bands present on the tibia and femur.

Head : Moderate size, slightly longer than broad; snout rounded, slightly pointed; canthus rostralis indistinct, slightly rounded; nostrils closer to tip of snout; tympanum more or less distinct, about two-thirds diameter of eyes; vomerine teeth closer to the anterior corner of choanae.

Forelimbs : Fingers broadly webbed; webs reaching the discs of second and fourth fingers; discs large, about one-third large than toe discs. A small oblong metatarsal tubercle present.

Hindlimbs : Moderately long; tibiotarsal articulation reaching anterior region of eye; toes fully and broadly webbed; tips of toes dilated into large, prominent discs; subarticular tubercles more or less prominent. Inner metatarsal tubercle present, outer metatarsal tubercle absent.

Distribution : India (Arunachal Pradesh).

Remarks : After Anderson (1871) there was no record of this species till

Annandale (1912) recorded it from Upper Rotung, Arunachal Pradesh. Annandale studied and compared his material with the Anderson's type. According to Annandale, this species has been found to occur in the internode of bamboos.

No more material was available during the present study. The description is based on literature.

DISCUSSION

The present study has been undertaken with a view to present an up to date account of all the known species of Amphibia (anura) of the northeast Indian region.

Collections were made from all the seven states of northeast India, viz., Assam, Meghalaya, Arunachal Pradesh, Nagaland, Mizoram, Manipur and Tripura, which represent an array of diverse ecological conditions. A total of 4120 species of anurans under 17 families and 248 genera are known from the world, of which only 180 species under six families and 24 genera have been recorded from Indian region. Out of the 180 species, as many as 54 species under six families and 18 genera have been found to occur in northeast India (Table I). This study clearly establishes that the anuran fauna of northeast Indian region is rich when compared to the anuran fauna of India, constituting nearly one-third of the total species known from the Indian region.

Dense tropical rainforests, high precipitation, varying altitudinal gradients, abundance of food species, and relatively less eco-disturbances have possibly contributed to the richness and diversity of anuran fauna in this region. Rainfall seems to be the most important single factor; the maximum rainfall in some of these areas reach 250 cm or more which is the highest rainfall record in the world. The richness of the faunal complex as revealed during this study may also be due to the greater number of surveys conducted recently by the Zoological Survey of India as well as by other institutions.

It is significant that representatives from all the six families of the anurans found in Indian region are available in the present study. Out of the 24 genera so far recorded from Indian region, 18 genera occur in northeast India. Four genera viz., *Bufoides* Pillai & Yazdani, *Pterorana* Kiyasetuo & Khare, *Chirixalus* Boulenger, and *Theloderma* Tschudi are endemic to this region. Four genera viz., *Leptobrachium* Tschudi, *Megophrys* Kuhl & V. Hass., *Scutigera* Theobald and *Hyla* Laur. have so far been found to occur only in the present area of study, in the Indian region. Analysis of the anuran species found in northeast India up to generic level reveals the following: out of the 18 genera, *Leptobrachium*, *Scutigera*, *Bufoides*, *Pedostibes*, *Hyla*, *Uperodon*, *Micrixalus*, *Pterorana*, *Chirixalus* and *polypedates* are represented by only one species each; *Bufo*, *Megophrys*, *Amolops* and *Theloderma* are repre-

sented by two species each ; *Microhyla* is represented by three species ; *Rana* is represented by 18 species, and *Philautus* and *Rhacophorus* are represented by nine and six species respectively. Out of 54 species of anurans recorded from this region, 24 species are endemic to Indian region and 21 are restricted to northeast India.

It has also been observed that the maximum number of anuran species have been recorded from Meghalaya followed by Assam, Arunachal Pradesh, Manipur, Nagaland, Mizoram and Tripura.

Among various localities in Meghalaya, at least two, Mawphlang (alt. 1500 m) and Cherrapunjia (alt. 1500 m) districts of Khasi hills can be specially mentioned, as they represent the type locality for a number of new species and this may probably be due to most congenial habitat conditions and less eco-disturbances from human agencies.

The commonest species in the region appear to be *Rana cyanophlyctis* and *Rana limnocharis*. Both of these are widely distributed throughout the Indian region. On the other hand, quite a number of species of the genus *Rana* have localised distribution. Besides, both interspecific as well as intraspecific variations have been observed in the above two species as can be seen from the text. The colour pattern of *R. limnocharis* shows considerable range of variations specially with regard to the dorsal vertebral line extending from snout to vent which is sometimes very prominent and broad, and in some cases totally absent. Intraspecific variations have also been observed in *R. cyanophlyctis* from Khasi hills, Meghalaya ; a few of them appears "Toad-like" (Pillai & Chanda, 1979).

It appears that anuran fauna of northeast India is more closely related to the anuran fauna of north and south India. A considerable number of northeast Indian anuran species (16%) have been recorded from South India and North India specially from the hilly regions of Tamil Nadu (Anamalai hills), Karnataka (Salient valley), Kerala (Wynad), Himachal Pradesh, Jammu & Kashmir (Rao, 1937 ; Satyamurthy, 1967 ; Murthy, 1968 ; Pillai, 1978, 1980 ; Dubois, 1980) (Table II). The closer relationship may be attributed to similarities of ecological condition specially with reference to stratiography.

The anuran fauna of the region, as expected, also shows close affinity with the fauna of Burma and as many as 14 genera and 18 species from northeast India have been known to occur in Burma (Bourret, 1942). It is interesting to note that *Microhyla berdmorei* (Blyth) which was originally recorded from Burma, has been recorded for the first time from Meghalaya (Pillai & Chanda, 1981). The similarities in ecological condition between northeast India and Burma perhaps have contributed towards close affinity of anuran fauna between the two regions.

