

VOL. 34

MARCH, 1966

NO. 2

**JOURNAL OF THE
BENGAL NATURAL HISTORY
SOCIETY**



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BENGAL NATURAL HISTORY SOCIETY
Estd. 1923

The Society under the name Darjeeling Natural History Society was started about the end of 1923, the objects being to maintain the Museum in a proper condition, to promote the study of Natural History and to get together as complete as possible collections of Natural History specimens from a limited area, including "the Civil Districts of Jalpaiguri and Darjeeling and the State of Sikkim", as well as what could be procured from the neighbouring countries of Tibet, Bhutan and Nepal.

Government and Municipal grants not being sufficient for our purpose, it was proposed to enrol members so as to increase our funds, and a quarterly journal was started. The journal is no longer confined to articles on the Natural History of the above mentioned area, but includes those from anywhere. It is hoped that everybody will join the Society and co-operate to make the Museum and Journal a success. The Journal is now issued half yearly.

The annual subscription is only Rs. 10. Life membership Rs. 150 ; those who have been members for over twenty years can become Life members on payment of Rs. 75.

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Natural History Museum
Darjeeling.

.....

To
The Curator,
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The Brown-headed Stork-billed } Kingfisher.	
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The Long-tailed Broadbill.	

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Estd. 1923

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Table of Contents.

VOL. 34

MARCH, 1966

No. 2

	PAGE
1. Birds of the Duars—Late C. M. Inglis (continued from p.4, Vol. 34, No. 1)	85
2. The Herpetology of Nepal:—Lawrence W. Swan and Alen E. Leviton	88
3. Orchids of Eastern Zone of India—B. N. Ghose ...	145

JOURNAL
OF THE
BENGAL NATURAL HISTORY SOCIETY

VOL. 34

MARCH, 1966

No. 2

BIRDS OF THE DUARS

By

C. M. INGLIS

Continued from Page 4, Vol. 34 No. 1.

FAMILY CAPITONIDAE

318. **The Himalayan Giant Barbet.**

Megalaima virens marshallorum: Swinhoe

Fauna B.I. 2nd. E.D. 1427.

Description.— Length 13 inches, sexes alike. Head and neck black, the feathers edged with violet-blue giving it a bluish sheen; on the hind-neck, and upper-back, there is a collar streaked with light yellow, back, shoulders, upper breast, olive-brown, rump, above the tail, tail, grass green, centre of lower-breast and abdomen, greenish-blue, patch under the tail crimson-scarlet, rest of lower plumage pale yellow, streaked with brown.

Bill chrome-yellow blackish along top of upper mandible, iris dark brown, legs olive-green.

In the Barbets the bill is stout and strong with a wide gape fringed with bristles, the feet are similar to those of Woodpeckers but the claws are weaker. They perch like ordinary birds and not like Woodpeckers.

Distribution and habits.— This Giant Barbet is common in the hills and wanders quite a long way into the plains in the winter. O'Donel found it 8 miles from the hills and I secured a specimen in the Dumchi forest on the 29th January, 1929. It is a forest bird and in the hills its loud, wailing call pee-o, pee-o, pee-o is often heard and it carries a very long distance. It has other notes syllabalized by Whistler as gyok-gyok-gyok and a harsh Karr-r uttered with reiteration. Although somewhat gaudy in appearance it is not very noticeable in the forest and what strikes one most is the big yellow bill and the scarlet patch below the tail. It feeds on berries, fruit and insects and has a strong, undulating flight.

319. The Nepal Lineated Barbet.

Thereiceryx lineata hodgsoni (Bonaparte)

Fauna B.I. 2nd E.D. No. 1432.

Description.— Length 11 inches. Sexes alike. Head, neck, breast, brown with broad, white shaft-streaks; upper plumage bright, deep grass-green, with some pale shaft-streaks on the upper-back, chin and throat, dullish-white, lower plumage, below the breast, yellowish green, under surface of tail blue-green. Bill fleshy-pink, tips grey, iris brown, small bare patch round the eye deep yellow, legs chrome-yellow.

This Barbet has a small, bare patch of yellow skin round the eye.

Distribution and habits.— A very common Barbet every where both in open country and the forest and its familiar note kotur-kotur is often heard wherever there are trees, either shade-trees in the tea, a small grove in the open, on trees in one's garden, or inside the forest. Stuart Baker has some interesting remarks about this bird's notes besides the one already mentioned which may be heard at all times of the day and even on moonlight nights. When angry it utters a wheezy pinch pinch.

its mouth wide open, its wings drooping and a general attitude of ferocity quite out of keeping with so feeble a sound, other notes mentioned by him are a guttural chuckle, when pleased and a musical whistle to call members of a family together. Besides fruit, berries and insects it eats, according to Stuart Baker, small lizards, tree-frogs and even nestlings of other birds which fall from the nest.

The principal breeding months are April and May. It excavates a hole in a dead stump or rotten branch of a tree sometimes it makes its nest-hole on the upper surface of a branch, the holes are usually between 6 and 16 feet from the ground but sometimes as high as 30 or 40 feet. The eggs number 2 to 4 and are dull white with a slight gloss. They measure about 1.27 by 0.87 inches.

(88)

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June 29, 1962.

THE HERPETOLOGY OF NEPAL :
A HISTORY, CHECK LIST,
AND ZOOGEOGRAPHICAL ANALYSIS
OF THE HERPETOFAUNA

by

Lawrence W. Swan¹

*San Francisco State College
San Francisco, California*

and

Alan E. Leviton

*California Academy of Sciences
San Francisco, California*

¹Research Associate, Department of Herpetology, California Academy of Sciences.

The Editor takes great pleasure in reprinting an article entitled THE HERPETOLOGY OF NEPAL : A HISTORY, CHECK LIST, AND ZOOGEOGRAPHICAL ANALYSIS OF THE HERPETOFAUNA by Dr. Lawrence W. Swan, Professor of Biology, San Francisco State College, California, and Dr. Alan E. Leviton, of the California Academy of Sciences, San Francisco, California.

The former writes:....."SAN FRANCISCO STATE
COLLEGE

1600 Holloway Avenue, San Francisco, California 94132
9th March, 1966.

Mr. Erach D. Avari C/o. Capitol Theatre, Darjeeling,
West Bengal, India.

...I have checked with Al Leviton and the Academy and there seems to be no restriction against republication. So go ahead as you wish. It is a pleasure to find that it merits such treatment. The paper helps to clarify the status of the Western Himalayas as well as Sikkim-Darjeeling even though its title suggests a concentration upon Nepal. I think the work emphasizes the remarkable assemblage of amphibians and reptiles which concentrate around our 'home town'. I doubt if there is another place (perhaps somewhere in S. America ?) which rivals the Darjeeling area in diversity and abundance. This holds for birds and some other things too. How fortunate you are! And how important your museum is!.....

When plans for the trip begin to finalize in May, I shall let you know more about our plans.

Sincerely,

Sd/- Lawrence W. Swan."

From an American Missionary family, Dr. Lawrence Swan, or Larry as he is affectionately known to his friends was educated in Mt. Hermon School and St. Joseph's College, Darjeeling. He is therefore no stranger to the Eastern Himalayan Region. He also accompanied the Snowman Expedition in 1960, and in 1954 had made an important collection of amphibians and reptiles with the California-Himalaya Expedition to Makalu. In a previous letter he wrote: "... I hope all is well and that you never take that beautiful spot called Darjeeling for granted. In every bush there's a new concept and along every road a new species. The rain is a blessing and the view, a redundant addition to perfection. But in the world of humans and their lives I suppose, like in all places, there is a long way to go. There are several additional papers of the Himalayas in the making. It keeps me busy. Perhaps we'll meet again in 1964. It is imaginary as yet but it is a nice thought. Sincerely, Larry..."

Sincerely,

Dr. Lawrence W. Swan

REPRINTED WITH THEIR KIND PERMISSION.

INTRODUCTION.

Herpetological collecting in Nepal has been sporadic and the literature describing the Nepalese herpetofauna has appeared irregularly and infrequently for more than a century. Prior to 1948 little was known of the fauna of the country beyond the centrally located capital of Katmandu, but during the last few years the remote regions have become more readily accessible and several important collections of animals and plants have been made.

Motivation for the present paper, in which we attempt to collate all hitherto published data dealing with Nepalese amphibians and reptiles, was derived from a joint interest in Himalayan zoogeography on the part of the authors. Nepal lies at the crossroads of four major faunal units. The Mediterranean and West Chinese divisions of the Palearctic Region meet the Indian and Indochinese subregions of the Oriental Region, and an understanding of the Nepalese fauna is basic to a study of the evolution and distribution of the high altitude fauna of southeast Asia.

The present report is divided into three parts. The first, a history of herpetological work in Nepal, is based on a collation of published works reporting on collections of amphibians and reptiles obtained in that country. A check list of amphibians and reptiles known to occur in Nepal follows; in this list all literature containing Nepal records are noted in the respective species synonymies and are the only citations so listed. The third section of this report represents a zoogeographical analysis of the herpetofauna of Nepal. In view of the fact that this analysis is based upon an incomplete knowledge of the country's fauna, we have prepared a detailed table (table I), in which all species known to occur in Nepal and adjacent areas, or in adjacent areas but which have not yet been recorded from

Nepal, have been listed. The table indicates the geographical relationships of the known fauna, and suggests species which are still likely to be found in the country.

The writers are grateful to Drs. Edward L. Kessel and Leo G. Hertlein, editors of the Academy's *Proceedings*, for their patience and their careful editing of the paper. The authors are solely responsible for the accuracy of the data presented and for the zoogeographic interpretation.

HISTORY

The earliest collector of Nepalese amphibians and reptiles, to the best of our knowledge, was Brian Hodgson who occupied the British Residence in Katmandu during the years 1820 to 1822, and 1824 to 1843. Although Hodgson was preceded in Nepal by at least two earlier naturalists, Nathaniel Wallich, in 1817, and Francis Buchanan-Hamilton, in 1802-1803, both of whom resided in Katmandu for short periods, there is no evidence that either obtained any amphibians or reptiles for museum specimens.

During his residence in Nepal, Hodgson distinguished himself as an authority in many disciplines, among which his researches in ethnology, Buddhism, ornithology, and mammalogy are preeminent. In addition to his normal diplomatic duties he found time to publish 127 papers on zoological subjects, although none dealt with amphibians or reptiles. His prime contribution to the field of herpetology was through his collection of Nepalese fauna, the specimens of which, presented to the British Museum in 1858, included 9,512 specimens of birds, 903 mammals, and 84 reptiles, and a number of drawings of which there were 1241 sheets of birds, 557 sheets of mammals, and 55 sheets of reptiles (Hunter, 1896).

Several years before his final return to England, delayed until 1858, a few of Hodgson's specimens found their way to London and were described by Cantor (1839); they were also

included in Gray's Catalogues of the British Museum herpetological collection (1844-1850). On his arrival in England, Hodgson turned over the bulk of his collections of amphibians and reptiles to Albert Günther who, in a series of three papers (1858, 1860, 1861), described their contents. In 1864, Günther monographed the reptilian fauna of "British India," incorporating the results of his earlier studies of the Hodgson material in the volume. In addition, he listed a single specimen of the agamid lizard *Calotes versicolor*, said to have been collected in Nepal by Thomas Hardwicke, and a turtle, *Chitra indica*, supposedly obtained by the botanist Hugh Falconer who, with Hardwicke, was one of several naturalists to visit Nepal in the early years of British contact with that country. All other Nepalese records given by Günther are attributed to Brian Hodgson.

Hodgson's influence at the Nepalese court enabled him to obtain a unique concession from the Prime Minister to permit Joseph Hooker access to eastern Nepal during the course of the latter's botanical travels in Sikkim. Hooker's collection of amphibians and reptiles are all reported as being obtained in Sikkim; there is no precise indication in known literature sources that he obtained any amphibians or reptiles while he was travelling in Nepal between November 5, 1848 and December 15, 1848 (Hooker, 1854, vol. 1, pp. 186-280).

Although Katmandu was visited periodically by European naturalists (including Hermann Schlagintweit, in 1856) and by Nepalese and Indian collectors during a sixty year period (1858-1906) following Hodgson's work there, there is scarcely any published evidence to indicate that amphibians or reptiles were collected. There is, however, one notable exception. In his lists of amphibians and reptiles in the Indian Museum (1891 and 1892), William Sclater gives Katmandu as the locality for specimens of several species stored in that museum's collections. Unfortunately, there is no indication who collected the material.

In 1907, Nelson Annandale, George Boulenger, and Frank Wall described a substantial collection of amphibians and reptiles obtained in the vicinity of Katmandu by R. Hodgart. Several new records, including two species of frogs, five lizards, and five snakes, are given for Nepal. Subsequently, in a series of papers published by Wall (1907-1924), a number of snakes were recorded for the first time from the country. Included among these is *Psammodynastes pulverulentus*, the only indication for its occurrence in Nepal being a distribution map published by Wall, in 1910, in which the locality Butal [= ? Butwal], Nepal, is given as a collecting site.

In 1913, Boulenger described a small collection of amphibians and reptiles taken at the extreme eastern frontier of Nepal, immediately adjacent to the Darjeeling District of Bengal, collected by N. H. Stevens. Two new snake records were included.

With publication of the reptile volumes in the *Fauna of British India* series (1931, 1935, and 1943), the widely scattered literature on reptiles of southern Asia was brought together for the first time. The three volumes on reptiles, written by Malcolm Smith, stand as the single most important contribution to Asian herpetology published to date. In preparing these works it was obviously impractical for Smith to give detailed locality, collector, date, and available ecological information for all the material he examined. Consequently, specific consideration of the reptiles of any one region, for example Nepal, is not possible in these volumes, and resort must be made to the original literature. Regrettably, a comparable volume dealing with the amphibians of southern Asia has not been published.

Since 1948, Nepal has been visited by numerous expeditions, and there are few portions of the country which have not been investigated by persons interested in the fauna and

flora. Nevertheless, the published literature suggests that only a few expeditions have obtained amphibians and reptiles in the course of their activities.

In 1949, an expedition under the leadership of H. W. Tilman explored the Langtang Himal, north of Katmandu. Herpetological collections were made by Oleg Polunin and were deposited in the British Museum where Malcolm Smith examined them and prepared a report published in 1951. An interesting ecological analysis of this Himalayan area was prepared by Polunin and published as an appendix to Tilman's "Nepal Himalaya" (1951).

Western Nepal was visited, in 1952, by an expedition sponsored by the British Museum and the Royal Horticultural Society. Oleg Polunin accompanied this group and again secured a number of amphibians and reptiles which are of special interest because of the altitude records. Malcolm Smith and James C. Battersby of the British Museum described this collection in 1953. Six new records of amphibians and reptiles in Nepal were reported on, in this paper.

