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AN ACCOUNT OF COLLECTIONS OF FROGS FROM CENTRAL NEW GUINEA

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(Figs. 1 and 2) (Plates 1–5) Manuscript received 20.6.62

Summary

In an account of frogs in the Australian Museum collected in Central New Guinea, two new Hylid species (*Nyctimystes disrupta* and *N. foricula* from the Schrader Mountains), and one new Ranid (*Rana jimiensis* from the Jimi River Valley) are described. Variations within the paratype series are reported, and the relationships of the species are discussed.

Series or individual examples of four additional species of the genus *Nyctimystes*, four *Hyla*, three *Rana*, and one *Cophixalus* are represented, and notes on their morphology, ecology, parasites, distribution and vernacular nomenclature are included.

The representation of the family Microhylidae by a solitary specimen is discussed, and assumed to indicate selective rather than representative sampling of the herpetofauna by the collectors.

Introduction

In 1954, Mr. E. L. Troughton and Mr. N. Camps, of the Australian Museum, visited the Central Highlands of the Australian Trusteeship Territory of New Guinea, and collected a large number of specimens of animals which occur in that region, including several hundred frogs. A few specimens were also obtained near the Jimi River, north of the Central Highlands. Additional specimens from the Central Highlands were collected by Dr. R. N. H. Bulmer (currently of the Department of Anthropology, The University of Auckland) in 1955 and 1959. Dr. Bulmer also collected frogs in the course of anthropological field work in the Kaironk Valley of the Schrader Mountains in 1959 and 1960, and subsequently presented his collections to the Australian Museum.

The present paper is a composite account of the frogs obtained by Troughton, Camps and Bulmer. Three species are new to science, whilst the records of a further three species which have not been previously found in the Trusteeship Territory provide valuable supplements to the existing knowledge of their distribution. Amongst the Troughton/Camps collection are approximately 60 specimens of *Hyla* whose specific identity remains undetermined, and which have therefore been excluded from the present paper. It is hoped to include identifications in a taxonomic revision of the New Guinea Hylidae which is being currently undertaken by the author.

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Collecting Localities

(A) *Troughton and Camps*

(1) *Wahgi Valley:* Detailed geographical notes and sketch maps of the Wahgi Valley have been prepared by Mayr and Gilliard (1954) and the author (1963).

(2) *Jimi River.*

(B) *Bulmer*

(1) *Mount Hagen Range:* Bulmer conducted anthropological research at Yaramanda on the northern slopes of the Mount Hagen Range in 1955, and returned to the same camp in September, 1959. Frogs were collected on each occasion.

Yaramanda is situated at an altitude of 5,000 feet near the source of the Baiyer River. The valley through which this river flows is approximately six miles wide, and extends in a direction which is almost due north. The Baiyer tributaries are within a few miles of a break in the Central mountains known as the " Hybrid Gap ", which was so named by Mayr and Gilliard (*supra. cit.*), who discovered that it had a profound influence upon the distribution of avian populations. Its probable influence upon the distribution of amphibians is discussed in the present paper. The Hybrid Gap is a region of grassland approximately 12 miles wide, and provides direct communication between the Baiyer River Valley and the Wahgi Valley.

(2) *Schrader Mountains:* The Schrader Mountains are situated approximately 50 miles north of the Wahgi Valley, and are separated from the Bismarck Mountains by the Kaironk Valley. Bulmer spent five weeks in the Upper Kaironk Valley from January to February, 1960, and collected numerous frogs during this period. Detailed maps of this area have yet to be prepared, and the following geographical information has been obtained from mimeographed ethnographic notes made by Bulmer, and an account of the valley by his colleague, Dr. B. Biggs (1960).

The Upper Kaironk refers to that portion of the valley which is east of the Mudubul River, and comprises an area of 20–25 square miles. The valley walls rise from 8,000 to 9,000 ft. on the north, and from 7,000 to 7,500 ft. on the south. The elevation of the valley floor varies from 5,000 to 6,400 ft. The valley walls are covered with tall grasses, interspersed with *Casuarina* groves to 6,500–7,000 ft., above which they are heavily forested. Views of the Kaironk River and the valley walls are depicted in Plates 1 and 2.

Shade temperatures recorded in February at 5,600 ft. did not exceed 75° F., whilst the minimum temperature experienced at night was 58° F. Rainfall in the same period was estimated to be in the vicinity of 40 inches.

Methods

With few exceptions the methods of description employed in the present paper conform closely to current herpetological practice. This particularly applied to the genus *Nyctimystes*, where the presentation of data follows the pattern used by Zweifel (1958), and the descriptions of palpebral pigmentation and fractional expressions of interdigital webbing comply with that author's definitions.

The following abbreviations have been used: TL (tibia length); S-V (snout to vent length); E-N (distance between anterior corner of eye and posterior margin of external naris); IN (internarial distance). Unless otherwise stated, the specimen references are the Australian Museum catalogue numbers.

SPECIES REPRESENTED

Family: **Hylidae.**

Hyla angiana Boulenger.

Hyla darlingtoni Loveridge.

Hyla iris Tyler.

Hyla montana Peters and Doria.

Nyctimystes daymani Zweifel.

Nyctimystes disrupta sp. nov.

Nyctimystes foricula sp. nov.

Nyctimystes humeralis (Boulenger).

Nyctimystes kubori Zweifel.

Nyctimystes narinosa Zweifel.

Nyctimystes semipalmata Parker.

Family: **Microhylidae.**

Cophixalus ateles (Boulenger).

Family: **Ranidae.**

Rana arfaki Meyer.

Rana grisea Van Kampen.

Rana jimiensis sp. nov.

Rana papua Lesson.

ACCOUNT OF SPECIES

Family: **Hylidae**

Hyla angiana Boulenger

Hyla angiana Boulenger, 1915. *Ann. Mag. nat. Hist.* 16 (8), p. 402.

Specimens: 18 adult males, 5 adult females, 1 juvenile. R. 14703, 14713, 14714, 14733, 18002–18006, 18051, 18075, collected by Troughton and Camps at Tomba, Mount Hagen in August, 1954; 14864, 14869, 16553, collected by Bulmer at Yaramanda, Baiyer River, in November, 1959; 15905, 15906, 15908, 15914, 15919, 15922, 15924, 15925, 15929, 15933, collected by Bulmer at the Kaironk Valley, Schrader Mountains, during the period February 5–17, 1960, at an altitude of 5,000–6,000 ft.