TABLE : I

Comparison of anuran (Amphibia) fauna of the World, India and Northeast India.

	World	India	Northeast India
Total number of families	17	6	6
Total number of genera	288	24	18
Total number of species	4120	180	54

TABLE : II

Comparison of anuran (Amphibia) fauna of Northeast India, South India, North India and Burma.

Name of species	Northeast India	South India	North India	Burma
1. <i>Leptobrachium hasseltii</i> Tschudi	+	—	—	+
2. <i>Megophrys boettgeri</i> (Boulenger)	+	—	—	—
3. <i>M. parva</i> (Boulenger)	+	—	—	+
4. <i>Scutigera sikkimensis</i> (Blyth)	+	—	—	—
5. <i>Bufo himalayanus</i> Gunther	+	—	+	—
6. <i>B. melanostictus</i> Schneider	+	+	+	+
7. <i>Bufoides meghalayana</i> (Yazdani & Chanda)	+	—	—	—
8. <i>Pedostibes kempfi</i> Boulenger	+	—	—	—
9. <i>Hyla annectens</i> (Jerdon)	+	—	—	—
10. <i>Microhyla berdmorei</i> (Blyth)	+	—	—	+
11. <i>M. ornata</i> (Dum & Bibron)	+	+	+	+
12. <i>M. rubra</i> (Jerdon)	+	+	—	—
13. <i>Uperodon globulosum</i> (Gunther)	+	+	—	—
14. <i>Micrixalus borealis</i> Annandale	+	—	—	—

Name of species	Northeast India	South India	North India	Burma
15. <i>Amolops afghanus</i> (Gunther)	+	—	+	+
16. <i>A. formosus</i> (Gunther)	+	—	+	—
17. <i>Pterorana khare</i> Kiyasetuo & Khare	+	—	—	—
18. <i>Rana alticola</i> Boulenger	+	—	—	—
19. <i>R. assamensis</i> Sclater	+	—	—	—
20. <i>Rana bilineata</i> Pillai & Chanda	+	—	—	—
21. <i>R. cyanophlyctis</i> Schneider	+	+	+	+
22. <i>R. danieli</i> Pillai & Chanda	+	—	—	—
23. <i>R. erythraea</i> Schlegel	+	—	—	+
24. <i>R. garoensis</i> Boulenger	+	—	—	—
25. <i>R. gerbillus</i> Annandale	+	—	—	—
26. <i>R. ghoshi</i> Chanda	+	—	—	—
27. <i>R. hexadactyle</i> Lesson	+	+	—	—
28. <i>R. khasiana</i> Boulenger	+	—	—	—
29. <i>R. limnocharis</i> Boiesduval	+	+	+	+
30. <i>R. leptoglossa</i> (Cope)	+	—	—	+
31. <i>R. livida</i> (Blyth)	+	—	—	+
32. <i>R. laticeps</i> Boulenger	+	—	—	+
33. <i>R. mawphlangensis</i> Pillai & Chanda	+	—	—	—
34. <i>R. mawlyndipi</i> Chanda	+	—	—	—
35. <i>R. tigerina</i> Daudin	+	+	+	+
36. <i>Chirixalus doriae</i> Boulenger	+	—	—	—
37. <i>Philautus andersoni</i> (Ahl)	+	—	—	+
38. <i>P. annandalii</i> (Boulenger)	+	—	—	—
39. <i>P. argus</i> Annandale	+	—	—	—
40. <i>P. cherrapunjiae</i> Roonwal & Kripalani	+	—	—	—
41. <i>Philautus garo</i> (Boulenger)	+	—	—	—
42. <i>P. kempiae</i> (Boulenger)	+	—	—	—

Name of species	Northeast India	South India	North India	Burma
43. <i>P. shyamrupus</i> Chanda & Ghosh	+	—	—	—
44. <i>P. namdaphaensis</i> Sarkar & Sanyal	+	—	—	—
45. <i>P. shillongensis</i> Pillai & Chanda	+	—	—	—
46. <i>Theلودerma asper</i> (Boulenger)	+	—	—	—
47. <i>T. moloch</i> Annandale	+	—	—	—
48. <i>Polypedates leucomystax</i> (Gravenhorst)	+	—	—	—
49. <i>Rhacophorus bipunctatus</i> Ahl	+	—	—	—
50. <i>R. jerdonii</i> (Gunther)	+	—	—	—
51. <i>R. maximus</i> Gunther	+	—	—	—
52. <i>R. naso</i> Annandale	+	—	—	—
53. <i>R. namdaphaensis</i> Sarkar & Sanyal	+	—	—	—
54. <i>R. tuberculatus</i> Anderson	+	—	—	—

SUMMARY

1. Anuran (Amphibia) fauna of northeast India has been studied in a comprehensive manner for the first time.

2. A total of 54 species belonging to 18 genera under six families are now known from the seven states of northeast India viz., Assam, Meghalaya, Arunachal Pradesh, Mizoram, Nagaland, Manipur and Tripura.

3. Collection data, distribution, measurement of body parts and important taxonomic characters together with illustrations of body parts of taxonomic importance have been provided.

4. All the 18 genera studied have been treated in detail on the basis of the material studied and available literature.

5. Eight species belonging to the genera *Rana* Linn., *Philautus* Gistel and *Bufoides* Pillai & Yazdani have recently been described as new taxa viz., *Bufoides meghalayana* (Yazdani & Chanda), *Philautus shillongensis* Pillai & Chanda, *Rana danieli* Pillai & Chanda, *Rana bilineata* Pillai & Chanda, *Rana mawphlangensis* Pillai & Chanda, *Rana ghoshi* Chanda *Rana mawlyndipi* Chanda and *Philautus shyamrupus* Chanda & Ghosh.