In 1954, the California-Himalaya Expedition to Makalu traversed eastern Nepal in the vicinity of the Arun River (a descriptive summary of this expedition was prepared by Houston and Long [1955] and a discussion of high-altitude ecology by Swan [1961]). The collections of amphibians and reptiles, made by Lawrence Swan, and including eight new records and a new species of frog from Nepal, were deposited in the Natural History Museum of Stanford University. Alan Leviton, George Myers, and Lawrence Swan reported on this collection in 1956 and, as an addendum to the paper, the authors also described a small collection of amphibians from Katmandu and Pokhara obtained by Alan Taft earlier that year.

Recently, a few specimens of *Natrix piscator* were collected by the joint Harvard-Yale universities expedition to

central Nepal. In addition, several snakes and frogs from Nepal were obtained for the Chicago Natural History Museum by Dr. Robert L. Fleming in the vicinity of Katmandu. These collections are reported in this paper for the first time. Collections of amphibians and reptiles made by L. W. Swan during 1960 in eastern Nepal between Katmandu and Darjeeling are not reported in this paper.

CHECKLIST OF NEPALESE AMPHIBIANS AND REPTILES²

Class AMPHIBIA

Order SALIENTIA

Family Bufonidae

Bufo andersoni Boulenger.

Bufo andersoni, LEVITON, MYERS, and SWAN, 1956, p. 4 (above Tamur River [1000 ft.]).

RANGE IN NEPAL. Eastern³ (Tamur Valley).

Bufo himalayanus Günther

Bufo himalayanus GÜNTHER, 1864, p. 422 (type loc.: Nepal and Sikkim). BOULENGER, 1882, p. 305 (Nepal). SMITH, 1951, p. 727 (Thangjet [5000 ft.]; Syarpagaon [Langtang Khola, 8000-9000 ft.]; Rasua Garhi District). SMITH and BATTERSBY, 1953, p. 703 (Jumla [7600 ft.]).

Bufo melanostictus (nec Schneider) GÜNTHER, 1860, p. 165 (Nepal); 1861, p. 220 (Nepal).

RANGE IN NEPAL. Central (Thangjet¹, Syarpagaon, Rasua Garhi); Western (Jumla).

²Many of Günther's records (between 1858 and 1864) noted in the following checklist were based on collections made by Brian Hodgson. Most of the specimens probably came from the vicinity of Katmandu, but it is known that Hodgson employed collectors to obtain specimens from elsewhere in the country. Unless otherwise noted, all of Günther's records are presumed to have been based on collections from central Nepal, from in and about the capital city of Katmandu.

³Nepal has been divided into Western, Central, and Eastern portions based on the major river systems of the country. See map, pages 120-121, fig. 1.

⁴The spelling of locality names has been corrected to follow the Survey of India Eight Mile Map of Nepal (1934) and the 1 inch to 4 mile map sheets of Nepal (1955).

Bufo melanostictus Schneider.

Bufo melanostictus, SCLATER, 1892, p. 27 (Katmandu). BOULENGER, 1907, p. 149 (Chitlong; Soondrijal). LEVITON, MYERS, and SWAN, 1956, pp. 4 and 14 (near Khandbari [7000 ft.]; near Dhankuta [6000 ft.]; near Num [5000 ft.]; near Yetung [8500 ft.]; Kalimati).

Chicago Natural History Museum 83096 (Patan).

RANGE IN NEPAL. Eastern (Dhankuta, Khandbari, Num, Yetung); Central (Chitlang, Kalimati, Katmandu, Sundarijal, Patan).

Family Microhylidae

Microhyla ornata (Duméril and Bibron).

Microhyla ornata, LEVITON, MYERS, and SWAN, 1956, p. 5 (Khandbari [4000 ft.]).

RANGE IN NEPAL. Eastern (Khandbari).

Family Pelobatidae

Scutigera sikkimensis (Blyth).

Scutigera sikkimensis, SMITH, 1951, p. 727 (Langtang Village [11,000 ft.]). SMITH and BATTERSBY, 1953, p. 703 (Khola north of Maharigaon [13,500 ft.]).

RANGE IN NEPAL. Central (Langtang Village); Western (Maharigaon).

Family Ranidae

Rana breviceps Schneider.

Rana breviceps, LEVITON, MYERS, and SWAN, 1956, p. 5 (Dharan [1000 ft.]).
RANGE IN NEPAL. Eastern (Dharan).

Rana cyanophlyctis Schneider.

Rana cyanophlyctis, SCLATER, 1892, p. 2 (Katmandu). BOULENGER, 1907, p. 150 (Soondrijal; Pharping); 1920, p. 12 (Nepal). LEVITON, MYERS, and SWAN, 1956, pp. 6, 14 (Tamur River [500 ft.]; near Dhankuta [4500 ft.]; near Num [6000 ft.]; near Khandbari [4500 ft.]; above Arun River [3500 ft.]; Sandarijal; near Pokhara [Mardi Khola]).

RANGE IN NEPAL. Eastern (Arun River, Dhankuta, Khandbari, Num, Tamur River); Central (Katmandu, Pharping, Pokhara, Sundarijal).

Rana formosa (Günther).

Rana formosa, BOULENGER, 1907, p. 151, (Soondrijal). SMITH, 1951, p. 727 (Rasua Garhi [6000 ft.]).

RANGE IN NEPAL. Central (Rasua Garhi, Sundarjal).

Rana liebighii (Günther).

Rana liebighii GÜNTHER, 1860, p. 157, pl. 28, fig. A (Nepal and Sikkim); 1861, p. 220 (Nepal); 1864, p. 407 (Nepal.) BOULENGER, 1913, p. 337 (Sandakpho [11,500 ft.]); 1920, p. 80 (Nepal [types]). SMITH, 1951, p. 727 (Rasua Garhi [6000 ft.]).

LEVITON, MYERS, and SWAN, 1956, p. 6 (near Num [5000 ft.]).

RANGE IN NEPAL. Eastern (Num, Sundakphu); Central (Rasua Garhi).

Rana limnocharis Wiegmann.

Rana limnocharis, SCLATER, 1892, p. 6 (Katmandu). BOULENGER, 1907, p. 151 (Soondrijal). LEVITON, MYERS and SWAN, 1956, p. 6 (above Yetung [7000 ft.]; near Dhankuta [4500 ft.]; Arun River [1000 ft.]; below Yetung [4000 ft.]; near Num [3500 ft.]; above Dhankuta [6000 ft.]).

RANGE IN NEPAL. Eastern (Arun River, Dhankuta, Num, Yetung); Central (Katmandu, Sundarjal).

Rana monticola (Anderson).

Leptobatrachium monticola, BOULENGER, 1907, p. 149 (Soondrijal).

RANGE IN NEPAL. Central (Sundarjal).

Rana polunini Smith.

Rana polunini SMITH, 1951, p. 727 (Langtang Village [11,000 ft], Nepal).

RANGE IN NEPAL. Central (Langtang Village).

Rana swani Myers and Leviton.

Rana swani MYERS and LEVITON, 1956 p. 4 (Dharan [1000 ft.], Nepal).

RANGE IN NEPAL. Eastern (Dharan; may also be represented in Arun Valley [see Leviton, Myers, and Swan, 1956, p. 6]).

Rana tigerina Daudin.

Rana tigerina, GÜNTHER, 1860, p. 164 (Nepal); 1861, p. 220 (Nepal) BOULENGER, 1907, p. 151 (Katmandu [4000-5000 ft.]; Soondrijal); 1920, p. 19 (Nepal). LEVITON, MYERS, and SWAN, 1956, p. 14 (Kalimati).

Chicago Natural History Museum 83091-83094 (Katmandu).

RANGE IN NEPAL. Central (Kalimati. Katmandu. Sundarjal).

Family **Rhacophoridae**

Rhacophorus maculatus (Gray).

Polypedates maculatus, GÜNTHER, 1861, p. 220 (Nepal).

Rhacophorus maculatus, LEVITON, MYERS, and SWAN, 1956, p. 9 (above Num [5000 ft.]).

RANGE IN NEPAL. Eastern (above Num); Central (without exact locality data²).

Rhacophorus maximus Günther.

Rhacophorus maximus GÜNTHER, 1858, p. 83 (Nepal); 1860, p. 165 (Nepal); 1861, p. 220 (Nepal); 1864, p. 435 (Nepal [5200 ft.]).

RANGE IN NEPAL. Central (without exact locality data²).

Class REPTILIA

Order CROCODILIA

Family Crocodylidae

Gavialis gangeticus (Gmelin).

Gavialis gangeticus, GÜNTHER, 1861, p. 215 (Nepal).

RANGE IN NEPAL. Central (without exact locality data²).

Order TESTUDINATA

Family Emydidae

Kachuga dhongoka (Gray).

Batagur dhongoka, GÜNTHER, 1861, p. 214 (Nepal); 1864, p. 42 (Nepal).

THEOBALD, 1876 p. 22 (Nepal).

RANGE IN NEPAL. Central (without exact locality data²).

Kachuga kachuga (Gray).

Batagur lineata (Gray), GÜNTHER, 1861 p. 214 (Nepal).

Batagur kachuga, THEOBALD, 1876, p. 19 (Nepal).

Kachuga kachuga, SMITH, 1931, p. 131 (Nepal).

RANGE IN NEPAL. Central (without exact locality data²).

Family Testudinidae

Testudo elongata Blyth.

Testudo horsfieldi, GÜNTHER, 1861, p. 214 (Nepal); 1864, p. 7 (Nepal).

Smith (1931, p. 143) states, "Hodgson obtained a specimen in the Saul forests of Nepal and has left a fine coloured sketch of it in his collection of drawings." It is uncertain whether Smith considered Hodgson's drawing (which Günther described as *T. horsfieldi*, *supra cit.*) to be *T. elongata* or whether Smith's reference is in error.

RANGE IN NEPAL. Central (without exact locality data²).

Family **Trionychidae**

Chitra indica (Gray).

Chitra indica, GÜNTHER, 1861, p. 214 (Nepal); 1864, p. 50 (Nepal). SMITH, 1931, p. 162 (Nepal).

RANGE IN NEPAL. Central (without exact locality data²).

Trionyx gangeticus Cuvier.

Trionyx gangeticus GÜNTHER, 1861, p. 214 (Nepal); 1864, p. 47 (Nepal). SMITH, 1931, p. 167 (base of Nepal foothills).

Trionyx javanicus GRAY, GÜNTHER 1861, p. 214 (Nepal).

RANGE IN NEPAL. Central (without exact locality data²).

Order **SQUAMATA**

Suborder **Sauria**

Family **Agamidae**

Agama tuberculata Gray.

Agama tuberculata, ANNANDALE, 1907, p. 154 (Chitlong). SMITH, 1935, p. 214 (Kashmir to Katmandu); 1951, p. 728 (Chattekhola [Rasua Garhi District], Rasua Garhi [7000 ft.]). SMITH and BATTERSBY, 1953, p. 703 (Jumla [7600 ft.]).

RANGE IN NEPAL. Central (Chattekhola, Rasua Garhi, Chitlang); Western (Jumla).

Calotes versicolor (Daudin).

Calotes versicolor, GRAY, 1845, p. 243 (Nepal). GÜNTHER, 1860, p. 140; 1864, p. 215 (Nepal). ANNANDALE 1907, p. 153 (Katmandu). SMITH, 1935, p. 189 (Nepal); 1951, p. 728 (Rasua Garhi District). SMITH and BATTERSBY, 1953, p. 703 (Lapha [Karnali Valley, 4000 ft.]), LEVITON MYERS, and SWAN, 1956, p. 10 (above Dharan [1500 ft.], Arun Valley [1000 and 2000 ft.], near Khandbari [3000, 4500 and 7000 ft.], below Yetung [4000 ft.]).

RANGE IN NEPAL. Eastern (Arun River Valley, Dharan, Khandbari, Yetung); Central (Katmandu, Rasua Garhi).

Japalura major (Jerdon).

Japalura major, SMITH and BATTERSBY, 1953, p. 703 (Barbung Khola, Kakkatgaon [1200 ft. *sic*], above Rimi [10,500 ft.], Samala [7500 ft.], Chaudhabise Khola [10,000 ft.]).

RANGE IN NEPAL. Western (Barbung Khola, Kakkatgaon, Rimi, Samala, Chaudhabise Khola).

Japalura tricarinata (Blyth).

Acanthosaura tricarinata, ANNANDALE 1907, p. 153 (Chandragiri [8000 ft.]).

Japalura tricarinata, SMITH, 1935, p. 169 (eastern Nepal); 1951, p. 728 (Langtang Khola [9500 ft.]).

RANGE IN NEPAL. Central (Chandragiri, Langtang Khola).

Family **Gekkonidae**

Cosymbotus platyurus (Schneider).

Hemidactylus nepalensis ANNANDALE, 1907, p. 151 (Katmandu).

Platyurus Platyurus, SMITH, 1935, p. 102 (Nepal).

Cosymbotus platyurus, LEVITON, MYERS, and SWAN, 1956, p. 9 (Khandbari [4000 ft.]).

RANGE IN NEPAL. Eastern (Khandbari); Central (Katmandu).

Hemidactylus frenatus Schlegel.

Hemidactylus frenatus, LEVITON, MYERS and SWAN, 1956, p. 10 (Dharan [1000 ft.]).

RANGE IN NEPAL. Eastern (Dharan).

Family **Scincidae**

Leiolopisma himalayanum (Günther).

Lygosoma himalayanum, ANNANDALE, 1907, p. 154 (Chitlong).

Leiolopisma himalayanum, SMITH, 1935, p. 299 (Nepal). SMITH and BATTERSBY, 1953, p. 703 (Jumla [7600 ft.]).

RANGE IN NEPAL. Central (Chitlang); Western (Jumla).

Leiolopisma ladacense (Günther).

Leiolopisma ladacense, SMITH and BATTERSBY, 1953, p. 703 (Balangra Pass, Tibrikot [11,500 to 12,000 ft.], Phoksumdo Tal [14,000 ft.], Pemringgaon [16,000 ft.], Kahajeng Khola [18,000 ft.]).

RANGE IN NEPAL. Western (Balangra Pass, Tibrikot, Phoksumdo Tal, Pemringgaon, Kahajeng Khola).

Leiolopisma sikkimense (Blyth).

Lygosoma sikkimense, ANNANDALE, 1907, p. 154 (Chitlong, Katmandu).

Leiolopisma sikkimense, SMITH, 1935, p. 301 (Chitlong, Katmandu); 1951, p. 728 (Thangjet [5000 ft.]).

RANGE IN NEPAL. Central (Chitlang, Katmandu, Tangjet).