Diagnosis: A relatively large species (males <57 mm., females <78 mm.). The head is broad and strongly depressed with widely spaced nares and a short E-N distance. The fingers are approximately one-third webbed and the toes, with the exception of the fourth, are webbed to the disks.

Description of specimens: There is a close similarity in the TL/S-V and the E-N/IN ratios which, in the present series, are 0.52-0.65 and 0.53-0.67 respectively. The snout-vent length ranges are: males 46.6-57.0 mm., females 58.5-69.2 mm., juvenile 40.6 mm. The largest male slightly exceeds the maximum previously recorded for this sex.

There are no significant morphological differences between the present specimens and material from the Wahgi-Sepik Divide which has been discussed recently (Tyler, 1963).

Comments: Several vernacular names were found to be applied to this species in the Kaironk Valley: "*as gonjengk*", "*as kwangk*", "*as saky*", "*as kambamun*" and "*as akok*".

Hyla darlingtoni Loveridge

Hyla darlingtoni Loveridge, 1945. *Proc. biol. Soc. Wash.*, 58, p. 53.

Specimens: 1 adult male, 4 adult females, 19 juveniles: R. 14743-14747, 18055-18066, 18071-18074, collected by Troughton and Camps at Korn, Mount Hagen, in August, 1954; 14868, 14873, 16558, collected by Bulmer in the Baiyer River region in September, 1955.

Diagnosis: A moderately sized species (males: < 43.7 mm., females < 50 mm.) with outer fingers three-quarters webbed (continuing to the disk as a fringe); tympanum only slightly less than the diameter of the eye, and a distinctive yellow and black colour pattern in the groin and on the posterior surface of the thighs.

Description of specimens: The series conform very closely to the description of the types, and exhibit only slight variation in finger webbing. The smallest juvenile has a snout-vent length of 24.3 mm., and the mean of the immature specimens is 27.7 mm.

Comments: The interesting feature is the high proportion of juveniles. Of a series of 24 specimens collected by the author in the Wahgi Valley in March, 1960 (Tyler, 1963) only one specimen was sexually immature: a male with a snout-vent length of 29 mm. (British Museum, Nat. Hist., cat. No. 1961.1127). Immature tadpoles were observed during the same period, and it is therefore most unlikely that the juveniles (which were believed to be much larger than transformation size), could have developed

from spawn laid at the same breeding period. The mean size of the juveniles in the present collection which were taken in September, and comparison with the previous material, suggest that *H. darlingtoni* may take two years to reach sexual maturity. Alternatively, there may be more than one spawning period each year.

The native vernacular name in the Baiyer River region was found to be "*mungki papokole*".

Hyla iris Tyler

Hyla iris Tyler, 1962. *Rec. S. Aust. Mus.*, 14 (2): 253.
Specimen: A single adult female (R. 14749) collected by Troughton and Camps at Korn, Mount Hagen.

Diagnosis: A multi-coloured, pygmy species with maximum snout to vent lengths of 31 mm. for males, and 38 mm. for females. The outer finger is webbed to the disk.

Description of specimen: The present specimen has a snout-vent length of 32.2 mm., and agrees very favourably with the Australian Museum paratype series (R. 16832-16836), with which it has been compared. In view of this conformity and the availability of the recent description of the species, further comments are excluded from the present account.

Hyla montana Peters and Doria

Hyla (*Litoria*) *montana* Peters and Doria, 1878. *Ann. Mus. Stor. Nat. Genova*, 13, p. 423.
Specimen: 1 gravid female (R. 15931), collected by Bulmer at the Kaironk Valley, Schrader Mountains, in February, 1960.

Diagnosis: A relatively large species in which the head is broader than long, the vomerine teeth are usually situated directly between the choanae, the outer finger is approximately one-third webbed, and crenulated dermal folds extend along the posterior surface of forearms, whilst a row of tubercles is present on the tarsus.

Description of specimens: The single representative of *montana* differs from the type description in few respects. The vomerine teeth are in two short and slightly oblique series directly between the choanae; the outer finger is one-third webbed, and the toes are webbed to the disks (the fourth has only a very narrow fringe on the sides of the penultimate phalanx). There is a crenulated fold on the posterior surface of the forearm, a row of tubercles on the posterior surface of the tarsus, and a few tubercles around the arms and on the heel.

In alcohol the dorsal suface is an immaculate dark-brown. There is a pale-blue triangular patch on the upper lip at the angle of the jaws, and there are a few small, faint blue spots on the side of the body. The ventral surface is dull yellow-brown, and the tubercles are white.

Nyctimystes daymani Zweifel

Nyctimystes daymani Zweifel, 1958. *Amer. Mus. Novit.* 1896, p. 8.

Specimens: 33 adult males, 3 adult females and one juvenile: R. 14700, 14701, 14705, 14718, 14719, 14724, 14725, 14732, 14741, 17998-18001, 18009, 18013, 18020-18022, 18024-18027, 18034-18037, 18047, 18049, 18052, 18054, 18068, 18069, 18078, 18079, 18081, 18082, collected by Troughton and Camps at Manjim, Ganz River, in July and August, 1954; R. 14876 collected by Bulmer at the Baiyer River on August 23, 1955.

Diagnosis: (As defined in the type description). Veins of palpebral reticulum orientated in near-vertical direction with few horizontal connections. Internarial distance distinctly less than distance from eye to naris. Legs relatively short (TL/S-V mean = 0.51). Size relatively small: largest of males measures 42 mm. from snout to vent.

Description of specimens: Measurements of this fine series are recorded in table 1. The E-N/IN and TL/S-V ratios encompass and exceed those of the type series, and the means are slightly lower and higher respectively.

TABLE 1.—Measurements of **Nyctimystes daymani**

	S-V		TL/S-V		E-N/IN	
	Range	Mean	Range	Mean	Range	Mean
Males (33) ..	40.1-46.0 mm.	44 mm.	0.50-0.57		1.05-1.43	
Females (3) ..	44.0-53.5 mm.	48 mm.	0.52-0.56	0.54	1.03-1.30	1.19
Juvenile (1) ..	30 mm.		0.54		1.08	

The interdigital webbing conforms to that of the type, and all specimens possess the small dermal heel lappet and row of tubercles on the outer edge of the forearm. Only six specimens exhibit a dorsal colouration resembling that of the type, and the remainder are grey, sparsely spotted with small black marks on the body and, to a lesser extent, on the limbs. Zweifel (1958) does, however, state that there is considerable variation in the colouration of the paratypes. The appearance of the majority of the present series bears a resemblance to Zweifel's illustration of *N. fluviatilis* Zweifel, a species known from a single specimen which has close affinities with *daymani*. The *fluviatilis* type has E-N/IN and TL/S-V ratios which are within the range of the present series, but the other morphological characteristics of the latter material are more closely allied to *daymani*. There is a possibility that *daymani* and *fluviatilis* are in fact conspecific, but this cannot be ascertained until further specimens are obtained from regions between the widely separated type localities.