6. Running keys to the families, genera and species with their diagnostic characters have been provided together with the important synonyms and original references.

7. Distribution maps have been presented for different genera and species.

8. Species reported earlier from this region by different authorities but not available for the present study have also been dealt with and descriptions provided, based on literature.

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REFERENCES

- Abdulali, H. (1954). Extension of range of the frog *Uperodon globulosum* Gunther. *J. Bombay nat. Hist. Soc.*, 52 : 637-639.
- Abdulali, H. (1954). Extension of range of *Rana temporalis* Gunther. *J. Bombay nat. Hist. Soc.*, 52 : 636-637.
- Abdulali, H. (1954). Distribution and habits of the batrachian *Ichthyophis glutinosus* Linn. *J. Bombay nat. Hist. Soc.*, 52 : 639-640.
- Abdulali, H. (1962). An account of a trip to the Barapede cave, Telewadi, Belgum Dist., Mysore State with some notes on reptiles and amphibians. *J. Bombay nat. Hist. Soc.*, 59 : 228-237.
- Abdulali, H. & Daniel, J. C. (1954). Distribution of *Rana leithi* Boulenger. *J. Bombay nat. Hist. Soc.*, 52 : 635-636.
- Abdulali, H. & Daniel, J. C. (1954). Some notes on *Rana beddomii* Gunther with an extension of its range. *J. Bombay nat. Hist. Soc.*, 52 : 938-939.
- Abdulali, H. & Daniel, J. C. (1955). Notes on *Bufo stomaticus* Lutken. *J. Bombay nat. Hist. Soc.*, 53 (4) : 716.
- Acharji, M. N. & Kripalani, M. B. (1951). On a collection of Reptilia & Batrachia from the Kangra and Kulu valleys, Western Himalayas. *Rec. Indian Mus.*, 49 (2) : 175-184.
- Allen, G. O. (1918). The habits of the tree frog (*Rhacophorus maculatus*) *J. Bombay nat. Hist. Soc.*, 26 : 681.
- Anderson, J. (1871). A list of the Reptilian accession to the Indian Museum, Culcutta from 1865 to 1870, with a description of some new species. *J. Asiat. Soc. Beng.*, 40 : 12-39.
- Annandale, N. (1907). Reptilian and Batrachians from an Island in the Chilka Lake, Orissa. *Rec. Indian Mus.*, 1 : 397-398.

- Annandale, N. (1908 a). Notes on some Batrachians recently added in the collection of the Indian Museum. *Rec. Indian Mus.*, 2 : 304-305.
- Annandale, N. (1909). Notes on Indian "Batrachians". *Rec. Indian Mus.*, 3 : 282.
- Annandale, N. (1910). An undescribed Burmese frog allied to *Rana tigerina*. *Rec. Indian Mus.*, 5 : 79.
- Annandale, N. (1910). Description of a South Indian frog allied to *Rana corrugata* of Ceylon. *Rec. Indian Mus.*, 5 : 191-192.
- Annandale, N. (1911-1912). Zoological results of the Abor Expedition Part I. Batrachia. *Rec. Indian Mus.*, 8 : 7-36.
- Annandale, N. (1913). Some new interesting Batrachians and Lizards from India, Ceylon and Borneo. *Rec. Indian Mus.*, 9 : 301.
- Annandale, N. (1917). The occurrence of *Rana pleskii* Gunther in Kashmir. *Rec. Indian Mus.*, 13 : 417.
- Annandale, N. (1917). Zoological results of a tour in the far east, Batrachia. *Mem. Asiat. Soc. Beng.*, 6 : 119-156.
- Annandale, N. (1918). Further notes on *Rana tigerina* and allied forms. *Rec. Indian Mus.*, 14 : 59.
- Annandale, N. (1919). "The fauna of certain small streams in Bombay Presidency". *Rec. Indian Mus.*, 16 : 109.
- Ayyanger, M.O.P. (1915). A South Indian flying frog, *Rhaeophorus malabaricus* (Jerdon) *Rec. Indian Mus.*, 11 : 140-142.
- Barbout, T. (1920). An undescribed *Microhyla*. *Occ. Pap. Mus. zool. Univ. Mich.* (76) : 1-4
- Behura, B. K. (1962). Fauna of Orissa. In souvenir 49th Indian Sci. Congress, Cuttack. (Utkal University, Cuttack) : 170-176.
- Behura, B. K., Das, P. K., Mahanty, P. and Ghosh, G. S. (1960). On the diet and feeding habits of the common toad *Bufo melanostictus* Schn. *Proc. Indian Sci. Congress.*, 47 (3) : 480-481. (Abst.).
- Berry, P.Y. and Hendrickson, J. K. (1963). *Leptobrachium nigrops*, a new pelobatid frog from the Malay Peninsula with remarks on the genus *Leptobrachium* in South Eastern Asia. *Copeia*, 4 : 643-648.