Mabuya carinata (Schneider).

Mabuya carinata, LEVITON, MYERS, and SWAN, 1956, p. 11 (Yetung [4500 ft.]).

RANGE IN NEPAL. Eastern (Yetung).

Mabuya macularia (Blyth).

Tiliqua rufescens (nec Shaw) GRAY, 1853, p. 388 (Nepal). GÜNTHER, 1860, p. 160 (Nepal); 1861, p. 215 (Nepal).

Euprepes rufescens, GÜNTHER, 1863, p. 79 (Nepal).

Mobuia macularia, ANNANDALE, 1907, p. 154 (Terai near Raxaul [Nepal; frontier]).

RANGE IN NEPAL. Central (Raxaul).

Riopa punctata (Gmelin)

Riopa punctata, LEVITON, MYERS, and SWAN, 1956, p. 11 (Dharan [1000 ft.]).

RANGE IN NEPAL. Eastern (Dharan).

Family Varanidae

Varanus flavescens (Gray).

Empagusia flavescens, GÜNTHER, 1860, p. 159 (Nepal); 1861 p. 215 (Nepal)

Varanus flavescens, GÜNTHER, 1864, p. 65 (Nepal).

RANGE IN NEPAL. Central (without exact locality data²).

Varanus monitor (Linnaeus).

Varanus heraldicus (Gray), GRAY, 1845, p. 8 (Nepal). GÜNTHER, 1860, p. 160 (Nepal); 1861, p. 215 (Nepal).

Varanus dracaena (Gray), GÜNTHER, 1864, p. 65 (Nepal).

Varanus monitor, SMITH, 1935, p. 402 (Nepal) LEVITON, MYERS, and SWAN, 1956, p. 11 (sight record; below Khandbari [4000 ft.], and north of Dhankuta).

RANGE IN NEPAL. Eastern (below Khandbari, north of Dhankuta; both sight records); Central (without exact locality data²).

Suborder Serpentes

Family Boidae

Python molurus (Linnaeus).

Python molurus, GÜNTHER, 1861, p. 215 (Nepal; known from colored drawing). WALL, 1907, p. 155 (Bichiakoh [Nepal terai]).

RANGE IN NEPAL. Central (Bichiakoh).

Family Colubridae

Boiga ceylonensis (Günther).

Dipsadomorphus nuchalis (GÜNTHER). WALL, 1924, p. 872 (Chitlong).

Boiga ceylonensis, SMITH, 1943, p. 351 (Chitlong).

RANGE IN NEPAL. Central (Chitlang).

Boiga multifasciata (Blyth)

Dipsadomorphus multifasciata, WALL, 1907, p. 157 (Chitlong); 1924, p. 871 (Chitlong).

Boiga multifasciata, SMITH, 1943, p. 357 (Nepal).

RANGE IN NEPAL. Central (Chitlang).

Boiga trigonata (Schneider).

Chicago Natural History Museum 83087 (Ampipalbhanjan [4000 ft.]); CNHM 83089 (Katmandu [4000 ft.]).

RANGE IN NEPAL. Central (Ampipalbhanjan, Katmandu).

Coluber fasciolatus Shaw.

Coryphodon fasciolatus, GÜNTHER, 1861, p. 218 (Nepal).

RANGE IN NEPAL. Central (without exact locality data²).

Elaphe cantoris (Cantor).

Spilotes reticularis (Cantor), GÜNTHER, 1858, p. 249 (Nepal); 1860, p. 163 (Nepal); 1861, p. 218 (Nepal).

Composoma reticulare, GÜNTHER, 1864, p. 245 (Nepal).

RANGE IN NEPAL. Central (without exact locality data²)

Elaphe hodgsonii (Günther).

Spilotes hodgsonii, GÜNTHER, 1860 p. 156 (Nepal and Ladak [15,200 ft.] 1861, p. 218 (Nepal).

Composoma hodgsonii, GÜNTHER, 1864, p. 246 (Nepal). THEOBALD, 1876, p. 166 (Nepal).

Coluber hodgsonii, SCLATER, 1891, p. 31 (Katmandu).

Elaphe hodgsonii, SMITH and BATTERSBY, 1953, p. 704 (Tarakot [10,500 ft.]).

RANGE IN NEPAL. Central (without exact locality data²); Western (Tarakot).

Elaphe radiata (Schlegel).

Elaphe radiata, LEVITON, MYERS, and SWAN, 1956, p. 12 (Arun Valley [1000 ft.]).

Chicago Natural History Museum 83098 (Hitara [4500 ft.]).

RANGE IN NEPAL. Eastern (Arun River Valley); Central (Hitaura).

Liopeltis rappii (Günther).

Ablabes rappii GÜNTHER, 1860, p. 154, pl. 26, fig. B (Nepal and Sikkim [5340 ft.]); 1861, p. 217 (Nepal); 1864, p. 225 (Nepal).

Ablabes owenii, GÜNTHER, 1861, p. 217 (Nepal).

Liopeltis rappii, WALL, 1924, p. 865 (Nepal). SMITH, 1943, p. 186 (Nepal).

RANGE IN NEPAL. Central (without exact locality data²).

Lycodon aulicus (Linnaeus)

Lycodon aulicus, GÜNTHER, 1860, p. 164 (Nepal); 1861, p. 219 (Nepal); 1864, p. 316 (Nepal). SCLATER, 1891, p. 14 (Katmandu). WALL, 1907, p. 152 (Katmandu [4500 ft.]). SMITH, 1943, p. 263 (Nepal).

Chicago Natural History Museum 83090 (Katmandu

[4000 ft.]).

RANGE IN NEPAL. Central (Katmandu).

Natrix himalayana (Günther).

Tropidonotus himalayanus GÜNTHER, 1864, p. 265, pl. 22, fig. H (Nepal and Sikkim). THEOBALD, 1876, p. 178 (Nepal).

RANGE IN NEPAL. Central (without exact locality data²).

Natrix parallela (Boulenger).

Tropidonotus parallelus, BOULENGER, 1913, p. 337 (Maikholha Valley [7000-10,000 ft.]).

RANGE IN NEPAL. Eastern (Mai Khola).

Natrix piscator (Schneider).

Tropidonotus quincunciatus Schlegel, GÜNTHER, 1858, p. 63 (Nepal); 1860, p. 162 (Nepal); 1861, p. 217 (Nepal); 1864, p. 260 (Nepal).

Tropidonotus piscator, WALL, 1907, p. 157 (Pharping [5000 ft.]).

Museum of Comparative Zoology, Harvard College 58224 (Patlikhot); MCZ 58235-58237 (Pokhara, Phewatal).

Chicago Natural History Museum 83081-83082 (Ampipalbhanjan [4000 ft.]); CNHM 83097 (Patan).

RANGE IN NEPAL. Central (Ampipalbhanjan, Patan, Pharping, Patlikhot, Phewatal, Pokhara).

Natrix platyceps (Blyth).

Tropidonotus chrysargus (nec Boie) GÜNTHER, 1858, p. 70 (Nepal); 1860, p. 162 (Nepal); 1861, p. 217 (Nepal). WALL, 1907, p. 156 (Chitlong).

Tropidonotus platyceps, GÜNTHER, 1860, p. 162 (Nepal); 1861, p. 217 (Nepal); 1864, p. 264 (Nepal [4000-7000 ft.]). THEOBALD, 1876, p. 174 (Nepal). WALL, 1907, p. 152 (Pharping [5000 ft.]).

Tropidonotus firthi WALL, 1914, p. 166 (Chitlong).

Rhabdophis firthi (Wall), WALL, 1923, p. 606 (Chitlong).

Natrix platyceps, SMITH, 1951, p. 728 (Thangjet [5000 ft.]). SMITH and BATTERSBY, 1953, p. 703 (Jumla [7600 ft.], Khanglagaon, [8000 ft.], Balangra Pass [12,000 ft.]).

RANGE IN NEPAL. Central (Chitlang, Pharping, Tangjet); Western (Balangra Pass, Jumla, Khanglagaon).

***Natrix stolata* (Linnaeus).**

Tropidonotus stolatus, GÜNTHER, 1858, p. 68 (Nepal); 1860, p. 162 (Nepal); 1861, p. 217 (Nepal). SCLATER, 1891, p. 39 (Katmandu). WALL, 1907, p. 156 (Gowchar, Pharping [5000 ft.]).

Chicago Natural History Museum 83095 (Katmandu [4400 ft.]).

RANGE IN NEPAL. Central (Gowchar, Katmandu, Pharping).

***Oligodon albocinctus* (Cantor).**

Simotes purpurascens (*nec* Schlegel) GÜNTHER, 1858, p. 245 (Nepal); 1860, p. 161 (Nepal); 1861 p. 216 (Nepal).

Simotes punctulatus GÜNTHER, 1864, p. 217 (Nepal).

RANGE IN NEPAL. Central (without exact locality data²).

***Oligodon arnensis* (Shaw).**

Simotes russellii (Daudin), GÜNTHER 1858, p. 24 (Nepal); 1860, p. 161 (Nepal); 1861, p. 216 (Nepal); 1864, p. 213 (Nepal).

RANGE IN NEPAL. Central (without exact locality data²).

***Oligodon erythrogaster* Boulenger.**

Oligodon erythrogaster BOULENGER, 1907, p. 217 (Nagarkote [6000 ft.]). WALL, 1923, p. 321 (Nepal). SMITH, 1943, p. 232 (Nagarkote); 1951, p. 728 (Thangjet [5000 ft.]). SMITH and BATTERSBY, 1953 p. 707 (8 miles west of Tibrikot [8500 ft.]).

RANGE IN NEPAL. Central (Nagarkote, Tangjet); Western (Tibrikot).

***Psammodynastes pulverulentus* (Boie).**

Psammodynastes pulverulentus, WALL, 1910, p. 76 (Butal).

RANGE IN NEPAL. Central (Butal [= ? Butwal]).

***Pseudoxenodon macrops* (Blyth)**

Pseudoxenodon macrops, BOULENGER, 1913, p. 338 (Maikhola Valley).

RANGE IN NEPAL. Eastern (Mai Khola)

Ptyas mucosus Linnaeus.

Coluber dhumna CANTOR, 1839, p. 52 (Nepal).

Coryphodon blumenbachii (Merrem) GÜNTHER, 1858, p. 111 (Nepal);
1860, p. 163 (Nepal); 1861, p. 218 (Nepal).

Zamensis mucosus, WALL, 1907, p. 157 (Kakani, Gowchar).

Ptyas mucosus, LEVITON, MYERS, and SWAN, 1956, p. 12 (Tamur River
Valley [500 ft.]).

RANGE IN NEPAL. Eastern (Tamur Valley); Central
(Gowchar, Kakani).

Sibynophis collaris (Gray).

Ablabes collaris, GÜNTHER, 1858, p. 28 (Nepal); 1860, p. 161 (Nepal);
1861, p. 216 (Nepal); 1864 p. 228 (Nepal).

RANGE IN NEPAL. Central (without exact locality data²).

Sibynophis sagittarius (Cantor).

Sibynophis sagittarius, SMITH and BATTERSBY, 1953, p. 704 (Dang Plain
[1500 ft.]).

RANGE IN NEPAL. Western (Dang Plain).

Trachischium fuscum (Blyth).

Trachischium fuscum, GÜNTHER, 1860, p. 161 (Nepal); 1861, p. 215
(Nepal).

Ablabes fuscus, GÜNTHER, 1864, p. 225 (Nepal [8500 ft.]).

RANGE IN NEPAL. Central (without exact locality data²)

Trachischium guentheri Boulenger.

Trachischium guentheri, SCLATER, 1891, p. 11 (Katmandu).

RANGE IN NEPAL. Central (Katmandu).

Trachischium tenuiceps (Blyth).

Ablabes tenuiceps, GÜNTHER, 1864, p. 224 (Nepal). THEOBALD, 1876, p.
154 (Nepal),

Trachischium tenuiceps, WALL, 1907, p. 156 (Chandragiri [8000 ft.]).
SMITH, 1943, p. 323 (Nepal).

RANGE IN NEPAL. Central (Chandragiri).

Xenochrophis cerasogaster (Cantor).

Tropidonotus cerasogaster, GÜNTHER, 1861, p. 218 (Nepal; based on
colored drawing).

RANGE IN NEPAL. Central (without exact locality data²).

Zaocys nigromarginatus (Blyth)

Coryphodon carinatus (part) GÜNTHER, 1858, p. 250 (Nepal); 1860, p. 163
(Nepal); 1861, p. 219 (Nepal).

Zaocys nigromarginatus, GÜNTHER, 1864, p. 257 (Nepal [7100 ft.]).
THEOBALD, 1876, p. 172 (Nepal). SMITH, 1943, p. 165 (Nepal).
RANGE IN NEPAL. Central (without exact locality data²).

Family Elapidae

Calliophis maclellandii (Reinhardt).

Elaps univirgatus GÜNTHER, 1858, p. 231 (Nepal); 1860, p. 164 (Nepal).
Callophis maclellandii, GÜNTHER, 1861, p. 219 (Nepal); 1864, p. 249
(Nepal). THEOBALD, 1876, p. 214 (Nepal). SCLATER, 1891 p. 56
(Katmandu). SMITH 1943, p. 423 (Nepal).
RANGE IN NEPAL. Central (Katmandu; see footnote "2"
regarding Günther records, p. 107).

Family Viperidae

Agkistrodon himalayanus (Günther).

Ancistrodon himalayanus, SMITH and BATTERSBY, 1953, p. 704 (8 miles
west of Tibrikot [8500 ft.], Jumla [9500 ft.], Sialgarhi [9000-10,000 ft.],
Turikot [10,000 ft.]).
RANGE IN NEPAL. Western (Jumla, Sialgarhi, Tibrikot,
Turikot).

Trimeresurus albolabris Gray.

Lachesis gramineus, (part) WALL 1907, p. 157 (Katmandu).
Trimeresurus albolabris, SMITH, 1943, p. 523 (Katmandu); 1951, p. 728
(Thangjet [5000 ft.]), Syarpagaon [9000 ft.]).
RANGE IN NEPAL. Central (Katmandu, Syarpagaon,
Tangjet).

Trimeresurus monticola Günther

Trimeresurus monticola GÜNTHER, 1864, p. 388, pl. 24, fig. B (Nepal).
SCLATER, 1891 (Katmandu).
Trimeresurus maculatus (nec Gray 1842, but Gray 1853), GÜNTHER, 1858,
p. 266 (Nepal).
Pariasis maculata, GÜNTHER, 1860, p. 164 (Nepal); 1861, p. 220 (Nepal).
Lachesis monticola, BOULENGER, 1896, p. 548 (Nepal). WALL, 1907, p.
157 (Chitlong, Kakani).