Comments: *N. daymani* has not been found previously in the Australian Trusteeship Territory.

Nyctimystes disrupta sp. nov.

Holotype: An adult female (R. 15923) collected by Dr. R. N. H. Bulmer at an elevation of 6,000 feet in the Kaironk Valley, Schrader Mountains, Australian Trusteeship Territory of New Guinea, on February 4, 1960.

Diagnosis: A species with a close affinity to *N. papua*, but clearly distinguished by more extensive webbing between the fingers, and a palpebral venation which, although disrupted, is far more pronounced than in that species.

Description of holotype: Vomerine teeth in two short, heavy, slightly oblique series lying directly between the large rounded choanae; tongue almost two-thirds as wide as mouth opening, broadly oval, its posterior border free and rounded; snout large, slightly rounded in profile; nostrils more lateral than superior, projecting, their distance from end of snout about one-third that from eye, separated from each other by an interval equal to about two-thirds their distance from eye. Canthus rostralis

well defined. Eye large, very prominent, its diameter equal to its distance from nostril; inter-orbital distance slightly greater than width of upper eyelid, which is relatively wide and slightly greater than distance between nostrils. Palpebral venation consists of numerous broken lines with a tendency to predominate in the vertical plane. Tympanum very distinct, about one-third the diameter of eye; separated from eye by a distance greater than its own horizontal diameter.

Fourth finger two-thirds webbed, others half-webbed, fourth longer than second, just reaching to disk of third which completely covers the tympanic area; metatarsal tubercles weakly developed; suggestion of a slight tarsal ridge; no dermal appendage on heel. Body not elongate, in post-axillary region a little narrower than greatest width of head; when hind leg is adpressed, heel reaches beyond tip of snout; when limbs are laid along the sides, knee and elbow considerably overlap; when hind legs are bent at right-angles to body, heels overlap slightly. Skin of upper parts minutely granular, a few small tubercles occur above and below tympanum; strong glandular ridge extends from position just behind eye to above insertion of forelimb, encircling the tympanum; skin of throat and anterior part of pectoral girdle smooth, that of remainder of ventral surface of body and femurs uniformly granular. Skin of head not co-ossified with skull.

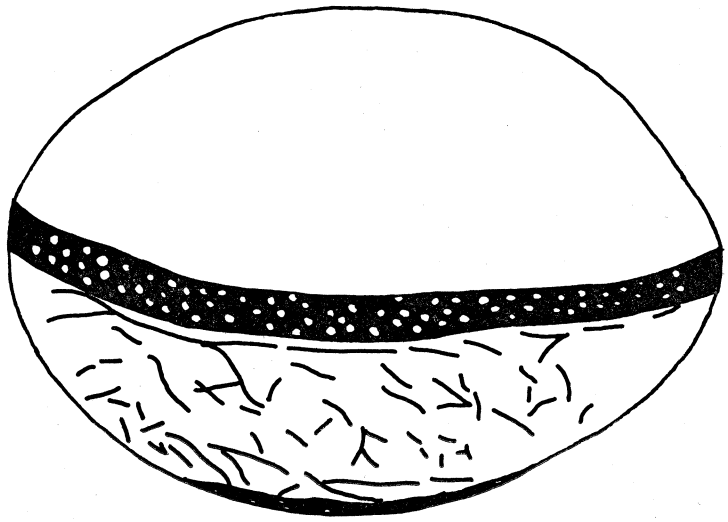

Fig. 1: Palpebral venation of *Nyctimystes disrupta*

Colour in alcohol of dorsal surface of head, body and limbs deep violet, with a few circular spots of white colour up to 2.5 mm. in diameter scattered upon them. Ventral surface of limbs, hands and feet pale copper; abdomen lilac; throat copper marbled with lilac. Photographs of holotype appear on Plate 3.

Dimensions of Holotype: Snout-vent 70 mm.; head length 23 mm.; head width 21 mm.; tibia 40.5 mm.

Variation: The paratype series consists of two adult females (R. 15916, 15921) taken at the type locality on February 5, 1960, and an adult male (R. 16600) collected at an elevation of 5,000 feet at the Baiyer River on October 4, 1959. Both female paratypes are smaller than the holotype, and the snout-vent length of the male is 46 mm. The distance between eye and naris is greater than the internarial span in all specimens.

The E-N/IN ratio range is 1.15-1.31, and the mean is 1.20. The tibiae of the male are relatively longer than those of the holotype and other paratypes, having a TL/S-V of 0.61, but the range is only 0.56-0.61, and the deviation from the mean of 0.58 is therefore not considerable.

Basic colour in alcohol is similar to that of the holotype, but all exhibit irregular lighter or darker patches upon the dorsal surface, whilst the white spotting is also constant.

In addition there are three badly distorted specimens, tentatively assigned to *disrupta*. These are R. 14862 and R. 14865, collected at Yaramanda (5,000 feet) on the western side of the Baiyer River, on November 21, 1955, and September 11, 1955, respectively; R. 15910 collected at the type locality on February 3, 1960. Field notes accompanying R. 14865 describe the colour in life as follows: " Back dark olive, legs mottled dark grey. Under-surface of legs translucent quartz, belly pink-mauve. Iris light olive."

Comparison with other species: The most salient feature which characterizes *disrupta* is the palpebral venation, and the only species approaching it in this respect is *papua*.

The British Museum cotypes of *papua* were examined by the author and, when certain specimens in that series had been rejected as not conspecific, the remainder were found to have a palpebral venation consisting of a few isolated dots (Tyler, 1963). In additional material these dots occasionally form a few scattered lines, but each line is invariably composed of a series of dots in close proximity to one another. The venation of *disrupta* is far more prominent, as seen in Figure 1. *N. disrupta* may be more clearly distinguished from *papua* by the degree of webbing of the hands. In the new species the outer finger is two-thirds webbed, and the other fingers are at least one-half webbed. *N. papua* has only one-quarter to one-third webbing. Although the TL/S-V ratios overlap (*papua:* 0.51-0.58; *disrupta:* 0.56-0.61), the E-N/IN ratios are distinct (*papua:* 0.89-1.12; *disrupta:* 1.15-1.31), and the difference between the minimum TL/S-V ratio of *papua* and the maximum of *disrupta* (0.42) is far greater than that within any single species currently known. Although Zweifel (1958) has reported geographic trends in E-N/IN and TL/S-V ratios of *N. montana*, no similar trends have been found in *papua*.