- Bhadury, J. L. (1929). A case of hermaphroditism in a common Indian frog *Rana tigerina* Daud, with a note on the classification of hermaphroditic cases. *J. Asiat. Soc. Beng.*, (n.s.) 24 : 485-499.
- Bhadury, J.L. (1932). On the life history of *Rhacophorus maximus* Gunther. *Acharyya Sir. P. C. Roy Commemoration Vol.* : 470-476.
- Bhadury, J. L. (1933). A note on the occurrence of *Rana hexadactyla* Lesson in Bengal. *J. Bombay nat. Hist. Soc.*, 36 : 514-516.
- Bhadury, J. L. (1944). Further locality records of *Rana hexadactyla* Lesson in Bengal with brief notes on its tadpoles. *J. Bombay nat. Soc.*, 44 : 48.
- Bhadury, J. L. (1944). A note on *Rana crassa* Jerdon, with extension of its range. *J. Bombay nat. Hist. Soc.*, 44 : 481.
- Bhadury, J. L. (1945). The Indian Bull frog (*Rana tigerina* Daud.) a menace to fishery. *Sci. & Cult.*, 11 (4) : 205-206.
- Bhadury, J. L. and Kripalani, M. B. (1955). *Nyctibatrachus humayuni*, a new frog from the Western Ghats, Bombay. *J. Bombay nat. Hist. Soc.*, 52 (4) : 852-859.
- Bhadury, J. L. and Kripalani, M. B. (1954-1955). A new frog from the Western Ghats, (with field notes by Humayun Abdulali). *J. Bombay nat. Hist. Soc.*, 52 (4) : 852.
- Bhadury, J. L. and Basu, S. L. (1956). Further extension of range of frog *Uperodon globulosum* (Gunther) in Jalpaiguri, West Bengal. *J. Bombay nat. Soc.*, 53 (4) : 712-713.
- Bhadury J. L. and Saha, S. S. (1980). Extension of range of the narrow-mouthed frog, *Uperodon globulosum* (Gunther) to Kamrup district, Assam. *J. Bombay nat. Hist. Soc.*, 77 : 151-152.
- Boulenger, G. A. (1882). Catalogue of the batrachia Salientia S. Ecaudata in the collection of the British Museum. London, Taylor & Franchis XVI + 503.
- Boulenger, G. A. (1882). Description of a new genus and species of frog of the family Ranidae. *Ann. Mag. nat. Hist.*, (5) 10 : 35.
- Boulenger, G. A. (1883). Description of new species of reptiles and batrachians in the British Museum. *Ann. Mag. nat. Hist.*, (5) 12 : 161-167.
- Boulenger, G. A. (1884). Reptilia and Batrachia. *Zool. Rec.*, 21 : 1-19.

- Boulenger, G. A. (1886). First report on additions to the Batrachian collection in the Natural History Museum. *Proc. zool. Soc. Lond.*, 411-416.
- Boulenger, G. A. (1887). On a rare Himalayan toad, *Cophophryna sikkimensis* Blyth. *Ann. Mag. nat. Hist.*, (5) : 405-407.
- Boulenger, G. A. (1888). Notes on the classification of Ranidae. *Proc. zool. Soc. London.*, 204-206.
- Boulenger, G. A. (1888). Description of two new Indian species of *Rana*. *Ann. Mag. nat. Hist. Ser.*, 6, 2 : 506-508.
- Boulenger, G. A. (1890). The fauna of British India, including Ceylon and Burma. Reptilia and Batrachia. London, XVIII + 541 p.
- Boulenger, G. A. (1891). Description of a new species of frog obtained by Mr. H. S. Fergusson in Travancore, Southern India. *J. Bombay nat. Hist. Soc.*, 6 : 450.
- Boulenger, G. A. (1892). Description of a new toad from Travancore (*Bufo fergusonii*). *J. Bombay nat. Hist. Soc.*, 7 : 317.
- Boulenger, G. A. (1894). Reptilia and Batrachia. *Zool. Rec.*, 31 : 1-44.
- Boulenger, G. A. (1896). Reptilia and Batrachia. *Zool. Rec.*, 33 : 1-38.
- Boulenger, G. A. (1896). Description of a new batrachian in the British Museum. *Ann. Mag. nat. Hist.*, 17 : 401-406.
- Boulenger, G. A. (1897). Reptilia and Batrachia. *Zool. Rec.*, 34 : 1-34.
- Boulenger, G. A. (1904 b). Description of three new frogs from South India and Ceylon. *J. Bombay nat. Hist. Soc.*, 15 : 450.
- Boulenger, G. A. (1908). A revision of the Oriental pelobatid batrachians (Genus : *Megalo-* *lophrys*). *Proc. zool. Soc. Lond.*, 4 : 407-430.
- Boulenger, G. A. (1919). Description of three new batrachians from Garo hills, Assam. *Rec. Indian Mus.*, 16 : 207.
- Boulenger, G. A. (1920). A monograph of the South Asian, Papuan, Melanesian and Australian frogs of the genus *Rana*. *Rec. Indian Mus.*, 20 : 1-226.
- Boulenger, G. A. and Annandale, N. (1918). Remarks on *Rana tigerina* and its varieties, *Rec. Indian Mus.*, 15 : 51-58.