RANGE IN NEPAL. Central (Chitlang, Kakani, Katmandu).

Trimeresurus stejnegeri Schmidt.

Chicago Natural History Museum 83081—83082 (Ampipal-
bhanjan [4000 ft.]); CNHM 83088 (25 miles north of Katmandu
[4000 ft.]).

RANGE IN NEPAL. Central (Ampipalbhanjan, Katmandu).

RECORDS OF UNCERTAIN STATUS

AMPHIBIA

Family Pelobatidae

Scutiger sikkimensis (Blyth).

UNCERTAIN ADDITIONAL RECORD. Slater (1892, p. 30) records this species from the Singalehla Range, Sikkim, from an altitude of 12,000 ft. This altitude suggests a collection station on the frontier between Sikkim and Nepal.

Family Ranidae

Rana swani Myers and Leviton.

UNCERTAIN IDENTIFICATION. Uncertain identification of two small frogs taken from above the Arun River [1500 ft.] has been recorded by Leviton, Myers, and Swan (1956, p. 9).

REPTILIA

Family Colubridae

Coluber monticolus Cantor.

UNCERTAIN SYNONYMY. Cantor's species (1839, p. 52) based on a specimen from Nepal may be a synonym of *Oligodon arnensis* (*vide* Boulenger, 1894, p. 229).

Hurriah sanguiniventer Cantor.

UNCERTAIN SYNONYMY. The identification of Hodgson's drawing of a very distinctive snake described by Cantor (1839, p. 52) as *H. sanguiniventer* and based on a specimen from the Valley of Nepal is uncertain. Smith (1943, p. 257) assigns the snake to the genus *Lycodon* (see also Günther, 1864, p. 222).

Lycodon jara (Shaw).

UNCERTAIN NEW RECORD. Smith (1943, p. 260) indicates that this animal is found in the "Eastern Himalayas as far west as longitude 85°." This would place the western limits in the

vicinity of Katmandu. We know of no specific records to substantiate this distribution.

Natrix subminiata (Schlegel).

UNCERTAIN NEW RECORD. Wall (1923, p. 606) indicated that this species was found from "Nepal to Sikkim." No specific collection sites were mentioned by him. Smith (1943, p. 302) states, "The whole of the Indo-Chinese subregion as far as Sikkim in the north-west."

Simotes octolineatus (Schneider).

UNCERTAIN SYNONYMY. Günther (1861, p. 216) recorded a specimen identified as *S. octolineatus* from Nepal. This certainly is in error for *Simotes* [= *Oligodon*] *octolineatus* is an Indonesian species. Either Günther's identification was in error or there was a mixup in locality data. Perhaps Günther had before him a specimen later referred to as *O. erythrogaster* by Boulenger, a species known from Nepal which bears a superficial similarity to the Indonesian species in color pattern.

Spilotes melanurus Schlegel.

UNCERTAIN SYNONYMY. Two half grown specimens identified as *S. melanurus* were recorded from Nepal by Günther, (1858, p. 97; 1860, p. 163; 1861, p. 218). That species is known from Indonesia; it has not been taken in the Indo-Burmese region. Either Günther's identification was in error or there has been a mixup in locality data.

Family **Elapidae**

Naja tripudians Merrem.

UNCERTAIN NEW RECORD. Concerning the distribution of *Naja tripudians*, Günther (1861, p. 219) states, "No record from Nepal" but "Hodgson presumes it to be there." Smith (1943, p. 426) indicates that the subspecies *N. n. kaouthia* is found "... as far west as Nepal;" and in his map (fig. 139, p. 434) both *N. n. naja* and *N. n. kaouthia* are shown to occur within

the frontiers of Nepal. We do not know of any specific records of this snake having been taken in that country though we agree with Hodgson and feel certain it is there.

Family Viperidae

Trimeresurus viridis (Daudin).

UNCERTAIN SYNONYMY. GÜNTHER (1861, p. 220) records a specimen of *T. viridis* from Nepal. That nominal species has been placed in the synonymy of *T. gramineus*, a species common to Peninsular India but which has not been reported from as far north as Nepal. Günther's specimen may belong to *T. stejnegeri*, a species which is closely similar to *T. gramineus* and which has been reported from Nepal.

THE ZOOGEOGRAPHY OF NEPAL AND ADJACENT AREAS

The Indo-Chinese Subregion of the Oriental Region as defined by Wallace (1876) includes large portions of south-eastern Asia and extends as a distinct western spur into the forested Himalayas. The fauna of Sikkim clearly exhibits affinities with Burma, Thailand, and southern China, whereas that of the western Himalayas appears to be a composite of faunal elements drawn largely from the Indian Subregion of the Oriental Region and the adjacent Palearctic Region. The country of Nepal (figure 1) bridges an intervening zone between the differing eastern and western Himalayan faunae. It represents an area of diminution, or cessation, of the Indo-Chinese Subregion.

An analysis of the distribution of Himalayan amphibians, lizards, and snakes suggests that the typical Indo-Chinese herpetofauna is essentially intact as far west as Sikkim and the Darjeeling District of Bengal. Fifty-one species found there (46 per cent of the local fauna) have a continuous distribution into the mountains; they also extend into Burma and other

south-eastern Asian portions of the Indo-Chinese Subregion (species designated IE and IW in table I (see appendix) and summarized in figure 2). Thirty-two additional species (29 per cent of the local fauna) are confined to the Himalayas (EH, EW, NE in table I). And a Panoriental and Indian complement of 29 species (25 per cent of the local fauna) found in the herpetofauna of the Himalayas east of Nepal extends from the plains of India into the mountains.

Only 15 typically Indo-Chinese species are known in Nepal, and one additional species, *Ophisaurus gracilis*, should be found there (on the basis of its presence beyond Nepal in the western Himalayas).

The obvious diminution of the Indo-Chinese fauna to the west of Sikkim is not very likely an artifact resulting from incomplete information and insufficient collection data from Nepal. The fauna of the western Himalayas, from the Nepalese frontier to the vicinity of Simla, is relatively as well known as is the plains fauna of India. If the distribution of the amphibians, lizards, and snakes in the areas contiguous with Nepal is analyzed, a fair approximation of the anticipated Nepalese species may be obtained. Of the widespread Panoriental and Indian species known to ascend into the mountains to the east and west of Nepal (in table I, species designated OR which are also recorded in the Western Himalayas and Sikkim Darjeeling), 8 may be anticipated in the mountains of Nepal. All have been collected there. Similarly, 7 of 9 expected Panoriental-Indian lizards have been collected in Nepal. However, only 12 of 28 anticipated Panoriental-Indian snakes have been obtained. If the same method of analysis is applied to amphibians, lizards, and snakes that are restricted to the mountains and are found on both sides of Nepal (i. e., in the western Himalayas and Sikkim-Darjeeling, table I, EW, IW and ME), the results indicate a collection of 2 out of 3 anticipated amphibians and all 9 anticipated snakes. A single lizard, *Ophisaurus gracilis*, which is rare in the western Himalayas falls in this category



Figure 1. Map of Nepal showing all principal collecting stations at which amphibians and reptiles have been obtained,

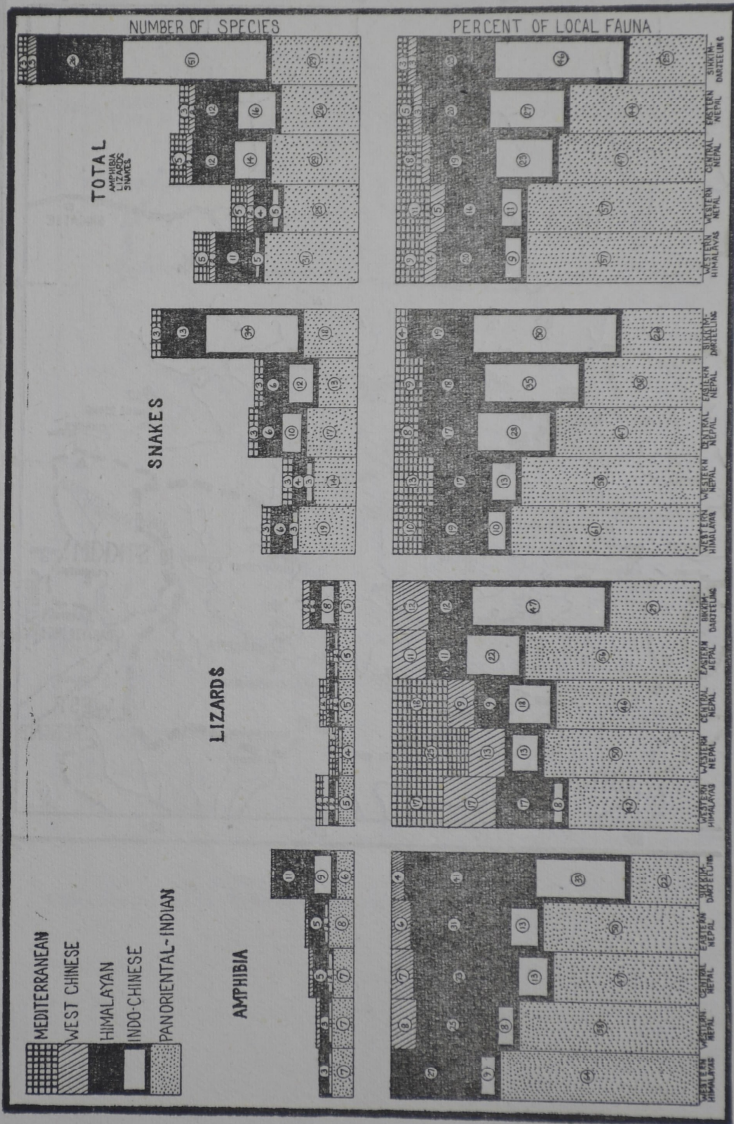


Figure 2. Comparisons of faunal groups in Nepal and adjacent areas. Species have been included in eastern, central, or western Nepal if they have been taken in areas both to the east and to the west.

and has not been obtained in Nepal. In summary then, 10 of 11 anticipated amphibians, 7 of 10 anticipated lizards, and 21 of 37 anticipated snakes have been collected in Nepal. This information may be used as an approximate index of the present knowledge of the Nepalese fauna, and sufficient information is available to permit a meaningful assessment of the zoogeography of the country. It is evident then that the dramatic diminution from 51 Indo-Chinese species in Sikkim Darjeeling to 15 Indo-Chinese species in Nepal is scarcely due to ignorance of that fauna. It is significant that the Indo-Chinese fauna in Nepal is a montane fauna and from the preceding data it can be seen that collections in the mountains of Nepal have yielded 11 of 13 anticipated montane species.

The striking diminution from 51 Indo-Chinese species in Sikkim-Darjeeling to 15 Indo-Chinese species in Nepal is, in all likelihood, associated with the obvious faunal barrier of the Singalchla Range, on the eastern frontier of Nepal. However, the occurrence of two Indo-Chinese snakes, *Natrix parallela* and *Pseudoxenodon macrops*, which have been collected west of this barrier (Mai Khola, southwest of Sundakphu) offers a tenuous suggestion that a gradual decline in Indo-Chinese species may occur in the Ilam district of Nepal or the Tamur Valley. This zone of reduction would be of limited extent inasmuch as collections made in the Arun Valley some 50 miles from the eastern frontier of Nepal reveal a marked change in the herpetofauna. Among 16 species of amphibians and reptiles obtained in this area only one, *Cosymbotus platyurus*, may be considered as typically Indo-Chinese. It is conceivable that outposts of Indo-Chinese reptiles and amphibians may be localized in isolated forests in the Arun Valley where aspects of the flora and some insects and birds are characteristic of Sikkim. But the primary herpetofauna indicates a more easterly termination of the Indo-Chinese Subregion.

One factor affecting this apparent termination is the greater human population and more extensive cultivation of the land in

eastern Nepal. Agriculture and associated deforestation is predominant up to 7000 feet and intact forests are, for the most part, above this level. Along the valley bottom and near the river itself, fields and villages are less frequent and lowland forests in various degrees of preservation are usual in this situation. Deep within the Himalayas where the lowest valley elevations exceed 3000 feet, the valley forests show the greatest similarity to the forests of Sikkim. It is perhaps in such isolated localities that the Indo-Chinese fauna remains relatively distinct.

A second factor affecting the reduction of the Indo-Chinese fauna is the apparent replacement of the Indo-Chinese forms by species typical of the Indian plains. This is clearly emphasized in the Arun Valley by the abundance of lowland species such as *Calotes versicolor* and *Ptyas mucosus*; it is even more strikingly demonstrated by the recent discovery of *Bufo andersoni*, *Microhyla ornata*, and *Elaphe radiata*, four plains species reported from the eastern Himalayas for the first time in 1956 (Leviton, Myers, and Swan).

Additional information concerning the fate of the Indo-Chinese fauna may be obtained from an analysis of the well-known herpetofauna of the western Himalayas adjacent to the western frontier of Nepal. Whereas there are 112 species of reptiles and amphibians in the Sikkim Darjeeling area (figure 2), the mountains between Simla and Nepal hold 54 species, of which five are typically Indo-Chinese. The major portion of the west Himalayan herpetofauna is composed of Panoriental-Indian species (31 species or 57 per cent), but there is a sizeable representation of endemic Himalayan species primarily of Indo-Chinese affinity (18 species, 33 per cent). The presence of this latter discrete group obviously distinguishes the western Himalayan fauna, and it does not seem fitting to assign the western Himalayas to the Indian Subregion.

Aside from the ubiquitous Panoriental-Indian forms, the Indo-Chinese species (augmented by the endemic Himalayan

species many of which are closely related to typical Indo-Chinese forms) represent a clear majority of the mountain forms in the western Himalayas. Although there is a great reduction in the typical Indo-Chinese fauna in a westward trend from Darjeeling to Simla (51 species to 5 species) (figure 2) there is also a concurrent reduction in the total fauna (112 species to 54 species). Excepting a few additional species characteristic of the Palearctic, no outstanding new assemblage of amphibians or reptiles appears in the western Himalayas. The Panoriental-Indian fraction remains essentially the same (29 species to 31 species); this draws attention to the fact that the western recession of the fauna is restricted to the mountain forms. It is clear that there is no category to which the western Himalayas may be assigned legitimately except to the Indo-Chinese Subregion. There is a manifest change in the herpetofauna of the Indo-Chinese Subregion at the eastern frontier of Nepal, but unless the 700 miles between Sikkim and Simla is considered a prolonged transition zone, the Indo-Chinese Subregion apparently extends through Nepal as far as Simla in the western Himalayas.