N. disrupta has an identical TL/S-V ratio to that of *semipalmata* as defined by Zweifel (*loc. cit.*), but lacks the large dermal appendage of that species, has a lower E-N/IN ratio, and an entirely different colouration. *N. semipalmata* is sympatric with *disrupta* in the Schrader Mountains, and is clearly distinct.

The head proportions and size of *disrupta* are very similar to *montana*. The latter species has a palpebral venation consisting of numerous vertical lines with a few horizontal connections; usually possesses a heel tubercle; has a higher TL/S-V mean, and entirely different colouration. *N. montana* has not been found within 350 miles of the Schrader Mountains.

Native vernacular name: " *mungki kunkupis*," for the Baiyer River paratype. Bulmer also recorded in his field notes the name, " *äs binfok*," which means, " red woman ".

Nyctimystes foricula sp. nov.

Holotype: An adult male (R. 15904) collected by Dr. R. N. H. Bulmer at an altitude of between 5,000 feet and 6,000 feet in the Kaironk Valley, Schrader Mountains, Australian Trusteeship Territory of New Guinea on February 4, 1960.

Diagnosis: A medium-sized species with TL/S-V and E-N/IN ratios which are shared by *N. kubori*. It differs from that and all other known species in possessing a very dense palpebral venation which only permits light to enter via a few narrow slits which are obliquely situated.

Description of holotype: Vomerine teeth in two short, transverse series lying close together and directly between the small, rounded choanae. Tongue one-half as wide as mouth opening, oval, its posterior border free and notched; snout rounded when viewed from above, slightly rounded in profile; nostrils more lateral than superior, their distance from end of snout about one-third that from eye, separated from each other by an interval almost equal to their distance from eye. Canthus rostralis slightly defined, loreal region oblique. Eye large, prominent, its horizontal diameter greater than its distance from nostril, interorbital distance slightly less than width of upper eyelid, which is relatively wide and greater than internarial span. Lower eyelid with a heavy palpebral venation of broad oblique veins. Tympanum distinct, about one-third the diameter of eye, separated from eye by a distance greater than its own diameter.

Fourth finger half-webbed, others webbed at base, third longer than fourth; disk of third covers the tympanic area; toes (with exception of fourth) fully webbed, the web on fourth toe reaching the middle of the penultimate phalanx, disk of fourth covering the tympanic area; a poorly developed, thin tarsal ridge, and a more marked ridge on outer edge of forearm and fourth finger; no dermal appendage on heel. Body rather elongate, in post-axillary region approximately three-quarters the greatest width of head; when hind leg is adpressed, heel reaches beyond tip of snout; when limbs are laid along the sides, knee and elbow overlap considerably; when hind legs are bent at right angles to body, heels overlap slightly.

Skin of upper parts smooth; a rather narrow but clearly defined supratympanic ridge extends from behind posterior corner of eye to above insertion of forelimb; skin of throat minutely granular, chest, abdomen and lower femur uniformly and more coarsely granular; vocal sac internal with long paired slit-like openings on floor of mouth. Large nuptial pad on inner surface of first finger. Skin of head apparently not co-ossified with skull.

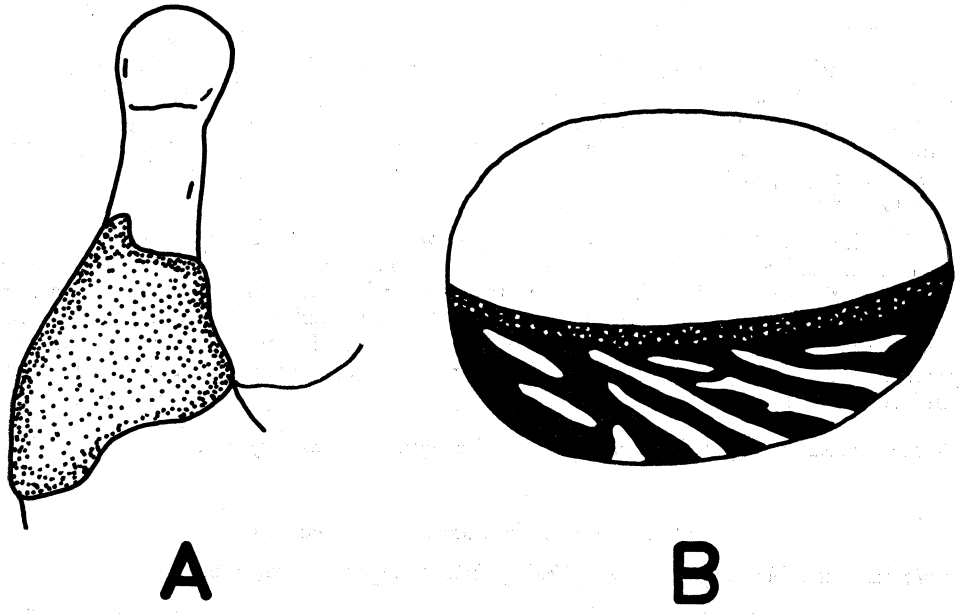

Fig. 2: *Nyctimystes foricula.* A, nuptial pad; B, palpebral venation

Colour in alcohol of dorsal surface of head, body and those portions of limbs probably exposed when living creature at rest, a pale blue. Ventral surface of body and limbs, and dorsal surface of humerus pale yellow. Upper lip bordered with white.

Dimensions of Holotype: Snout-vent 38 mm.; head length 13 mm.; head width 14 mm.; tibia 21 mm.

Variation: The paratype series comprises four adult males (R. 15909, 15918, 15926, 15928) collected at altitudes of between 5,000 feet and 6,000 feet at the type locality, between February 4 and 6, 1960; one gravid female (R. 15911) collected at 5,700 feet on February 3, 1960.

There is little variation in the size of the male paratypes. The smallest (R. 15909) has a snout to vent length of 35 mm., and the largest (R. 15926) one of 38 mm. The single female measures 52 mm. The distance between eye and naris of this specimen and four of the males is slightly greater than the internarial span. The exception (R. 15928) is only slightly less, with an E-N/IN ratio of 0.96. The mean for the entire series is 1.04, and there is probably no significance in the exception. The TL/S-V range of 0.52-0.59 is also very limited, and the mean is 0.56.