- Boulenger, G. A. and Annandale, N. (1918). Further observations on *Rana tigerina*. *Rec. Indian Mus.*, 15 : 51-67.
- Bourret, R. (1942). Les Batrachians de l' Indochine. Institut Océanographique de' Indochina, Hanoi, X + 547 pp.
- Chakko, G. (1968). Salinity tolerance of some Indian anurans. *Proc. Indian Acad. Sci., Sec. B*, 67 : 233-236.
- Chanda, S. K. (1986). On a collection of anuran amphibians from Sikkim Himalayas with description of a new species of *Rana* (Ranidae). *J. Bengal nat. Hist. Soc.*, New Series, 5 (2) : 140-1
- Chanda, S. K. (1990a). Amphibia species and their altitudinal distribution in northeast India. *J. Bombay nat. Hist. Soc.*, 87 (1) : 157-158.
- Chanda, S. K. (1990 b). *Rana mawlyndipi*, a new frog (Ranidae) from Khasi hills, Meghalaya, India. *J. Bengal nat. Hist. Soc.*, N. S. 9 (1) : 44-48.
- Chanda, S. K. (1990 c). A new frog of the genus *Rana* (Ranidae) from Manipur, northeast India. *Hamadryad* 15 (1) : 16-17.
- Chanda, S. K. (1991). Faunal Resources of Ganga, (Amphibia) Part-I: 51-57.
- Chanda, S. K. (1991). *Animal Resources of India Zoological Survey of India* : 631-636.
- Chanda, S. K. and Ghosh, A. K. (1988). Addenda to the amphibian fauna of India. *J. Bombay nat. Hist. Soc.*, 85 (3) : 626-627.
- Chanda, S. K. and Ghosh, A. K. (1989). A new frog of the genus *Philautus* Gistel, from the proposed Namdapha Biosphere Reserve, Arunachal Pradesh, Northeast India. *J. Bombay nat. Hist. Soc.*, 86 (2) : 215-217.
- Chanda, S. K. and Talukdar, S. K. (1973). Preliminary observations on the foam nest and early development of a frog *Rhacophorus* sp. *J. Assam Sci. Soc.*, 16 (2) : 32-34.
- Chari, V. K. (1962). A description of the hitherto undescribed tadpoles of and some field notes on the fungoid frog *Rana malabarica* (Tschudi). *J. Bombay nat. Hist. Soc.*, 59 : 71-76.
- Chari, V. K. and Daniel, J. C. (1953). The tadpoles of *Rana leithii* Boulenger. *J. Bombay nat. Hist. Soc.*, 57 (2) : 512-514.
- Daniel, J. C. (1962). Notes of amphibians of the Darjeeling area, West Bengal. *J. Bombay nat. Hist. Soc.*, 59 (2) : 666-668.

- Daniel, J. C. (1963 a). Field guide to the amphibians of Western India. Part I. *J. Bombay nat. Hist. Soc.*, 60 (2) : 415-438.
- Daniel, J. C. (1963 b). Field guide to the amphibians of Western India. Part II. *J. Bombay nat. Hist. Soc.*, 60 (2) : 690-702.
- Daniel, J. C. (1975). Field guide to the amphibians of Western India. Part III. *J. Bombay nat. Hist. Soc.*, 72 (2) : 507-522.
- Daniel, J. C. and Shull, E. M. *et al.* (1963). List of the Reptiles and Amphibians of the Surat Dangs, South Gujarat. *J. Bombay nat. Hist. Soc.*, 60 : 737-745.
- Daniel, J. C. and Sulekar, T. G. (1963). Occurrence of the fungoid frog *Rana malabarica* (Bibr.) at jagadapur, Bastar District, M. P. *J. Bombay nat. Hist. Soc.*, 60 : 743-744.
- Dutta, S. K. (1985). Replacement names for two Indian species of *Philautus* (Anura : Rhacophoridae). *J. Bombay nat. Hist. Soc.*, 82 (1) : 219-220.
- Dutta, S. K. (1985). Notes on the correct spelling of Indian Bull frog (*Rana tigerina*) *J. Bombay nat. Hist. Soc.*, 82 (1) : 220-221.
- Dutta, S. K. and Pradhan, B. (1985). Burrowing specialisations in anurans. *Pranikee*, 6 : 41-52.
- Dutta, S. K. (1986). First record of *Kaloula pulchra* (Anura : Microhylidae) from Orissa, India, with comments on its distribution. *J. zool. Soc., India*. 38 (1 & 2) : 111-112.
- Dutta, S. K. (1987). Misidentification, wrong nomenclature and misspelling of some Indian amphibians. *J. zool. Soc., India*. 39 (1 & 2) : 109-114.
- Dutta, S. K. (1990 a). *Rana bhagmandlensis* : A junior synonyms of *Rana aurantica* Boulenger (Anura : Ranidae). *J. Bombay nat. Hist. Soc.*, 87 (2) : 310.
- Dutta, S. K. (1990 b). Ecology, Natural History and conservation of Herpetofauna of Orissa, India. Tiger Paper, 17 : 20-28. (July-Sept.).
- Dutta, S. K. and Routroy, N. (1990 c). First record of *Rana hexadactyla* Lesson (Anura : Ranidae) from Orissa, India, with comments on their ecology and distribution. *Herpeton*, 3 : 5-6.
- Dubois, A. (1981). Biogeographie Des Amphibiens De L' Himalaya *Paleogeographie et de l' Himalaya et au sous-continent Indian*, Paris, C. N. R. S., Cashiers nepalais, : 63-64.