The boundary lines which circumscribe any zoogeographic province are approximations. Since the time of Alfred Russell Wallace, faunal limits have been indicated geographically with simple lines. Between contiguous major faunal zones, small or large transitional areas have been assumed. In Nepal and the western Himalayas, what may appear outwardly to be a prolonged transition area of the Indo-Chinese fauna is perhaps something different. The dissected mountainous region distinguishes cultivated valley slopes harbouring a predominant Panoriental-Indian fauna from the montane and valley forests where a higher incidence of Indo-Chinese and endemic species are in evidence. The frequency and size of these faunal pockets apparently decreases westward with a concurrent decrease in precipitation. But there is no dramatic increase of a new and different fauna; there is essentially a simple

diminution of the mountain and forest forms. Beyond Simla, where Palearctic species become frequent, the Indo-Chinese species which still persist may create a minor transition zone of a classical sort within the boundary of Palearctic Region. In summary, it would seem that a transition zone should reflect a decrease of one fauna with an accompanying proportional increase of another fauna as a new province is approached. When there is an alteration of the fauna involving primarily a reduction of this fauna, and there is no accompanying significant increase in a new assemblage of species, the area involved is not in reality a transition zone. The latter applies to the Indo-Chinese Subregion in Nepal and the western Himalayas. The region seems to represent an intermediate condition where a fauna of eastern affinities is in the process of being extinguished while a fauna of western origin has not yet become prominently developed. On the map (figure 3), the protracted and weak extension of the Indo-Chinese Subregion is indicated by localized areas in the mountains which are separated by segments of the Indian Subregion. The very minor inroads of the Palearctic species into the Himalayas proper to the east of Simla have been superimposed onto the Panoriental-Indian fauna rather than the Indo-Chinese fauna.

At the present time, 69 species of amphibians and reptiles have been reported from Nepal. Of these, two frogs, *Rana polunini* and *Rana swani*, are known to be restricted to the country: both were discovered in recent years. *Rana polunini* is closely related to *R. blanfordi* and may be a high altitude derivative of the latter widespread Himalayan species, *Rana swani* shows affinity with *Tomopterna* ranids in southwest India and is probably a Himalayan representative of a relictual group of frogs which at one time were more widely distributed. Nepal is also the type locality of a few other species whose distributions extend beyond its frontiers (*Rhacophorus maximus*, *Oligodon erythrogaster*, and *Trimeresurus monticola*), and the

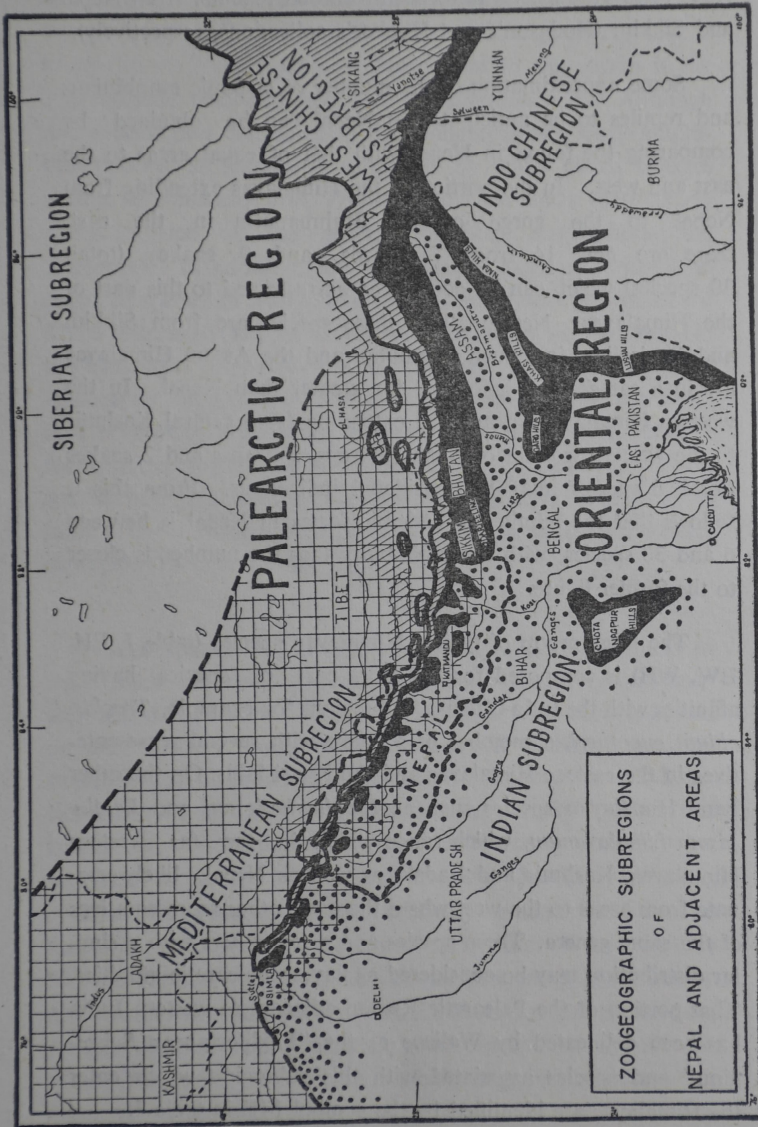


Figure 3. Zoogeographic subregions of Nepal and adjacent areas.

types of several species have been recorded together from Nepal and Sikkim (Hodgson's and Hooker's collections, respectively).

Some approximation of the number of endemic amphibians and reptiles to be anticipated in Nepal can be obtained by comparing the fauna in Nepal with that of equal areas to the east and west. In the portion of the Himalayas extending from Nepal to the gorge of the Brahmaputra in the east, there are now 14 frogs, 7 lizards, and 9 snakes (total 30 species) which can be considered as restricted to this part of the Himalayas. Nearly all of these species are from Sikkim and Darjeeling, inasmuch as Bhutan and the Assam Himalayas are in a category of ignorance far greater than Nepal. In the western Himalayas, in an area extending from central Kashmir to the western frontier of Nepal, 2 frogs, 2 lizards and 2 snakes (total, 6 species) may be considered indigenous. From this it follows that the number of endemic forms in Nepal is between 6 and 30 species, with the probability that the number is closer to the former figure.

The large group of typical Himalayan species (table I, EH, EW, WH) is composed for the most part of species having affinities with the Indo-Chinese Subregion, for example, *Trachischium guentheri*, a member of a genus with several representatives in the eastern Himalayas and the Khasi Hills. On the other hand Himalayan species such as *Elaphe hodgsoni* and *Leiopisma himalayanum*, which range widely in the far western Himalayas, Kashmir and Ladak, as well as Nepal, likely emanate from areas to the west where there are other representatives of the same genera. These species and a few others with a similar distribution may be considered as having Palearctic affinities. That portion of the Palearctic Region adjacent to western India has been delineated by Wallace as the "Mediterranean Subregion" and species associated with this subregion which enter the Himalayas are identified by the symbol ME in table I.

In addition to the purely mountain species that can be assigned either to the Indo-Chinese or Palearctic faunae, there

is an aggregation of species which generally occupy an elevated wet zone in the Himalayas and which are fundamentally related to species in Western China. Preeminent in this group is the high altitude pelobatid frog *Scutigera sikkimensis*. Although this zone is best delineated in the Himalayas by a single amphibian species, its identity is supported by many plants (species groups of *Rhododendron*, *Primula*, etc.) and birds (particularly pheasants such as the genera *Ithaginis*, *Lophophorus*, and *Tragopan*). In addition, the lizard genus *Japalura*, with 5 recognized species in west China (other species also present in the Khasi Hills, north Burma and north Viet Nam) and 5 species in the Himalayas, may represent this biogeographic province in the Himalayas. *Scutigera sikkimensis*, *Japalura major*, and *Japalura tricarinata* are among the few amphibians and reptiles found above 10,000 feet in the outer, wetter Himalayas. These species have not been segregated into a special category in table I, but they have been considered as belonging to a distinct subregion (in figures 2-4).

Other species with a distinct association with the fauna of west China are the frogs *Scutigera alticola*, *Scutigera mammata*,⁵ and *Altirana parkeri*. These three species have been collected on the Tibetan Plateau immediately north of Nepal and presumably may be found in those parts of the country which are extensions of the plateau. They are apparently widespread species but not continuous in their distribution, for they are restricted to scattered lakes and streams. *Scutigera mammata*, or a closely related species, probably extends as far as Kashmir. It appears, therefore, that the West Chinese fauna is divided between a wet Himalayan group and a contingent on the dry plateau of Tibet. The latter group expresses Asian Palearctic rather than Oriental characteristics and the West-Chinese herpetofauna as a whole may be considered as essentially Palearctic. This is emphasized by the distribution

5. *Aelurophyne mammata* was recently shown to be congeneric with *Scutigera sikkimensis* (Myers and Leviton, 1962).

of other vertebrate species, including hynobiid salamanders, which, like *Scutigera*, extend west across Tibet to Afghanistan. Perhaps the West-Chinese Province is in reality identical to the western portion of the Manchurian Subregion of Wallace which was conceived as a vast area embracing most of northern China and Japan with an extension into the Himalayas. A tentative appraisal of this subregion suggests that the mountain fauna of west China is sufficiently distinct to merit the status of a related but distinct subregion of the Palearctic.

Whereas the amphibian representatives on the plateau adjacent to Nepal are affiliated with West Chinese species, the saurian complement (*Agama*, *Phrynocephalus*, *Alsophylax*, etc.) is entirely related to the fauna of Afghanistan, Iran, and the Caspian area. This is the eastern limit of the Mediterranean Subregion as conceived by Wallace, but the invasion of Tibet by members of this subregion may well extend the Mediterranean Palearctic to the borders of Sikang and Szechwan. One of the species typical of this group of Mediterranean-plateau species, *Leiopisma ladacense*, has been collected in Nepal near the Tibetan border at 18,000 feet, a record altitude for any amphibian or reptile.

The Tibetan Plateau herpetofauna directly north of Nepal and in places actually entering within the frontiers of Nepal is therefore a curious mixture derived from two Palearctic subregions. The amphibians (and perhaps the relictual Tibetan snake, *Thermophis baileyi*) live near water and have West-Chinese affinities, whereas the lizards have opposite origins and represent a Mediterranean extension into the area. Similarly there is a West-Chinese group of frogs and lizards in the Himalayas proper which are only weakly delimited by altitude from a small group of Himalayan lizards and snakes with Mediterranean affinities (*Agama tuberculata*, *Elaphe hodgsoni*, etc.). This

Figure 4. Altitudinal distribution of Nepalese amphibians, lizards and snakes and of the zoogeographic subregions of the Nepal Himalayas. Some species have been included among the Plateau species that have not been obtained within the borders of Nepal.

Himalayan-Mediterranean fauna is, however, a minority conflux of species among the far more numerous Panoriental-Indian, Indo-Chinese, and Himalayan amphibians and reptiles. This confusion of faunal groups is an outcome of both vertical and horizontal patterns of distribution in the mountains; the interaction between these two factors as they relate to the zoogeography of Nepal is shown in figures 3 and 4.

The altitudinal distribution of the various faunal groups (figure 4) is characterized by wide overlapping zones rather than discrete altitude-limited belts. Two altitudinal zones which are occupied exclusively by discrete faunal groups are confined to elevations between 11,500 feet and 13,500 feet on the southern exposure of the Himalayas and between 17,000 and 18,000 feet on the Tibetan slope (West-Chinese and Mediterranean subregions, respectively). On the Tibetan slope of the Himalayas and on the plateau below 17,000 feet, as described above, the Mediterranean and West-Chinese faunae occupy similar altitudes but can be distinguished ecologically inasmuch as the lizards have dry habitats whereas the amphibians live near streams and lakes. Below 11,500 feet and above 8,500 feet on the southern flank of the Himalayas, the West-Chinese and Mediterranean species are joined in the Nepal Himalayas by two Himalayan species, *Rana liebigii* and *Rana polunini*, which appear to range considerably higher than other species with Indo-Chinese affinities. The elevated distribution of these frogs (and possibly *R. blanfordi*, which has not yet been collected in Nepal), suggests that they may be related to the group of rapid frogs (*R. pleuraden*, *R. phrynooides*, and *R. boulengeri*) which are distributed in the mountains of West-China. If this relationship has any real basis, the Himalayan frogs may have West-Chinese rather than Indo-Chinese affinities. At the present time they are viewed as exceptional species and have not been considered as part of the West-Chinese fauna.

If a few altitudinal records obtained from the western Himalayas are utilized to reinforce the limited information

from Nepal itself, the altitudinal distribution of the Mediterranean fauna in the Himalayas of Nepal appears more intelligible. Species such as *Elaphe hodgsoni* and *Agkistrodon himalayanus* appear to range on both the north and south sides of the Himalayas and may be part of both plateau and Himalayan segments of the Mediterranean fauna. They ascend to much higher altitudes on the north slope, both species apparently exceeding 15,000 feet. Toward the southern flanks of the Himalayas these species and other Mediterranean forms such as *Agama tuberculata*, *Leiopisma himalayanum*, and *Natrix platyceps* rarely exceed 10,000 feet. These same species, however, are found as low as 3000 feet. Some of these species, particularly *Agama tuberculata*, appear to occupy rocky, drier areas and to some degree these Mediterranean forms, despite their wide range, are ecologically distinct from the Indo-Chinese, West-Chinese, and Panoriental-Indian species which are altitudinally contiguous. It appears therefore, that the Mediterranean species have wide altitudinal ranges and in western Nepal extend from the southern slopes continuously through the Himalayas to join the Mediterranean fauna of the plateau. In eastern Nepal and the eastern Himalayas, the Mediterranean fauna is divided, as is the West-Chinese fauna, into separate Himalayan and plateau portions.

The altitudinal distribution of the Indo-Chinese fauna (including typically Himalayan species) extends from the lower foothills up to 11,500 feet (if *Rana liebigii* and *R. polunini* are considered). It is, however, primarily confined between 3000 feet and 7000 feet and at these altitudes it is rivalled by the more widespread Panoriental-Indian species. The latter fauna, however, is predominant below 3000 feet.

In many ways the altitudinal distribution of amphibians and reptiles mirrors the altitudinal distribution of vegetation. The dominant forest categories (figure 4) fairly coincide with the range of the Indo-Chinese and Panoriental-Indian amphibians and reptiles which are confined to the Lower, Middle,

and Upper Monsoon forests. However, most of these species do not exceed an altitude of 6000 feet, which approximates the altitude of killing frosts in winter. Rhododendron trees of several species extend from below 6000 feet to tree line, which in eastern Nepal reaches a maximum altitude of 13,500 feet. They are, however, more prominent in the deciduous forests (8,500 feet to 10,500 feet) and in the zone of conifer forests (10,500 feet to 13,500 feet). The altitudinal distribution of japalurid lizards resembles the distribution of rhododendron forests; this vegetation mixes with the Upper Monsoon forests and the deciduous forests. In the latter zone *Japalura tricarinata* and *J. major* are the commonest reptilian species encountered. The rhododendron-conifer forests coincide strikingly with the range of *Scutiger sikkimensis*. In general, it would seem that the Monsoon forests harbor Oriental species (Panoriental-Indian and Indo-Chinese), whereas forests which include rhododendron trees incorporate a West-Chinese herpetofauna. The Mediterranean species extend over the altitudinal range of nearly all of these forests but they are primarily non-forest species.