The paratypes are in an excellent state of preservation, and it is unlikely that the extent of the finger webbing differs appreciably from that found in living specimens. All of the finger disks of the female cover the tympanum. The appearance of the nuptial pad of the male (R. 15928) is depicted in Figure 2A.

The colouration of the paratypes is largely similar to the holotype. The pale blue dorsal surface of the body of R. 15909 is sparsely suffused with pale pink, and the head and body are finely stippled with black. Three specimens exhibit a narrow pink line which forms a margin at the termination of the dorsal colour, between axilla and groin. It is probable that *N. foricula* is green in life.

The ova of the gravid female are unpigmented and approximately 2.5 mm. in diameter.

Comparison with other species: The extensive palpebral venation of *foricula* (Figure 2B) will distinguish this species from all other known *Nyctimystes*. The only species with a venation approaching it is *kubori*, but the pattern of the latter forms a dense reticulum which lacks any directional orientation into lines. The TL/S-V and E-N/IN ratios of *kubori* are similar to those of *foricula*, but the two species may be distinguished by the following characteristics:—

The diameter of the tympanum of *kubori* is equal to the distance between tympanum and eye, whereas in *foricula* it is approximately one and one-half times the distance; the dermal fold on the forearm of *kubori* is broken into a row of tubercles, but is a continuous ridge in the new species; the snout of *kubori* is high, and the canthus rostralis sharp and quite distinct, but the snout of *foricula* is depressed, and the canthus rostralis only slightly defined; *kubori* is a slightly larger species which is brown in life and in alcohol.

Native vernacular name: Bulmer recorded the name of "*as gonjemai*".

Nyctimystes humeralis (Boulenger)

Hyla humeralis Boulenger, 1912. *Zool. Jahrb.* 1, suppl. 15, p. 216.

Specimens: 6 adult males, 3 adult females, 1 immature female. R. 14694, 14695, 14702, 18043-18045 collected by Troughton and Camps at Manjim, Ganz River,

in July, 1954; 14863 collected by Bulmer at Yaramanda (5,000 feet) in the Baiyer River region on September 5, 1955, and 16550, 16551, 16582 taken at the same locality during the period September 30-October 18, 1959.

Diagnosis: A large species (maximum snout-vent length of males = 100 mm., and of females = 83 mm.) with an immaculate colouration. The males have a large projecting spine on the humerus, and two patches of prominent conical nuptial spines on the first finger.

Description of specimens: Males in the present series all possess the characteristic sexual characters mentioned in the diagnosis. The snout-vent lengths are as follows:—

males 71.8-89.5 mm.

females 50.3-83.6 mm.

The E-N/IN mean is 1.00, and the range 0.93-1.06, whilst the TL/S-V mean is 0.61 and the range 0.56-0.64. These means are respectively slightly lower and higher than those quoted by Zweifel (1958), but as the latter series included specimens which are now believed to represent a species close to *humeralis* but distinct from it (Zweifel, *in litt.*), no significance can be placed upon the deviation. A coloured sketch of a live specimen (R. 14863) depicts an immaculate pale green dorsal surface, with lemon-yellow margins on the outer surfaces of the limbs. The undersurface is shown to be a similar colour, and the toe webbing pale rust. The abdomen is said to be " yellow-green ".

Comments: Despite the uniformity in the appearance of specimens in life, Bulmer recorded different vernacular names for the three specimens taken at the Baiyer River in 1955: " *mungki elambo*," " *mungki lyambo* " (regarded as an alternative spelling of *elambo*) and " *mungki kunkupis* ".

Nyctimystes kubori Zweifel

Nyctimystes kubori Zweifel, 1958. *Amer. Mus. Novit.* 1896, p. 18.

Specimens: 3 females, R. 15912, 15913, 15920, collected by Bulmer in the Kaironk Valley, Schrader Mountains, during the period February 3-5, 1960, at an elevation of between 5,000 feet and 6,000 feet.

Diagnosis: Palpebral venation forming a dense reticulum; outer fingers one-third webbed. Maximum size recorded: males 53 mm., females 58 mm.

Description of specimens: The E-N/IN range of 0.94-1.16 and TL/S-V range of 0.53-0.57 approximate those of the types. The appearance and other characteristics used in the determination conform closely to those defined by Tyler (1963), with the exception that the dorsal surface of R. 15912 is grey instead of brown.

Nyctimystes narinosa Zweifel

Nyctimystes narinosa Zweifel, 1958. *Amer. Mus. Novit.* 1896, p. 26.

Specimens: 8 adult males, 1 adult female, 1 immature female, 3 juveniles: R. 14704, 14715-14717, 14736, 14737, 18010-18012, 18083, 18084, 18099, 18100 collected by Troughton and Camps at Tomba, Mount Hagen in August, 1954.

Diagnosis: A relatively large species (males < 59.5 mm., females < 69.8 mm.) with slightly webbed fingers and extensively webbed toes. The distance between the nares is greater than that between eye and naris.

Description of specimens: All of the males exhibit secondary sexual characters, of which the nuptial pad conforms closely to the described shape (Tyler, 1963). None of the present specimens approach the maximum snout-vent length recorded, and their range is 48.3-53.8 mm. The TL/S-V range of 0.55-0.63 and mean of 0.59 are only slightly higher than those for the types. The range of E-N/IN is 0.78-1.00 and the mean 0.86, both of which also compare favourably with the type series.

The body proportions, palpebral venation and colouration of the three juveniles do not show any marked difference from the adults. The snout-vent lengths of 16.4 mm., 18.0 mm. and 20.0 mm. are the smallest yet known, and that of the first-mentioned is probably only slightly above transformation size.

Nyctimystes semipalmata Parker

Nyctimystes semipalmata Parker, 1936. *Ann. Mag. nat. Hist.*, ser. 10, 17, p. 83.

Specimens: One adult male (R. 14875), and one adult female (R. 16556) collected by Bulmer at the Baiyer River in 1955.

Diagnosis: A large species (maximum snout-vent length of females 84 mm.) with a high E-N/IN ratio (mean 1.34—Zweifel), and a large triangular dermal lappet on the heel.