- Dubois, A. (1981). Liste des genres et Sous-genres nominaux de Ranoidea (Amphibiens-Anoures) du monde, avec Consequences nomenclaturales. *Mont. zool. ital.* (N. S.) *Suppl.* 13 : 225-284.
- Dubois, A. (1982). Le statut nomenclature des noms generique d'Amphibiens Anoures srees par Kuhl & V. Hass (1822) : *Megophrys*, *Occidoxyga* et *Rhacophorus*. *Bull. Mus. natn. Hist. nat.*, Paris, 4 ser. 1982 section A, n.s. 1-2 : 261-280.
- Dubois, A. (1983). Classification et Nomenclature supragenerique des Amphibiens Anurans. *Extrait Du Bulletin Mensuel De La Societe Linneenne De Lyon* 52° annee n° : 270-276.
- Dumeril, A. M. C. and Bibron, G. (1841). Erpetologie generall ou histoire naturelle complete des Reptiles. *Tome 8 Paris*, 3 : 1-192.
- Fergusson, H. S. (1904). A list of Travancore batrachians. *J. Bombay nat. Hist. Soc.*, 15 : 499-509.
- Fatedar, D. N. (1965). *Rhabdias bufonis* (Schrank, 1788) Stiles & Hassall, 1905, from the lungs of *Bufo viridis* in Kashmir and some notes on some amphibian species. *Kashmir Sci.*, 2 : 20-26.
- Gistel, J. Von. N. F. X. (1848). Naturgeschichto des Thierreichs fur hohere Schulen. *Stuttgart* : 1-216.
- Goraham, S. W. (1974). *Checklist of world amphibians upto January 1, 1970*. Saint John, Canada, the new Brunswick Meseum : 1-173.
- Grandison, A. G. C. and Daniel, J. C. (1964). Description of a new species of toad (Anura : Bufonidae) from Surat district, Maharashtra, India. *J. Bombay nat. Hist. Soc.*, 61 : 192-194.
- Gunther, A. (1858). *Catalogue of the Batrachia, Salientia in the collection of British Museum, London*. Taylor & Francis, xvi+160 pp.
- Hora, S. L. (1922). Animal life in torrential streams. *J. Bombay nat. Hist. Soc.*, 32 : 111-126.
- Hora, S. L. and Chopra, B. (1923). Reptilia and Batrachia of the salt range, Punjab. *Rec. Indian Mus.*, 25 : 369-376.
- Jerdon, T. C. (1953). Catalogue of Reptilia inhabiting the peninsula of India. *J. Asiat. Soc. Beng.*, 22 : 522-534.
- Jerdon, T. C. (1870). Notes on Indian herpetology. *Proc. Asiat. Soc. Beng.* : 66-85.

- Kampen, V. (1923). *The amphibia of the Indo-Australian Archipelago*, Leiden, xii+304 pp.
- Khan, M. S. (1979). On a collection of amphibians from northern Punjab and Azad Kashmir, with ecological notes. *Biologia (Pakistan)*, 25 (1-2) : 37-50.
- Kripalani, M. B. (1953 a). On Indian tadpoles on suctorial disc. *Rec. Indian Mus.*, 50 : 359-365.
- Kripalani, M. B. (1953 b). On two remarkable tadpoles from Darjeeling district. *Everyday Science., Hoshiapur*, 2 : 57-61.
- Kripalani, M. B. (1961). Zoological results of the Indian CHO-OYO Expedition (1958) in Nepal. Part-5. Amphibia. *Rec. Indian Mus.*, 59 : 241-244.
- Kuhl, H. (1829). *Deliciae Musei Zoologici vrbatislaviensis Fasciculus primus, continens Chelonies et Batrachia*, *Deliciae Mus. Zool. vrbatislav.*, Fasc. 1, Lipsiae : 25.
- Kuhl, H. and Hasselt, J. C. V. (1822). Uittreksel uit de brieven van de Herren Kuhl en van Hasselt, aan de Herren C. J. Temminck, Th, van Swinderen en W. de Hann. *Algemene Konst-en Letterbode voor het jaar*, : 102.
- Laurenti, J. N. (1768). Specimen medicum, exhibens Synopsin Reptilium emondatam cum experiments circa vancnn et antidota Reptilium austriacorum, good autoritate et consens u. Vienna : 1-217.
- Mansukhani, M. R. and Murthy, T. S. N. (1964). Fauna of Rajasthan. Part 6, Amphibia. *Rec. zool. surv. India.*, 62 (1 & 2) : 51-60.
- Mansukhani, M. R. and Sarkar, A. K. (1980). On a new species of toad (Anura : Bufonidae) from Camorta, Andaman and Nicobar, India. *Bull. zool. Surv. India.*, 3 (1 & 2) : 97-101.
- Mansukhani, M. R. and Sarkar, A. K. (1981). Notes on some Amphibian collection from Tripura, India. *Rec. zool. Surv. India*, 79 : 267-273.
- McCann, C. (1932). Notes on Indian Batrachians. *J. Bombay nat. Hist. Soc.*, 36 : 161.
- McCann, C. (1934). Occurrence of the Si-toad frog (*Rana hexadactyla* Lesson) in Bombay presidency. *J. Bombay nat. Hist. Soc.*, 37 : 742.
- McCann, C. (1938). Reptiles and Amphibians of Cutch State. *J. Bombay nat. Hist. Soc.*, 40 : 425-427.

- McCann, C. (1940). A Reptile and Amphibian Miscellany. *J. Bombay nat. Hist. Soc.*, 42 : 45-64.
- McCann, C. (1945), Reptiles and amphibians of Vizagapatnam and neighbouring Ghats. *J. Bombay nat. Hist. Soc.*, 45 (3) : 435-436.
- McCann, C. (1946a). The distribution of *Rana leithii* Boulenger. *J. Bombay nat. Hist. Soc.*, 46 (2) : 405.
- McCann, C. (1946 b). Aestivation of the frog *Ramanella montana* (Jerdon). *J. Bombay nat. Hist. Soc.*, 46 (2) : 409.
- Mohanti Hejmadi, P. (1974). Amphibian fauna of Orissa. *Prakruti-Utkal University Journal Science*, 2 (1 & 2) : 89-97.
- Mukherjee, A. K. (1975). The Sundarbans of India and its Biota. *J. Bombay nat. Hist. Soc.*, 72 (1) : 12-17.
- Murthy, T. S. N. (1967-1968a). Notes on a collection of amphibians from Madras and its neighbourhood with brief remarks on their distribution and habit. *J. Univ. Bombay*, 36 (3 & 5) : 4-8.
- Murthy, T. S. N. (1967-1968 b). Notes on rare and interesting Microhylid frog (*Ramanella variegata* (Stol.) from Madras. *J. Univ. Bombay*. 36 (3 & 5) : 1-3.
- Murthy, T. S. N. (1968). Notes on a collection of amphibians from Nagarjun valley (Andhra) with one new record. *J. Univ. Poona*, 34 (Supplement) : 5-7.
- Myers, G. S. (1942a). Frogs of Southern India. *Proc. biol. Wash.*, 55 : 71-74.
- Myers, G. S. (1942b). A new frog from Annamallai Hills, with notes on other frogs and some snakes from South India. *Proc. biol. Soc. Wash.*, 55 : 49-56.
- Myers, G. S. (1942c). A new frog of the genus *Micrixalus* from Travancore. *Proc. biol. Soc. Wash.*, 55 : 71-74.
- Myers, G. S. (1968). Notes on a collection of amphibians from Madras and its neighbourhood with brief remarks on their distribution and habits. *J. Univ. Bombay*, 35 (3 & 4) : 10-12.
- Myers, G. S. and Leviton, A. E. (1962). Generic classification of the high altitude pelobatid toads of Asia. (*Scutigera*, *Aelurophryne* and *Oreolalax*),