A belt of piedmont forest mixed with swamps and open fields, a foothill and plains region known as the Terai, separates the Himalayas from the true plains of India and Nepal. The amphibians and reptiles of this zone are known primarily from collections obtained in the Terai near the Darjeeling District east of Nepal. With the possible exception of *Elachistodon westermanni* and *Bungarus lividus* there appear to be no reptiles or amphibians which are exclusively confined to the Terai zone. The herpetofauna of this intermediate area seems to be composed entirely of Panoriental-Indian species although many of the Terai forms do not extend far into the adjacent plains. Examples of this latter fauna which appear to be confined to the plains within 100 miles of the Himalayas are: *Rhacophorus taeniatus* and *R. tuberculatus* of Assam, and *Boiga forsteni* of Bihar and Uttar Pradesh. The Terai fauna and the plains fauna of Nepal are very poorly known and the great majority

of collections in this portion of the country were made by Brian Hodgson and his collectors. Comparing the Nepalese plains with the well-known fauna of the adjacent Indian plains, it is found that 5 chelonian species have been collected in Nepal out of 11 species which may readily occur in Nepal. Similarly, 7 of 15 lizards have been obtained and 11 of 37 plains snakes. Perhaps the best indication of the status of collections on the plains of Nepal is reflected in the fact that at the present time there seems to be no published record of the occurrence of the common cobra in Nepal (though Malcolm Smith [1943, p. 434] shows it to be present in his map). It is obvious that collections on the Nepal plains would rapidly increase the known fauna of the country and, inasmuch as the plains fauna is richer in adjacent Bengal, it may be assumed that most new records of amphibians and reptiles will be obtained from the south-eastern corner of Nepal.

Much of the preceding discussion has referred entirely to amphibians, lizards, and snakes as the Nepalese crocodylians and chelonians are primarily plains species and are poorly represented in collections. Only one tortoise, *Testudo elongata*, collected in Nepal can be considered as typical of the Indo-Chinese Subregion, the remainder being Indian and Panoriental. The presence of *T. elongata* in Nepal and the occurrence of *Geoemyda tricarinata* and *G. trijuga* in the Darjeeling District immediately east of Nepal point to a curious affinity between the eastern Himalayas and the hills of Chota Nagpur over 300 miles south of Nepal and separated from the Himalayas by the wide plain of the Ganges. All of these tortoises, together with two Indo-Chinese lizards (*Leiolopisma sikkimense* of the eastern Himalayas as far as central Nepal and *Sphenomorphus maculatum* of the eastern Himalayas and southeast Asia), are found in the restricted area of Chota Nagpur. The five species do not represent a majority of the reptiles in the area (although they may have some ecological distinction), but as a group of relictual species surrounded by ubiquitous Oriental forms, their

presence and significance may be emphasized by referring this isolated pocket to the Indo-Chinese Subregion. The species just cited indicate that a continuous fauna, presumably a forest fauna, likely extended across the Gangetic plains at one time. The hiatus in the distribution of the Indo-Chinese fauna calls attention to a recession of the subregion and climatic changes of the past. The Chota Nagpur link with the Indo-Chinese Sub-region is based on the presence of identical species in the two areas. If genera and allied species are taken into consideration, some representatives of the Indo-Chinese Subregion can be associated with species in Chota Nagpur, the western Ghats of southwest India and the Ethiopian Region. This distribution presumably represents a relictual situation dating from the Tertiary Period, and it would seem that the tortoises and lizards of Chota Nagpur, still specifically linked to the Indo-Chinese Subregion, represent the last segment of this earlier distribution pattern.

It would seem that the fauna of the Gangetic plains is newer and is occupying a region which has been deforested through the agency of a changing climate which in turn has recently been aided by man. The distributional patterns of animals of central Asia and of the Himalayas also show the effects of climatic change, obviously reflecting a trend toward arid conditions. The narrow altitudinally limited wet and cold zone occupied by *Scutigera sikkimensis* harbors populations which are totally isolated from each other by deep tropical valleys, and it is obvious that this West-Chinese fauna was formerly more widely distributed. On the plateau of Tibet, the isolated pockets of amphibians and snakes indicate that this portion of the West-Chinese fauna was at one time also far more extensively distributed. Superimposed on this West-Chinese fauna are the wide-ranging, successful, desert lizards related to the Mediterranean Palearctic. The total pattern clearly suggests the encroachment of an arid environment in central Asia which has depopulated a preceding West-Chinese fauna and

isolated a fringe of this fauna on the outer slopes of the Himalayas, which are still wet and cool. The Mediterranean invasion has also involved the southern slopes of the Himalayas, but, as noted earlier, the several species which typify this expansion are as yet a very minor percentage of the total herpetofauna. The climatic modifications on the Gangetic plain are presumably related to the changes in central Asia, and the plains fauna also contains a number of species which evidence Mediterranean affinities. It is significant that the deforested Gangetic plain has been occupied by ubiquitous species from the surrounding areas, leaving few if any relictual species. However, occupation of this area has not been accomplished by any substantial number of Indo-Chinese species. The latter, it seems, have retreated with the forests and remain remarkably discrete in the Himalayas east of Nepal. In Nepal itself and in the Himalayas to the west, the plains fauna has made successful inroads into the Himalayan valleys and the Indo-Chinese fauna in these areas appears to be declining toward a relictual status.

In summary, the zoogeography of Nepal is a complex of interdigitating faunal subregions. The Indo-Chinese fauna (composed of species which range from southeastern Asia into the Himalayas together with the majority of strictly Himalayan species) becomes greatly reduced on the eastern frontier of Nepal, but continues westward through Nepal, primarily in isolated forest areas which lie between 3000 and 7000 feet. A large group of widespread Pan-oriental-Indian species extend from the plains and are the dominant species on the plains of Nepal and in the Valleys and the lower foothills. They are also largely coextensive in their altitudinal range with the Indo-Chinese fauna. The plains fauna is also composed of species which do not extend into the mountains. Several species of lizards and snakes which extend from Kashmir into Nepal from the west and which are derivatives of the Mediterranean Sub-region fauna, have a wide altitudinal distribution. On the southern slopes of the Himalayas they are found generally

below 10,000 feet; but in western Nepal this fauna links with Mediterranean species of the Tibetan Plateau and on the frontier of Nepal these species ascend as high as 18,000 feet. The Mediterranean fauna in Nepal overlaps the altitudes occupied by the Indo-Chinese and Pan-oriental-Indian species, but they are to some extent ecologically distinct from the latter groups. The highest elevations on the southern exposure of the Himalayas are dominated by a few species with West Chinese affinities. Similarly, on the plateau immediately north of Nepal (and presumably in some places within Nepal itself), there are additional West-Chinese species which are not continuous with the Himalayan forms. The Tibetan Plateau is therefore dominated by wide-ranging Mediterranean lizards which overlap a seemingly relictual group of West-Chinese amphibians. It appears that the West-Chinese and Indo-Chinese faunae are retreating from Nepal and Tibet, whereas there is a concurrent expansion of Mediterranean species from the west and Panoriental-Indian species from the south. With Indo-Chinese, Indian, and Panoriental faunae of the Oriental Region combining vertically and horizontally in wet and dry areas with two groups of Mediterranean Palearctic species and two groups of West-Chinese Palearctic species, the zoogeography of Nepal is somewhat bewildering. It has a labyrinthian quality which rivals the distribution patterns of any area of similar dimensions on the face of the earth, and it is particularly instructive concerning the manner in which two major zoogeographic regions converge and meet in a montane faunal barrier which is common to both regions.

APPENDIX

Table I represents a list of amphibians and reptiles known to occur in Nepal and the immediately adjacent areas. Information on the Tibetan, Indian, and Himalayan species and their distribution has been compiled with the aid of an unpublished work by Swan (1947). The area designations and the symbols utilized in the table are as follows:

- ADJACENT PLAINS. The plains of India within approximately 50 miles of the southern frontier of Nepal which are essentially continuous with the plains area of Nepal itself.
- W. HIMALAYAS. The mountainous area between Simla and the western frontier of Nepal.
- W. NEPAL, C. NEPAL, E. NEPAL. Divisions of Nepal into western, central, and eastern portions based upon the drainage systems of the major rivers (see map).
- SIKKIM-DARJEELING. The mountainous area of Sikkim and the Darjeeling District immediately to the east of Nepal.
- ADJACENT TIBET. The southern plateau area of Tibet adjacent to Nepal which is north of the primary crest of the Himalayas.
- X. This indicates the known presence of the species.
- X1, 2, 3. These indicate the known presence of the species in Nepal and the number of times it has been obtained by different collectors in the area.
- O. This indicates a real expectation of the species in Nepal based on the known presence of the species in areas to the east and the west.

- P. This indicates the possible presence of the species in Nepal based on the known presence of the species on the plains of India adjacent to Nepal.
- OR. Species with a distribution typically Indian or Pan-oriental which may be found in wide areas of the plains and mountains of India and may frequently extend into S. E. Asia.
- IE. Species with a distribution characteristic of the Indo-Chinese Sub-region and which extend into the Eastern Himalayas.
- IW. Species with a distribution characteristic of the Indo-Chinese Sub-region and which extend into the Himalayas west of Nepal.
- EH. Species with a distribution essentially confined to the Eastern Himalayas.
- EW. Species with a distribution essentially confined to the Himalayas, including both eastern and western portions.
- WH. Species with a distribution essentially confined to the Western Himalayas.
- ME. Species with a distribution which appears to extend from the Mediterranean Subregion into the Himalayas as far as the Eastern Himalayas.
- TB. Species with a distribution on the Tibetan plateau adjacent to Nepal.

The data presented in table I are summarized for convenient reference in table, II. The data have been grouped by areas and major subordinal or ordinal groups of amphibians and reptiles.

A distributional analysis of faunal groups by faunal subregions is presented in table III.

TABLE I
Distribution of Amphibians and Reptiles of Nepal and Adjacent Areas

	Adjacent Plains	Western Himalayas	West Nepal	Central Nepal	East Nepal	Sikkim Darjeeling	Tibet.	Distribution Category
AMPHIBIA								
APODA								
COECILIIDAE								
<i>Ichthyophis glutinosus</i>	...					X		IE
URODELA								
SALAMANDRIDAE								
<i>Tylototriton verrucosa</i>	...					X		IE
ANURA								
BREVICIPITIDAE								
<i>Microhyla ornata</i>	... X				XI			OR
BUFONIDAE								
<i>Bufo andersoni</i>	... X	X	O	O	XI			OR
<i>Bufo himalayanus</i>	...		X1	X2	O	X		EW
<i>Bufo melanostictus</i>	... X	X	O	X3	X1	X		OR
PELOBATIDAE								
<i>Megophrys major</i>	...					X		IE
<i>Scutigera alticola</i>	...						X	TB
<i>Scutigera mammata</i>	...						X	TB
<i>Scutigera sikkimensis</i>	...		X1	X1	O	X		EW
RANIDAE								
<i>Altirana parkeri</i>	...						X	TB
<i>Rana annandalii</i>	...					X		EH
<i>Rana assamensis</i>	...					X		IE
<i>Rana blanfordi</i>	...	X	O	O	O	X		EW
<i>Rana breviceps</i>	... X	X	O	O	X1	X		OR
<i>Rana cyanophlictis</i>	... X	X	O	X3	X1	X		OR
<i>Rana formosa</i>	...	X	O	X2	O	X		IW
<i>Rana gammiei</i>	...					X		EH
<i>Rana gerbillus</i>	...					X		EH
<i>Rana liebigii</i>	...	X	O	X2	X2	X		EW
<i>Rana limnocharis</i>	... X	X	O	X2	X1	X		OR
<i>Rana livida</i>	...					X		IE
<i>Rana monticola</i>	...			X1	O	X		EH
<i>Rana polunini</i>	...			X1				EH
<i>Rana swani</i>	...				X1			EH
<i>Rana tigerina</i>	... X	X	O	X4	O	X		OR
<i>Rana vicina</i>	...	X						WH
<i>Staurois afghanus</i>	...					X		IE
<i>Staurois himalayana</i>	...					X		EH

TABLE I (Continued)

Distribution of Amphibians and Reptiles of Nepal and Adjacent Areas,

	Adjacent Plains	Western Himalayas	West Nepal	Central Nepal	East Nepal	Sikkim Darjeeling	Tibet	Distribution Category
ANURA (Continued)								
RHACOPHORIDAE								
<i>Philautus annandali</i> ...						X		EH
<i>Philautus dubius</i> ...						X		EH
<i>Rhacophorus jerdoni</i> ...						X		EH
<i>Rhacophorus leucomystax</i>						X		IE
<i>Rhacophorus maculatus</i> ...	X	X	O	XI	XI	X		OR
<i>Rhacophorus maximus</i> ...				XI	O	X		IE
REPTILIA								
CHELONIA								
EMYDIDAE								
<i>Geoclemys hamiltoni</i> ...	X		P	P	P			OR
<i>Geoemyda tricarinata</i> ...						X		IE
<i>Geoemyda trijuga</i> ...						X		IE
<i>Hardella thurjii</i> ...	X		P	P	P			OR
<i>Kachuga dhongoka</i> ...	X		P	XI	P			OR
<i>Kachuga kachuga</i> ...	X		P	XI	P			OR
<i>Kachuga smithi</i> ...	X		P					OR
<i>Kachuga tecta</i> ...	X		P	P	P			OR
TESTUDINIDAE								
<i>Testudo elongata</i> ...				XI	O	X		IE
TRIONYCHIDAE								
<i>Chitra indica</i> ...	X		P	XI	P			OR
<i>Lissemys punctata</i> ...	X		P	P	P			OR
<i>Trionyx gangeticus</i> ...	X		P	XI	P			OR
<i>Trionyx hurum</i> ...	X				P			OR
<i>Trionyx leithi</i> ...	X		P	P	P			OR
CROCODILIA								
CROCODILIDAE								
<i>Crocodylus palustris</i> ...	X		P	P	P			OR
<i>Gavialis gangeticus</i> ...	X		P	XI	P			OR

TABLE 1 (Continued)