Description of specimens: The mature female conforms to the rediagnosis of Zweifel (1958), and has a snout-vent length of 79.4 mm. The TL/S-V and E-N/IN ratios of 0.63 and 1.55 respectively are slightly higher than the known ranges but, as those were based on only six specimens, the differences probably lack significance.

The male is badly damaged, but is referred to *semipalmata* on the evidence of the following features: the extremely broad head; a TL/S-V ratio of 0.603, and E-N/IN ratio of approximately 1.6; the large heel lappet and the colour pattern.

Comments: This is the first record of the occurence of *N. semipalmata* in the Australian Trusteeship Territory. The present locality is approximately midway between the widely separated previous records of Idenburg River (Dutch New Guinea), and south-east Papua in the vicinity of Kokoda, the type locality.

Family: **Microhylidae**

Cophixalus ateles (Boulenger)

Sphenophryne ateles Boulenger, 1898. *Ann. Mus. Stor. nat. Genova*, 38, p. 708.

Specimen: A single specimen collected by Bulmer at Yaramanda during the period October-December, 1959.

Diagnosis: A very small species, adult from approximately 15 mm. snout-vent length; may be distinguished from all other known members of the genus, except *shellyi* Zweifel, by its extremely short first finger.

Description of specimen: This specimen is rather distorted as a result of dehydration, so estimates of ratios involving a high degree of accuracy have been ommitted. The S-V length is approximately 15 mm.

The dorsal surface is grey, lightly stippled with black. The side of the head beneath the canthus rostralis, the lateral margin of the upper eyelid and the lower half of the tympanum are black. The dorso-lateral surfaces of the body are grey with sparse, irregularly-shaped black markings, whilst the limbs are spotted with black. The ventral surface of the body is brown, densely flecked with white, grey and black.

Comments: Details of the examination of part of the *ateles* type series have been published elsewhere (Tyler, 1963).

Family: **Ranidae**

Rana arfaki Meyer

Rana Arfaki Meyer, 1874. *Monatsb. Akad. Wiss. Berlin*, p. 138.

Specimens: 2 adult females: R. 14710, 18050 collected by Camps at the middle Jimi River in July, 1954.

Diagnosis: A very large species with a maximum snout-vent length of approximately 200 mm. Dorso-lateral dermal folds on the body are either weakly developed or absent. Outer metatarsals are almost entirely separated from one another. Finger and toe disks are only slightly dilated.

Description of specimens: The two specimens collected by Camps were both partially deviscerated in the field to ensure satisfactory fixation. The snout-vent lengths are 142 mm. and 98 mm. respectively, and the specimens conform very closely to the description of van Kampen (1923).

The vomerine teeth are in two feebly curved oblique series between the semi-circular choanae. The tympanum is almost circular in shape, and has a diameter which is approximately one-half and two-thirds of the eye diameter respectively. When the hind limbs are held at right-angles to the body, the heels overlap. The TL/S-V ratios are 0.58 (R. 14710) and 0.63 (R. 18050). Further details of these specimens are included on page 126, where they are compared with the new species of *Rana.*

Comments: This is the first record of the occurence of *R. arfaki* in the Australian Trusteeship Territory.

Rana grisea Van Kampen

Rana grisea Van Kampen, 1913. *Nova Guinea*, 9 (3) p. 460.

Specimens: 5 adult males, 13 adult females, 7 juveniles: R. 14709, 14712, 14720, 14730, 14738, 14739, 18007, 18008, 18017-18019, 18070, collected by Troughton and Camps at Manjim, Ganz River, in July, 1954; R. 14861, 14877, collected by Bulmer at Yaramanda, Baiyer River, in August, 1955; R. 16557, 16566-16570, 16598, 16599, 16611, collected at the same locality in October-November, 1959; R. 15917, 15927, collected by Bulmer at the Kaironk Valley, Schrader Mountains, in February, 1960.

Diagnosis: The possession of a first finger longer than the second, a lateral groove between the superior and inferior surfaces of the digital disks, and widely separated dorso-lateral, glandular dermal folds will distinguish *R. grisea* from other New Guinea species with the exception of *R. papua.* The diagnostic characters separating *grisea* from *papua* are discussed in the account of the former species by Parker (1936).

Description of specimens: The characteristic features of *grisea* have received considerable attention: Van Kampen (*loc. cit.*), Parker (*supra cit.*), Loveridge (1948), Tyler (1963). The present description is therefore largely concerned with variation within the Australian Museum material.

Eight of the females have snout-vent lengths exceeding 80 mm. The range is 63.0-87.5 mm., and the mean is 79 mm. The males range from 59 mm. to 68 mm., and their mean is 62.2 mm.

The distance separating the dorso-lateral, glandular folds at the occiput is equal to the distance between the naris and (*a*) a point midway between the posterior corner of the eye and the tympanum (7 specimens); (*b*) a point nearer to the

tympanum than the eye (7); (*c*) the anterior border of the tympanum (8), or (*d*) the anterior half of the tympanum (2). The tympanal diameter varies from slightly less than one-third to two-thirds of the eye diameter, and the two are separated by a distance which is equivalent to one-half of the tympanal diameter (15), or greater than one-half but less than three-quarters (10).

Comments: Loveridge (1948) described the sub-species *R. grisea milneana* from Milne Bay in south-east Papua. His diagnosis is apparently a comparison between that type and the description of the type of *grisea*. Although inferred in the description of the *milneana* type, the complete webbing between the toes is by no means unique for, in Van Kampen's (1923) definition of *grisea* it is stated: " toes entirely webbed or two phalanges free." As it is impossible to distinguish *milneana* from *grisea* by means of the remaining information supplied, it is suggested that present evidence is insufficient to warrant the continued recognition of *milneana*.

A large proportion of the series were infested with various parasites. Four specimens were hosts to larvae of the dipterous parasite *Batrachomyia* sp. (Family: Chloropidae), situated sub-dermally on the dorso-lateral surface near the glandular folds. The outer muscle walls of several digestive tracts were found to be infested with large numbers of Cestode cysts, whilst Nematodes and immature Trematodes were recovered from within the ilea. One frog (R. 16568) was infested by a leech situated subcutaneously on the dorsal surface of the body.

Bulmer found that the native vernacular names applied to this species of frog were " *mungki alu* " and " *mungki kwikyelo* " at Yaramanda, whilst " *as tyembas* " was the name used in the Kaironk Valley.

Rana jimiensis sp. nov.

Holotype: A gravid female (R. 14711) collected by Mr. N. Camps at Manjim, Ganz River, on July 16, 1954.