- Myers, G. S. and Karunakaran, C. (1932). A 'flying' frog. *J. Bombay nat. Hist. Soc.*, 35 : 220.
- Noble, G. K. (1931). *The Biology of the Amphibia*. Dover Publication, Inc., New York xiii+577 pp., 174 figs.
- Parker, H. W. (1925). On a collection of Reptiles and Batrachians from Tonkin. *Ann. Mag. nat. Hist.*, 9 (15) : 300-306.
- Parker, H. W. (1928). The brevicipitid frogs of the genus *Microhyla*. *Ann. Mag. nat. Hist.*, 2, 10th Series : 473-499.
- Parker, H. W. (1934). A monograph of the frogs of the family Microhylidae. viii+208 pp., London, (British Museum).
- Peters, W. (1871). Uber einige Arten der Herpetologisches Sammlung des Berliner Zoologischen Museums. *Mber. dt. Akad. Wiss. Berl.*, 36 : 644-652.
- Pillai, R. S. (1978). On *Nyctibatrachus major* Boul. (Ranidae) with description of its tadpole. *Bull. zool. Surv. India.*, 1 (2) : 135-140.
- Pillai, R. S. (1976). A new frog of the genus *Micrixalus* Boul. from Wynad, S. India. *Proc. Indian Acad., Sci.*, 87 B (Animal Sciences-2) No. 6 : 173-177.
- Pillai, R. S. (1977). A new species of *Rana* (Family : Ranidae) from Western Ghats, S. India. *Bull. zool. Surv. India.*, 2 (1) : 39-42.
- Pillai, R. S. (1980). Distribution, status and notes on habits of *Rana brevipalmata* Peters. *Bull. zool. Surv. India*, 3 (1 & 2) : 31-33.
- Pillai, R. S. (1981a). A new species of torrent toad (Genus : *Ansonia*) from Silent Valley, S. India. *Proc. Indian Acad. Sci.*, 90 (2) : 203-208.
- Pillai, R. S. (1981 b). Two new species of amphibia from Silent Valley, S. India. *Bull. zool Surv. India*, 3 (3) : 153-158.
- Pillai, R. S. (1986). Amphibian fauna of Silent Valley, Kerala, S. India. *Rec. zool. Surv. India*, 84 (1-4) : 229-242.
- Pillai, R. S. and Chanda, S. K. (1973). *Philautus shillongensis*, a new frog (Ranidae) from Meghalaya, India. *Proc. Indian Acad. Sci.*, 78 (1) : 30-36.
- Pillai, R. S. and Chanda, S. K. (1976). The distribution pattern of Amphibia in northeast India. *J. Assam Sci. Soc.*, 19 : 53-56.

- Pillai, R. S. and Chanda, S. K. (1977). Two new species of frogs (Ranidae) from Khasi hills, India. *J. Bombay nat. Hist. Soc.*, 74 (1) : 136-140.
- Pillai, R. S. and Chanda, S. K. (1979). Amphibian fauna of Khasi hills, Meghalaya. *Rec. zool. Surv. India*, 75 : 383-395.
- Pillai, R. S. and Chanda, S. K. (1981). Amphibian fauna of Garo hills, Meghalaya with description of a new species of *Rana*. *Rec. zool. Surv. India*, 79 : 159-168.
- Pillai, R. S. and Pattabiraman, R. (1981). A new species of torrent toad (Genus : *Ansonia*) from Silent Valley, S. India. *Proc. Indian Acad. Sci. (Animal Science)* 90 (2) : 203-208.
- Pillai, R. S. & Yazdani, G. M. (1973). *Bufoides*, a new genus for the rock toad, *Ansonia meghalayana* Yazdani & Chanda, with notes on its ecology and breeding habits. *J. zool. Soc. India*. 25 (1 & 2) : 65-70.
- Rao, C. R. N. (1915). Notes on some south Indian batrachia. *Rec. Indian Mus.*, 11 : 31.
- Rao, C. R. N. (1920). Some South Indian batrachia. *J. Bombay nat. Hist. Soc.*, 27 : 119.
- Rao, C. R. N. (1923). Notes on batrachia. *Rec. Indian Mus.*, 28 : 439-447.
- Rao, C. R. N. (1937). On some new forms batrachia from South India. *Proc. Indian Acad. Sci.*, 6, Sec. B : 387-425.
- Romer, J. D. (1949). Herpetological observations in Assam and Bengal (1944). *J. Bombay nat. Hist. Soc.*, 48 : 376-387.
- Roonwal, M. L. & Kripalani, M. B. (1951). A new frog *Philautus shillongensis* (Fam : Ranidae) Assam, India with field observation on its behaviour and metamorphosis. *Rec. Indian Mus.*, 59 : 325-330.
- Sahu, A. K. & Khare, M. K. (1983). Field key of *Rana alticola* Annandale (Anura : Ranidae) tadpoles. *J. Bombay nat. Hist. Soc.*, 80 (1) : 144-148.
- Sarkar, A. K. (1984). Taxonomic and ecological studies on the amphibians of Calcutta and its environs. *Rec. zool. Surv. India*, 81 (3 & 4) : 215-236
- Sarkar, A. K. & Sanyal, D. P. (1985). On a collection of amphibians from Namdapha National Park, Tirap district, Arunachal Pradesh. *Rec. zool. Surv. India*, 82 (1-4) : 285-295.