Distribution of Amphibians and Reptiles of Nepal and Adjacent Areas

	Adjacent Plains	Western Himalayas	West Nepal	Central Nepal	East Nepal	Sikkim Darjeeling	Tibet	Distribution Category
SQUAMATA-SAURIA								
AGAMIDAE								
<i>Agama himalayana</i> ...		X					X	TB
<i>Agama tburculata</i> ...		X	X1	X2				ME
<i>Calotes versicolor</i> ...	X	X	X1	X4	X1	X		OR
<i>Japalura kumaonensis</i> ...		X						WH
<i>Japalura major</i> ...		X	X1					WH
<i>Japalura tricarinata</i> ...				X2	O	X		EH
<i>Japalura variegata</i> ...						X		EH
<i>Phrynocephalus theobaldi</i>							X	TB
<i>Sitana ponticeriana</i> ...	X		P	P	P			OR
ANGUIDAE								
<i>Ophisaurus gracilis</i> ...		X	O	O	O	X		IW
GEKKONIDAE								
<i>Alsophylax tibetanus</i> , ...							X	TB
<i>Cosymbotus platyurus</i> ...				X1	X1	X		IE
<i>Cyrtodactylus fasciolarus</i>		X						WH
<i>Cyrtodactylus gubernatoris</i>						X		EH
<i>Cyrtodactylus khasiensis</i> ...						X		IE
<i>Cyrtodactylus laoderanus</i>	X	X						WH
<i>Gecko gecko</i>	X				P			OR
<i>Hemidactylus bowringi</i>						X		IE
<i>Hemidactylus brooki</i> ...	X		P	P	P			OR
<i>Hemidactylus flaviviridis</i>	X		P	P	P			OR
<i>Hemidactylus frenatus</i> ...	X				XI	X		OR
<i>Hemidactylus garnoti</i> ...						X		IE
SCINCIDAE								
<i>Leiopisma sikkimense</i> ...				X2	O	X	X	EH
<i>Leiopisma himalayannum</i>		X	X1	X1				ME
<i>Leiopisma ladaense</i> ...			X1				X	TB
<i>Mabuya carinata</i> ...	X				X1	X		OR
<i>Mabuya maculria</i> ...	X		P	X2	P			OR
<i>Mabuya multifasciata</i> ...						X		IE
<i>Ophisops jerdoni</i> ...	X	X	P					OR
<i>Riopa albopunctata</i> ...	X			P	P			OR
<i>Riopa punctata</i> ...	X	X	O	O	XI			OR
<i>Sphenomorphus indicum</i>						X		IE
<i>Sphenomorphus maculatum</i>						X		IE

TABLE 1 (Continued)

Distribution of Amphibians and Reptiles of Nepal and Adjacent Areas

	Adjacent Plains	Western Himalayas	West Nepal	Central Nepal	East Nepal	Sikkim- Darjeeling	Tibet	Distribution Category
SQUAMATA SAURIA (Continued)								
VARANIDAE								
<i>Varanus flavescens</i>	... X	X	O	X1				OR
<i>Varanus monitor</i>	... X	X	O	X1	O	X		OR
<i>Varanus saltaor</i>	... X				P	X		OR
SQUAMATA-SERPENTES								
BOIDAE								
<i>Eryx conicus</i>	... X	X	P	P				OR
<i>Python molurus</i>	... X	X	O	X2	O	X		OR
COLUBRIDAE								
<i>Ahaetull fronticincta</i>	...					X		EH
<i>Ahaetulla nasuta</i>	... X				P			OR
<i>Ahaetulla prasina</i>	...					X		IE
<i>Boiga ceylonensis</i>	...			X1				OR
<i>Boiga cyanea</i>	...					X		IE
<i>Boiga cynodon</i>	... X				P	X		IE
<i>Boiga forsteni</i>	... X			P	P	X		OR
<i>Boiga gokool</i>	...					X		IE
<i>Boiga multifasciata</i>	...	X	O	X1	O	X		EW
<i>Boiga ochracea</i>	... X				P	X		IE
<i>Boiga trigonata</i>	... X	X	O	X1	O	X		OR
<i>Chrysopelea ornata</i>	... X				P	X		OR
<i>Coluber diadema</i>	... X		P					OR
<i>Coluber fasciolatus</i>	... X		P	X1	P			OR
<i>Coluber ventromaculatus</i>	X	X						OR
<i>Dendrelaphis cyanochloris</i>	...					X		IE
<i>Dendrelaphis gorei</i>	...					X		IE
<i>Dendrelaphis pictus</i>	...					X		OR
<i>Dendrelaphis tristis</i>	... X				P	X		OR
<i>Dinodon gammei</i>	...					X		EH
<i>Dinodon septentrionalis</i>	...					X		IE
<i>Elaphe cantoris</i>	...			X1	O	X		IE
<i>Elaphe helena</i>	... X	X	O	O	O	X		OR
<i>Elaphe hodgsoni</i>	...	X	X1	X2	O	X		ME
<i>Elaphe porphyracea</i>	...					X		IE
<i>Elaphe prasina</i>	...					X		IE

TABLE I (Continued)

Distribution of Amphibians and Reptiles of Nepal and Adjacent Areas

	Adjacent Plains	Western Himalayas	West Nepal	Central Nepal	East Nepal	Sikkim Darjeeling	Tibet	Distribution Category
SQUAMATA-SERPENTES (Continued.)								
COLUBRIDAE (Continued)								
<i>Elaphe radiata</i> ...	X			X1	X1	X		OR
<i>Elaphe taeniura</i> ...						X		IE
<i>Enhydris enhydris</i> ...	X	X	O	O	O	X		OR
<i>Enhydris sieboldi</i> ...	X		P	P	P			OR
<i>Liopeltis calamaria</i> ...	X	X						OR
<i>Liopeltis rappi</i> ...		X	O	X2	O	X		EW
<i>Liopeltis stoliczkae</i> ...						X		IE
<i>Lycodon aulicus</i> ...	X	X	O	X4	O	X		OR
<i>Lycodon fasciatus</i> ...						X		IE
<i>Lycodon jara</i> ...						X		IE
<i>Lycodon mackinnoni</i> ...		X						WH
<i>Lycodon striatus</i> ...	X		P					OR
<i>Natrix himalayana</i> ...				X1	O	X		IE
<i>Natrix parallela</i> ...					X1	X		IE
<i>Natrix piscator</i> ...	X	X	O	X4	O	X		OR
<i>Natrix platyceps</i> ...		X	X1	X3	O	X		ME
<i>Natrix stolata</i> ...	X	X	O	X4	O	X		OR
<i>Natrix subminiata</i> ...						X		IE
<i>Oligodon albocinctus</i> ...				X1	O	X		IE
<i>Oligodon arnensis</i> ...	X	X	O	X1				OR
<i>Oligodon cyclurus</i> ...	X			P	P			OR
<i>Oligodon erythrogaster</i> ...			X1	X2	O	X		EW
<i>Oligodon juglandifer</i> ...						X		EH
<i>Oligodon melaneus</i> ...						X		EH
<i>Pareas macularius</i> ...						X		IE
<i>Pareas monticola</i> ...						X		IE
<i>Psammodynastes pulverulentus</i> ...				X1	O	X		IE
<i>Psammodphis condanarus</i> ...	X	X	P	P	P			OR
<i>Psammodphis leithi</i> ...	X		P					OR
<i>Pseudozenodon macrops</i> ...					X1	X		IE
<i>Ptyas mucosus</i> ...	X	X	O	X2	X1	X		OR
<i>Sibynophis collaris</i> ...		X	O	X1	O	X		IW
<i>Sibynophis sagittarius</i> ...	X	X	X1					OR
<i>Trachischium fuscum</i> ...		X	O	X1	O	X		EW
<i>Trachischium guentheri</i> ...				X1	O	X		EH

TABLE I (Continued)
 Distribution of Amphibians and Reptiles of Nepal and Adjacent Areas

	Adjacent Plains	Western Himalayas	West Nepal	Central Nepal	East Nepal	Sikkim- Darjeeling	Tibet	Distribution Category
SQUAMATA-SERPENTES								
(Continued.)								
COLUBRIDAE (Continued)								
<i>Trachischium laeve</i> ...		X						WH
<i>Trachischium tenuiceps</i> ...				X2	O	X		EH
<i>Xenochrophis cerasogaster</i> ...	X			X1				OR
<i>Zaocys nigromarginatus</i> ..				X1	O	X		IE
DASYPELTIDAE								
<i>Elachistodon westermanni</i> ...	X				P	X		EH
ELAPIDAE								
<i>Bungarus bungaroides</i> ...						X		IE
<i>Bungaris caeruleus</i> ...	X	X	P	P	P			OR
<i>Bungarus fasciatus</i> ...	X			P				OR
<i>Bungaris lividus</i> ...						X		EH
<i>Bungaris niger</i> ...						X		IE
<i>Bungaris walli</i> ...	X			P	P			OR
<i>Calliophis maccllellandi</i> ...		X	O	X2	O	X		IW
<i>Naja naja</i> ...	X	X	O	O	O	X		OR
<i>Ophiophagus hannah</i> ...	X	X	O	O	O	X		OR
TYPHLOPIDAE								
<i>Typhlops bothriorynchus</i> ...		X						EW
<i>Typhlops braminus</i> ...	X		P	P	P	X		OR
<i>Typhlops jerdoni</i> ...						X		IE
<i>Typhlops oligolepis</i> ...						X		EH
<i>Typhlops porrectus</i> ...	X	X	O	O	O	X		OR
VIPERIDAE								
<i>Agkistrodon himalayanus</i> ...		X	X1	O	O	X		ME
<i>Trimeresurus albolabris</i> ...		X	O	X2	O	X		IW
<i>Trimeresurus erythrurus</i> ...						X		IE
<i>Trimeresurus monticola</i> ...				X2	O	X		IE
<i>Trimeresurus popeorum</i> ...						X		IE
<i>Trimeresurus stejnegeri</i> ...				X1	O	X		IE
<i>Vipera russelli</i> ...	X	X	O	O	O	X		OR

TABLE II

*Distributional Analysis by Areas :**Total Based on Summary of Data Presented in Table I*

	Adjacent Plains	Western Himalayas	West Nepal	Central Nepal	East Nepal	Sikkim- Darjeeling	Tibet	
AMPHIBIA								
Species collected	...	8	11	2	12	9	27	3
Additional species expected (O)	...			10	3	7		
Plains species possibly present (P)				0	0	0		
CHELONIA								
Species collected	...	11	0	0	5	0	3	0
Additional species expected (O)	...			0	0	1		
Plains species possibly present (P)...				0	5	0		
CROCODILIA								
Species collected	...	2	0	0	1	0	0	0
Additional species expected (O)	...			0	0	0		
Plains species possibly present (P)...				2	1	2		
SAURIA								
Species collected	...	15	13	5	9	5	17	5
Additional species expected (O)	...			4	2	4		
Plains species possibly present (P)...				5	4	7		
SERPENTES								
Species collected	...	37	31	5	9	4	68	0
Additional species expected (O)	...			19	7	30		
Plains species possibly present (P) ..				9	9	14		

TABLE III
 (Totals for Table I) *Distributional Analysis of Faunal Groups.*

	Amphibia		Crocodilia		Chelonia		Sauria		Serpentes		Combined Amphibians & Reptiles	
	All	Nepal	All	Nepal	All	Nepal	All	Nepal	All	Nepal	All	Nepal
Indian-Oriental (OR)	8	8	2	1	11	4	14	7	36	12	71	32
Indochinese-E. Himalayan (IE)	8	1	0	0	3	1	7	1	31	9	49	12
Indochinese-W. Himalayan (IW)	1	1	0	0	0	0	1	0	3	3	5	4
Eastern Himalayan (EH)	10	3	0	0	0	0	4	2	9	2	23	7
E. and W. Himalayan (EW)	4	3	0	0	0	0	0	0	5	4	9	7
Western Himalayan (WH)	1	0	0	0	0	0	4	1	2	0	7	1
Mediterranean-E. Himalayan (ME)	0	0	0	0	0	0	2	2	3	3	5	5
Tibetan (TB)	3	0	0	0	0	0	4	1	0	0	7	1
...	35	16	2	1	15	5	36	14	89	33	176	69

Amphibians and Reptiles, Total All Species.....176 species
Total Nepal Species..... 69 species

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ORCHIDS
OF
EASTERN ZONE OF INDIA

*Which include Behar, Orissa, Bengal, Bhutan, Assam,
Tripura, Nagaland and Manipur.*

BY

B. N. GHOSE

ORCHIDACEAE

Herbaceous perennial plants, terrestrial with tuberous or fibrous roots or epiphytes with or without stems attaching themselves to branches of trees or rocks to which they fix themselves by means of their fleshy roots. Stems oblong, thickened or flattened, called, pseudobulbs. Lower leaves radicle, upper equitant, alternate or opposite rarely cylindric, fleshy or membranous.

Flower hermaphrodite, in racemes or panicles, rising from the base, sides or tops of pseudobulbs. The floral envelope consists of 3 sub similar exterior segments called *sepals* and 3 interior pieces called *petals*. These are often showy, beautifully and brilliantly coloured. The lateral petals are like sepals but the 3rd one is quite different, it varies greatly in form and frequently has a spur or a sac at its base. The centre of the flower is occupied by a body called *column*. Stamen normally one, is placed on the top of the column, in all orchids except in Cyripedeae which has two stamens. The pollen consists of grains, cohering in pairs or more and agglomerated into masses called *pollinia*. The *stigma* is a hollow surface in the column facing the lip and is sticky. Pollination is effected by the agency of insects and not by wind as in most flowers. The ovary is inferior, one celled. Carpels dehiscent in 3 semi-placentiferous valves which separates from 3 persistent midribs of

the carpels. Seeds very numerous and minute, testa loose hyaline, embryo exalbuminous, generally dispersed by wind.

Pfitzer has pointed out that most orchids have the habit of growing stems or pseudobulbs that mature and flower in one or two seasons and eventually cease to grow but a fresh shoot rises from the base of the old growth and develop its own stem, roots and flowers; this he called *Sympodial* growth. The growth is entirely different in the other kind which he called *Monopodial*. It has only a single stem which grows continuously taller and taller and produces its flowers from the main stem between two leaves but sometimes from the base of the plant.

Lindlay's system of classification with the modification made by later botanists-Benthum, Hooker etc. have been followed here. We have rearranged the genera included in Lindlay's *Vandea* into two groups, according to their vegetative character. In one group we have placed all plants with sympodial growth and in the other those with monopodial ones. The genera with sympodial growth have been placed under a new tribe *Cymbideae* leaving only those with monopodial growth under *Vandaeae*.