Diagnosis: A large species, with a snout-vent length of 100 mm., distinguished from other Papuan *Rana* by its blunt snout, tubercular skin and a small tympanum whose marginal annulus is partially obscured by tubercles. The tibiae are short, and the finger and toe disks markedly dilated.

Description of holotype: Vomerine teeth in two slightly oblique series extending considerably behind the small slits of the choanae; tongue cordiform and deeply notched on posterior margin. Head broader than long; snout abrupt when viewed from above, truncate in profile; canthus rostralis prominent and slightly rounded, loreal region oblique and concave; nostril nearer to tip of snout than to eye. Inter-orbital space less than breadth of upper eyelid, with a shallow groove extending along the occiput. Tympanum indistinct, the annulus being partially obscured by epidermal tubercles, tympanal diameter approximately one-third the diameter of eye. Disks of fingers clearly defined, and very prominent sub-articular tubercles are present; fingers in decreasing order of length $3 < 4 < 1 < 2$. Toes with large disks, each of which have a horizontal diameter approximately three times greater than the breadth of the penultimate phalanx; webbing extending to the disks of all toes except fourth, where it is present as a fringe on the penultimate phalanx; outer metatarsals separated to the base; sub-articular tubercles prominent, inner metatarsal tubercle large and oval, outer metatarsal tubercle smaller, but prominent and rounded. No tarsal fold. When hindlimb is adpressed along side of body, heel reaches beyond tip of snout; when hind-limbs are held at right-angles to body the heels just meet.

Dorsal surface of head, body and limbs strongly rugose, particularly on upper eyelids. No dorso-lateral glandular skin folds, but a few short, thin longitudinal

plicae behind head forming no particular pattern, and a short, weak supratympanic fold. Ventral surface minutely granular.

Dorsally a uniform dark brown. Throat, pectoral region and upper abdomen cream, heavily mottled with dark brown. Lower abdomen and hindlimbs creamish-yellow, lightly marked with brown. Dorsal and lateral views of the holotype may be seen in Plates 4 and 5.

Dimensions of Holotype: Head and body 100 mm.; head length 35 mm.; head width 42 mm.; femur 50 mm.; tibia 55 mm.; foot 52 mm.; hand 32 mm.

Comparison with other species: The slender habitus of five of the six species of *Rana* currently recognized as valid for the Papuan region (Loveridge, 1948), prevents any confusion with *jimiensis*. The only species bearing a remote resemblance is *R. arfaki*, but may be distinguished from it by the difference in head proportions. In specimens of *arfaki* sympatric with *jimiensis*, the distance between the anterior corner of the eye and the middle of the tip of the snout is one and one-half of the horizontal eye diameter, whereas in *jimiensis* the distance is only one and one-quarter of the eye diameter. Similarly, the longer head of *arfaki* may be expressed by comparison of the breadth of the head immediately posterior to the eyes, and the distance between the tip of the snout and the posterior corner of the eye. In *arfaki* this head measurement is greater than the snout-eye distance, but in *jimiensis* it is less than it.

As mentioned above, the exact tympanum diameter cannot be accurately determined due to the presence of tubercles upon a portion of each annulus, but the diameter is no more than one-third of the eye diameter, and it is separated from the eye by a distance equivalent to one and one-third of its own diameter. In *arfaki* the tympanum is distinct, and between one-half and three-fifths of the eye diameter, from which it is separated by a distance equal to its own diameter.

The tibia of *arfaki* is distinctly greater than the distance between the head of the femur and the mid-ventral line, but only just equal to it in the new species. The relative size of digital disks, the presence of an outer metatarsal tubercle in *jimiensis*, the appearance of the skin, and the colouration of the two species leave no doubt that they are quite distinct from one another. Parker (1936) commented upon the fact that specimens of *arfaki* from Kokoda in Papua possessed much smaller tympani than those from elsewhere, and therefore agreed closely with *R. waigeensis* van Kampen, which is considered to be a synonym of *arfaki*. Parker's material was, however, stated to fall within the limits of variation recorded for *arfaki*; the present specimen does not.

Rana papua Lesson

Rana papua Lesson, 1830. *Voyage Coquille*, Zool. 2 (1) p. 59.

Specimens: 2 adult males: R. 14708, 14748, collected by Troughton and Camps at the middle Jimi River in July, 1954.

Diagnosis: A species closely allied to *R. grisea* and distinguished from it by relatively narrower dorso-lateral glandular folds, and a shorter distance between eye and tympanum in relation to the tympanal diameter.

Description of specimens: The specimens have snout-vent lengths of 73 mm., and 50 mm. respectively. The distance between the dorso-lateral glandular folds is equal to the distance from the naris to the posterior corner of the eye. The tympanum is separated from the eye by a distance which is equal to approximately half the horizontal tympanal diameter.

The colouration of the dorsal surface of the body of R. 14748 is similar to the description prepared by Loveridge (*loc. cit.*). Much of the head and back of R. 14708 is grey, but this is believed to be an artefact which has occured after preservation. The ventral surface of the latter is an immaculate white, and R. 14748 is only faintly marked with brown on the throat.

Comments: The status of the Ranid frogs *grisea*, *papua*, *kreffti*, *daemeli* and *noveabrittanae* has been the subject of much discussion and considerable confusion. Whilst not disputing the distinction of *grisea* and *papua*, it is suggested that the currently recognized sub-species are inconsistently founded, and without adequate supporting biological evidence.

The present locality record is the first in the Central Highlands region.

Discussion

A rather unusual feature of the collections is the great variety of Hylid species, but the presence of only a single representative of the Microhylidae. That there are numerous Microhylid species in the moss-forests on the mountain slopes bordering the Wahgi Valley has been established (Tyler, 1963), which suggests that the lack of such material in the Troughton/Camps collection simply reflects the nature of the environments in which specimens were taken (i.e., at altitudes below the moss-forests, in areas where the Hylidae and Ranidae are known to dominate the Anuran fauna). No less than four of the five Hylid species which they collected were at that time undescribed, whilst a further two were only known from type series.

The representation of the Microhylidae by a single specimen in the collection made by Bulmer in the Schrader Mountains, may be only partly referred to environmental conditions. The grass-covered slopes would certainly be unsuitable for Microhylids which tend to exhibit preferences for less exposed areas at such altitudes. It must, however, be borne in mind that Bulmer was primarily interested in vernacular zoological nomenclature, and a bias towards collecting frogs which are eaten by, and therefore familiar to, the natives is believed to have occurred. Few Microhylids attain a size large enough to be eaten. Although the Bulmer collection is unlikely to be truly representative, it is nevertheless extremely valuable.