- Sarkar, A. K. (1990). Taxonomic and ecological studies on the amphibians of Andaman and Nicobar Islands, India. *Rec. zool. Surv. India*, 86 (1) : 103-117.
- Sarkar, A. K. (1993a). Amphibian Fauna of Orissa. State Fauna Series, 1 : Fauna of Orissa, Part 4 : 39-49.
- Sarkar, A. K. (1993b). Fauna of Andhra Pradesh. Part-1—Amphibia : State Fauna Series, (5) : 65-87.
- Sarkar, A. K., Biswas, M. L. & Ray, S. (1993). Amphibian fauna of West Bengal. State Fauna Series, 3 : Part 2 : 67-100
- Satyamurthi, S. T. (1963). Guide to the galleries of foreign animals, general zoology, skeletal exhibits and amphibians (Madras Govt. Museum). 1-11 pp. + 1-65 pp., 40 figs.
- Satyamurthi, S. T. (1967). The south Indian amphibia in the collection of the Madras Govt. Musium. *Bull. Govt. Mus.*, N. S. 7 (2) : 1—87 pp. + 12 pls.
- Schlegel, H. (1837-1844). Abbildungen neuer order unvollständig Amphibien, nech der Natur order dem Leben entworfen herausgegeben und mit erlouterden Texta begleitet von. Dr. H. Schlegel, Conservator des Niederlandischen Reichs-Museums. *Dusseldorf, verlag Von Arnx & Comp.* XIV : 1-141.
- Schneider, J. G. (1799). *Historiae Amphibiorum naturalis. Fasc. I.* Jenna, XIII : 370.
- Sclater, W. L. (1892a). On some specimens of frogs in the Indian Museum, Calcutta, with description of several new species. *Proc. Zool. Soc. London* : 341-348.
- Sclater, W. L. (1892 b). List of Batrachia in the Indian Museum. *Proc. Zool. Soc. London*, 1 : 43.
- Smith, M. A. (1917). A list of the batrachians at present known to inhabit in Siam. *J. nat. Hist. Siam*, 11 : 226-231.
- Smith, M. A. (1924). Descriptions of Indian and Indochinese tadpoles. *Rec. Indian Mus.*, 25 (1) : 137-144.
- Smith, M. A. (1927). Contribution to the herpetology of the Indo-Australian region. *Proc. Zool. Soc. London* : 199-225.
- Smith, M. A. (1929). On a collection of Amphibians and Reptiles from upper reaches of Brahmaputra. *Rec. Indian Mus.*, 34 : 77-80.
- Smith, M. A. (1935). The Amphibians and Reptiles obtained by Capt. Kingdom Ward in upper Burma : Assam and Tibet. *Rec. Indian Mus.*, 37 (2) : 237-240.

- Smith, M. A. (1940). On a collection of Amphibians and Reptiles from Nepal. *Ann. Mag. nat. Hist.*, Ser. 12, 4 : 726-728.
- Smith, M. A. (1953). Description of a new species of frog of the genus *Philautus*. *Ann. Mag. nat. Hist.*, 6 (66) : 477-478.
- Stoliczka, F. (1870). Observation on some Indian and Malayan Amphibians and Reptiles. *J. Asiat. Soc. Beng.*, 39 : 134-158.
- Stoliczka, F. (1872). Observations on the Indian Batrachia. *Proc. Asiat. Soc. Beng.* : 101-113.
- Theobald, W. (1868). Catalogue of Reptiles in the Museum of the Asiatic Society of Bengal. *J. Asiat. Soc. Beng.*, extra number 111 : 1-88.
- Theobald, W. (1872). Notes on some new species of Reptilia and Amphibia collected by Dr. W. Waagen in north-western Punjab. *J. Asiat. Soc. Beng.* : 124-131.
- Thurston, E. (1888). Catalogue of the Batrachia Salientia and Apoda (frogs, toads and cicilians) of Southern India. *Bull. Madras Govt. Press*, 42 (old series).
- Tschudi, J. J. (1838). Classification der Batrachier, mit Berücksichtigung der fossilen Thiers. *Mem. Soc. Sci. nat. Neuchatel*, 2 : 28.
- Wall, F. (1922). Notes on some lizards, frogs and human beings in the Nilgiri hills. *J. Bombay nat. Hist. Soc.*, 28 : 493-499.
- Wiegmann, A. F. A. (1835). Beiträge zur Zoologie gesammelt auf einer Reise um die Erde, von Dr. F. J. F. Meyer. Siebente Abhandlung : Amphibien. *Nova Acta. Acad. Leop. Carol.*, 17 : 185-268.
- Yazdani, G. M. and Chanda, S. K. (1971). A new toad *Ansonia meghalayana* (Fam : Bufonidae) from Meghalaya, India, with observations on its breeding on *Pandanus furcatus* Roxb. (Pandanales : Pandanaceae). *J. Assam Sci. Soc.*, 14 (1) : 76-80.
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