Sub family *Sympodial*

Tribe I—*Cypripedeae*

It is the most primitive amongst the family of orchids. It is semi-epiphytal or terestrial herbs, stemless or with a leafy stem; flower large generally solitary, sepals spreading, the dorsal large conspicuous free and erect the lateral pair smaller and narrow, usually connate and lie behind the lip; petals spreading varying in shape sometimes greatly elongated decidedly slipper shaped, column short, terete; fertile anthers 2, placed one on each side of the column, subglobose; pollen is granulose, smeared with a viscid substance; stigma is a disc hidden by another large disc-like staminode in front; ovary one celled, the flowers generally retain their freshness for several weeks.

Indian *Cypripedium*s may be divided into two sub genus :—

(a) *Paphiopedilum*—stemless, leaves perennial, coriaceous, often coloured, increasing in size by lateral growth flowers solitary on a long scape, rising from the middle of the imbricating bases of the leaves.

(b) *Eucypripedium*—Leaves membranous plicate, deciduous, flowers at the apex of the leafy stem.

Cypripedium (*Paphiopedilum* sub genus)

Cyp. villosum Lindl, Gard Chron 1854.

Leaves green, linear ligulate 12 to 18 inches long, epiphytic in character grows mostly on trees and rocks in windy places at an elevation of 5000 feet on the hill that separates Mizo Hills of Assam from Burma. Flowers largest in the genus, on a villous scape with glossy varnished surface, dorsal sepals sub-erect ovate oblong with the lower margin revolute towards the base which is brownish purple in colour, keeled at the back with a white marginal band, lip prominent, brownish yellow, blooms in April and May.

var *Boxalli Reichb* f. in Gard Chron 1877.

Bracts larger, flowers more brownish, dorsal sepal with darker spots, the petals are a bit narrower at the base and their colouring has a tassellated appearance.

C. hirsutissimum Lindl. in Bot. Mag. t. 4990.

Leaves 9 to 12 inches green, scape 12 inches green having dark purple hairs, flower 4 to 5 inches across, the segments ciliated, petals spreading dorsal sepal broadly cordate, the central basal area densely spotted with blackish purple, margins crisped and undulated along the basal half, the narrower basal part green, blotched and spotted with deep purple and shaded with blackish hairs, apical part bright violet purple, lip dull green, stained with brownish purple, bearing blackish warts. Found in Assam, epiphytic in

habit, growing on trees or rocks at 3 to 4000 feet elevation in Khasia, Manipur and Nagaland and in the Patkoi ranges. Flowering in April/May.

C. insigne Wall. MSS in Lindl. Coll. Bot. t. 32.

Leaves linear, ligulate, 8 to 12 inches long, pallid green, scape 12 inches high generally one flowered. Flowers have a glossy varnished surface, 4 to 5 inch across, yellowish green with brownish purple. The upper sepal broadly oval with numerous purple spots along the longitudinal green veins, apical portion pure white, petals linear oblong, spreading, undulate, pale yellow green, veined brown purple, lip yellowish green. It was discovered in the gorges of Khasia and Jaintea hills of Assam at about 3000 feet elevation from the sea level, growing on calcareous precipices having southern aspect exposed to the severe rains which lasts from June to October. The flowers greatly vary in colour and spotting of the dorsal sepal and some of them have been recognised by horticulturists :

var. *albo marginatum* Hort—flowers soft greenish yellow the dorsal sepal pure white entirely margined with white.

var. *amesianum* Pfitz—flowers rather large, not spotted resembling those of the *Cypripedium insigne* var. *maulei*, dorsal sepal with a broad white margin, the green part suffused with brown.

var. *ameanum* Pfitz—Dorsal sepal olive green, marked with large brown spots and widely bordered with white, violet spots in the lower part of the border, petals olive green, suffused with brown, lip clear maroon brown.

var. *arnoldianum* Pfitz—Flowers larger than var. *maulei*, dorsal sepal greenish yellow, broadly white margined, the spots confined to the green parts.

var. *aureaum* Pfitz—Dorsal sepal yellow below, petals and lip clear yellow brown.

var. *brownii*—Flowers large pale green, dorsal sepal strongly marked with dots at the apex, petals spotted.

var. *chantinii* Pfitz—one of the best varieties, dorsal sepal large olive green, bent forward and folded at the apex, the white margin extending nearly halfway down and prolonged laterally to the base, heavily spotted with brown, the upper part only white, with a few large maroon spots, lip mahogany, polished, broader at the aperture.

var. *citrinum* Pfitz—Flower clear citron yellow, except dorsal sepal, which is clear green at base bordered with white and some clear maroon spots.

var. *corrogatum* Hort—lip corrogated.

var. *colsonianum* Pfitz—Flower large with a broad dorsal sepal.

var. *cowhianum*—Flower greenish yellow, dorsal sepal like that of the *albo-marginatum*, spotted at base, petals larger, lip large.

var. *cuhingianum* Pfitz—Flowers large clear green, dorsal sepal broad the upper part white, with numerous clear violet spots.

var. *Clara Dow*—G. C. January 1907 Dorsal sepal $2\frac{1}{2}$ inches and as much in breadth apple green on the dorsal $2/3$ rd. pure white above with 7 to 8 irregularly placed, rows of large chocolate blotches, the upper blotches on 3 central rows being on the white ground, petals when extended are 6 inches long and 1 inch wide yellowish tinged and veined with purple.

var. *Cohen Edgar*—is attractive and peculiar in markings, the dorsal sepal having the basal and central portions suffused with a large deep olive bronze shade, arranged in feather like

flakes. The upper portion is clear white with a few lilac rounded spots.

var. *ernestii* Pfitz—In form and colour resembling var. *sandrae*, but the spots on dorsal more distinctly defined.

var. *forstermannii* Pfitz—Dorsal sepal with a broad white border, petals distinctly brown veined, spots violet coloured on the wide white border, pouch very shining.

var. *gilmoreanum*—Flowers large resembling those of var. *chantinii*, dorsal sepal very broad, bordered white with large brown spots in the centre and smaller ones towards the border.

var. *gracile* Pfitz—Dorsal sepal narrow, yellowish green, irregularly brown spotted.

var. *grararoi anum* Pfitz—Flowers on a long peduncle, dorsal sepal with a broad white border and numerous brown spots arranged in regular lines.

var. *hallianum* Pfitz—sepals longer and broader than usual.

var. *Harefield Hall*—This is a very large variety, dorsal sepal pale yellowish green heavily spotted with chocolate, margin with broad pure white band : lip yellowish green suffused with brown.

var. *horsmanianum* Pfitz—Dorsal sepal cuniate oblong with the centre upper portion white, lip has a beak in the middle.

var. *Hurrellianum* Hort—Dorsal sepal greenish yellow, the basal half suffused with raddish brown, the apex white.

var. *illustre* Hort—Flower yellowish, the sepals petals and upper portion of lip spotted with chestnut.

var. *Kimbellianum* Pfitz—Sepals more than 3 times longer than broad, flat yellowish green, the spots running in lines into the white border, petals strongly veined (Khasia).

var. *Laura Kimball*—Flowers resembling those of var. *sanderæ* but of a chamois yellow, with a few brown patches at the base of the petals.

var. *Lewisianum*—new variety—A companion of the variety Harefield Hall, larger and more brightly coloured. This was named after Mr. Lewis, President of the 4th. World Orchid Conference, Singapore.

var. *longisepalum* Pfitz—Dorsal sepal very long narrow appearing narrower on account of the reflexed margin, with a small white apex, not spotted.

var. *lucianii* Pfitz—Flower bright yellow, tinted green, dorsal sepal clear green at base with 2 or 3 large dots on the bronzy yellow white border, very broad.

var. *luteo album* Hort.—Upper two thirds of dorsal pure white, remainder yellowish green with a few spots.

var. *Lutcharycheanum* Pfitz—dorsal sepal narrower basal margin wavy, the upper white passing into pale yellow, spots hardly visible.

var. *mabel* G.C. January 1903—Large finely shaped flower, the dorsal sepal bearing numerous spots as in var. *Sylhetense* but the apical half of the dorsal is white and the spotting is bolder and placed most distinct, deeper in colour and highly polished.

var. *Macferlane* Rolfe—flowers clear yellow, dorsal sepal with a broad white border, without spots.

var. *maculatum* Hort. like var. *maulei* but less spotted.

var. *Manderilleanum* Pfitz—resembles var. *albo marginatum*, petals with numerous spots in regular lines.

var. *Marlii* Pfitz—dorsal sepal with the white predominant extending to the base on either side of the green centre, the upper spots violet purple, the other largest and brownish.

var. *Maulei*—named by Maule and Sons, Bristol, England. It has shorter and smaller foliage. Flowers somewhat larger, the dorsal sepal more arching and the lateral margin revolute towards the base and the white margin confined to apical half, heavily and regularly spotted with purple brown, spots larger.

var. *maximum* Pfitz—dorsal sepal very large of deep green undulate, striped with dark green, spotted with brown, large white portion spotted with violet, pouch wide.

var. *Montanum* Pfitz—dorsal sepal with a narrow yellow line, the lower $\frac{3}{4}$ th of a golden yellow with a brownish tinge with large spots, petals yellow with brown red.

var. *moensi* Hort—dorsal sepal ochre yellow spotted with black bordered by white, pouch yellow marbled with brown.

var. *Mooreanum* Pfitz—flower pale yellow, petals pale greenish, yellow, dorsal sepal broad ovate with a broad white margin, central spots largest, smaller towards the margin.

var. *Nelsonii* Pfitz—lip small round.

var. *Punctatissimum* Hort—dorsal sepal entirely curved with brown-spots, except a narrow white margin.

var. *Sanderae* Pfitz. Leaves and scapes pale, dorsal sepal primrose yellow with the exception of the broad white apical margin with a few minute reddish brown on the central veins of the upper sepal, waxy yellow. Comes true from seeds.

var. *Sanderianun* Pfitz—flower similar to var. *Sanderae* but the yellow colouring is shaded green reticulated with darker green nerves, the dorsal sepal with a broad white border, the brown dots are missing.

var. *Sylhetense* Pfitz—Dorsal sepal is thickly covered with large spots somewhat confluent along the middle, the apex and upper portion white.

var. *Punctatum violaceum*—It is a finer variety than var. *maulei*, the flower is rather smaller, but the breadth of the dorsal sepal is larger and the white portion more pronounced and carried further towards the base, purple spotting considerably bolder and of violet colour. The lip is smaller and narrower and of darker chestnut brown.

Cypripedium fairieanum Lindl in Gard Chron. 1857
Leaves ligulate, scape slender, pale green stout 6 to 12 inches high flower about 3 inches across, lip brownish green veined and spotted with purple. One flowered, borne on a slender scape, upper sepals large ciliated margin undulate, reflexed at the apex with a hairy keel behind, white with purple longitudinal anastomosing veins, petals reflexed and rounded like a buffalos horn, fringed at the undulate margin with blackish minute hairs. In tropical Himalaya at 3000 to 4000 feet elevation along the eastern sides of river banks such as Rungeet in Sikkim, Bhutan and Duphla Ammochu etc on calcereous soil. Flowers in November.

Two forms have been collected, one with dwarf leaves and brighter flowers and another with taller and paler green leaves and taller spikes of flowers.

Cypripedium spicerianum Reichb f—in Gard. Chron. 1888.
Leaves 9 to 12 inches long, ligulate, margins more or less waived purple spotted in the underneath near the base. Scape 12 inches pubescent, one flowered sometimes two flowered, flower about 3 inches across, dorsal sepal brown tinged with crimson broadly obcordate folded in the middle with lateral margin much reflexed at the base, apical margin bent forward, white except at the fold there is a crimson band and at the base there is a green blotch speckled with red, petals horizontal, ligulate, deflexed and moved forward, undulate at the margins, yellowish green spotted with dull red and with a reddish crimson midline. Lip bell shaped. In tropical regions of the Patkoi Hills generally on rocks in Barrack River Valley in Manipur at 2000 to 3000 feet elevation and

also in the Mizo Hills of Assam. Flowers from September to January.

Cypripedium charlsworthii Rolfe in Orchid Review 1912.

Leaves lorate about 1 inch broad, 10 inches long, green spotted at the back near the base, scape one flowered about 10 inches tall, flower 3 inches dorsal sepal broadly ovate about $2\frac{1}{2}$ inches or more long, white suffused with pale rose, petals horizontal spreading and tinged with brown. Flowers in Autumn, found in Naga land and Jaintea Hills in about 3500 feet elevation. It is a Burmese plant, very scarce in Assam. Flowers in September.

C. venustum Wall in Bot. Mag. t 21.39 Cat. 7023. Leaves lori-form tassellated with deep green marbled and blotched with pale greyish green above, sometimes heavily mottled with dull purple beneath. Scape erect 9" high, flower $2\frac{1}{2}$ " across, rather homely, upper sepal broadly cordate, white with dark green vertical stripes, petals spreading, margins ciliate, basal portion green with some blackish warts near the margin, apical portion dull purple toned with brown, lip pale yellow green, tinged with rose colour, veined and reticulated with green. Flowers during January to March. Found in the Khasia & Jaintea Hills and also in Sikkim & Bhutan eastward at about 2,000 ft. elevation.

var. *pardilinum*—Gard. Chron. 1887 p 382.—Flowers larger the sepals of a purer white, the warts on the petals, larger and more scattered, lip of bright colour with more prominent reticulation.

II—Eucypripedium

Cyp. elegans—Reichb f, in Flora-1886.560.

Leaves 2 opposite, plant 4 inch high, flower 1 inch in diameter, brownish with darker lines of the same colour, flowers

in June-July in Sikkim at Lumtang and Lachen Valley 10,000 feet and also in the Zemu valley at 13,500 feet elevation.

Cyp. tibeticum—Rolfe & King in Journ. Linn. Society XXIX 320.

Leaves 3, close together, plant 12 inch high, flower ventricose, light purple near the mouth. In Lonak & Lachen Valleys of Sikkim and also in the border of Bhutan at 10,000 feet. Flowers in July.

Cyp. macranthon—Swartz—in At. Holn. 1800.

Stem usually very stout, pubescent, flower 1 to 2, $1\frac{1}{2}$ inches to 2 inches in diameter, yellowish or greenish with dark purple veins or altogether purple, Alpine Sikkim at 15,000 feet. Flowers in July.

Cyp. himalaicum Rolfe—in John-Linn Society XXIX.

Height of plant 8 to 12 inches, leaves 3, unequal, stem 3 to 5 inches long, bearing a single flower at the apex, flower $2\frac{1}{2}$ inches in diameter, brownish lip having a strong tinge of purple, ventricose, petals spreading, narrowly oblong, longer than the dorsal sepal. Flowers during July in the Lonak and Lachen valleys of Sikkim at 10 to 12,000 feet and also in Bhutan.

(to be continued)

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