Despite the fact that knowledge of the geographical distribution of New Guinea frogs is very limited, it is possible to establish that the Hybrid Gap is of more importance as a means of direct communication between the Wahgi and Baiyer River Valleys than as a barrier between the mountain ranges on either side. For example, *Hyla darlingtoni*, which breeds in static or slowly moving water, and which is therefore unable to exist upon the mountain slopes, is known to be prolific throughout the length of the Wahgi Valley. The record of this species in the Baiyer Valley extends its known distribution further north, and suggests that it is likely to occur in an uninterrupted chain throughout the numerous valleys leading to the Schrader and Bismarck Mountains. The valley floors have provided routes for the migration of *Rana grisea*. This species was assumed to be the only member of the genus in the Western Highlands region, and is apparently equally well established in both tropical lowland and sub-tropical highland areas throughout the island. The finding of *R. papua* in the Central Highlands is the first record in the Trusteeship Territory south of the Bismarck Mountains, whilst the appearance of *R. arfaki* and the new species at the Jimi River suggests that the area monopolised by *grisea* is a relatively restricted one.

Most of the remaining Hylid species in the present collection are only known from type series or two or three records. It is apparent, however, that *Nyctimystes* spp. are to be found in isolated communities whose locations are probably related to strict microclimatic preferences, within what appears to be a relatively uniform environment.

Until the taxonomy of the New Guinea Hylids and the variation of genotypic and phenotypic characters within the constituent species have been established, the presence of naturally occurring hybrids in the highlands cannot be determined with any degree of accuracy. It can be safely assumed that the gap between the Mt. Hagen Range and the Wahgi-Sepik Divide is an effective and complete barrier preventing migration between the mountains. As the environmental conditions on the gap are quite unsuitable for *Nyctimystes* and all *Hyla* but *darlingtoni*, the question of hybridisation at that point does not arise, and the description of the gap is inapplicable to amphibians.

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EXPLANATION OF PLATES

1. Kaironk River at approximately 5,000 feet a.s.l.
2. Middle Kaironk Valley. (Photographer facing east at an altitude of approximately 5,000 feet).
3. Left: *Nyctimystes disrupta*—top, ventral view of holotype (R. 15923); bottom, dorsal view. Right: *Nyctimystes foricula*—top, ventral view of holotype (R. 15904); bottom, dorsal view.
4. *Rana jimiensis*—dorsal view of type (R. 14711).
5. *Rana jimiensis*—ventral view of type (R. 14711).

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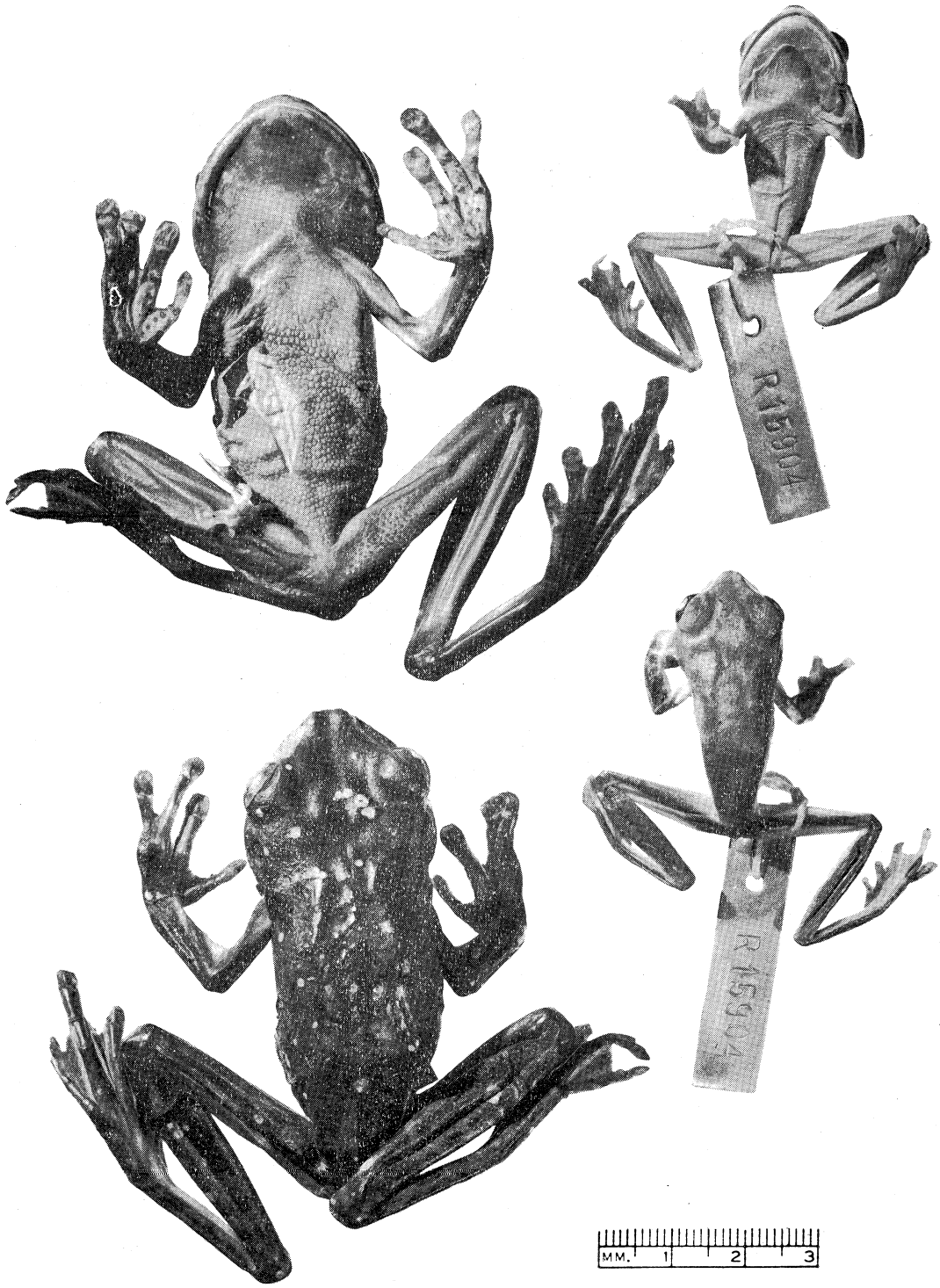
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